Project Report

The Impact of 'COVID-19' Pendemic on Education

A questionare based online Survey Project

Submitted by

Dr. Ravi Gautam
Head of Department
Journalism & Mass communication
Shri Ram College, Muzaffarnagar

Funded by

Rotary Club Mid Town Muzaffarnagar

Co-ordinator
IQAC, Shri Ram College
Muzaffarnagar

Chairman
IQAC, Shri Ram College,
Muzaffarnagar

SHRI RAM COLLEGE

(Affiliated To CCS University, Meerut & Approved By NCTE) CIRCULAR ROAD, MUZAFFARNAGAR

'A' Grade Accredited by NAAC

09/11/2021

To,

Dr. Ravi Gautam

Dept of Journalism & Mass Communication,

Shri Ram College, Muzaffarnagar

Dear Dr. Ravi Gautam

On behalf of the Board of directors, I am pleased to inform you that we have received a grant of Rs 15,000 from Rotary Club Mid Town MZN which has been approved for the research project **'THE IMPACT OF COVID-19 PANDEMIC ON EDUCATION'** as proposed by you and your team to Rotary Club Mid Town MZN.

Grant funds must be used in accordance with the budget included with your proposal. No changes in the budget or the grant period 3 months may be made without prior written approval from the management board. Any funds not used for the purposes described in your proposal will revert to the company. If this grant agreement is acceptable, please countersign and return it to me, making a copy for your records. Please let me know if you have any questions. We wish you all the best.

Your Sincerely,

Authorized signatory

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To,
The Head of Department
Journalism & Mass Communication
Shri Ram College
Muzaffarnagar

Dear Sir

We are writing to inform you that after careful analysis, we have decided to accept your proposal to conduct survey on **"IMPACT OF COVID -19 PANDEMIC ON EDUCATION"** for the favour of society and Rs 15000 has been sanctioned to you for the same. We would like to begin the project as soon as possible. Please submit your plan of action in details, person engaged, name and contact number of principal investigator, etc. and submit the detail of the person for paying the amount.

Thank You
With regards

Secretary,
Rotary Club Mid Town
Muzaffarnagar

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IQAC, Shri Ram College
Muzaffarnagar

Chairman
IQAC, Shri Ram College,
Muzaffarnagar

To,

The Secretary
Rotary Club Mid Town,
Muzaffarnagar

Dear Sir,

As per our conversation, we are herewith submitting our proposal for the session 2020-21 During the year, we are proposing to conduct a survey on **"IMPACT OF COVID -19 PANDEMIC ON EDUCATION"** in the favour of society.

After the completion of the project, we will submit a report to you that will consist of the following:

1. The objective of the survey
2. Questionnaire
3. Analysis of the survey
4. Report of the survey
5. Findings and Conclusion of the Survey

Budgeted Expenditure details:

1.	Remuneration	:	10,000
2.	Printing and stationery	:	2000
3.	Local conveyance charges	:	1500
4.	Meal expenses	:	1500
5.	Mobile and internet expenses	:	1000

We wish to have continued alignment with you.

Thank You,
With Regards

Dr Ravi Gautam
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Journalism & Mass Communication
Shri Ram College
Muzaffarnagar

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IQAC, Shri Ram College,
Muzaffarnagar

Co-ordinator
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To,
The Secretary
Rotary Club Mid Town
Muzaffarnagar

Dear Sir,
With reference to your letter, we are herewith submitting our plan of actions and the details as demanded by you.

Name of the Principal Investigator :	Dr. Ravi Gautam
Contact number of principal investigator :	9927668855,9368917974,7302917974
Name of Deputy Coordinator:	Shivani Burman
Contact number of Deputy Coordinator:	9761613892
Team members Voluntary involved students :	1. Maroof Chaudhry (Bjmc final year) 2. Rohit Rathi (Bjmc final year) 3. Rishabh Chaudhry (Bjmc final year) 4. Vibhor Kumar (Mjmc final year)

The survey will be conducted with the following objectives :

Objectives:-

1. The main objective of the study is to examine the impact of COVID-19 on education consequently the study also investigated the various challenges for the colleges to continued education during the COVID-19 lockdown.

2. To analyze the effects of COVID-19 on teaching methodology.

3. For finding out the impact of COVID-19 on offline classes.

4. The impact of the crisis on education.

5. To analyze the positive and negative effect of COVID-19 on education.

6. To analyze the students attendance in online classes.

The survey will cost Rs-16000 which includes printing and stationery expenses , remuneration, travelling expenses, meals expenses, etc.
We are waiting for your positive response and acceptance of the project.

Thank You.
With regards,
Dr. Ravi Gautam
Head of Department,
Journalism & Mass Communicatio
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Muzaffar nagar

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THE IMPACT OF COVID-19 PENDEMIC ON EDUCATION

1. Objectives:-

1. The main objective of the study is to examine the impact of COVID-19 on education consequently the study also investigated the various challenges the colleges continued education during the COVID-19 lockdown.

2. To analyze the effects of COVID-19 on teaching methodology.

3. For finding out the impact of COVID-19 on offline classes.

4. The impact of the crisis on education.

5. To analyze the positive and negative effect of COVID-19 on education.

6. To analyze the students attendance in online classes.

Keywords:- COVID-19, Education system, Online classes.

2. Introduction:-

Web survey: - web survey or internet survey are defined as a data collection method where surveys or questionnaires are sent over the internet to a sample of respondents and they can respond to this survey over the world wide web. Respondents can be sent web surveys via various mediums such as email, embedded over the web site, social media etc. In web surveys , respondents answer the questionnaire with the help of a web browser and the survey responses are stored in web-based databases.

2.1 Advantages of web surveys:-

1. Faster medium to reach the target audience:- In comparison to the other surveys techniques such as pen-and-paper surveys, web surveys are exceedingly fast in acquiring feedback from respondents.

2. Real time analysis :- After collecting information ,the analysis is an important step for researchers to take prompt actions. With the availability of web survey software such as question pro, researchers can analyze collected data in real time from a central dashboard.

3. Cost-efficient:- Due to the minimum required resources, web surveys are much cheaper than the other surveys methods such as telephonic or pen-and-paper surveys.

4. Minimum margin-of-error: - unlike the traditional survey methods, respondents directly answer the surveys, without the involvement of a mediator. The margin-of-error in case of web surveys is hence, very limited.

5. Convenient to understand for respondents:- Web surveys are usually very easy to answer as they either come to the email inbox or social media, it can be answered with a click.

6. Saves researchers' time: - Web surveys are quick to configure and due to ease, they tend to save researchers' time.

7. Respondents are more truthful: - When a web survey is conducted within a target audience, researchers allow respondents to answer anonymously. Due to the anonymity involved in web surveys, respondents usually depict a more honest and truthful behavior in providing feedback.

2.2 COVID-19

We have experienced during the covid19 pandemic that this period created a very strong impact on the educational system, teachers and students has been greatly affected. The impact on the educational system is both positive and negative. In this period of Covid19 challenges were faced, but new opportunities also developed to make education better and accessible? The traditional existence of offline classes have been challenged by the online educational platform during the pandemic of covid19. Its breaks all the limitation of offline classes and provides more effective and objective educational opportunity. We realized our responsibility and we also took the initiative that even though we are confined to homes, we must do whatever we can contribute with a dedicated spirit towards our work. In such a situation, we got the idea of online survey; because the problem was topical.

We did research survey on teachers and students of Shri Ram College. And through this survey we got a lot of such data, which gave us an opportunity to share our experience with everyone during this pandemic time.

Few months ago, the outbreak of the corona virus disease in 2019, also known as COVID-19 was declared on 30th January 2020, by the Director General of World Health Organization (WHO). In 2019, there was nervousness about the effect of a

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US-China trade war. This was the US presidential elections and the famous Brexit on World Economy. Upon the justification of these, the IMF had projected weakened international growth of 3.4 percent. But COVID-19 – the sickness caused by SARS-CoV-2, a new strain of corona virus from the SARS-COV strains– transformed the position suddenly. Due to nervousness and vagueness, and to normal valuation that firms' returns are expected to be reduced owing to the effect of COVID-19, international stock markets obliterated about US$6 trillion in capital in a single week from 24th to 28th of February, 2020 [1]. The S&P 500 index missed more than $5 trillion worth in the same week in the US, whereas the S&P 500's principal 10 companies had a mutual cost of over $1.4 trillion (https://www.reuters.com), even though some of these were improved in the succeeding week. Some of the cost in rate was due to coherent assessment by investors that firms' profits would decline due to the impact of the corona virus. The COVID-19 epidemic far-reaching the earth has affected masses of students, whose school, colleges closings have further caught them, their families and teachers by disbelief. It means lost class altogether for some, whereas others are testing online learning frequently facing problems with online networks and also psychosocial well-being and motivational trials. These hitches point to a life-threatening gap in school-based exigency arrangement within wider education sector readiness planning and alternative management. Education section readiness aims to shield students and educationalists, strategies for continuousness of education, and protect education segment reserves, all of which eventually contribute to supported flexibility through education. The Disease control Department of the Health Service's readiness and guidance for education based pandemic proposed that education -based pandemic often increase communitywide pandemics; consequently, planning and working for these pandemics are a way of protecting not only the well-being of staff and students, but also of the broader community

A considerable number of the worldwide guidance for colleges involving the current COVID-19 pandemic emphasizes on keeping schools and teachers safe, physically fit over individual and ecological no pharmaceutical interventions (NPIs). This comprises communication about everyday preventive activities like inspiring staff and students to remain home when they are sick, cover sneezes and coughs, washing hands frequently, and sanitizing regularly touched surfaces and items. Some schools in societies with isolated cases of the corona virus are introducing community NPIs, such as practicing social distancing among people at school to about three feet, thereby making attendance and sick-leave procedures

more supple, deferring or withdrawing large colleges events and momentarily dismissing students.

3..REVIEW OF RELATED LITERATURE

Corona virus disease (COVID-19) is an infectious disease caused by a new corona virus belonging to the SARS-COV family. Most people infested with COVID-19 will feel mild to moderate respiratory illness and may recover without special treatment. Older people, and those with underlying health problems like diabetes, cardiovascular disease, cancer and chronic respiratory illness are more likely to develop grave illness. One of the important ways to contain and slow the spread is to intensify education on the mode of trans mission and the signs and symptoms of the disease. Guard yourself and others against infection by using an alcohol-based sanitizer regularly or washing your hands and not touching your face .

1. Effect of the 2019/2020 Corona virus Epidemic on Education

The 2019 corona virus epidemic has affected educational arrangements globally, leading to the near-total closing of schools, colleges and universities. As of 27 April 2020, nearly 1.725 billion learners are presently affected owing to school closings in response to the epidemic. According to a monitoring report by UNICEF, one hundred and eighty-six (186) countries are presently engaging national closures and are engaging local closures, impacting about 98.5 percent of students' population in the world. On 23 March 2020, Cambridge International Examinations (CIE) made a pronouncement that the annulment of Cambridge O Level, Cambridge IGCSE, Cambridge AICE Diploma, Cambridge International AS & A Level, and also Cambridge Pre-U examinations for the May/June 2020 series all over the world. International Baccalaureate exams have also been annulled

School closings impact not only teachers, students and families, but have extensive economic and societal costs. School closings in response to COVID-19 have thrown light on numerous social and economic issues, including homelessness, digital learning, student debt and food insecurity as well as health care, access to childcare, housing, disability services and internet. The impact was severe for underprivileged families, and their children, causing intermittent learning, conceded nutrition, childcare complications, and resultant economic cost to families who could not work.

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Efforts to stalk the spread of COVID-19 through non-pharmaceutical involvements and protective procedures such as self-isolation and social distancing have sparked the extensive closure of all tertiary, second cycle and basic schooling in more than 100 countries. Previous epidemics impelled widespread school closings round the world, with varying stages of effectiveness. Mathematical modeling has revealed that spread of an outbreak may be delayed by school closings. Also, in some instances, the resumption of schools after a period of closings have caused increased infection rates. As closings tend to happen simultaneously with further intercessions such as communal gathering prohibitions, it can be problematic to measure the exact impact of school closings [5]. During the 1918-1919 influenza epidemic in the United States, school closings and public gathering prohibitions were linked with lesser total death rates. Cities that applied such interventions earlier had larger delays in reaching highest death rates. Schools closed for average period of 4 calendar week according to a study of forty-three (43) US towns' reply to the Spanish Flu. School closings were made known to reduce illness from the Asian flu by 90% throughout the 1957-58 outbreak, and up to 50% in governing influenza in the US, 2004- 2008

2.Impact of COVID-19 on education in India

3.COVID-19 and education in India a new education crisis in the making.

4.The UNICCO's India case study "Situation analysis on the effects of and responses to COVID-19 on education sector in Asia"

4. RESEARCH METHODOLOGY

4.1 Research Design:-

The researchers used descriptive research survey design in building up this research work. The choice of this research design was considered appropriate because of its advantages of identifying attributes of a group of individuals from a large no. of teachers & students. The design was suitable for the study as the study sought the impact of COVID19 on education in . Data were collected from online questioner sources.

4.2 Target groups of Survey:- Students and teachers of Shri Ram College and other college's faculty (Online Whatsapp, Gmail users' Groups)

4.3 Characteristics of Descriptive Research Methodology:-

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1.In this the subject is carefully selected.

2. In this the researcher acts as an unbiased observer.
3. The hypothesis is also formed in this study.

5. Data collection:-

Web survey technique has been used for data collection. The sample number in this research is 1130, this research has been done on students and teachers in which both men and women are included, a demographic variable gender has been taken in this research.

5.1 Data analysis and interpretation: The data obtained using web survey has been analyzed and interpreted using descriptive data like frequency percentage.

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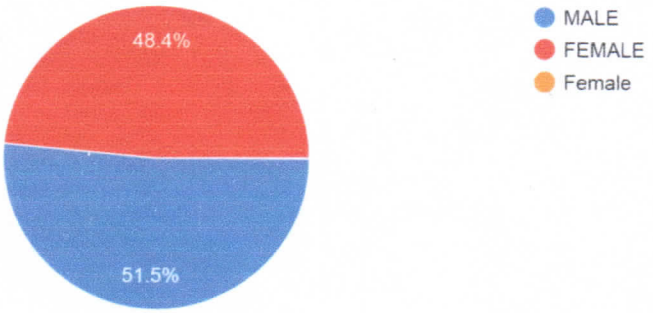
GENDER

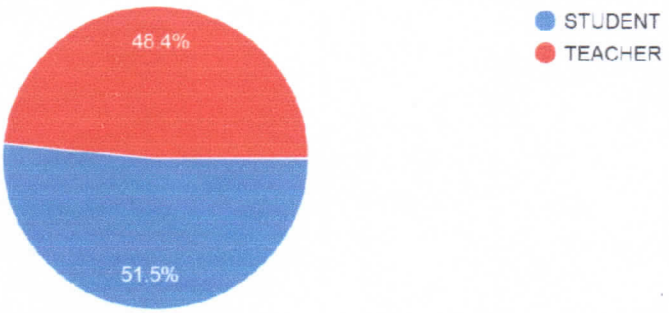
1,124 responses



According to the data received it was seen that males constitute 51.5% of the respondents while females are 48.4%.

PROFFESION

1,124 responses



In the present research, the teacher respondents are 48.4% and the students respondents are 51.5%.

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1. Did you know about online education before the Pendamic covid-19.

1,105 responses

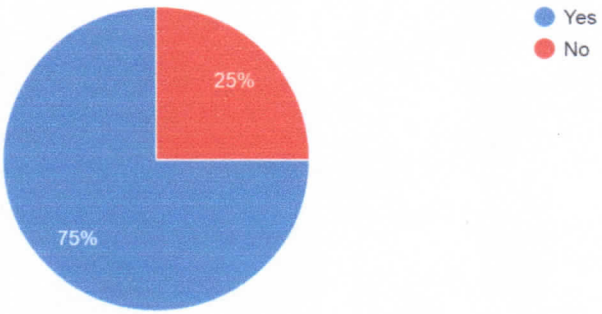

Table no. 1.

As per the data obtained in table no.1, it is seen that 75% of the people were aware of online education before the COVID-19 pandemic and 25% were not aware of the online learning till before the COVID-19 pandemic.

2. Did pendamic of covid-19 effect on education.

1,107 responses

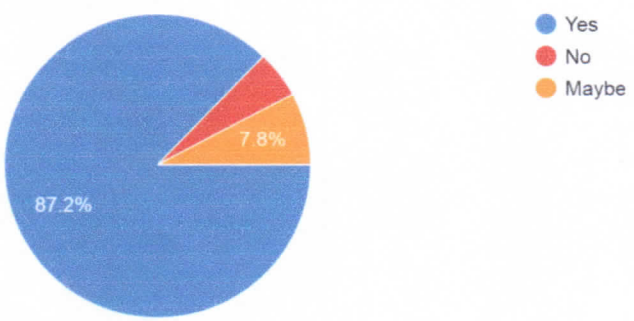

Table 2.

According to the data obtained in table no. 2. 87.2% people feel that the impact of the Covid-19 pandemic has been on education. At the same time, 7.8% people believe that the Covid-19 Pandemic has hardly affected education.

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3. Do you think that covid-19 developed the new opportunities for education system.

1,103 responses

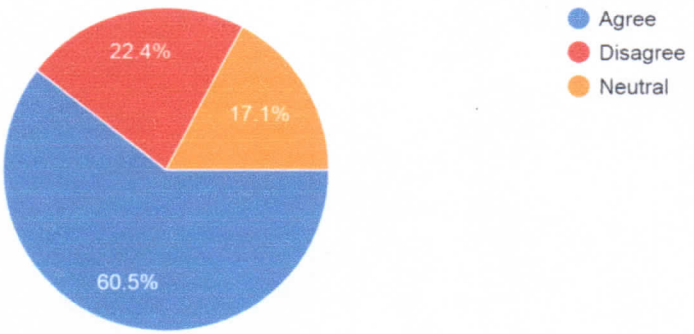

Table no. 3.

According to the data obtained in Table No. 3, 60.7% percent of the people believe that new education opportunities have developed during the Covid-19 pandemic and 21.8% disagree. Whereas 17.5% of the people have the answer. neutral.

4. online classes are more effective than class room mode.

1,107 responses

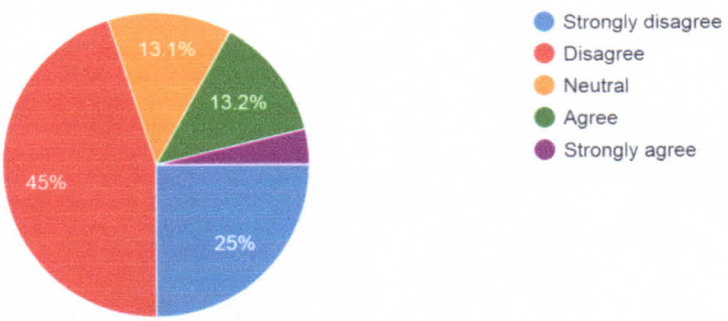

Table no. 4.

According to the data obtained in table no. 4. 45% teachers & students disagree with this statement online classes are more effective than classroom mode. 25% are strongly disagree only 13.2% are agree with this statement and 13.1% are neutral.

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5. Do you think online class helps in overall development for student.

1,109 responses

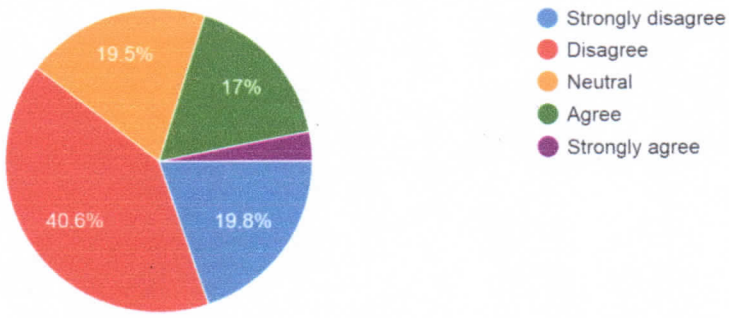

Table no. 5.

As per the data obtained in table no. 5., 40.6% of the students and teachers feel that online classes are not helpful in the overall development of the students and 19.8% completely disagree with this statement while 17% agree and 19.5% are neutral.

6. Online classes are more convenient than classroom method.

1,105 responses

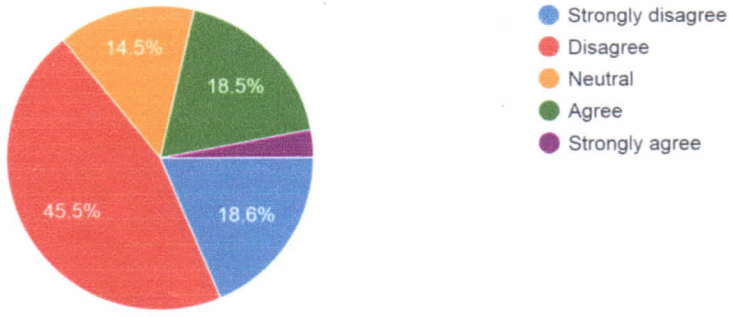

Table no. 6.

According to the data obtained, 45.5% of the students and teachers believed that online classes are less convenient than the classroom method whereas 18.6% totally disagree with this statement and 18.5% are agree or 14..55 are neutral.

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7. Teaching enviouronment in online class helped in better learning.

1,129 responses

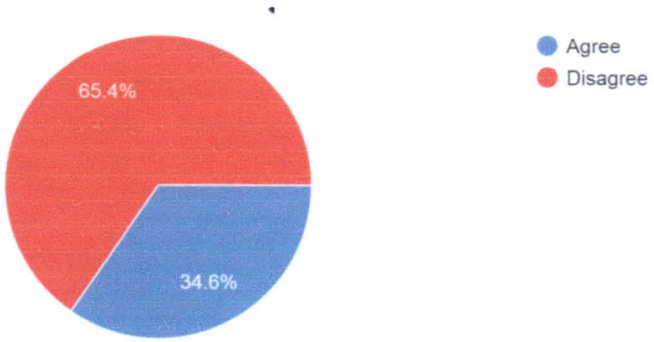

Table no. 7.

According to the aptly obtained data 65.4% of students and teachers disagree that the online classroom environment has helped in better learning and 34.6% are agree with this statement.

8. Do you think online education will be helpful for growth in career.

1,129 responses

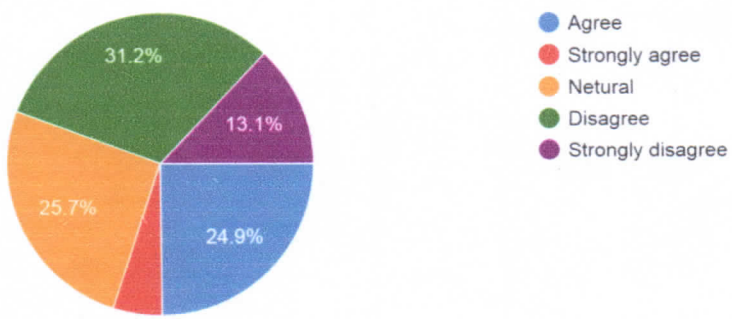

Table no. 8.

As per data obtained in table no.8., 24.9%of the students and teachers feel that online classes will be helpful in career and 31.2% disagree with it, whereas 13.1% completely disagree and 25.7% are neutral.

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9.There is lack of teachers-student interaction in online classes.

1,130 responses

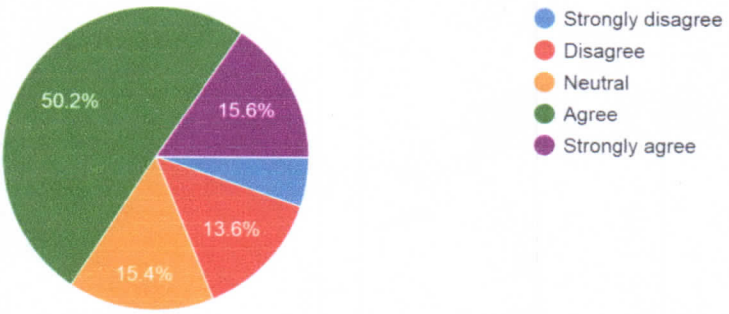

Table.9.

In online classes there is lack of teachers-students interaction . 50.2% of the students and teachers agree with this statement. Whereas 15.4% fully agreed and 13.6% disagree and 15.4% answered neutral.

10. It is difficult to clarify doubts in online classes.

1,130 responses

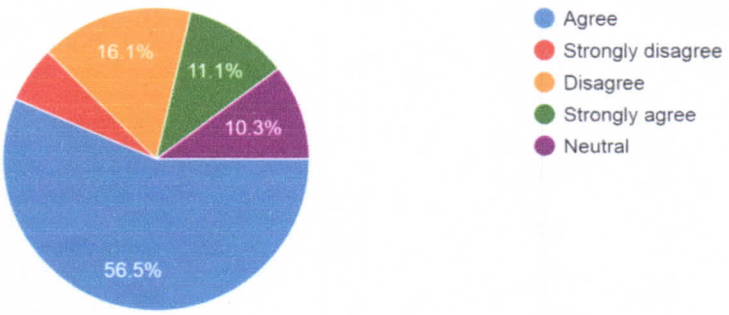

Table.10.

According to the above data, 56.5% of the students and teachers agreed that it is difficult to clarify the doubts in the online class and 11.1% completely agreed. 10.3% disagreed, 16.1% disagreed completely, and 10% were neutral.

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11. I get easily distracted during online classes?

1,130 responses

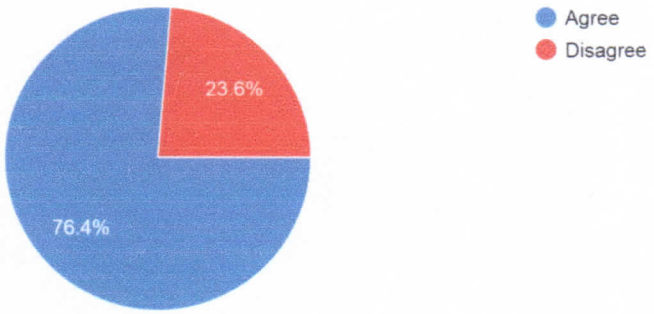

Table.11.

According to the above data, 76.4% students and teachers admitted that they get distracted quickly during online classes and 26.6% students and teachers expressed their disagreement on this.

12. Difficult to keep classes for longer duration during online classes.

1,130 responses

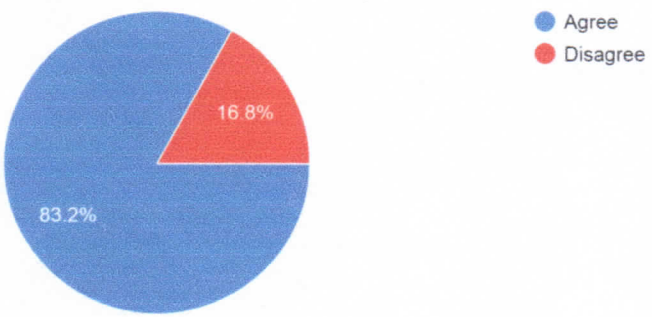

Table.12.

As per the data obtained in Table No. 12, 83.2% of the students and teachers find it difficult to keep the classes for a long time during the online classes. Agree with this statement and 16.8% disagree

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13. There is lack of work satisfaction while taking online classes .

1,130 responses

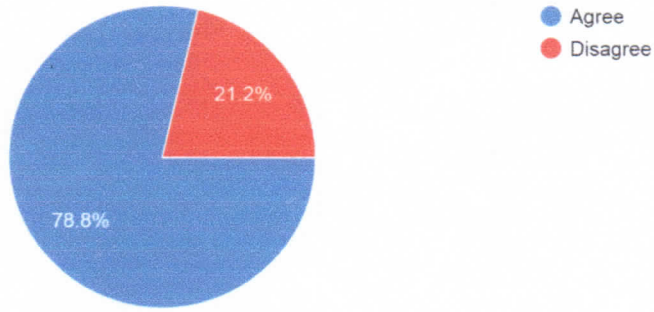

Table.13.

According to the above data, 78.8% of students and teachers lack work satisfaction while taking online classes. Whereas 21.2% of the people do not think so.

14. It is difficult to control group in intreraction during online classes.

1,130 responses

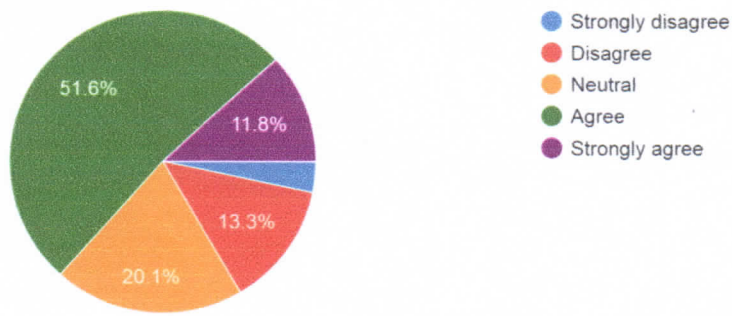

Table.14.

As per the data obtained above, it is difficult to control the group through interaction in online classes. 50.6% of the students and teachers agree with this statement. 11.8% completeness agree. 13.3% disagree. , 20.1% stay neutral.

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15. I feel lazy and disinterested during online class.

1,130 responses

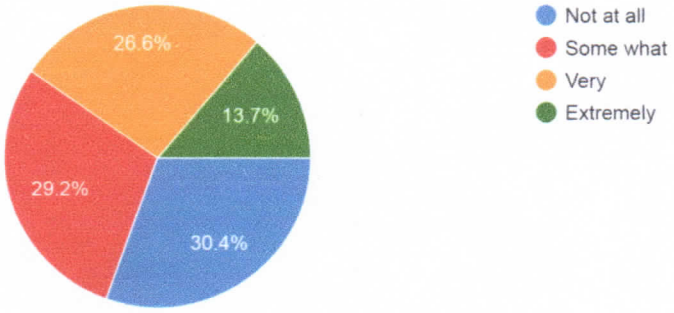

Table.15.

According to the data obtained above, 30.4% of students and teachers do not feel lazy and indifferent during online class at all and 26.6% do a lot and 29.2% feel this to some extent and 13.7% feel very much

16. The major problem for online classes is :

1,130 responses

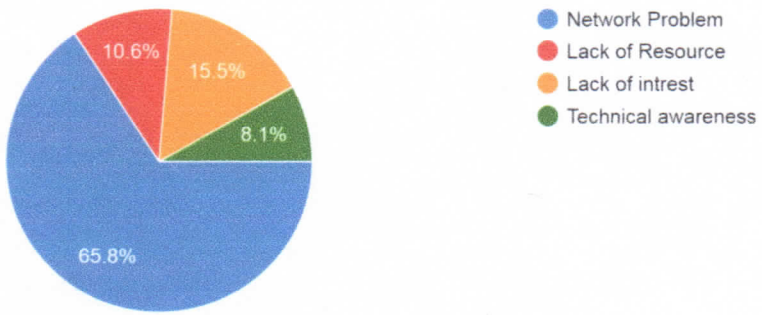

Table.16.

According to the above data, 65.8% students and teachers believed that the problem arising in online classes is due to network problem and 10.6% due to lack of resources and 15.5% due to lack of interest and 8.1% due to lack of technical awareness in online classes. considered a hindrance.

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17. Technical issues disrupt the flow and pace of online classe.

1,130 responses

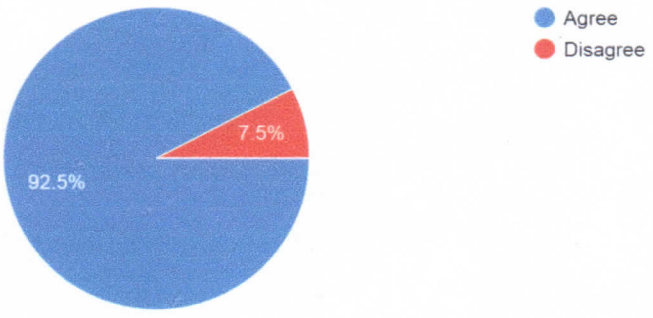

Table.17.

According to the above data, 92.5% of students and teachers believed that technical issues hinder the flow and speed of online classes and 7.5% did not.

18. Which of these applications do you find most convenient for online classes.

1,130 responses

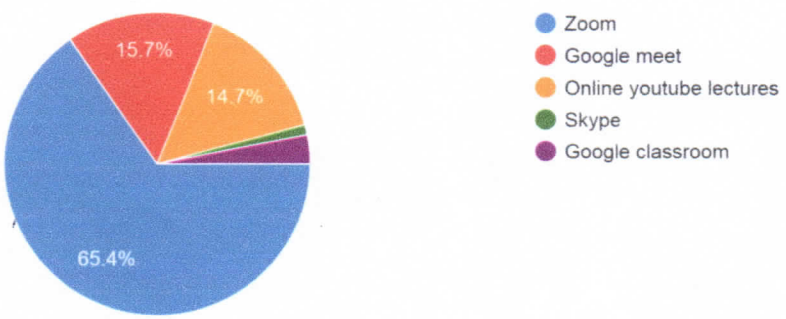

Table.18.

Table no. In 18, students and teachers were asked which application they find convenient for online class. In response to this, 65.4% of the people answer-zoom and 15.7% find Google Meet convenient and 14.7% online YouTube lectures

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19. Online Classes save time

1,130 responses

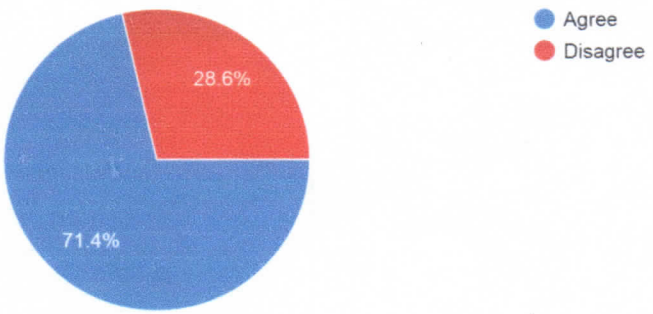

Table.19.

According to the above data, 71.4% students and teachers feel that online classes save time and 28.6% believe that it is not so.

20. .Is there any future of online education is offline education facing the challenges.

1,130 responses

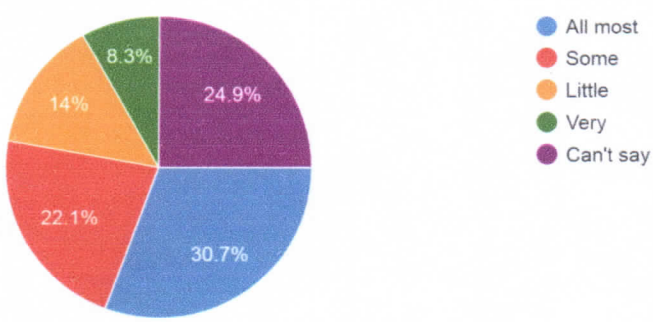

Table.20.

According to the above data, 30.7% of the students and teachers feel that online class can be a challenge to offline class in future and 22.1% feel that it can be a challenge. Online Classes Offline Classes and 14% think it's a bit of a challenge and 8.3% think a lot while 24.9% say can't say

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6. FINDINGS

1. In the present research, the question answerer is 50% while the female respondents are 50%.

2. The research was done on students and teachers in which students are 50% and teachers are 50%.

3. The data obtained in the research shows that students and teachers knew about online education even before the corona epidemic.

4. It is known from the present research that the corona pandemic has had a greater impact on education. This is the opinion of 87% of students and teachers.

5. It is known from research that the corona epidemic has given a new opportunity to education.60.4% of students and teachers agree with this new opportunity and 22.4% agree. 17.2% is neutral.

6. The obtained data shows that students and teachers are not yet practical with online classes.45% of students and teachers found online class practical and 13% found online class right.

7. 45% of students and teachers found online class practical and 13% found online class right.

8. 40% of the students and teachers did not like the online classroom method for the overall development of the students.

9. 17% of students and teachers find online classes better for overall development of students.

10. The presented data shows that 14% of the students and teachers felt that the online technical environment was better and 65% felt that the technical environment of the online classroom was not good.

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11. From the data revealed in the present research, it appears that 25% of students and teachers feel that online classes are helpful in increasing the career of students.
At the same time 31% of students and teachers do not think so and 25.7% are neutral about this matter.

12. From the present research, we have learned that 51% of the students and teachers are still not successful in clearing the doubts in online classes.

13. According to the data presented in the research, 51% of students and teachers agree that successful interaction between student and teacher does not happen in online classes.

14. The data obtained in the research shows that 76.4% of students and teachers get distracted quickly during online class. And 23.6% of students and teachers don't feel that way.

15. The data obtained in the research shows that a large number of students and teachers do not want to continue online classes for a long time. The percentage of which was 83%.

16. The data obtained in the research shows that the biggest hindrance during online classes is network problem.
Network problem is the biggest problem for 65% of students and teachers.

17. The data obtained in the research shows that a large section believed that technical issues hinder the care and speed of online classes.
92% of students and teachers agree with this.

18. The data obtained in the research shows that the most popular application among teachers and students is Zoom compared to any other application.
65% of students and teachers are using Zoom Convenience Application.

19. One of the positive views among students and teachers in the research data is that online classes save time.
76.4% of students and teachers agree with this statement.

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20. The data obtained in the research shows that in the coming times, online classes are somewhat of a challenge in front of offline classes.

7. CONCLUSION:-

The impact of pandemic COVID-19 is observed in every sector around the world. The education sectors of India as well as world are badly affected by this. It has enforced the world wide lock down creating very bad effect on the students' life. Around 32 crore learners stopped to move schools/colleges, all educational activities halted in India. The outbreak of COVID-19 has advised us that change is inevitable. It has worked as a catalyst for the educational institutions to grow and opt for platforms and techniques, which have not been used before. The education sector has been fighting to survive the crises with a different approach and digitizing the challenges to wash away the threat of the pandemic. This research project highlights side effect of covid-19 on education and suggesting some important points for enhancing the educational efficiency during the covid-19. Both the positive and negative impacts of COVID-19 are discussed and some fruitful suggestions are pointed to carry out educational activities during the pandemic situation.

The pandemic Covid-19 has spread over whole world and compelled the human society to maintain social distancing. It has significantly disrupted the education sector which is a critical determinant of a country's economic future. February 11, 2020, the World Health Organization (proposed an official name of the virus as COVID acronym for Corona virus disease 2019. It was first identified in Wuhan, China on December 31, 2019. First death by COVID19 was the 61-year old man in Wuhan, China 2020. WHO declared COVID-19 as a pandemic on 2020. The first case of the COVID-19 pandemic reported on 30 January 2020 in the state of Kerala and the affected had a travel history from Wuhan, China (Wikipedia).The first death due to COVID-19 was reported in India on March 12, 2020. It has affected more than 4.5 million peoples worldwide (WHO). According to the UNESCO report, it had affected more than 90% of total world's student population during mid April 2020 which is now reduced to nearly 67% during June 2020. Outbreak of COVI-19 has impacted more than 120 crore of students and youths across the planet. In India, more than 32 crore of students have been affected by the various restrictions and the nationwide lockdown for COVI-19. As per the UNESCO report, about 14 crore of primary and 13 crore of secondary students are affected which are two mostly affected levels in India.

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After observing the corona virus pandemic situation the WHO advised to maintain social distancing as the first presentation step. So every country started the action of lockdown to separate the contaminated people. The education sectors including entrance tests were postponed indefinitely. Thus, the lockdown destroyed the schedules of every student. Thought it is an exceptional situation in the history of education. Covid-19 has created many opportunities to come out of the rigorous class room teaching model to new era of digital model.

The lockdown has compelled many educational institutions to cancel their classes, examination, internship etc and to choose the online modes. Initially, the educators and the students were quite confused and didn't understand how to cope up with the situation of this sudden crisis that compelled closure of the educational activities. But latter on all realized that the lockdown has taught so many lessons to manage with the emergence of such pandemics. Thus, Covid-19 has created many challenges and opportunities for the educational institution. The lockdown has given them a ray of hope for teachers and students to continue their educational activities through online. We have been conducted an online Google survey for finding out side effects and problems of covid19 on education system. We have been conducted this research survey on the teachers and students of Shri Ram College, Muzaffar Nagar and other colleges.

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Date 03-09-2021

The Manager
Agarwal Duplex Board Mills Ltd
Muzaffarnagar

Sub: Proposal letter for approval of research project.

Sir,

I, Dr. Vikas Kumar, am working as Assistant Professor in Department of Bioscience, Shri Ram College. I am planning to start a research project on treatment of paper mill effluent with the help of phyto-plant. I would like to request your approval for our project proposal so we can continue moving; our team has been hard at work envisioning the ideal **"Screening of Phyto-plants for Remediation of Paper Mill Effluent"**.

Here is a brief summary of our proposal including the scope, budget and objective. Here are a few aspect of the proposal we are most excited about accomplishing. We hope these highlight accurately demonstrate the goal and vision of our project to you.

Please let us know if there is any other information you need regarding our proposal to help you make your decision.

With Regards,

Dr. Vikas Kumar
Assistant Professor
Department of Bioscience
Shri Ram College, Muzaffarnagar

Co-ordinator
IQAC, Shri Ram College
Muzaffarnagar

Chairman
IQAC, Shri Ram College,
Muzaffarnagar

TIN 09372800376

AGARWAL

DUPLEX BOARD MILLS LIMITED

Office & Works : 4TH KM. STONE, BHOPA ROAD, MUZAFFARNAGAR-251001(U.P.)
✆ 0131-2614623, 2614200, 2614734, 2411509 FAX : 2614881

Ref. No. .....

To

Dr. Vikas Kumar

Assistant Professor
Department of Bioscience
Shri Ram College, Muzaffarnagar

Sir,

With reference to you're the letter dated 03-09-2021 regarding approval of proposal of research project. We are glad to offer our association with you for this Industry sponsored project. Our Industry is ready to release a grant as per mention in proposal letter by you.

Please send your acceptance if you are ready to handle this project on the following terms and conditions.

1) The company is ready to pay Rs. 100000/- as the cost of the project.
2) The company will not bear TA and other cost including stay arrangements.
3) Cost of project will be paid in advanced at the beginning of the task.
4) After completion of the project, it will be necessary to submit the final report.
5) A Certificate of completion will be issued after satisfactory completion of the project.

Hope you find the document in order. Please send a signed copy of the letter as your acceptance as soon as possible, so that we send the other required documents and the payment of **Rs. 100000/-**

Thanks and regards

Date: 10-09-2021

For Agarwal Duplex Board Mills Ltd.
Muzaffarnagar

Correspondence Address : 122, SOUTH BHOPA ROAD, NEW MANDI, MUZAFFARNAGAR - 251001 (U.P.)
Regd. Office : 301-AGARWAL CITY MALL, OPP. M-2-K CINEMA, PITAMPURA, NEW DELHI-110034

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Ref. No. .....

Completion Certificate

We are pleased to certify that Dr. Vikas Kumar, Assistant Professor , Department of Bioscience Shri Ram College, Muzaffarnagar worked for Agarwal Paper Mill Ltd, Muzaffarnagar on a industry Sponsored consultancy project on **"Screening of phyto plants for remediation of paper mill effluent".**

He and his team have worked up to the entire satisfaction of company's Management and his findings and recommendation are found to be useful for decreasing company effluent load . We wish him all the best his future.

Date 12-04-2022

For Agarwal Duplex Board Mills Ltd.
Muzaffarnagar

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GOEL RAKESH & CO
CHARTERED ACCOUNTANTS

57-A, Aggarwal Market first floor,
Mahavir Chowk
Muzaffarnagar(U.P.)-251001
Phone no-0131-2622405

Utilization certificate

S.N.	Detail of sanction of fund with project name and duration	Amount
	180 –Days project on in "Screening of Phyto- plants for Remediation of Paper Mill Effluent". system Date of 03-09-2021 as per sanction latter	100,000/-
	Total	100,000/-

It is certify that out of Rs.100,000/- (One lack) of grant sanction by Aggarwal Duplex Board Mills Limited. Muzaffarnagar during the year 2021-22 in favor in Shri Ram College Muzaffarnagar a sum of Rs. 100,000/- has been for which it was sanction and that the balance of Rs. Nil remaining unutilized at the end of the year has been surrendered) the extra amount (if any) is met out by Shri Ram College

2. Certified that we have satisfied our self that the conditions on which the grant was sanction have been duly fulfilled/are being fulfilled and that we have exercised the following checkes to see that the money was actually utilized for the purpose for which it was sanctioned

For Shri Ram College

Secretary
Place : Muzaffarnagar

Co-ordinator
IQAC, Shri Ram College
Muzaffarnagar

For Goel Rakesh& Co
Chartered Accountants

Rakesh Goel (Proprietor)
M.N0 :0711858
FRN.:003374C

Chairman
IQAC, Shri Ram College,
Muzaffarnagar

Duration of Project

Six Month (From 05 October 2021 To 25 March 2022)

Sanctioned Amount of Project

Amount – 100,000/-

Supervisor

Vikas Kumar, Faculty of Bioscience, Shri Ram College, Muzaffarnagar

Student Engaged in project

One student was involved in research and data collection for the project

Expenditure

Head	Number of Unit	Amount (in Rs./-)
Manpower	01	10,000 × 6 (Months) = 60,000/-
Honorarium	Given to Project Supervisor	20,000/-
Miscellaneous		20,000/-
Total		100,000/-

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Project Report

On

Screening of Phyto-plants for Remediation of Paper Mill Effluent

Submitted by

Vikas Kumar

Assistant professor, Department of Bioscience,
Shri Ram College, Muzaffarnagar

Submitted to

Agarwal Duplex Board Mills Ltd.,
Muzaffarnagar

2021-2022

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Muzaffarnagar

Chairman
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INTRODUCTION

Muzaffarnagar is an important district regarding geographically in western Uttar Pardesh, India it is located as 27^0 12" north latitude and 79^0 78" east longitude from a part of Saharanpur division and is situated in the interfluves of Ganga and Yamuna rivers between of Saharanpur on the north and Meerut on the south. On the west, the Yamuna separates it from district Karnal of Haryana and on the east. The Ganga from boundary between district and the district on Bijnor district.

Muzaffarnagar district is a zone of intensive agriculture with cropping intensive of 149% in which 57.4% area is covered by sugarcane crop. The net sown area is 325927 ha, 77.33% of total area of the district (Sankhyakiyapatrika, 2006). Sugarcane is the main commercial crop, while the wheat and paddy are the other crop of the district. The farmers in the study are have a tendency of flood irrigation, which requires a large quantity of water Hence, the sustainable growth of commercial crop and for other domestic requirement availability of adequate quantity of water in terms of good quality draws the concern of researcher and planners. Ground water in Yamuna-Krishna sub basin of Muzaffarnagar district is deteriorating due to industrial and sewage pollution (Umar and Ahemed, 2007). In contest of availability of surface water, it is reducing day by day result in pressure to ground water resource. We recharge in this region is quite good i.e., ground 20% of the inputs (irrigation and rainfall). Hence, increasing the possibility of the recycling of ground water which may carry or tend to concentrate the contaminants load supply through chemical fertilizer and other anthropogenic sources, may deteriorate the quality of ground water and subsequently of soil physic-chemical properties overload term use. Water is one of the most important precious resources found on the earth. The water resources are most often affected by anthropogenic activities and also industries.

Growth of population, massive urbanization, rapid rate of industrialization and modern techniques in agriculture have accelerated the water pollution lead to gradual deterioration of its quality. Due to continues disposal of waste water into the water bodies, surface water quality through out the country has deteriorated because of mixing various chemical pollutants of the effluent with water. This effluent contents various micronutrients essential for growth of crop plants. However, many industrial waste may have harmful effect and may cause soil fatigue.

industrial waste is widely practiced as a measure and economy source of nutrients and organic matter for growing cereal crop. Among others, one of the most important irrigation as well as

nutrient resources is waste water, which consist of about 95% water and reset as organic and inorganic nutrients.

Irrigations water is one which becoming costlier due to increasing demands of human pollution. Simultaneously, the demand for food is also increasing, which is brought more land and under cultivation focused the attention on future and irrigation water. With this certain limitation on has to turn to know conventional resources to meet the irrigation water demand. The Black River originates in the Doon valley and passes through Saharanpur, Muzaffarnagar and Bagpat district, before merging with Hindon river at Barnava, Bagpat, which goes on to merge with the Yamuna River nearby Delhi further more, which itself goes to merge with the Ganga River, which finally merge by of Bengal. The discharge of sewage and industrial effluent in water sources makes it unpalatable and useless for rinking and irrigation (killing 1977a,1977b,Ruttle, 1977). In the last few years some scantest have worked on the effect of waste water on growing crops, soil characteristics and other related aspects (Agarwal and Kumar 1978).

In a report, **Multicar 1977** observed that underground injection of liquid waste can be environmentally sound for growing crops in **1981 Verma** described the manure value of Paper Mill effluent.

OBJECTIVE

1) **Collection of effluent samples and analysis**
2) **Physico-chemical analysis of water sample collected from Agarwal Papers Mills Ltd. (Muzaffarnagar).**
3) **Determination of growth parameters and heavy metal analysis**

MATERIALS AND METHODS

Collection of effluent samples and analysis

Agarwal Pulp and Paper Mill, Muzaffarnagr, India was selected for the collection of paper mill effluent samples. The pulp and paper mill is located about 3.0 km away from Muzaffarnagar. The effluent samples were collected from the effluent disposal channel at pulp and paper mill in

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thoroughly cleaned plastic container. The plants of water caltrop nut (*T. natans*) were collected from the local pond situated at Faizpur, Bijnor (Uttar Pradesh).

Physico-chemical analysis of water sample collected from Agarwal Papers Mills Ltd

The collected effluent samples were brought to the laboratory and were analyzed before and after phytoremediation for various physico-chemical parameters and heavy metals, viz. total dissolved solids (TDS), pH, electrical conductivity (EC), total nitrogen (N), phosphorus (P), calcium (Ca), magnesium (Mg), potassium (K), iron (Fe), cadmium (Cd), chromium (Cr), nickel (Ni), lead (Pb), and zinc (Zn) using *T. natans* at 0, 15, 30, 45, and 60 days following standard techniques.

Determination of growth parameters and heavy metal analysis

The growth parameters, viz. fresh, dry, and leaf area index (LAI) of *T. natans* before and after phytoremediation experiments at 0, 15, 30, 45, and 60 days were estimated. For heavy metal analysis, 1.0 g of air-dried *T. natans* were taken in digestion tubes and 3 ml of concentrate HNO_3 was added and digested in an electrically heated block for 1 h at 145°C. To this mixture, 4 ml of $HClO_4$ was added and heated to 240°C for 1 h. The mixture was cooled and filtered through Whatman No. 42 filter paper. The volume was made to 50 ml by adding double-distilled water and used for analysis. Metals were analyzed using an atomic absorption spectrophotometer.

RESULTS AND DISCUSSION

Physico-chemical characteristics of paper mill effluent before phytoremedation

The paper mill effluent was found to be alkaline (pH 7.96) and it is likely due to the applications of various alkalis to adjust the pH during effluent treatment. The most contents of TDS (980.00 mg/L), EC (1.44 dS/cm), BOD (1,295.00 mg/L), COD (1645.39 mg/L), TKN (142.38 mg/L), PO3−4 (64.95 mg/L), Ca^{2+} (306.45 mg/L), Mg^{2+} (92.45 mg/L), K^+ (118.90 mg/L), Cd (4.12 mg/L), Cu (9.84 mg/L), Fe (12.65 mg/L), Ni (3.26 mg/L), Pb (4.07 mg/L) and Zn (11.19 mg/L) were recorded with 100% concentration of paper mill effluent before phytoremediation.

Physico-chemical characteristics of paper mill effluent after phyto remediation

The reduction of various parameters, viz. TDS, BOD, COD, TKN, PO3−4, Ca^{2+}, Mg^{2+}, and K^+ of paper mill effluent as per concentration after phytoremediation at different days, viz. 0 days

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(before phytoremediation), 15, 30, 45, and 60 days using *T. natans*. During the investigation, ANOVA analysis on data indicated that phtoremediation treatment of paper mill effluent using *T. natans* significantly ($p < 0.05/p < 0.01$) reduced the contents of TDS, BOD, COD, TKN, PO3–4, Ca^{2+}, Mg^{2+}, and K^{+} of paper mill effluent when compared to control experiments at different days (Table ; Figures). Among different days of treatment, most reduction of TDS (140.00–770.00 mg/L), BOD (145–986 mg/L), COD (252.34–1402.88 mg/L), TKN (6.53–106.94 mg/L), PO3–4 (3.45–35.94 mg/L), Ca^{2+} (31.89–252.79 mg/L), Mg^{2+} (4.04–52.88 mg/L), and K^{+} (6.34–67.33 mg/L) were recorded with 25–100% concentrations of the paper mill effluent after 60 days of the phytoremediation experiments using *T. natans*. It is interesting to note that the reduction of parameters was gradually increased with 15–45 days of phytoremediation experiments using *T. natans*. Thus, the maximum removal rate of different parameters was observed with 45 days of the phytoremediation

Analysis of heavy metals after phyto remediation

Phytoremediation of paper mill effluent using *T. natans* significantly decreased the contents of Cd, Cu, Fe, Ni, Pb, and Zn after 60 days of the phytoremediation. The removal of heavy metals from 15 to 60 days were ranged Cd (0.67–3.65 mg/L), Cu (1.52–6.45 mg/L), Fe (1.88–8.75 mg/L), Ni (0.47–2.64 mg/L), Pb (0.54–3.66 mg/L) and Zn (1.84–7.62 mg/L) of 25–100% concentrations of the paper mill effluent after phytoremediation experiments using *T. natans*. The reduction rate of heavy metals gradually increased from 25 to 50% concentrations of paper mill effluent with 15–45 days and it was slightly lower at 60 days.

Conclusions

The present study concluded that the paper mill effluent was loaded with various inorganic and organic pollutants. The phytoremediation experiment of paper mill effluent using *T. natans* was found effective for the reduction of various pollutants from the paper mill effluent. Among different days, the most reduction of TDS, BOD, COD, TKN, Ca^{2+}, Mg^{2+} and K^{+}, Cd, Cu, Fe, Ni, Pb, and Zn were recorded at 60 days of the phytoremediation experiments using *T. natans* but the removal rate of the pollutants were accelerated from 15 to 45 days of the phytoremediation experiments.

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Physico-chemical parameter of Paper Mill effluent

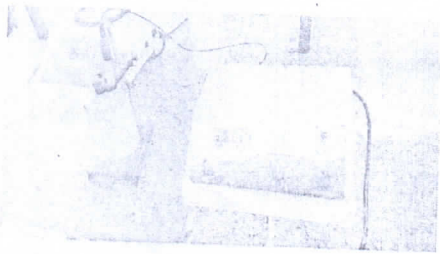

Fig. Image show the Ph of industrial water

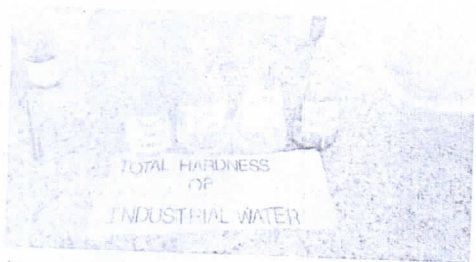

Fig. Image show the solution used for the analysis of hardness industrial water

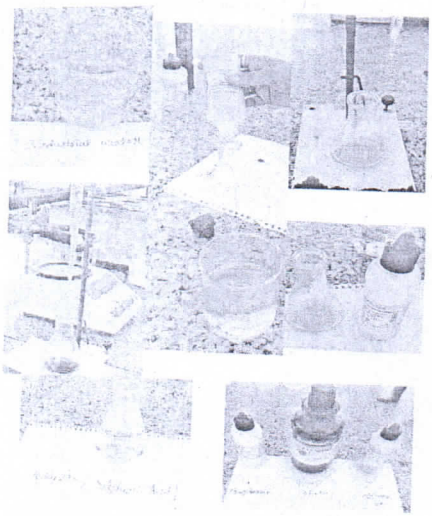

Fig.. Image show the solution used for the analysis of alkality industrial water

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Muzaffarnagar

Chairman
IQAC, Shri Ram College,
Muzaffarnagar

SHRI RAM COLLEGE

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'A' Grade Accredited by NAAC

To
The Principal
CHS College
Gothni, Khurja.

Dated: 05/07/2021

Sub: Regarding Proposal for Transformative Redesign and Development of Website for CHS College Gothni

Dear Sir,

I hope this letter finds you well. It is with great enthusiasm that we present this proposal for the development of a website for your esteemed institution. We appreciate the opportunity to be considered as your preferred partner for this important project.

We understand that your college is in need of a professional and user-friendly website to enhance its online presence and effectively communicate with its target audience. Our team has carefully reviewed your requirements and is confident in our ability to deliver a solution that aligns with your goals.

Our proposed solution includes the following key components:

1. Consultation and Planning
2. Design and Development
3. Content Management System (CMS)
5. Testing and Quality Assurance

We propose to complete the project within 16 weeks ensuring timely delivery without compromising on quality. The detailed report regarding scope of work, estimated cost and timeline for the development of the website is attached herewith.

We are excited about the possibility of working with your college on this project. If you have any questions or would like to discuss any specific details, please feel free to reach out to the project Principal Investigator **[Mr. Sanjaykant Tyagi, M: 8445744153]**.

Thank you for considering Department of Computer Applications, Shri Ram College for your website development needs. We look forward to the opportunity to bring your vision to life.

Sincerely,
(Dr. Prerna Mittal)
Principal

Co-ordinator
IQAC, Shri Ram College
Muzaffarnagar

Chairman
IQAC, Shri Ram College,
Muzaffarnagar

Phone No.: 0131-2660738, 2620899, 9927028908
Web: www.srgcmzn.com E-mail: src_mzn@rediffmail.com

The Principal
CHS College
Gothni, Khurja.

Dated: 05/07/2021

Sub: Proposal for Transformative Redesign and Development of Website for CHS College Gothni, Khurja

I. Executive Summary:

The proposed project aims to revolutionize the online presence of CHS College Gothni, Khurja by developing a dynamic and user-centric website. The project will encompass a comprehensive redesign, modernization, and expansion of the existing website to enhance its functionality, aesthetics, and overall user experience.

II. Objectives:

1. **Improved User Experience:** Enhance the website's usability, responsiveness, and navigation to provide an optimal experience for students, faculty, staff, and visitors.
2. **Comprehensive Information Hub:** Develop a centralized platform for accessing academic resources, news, events, and other relevant information to streamline communication and information dissemination.
3. **Engagement and Collaboration:** Foster student engagement through interactive features, such as discussion forums, collaborative projects, and social media integration. Encourage faculty-student interaction beyond the traditional classroom setting.
4. **Efficient Administration:** Implement an intuitive content management system (CMS) to facilitate easy content updates, ensuring that information is current and relevant.

III. Scope of Work:

1. **Website Redesign:** Conduct a thorough analysis of the existing website and design a visually appealing, modern, and responsive interface.
2. **Content Management System (CMS):** Integrate a robust CMS that allows various departments to manage and update their content independently.
3. **User Authentication and Profiles:** Develop a secure authentication system and create personalized user profiles for students, faculty, and staff.
4. **News and Events System:** Implement a system to display academic schedules, events, and important deadlines.
5. **Virtual Campus Tour:** Create an immersive virtual tour using 360-degree images and videos to showcase campus facilities and highlights.
6. **Online Forms and Applications:** Digitize and streamline various forms and applications to simplify administrative processes, including admissions and course registrations.

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Chairman
IQAC, Shri Ram Colle

IV. Budget:

I. Design Phase:

1. **UI Design:**
   - Hiring a designer: Rs10000-20000
2. **Graphic Elements and Imagery:**
   - Preparing high-quality images: Rs10000 – 15000

II. Development Phase:

3. **Content Management System (CMS) Integration:**
   - Implementation and customization: Rs10000-15000
4. **User Authentication and Profiles:**
   - Development and security measures: 5000-8000
5. **News and Events System:**
   - Integration and customization: Rs2000-5000
6. **Online Forms and Applications:**
   - Digitization and streamlining: Rs5000 – 8000

III. Testing Phase:

7. **Quality Assurance:**
   - Testing and debugging: Rs5000-10000

IV. Miscellaneous:

8. **Domain and Web space:**
   - Domain registration and web space: Rs 10000

V. Contingency:

9. **Contingency Fund:**
   - Reserve for unforeseen expenses: 5000

VI. Total Estimated Budget:

- Low-End Estimate: Rs. 62000
- High-End Estimate: Rs. 96000

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V. Timeline:

I. Planning Phase (3 Week):

1. **Project Kickoff:**
   - Define project scope, objectives, and requirements.
   - Identify key stakeholders and establish communication channels.
2. **Research and Analysis:**
   - Conduct a comprehensive analysis of the existing website.
   - Gather requirements from different departments and user groups.

II. Design Phase (4 Weeks):

3. **UI Design:**
   - Develop wireframes and prototypes.
   - Collect feedback and iterate on design concepts.
4. **Graphic Elements and Imagery**:
   - Procure or create necessary graphic elements and high-quality images.

III. Development Phase (6 Weeks):

5. **Content Management System (CMS) Integration:**
   - Implement and customize the CMS.
6. **User Authentication and Profiles:**
   - Develop and integrate user authentication features.
7. **News and Events System:**
   - Implement an interactive calendar system.
8. **Online Forms and Applications:**
   - Digitize and streamline various forms and applications.

IV. Testing Phase (1.5 Week):

9. Quality Assurance:
   - Conduct thorough testing and debugging.
10. **User Acceptance Testing (UAT):**
   - Involve stakeholders in UAT to ensure the system meets expectations.

V. **Deployment Phase (1.5 Week):**

11. **Launch Preparation:**
   - Finalize server configurations and deploy the website to a staging environment.
12. **Training:**
   - Train content managers, administrators, and end-users.
13. **Launch:**
   - Deploy the website to the live environment.

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VI. **Post-Launch Phase (Ongoing):**

14. **Monitoring and Optimization:**
    - Monitor website performance and user feedback.
    - Implement optimizations as needed.

VI. **Conclusion:**

This proposal outlines a comprehensive plan for the redesign and development of CHS College, Gothni website. The proposed enhancements will contribute to a more engaging, informative, and efficient online platform, benefiting the entire college community. We seek funding to realize this transformative project, ensuring a positive and lasting impact on the college's digital presence.

Thank you for considering our proposal. We are open to further discussions and look forward to the opportunity to bring this vision to life.

(Sanjaykant Tyagi)
Principal Investigator,
Department of Computer Applications
Shri Ram College
Muzaffarnagar.

Co-ordinator
IQAC, Shri Ram College
Muzaffarnagar

Chairman
IQAC, Shri Ram College,
Muzaffarnagar

CH. HARCHAND SINGH MAHAVIDHYALYA

GOTHANI (BULANDSHAHR)

[Affiliated to CCS University Meerut, Approved by NCTE]

Ref No.

Dated..12/07/2021

To
The Principal
Shri Ram College
Muzaffarnagar.

Subject: Acceptance of Website Development Proposal

Dear Sir/ Madam,

I am pleased to inform you that CHS College Gothni has reviewed the proposal for the website development project, and we are excited to accept your proposal. We believe that Department Of Computer Application, Shri Ram College is the ideal partner to bring our vision to life, and we are eager to commence the project.

Key Points of Acceptance:

Project Commencement:
We agree to initiate the website development project on 12/07/2021 as outlined in your proposal.
Payment Terms:
We acknowledge the estimated cost of Rs. 62000 for the project and agree to adhere to the proposed payment schedule.
Collaboration and Communication:
We are committed to providing all necessary information and resources promptly to ensure the smooth progress of the project. Effective communication will be maintained throughout the development process.
Timeline:
We understand and accept the proposed timeline for project completion, targeting 16 weeks
Point of Contact:
Mr. Ajay Ragahav, shall be the point of contact for all necessary communications in this regard (Contact No: 7906184328)
We are confident that your team's expertise and dedication will result in a website that meets and exceeds our expectations. We appreciate your commitment to delivering a high-quality product, and we look forward to a successful collaboration.
Please share any additional details or documentation required to formalize the agreement. We are ready to proceed with the next steps outlined in your proposal.

Thank you for the comprehensive proposal, and we are excited about the journey ahead.

Sincerely,

(Dr. Narendra Kumar)
Principal

Principal
Harchand Singh Mahavidyalaya
Gothani (BSR)

Co-ordinator
IQAC, Shri Ram College
Muzaffarnagar

Chairman
IQAC, Shri Ram College,
Muzaffarnagar

Campus - Shahpur, Jewar Road Khurja, Bulandshahr UP 203131
Contact No. 9412689321,9412689322,9412326388
Email ID - chscollege@yahoo.co.in, Website - chsgckrj.com

Progress Report - Planning Phase

(Website Development for CHS College Gothni, Khurja)
[12/07/2021 to 02/08/2021] - (3 Week)

- In view of transformative redesign of website for CHS College Gothni, Khurja is to plan the development of a new website.
- Mr. Ajay Raghav provides the communication bridge to interact with all stakeholders to gather information from different departments and user groups.

The project team consists of the following members:

Project Manager: Mr. Sanjaykant Tyagi
UI/UX Designer: Mr. Hans Tyagi
Web Developer: Mr. Vishwas Sharma

In this phase we reviewed the following tasks:

- A review of the performance of existing websites
- A website content audit
- Outlining a top-level information architecture
- Outlining a Multi-layer information architecture
- A content strategy and content guidelines

In order to effectively address the above requirements we conducted comprehensive analysis with pre existed website and collect real-time capabilities or access to current data. To enable us to gather the insights required for this project, we developed a research plan designed to cover online information and stakeholders to produce qualitative and quantitative findings.
We used a range of research methods, including:

- Telephone interviews with stakeholders
- Surveys of various CHS College audiences
- Review of CHS college's website analytics
- Review of existing documents

Detailed findings in the planning phase of this project are included in their relevant sections, but some of our key points are as follows:

- Stakeholders were less clear on other uses of the website or Portal.
- A large majority of website visitors are prospective students. They are drawn to course pages on their first visit, and then subsequent visits are likely to incorporate secondary information such as fee structure, courses, placements, and library.
- Prospective students are keen to hear from current students about their experiences of CHS College and they expect to find this content on the website.

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- The CHS College audience is likely to think of the content they need in terms of its relationship to their role in the university – students will organize by Course and Student Life, whereas staff will think of categories based on the internal structures they are aware of.

The discovery of research methods aims:

- To Provide a user-friendly interface
- To Develop a visually appealing homepage
- To better define CHS College audiences and their behavior
- To identify CHS College own desires and requirements for the website
- To understand the competition and marketplace in which CHS College operates
- To identify potential challenges and opportunities

(Mr. Sanjaykant)
Project Manager

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Progress Report - Design Phase

(Website Development for CHS College Gothni, Khurja)
[03/08/2021 to 31/08/2021] - (4 Week)

- The design team visited the CHS College on August 03, 2021 to initiate the design phase of the website development of the college.

- Three (03) meetings with the different stakeholders conducted with the help of Mr. Ashish Raghav.

The design team, led by Mr. Sanjaykant Tyagi, undertook the following activities:

- Conducted user research to understand preferences and expectations.
- Created wireframes and multi-layer architecture of the website pages.
- Developed a comprehensive style guide including color schemes.
- Incorporated feedback from stakeholders and potential users.

The design team produced detailed wireframes and interactive prototypes for critical pages of the website, including:

Home
About Us
Admission
Admission Process
Online Admission
Faculty
Education Department
Art Department
Commerce Department
Business Administration Department
Computer Application Department
Physical Education Department
Facility
Course
BA
B.COM
B.Sc
BBA
BCA
B.Ed

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BALLB
MA
LLB
M.COM
M.Ed

Syllabus
Student Zone
E-Library
Contact
Fee & Courses
Law College

Above multilayer architecture of the website were reviewed by the stakeholders and refined based on feedback to ensure alignment.

- A meeting held with the important stakeholders to finalize the color scheme for the web pages of website. Some issues regarding quality of photographs also discussed in the meeting.

- Regular communication and collaboration occurred with Mr. Ashish Raghav to ensure a seamless transition from design to implementation. Design specifications were documented and shared to guide the development process.

- Challenges encountered during the design phase included old/blurred images of institute and other activities. Solutions implemented to send a professional photographer to capture current images of your institute/activities then incorporate into the design of the website.

(Mr. Sanjaykant)
Project Manager

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Progress Report – Development Phase

(Website Development for CHS College Gothni, Khurja)

[01/09/2021 to 14/10/2021] - (6 Week)

- Development of the decided structure or multilayer architecture is started by the development team on September 01, 2021.

- They started implement the design specifications, create functional features, and ensure the technical integrity of the website.

The development team undertook the following activities:

- The website designed with the help of the frontend technology like HTML, JavaScript & .NET.
- Translated design specifications into code for the homepage and key content pages.
- Integrated interactive elements and functionalities based on approved prototypes.
- The database structure, using MS-Access, was implemented to support dynamic content and seamless data management.
- Conducted regular code reviews and quality checks.
- Integration with the Content Management System (CMS) was successfully executed.

Key milestones achieved during the development phase include:

- Homepage Development Completed

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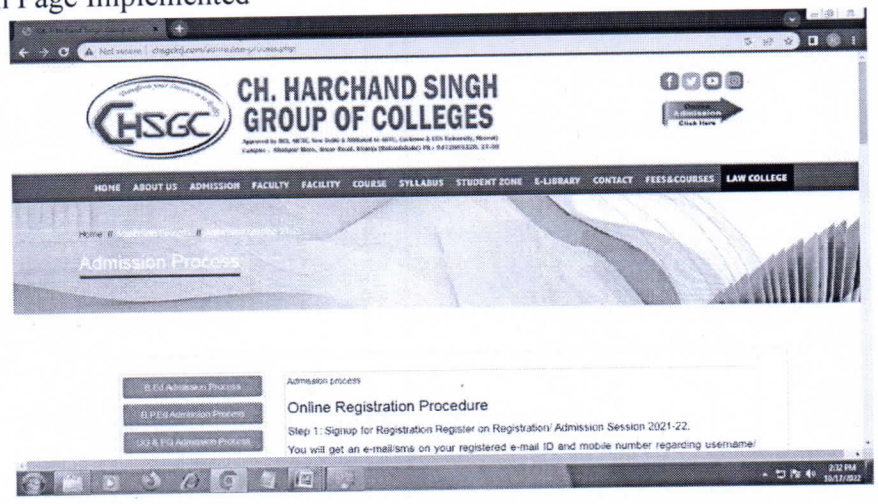
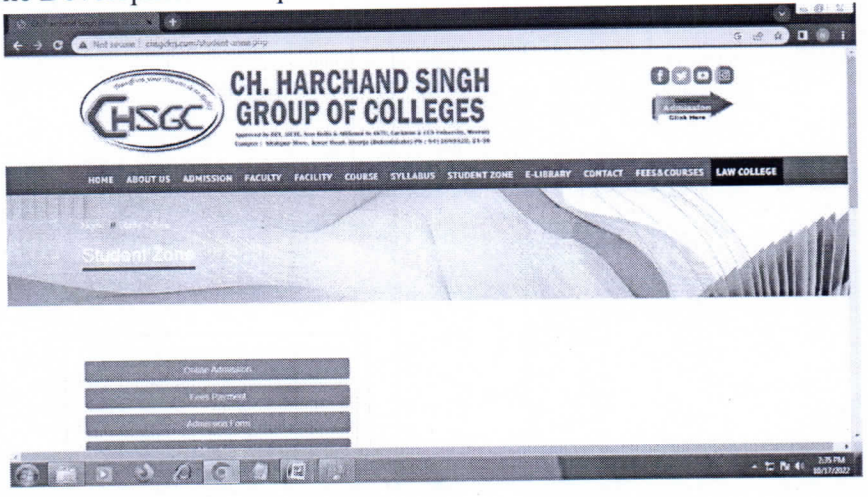
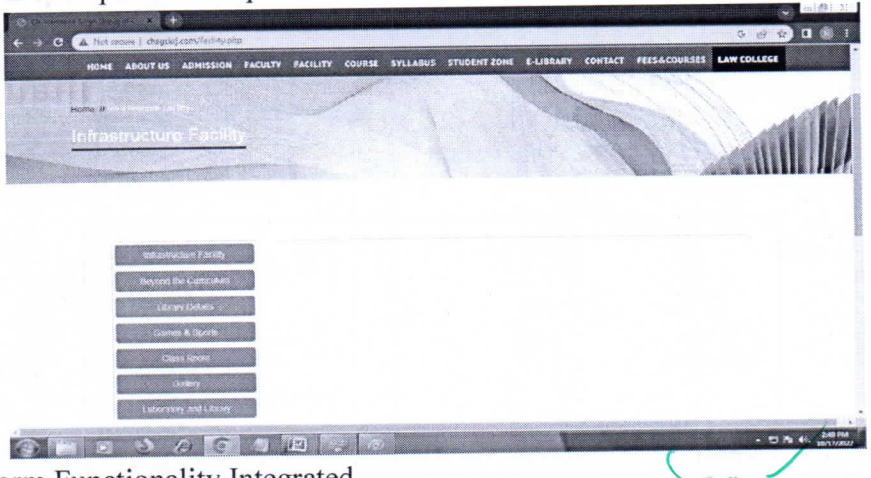
- Admission Page Implemented



- Student Zone Development Completed



- Homepage Development Completed



- Contact Form Functionality Integrated

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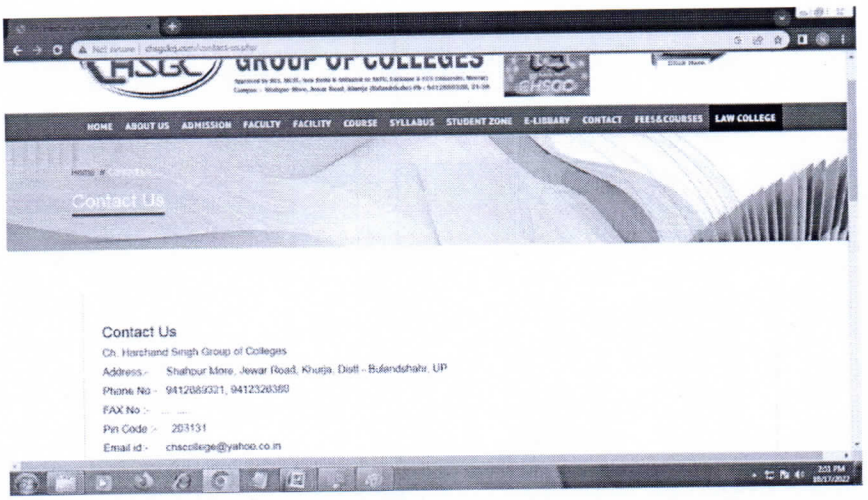
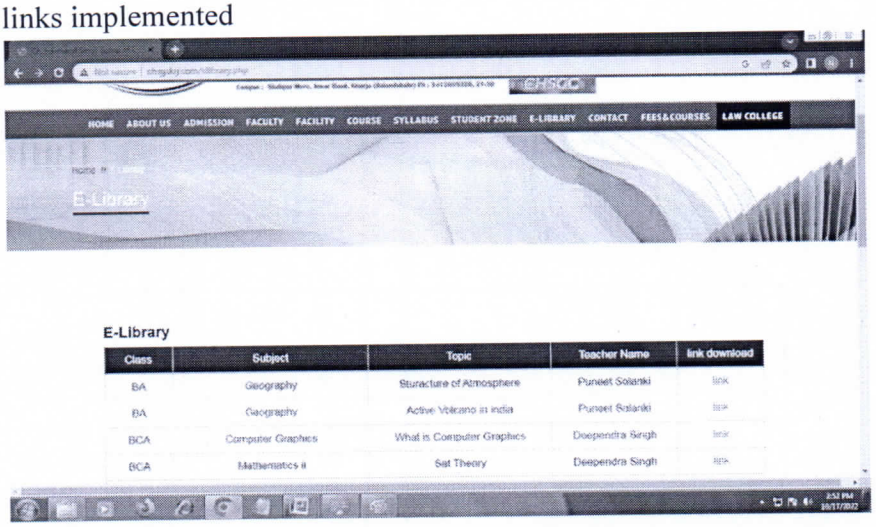
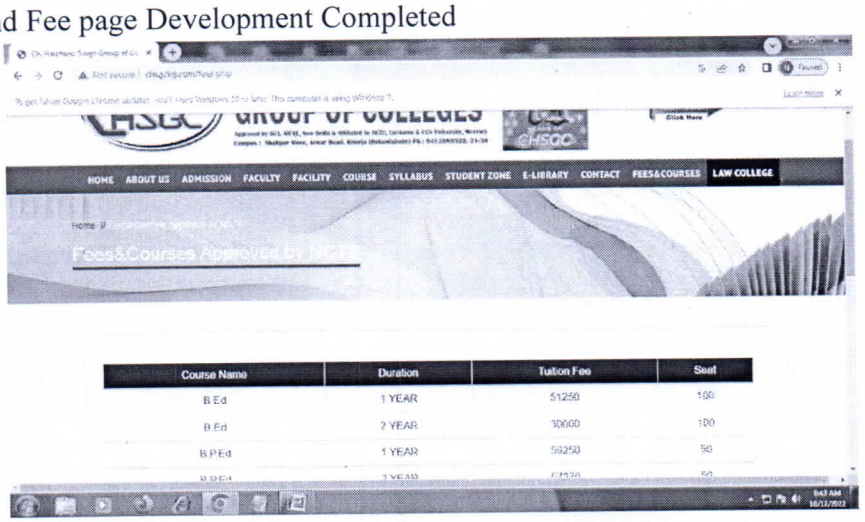


- E-Library links implemented



- Courses and Fee page Development Completed



- Syllabus Page Completed

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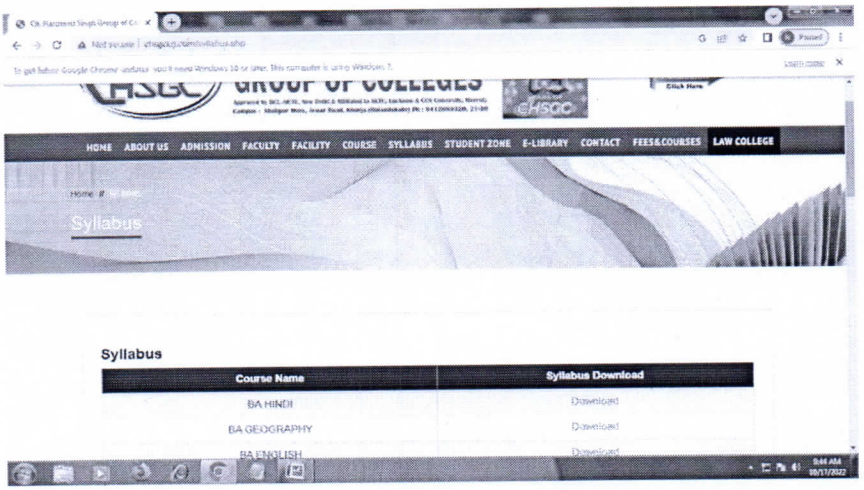
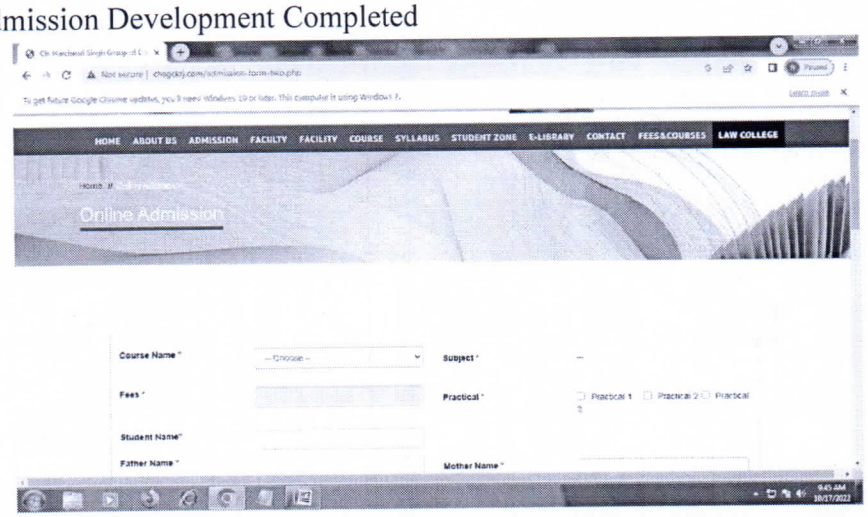
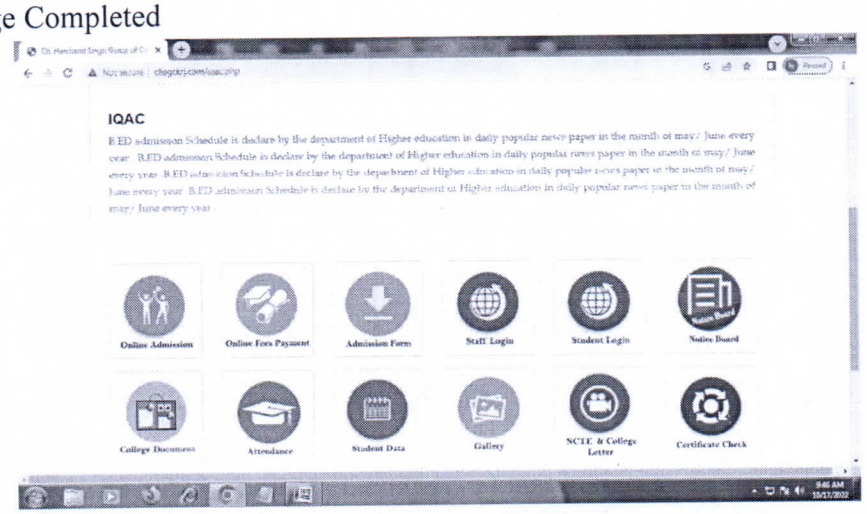


- Online Admission Development Completed



- IQAC Page Completed



- CHS Law College Homepage Development Completed

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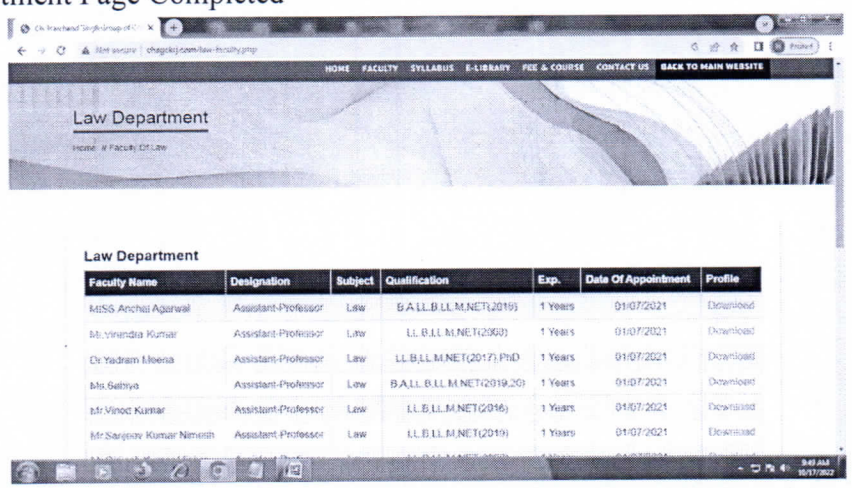
- Law Department Page Completed



- These milestones were achieved in alignment with the established project timeline.
- Some of the pages are undergoing developing phase and will be implemented with the testing phase.

(Mr. Sanjaykant)
Project Manager

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Progress Report - Testing Phase

(Website Development for CHS College Gothni, Khurja)
[15/10/2021 to 25/10/2021] - (1.5 Week)

- We started the testing from October 15, 2021 of developed website outcomes for to ensure the website's functionality & performance.
- This phase was conducted in two modes; On-site testing and testing from the remote locations to identify and rectify any issues related to functionality, performance, security, and user experience before the website's launch.
- User acceptance testing was conducted in two phases to ensure that the website meets the expectations of the end users.
- We called two groups of students on October 18, 2021 and got them to survey the entire website, which revealed some flaws, which our team fixed the next day.
- On 21- October-2021, we called a group of teachers to check the flow of the website and its functioning, after spending a lot of time they found that the website was working well.
- In a meeting with management members, financial clerks and important stakeholders on 23-October-2021, they were agreed for implementation of the website. Then the decision was taken to deploy the website.
- Ultimately our team made preparations for deployment under the guidance of Mr. Sanjaykant Tyagi. The college administration was asked to provide the required equipments and facility.

(Mr. Sanjaykant)
Project Manager

Co-ordinator
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Muzaffarnagar

Progress Report - Deployment Phase

(Website Development for CHS College Gothni, Khurja)
[26/10/2021 to 06/11/2021] - (1.5 Week)

- We started deploying the website on October 26, 2021. One of our team members found a glitch in the functionality of the main page. We were resolved in the same day.
- Conducted a final round of testing on October 27, 2021 in the live environment to verify the functionality and performance.
- Implemented backup procedures to safeguard existing data and configurations on October 29, 2021.
- Developed and tested a rollback plan in case of unexpected issues during deployment on November 2, 2021.
- Executed the migration of the database on November 3, 2021 to ensure the availability of the latest data.
- Configured server settings, domain mappings, and other environment-specific configurations till November 4, 2021.
- We release the finalized website on November 6, 2021 to the live environment for public access.
- Ensured that the correct version of the application was deployed.

Upon deployment, the team actively monitored the live environment for any anomalies and verified that the website was functioning as expected:

- Performance Monitoring: Checked server performance metrics to ensure optimal response times.
- User Access Verification: Verified that users could access the website without encountering errors.

Notified to Mr. Ashish Raghav and stakeholders including project sponsors about the successful deployment and conducted a handover session on November 10, 2021 to transfer control to the operational team and provided necessary training for maintenance tasks.

(Mr. Sanjaykant)
Project Manager

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Muzaffarnagar

3.1.1./3.1.3

PROJECT PROPOSAL

ON

"Design and development of the manually operated multi crop planter"

SUBMITTED BY:

Principal Investigator
Dr. Nayeem
HoD & Assistant Professor

Co- Principal Investigator
Mr. Vikrant
Assistant Professor

DEPARTMENT OF AGRICULTURE

SHRI RAM COLLEGE, MUZAFFARNAGAR

Co-ordinator
IQAC, Shri Ram College
Muzaffarnagar

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Muzaffarnagar

Budget Estimation for the project on "Design and development of the manually operated multi crop planter"

Item	Budget 1st Year
A. Expenditure	
1. Remuneration	20,000
2. Travel	5,000
3. Printing and Stationary	3,000
4. Materials	22,000
Grand Total	50,000

Project Committee

S.N.	Name	Department	Designation	Signature
1.	**Dr. Nayeem**	Agriculture	Principal Investigator	
2.	**Dr. Vikrant**	Agriculture	Co-Principal Investigator	
3.	**Mr. Himalya Kumar**	Agriculture Student	Member	
4.	**Mr. Pawan**	Agriculture Student	Member	
5.	**Ms. Chandni**	Agriculture Student	Member	

Director

Chairman
IQAC, Shri Ram College,
Muzaffarnagar

Co-ordinator
IQAC, Shri Ram College
Muzaffarnagar

REPORT

ON

"Design and development of the manually operated multi crop planter"

Session: 2021-22

SUBMITTED BY:

Principal Investigator

Dr. Mohd Nayeem
HoD & Assistant Professor

Dr. Vikrant Kumar
Assistant Professor

DEPARTMENT OF AGRICULTURE

SHRI RAM COLLEGE, MUZAFFARNAGAR

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LIST OF CONTENT

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Muzaffarnagar

1. INTRODUCTION

Agricultural mechanization is the application of machinery, technology and increased power to agriculture, largely as a means to enhance the productivity of human labour and often to achieve results well beyond the capacity of human labour. There are three sources of farm power utilized for these tools, machines and equipment, manual and animal draft, and motorized power. Mechanization also includes irrigation system, food processing and related technologies and equipment.

Farm mechanization is the use of mechanical devices or systems to replace human muscle in all forms and at any level of sophistication in agricultural production, processing storage and so on in order to reduce tedium and drudgery, improve timeliness and efficiency of various farm operations, bring more land under cultivation, preserve the quality of agricultural produce, provide better rural living condition and markedly advance the economic growth of the rural sector **(Anazodo, 1986;Onwualu et al., 2006).**

Farm mechanization helps in effective utilization of inputs to increase the productivity of land and labour. Besides it helps in reducing the drudgery in farm operations. The early agricultural mechanization in India was greatly influenced by the technological development in England. Irrigation pumps, tillage equipment, chaff cutters, tractors and threshers were gradually introduced for farm mechanization. The high yielding varieties with assured irrigation and higher rate of application of fertilizers gave higher returns that enabled farmers to adopt mechanization inputs, especially after Green revolution in 1960s.

Under intensive cropping, timeliness of operations is one of the most important factors which can only be achieved if appropriate use of agricultural machines is advocated. Manual method of seed planting, results in low seed placement, spacing efficiencies and serious back ache for the farmer which limits the size of field that can be planted. To achieve the best performance from a seed planter, the above limits are to be optimized by proper design and selection of the components required on the machine to suit the needs of crops.s

A seed planter is simply a device or tool used to sow seeds. In small scale landscaping and gardening, manually operated seed planters can be used, while in large farm cultivations, the planter can be a massive device usually attached to the back of a tractor. Seed planters depend on

both human and machine effort for its operation. Preparation of seed bed is a specialized task which requires skill, time energy and labour in addition to different soil manipulating implements. The first seed cum fertilizer drills was small enough to be drawn by a single animal but the availability of source and, later, gasoline tractors shows the development of larger and more efficient drills that allowed farmers to seed even larger tracts in a single day. Recent improvements to drills permit seed-drilling without prior tilling. Main objectives taken in the research are to conduct a testing of animal drawn MPT seed cum fertilizer drill for direct seeded paddy and study comparative performance evaluation of MPT seed cum fertilizer drill and conventional Seed cum fertilizer drill.

The planting operation is one of the most important cultural practices associated with crop production. Increases in crop yield, cropping reliability, cropping frequency and crop returns all depend on the uniform and timely establishment of optimum plant populations. There are two broad areas in optimizing plant establishment. First, plant breeders, seed growers and seed merchants have a responsibility to provide quality seed. Second, farm managers must be aware of the agronomic requirements for optimum plant establishment and be able to interpret this information in a meaningful way so as to assist with the selection, setting and management of all farm machinery, especially planters.

As our population continues to increase, it is necessary that we must produce more food, but this can only be achieved through some level of mechanization. Manual method of seed planting, results in low seed placement, spacing efficiencies and serious back ache for the farmer which limits the size of field that can be planted. However, planting machine or planter that is normally required to produce more food is beyond the buying capacity of small holder farmers.

These small holder farmers still continue to plant manually, the result of which is low productivity of the crops. It is therefore necessary to develop a low cost planter that will reduce tedium and drudgery and enable small holder farmer to produce more foods and also environmental friendly.

A developing country like India is expected to continue to rely more on hand tools for the foreseeable future for cultivation. The use of hand tools for land cultivation is still predominant in India because draft animals and tractors require resources that many Indian farmers do not have easy access to. The need for agricultural mechanization in India must therefore be assessed

with a deeper understanding of the small holder farmer's activities and what values farm power generated for them **(Hiroyuki and Sheu, 2010).**

Most of our farmers especially in the rural areas and small scale farmers use matchet or sticks to sow different seeds. This matchet or sticks is used to open the soil as the farmer drops the required numbers of seed (often times more than they require numbers are dropped) and then covers them up. This method of planting is labour-intensive and can benefit considerably from simple mechanization **(Bamiro et al, 1986)**. According to Bamgboye and Mofolasayo (2006), the traditional planting method is tedious, causing fatigue and backache due to the longer hours required for careful hand metering of seeds if crowding or bunching is to be avoided. The importance of machine in agricultural operations in the world today should never be underestimated, be it manually operated or powered **(Sam and Okokon, 2013).** One of the major problems confronting the peasant farmers in India is in the area of planting seeds because of the limited economy they can put up and most of them cannot afford the money to procure or hire sophisticated machinery that can be used for their planting.

So if a machine designed which operated manually and also it have capability for multi-crops planting operation then many problems of the poor farmers have solved. A manually operated single row planter **(Hossain, 2013)** is capable of delivering seeds precisely in a straight line with uniform depth in the furrow, and with uniform spacing between the seeds. The work demonstrates the application of engineering techniques to reduce human labour specifically in the garden, that is cheap, easily affordable, easy to maintain and less laborious to use. The planter will go a long way in making farming more attractive and increasing agricultural output. All parts of the planter were fabricated from mild steel material, except for the metering mechanism which was made from good quality wood (mahogany) and the seed funnel and tube, which were made from rubber material. The seed metering mechanism used for this work was the wooden roller type with cells on its periphery. For this design, the drive shaft directly controls the seed metering mechanism which eliminates completely attachments such as pulleys, belt systems, and gears thereby eliminating complexities which increase cost, and increasing efficiency at a highly reduced cost.

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Justification

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India is a populated country, so it requires more food grains which results required more productivity in the agriculture sector. Farm mechanization helps in effective utilization of inputs to increase the productivity of land and labour. Besides it helps in reducing the drudgery in farm operations. Many farm machineries have introduced in the field of agriculture in recent years but these are not affordable by poor farmers. So manually operated and low cost machines should be introduced which have capability as tractor operated and easily operated by low intensity human. It should perform Two or more seeds planted in the same place it reduces yield potential due to intra-specific interference.

Hence if manually operated multi crop planters manufacture then it must have following features:

- Plant spacing is generally too large during traditional planting, which reduces the potential yield so in manually operated planter have different metering wheal for different seed which maintain seed spacing in row according to actual distance of crop.
- Seed metering device should have low cost.
- Beneficial for small scale and marginal farmer
- Cost is less so that every farmer easily purchases it.
- Easy to operate both male and female person can be operating.
- Row marker is available in planter which maintains row to row spacing according to crop.
- Easy to replace of seed metering device (wheel type) from outside.
- Adjustable handle which is more helpful for both small and big height person.
- Adjustable furrow opener also provides that is control depth of sowing of seed according to crop.
- Parking stand is also provides which is suitable to stand of the planter at the time of rest.
- Slippage is less because lugs also provides on front wheel of planter.
- Furrow covering device is available.

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OBJECTIVE

The present study was undertaken with the following objectives:-

- To determine the various physical properties of selected crop seeds (Maize, Pigeon Pea and Okra)
- To design and develop a manually operated planter for sowing different seeds.
- To design and develop various seed metering device for sowing maize, Pigeon Pea and okra crop seeds
- To evaluate the performance of the develop planter for sowing maize, Pigeon Pea and okra crop seeds.
- To estimate cost analysis and payback period of develop planter.

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2. REVIEW OF LITERATURE

This chapter compiles the work done by several authors have studied and developed the crops planters and its evaluation. In the past, various types of design have been developed with different design approaches which have their advantages and disadvantages and also operational limitations. Klocke (1979) described the building of two experimental planters, one using a smooth coulter and the other a ripple edged coulter. Both types of coulters were followed by hoe openers. The performance of the drills was satisfactory as long as the seed was placed into adequate soil moisture.

2.1 Planting of different crops

Heinemann *et al.* (1973) studied experimental machines for autodibble planting. Author stated that physically weak seedlings such as carrot, lettuce, onion, and beet may fail to emerge because of premature soil drying, accumulation of salts in the shallow seedbeds, or from not being able to break through even weak soil crusts. To insure adequate stands of these crops, excess seed is often planted which later requires time-consuming and expensive thinning. Precision planting methods that eliminate hand labor and thinning are needed. Any such method must insure a consistently high emergence of seedlings under the variety of microclimate and soil conditions which are encountered from year to year during the planting period. This type of planting would have a number of important advantages for small seeded row crops. A uniform, precisely spaced seedling emergence would be more nearly assured than for any cultural practice currently used. For example, if the weather were unseasonably warm, the field could be irrigated from corrugates during germination without danger of subsequent soil crusting over the seedlings. The holes would be stable even with moderate rain showers. seedlings would be less subject to injury by the accumulation of salt at the surface. It might also be possible to apply higher herbicide rates to the soil above the seed for even better weed control than is presently available. The accumulation of salt in the convex portion of the seed row might also help reduce weed germination.

2.2 Design of different crops planter

Klocke (1979) described the building of two experimental planters, one using a smooth coulter and the other a ripple edged coulter. Both types of coulters were followed by hoe openers. The performance of the drills was satisfactory as long as the seed was placed into adequate soil moisture.

Gard and McKibben (1973) reported work on a planter consisting of a ripple coulter, runner opener and an angled coulter to close the seed furrow. A very popular method (especially in the United Kingdom) was the used of triple-disks, in which one disk cuts through the residue and makes a slot in the soil and a double Vshaped disk follow after, widening the slot and feeding in the seed. These drills are suitable for most soil conditions.

Allen *et al.* (1975) used a fluted coulter in combination with a double-disk on a conservation planter. The coulter cut residue and loosened a zone of soil about 6 cm (2.36 in) wide and 7.5 cm (2.95 in) deep.

2.3 Performance Evaluation of Different Crops Planter

Pradhan *et al.* (1997) developed a power tiller operated groundnut planter-cum-fertilizer drill. The actual field capacity of the planter was 0.16 ha/hr with field efficiency closes to 81%. The planter saved Rs. 237 per ha over manual dropping of seed behind the plough.

Staggenborg *et al.* (2004) studied effect of planter speed and seed firmers on corn stand establishment.Author stated that proper planter adjustment and operation play an important role in uniform stand establishment for corn. A two−year study was conducted to assess the impact of planter speed and a seed−firming device on corn stand establishment and grain yield. A planter equipped with a vacuum metering system and commercial seed firming devices was used in this study. Corn was seeded in a randomized complete block experiment at three speeds at two locations in Kansas (USA). Plant stand was counted at regular intervals after the first plant emerged to determine emergence rate. Plant spacing within each treatment was measured after complete emergence. Mean plant spacing, standard deviation in spacing, and four spacing indices (miss, multiple, quality of feed, and precision) were calculated to evaluate

the plant spacing data. The miss and multiple indices indicate the number of skips and doubles. Planter performance as measured by these indices and standard deviation in plant spacing decreased as planter speed increased. The seed firmer reduced plant spacing standard deviations at a rate equivalent to the standard deviation increase observed when planter speed increased approximately 1.6 km/h (1 mph). Corn yield was reduced as planter speed increased at one location, but not the others. This response was the result of lower plant densities at the higher planter speeds, suggesting that one of the goals of the planting process should be to establish adequate plant densities. The seed firmer had no impact on corn yield.

2.4 Manually operated different crops planter

Chukwu and Akande (2007) presented the development of an apparatus for measuring the angle of repose of granular materials. The basic types of angle or repose, the methods of measuring angle of repose of solid, were discussed. The effect of the physical properties of the granular materials on the measured angle of repose to design and construction of bins, hoppers and other storage facilities such as silos were briefly discussed. The angles of repose of twenty different agricultural materials were determined using the developed apparatus. Having tested the developed apparatus with twenty different agricultural materials and comparing the results with the standard from literature, a difference of $\pm 0.96^{0}$ to $\pm 9^{0}$ was noticed. In conclusion, the developed apparatus can be used to determine the angle of repose of selected grains, which have application in the design of bins, hoppers and other storage structures.

2.5 Physical properties of different crops

E.U. Odigboh (1978) developed a two-row automatic cassava cuttings planter and explained its development, design and prototype construction. The manual planting of cassava cuttings is an ardous back-breaking operation and constitutes one of the major factors limiting the development of large-scale cassava industries in Nigeria. The two-row cassava planter described in this paper is fully automatic. The planter prototype is trailed, tractor-drawn at speeds up to 10 km per hour. It is designed to plant the cassava cuttings at an inclination of up to 80° to the horizontal, depending on planter speed, and spaced 890 mm on small ridges which are 900 mm apart.

Maize

Wohab (2003) developed a minimum tillage planter with effective field capacity of 0.1 ha/hr. The planter saved 35% time and 27% cost when compared to traditional methods. In a related study, maize seeder was found to have no detrimental effect on yield using a multi-seeder or a single row seeder (Roth, *et al.*, 2001) and an air seeder (Roth, *et al.*, 2002).

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3. MATERIALS AND METHODS

This chapter deals with the description of various materials and methods used to accomplish the research work done to attain the desired objectives of the study entitled "design and development of the manually operated multi crop planter. ''

The experimental studies will be carried out at the Department of Agriculture, Shri Ram College, Muzaffarnagar. The study will be conducted with a view to obtain different crop seeds and planter parameters suitable for the development of the manually operated planter. The methodology used for the development and performance evaluation of the manually operated planter has been discussed under the following heads:

3.1 Raw materials

3.2 Evaluation of the various physical properties of Maize, Pigeon pea and Okra seeds relevant to design a manually operated multi-crop planter.

3.3 Design and development a manually operated planter for sowing different seeds

3.4 Design and develop various seed metering device for sowing different crops

3.5 Evaluation of performance of manually operated multi-crop planter.

3.6 Estimate cost analysis of developed planter.

3.1 Raw Materials

In this section we are studying all types of raw materials used for the design, development and evaluation of the manual operated planter.

3.1.1 Collection of seeds (Maize, Pigeon pea and Okra).

The certified crop seeds will be collected from the Local market in Muzaffarnagar. The crop seeds will be collected from different shopkeeper so as to obtain maximum variation in the size of seeds; as a result the developed planter may be used for sowing a wide variety of seeds.

3.1.2 Machines and tools required for the development of the planter

The required machines and tools for the development of the manually operated multi-crop planter are described below:

Table 3.1: Machines and Tools required for development of the planter

S.No.	Machine/Tool name	Purpose
1	Stellram hard core drills machine	Hole/Cell making
2	Lathe machine	Threading/Cutting/Finishing/ Shaping/Machining.
3	Grinding machine	Grinding/Cutting tool
4	Cutting blade	Cut flat bar
5	Manual Facing Lathe Machine	Making circular wheel
6	Round file	Smooth rough edges
7	Electric welding machine	Welding
8	Steel scale	Measurement of linear distance
9	Steel tape	Measurement of linear distance
10	Vernier calipers	Measurement of outer diameter and inner diameter
11	Centre punch	Hole Marking
12	Choke	Marking
13	Hammer	Used to strike an object
14	Chisel	Cutting
15	Scissors	Cutting sheet metal
16	Vice	Clamping or holding
17	Spanner	Tighten nut and bolt
18	Screw driver	Tighten screw
19	Hand grinder	Grinding metal sheet
20	Flat file	Smooth rough edges
21	Grease Belt	Uniformity of seed
22	Seed Germinator	Germination test

3.1.2.1 Drill Machine

A drilling machine is a tool used for drilling holes in various types of seed metering device and metal.

3.1.2.2 Lathe Machine

A lathe is a machine tool which rotates the work piece on its axis to perform various operations such as cutting, sanding, knurling, drilling, or deformation, facing, turning, with tools that are applied to the work piece to create an object which has symmetry about an axis of rotation.

3.1.2.3 Grinding Machine

A grinding machine uses an abrasive wheel as a cutting tool to shape or change the dimensions of a hard material. The types of materials that need grinding are usually metallic items such as tools and rods. These machines generally work by reducing the material through abrasion. Generally, the grain of the abrasive wheel chips away at the material, changing its shape or dimension.

3.1.2.4 Round File

A round file is a wood or metalworking hand tool of cylindrical cross section that is used to remove small amounts of material from a work piece. Round files typically consist of a long tapered body and a pointed square tang at one end for attaching a handle. The body of the file is cut with a series of parallel ridges which remove material from the work piece when the file is drawn across it. These files are most commonly used to debar or remove material from the inside surfaces of cylindrical work pieces or to cut half round grooves. Round files are available in a large selection of sizes and tooth pitches to suit a variety of applications and materials.

3.1.2.5 Electric welding machine

Welding machine performs the function of creating an arc which may be due to electric short or gas to melt a puddle of molten metal on to the other medium where joining is to take place. The most common welder in industrial use is the arc welder. This type of electric machine uses a stick electrode to conduct the electricity to the work piece and melts at the same time to fill in the gaps. A wire feed machine uses a roll of wire that feeds through a tube to the work pieces to be

joined together. The operator presses a button on a hand held torch and the wire feeds into the blue arc and fills in the gap between the two pieces of metal. A TIG welder or Tungsten Inert Gas machine uses a tungsten tip that creates the high temperature needed to weld aluminum together. Along with the arc, an inert gas such as argon is fed into the TIG welding puddle of metal to remove any impurities from the surrounding environment.

3.1.2.6 Steel scale

Scales of measurement refer to ways in which variables/numbers are defined and categorized. Each scale of measurement has certain properties which in turn determine the appropriateness for use of certain statistical analyses. The four scales of measurement are nominal, ordinal, interval, and ratio

3.1.2.7 Tape

A tape measure or measuring tape is a flexible ruler. It consists of a ribbon of cloth, plastic, fiber glass, or metal strip with linear-measurement markings. It is a common measuring tool. Its design allows for a measure of great length to be easily carried in pocket or toolkit and permits one to measure around curves or corners. Today it is ubiquitous, even appearing in miniature form as a keychain fob, or novelty item. Surveyors use tape measures in lengths of over 100 m (300+ ft).

3.1.2.8 Vernier Caliper

The Vernier Caliper is a precision instrument that can be used to measure internal and external distances extremely accurately. The example shown below is a manual caliper. Measurements are interpreted from the scale by the user.

3.1.2.9 Centre punch

A center punch is a tool, usually made of metal, that will be created to aid a carpenter with drilling holes. An individual uses a center punch to make a small impression in the piece of wood, plastic, or metal he or she intends to drill a hole into. The mark the punch makes not only helps the person know where to place the end of the drill bit, it also helps to guide the bit, keeping it from slipping out of place.

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3.1.2.10 Hammer

A hand tool consisting of a handle with a head of metal or other heavy rigid material that is attac hed at a right angle, used for striking or pounding.

3.1.2.11 Chisel

Chisel is a tool with a characteristically shaped cutting edge (such that wood chisels have lent part of their name to a particular grind) of blade on its end, for carving or cutting a hard material such as wood, stone, or metal by hand, struck with a mallet, or mechanical power.

3.1.2.12 Scissors

They consist of a pair of metal blades pivoted so that the sharpened edges slide against each other when the handles (bows) opposite to the pivot are closed. Scissors are used for cutting various thin materials, such as paper, cardboard, metal foil, thin plastic, cloth, rope, and wire.

3.1.2.13 Vise bench

A bench vice is a vice that is attached to a bench. When people say vice they are almost always talking about a bench vice. It is a device for firmly holding an object that someone is working on. It consists of two flat jaws--one fixed and the other movable--that can be brought together with a screw mechanism

3.1.2.14 Spanner

A wrench (also called a spanner) is a tool used to provide grip and mechanical advantage in applying torque to turn objects—usually rotary fasteners, such as nuts and bolts—or keep them from turning

3.1.2.15 Screw driver

The function of a screwdriver is to turn screws with slotted heads. Screws that have a single slot require the use of a flat-head or slot-head screwdriver.

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3.1.2.16 Hand grinder

An angle grinder is a hand held power-tool originally intended to grind metal. The most common use is to grind welds and smooth cut metal surfaces. Fitted with a variety of implements, the angle grinder can be used to cut tile, pavers and can remove paint and rust.

3.2 Evaluation of the Various Physical Properties of Maize, Pigeon pea and Okra Seeds Relevant to Manually Operated Planter

3.2.1 Preparation of sample

Amongst one varieties of each crop certified seed will be selected which mostly cultivated in Muzaffarnagar region (Uttar Pradesh). The different grains of each variety will be used for the study which procured from the Alopi baagh market, Muzaffarnagar. The grains will be cleaned manually to remove all foreign matter such as dust, dirt, stones, chaff, immature and broken grains. The clean grains will be randomly selected. Finally cleaned grain of each variety sample will be taken for each experiment as explained here under. The quantity used for respective experiment will be not repeatedly used for conducting the other experiments.

The following properties of Maize, Pigeon pea and Okra seeds will be identified and evaluated for the design of manually operated planter:

i. Size
ii. Shape
iii. Volume, bulk density and true density
iv. Porosity
v. Angle of repose
vi. Coefficient of static friction
vii. Thousand seed weight

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3.2.2 Size

The size of the seed will be specified by length, width and thickness. The axial and lateral dimension of the seeds will be measured by using vernier caliper (least count 0.01). Twenty seeds will be selected randomly for the dimension.

3.2.3 Shape

This parameter of seed will be relevant to design of seed metering device and hopper. The shape of the seed will be expressed in term of roundness and sphericity.

3.2.3.1 Roundness: A seed will be selected randomly and its dimension will be taken by using image analysis method in natural rest position. The area of smallest circumscribing circle will be calculated by taking the largest axial dimension of seed at natural rest position as the diameter of circle. The percent roundness will be calculated as follow:

$$R_p = \frac{Ap}{Ac} \times 100 \qquad (3.1)$$

Where,

R_p = percent roundness

A_p = projected area, mm^2

A_c = area of smallest circumscribing circle, mm^2

The procedure will be repeated for twenty seeds of each crop seeds will be selected randomly. The mean will be taken will be the characteristic value of roundness.

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3.2.3.2 Sphericity

The sphericity is a measure of shape character compared to a sphere of the same volume. Assuming that volume of solid is equal to the volume of tri-axial ellipsoid with intercepts a, b, c

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and that the diameter of circumscribed sphere is a largest intercepts of the ellipsoid, the degree of sphericity will be calculated as follows (Mohsenin,1986):

$$DS = \frac{(a \times b \times c)^{1/3}}{a} \quad (3.2)$$

where,

DS = degree of sphericity

a = largest intercept, mm

b = largest intercept normal to a, mm

c = largest intercept normal to a and b, mm

The procedure will be repeated for twenty seeds of each crop seeds will be selected randomly. The mean will be taken will be the characteristic value of sphericity.

3.2.4 Bulk density

A wooden box with inside dimension of 10× 10 × 10 cm will be used for the measurement of bulk density of each crop seeds. The box will be filled with seeds without compaction and then weighed. The bulk density will be calculated as follow:

$$BD = \frac{W}{V} \quad (3.3)$$

where,

BD = bulk density, g/cm^3

W = weight of seeds, g

V = volume of wooden box, cm^3

The procedure will be repeated five times and the average bulk density of the seed will be calculated.

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3.2.5 Volume and true density

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Toluene displacement method will be used to determine the volume and true density of each crop seed. A sample of 100 seeds will be weighed. The sample will be immersed in a jar containing toluene displaced by the sample will be recorded, thus volume of single seed will be calculated. True density will be calculated as the ratio of weight of the sample to its volume. Five set of observation will be taken separately for volume and true density of seed.

$$\text{True density} = \frac{Weight\ of\ grain(g)}{True\ Volume\ occupied\ by\ the\ same\ grains(\ cm)^3} \quad (3.4)$$

3.2.6 Porosity

The porosity of the each crop seed will be calculated using the following expression:

$$\text{Per cent porosity} = (1-\frac{BD}{TD}) \times 100 \quad (3.5)$$

where,

BD = bulk density, g/cm^3

TD = true density,

Bulk and true density values obtained from previous experiments will be used to calculate the per cent porosity of the seed.

3.2.7 Angle of repose

The angle of repose of the grains of each crop seeds will be used for designing the hopper of planter. A box having circular platform fitted inside will be filled with different grains. The circular platform will be surrounded by a metal funnel leading to a discharge hole. The extra grains surrounding the platform will be removed through discharge hole leaving a free standing cone of pigeon pea grains on the circular platform. A stainless steel scale will be used to measure the height of cone and angle of repose will be calculated by the following formula:

$$\Phi = \tan\text{-}(\frac{2h}{d}) \quad (3.6)$$

where,

Φ = angle of repose, degrees

h = height of cone, cm

d = diameter of cone, cm.

Five observations will be taken and the mean value of angle of repose will be calculated for each crop seeds.

3.2.8 Coefficient of static friction

The coefficient of static friction of each crop seed will be measured by using inclined plane method on mild steel surface. The seed will be kept separately on a horizontal surface and the slope will be increased gradually. The angle at which the materials started to slip will be recorded. The coefficient of static friction will be calculated by using the following formula:

Coefficient of static friction = $\tan \Phi$ (3.7)

where,

Φ = angle of static friction, degrees.

Five replications will be done for each crop seed and mean value of Φ for seed will be calculated separately.

3.2.9 Thousand seed weight

One thousand seed weight of each crop seed will be weighing on a digital weighing balance.

3.3 Design and Development of a Manually Operated Planter for Sowing Different Seeds

For the design of a machine the main required things are that what we required from it. So the main objective or requirements with advantages of the designed multi-crop planter are given below:

- To open the furrow
- To meter the seed
- To deposit the seed in the furrow

- To cover the seeds and compact the soil over it.
- Removable metering device for different crops
- Minimum human power required so that anybody can operate.
- Without extra furrow, operator can mark other row.
- Adjustable furrow opener.
- Low cost

3.3.1. Design Considerations

The design of manually operated multi-crop planter based on the following considerations.

- The ease of fabrication of component parts.
- The safety of the operator
- The operation of the machine should be simple for small scale or rural farmers.
- The materials available locally will be used in the fabrication of the components.
- Availability and cost of the materials for construction.

3.3.1.1 Power developed by the operator of machine

According to Campbell (1990), power of useful work done by an average human on the drive machine is given by:

$$HP = 0.35 - 0.092 \log t \qquad (3.8)$$

where,

t = operation time in minutes.

Now, on average a human can work on the field 2-4 hour's continuous. So power developed by the operator is 0.13 – 0.16 hp.

Now if we take working time four hours then the power developed by a human is

HP = 0.35-0.092×log 240

= 0.35-0.092×1.60

= 0.13hp.

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Now we know that developed power by a chain drive is:

$$HP = \frac{Push\ force(kgf) \times Speed\ of\ machine(m/s)}{75} \quad (3.9)$$

The operating speed of the machine is 2.5 km/h (0.7 m/s).

$$0.13 = \frac{Push\ force\ (kgf) \times 0.70}{75}$$

$$= 13.92 \text{ kgf.}$$

3.3.1.2 Speed of ground wheel (N_w), rpm

$$N_w = \frac{speed\ of\ machine\ in\ m/s \times 100}{\pi \times 60} \quad (3.10)$$

$$N_w = \frac{41.66 \times 100}{3.14 \times 60}$$

$$= 22.11 \text{ r.p.m.}$$

3.3.1.3 Torque on ground wheel (T_w), N.m

$$T_w = K_w \times W_t \times R_w \quad (3.11)$$

where,

K_w = coefficient of rolling resistance (0.3 for the metallic wheel)

W_t = active weight of the machine (20 Kg) and R_w is the radius of ground wheel (16.5 cm).

$$= 0.3 \times 20 \times 0.16$$

$$= 0.96 \text{ kg-m}$$

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$$HP = \frac{2\times\pi\times N_w\times T_w}{4500} \quad (3.12)$$

$$= HP = \frac{2\times3.14\times22.116\times0.99}{4500}$$

= 0.0306 hp.

3.3.1.4 Determination of maximum bending moment on the shaft

We know that the power is transfer to the machine by the chain drive system so for the measurement of the bending moment of the shaft or machine is measured by the theorem of the chain drive system. So load on the chain or chain load (Q) is:

$$Q = K_l \times P_t\ kgf \quad (3.13)$$

Where,

K_l = coefficient of chain (1.15 for the mild steel) and Pt is the push force of the chain.

= 1.15×13.92

= 16.008 kgf

Now chain drive is working at an angle φ (35^0) with the horizontal. Therefore equivalent chain load on the machine is

$$Q_v = Q\ sin\varphi \quad (3.14)$$

= 16.008×sin 35

= 9.18

Now Maximum bending moment on the shaft given by the chain drive system

$$Mb = (\text{Weight on wheel} \times \text{overhung}) + (Qv \times \text{overhung}) \quad (3.15)$$

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Assume that overhung of wheel = 15 cm and so that the Overhung of sprocket = 5 cm.

Total weight of machine will be 20 kg. So weight on one wheel is 10 kg.

M_b = (10×0.15) + (9.18×0.05)

= 1.5459 kgf

Hence;

Equivalent bending moment = $\sqrt{(M_{b^2} + M_{t^2})}$ (3.16)

Where

$M_t = T_W$

$\sqrt{(1.5459^2 + 0.99^2)}$

= 1.83 kg-m

3.3.1.5 Determination of rolling resistance of wheel (R_r)

R_r = co-efficient of rolling resistance × weight on drive wheel

= 0.3×10

= 3 k

Allowable shear stress = (τ_s) = in shaft is 5.01 kg/cm^2

$$M_{eq} = \frac{\pi}{16} d^3 \tau_s \quad (3.16)$$

So from the equation the diameter of the shaft of the machine is:

$$d^3 = \frac{16}{\pi \tau_s} M_{eq} \quad (3.17)$$

Where,

d = diameter of shaft in cm.

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$d^3=(16/3.14)(1/5.01)\times1830=1861.2$

d=12.3mm

3.3.1.6. Design of the size of the planter

For the design of the planter, first of all we design the number of furrow opener for the sowing of the seeds. So

Number of furrow opener in the planter

$$(Z) = \frac{draft\ of\ planter\ (D)kgf}{draft\ of\ each\ row(d_r)} \quad (3.18)$$

$$1 = \frac{13.92}{draft\ of\ each\ row(d_r)}$$

$d_r = 13.92$ kgf

Now the working width of the machine

$$(W) = Z \times row\ to\ row\ distance\ (depend\ on\ type\ of\ crop) \quad (3.19)$$

For Maize

W = 1×60 =60 cm

For Pigeon pea

W = 1×90 =90 cm

For okra

W = 1×45 =45 cm

3.3.1.7. Design of seed hopper

Volume of seed $hopper\ (V_b) = 1.1 \times V_s$ (3.20)

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$$Volume\ of\ seed\ (V_s) = \frac{Weight\ of\ seed\ in\ the\ box\ (W_s\ )g}{Bulk\ density\ of\ the\ seed\ (\gamma_s)g/cm^3} \quad (3.21)$$

Now from the structure of seed hopper

$V_b = V_a + V_c$ (3.22)

$V_a = a \times b \times l\ cm^3$ (3.23)

$22.2 \times 22.2 \times 15 = 7392.6\ cm^3$

$h_2 = \sqrt{10739 \times}$

$= 103.63$ mm or 10.36 cm

$V_c = (22.2 \times 22.2 \times 10.36) - (1/2 \times 60 \times 10.36 \times 22.2)$

$5105\text{-}1380 = 3723\ cm^3$

$V_b = V_a + V_c$

$= 7392.6 + 3725.8 = 11118.92\ cm^3$

3.3.1.8 Design of seed metering device

For the design of the seed metering device the most important thing is that how many cells would be developed for desired crop; so that the requirement of the plant to plant spacing is achieved. So

Now the first thing is that what would be the diameter of the seed metering device. So the diameter of the seed metering device calculated by following equation:

$$D_m = \frac{V_r}{\pi N_r} \quad (3.24)$$

where,

D_m = diameter of seed metering device, cm

V_r = Peripheral velocity of seed metering device in m/min

N_r = rpm of seed metering device.

Peripheral length of seed metering device = $2\pi r$

$= 2 \times 3.14 \times .165$

$= 1.0362$m

Forward speed of the planter = 2.5 km/h

$$\text{Speed of small sprocket (rpm)} = \frac{\textit{Forward speed in metre/min}}{\textit{peripheral length of seed metering device}}$$

$$= \frac{41.67}{1.0362} = 40.21\ rpm$$

Speed of large sprocket (rpm) = Speed of small sprocket × drive ratio

$= 40.21 \times 0.375 = 15.08$ rpm.

So minimum speed for seed breakage 0.2892 km/h

$$\text{Diameter of seed metering device} = \frac{V_r}{\pi N_r} = \frac{4.81}{3.14 \times 15.08}$$

$= 0.101$ m

$= 10.1$cm

3.3.1.9 Power transmission system of manually operated planter

The planter will be operated manually to make it cost effective. Power is transmitted from the transported wheel to the seed metering device through pintle chain. Flow diagram of the power transmission system is shown in Figure and the photographic view of the power transmission is shown in Fig.

Since a power (HP) transmitted in manual seed planter is very low. So, for the amplification of the power for desired power requirement of seed metering device, we apply a chain sprocket system which have two chain sprockets (small sprocket have 18 teeth and large sprockets have 48 teeth). The chain length is calculated by the following equation (D.N. Sharma, 2010):

$$m = \frac{2C}{p} + \left(\frac{Z_1+Z_2}{2}\right) + \frac{(Z_2-Z_1)^2}{2\pi p} \quad (3.25)$$

Where,

m = number of chain links

C = centre to centre distance between two sprocket mm,

P = is the chain pitch, mm

Z_1 and Z_2 are the number of teeth in the driver sprocket and driven sprocket respectively.

Now $m = \frac{2\times450}{10} + \left(\frac{18+48}{2}\right) + \frac{(48-18)^2}{2\times3.14\times10}$

$= 137$ links

$L_c = m \times p$ (3.26)

where,

L_c = chain length, mm

m = number of chain links

p = chain pitch, mm

$L_c = 137 \times 10 = 1370$ mm or 1.370 m

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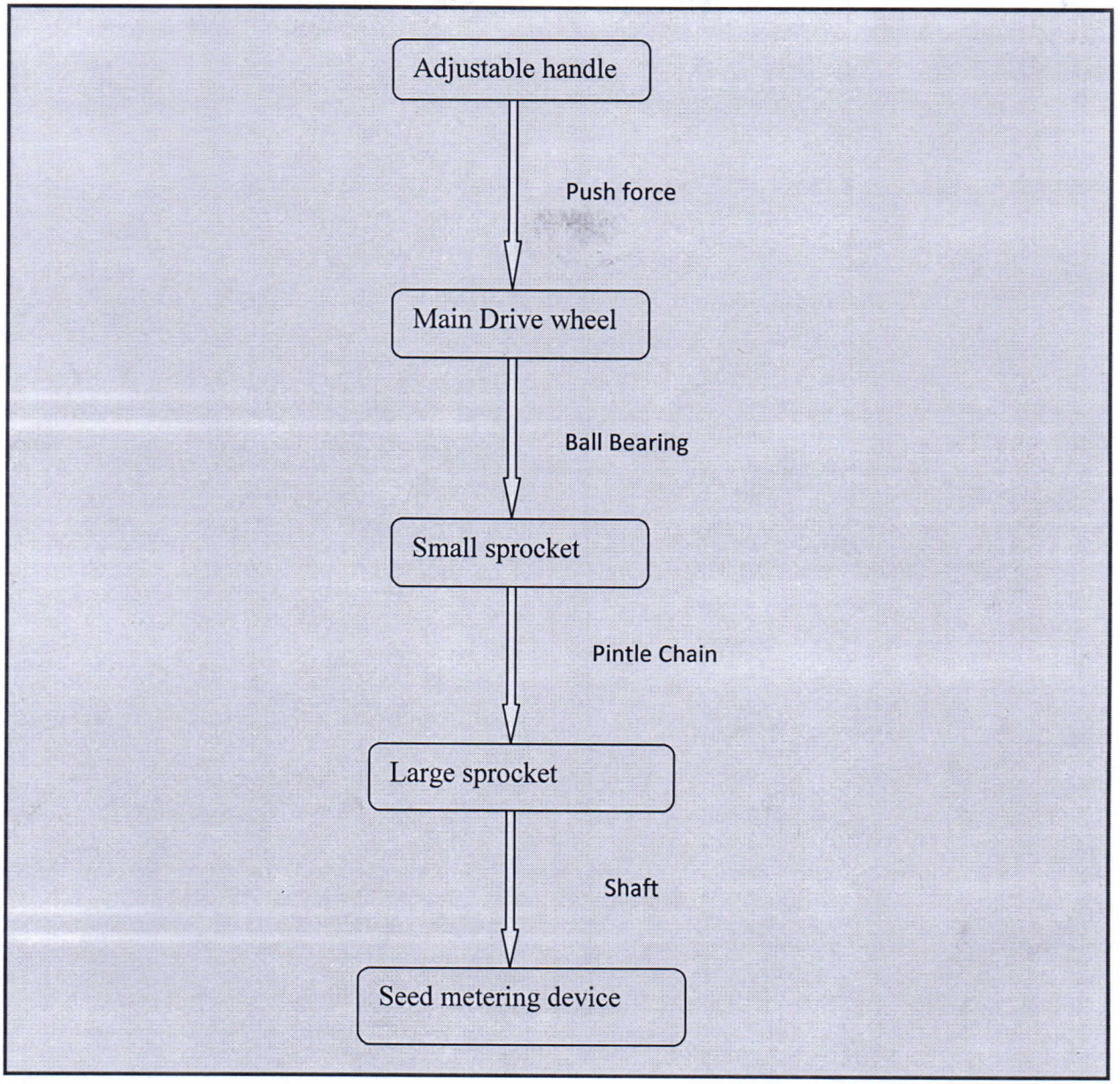

Fig. Flow diagram of power transmission system of manually operated planter

3.3.1.10 Design of handle of the planter

The adjustable handles of the planter will be designed to be adjustable for the different height of person male/female which can adjust according to own height which reduced drudgery. The adjustable handle helps the operator to push the planter at the time of operation (D.N Sharma and S. Mukesh, 2010). The materials will be used for adjustable handle will be a combination of two mild steel flat bar fastened to the frame and mild steel circular pipe.

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Length of the handle is calculated based on average standing elbow height of female operator. So, the average standing elbow height of women workers is the 100cm.

Distance of wheel centre from the operator (for operator height of 95-105 cm) in operating condition is the 115 cm. therefore angle of inclination.

So, the angle of inclination (θ_h) with the horizontal is

$$tan\theta_h = \frac{a_1}{a_2} \qquad (3.27)$$

where,

a_1 = height of centre of wheel to the elbow, cm

a_2 = horizontal distance between the normal to the centre of wheel and normal to the elbow line, cm

$tan\theta_h = \frac{89}{115} = 0.77$

$\theta_h = 37.06$

$Tan^{-1} = 0.77$

37.6^0 (It varies 34 to 37^0 because handle is adjustable)

3.3.1.11 Design of the furrow opener

Considering lower push/pull available and easy operation of the planter is selected for the planter. The furrow opener includes:

- Selection of standard (tyne)
- Furrow opening portion

For the selection of standard (tyne) the draft force on furrow opener is F kgf/tyne and acting at a height of h/3 from the bottom of the furrow opener where the h is a total length of furrow opener and tyne.

Distance of draft application on furrow opener tyne,

$a = h/3$ (3.28)

$= 225/3 = 75$ mm

Moment arm length = (h-a) (3.29)

$= 225-75 = 150$

Bending moment (B.M.) in tyne = D (h-a) (3.30)

$= 63 \times (150)$

$= 9450$

Therefore maximum bending moment (M_b) in tyne= B.M. ×F.O.S. (3.31)

Where,

F.O.S.= factor of safety = 2

$= 9450 \times 2 = 18900$kg-mm

$$Z_t = \frac{M_b}{f_b} \quad (3.32)$$

Where,

Z_t = section modulus of tyne

M_b = maximum bending moment of tyne

M.S. flat tyne is used in planter ($f_b = 56$ N/mm^2 for mild steel)

$$Z_t = \frac{18900}{56} = 337.5$$

$$Z_t = (1/6)tb^2 \text{(For rectangular section)}$$

$= (1/6) \times 125 \times 32^2$

$= 21333.33$

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3.3.1.12 Determination of Planter Capacity

The capacity of the planter may be determined in terms of the area of land covered per time during planting or the number of seeds planted per time of planting. The capacity of the planter in terms of the area of land covered per time may be obtained from the following expression:

For maize:

$$C_{PA} = \frac{Area\ covered\ by\ planter}{10000}\ (hectare/time) \qquad (3.33)$$

C_{PA} = Capacity of planter in hectare/time

Length of one row =1000 cm or 10m
Row width= 60 cm

Row area = (1000 × 60) = 60000 cm

$\frac{60000}{100000000}$ [1 ha =10^8 cm^2]

= 0.0006 ha

Time taken to complete 10m length of grease belt =14.5 sec or 0.0040 hours

Effective field capacity $= \frac{A}{t}$

$= \frac{0.0006 \times 3600}{14.5}$ = 0.13 ha/h

For pigeon pea

Length of field =1000 cm or 10m
Row width= 90 cm

Row area = (1000 × 90) = 90000 cm

$\frac{90000}{100000000}$ [1 ha =10^8 cm^2]

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= 0.0009 ha

Time taken to complete 10m length of grease belt =14.5 sec or 0.0040 hours

Effective field capacity $= \frac{A}{t}$

$= \frac{0.0009 \times 3600}{14.5}$ = 0.21 ha/h

For okra

Length of the field =1000 cm or 10m
Row width= 45 cm

Row area = (1000 × 45) = 45000 cm

$\frac{45000}{100000000}$ [1 ha =10^8 cm^2]

= 0.00045 ha

Time taken to complete 10m length of grease belt =14.5 sec or 0.0040 hours

Effective field capacity $= \frac{A}{t}$

$= \frac{0.00045 \times 3600}{14.5}$ = 0.10 ha/h

The capacity of the planter in terms of number of seeds planted per time may be obtained from the following expression:

$$C_{NP} = \frac{\text{Distance covered by planter per time}}{\text{Intera row spacing}} \times \text{No. of seeds per hole (seeds/time)} \quad (3.34)$$

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For maize

Speed of the planter = 2.5 km/h or 2500m/h

$C_{NP} = \frac{2500}{0.25} \times 1 =$ 10000 seeds/h

For pigeon pea

$C_{NP} = \frac{2500}{0.30} \times 1 =$ 8333 seeds/h

For okra

$C_{NP} = \frac{2500}{0.20} \times 1 =$ 12500 seeds/h

3.3.1.13 Time required cultivate a hectare of land

The time required to cultivate of one hectare of land is therefore obtain from following equation:

Time required $= 1/C_{PA}$ (3.35)

3.3.1.14 Number of days required to plant on a hectare of land

Assuming 8hrs is used per day for planting, the number of days required to plant on 1 hectare of land is obtained as follows

Number of days required =time required to cultivate of one hectare of land (hrs) /no. of hours worked per day. (3.36)

For maize, area covered in one hour = 0.13ha

Area covered in 8 hours = 0.13×8 = 1.04ha

For pigeon pea, area covered in one hour = 0.21ha

Area covered in 8 hours = 0.21×8 = 1.68

For okra, area covered in one hour = 0.10ha

Area covered in 8 hours = 0.10×8 = 0.8ha

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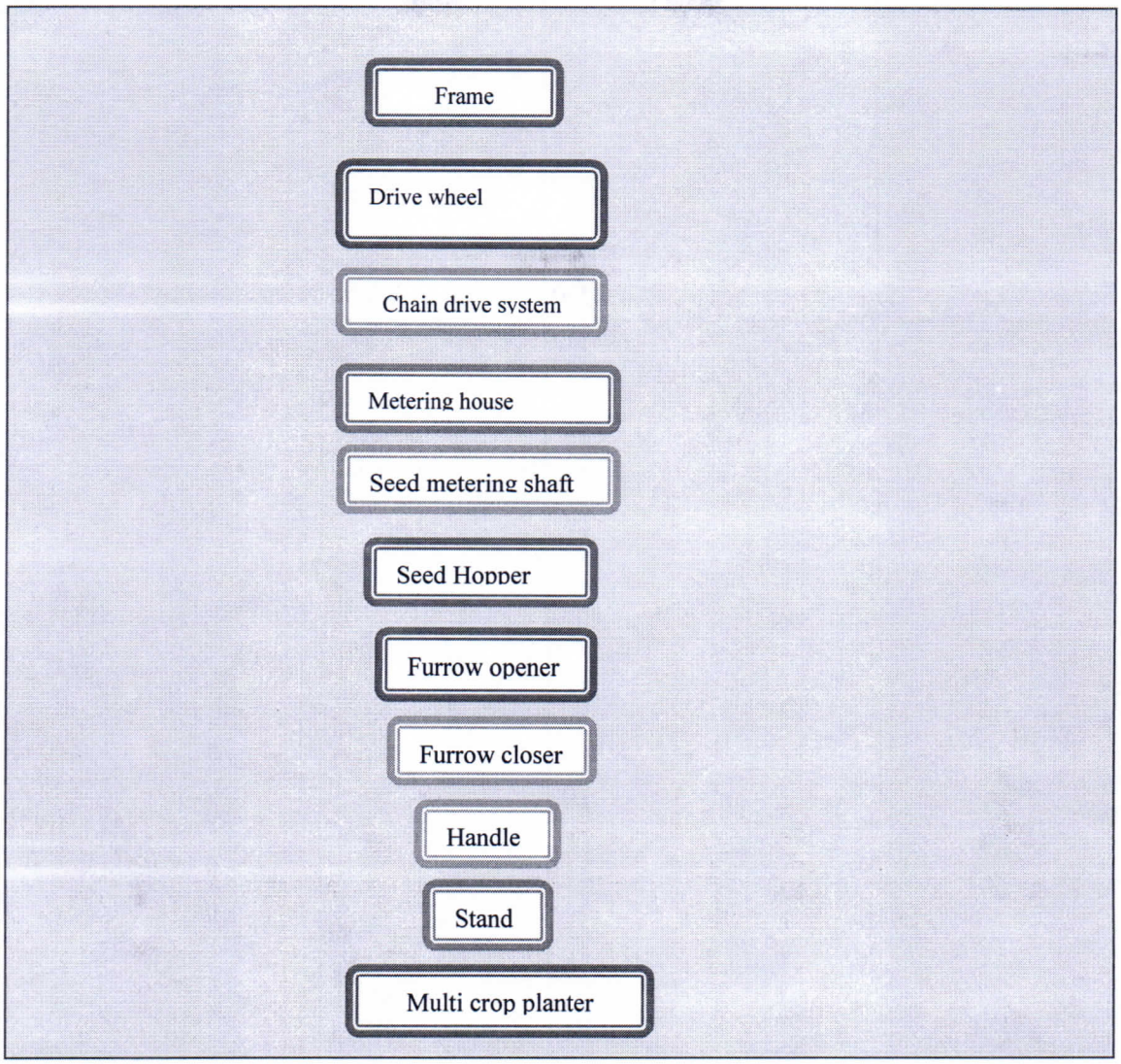

Figure 1: Flow chart of **design** of manually operated multi-crop planter.

3.3.2 Fabrication of the Manually Operated Planter sowing for different seeds crop.

1. Frame.
2. Adjustable handle.
3. Seed hopper.
4. Seed metering device shaft.
5. Seed metering device (Wheel type).
6. Seed metering device house.
7. Adjustable furrow opener.
8. Adjustable furrow closer.

9. Adjustable row marker.
10. Front wheel.
11. Rear wheel.
12. Lugs.
13. Small sprocket.
14. Large sprocket.
15. Seed tube.
16. Pintle chain.
17. Ball bearing.
18. Idler sprocket.
19. Parking stand.

3.3.2.1 Frame

The main frame is the skeletal structure of the seed planter on which all other components are mounted. The two design factors considered in the determination of the material required for the frame are the weight and strength. In this work, mild steel flat bar 844mm length and 119mm width and 5mm thickness will be used to give require rigidity.

3.3.2.2 Adjustable handle

The adjustable handles of the planter will be designed to be adjustable for the different height of person male/female which can adjust according to own height which reduced drudgery. The adjustable handle helps the operator to push the planter at the time of operation. The materials will be used for adjustable handle will be a combination of two mild steel flat bar each of 895 mm long fastened to the frame and mild steel circular pipe with 20mm diameter.

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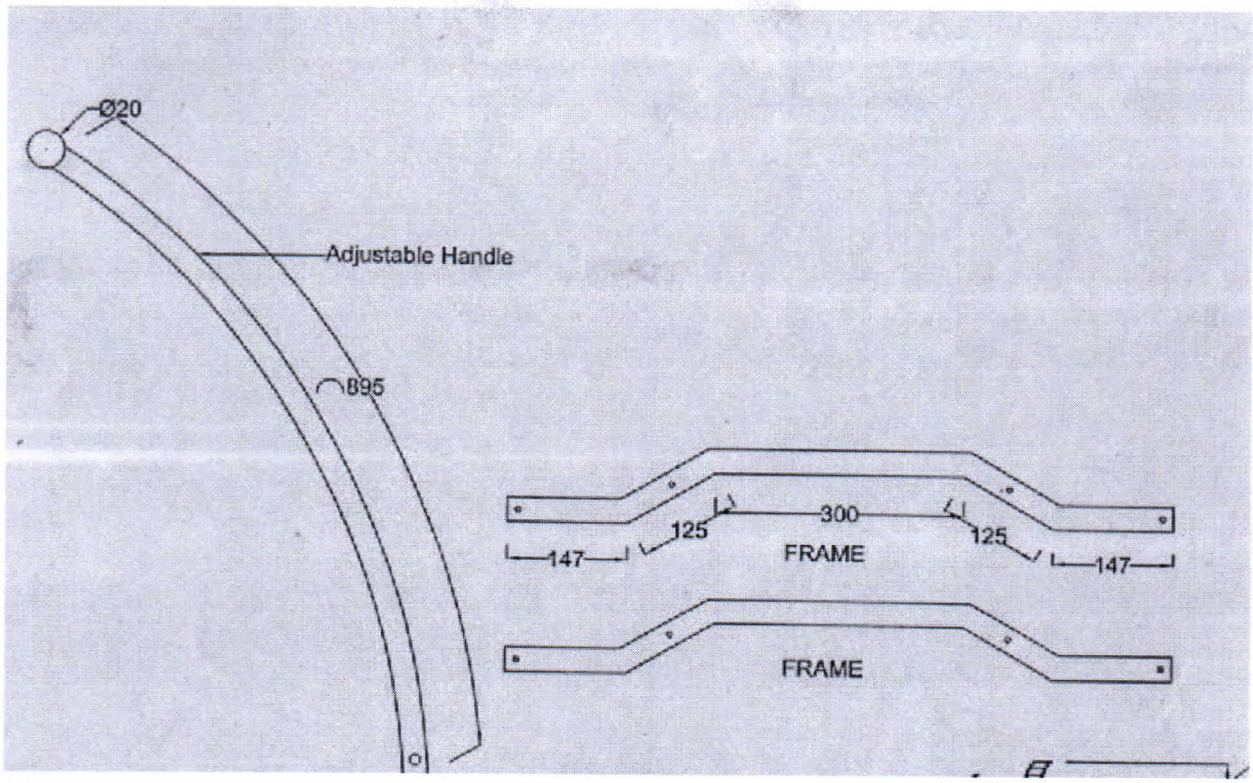

Fig. 3.1 An isometric view of adjustable handle and frame of manually operated planter. (All dimensions in millimeter)

3.3.2.3 Seed hopper

It contains seed and the seed metering device. The amount of seed contained depends upon the size of the seed hopper. The hopper has the shape of a frustum of a pyramid truncated at the top. The capacity of this seed hopper is around 5 kg. The height top to bottom 270 mm and 223 mm square at the top. To obtain free flow of seeds, the slope of the hopper will be fixed at 32^0, which is modestly higher than the average angle of repose of the seeds. The material will be used for the design 2.5 mm thick mild steel metal sheet for low cost, light weight and longer life. The Isometric view of seed hopper is shown in Fig.

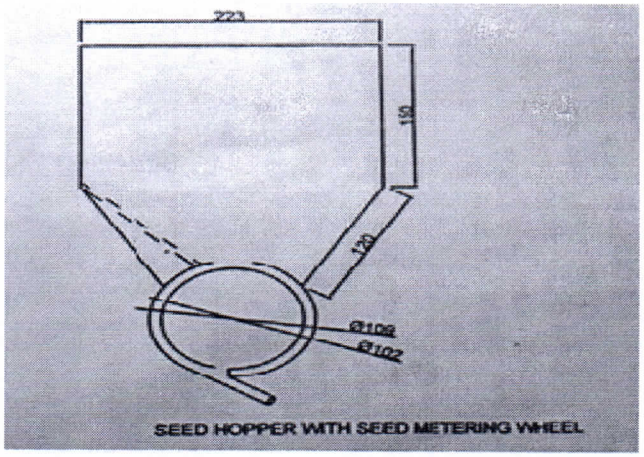

Fig. 3.2 An isometric view of seed hopper of manually operated planter. (All dimensions in millimeter)

3.3.2.4 Seed metering device shaft

It rotates the seed metering device and have ball bearing at the both end of the shaft. The length and diameter of seed metering device shaft 207 mm and 12.2 mm respectively. The material will be used for the design medium carbon steel.

3.3.2.5 Seed metering device (Wheel type)

Metering mechanism is the heart of sowing machine and its function is to distribute seeds uniformly at the desired application rates [6]. In planters it also controls seed spacing in a row. A seed planter may be required to drop the seeds at rates varying across wide range [6]. Proper design of the metering device is an essential element for satisfactory performance of the seed planter. The seed metering device used for this work is the nylon (Fiber) seed metering wheel with cells on its periphery. The size and number of cells on the seed metering device depends on the size of seed and desired seed rate. In this design, the seed metering device (wheel type) lifts the seeds from the hopper in the cells and drops these into the seed funnel which is conveyed to the open furrow through the seed tube. For varying the seed rate, plant spacing and sowing various seeds crop, three separate seed metering device will be designed. The diameter of seed metering device will be 102 mm for each crop seeds and number of cell on its periphery change according to plant spacing.

3.3.2.6 Seed metering device house

In seed metering device house, rotates the seed metering device (wheel type) with seed metering device shaft. The length and diameter of seed metering device house will be 118 mm and 109 mm respectively. It will be well smooth to inside so seed metering device easily rotate. The material will be used for the design hollow pipe of cast iron.

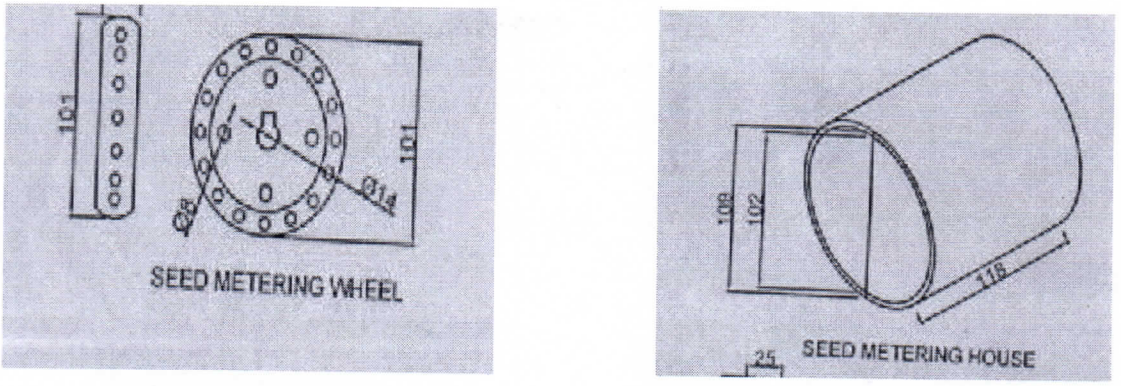

Fig. 3.3 An isometric view of seed metering device and seed metering house of manually operated planter. (All dimensions in millimeter)

3.3.2.7 Adjustable furrow opener

The design of adjustable furrow openers of seed planter varies to suit the soil conditions of particular region. The depth of sowing of various seeds control by the adjustable furrow opener. The type of furrow opener will be used shoe type and pointed bar type with narrow slit in the soil for seed deposition. This adjustable furrow opener permits planting at each variety's ideal ground depth. These types of furrow openers will be used for forming narrow slit under heavy soils for placement of seeds at medium depths. The material used for the design will be 60 mm x 5 mm mild steel flat bar.

3.3.2.8 Adjustable furrow closer

The adjustable furrow closer will be also designed to be adjustable. The type used for this design is the shoe type furrow closer. It will be designed to allow for proper covering and compaction of the soil over the seeds in the furrows. The material used for the design will be 60mm x 5mm mild steel flat bar.

3.3.2.9 Adjustable row marker

The adjustable row marker will be also designed to be adjustable. The function of the adjustable row marker in the manually operated planter help to the operator maintains a more accurate or constant accurate row spacing. Constant crop row spacing will make for simpler and more effective cultivation especially when cultivating between rows. Before planting of any type crop, consideration should be given to the subsequent cultivation operation. It will be made of mild steel flat bar with many slot.

3.3.2.10 Front wheel and Rear wheel

There are two wheels (Front and Rear) in manually operated planter. The front wheel will be also designed with lugs on its periphery which increase the traction and reduced slippage at the time of operation. The rear wheel will be also designed without lugs on its periphery. The small sprocket will be attached to front wheel axle and large attached to seed metering device shaft. When a human push the planter, wheel will be rotates and transfer the power small sprocket to large sprocket with the help of chain, in such a way seed metering device rotate, seed will be singulated into the cell and dropped into the planting shoe/ground opener with the help of seed discharge tube that deposits the seed in the soil. They are circular in shape containing periphery width 75 mm which reduce side thrust of the manually operated planter. The plastic spokes are arranged in such a way that it braced the wheels circular circumference and also gives it necessary radial support. The diameter of front wheel of manually operated planter will be 330 mm and material used for the design will be plastic and 3.5 mm thick metal sheet.

3.3.2.11Wheel lugs

The wheel lugs will be designed to be rectangular in shape. The function of lugs on front wheel in manually operated planter to increase the traction and reduced wheel slippage at the time of operation. The length, width, thickness and number of lugs will be 84, 28, 5 mm and 12 respectively. The material used for the design will be mild steel flat bar.

3.3.2.12 Small sprocket

Power transmission is done by the gear sprocket and pintle chain. When push the planter, front wheel rotate then small sprocket of front wheel also rotates and transfers the power to seed

metering wheel shaft sprocket with the help of chain. The number of teeth in small gear sprocket will be 18. The material used for the design will be medium carbon steel.

3.3.2.13 Large sprocket

Small sprocket transfer power small sprocket to large sprocket with help of pintle chain. The number of teeth in large gear sprocket will be 48. The material used for the design will be medium carbon steel.

3.3.2.14 Seed tube

The seed tube is made of rubber hose pipe 30mm diameter and 300mm long. One end of the seed tube joint to lower pipe of seed metering house and other end joint to furrow opener. Seeds picked from the hoppers pass through the upper hole at the slide of the castellated metering mechanism to the lower hole. Into the discharge tube which deposits the seeds at desired uniform spacing into the opened furrow.

3.3.2.15 Pintle chain

Chain and sprocket drive is used where two parallel shaft are spaced apart at short distance. A chain drive system needs an endless chain and sprocket. It positive drive and is very reliable method. Pintle chain is used for heavy duty, slow speed work in any exposed atmosphere. It made of malleable links, held together by suitable pins.

3.3.2.15Ball Bearing

Bearings are selected based on their load carrying capacity, life expectancy and reliability. Ball bearings are fixed in the bushing provided at the two ends of the frame in other to support the eccentric shaft on which the wheels are attached. They allow the carrying of an impressive load without wear and tear and with reduced friction. This device ensures the smooth operation of the wheels. The material for the bearing is high speed steel. It consist one or more row of hardened steel ball held in a cage. The balls roll between inner and outer races. The balls are separated and held in position by a retainer. It may carry radial load, thrust load, as well as radial and thrust load combined. The contact surface between the ball and shaft is small hence friction is very less.

3.3.2.17 Idler sprocket

Idler sprockets should not rotate at greater speeds than are allowable for drive sprockets of the same size. They should be mounted in contact with the "slack" span of chain, whenever possible. Mount them on the outside of the chain when the arc of chain wrap on the smaller sprocket would otherwise be less than 120°. It is advisable that idler sprockets have at least three teeth in mesh with the chain. Inside mounted idlers usually account for quieter operation, especially if centers are short and speed is moderately high. An adjustable idler sprocket will be used to:

- Obtain proper chain tension when neither driving nor driven shaft is adjustable.
- Guide chain around an obstruction.
- Prevent whipping action in the slack span of chain transmitting an uneven load.
- Bring about greater chain wrap around a small sprocket, particularly if it is the lower sprocket in a vertical drive.
- Take up slack chain caused by normal chain wear.
- Provide for reversed direction of rotation of a sprocket in contact with the outside of the chain.

3.3.2.18 Parking stand

When a farmer completed the work in the field or he tired, that time parking stand is necessary for stand the planter for taking rest. The material used for the design will be mild steel solid rod with 250 mm in length and 10 mm diameter.

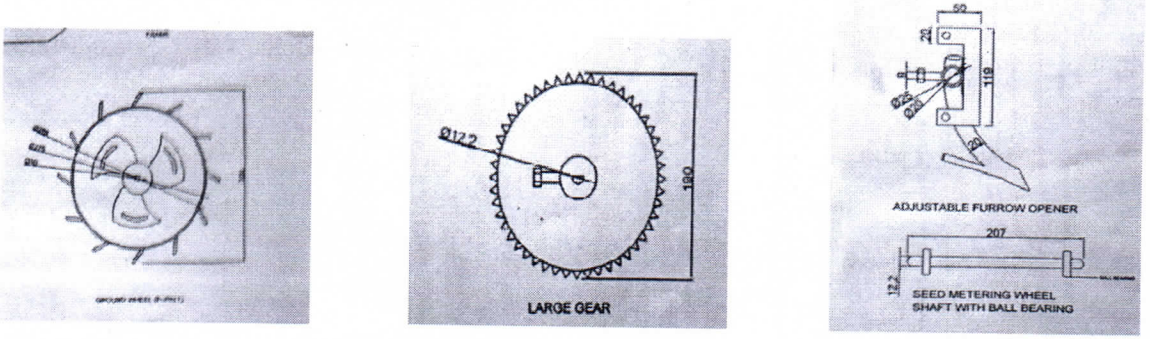

Fig. 3.4 An isometric view of drive wheel, large sprocket, adjustable furrow opener and seed metering device shaft of manually operated planter. (All dimensions in millimeter)

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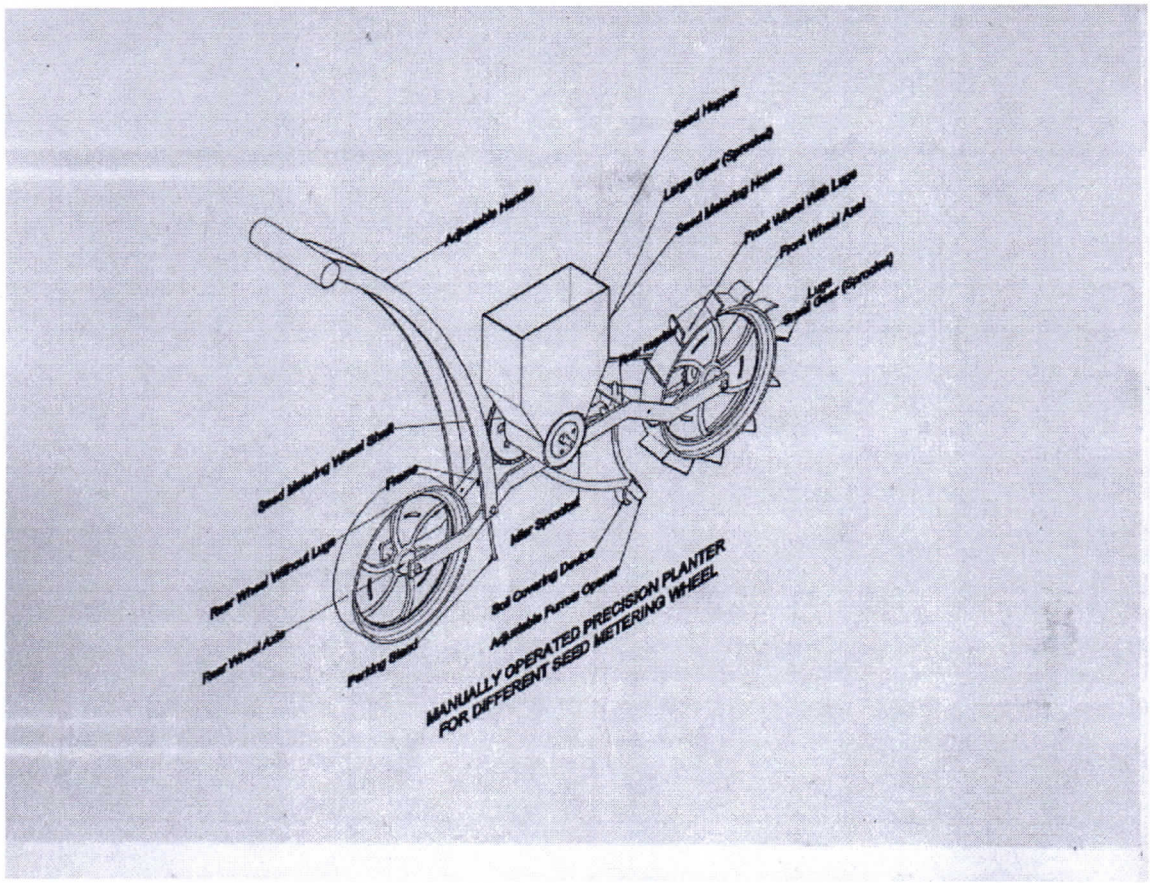

Fig. 3.5 An isometric view of manually operated single row multi-crop planter.

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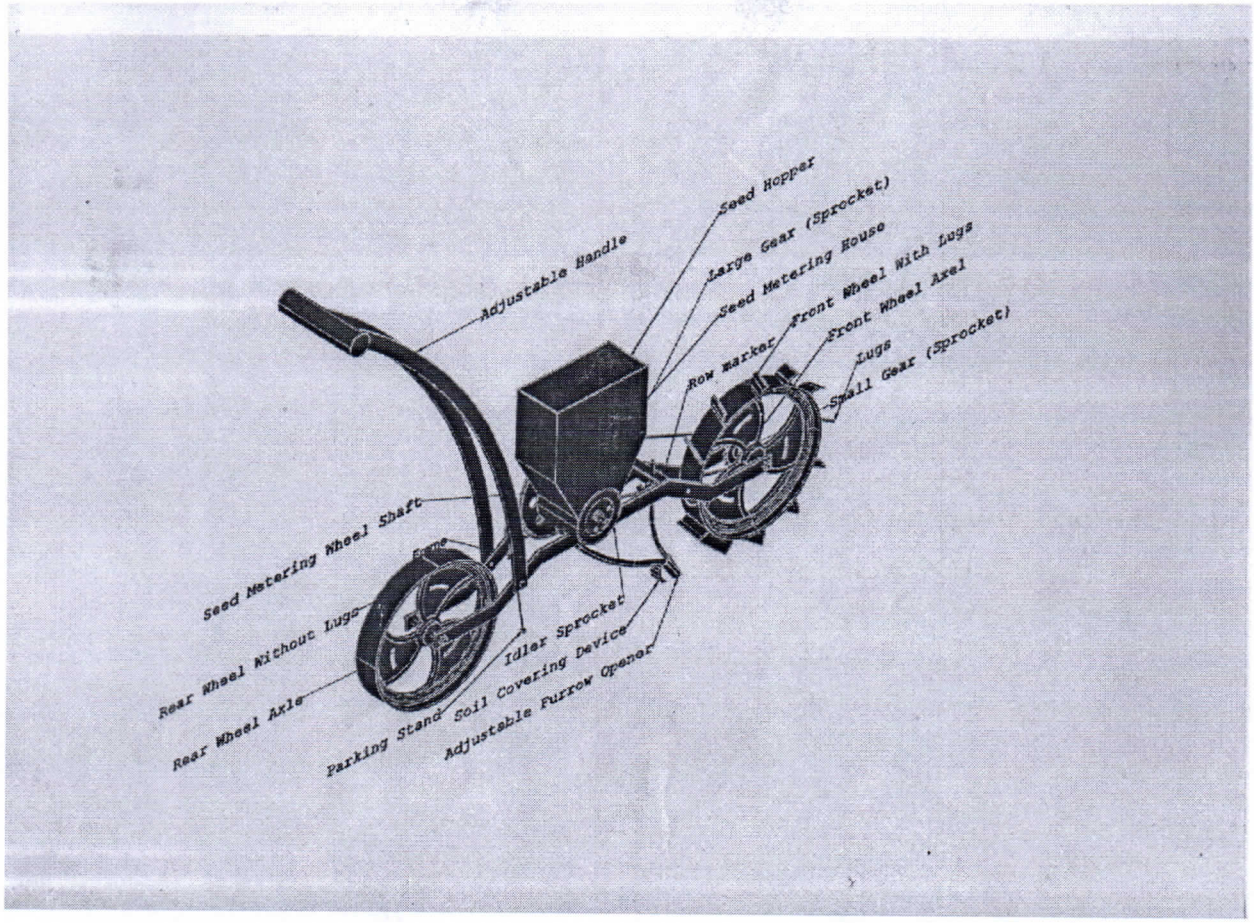

Fig. 3.6 A solid isometric view of manually operated single row multi-crop planter.

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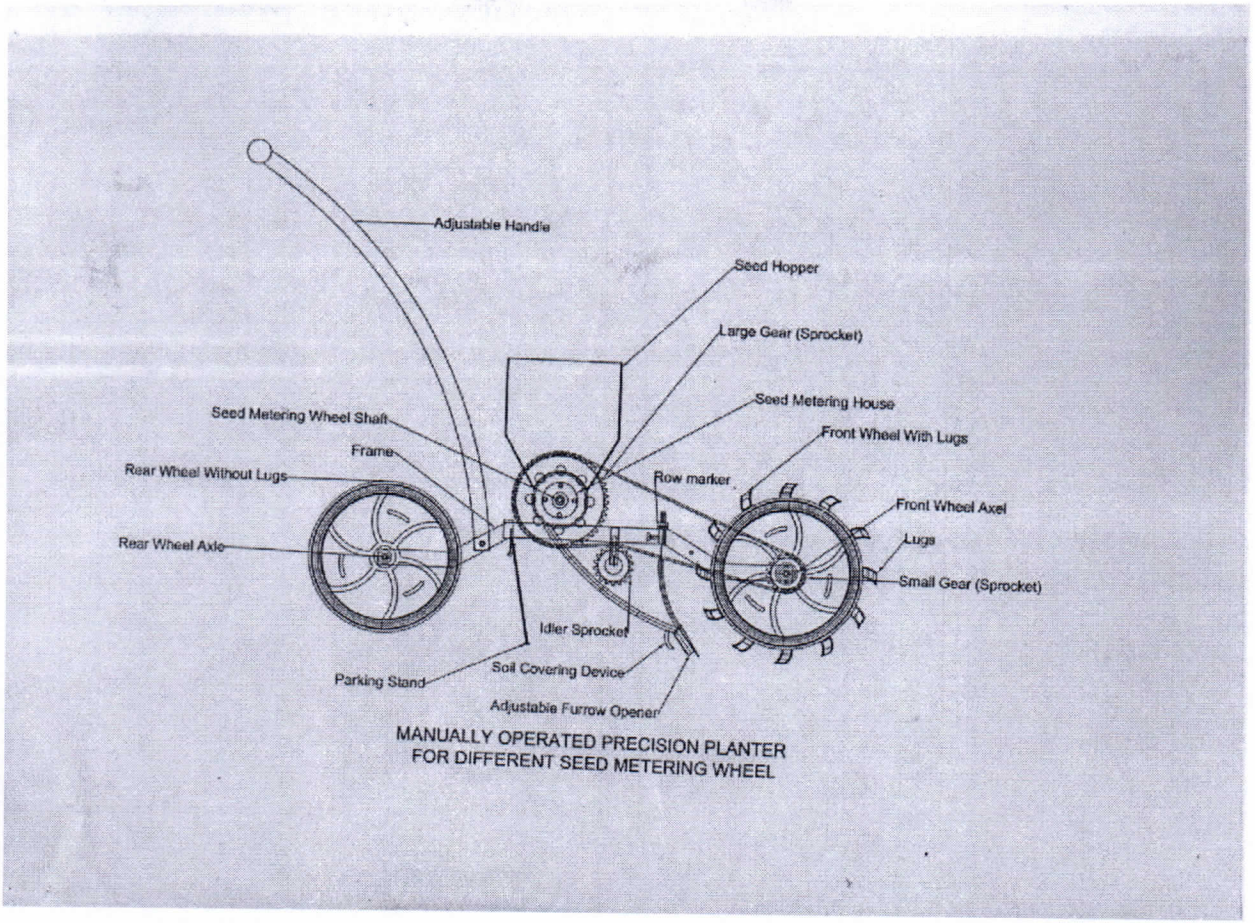

Fig. 3.7 A front view of manually operated single row multi-crop planter.

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3.4 Design and Development Various Seed Metering Device for Sowing Different Crops

In this section we are going to discuss about the design and fabricate of various seed metering device of a manually operated single row multi crop planter sowing for maize, pigeon pea and okra seeds. Since most of our farmers especially in the rural areas and or small scale farmers use dibbler, matchet or sticks to sow different seeds. This dibbler, matchet or sticks is used to open the soil as the farmer drops the required numbers of seed (often times more than they require numbers are dropped) and then covers them up that means efficiency is low.

So metering mechanism is the heart of sowing machine and its function is to distribute seeds uniformly at the desired application rates [Sowing and planting equipment]. In planters it also controls seed spacing in a row. A seed planter may be required to drop the seed at rates varying across wide range [Sowing and planting equipment]. The proper design of the metering device is an essential element for satisfactory performance of the seed planter. In present study seed metering device (wheel type) will be made by nylon materials with cell on its periphery. The seed metering device (wheel type) will be fabricated in the laboratory of farm machinery and power engineering department, SHIATS, Muzaffarnagar. The size and number of cells on the seed metering wheel depends on the size of seed diameter and actual plant spacing.

3.4.1 Design of seed metering device for maize, pigeon pea and okra seeds

For the design of the seed metering device the most important thing is that how many cells would be developed for desired crop; so that the requirement of the plant to plant spacing is achieved. So

Now the first thing is that what would be the diameter of the seed metering device. So the diameter of the seed metering device calculated by following equation:

$$D_m(\text{cm}) = \frac{V_r}{\pi N_r} \qquad (3.37)$$

D_m = diameter of seed metering device, cm

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V_r = Peripheral velocity of seed metering device in m/min

N_r = rpm of seed metering device.

Peripheral length of seed metering device = $2\pi r$

$= 2 \times 3.14 \times .165$

$= 1.0362$m

Forward speed of the planter = 2.5 km/h

Speed of small sprocket (rpm) = $\frac{Forward\ speed\ in\ metre/min}{peripheral\ length\ of\ seed\ metering\ device}$

$= \frac{41.67}{1.0362} = 40.21\ rpm$

Speed of large sprocket (rpm) = Speed of small sprocket × drive ratio

$= 40.21 \times 0.375 = 15.08$ rpm.

So minimum speed for seed breakage 0.2892 km/h

Diameter of seed metering device = $\frac{V_r}{\pi N_r} = \frac{4.81}{3.14 \times 15.08}$

$= 0.101$ m

$= 10.1$cm

3.4.2 Number of cell in seed metering device (wheel type).

To obtain the actual plant spacing by change the number of cells in the seed metering device and drive ratio. The numbers of cells on seed metering device calculated by following equation:

$$\text{No of cells in seed metering device} = \frac{\pi \times diameter\ of\ drive\ wheel\ (cm)}{drive\ ratio \times plant\ spacing\ (cm)} \quad (3.38)$$

For maize

No of cells in seed metering device = $\frac{\pi \times 33}{0.375 \times 25}$

$= 11$

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For pigeon pea

$$\text{No of cells in seed metering device} = \frac{\pi \times 33}{0.375 \times 30}$$

$$= 09$$

For maize

$$\text{No of cells in seed metering device} = \frac{\pi \times 33}{0.375 \times 20}$$

$$= 14$$

3.5 Evaluation of Performance of Manually Operated Multi Crop- Planter.

The developed manually operated planter will be evaluated for its performance in the department of Farm Machinery and Power Engineering, SHIATS, Muzaffarnagar. The test will be conducted on the basis of following parameters:

1. Laboratory test.
2. Field test.

Laboratory test.

1. Calibration of manually operated planter
2. Seed germination test
3. Mechanically damaged seed due to the manually operated planter
4. Uniformity of spacing
5. Missing rate

6. Theoretical field capacity

Field test

Independent variables

1. Type of seed (Maize, Pigeon pea, and Okra)
2. Type of soil (Light soil, Medium soil)

Dependent variables

1. Angle measurement
1. Draft
2. Drive wheel skidding
3. Hill to hill spacing
4. Hill population
5. Missing hills
6. Field capacity
7. Field efficiency.

Seed Variety:

One variety of each crop seed take for research which are mostly grow in Muzaffarnagar region (Maize-COH-3, Pigeon pea – BAHAR, Okra - Kashi Pragati) will be used for the testing at 10 % moisture content. The major tests carried out on the machine will be done in the laboratory and on the field. The laboratory and field tests will be carried out at the Farm Machinery and Power Engineering Department, Sam Higginbottom Institute of Agriculture, Technology and Science, Muzaffarnagar (U.P).

3.1 Laboratory test.

3.1.1 Calibration Test

The hopper of the manually operated planter will be fully loaded of the seeds. The planter will be suspended on a voice and turning the drive wheels rotates the metering device. A paint mark will be made on the drive wheel to act as a reference point to count the number of revolutions when turned, and a bag will be placed on the discharge tube to collect the seeds discharged. The drive wheels will be rotated 50 times at low speed. A stop clock will be used to measure the time taken

to complete the revolutions. The seed in the bag will be weighed on a balance and the procedure will be repeated five times. Similar test will be carried out for each crop seed.

3.1.2 Seed germination percentage

Germination testing is considered as the most important quality test in evaluating the planting value of seed lot. The ability of seeds to produce normal seedling and plants later on is measured in terms of germination test. Testing of seeds under field conditions is normally unsatisfactory as the results cannot be reproduced with reliability. Laboratory methods then have been conceived where in the external factors are controlled to give the most uniform, rapid and complete germination. Testing conditions in the laboratory have been standardized to enable the test results to be reproduced within limits as nearly as possible those determined by random sample variations.

All three crop seed to be used for sowing should be germination tested. Germination test will be done in seed germinator in the laboratory of Department of Genetics and Plant Breeding SHIATS, Muzaffarnagar. Laboratory germination tests will be normally conducted at different temperature for different seed, so if the test is to be done indoors aim to conduct it at this temperature. Count out 100 seeds (including damaged ones) and sow 10 rows of 10 seeds —the rows make it easier to count seedlings. Seeds should be sown at normal seeding depth of 2-3 cm in seed germinator. Place the seeds on top of the sand or soil and push them in with a piece of dowel or a pencil and cover with a little more sand. Counting Seedlings should be counted after 7 to 10 days when the majority of seedlings are up. Do not wait until the late ones emerge–these are the damaged, weak ones. Only normal seedlings should be counted. Do not count badly diseased, discolored or distorted seedlings or, in the case of lupines, those missing a cotyledon. Remember, you want to know the total number of normal, vigorous, healthy seedlings. Similar test will be carried out for each crop seed. In this study counted only normal seedlings and germination percentage calculated by following formula:

$$SG = \frac{GS}{TS} \times 100$$

Where,

SG = seed germination percentage.

GS = germinated seed in seed germinator.

TS = total seed (Including damage seed).

3.1.3 Mechanically damaged seed due to the manually operated planter

The test for percentage seed damaged will be done with the machine held in a similar position to that described above. The hopper of the manually operated planter will be full loaded by seeds and rotates the drive wheel of planter at waking speed. The wheel will be rotated 20 times in turns and the time taken to complete the revolution will be recorded with the aid of stop clock. The seeds discharged from the seed tube will be observed for any external damage. Similar test will be carried out for each crop seed.

$$\text{Seed damage per cent} = \frac{\text{Total no of damaged seed}}{\text{total no.of seeds}} \times 100$$

3.1.4. Uniformity of seed spacing: To determine the uniformity of seed spacing (Seed to seed spacing in row) of manually operated planter, the planter will be fully loaded with seed. A 10 m thin layer of grease belt will be laid out on the plain ground and the machine run at working speed of approximately 2.5 km/hr. A measuring steel tape will be used to measure the distance between seed to seed in the row. This process will be repeated five times and measurement of distance between seed to seed will be recorded. Similar test will be carried out for each crop seed.

3.1.5. Missing rate

The accurate missing rate measurement during operation in the field is not an easy task, keen attention is needed while operating the manually operated planter in the field (laboratory testing grease belt). So, during operation operator and one observer counted the number of seeds missed to drop into the seed tube. Then determined the actual number of seeds drop in experimental area if no missing occurred. Then missing rate is determined by the following equation.

$$\text{Percent missing rate} = \frac{N}{M} \times 100$$

where,

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N = number of seeds missing during pickup by metering device into seed tube

M = number of seed dropped by the metering device if no missing occurred and not more than one seed per cell

3.1.6. Theoretical field capacity:

Theoretical and effective field capacity of the maize seeder will be determined by the following two equations:

$$TFC = \frac{SW}{10}$$

where,

TFC = theoretical field capacity, ha/hr

S = forward speed, km/hr

W = width of coverage, m

Field test

After proper checking for its satisfactory operation in the laboratory then the testing of planter is necessary in the field for its actual performance at a speed of 2.5 km/h. A prepared field takes by two pass of rotavator under a conventional tillage system to obtain a fairly flat field. The length and width of the testing field will be 10 × 25 m used for maize, 10 × 22.5 m for pigeon pea and $10 \times 11.25m$ for okra.

3.2.1. Angle measurement

The height and horizontal length of pulling and pushing handle will be measured by a tape for measuring the pulling or pushing angle. By measuring the height and width of a triangle, angle of pull or push easily determined using the following formula.

$$\text{Pushing angle, } \theta = \tan^{-1}\frac{Height\ of\ tangle}{Width\ of\ traingle}$$

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3.2.1.1 Draft

The draft requirement of different working component of the planter will be studied in order to determined power losses. The planter will be run on a well prepared uniform seedbed under optimum soil condition. It is the horizontal component of the pull, parallel to the line of motion. The draft will be calculated by the following equation.(J.Sahay)

$$D = P \cos \theta$$

where,

D = draft, kg

P = pull, kg

θ = Angle between line of pull and horizontal

3.2.1.2. Drawbar Power

Drawbar power is a measure of the pulling power of the implements or how much horse power would it take to pull the particular machine. It calculate by following equation:

$$\text{Dbp(hp)} = \frac{Draft(N) \times Speed\ in\ m/s}{1000}$$

3.2.3. Operating speed

The speed of the planter is important role for better performance during operation. If the speed is more than to recommended speed, its more damage seeds and affect seed to seed distance in the row but in other way if speed is less, efficiency of planter automatically reduce. So for better performance normal walking is good. The actual speed in the field will be measured by two mark made in the field at a distance of 10 m. One person stood a first mark with a stop watch when the planter will be started for the operation the stop watch will be switched on and the time will be noted to cover 10 m distance. Five observations will be taken and speed will be calculated on the basis average time taken to 10 meter distance. The average speed will be 2.5 km/h at the time of planting operation.

3.2.4. Drive wheel skidding

When the planter will be operated on the prepared seedbed. Two flags 10 m apart where erected on the field to mark the test path. The power transmission clutch will be disengaged for the first test. A piece of cloth tie on the wheel will be made to facilitate and counting the number of revolution to cover the distance between two flag. The power transmission clutch will be engaged in the next run and the number of revolution of wheel to cover the same distance will be a before. Several run of each test will be made and data will be recorded. The drive wheel skidding will be calculated by following equation:

$$\text{Drive wheel skidding} = \frac{A-B}{A} \times 100$$

where,

A = number of r.p.m. of wheel when the transmission clutch will be disengaged.

B = number of r.p.m. of wheel when the transmission clutch will be engaged.

3.2.5 Hill to hill spacing

This test will be conducted by operating the planter in the field after removing furrow opener from the planter. The seeds will be to allow dropping on the grease belt will be laid on the flat surface on the ground. The distance will be measure with the help of measuring tape between two consecutive hills. Similar test will be carried out for each crop seed.

3.2.6. Number of seed per hill

Five hills will be selected randomly from each plot after 20 days from the date of sowing and number of the plant per hill will be counted. The mean of five hills represent the average number of seed survived per hill. Similar test will be carried out for each crop seed.

3.2.7. Missing hills

Observations for missing hills will be taken after twenty days of planting operation. The total number of missing hill will be counted separately for one row in a 10 m distance. These observations will be repeated five times for each crop seed. Similar test will be carried out for each crop seed. The total percentage of missing hills will be calculated by following formula

$$\text{Missing hill \%} = \frac{Actual\ number\ of\ missing\ hill\ in\ 10\ m}{Theoretical\ number\ of\ hill\ to\ be\ planted\ in\ 10\ m} 100$$

3.2.8. Theoretical field capacity

The Theoretical field capacity will be determine by considering the width of coverage of planter and its average operating speed in the field 2.5 km/hr. Similar test will be carried out for each crop seed. Theoretical field capacity will be calculated by following formula:

$$\text{Theoretical field capacity} = \frac{W \times S}{10}$$

Where,

W = width of operation, m

S = speed of operation, km/hr

3.2.9. Field efficiency

Field efficiency represents the ratio of effective field capacity to theoretical field capacity and will be expressed as percentage. The field capacity will be calculated by following formula:

$$\text{Field efficiency \%} = \frac{Effective\ field\ capacity,ha/h}{Theoretical\ field\ capacity,ha/h} \times 100$$

3.6 Estimate cost analysis of developed planter.

The cost of manually operated planter will be calculated based on the amount of materials used and the estimated cost incurred in the fabrication of the manually operated planter. The total cost of the manually operated planter will be determined base on fixed and variable cost. The cost of operation obtained will be compared with the convectional practice of manual planting of seeds. The following variables will be considered in determining the cost of operation of the manually operated planter

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1. **Fixed cost**
    - **A.** Depreciation
    - **B.** Interest
    - **C.** Insurance and taxes
    - **D.** Shelter
2. **Variable cost**
    - **A.** Electricity charges
    - **B.** Labour charges
    - **C.** Repair and maintenance charges

The total cost of operation will be determined as sum of the fixed cost and variable cost.

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27/Sep/2022

The Chairman
Bookman India Muzaffarnagar

Subject- Proposal for approval of Rs 70,000 for Graphic Design Project

Dear Sir,

I trust this letter finds you well. I am writing to express our gratitude for the exciting project opportunity recently presented by Bookman Publisher to the applied arts students at Department of Fine Arts Shri Ram College Muzaffarnagar. It is an honor for us to collaborate with a reputable publisher, and we are enthusiastic about the prospect of undertaking this project. After careful consideration and planning, our team has put together a comprehensive proposal for the project. The objective is to not only meet the expectations set by Bookman Publisher but also to exceed them by delivering a creative and impactful outcome. In order to execute this project successfully and to ensure that the students have the necessary resources at their disposal, we are seeking financial support. After a thorough assessment of the project's requirements, we have determined that a funding amount of Rs70,000 would be instrumental in achieving the desired outcomes.

We are confident that this project aligns with Bookman Publisher's vision of promoting creativity and innovation. By supporting this initiative, Bookman Publisher not only invests in the education and development of aspiring artists but also contributes to the enrichment of the applied arts community. We are committed to ensuring that this project reflects the high standards of excellence associated with Bookman Publisher.

We look forward to the positive impact it will have on both the students and the continued partnership between Department of Fine Arts and Bookman Publisher.

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Yours sincerely,

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To
Head of Department
Department of Fine Arts
Shri Ram College, Muzaffarnagar

Dear sir/Madam

I hope this letter finds you well. I am writing to express my gratitude and formally accept the project offer of Rs 70,000 from Book Man for the project at Shri Ram College in Muzaffarnagar. I am enthusiastic about the opportunity to contribute to the success of this project and to collaborate with the esteemed team at Shri Ram College. I acknowledge the terms and conditions outlined in the project agreement and assure about your commitment to delivering high-quality work within the specified timelines. Further I would like to tell you that bookman provide this fund within three installments like Rs 25000 on the starting of project, Rs 25000 in mid of project & Rs 20000 on completion of the project. Please let me know if there are any additional formalities or documentation required from my end to initiate the project seamlessly.
Looking forward to a productive and successful collaboration.
Thank you once again for this opportunity.

Sincerely

For Bookman India

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Date: 2nd April 2022

Summary Report on Bookman Project

Title: Summary Report on six months duration Photography and Illustration Project by Applied Arts Students in Collaboration with Bookman India, Muzaffarnagar

Introduction: Bookman India's collaboration with the Applied Arts students in Muzaffarnagar unfolded into a dynamic project that seamlessly blended photography and illustration. This venture, generously supported with a payment of Rs 70,000 by Bookman India, aimed to harness the creative process of students in the realm of applied arts.

Project Scope and Objectives: The project tasked students with leveraging their skills in photography and illustration to create a visually compelling narrative. The overarching goal was to produce a body of work that not only showcased technical proficiency but also conveyed a thoughtful and impactful message.

Photography Highlights: The photography component of the project featured a diverse range of subjects, capturing moments that ranged from the mundane to the profound. Students employed various techniques, including composition, lighting, and post-processing, to craft visually stunning images that resonated with artistic and thematic depth.

Illustration Endeavors: In the realm of illustration, students brought their ideas to life through a combination of traditional and digital mediums. From intricate drawings to digital paintings, the applied arts students demonstrated versatility and creativity in translating concepts into compelling visual narratives.

Collaborative Process: A key aspect of the project was the collaborative process, where photographers and illustrators worked in tandem to create cohesive and impactful visual stories. This not only provided a holistic learning experience for the students but also emphasized the power of interdisciplinary collaboration in the creative process.

Impact and Recognition: Bookman India's investment of Rs 70,000 proved instrumental in facilitating the successful execution of the project. The impact extended beyond monetary

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support, contributing to the students' professional development and enhancing the visibility of their work within the local arts community.

Conclusion: The Photography and Illustration project undertaken by the Applied Arts students in collaboration with Bookman India stands as a testament to the transformative power of artistic endeavors. The Rs 70,000 contribution from Bookman India not only supported the students' creative exploration but also underscored the importance of fostering partnerships that encourage and elevate emerging talent in the field of applied arts.

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Participated Students	1- Himanshi Tyagi
	2- Kanishka
	3- Priyanshi Sharma
	4- Vidushi Tyagi
	5- Sumit Tyagi
	6- Anuradha
	7- Sejal
	8- Mukul Saini

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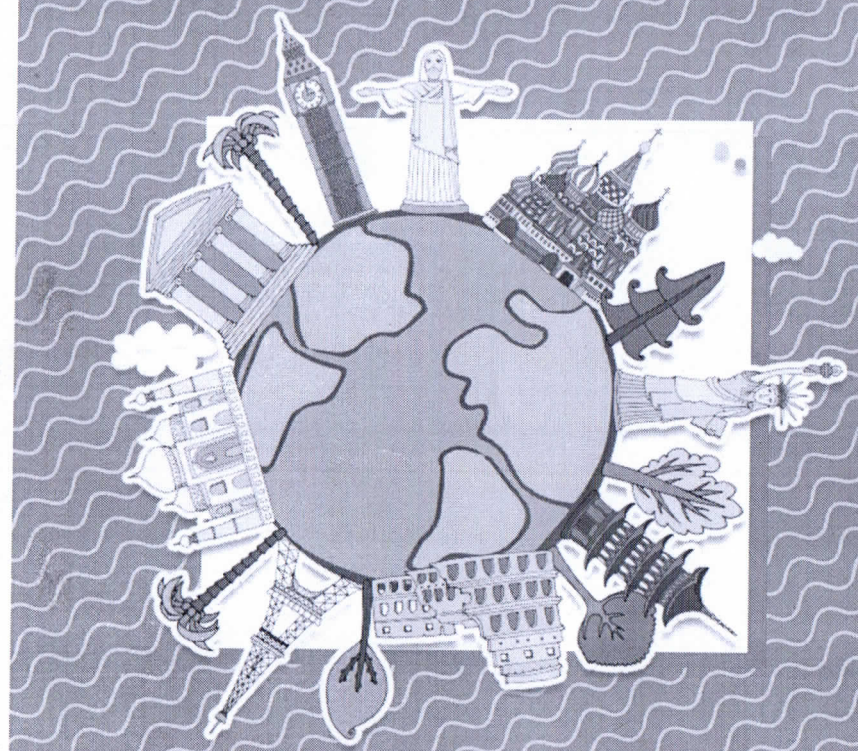

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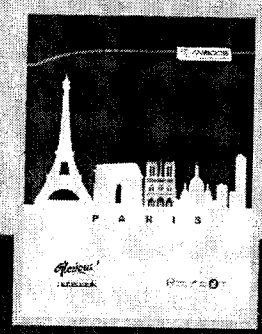

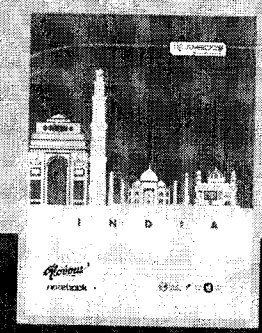

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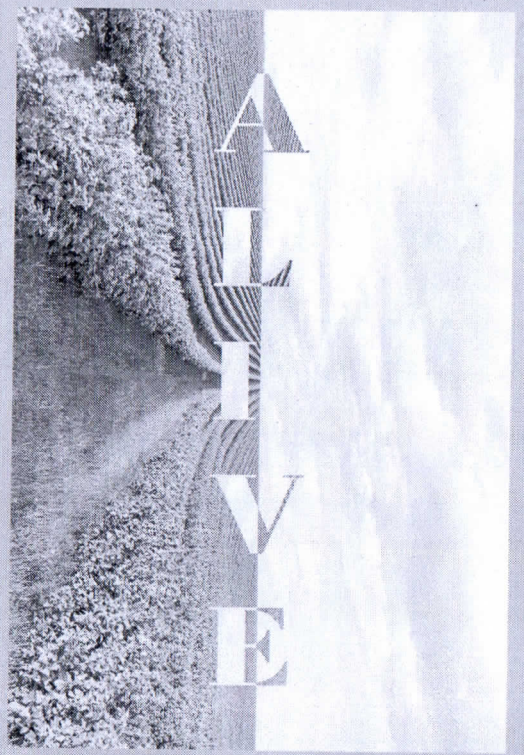

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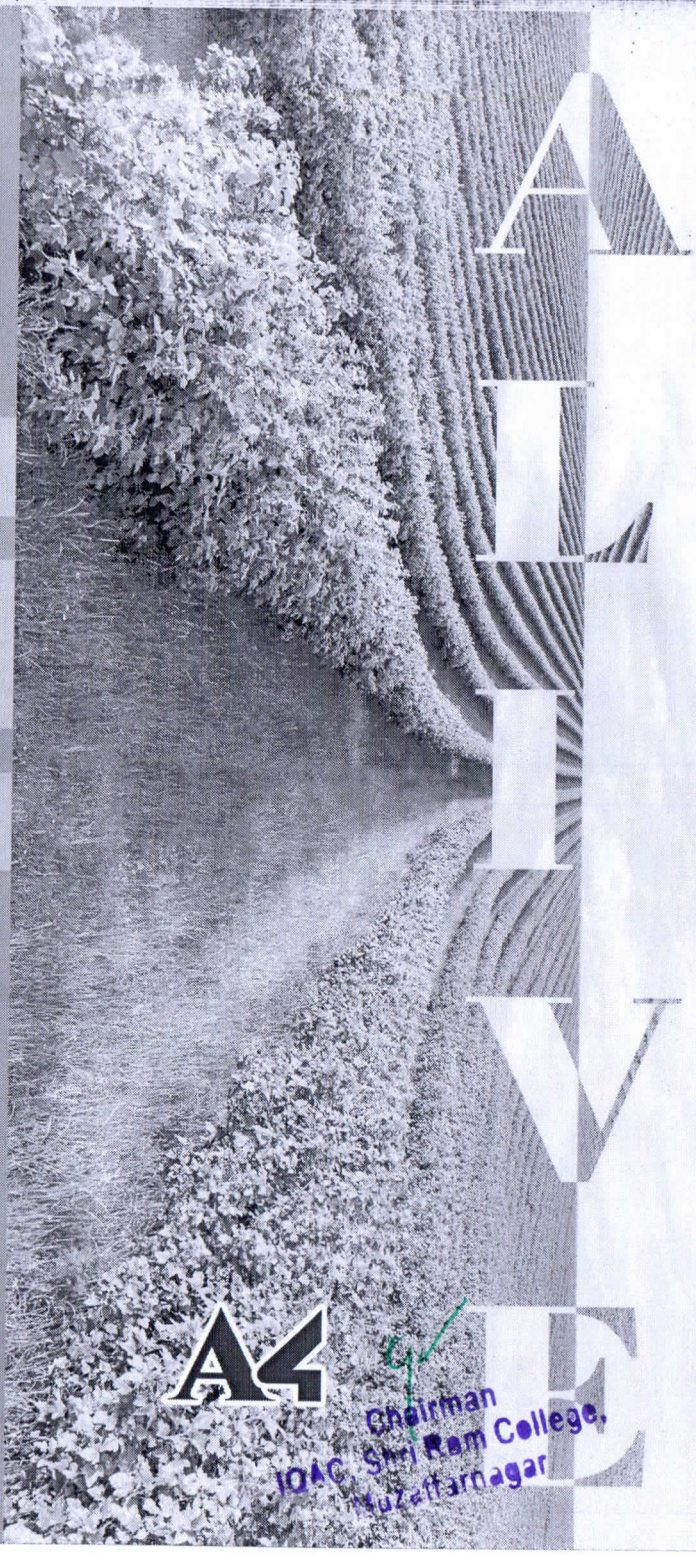

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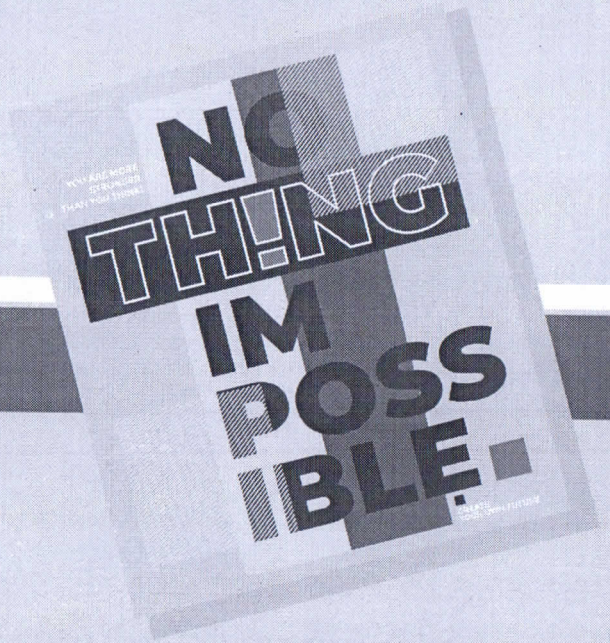

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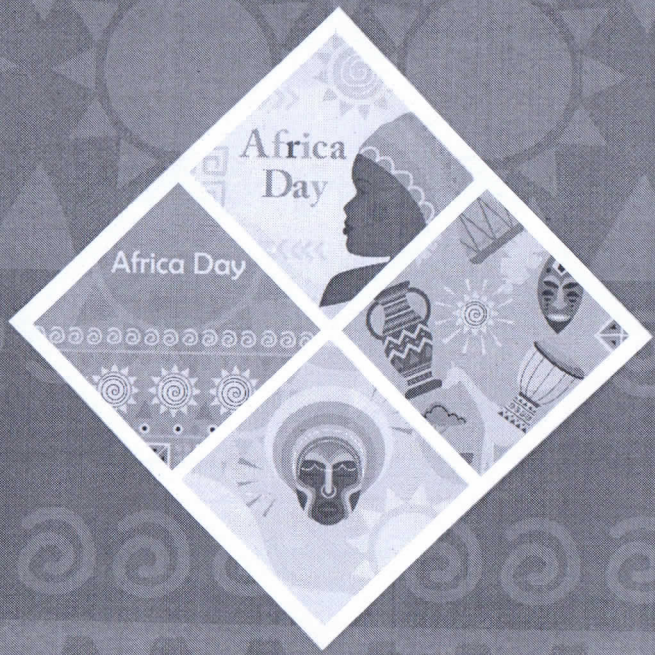

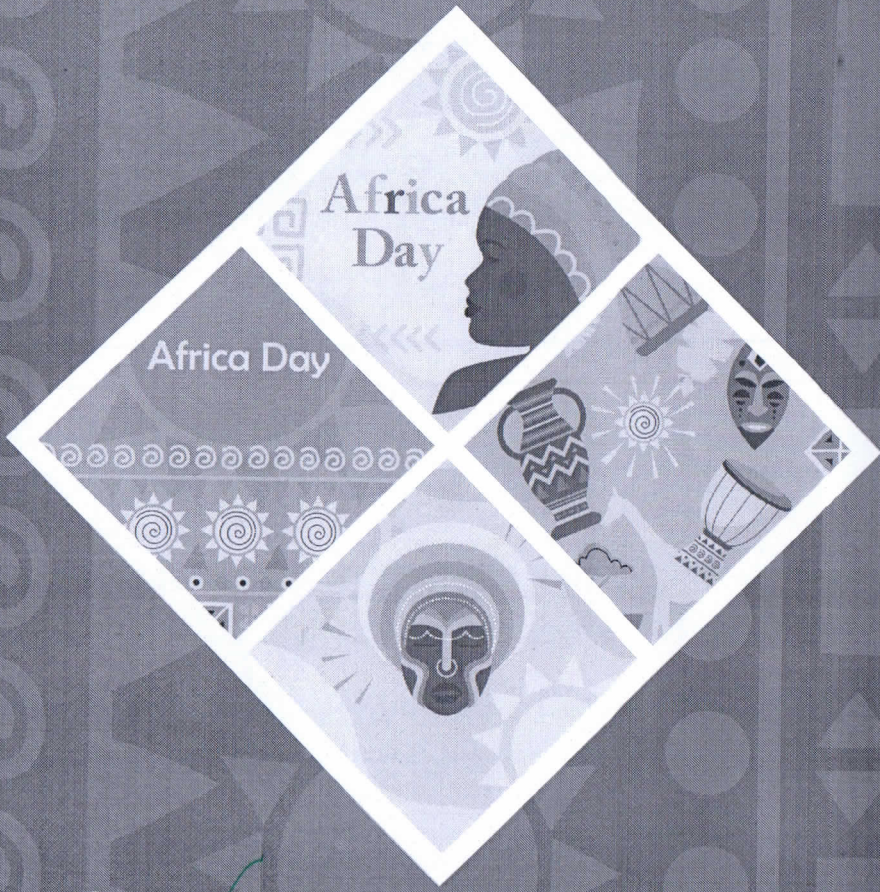

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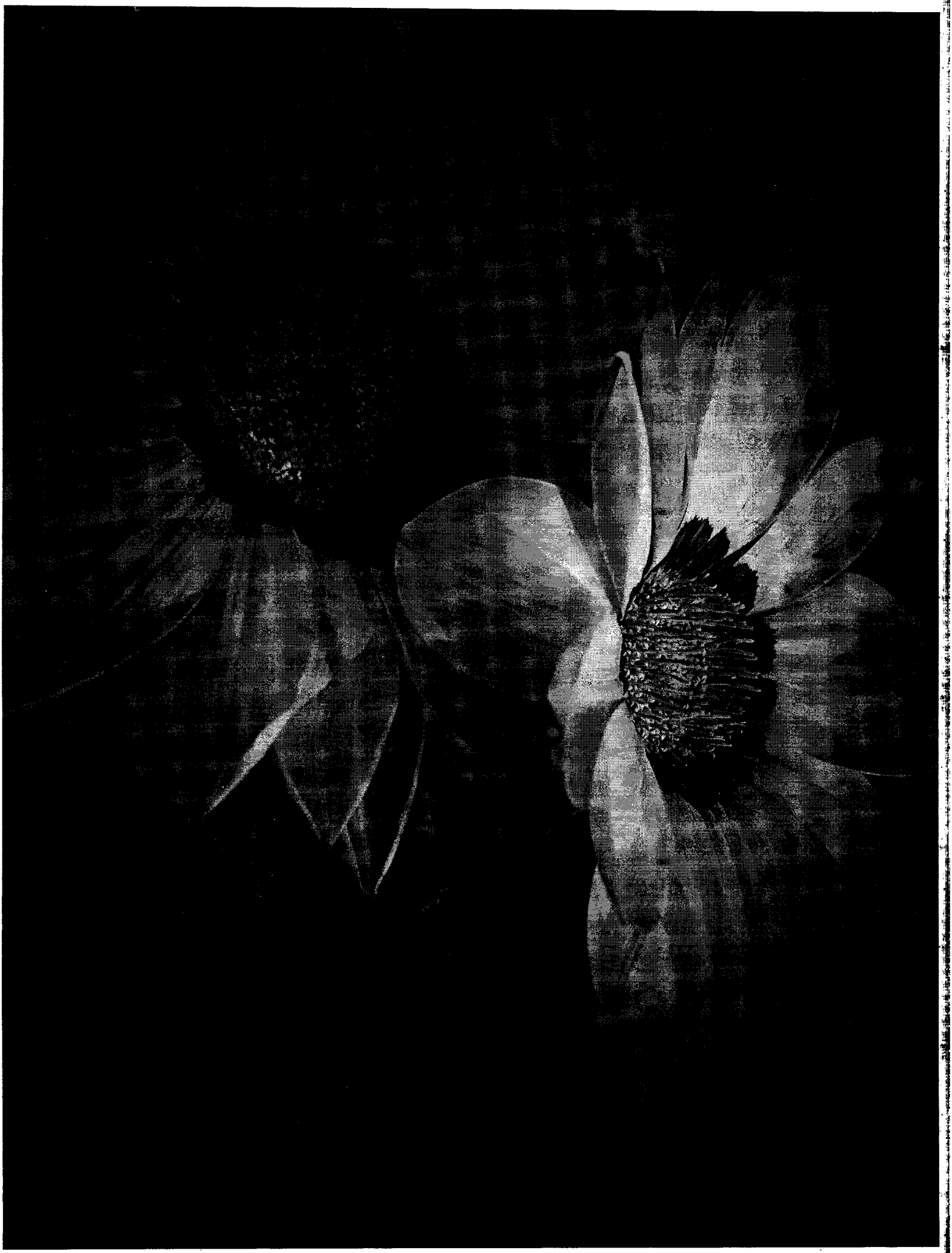

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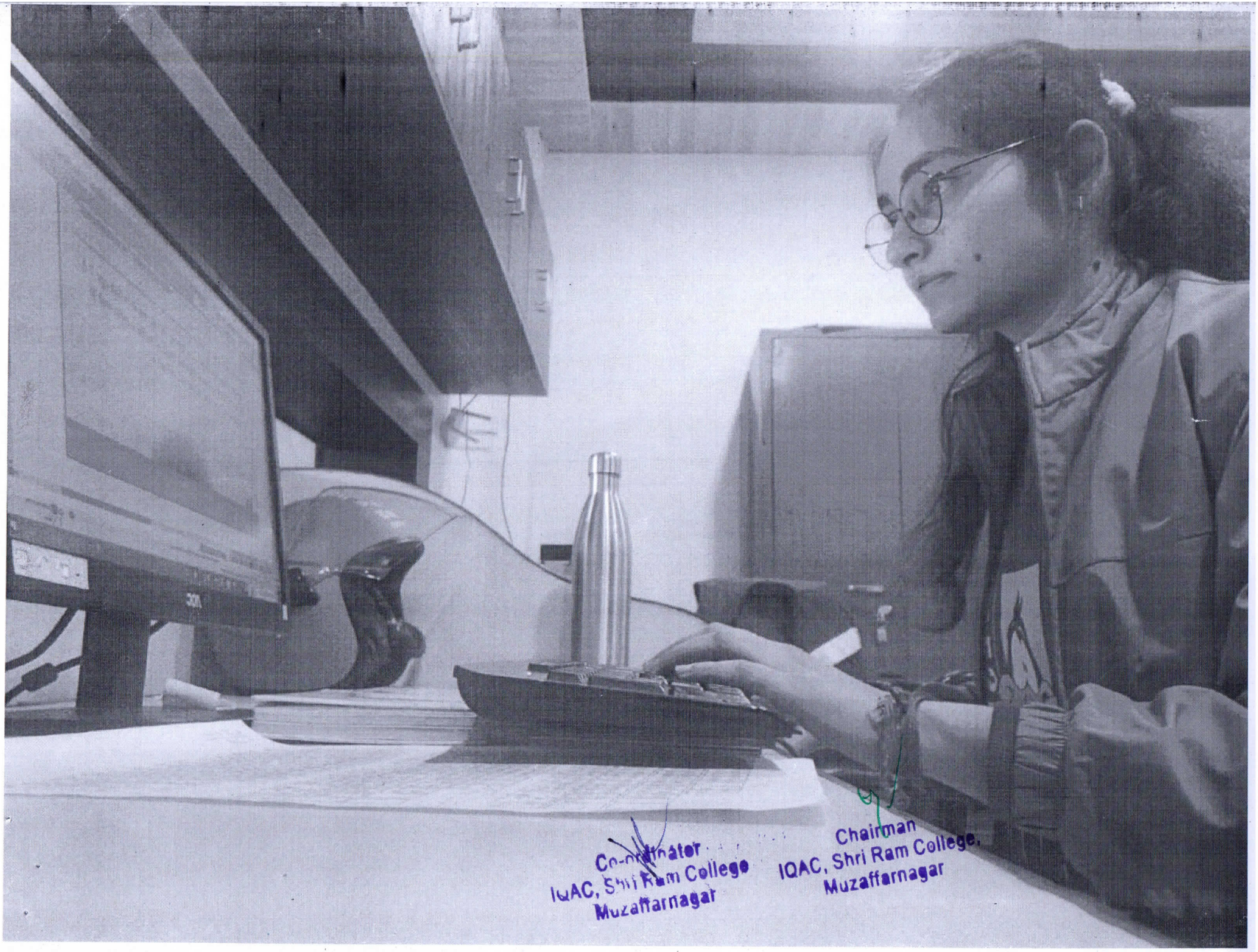
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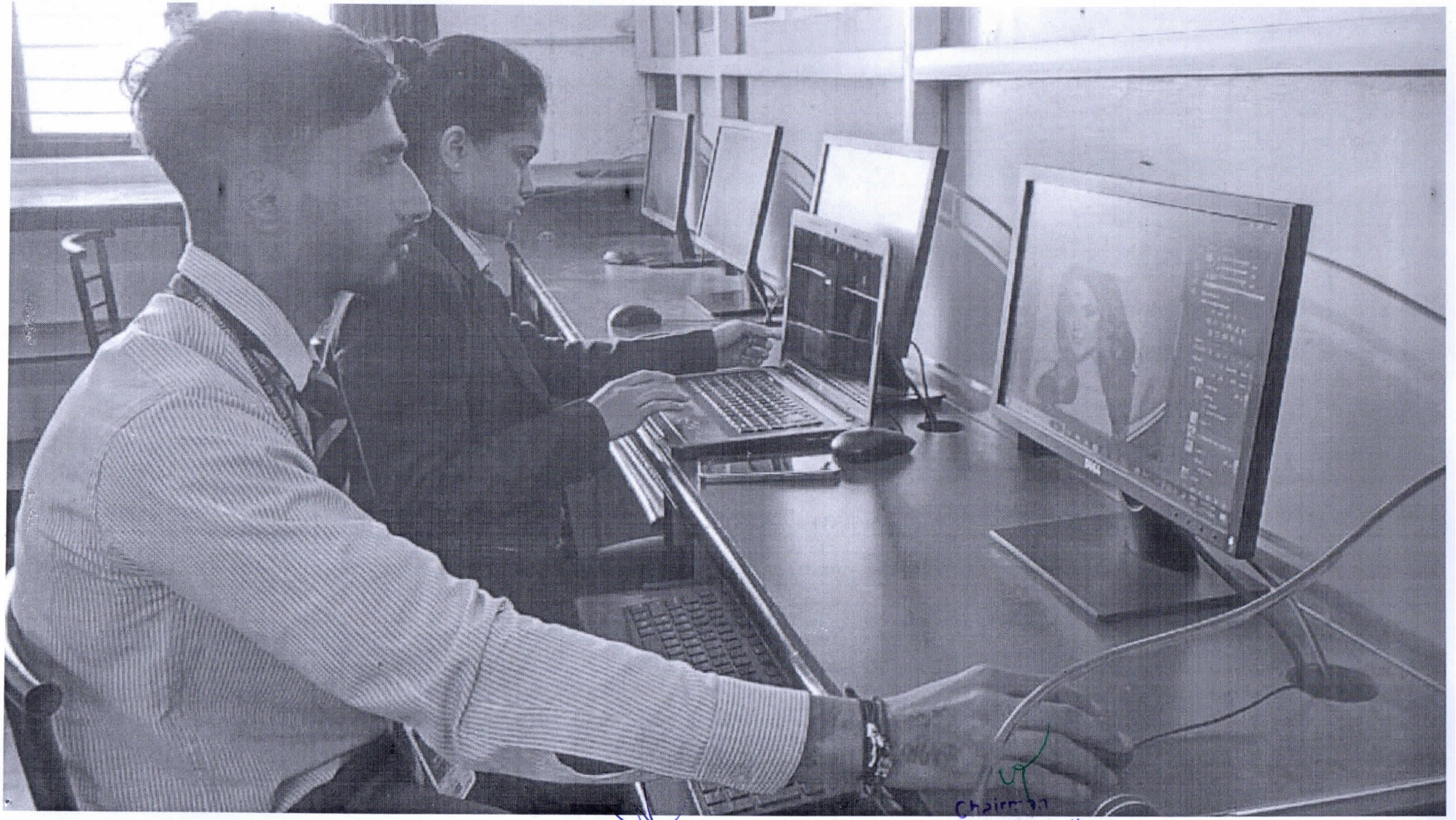

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DEPARTMENT OF AGRICULTURE
SHRI RAM COLLEGE, MUZAFFARNAGAR

Budget Estimation for the project on "Development of Technology to manufacture fiber enriched Coconut milk frozen dessert"

Item	Budget 1st Year
A. Expenditure	
1. Non Consumable Materials	5000
2. Consumable Materials	7,000
3. Printing and Stationary	3,000
4. Travels	1,000
Grand Total	16,000

Project Committee

S.N.	Name	Department	Designation	Signature
1.	**Dr. Nayeem**	Agriculture	Principal Investigator	
2.	**Mr. Yash Malik**	Agriculture Student	Member	
3.	**Mr. Arjun**	Agriculture Student	Member	
4.	**Mr. Vansh Dhama**	Agriculture Student	Member	
5.	**Mr. Anoop**	Agriculture Student	Member	

Director

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DEPARTMENT OF AGRICULTURE
SHRI RAM COLLEGE, MUZAFFARNAGAR

Fund requirement for project

Date:25.08.2021

To

Honorable Director Sir

Shri Ram College, Muzaffarnagar (U.P.)

Subject: Requirement for cash for the project titled: **"Development of Technology to manufacture fiber enriched Coconut milk frozen dessert"**

Respected Sir,

With Due respect, the department is in need to make request of fund from college for bellow mentioned item for our project. Kindly, Cooperate by providing the same.

Principal
Investigator

Co-ordinator
IQAC, Shri Ram College
Muzaffarnagar

Chairman
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Muzaffarnagar

ABSTRACT

The consumers are becoming more and more health conscious; as a result health and wellness concept has added a new dimension to ice cream and frozen dessert. Major competitors have switched over from dairy based ice cream to vegetable fat based ice cream, which is called frozen dessert, as fat happens to be the most expensive ingredient of ice cream. Although coconut is high in saturated fat, but greater proportion is made up of medium chain triglycerides (MTC's), and is burnt for energy rather than stored as body fat. Approximately 50% of the fatty acids in coconut fat are lauric acid, which is antiviral, antibacterial, and antiprotozoal and gets converted inside the human system into Monolaurins– the best fat that mother's milk has. Coconut milk ice-cream brings a ray of hope for nutritionists, to eliminate the problems of health, by providing nutrients at a lower cost to a larger no. of population. With this in view, the present investigation was made with an attempt to manufacture **"Fibre enriched coconut milk frozen dessert"** and adopt a standardized technique for its manufacture, with optimum rate of addition of coconut residue for fiber enrichment, without compromising with its sensory, microbiological and chemical attributes. For control ice cream, mix was standardized to 10% milk fat, solids not fat 12%, sugar 15%, stabilizer 0.3%, and emulsifier0.2%. and experimental coconut milk frozen dessert mix was standardized to 10% fat from coconut milk, 12% serum solids from coconut milk & SMP, 15% sugar, stabilizer & emulsifier 0.5%, the total solids content was adjusted to 37.5%. In addition, shredded coconuts for all the three treatments were added at the rate of 0.2%, 0.4% and 0.6% respectively for fibre enrichment. The product was analyzed for orgaonoleptic attributes like (Flavour & taste, Body & texture, Colour & appearance, Melting resistance) by trained panelist using 9 point hedonic scale. Physico-chemical and microbiological analysis was done for estimating its nutritional content and safety. (Total solids, fat, protein, and SPC & coliform respectively). Based on the statistical analysis of data obtained from various parameters using appropriate statistical tools it can be inferred that the treatment containing 0. 2% level of coconut shreds was at par with control as far as orgaonoleptic attributes are concerned.and treatments containing 0.4% and 0.6% level of coconut shreds were far more superior to control in most of the attributes and comparatively much lower in cost (32 % reduction in cost). Thus the treatments can be rated as $T_3 > T_2 > T_1 = T_0$

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INTRODUCTION

The origin of ice cream goes back to a few centuries; the future of ice-cream seems endless. The popularity of ice-cream is attributed to its refreshingly cool and delightfully sweet characteristics. No wonder then that it has remained immensely popular with children and young people. It is no longer confined to special celebration like birthdays and passing examinations. From occasional outdoor celebrations to an all-family delight is a big leap in ice cream consumption in the country. Thanks to Market liberalization which has come to the land of the Taj Mahal and for Indian consumers; one of life's simple pleasures - enjoying ice cream - just became a lot easier. Ice cream products have a long way to go in this country just shy of a billion populations. With a yearly per capita consumption at 0.12 liters, far less than neighboring Pakistan and Sri Lanka, the expected rise in consumption could provide a vast market. Though ice cream consumption is still limited mostly to urban areas during the summer, but still the market is showing signs of diversification. Following the government's "deverserving" of ice cream products in 1996 and 1997, the industry saw big changes. The domestic dairy cooperative sector entered the market in late 1996, launching a price war that caused many small and medium-sized businesses to leave the market or merge with large-scale producers. Major national brands like Amul, Kwality and Vadilla and Regional players like Mother Dairy, Arun, Joy, Nandini, Naturals, Dinshaw Etc. These larger companies expanded their distribution networks and broadened offerings. ***(Thomson, 1999)***

Major competitors have switched over from dairy based ice cream to vegetable fat based ice cream, which is called frozen dessert. In most cases, this happens because fat happens to be the most expensive ingredient of ice cream. It is also important to observe that vegetable oils/ fats are cheaper and have longer shelf-life thus, use of vegetable oils as a food fat has significant value in economy and in meeting nutritional requirements of country. ***(James, 1996)***

Launch of innovative frozen desserts by Lipton's, backed by a big advertising campaign, gave it a marketing edge in the non-dairy ice cream segment. The Ahmedabad-based Vadilal also has plans to manufacture non-dairy ice creams; their plant is coming up at Ahmedabad in Gujarat with an estimated investment of Rs. 3.87

crores. As is evident from the low per capita consumption level, India's ice cream market is on the threshold of registering unprecedented growth. Some essential policy changes by the Government, as desired by the industry, would facilitate and accelerate this growth. The ice cream prices in India are three times higher than those prevailing in the United States. The entrepreneurs must bring in the latest technology and launch innovative products to capitalize on the business prospects offered by the ice cream market. ***(Bharat, 2005)***

Milk Fat contributes to the food, various orgaonoleptic and Rheological characteristics such as flavour, mouth feel, body texture, etc. This attributes to the richness of the food product. The consumers are becoming more and more health conscious as a result health and wellness concept has added a new dimension to ice cream and frozen dessert. This thesis research was designed to develop a non-dairy frozen dessert containing coconut milk and to determine the consumer sensory characteristics that determine product acceptance and purchase intent. Keeping this in mind an attempt will be made to manufacture coconut milk ice cream / frozen dessert.

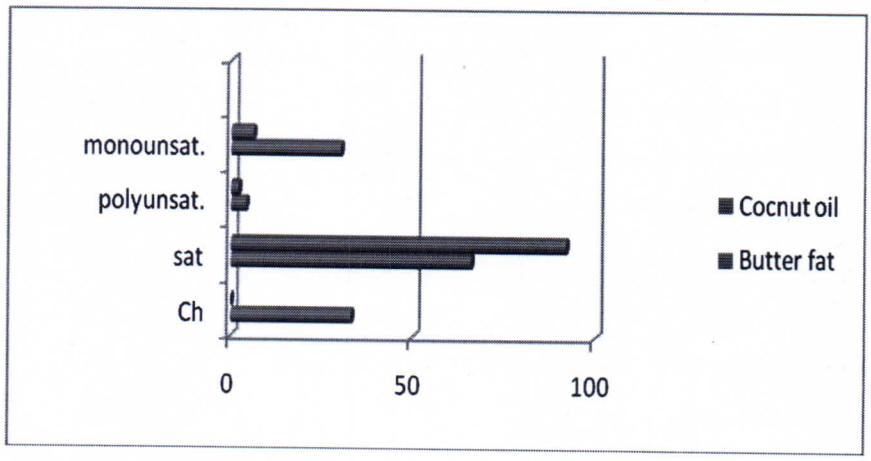
Coconut milks and coconut creams are the products prepared using a significant amount of separated, whole, disintegrated macerated or comminuted fresh endosperm (kernel) of coconut palm (*Cocos nucifera* L.) and expelled, where most filterable fibers and residues are excluded, with or without coconut water, and/or with additional water.***(FAO/WHO)***

Composition:-

It would be expected that the chemical composition of coconut milk would show very wide variations because of differences in factors such as variety, geographical location, cultural practices, maturity of the nut, method of extraction, and the degree of dilution with added water or liquid endosperm (Cancel, 1979). The main carbohydrates present in the coconut milk are sugars (primarily sucrose) and some starch. The major minerals found in raw coconut milk appear to be phosphorous, calcium, and potassium. Freshly extracted milk will very likely contain small amounts of water-soluble B vitamins and ascorbic acid (Gwee, 1997). Based on their solubility characteristics, at least 80% of proteins in coconut endosperm would be classified as albumins and globulins (Balachandran and Arumughan, 1992). These

would also be the predominant proteins in coconut milk. The protein content of undiluted milk ranges from 5 to 10% (on dry basis). Although coconut is high in saturated fat, as saturated fat is made up of fatty acids known as medium chain triglycerides (MTC's), coconut fat is smaller than the standard storage unit and is burned for energy rather than stored as body fat. Approximately 50% of the fatty acids in coconut fat are lauric acid. Lauric acid has been recognized for its unique properties in food use, which are related to its antiviral, antibacterial, and antiprotozoal functions. Another one of the coconut's antimicrobial components is capric acid. This is another medium chain fatty acid that has a similar benefit to lauric acid. Approximately 6-7% of the fatty acids in coconut fat are caprice acid.

Comparison of Dietary Fat:-



Sources: Agriculture Handbook no.8-4 and human nutrition information service, United States Department of Agriculture, Washington, D.C.1979

Saturated fat

If we are concerned about the saturated fat content in coconut milk, this saturated fat has been shown in many independent studies to be a good saturated fat, easily metabolized to give your body quick energy. Contrary to popular myth, it does not transform into bad cholesterol to clog up arteries. In fact, cultures around the world that depend on coconut as their main source of fat have been found to be free of heart disease. The principal fatty acid in coconut milk is lauric acid, which is the same fat found in abundance in mother's milk and is known to promote normal brain development and contribute to healthy bones. It also has important anti-carcinogenic

and anti-pathogenic properties and is less likely to cause weight gain than polyunsaturated oils. The potent anti-viral, anti-fungal and anti-microbial effects of coconut oil have implicated it in the treatment of both AIDS and Candida. Whatever bad things you may have heard or read about coconut milk have not stood up to scrutiny by unbiased food scientists; however, the goodness of coconut milk has not been given equal press because of intensive lobbying against it by the powerful vegetable oil industry. Southeast Asians, meanwhile, have been staying healthy for generations with coconut an integral part of their diet. It acts as a source of a wide range of vitamins, minerals, potassium, foliate and other vital nutrients. Talking about the coconut milk calorie, 1 cup canned coconut milk contains 445 calories, whereas frozen milk contains 485 calories. Raw coconut milk contains the maximum number of calories, which are approximately 552. Coconut milk is available in the market in different styles of packaging like cans and tetra packs. ***(Kasma , 2000)***

High-Fibre, Low-Carbohydrate

There are two types of carbohydrate in foods: digestible and non-digestible. The type of carbohydrate that is of concern to most people is digestible carbohydrate—the starch and sugar in our foods. These are the carbohydrate that the body converts into fat and packs into our fat cells. These are the carbohydrate that, when eaten in excess, contribute to an assortment of health problems such as insulin resistance, obesity, and diabetes. These are the carbohydrate that people on low-carbohydrate diets try to avoid. Non-digestible carbohydrate, on the other hand, is composed of fiber and passes through the digestive tract without being broken down or absorbed and is passed out of the body essentially unaltered. Instead of contributing to health problems like starch and sugar do, fiber promotes good health. Coconut is a natural low-carbohydrate, high-fiber food ideally suited for low-carbohydrate diets. One cup of shredded fresh coconut (80 grams) contains a mere 3 grams of digestible carbohydrate and 9 grams of fiber. The remaining 68 grams consists primarily of water, fat, and protein. Although a piece of fresh coconut may taste sweet, its digestible carbohydrate content is lower, and its fiber content higher than most fruits and vegetables. Coconut has three times as much fiber as it does digestible carbohydrate.

Coconut milk products:

Researchers in the Phillipines have been at the forefront of efforts to develop new dairy foods using a combination of skim (cow's) milk and coconut milk **(Davide *et al.*, 1990).** Amongst the products developed, flavored filled milk beverages, soft and blue cheeses, and low fat fruit yogurt appear to show good commercial potential. Other products that have been developed over the years include soy/coconut milk, a butter-like product, and a Lactobacillus fermented beverage. The addition of certain levels of coconut milk has also been suggested as a simple, but effective means of increasing the caloric density of tofu without affecting the acceptability of the product **(Escueta et al., 1985).**

Coconut milk frozen dessert brings a ray of hope for nutritionists, to eliminate the problems of health, by providing nutrients at a lower cost to a larger no. of population. Under these circumstances and with current technical knowledge, replacing butter fat with coconut milk would be one of the best solutions to produce cheaper, nutritive, healthy and acceptable frozen dessert.

OBJECTIVES

1. To standardize a technique for the manufacture of fiber enriched coconut milk frozen dessert.
2. To find out the rate of addition of coconut residue for fiber enrichment of coconut milk frozen dessert in order to produce most acceptable frozen dessert.
3. To evaluate frozen dessert for its Orgaonoleptic, Chemicals, Microbiological quality.
4. To study the cost of production.

Review of Literature

The review of literature is broadly presented under the following sub heading.

- Statistical details on coconut and ice cream production in India and abroad.
- Per capita consumption of ice cream in India and abroad
- Standards for frozen dessert.
- Regulations governing the definition of the term coconut milk, coconut cream and coconut water.
- Different type of coconut milk and there composition.
- Process of extracting coconut milk.
- Stability of coconut milk.
- Dietary fiber.
- Utilization of coconut milk in different products.
- Medium vs. Long Chain Saturated Triglycerides
- Myth and health benefits of coconut oil.
- Report on claimed health benefits on the basis of Clinical trials

➢ Statistical details on ice cream and coconut production in India and abroad.

Marcose V.T. (1995) reported that the processing possibilities of coconut are discussed with reference to India. Information is presented on the trends in area, production and productivity, and the role of the coconut industry to the Indian economy. The processing sector of coconut is currently restricted to: copra production, oil extraction, manufacturing using coir products, and the production of desiccated coconut.

Nadanasabapathy *et al.* (1999) reported an introduction to the Indian coconut industry, recent research and development efforts in to developing new products and

more efficiently utilizing byproducts are outlined. An overview of coconut based products is presented looking at both products based on coconut water. The particular reference is made to coconut burfi, coconut chutney, and tender coconut water.

Thomson (1999) reported that the popularity of ice-cream is attributed to its refreshingly cool and delightfully sweet characteristics. No wonder then that it has remained immensely popular with children and young people. It is no longer confined to special celebration like birthdays and passing examinations. From occasional outdoor celebrations to an all-family delight is a big leap in ice cream consumption in the country. Thanks to Market liberalization which has come to the land of the Taj Mahal and for Indian consumers; one of life's simple pleasures - enjoying ice cream - just became a lot easier. Ice cream products have a long way to go in this country just shy of a billion populations. With a yearly per capita consumption at 0.12 liters, far less than neighboring Pakistan and Sri Lanka, the expected rise in consumption could provide a vast market. Though ice cream consumption is still limited mostly to urban areas during the summer, but still the market is showing signs of diversification. Following the government's "deverserving" of ice cream products in 1996 and 1997, the industry saw big changes. The domestic dairy cooperative sector entered the market in late 1996, launching a price war that caused many small and medium-sized businesses to leave the market or merge with large-scale producers. Major national brands like Amul, Kwality and Vadilal and Regional players like Mother Dairy, Arun, Joy, Nandini, Naturals, Dinshaw Etc. These larger companies expanded their distribution networks and broadened offerings.

Sherman P. (2003) the proceeding of the 2nd International symposium on ice cream, under the auspices of the International Dairy Federation, will by it self establish the present state of ice cream science and technology in 2003.

Bharat Bhushan (2005) reported that India's ice cream market is valued at Rs. 2400 crores per annum of which the organized sector accounts for Rs. 950 crores. It has emerged as the fastest growing dairy favourite in the Asia pacific region. The major players in India are: GCMMF's Amul, NDDB's Mother dairy, Hindustan lever's kwality walls, vadilal, Baskin Robbins, Dinshaw and Hatsun's Arun. The rest

of the cone is filled up by regional brands. Almost all the state co-operative dairy federations in the country are also manufacturing and marketing ice cream under their own brand names. The import of ice cream is permitted unrestricted but attracts duty. The non organized sector though accounts for 60 % of the Indian ice cream market; it is shrinking considerably in the urban areas. However in rural areas, kulfis/ice creams made by small/cottage industry are popular. In small towns and villages, there are thousands of small player who produced ice cream/kulfis and cater to the local demand. The market for organized sector is restricted to large metropolitan cities. Eight cities account for 60 percent of India's total ice cream consumption. One notable shift in the consumption pattern form impulse purchase by youngsters as fun food to its regular use as dessert. Thus, the sale of ice cream bricks is increasing. The share of take-home sector over five years (till 2005) has increased from 48 percent to 53 percent.

➢ Per captia consumption in India and abroad

Bharat Bhushan (2005) reported that India's per captia consumption of ice cream is just 500 ml compared to an estimated 30 liters in the US and 1.2 liters in China. So, in India there is enough scope for more growth than the 8 to 10 percent observed over the past few years.The government of India dereserved the production of ice cream in 1996-97. Earlier the manufacture of ice cream was reserved for the small scale sector. This move has encouraged high investment from medium and large scale sector and helps the market grow. The country is western region has a much higher consumption than the all India average. Almost 35 percent of the ice creams sold in the country are consumed in the western region with Mumbai being the main market, followed by 30 percent in the north, 20 percent in the south and 15 percent in the eastern and central India. Delhi and Gujarat together account for 30 percent of the country's ice cream market. The kolkata market is the largest for ice cream in the eastern region. The ice cream prices in India are reported to be three times higher than the prices prevailing in America. One reason is the legal requirement in India stipulating at least 10 percent milk fat in ice cream. This standard needs to be reviewed to bring down the ice cream price for increasing its consumption. Another inflationary factor is the high cost of transportation, particularly the refrigerated type. Taxes also contribute to high prices of ice cream. Absence of a nationwide efficient

Materials and Methods

The experiment "Development of Technology to manufacture fiber enriched Coconut milk frozen dessert" was conducted in the Student Training & Dairy Laboratory of Shri ram College, Muzaffarnagar.

Method of extracting coconut milk:-

For each trial, coconut milk was extracted from coconut ball (10-12 months old) obtained from local market and milk collected after a process of cutting, grinding and squeezing coconut meat with the help of mixer, juicer and muslin cloth.

- The eyes of fresh coconut are penetrated and liquid was drained and coconut was placed a clean sanitized vessel.
- Fresh coconut was removed and broken in to pieces with help of hammer an hence the shell broken in to several pieces.
- All the coconut meat was removed from the cell brown skin was placed of and the meat was cut in to the very small cubes.
- The meat was placed in the blender and the blended by adding hot water till it was finally grated.
- The liquid was extracted from the coconut meat by placing the coconut meat in a cheese cloth by squeezing the content with the hand.
- The squeezed coconut meat was discarded and the coconut milk was refrigerated.

Material required:-

Fresh coconut

Sugar

Stabilizer

Skim Milk Powder

Shredded coconut

Emulsifier

Procurement and collection of ingredients:-

Whole milk and skim milk:- It was procured from the local market of Muzaffarnagar.

Coconut:- Fresh coconut was procured from the local market of Muzaffarnagar.

Skimmed milk powder:- Skimmed milk powder manufactured by Lipton India Limited sold under the brand name 'Anik spray' was procured from the local market of Muzaffarnagar.

Sugar: - This was procured from the local market of Muzaffarnagar.

Flavor:- Coconut flavor manufactured by IFF (Indian Flavor and Fragrance) under the brand name 'Bush' was procured from the local market of Muzaffarnagar.

Stabilizer:- Carrageenan was procured from the local market of Muzaffarnagar.

Emulsifier:-Monoglycerides or diglycerides were procured from the local market of Muzaffarnagar.

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The Procedure Adopted for the Preparation of Fiber Enriched Coconut Milk Frozen Dessert.

For control ice cream, mix was standardized to 10% milk fat, solids not fat 12%, sugar 15%, stabilizer 0.3%, and emulsifier0.2%.

For experimental coconut milk frozen dessert, mix was standardized to coconut milk fat10%, 12% serum solids from coconut milk & SMP, sugar 15%, stabilizer & emulsifier 0.5%. In addition, shredded coconuts for all the three treatments were added at the rate of 0.2%, 0.4% and 0.6% respectively for fibre enrichment.

T_0(control) → Ice cream mix, standardized to 10% milk fat, serum solids 12%, sugar 15%, carrageenan 0.3% and emulsifier (GMS) 0.2%.

T_1→ Frozen dessert mix was standardized to 10% fat from coconut milk, 12% serum solids from coconut milk & SMP, 15% sugar, 0.3% carrageenan and 0.2% emulsifiers (GMS). Dessert was prepared with the addition of 0.2% shredded coconut for fibre enrichment.

T_2→ Frozen dessert mix was standardized to 10% fat from coconut milk, 12% serum solids from coconut milk & SMP, 15% sugar, 0.3% carrageenan and 0.2% emulsifiers (GMS). Dessert was prepared with the addition of 0.4% shredded coconut for fibre enrichment.

T_3→ Frozen dessert mix was standardized to10% fat from coconut milk, 12% serum solids from coconut milk & SMP, 15% sugar, 0.3% carrageenan and 0.2% emulsifiers (GMS). Dessert was prepared with the addition of 0.6% shredded coconut for fibre enrichment

FLOW DIAGRAM

For control ice cream

Mix liquid ingredients - milk+ cream

⇩

Mix dry ingredients - skim milk powder+ sugar+ stabilizer+ emulsifier

⇩

Standardized the mix for T_0

⇩

Heated to (60-62^{0}C) in a double jacketed vat

⇩

Homogenization in first stage (150 Kg/cm^2) and second stage (50 kg/cm^2)

⇩

Pasteurization (68.3^{0}C/30min) in double jacketed vat

⇩

Cooling to (5^{0}C)

⇩

Ageing (5^{0}C /3-4 hrs)

⇩

Freezing (-3 to -4^{0}C)

⇩

Packaging (in cups)

⇩

Hardening (-16 to -23^{0}C)

A calculated amount of milk and cream was placed in a stainless steel bucket with a stainless steel plunger and heated by placing bucket in a steam-jacketed vat containing water.

FLOW DIAGRAM

For Experimental Coconut Milk Frozen Dessert

Mix liquid ingredient - coconut milk

⇩

Mix dry ingredients - skim milk powder+ sugar+ stabilizer+ emulsifier + Shredded coconut

⇩

Standardized the mix for T_1, T_2 & T_3

⇩

Heated to (60-62^{0}C) in a double jacketed vat

⇩

Homogenization in first stage (150Kg/cm^2) and second stage (50kg/cm^2)

⇩

Pasteurization (68.3^{0}C/30min) in double jacketed vat

⇩

Cooling to 5^{0}C

⇩

Ageing (5^{0}C /3-4 hrs)

⇩

Addition of flavor (coconut)

⇩

Addition of shredded coconut for T_1, T_2 &T_3 @ 0.2, 0.4& 0.6%

⇩

Freezing (-3 to -4^{0}C)

⇩

Packaging (in cups)

⇩

Hardening (-16 to -23^{0}C)

A calculated amount of coconut milk was placed in a stainless steel bucket with a stainless steel plunger and heated by placing bucket in a steam-jacketed vat containing water.

Ice cream (T_0) Calculated amount of dry ingredient like skim milk powder, sugar, stabilizer and emulsifier was added before the temperature reached to 48-49^{0}C and thoroughly stirred the contents.

Experimental (coconut frozen dessert)

2.1 A calculated amount of coconut milk was taken in a stainless steel bucket with a stainless steel plunger and heated till temperature reaches to 48-49^{0}C.

2.2 The calculated amounts of dry ingredients like skim milk powder, sugar, stabilizer and emulsifier was gradually added in the emulsified mixture at 60-62^{0}C to get the desired composition.

3. Homogenization:

The ice cream mixes for control and experimental coconut milk frozen dessert were homogenized at 150kg/cm^2 in first stage and 50kg/cm^2 in 2nd stage at 60-62^{0}C using a Nonton Gaulin two stage homogenizer.

4. Pasteurization:

The control and experimental frozen dessert mixes was pasteurized at 68.3°C for 30min. by batch method. Pasteurization was done after homogenization to avoid any contamination that could be caused by the homogenizer (Hammer 1948) and to avoid lipolysis of fat during ageing period (Trout 1950).

5. Cooling: Mix was cooled to 5^{0}C.

6. Ageing: Ageing of mix was done at 5^{0}C for 3-4 hours.

7. Freezing of ice cream and frozen dessert mixes.

7.1 Equal quantity of coconut flavor (8-9 ml) was added in the lots of ice cream and frozen dessert mixture .shredded coconut powder was added in treatments @ 0.2%, 0.4% & 0.6%.

7.2 The mixes were frozen in a mechanically operated batch freezer having air injection system. The temperature at which frozen mix was taken out from the freezer was -4^{0}C to -5^{0}C.

7.3 The frozen ice cream was filled in long ice cream containers and kept in deep freezer for hardening at a temperature of -16 to -24^{0}C.

Analysis of coconut milk frozen dessert:

The different samples of coconut milk frozen dessert in treatment were analyzed for –

Chemical Analysis

Percent fat content.

Percent total solids

Percent protein

Percent acidity

Percent overrun.

Microbiological Analysis

Standard plate count (SPC)

Coliform test

Orgaonoleptic quality

1) Flavour & taste
2) Body & texture
3) Colour & appearance
4) Melting resistance

Number of treatments	-	4
Number of replications	-	10
Total number of samples	-	40

The data collected were statistically analyzed using analysis of variance technique.

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Analysis of sample

Sampling

According to Codex General Guidelines on Sampling.

1. **Determination of total solids**

   According to AOAC 925.23A (IDF-ISO-AOAC Method).

2. **Determination of total fat**

   According to AOAC 945.48G (Rose-Gottlieb Method)

3 **Determination of non-fat solids**

   Determine by difference of total fat from total solids

5. **Determination of moisture**

   Determine by difference of total solids from a numerical value of 100.

6. **The Fat percentage in cream**

   The fat percentage of cream was determined as per I.S.1224 (1958).

7. **Moisture percentage in skim milk powder**

   The moisture percent in skim milk powder was determined as per I.S.1165 (1957).

8. **Sampling of ice cream & frozen dessert**

   The technique followed for sampling of ice cream for analysis was as per I.S.2802 (1964).

Percent over run

The percent over run was determined as per IDD Manual in Dairy Technology (1972).

Freezing time

The total time taken for freezing was determined by noting time when freezing was started up to the time the mixture was taken out from the freezer and then taking their difference.

Fat percent in ice cream & frozen dessert

The fat percent in ice cream was determined as per I.S.2802 (1964).

Total solids in ice cream & frozen dessert

The percent total solid in ice cream was determined as per I.S.: 2802 (1964).

Statistical Analysis:-

The data that would be obtained from the chemicals and sensory analysis would be analyzed using suitable statistical method.

ORGANOLEPTIC EVALUATION

Judging panel

Five experienced staff members of the Dairy Technology Department served as a judging team and evaluated the samples of control and experimental frozen dessert. Numerical scores were allocated for flavor, body and texture, melting quality and color of the ice cream. The numerical score was used as an indication of the quality. The Judges also identified qualities they considered to be unsatisfactory.

STATISTICAL ANALYSIS:-

The data were analyzed using, analysis of variance technique of Chancel (1972).

SCORE CARD FOR SENSORY EVALUATION OF COCONUT MILK FROZEN DESSERT

Name- Arvind Kumar Rawat

Please place scores in the space provided. Defects observed in the product may be expressed critically in the column of remark.

GUIDELINES

Examine the body of the sample

Examine the texture of the sample

Examine the flavour of the sample

Examine the colour and appearance of the sample

Hedonic ratings	Scores
Like extremely	9
Like very much	8
Like moderately	7
Like slightly	6
Neither like nor dislike	5
Dislike slightly	4
Dislike moderately	3
Dislike very much	2
Dislike extremely	1

Sample no.	Score			Melting Resistance	Remarks
	Flavour	Body and Texture	Colour and Appearance		
T_0					
T_1					
T_2					
T_3					

Date ----------

Signature ----------

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RESULT & DISCUSSION

The present study was based to evolve "Development of Technology to Manufacture Fiber Enriched Coconut Milk Frozen Dessert" The data collected on different aspects were tabulated & analyzed statistically. The results obtained from the analysis are presented in this chapter.

Control ice cream & experimental coconut milk frozen dessert samples of different treatments were evaluated for their orgaonoleptic quality.

The data were further analyzed statistically using the methods of analysis of variance & critical difference. The significant & non-significant differences observed have been analyzed critically within & between the treatment combinations. The data obtained were summarized in this chapter.

4.1 Fat percent in ice-cream

The data regarding fat percent in coconut milk frozen dessert sample of different treatments are presented in table **1-A** and analysis of variance (ANOVA) for the same is given in table **1-B**. Following observations were made:

1. In general, the fat percentage in samples of coconut milk frozen dessert in different treatments and control ranged from 10.00-12.10 and 9.80-11.50 respectively.

2. The mean fat percentage in coconut milk frozen dessert samples of control (T_o) and T_1, T_2, T_3 was 10.28, 10.56, 10.75 &10.88 respectively.

3. The differences in the fat percentage of coconut milk frozen dessert between treatments and control were non-significant.**(table 1-B)**

4. The differences in the fat percentage of coconut milk frozen dessert between T_1, T_2, T_3 were non significant (c.d-0.62)

From the perusal of data on fat percentage in coconut milk frozen dessert samples of different treatments and control furnished in table **1-A** and figure **4.1**, it was noted that highest mean fat percentage was recorded in the coconut milk frozen dessert sample of T_3 (10.88) followed by T_2 (10.75), T_1 (10.56) and T0 (10.28).

However the differences in these values were found non significant indicating by their non significant effect on treatments in the fat content between samples of different treatments.

5. Nevertheless the mean fat content in the samples of treatment was found significantly higher than the control (10.28)

4.2 Total solids percentage

The data regarding total solids (T.S) percentage in samples of coconut milk frozen dessert of control and treatments are presented in table **2-A** and ANOVA of the same is given in table **2-B**. The following observations were made:

1. T.S percentage in coconut milk frozen dessert samples of T_o, T_1, T_2 and T_3 ranges from 37.10 to 37.50, 37.30 to 37.80, 37.60 to 37.38 and 37.80 to 38.40 respectively.

2. The mean T.S percentage in coconut milk frozen dessert samples of T_o, T_1, T_2 and T_3 was 37.26, 37.52, 37.84 and 38.11 respectively.

3. The differences in the T.S percentage of coconut milk frozen dessert samples between control and treatments were significant. **(Table 2-B).**

The perusal of data T.S percentage in ice-cream samples contained in Table **2-A** and figure **4.2** indicated that among the treatments the highest T.S percentage in ice-cream was observed in T_3 (38.11) followed by T_2 (37.84), T_1 (37.52) and T_0 (37.26). Since differences in the T.S. percentage in samples of ice-cream were found significant, hence it indicated a significant influence of the treatments on these parameters.

4. It is therefore concluded from the Table **2-A** that the difference in total solids content of coconut milk frozen dessert was significant (T_0, T1), (T_0, T2), (T_0, T3), (T_1, T_2) and (T_1, T3) but there was no significant difference between (T_2, T3).

5. Nevertheless the mean total solids content in the samples of treatment was significantly higher than the control (37.26).

4.3 Protein percentage

The data regarding protein percentage in samples of coconut milk frozen dessert of control and treatments are presented in table **3-A** and ANOVA of the same is given in table **3-B**. The following observations were made:

1. Protein percentage in coconut milk frozen dessert samples of T_o, T_1, T_2 and T_3 ranged from 3.20 to 3.80, 3.70 to 4.40, 3.70 to 4.60 and 3.60 to 4.40 respectively.

2. The mean protein percentage in coconut milk frozen dessert samples of T_o, T_1, T_2 and T_3 was 3.45, 4.01, 3.99 and 3.99 respectively.

3. The difference in the protein percentage of coconut milk frozen dessert samples between control and treatments were significant **(Table 3-B).**

The perusal of data on protein percentage in coconut milk frozen dessert samples contained in Table **3-A** and figure **4.3** a indicates that among the treatments highest protein percentage in coconut milk frozen dessert was observed in T_1 (4.01) followed by T_3 (3.99), T_2 (3.99) and T_0 (3.45).Since differences in the protein percentage in samples of coconut milk frozen dessert were found significant, it indicates a significant influence of the treatments on these parameters.

4. It is concluded from the table **3-C** that the difference in protein content of control and treatments of coconut milk frozen dessert was significant between (T_0, T_1), (T_0, T_2), and (T_0, T_3) but there was no significant difference between (T_1, T_2), (T_1, T_3) and (T_2, T_3).

5. Nevertheless the mean protein content in the samples of treatments was found significantly higher than the control (3.45).

4.4 Acidity percentage

The data regarding acidity percentage in samples of coconut milk frozen dessert of control and treatments are presented in table **4-A** and ANOVA of the same is given in table **4-B**. The following observations were made:

1. Acidity percentage in coconut milk frozen dessert samples of T_o, T_1, T_2 and T_3 ranges from 0.206 to 0.218, 0.182 to 0.192, 0.140 to 0.149 and 0.176 to 0.181 respectively.

2. The mean acidity percentage in coconut milk frozen dessert samples of T_o, T_1, T_2 and T_3 was 0.21, 0.19, 0.14 and 0.18 respectively.

3. The difference in the acidity percentage of coconut milk frozen dessert samples between control and treatments were significant **(Table 4-B).**

The perusal of data on acidity percentage in coconut milk frozen dessert samples contained in Table **4-A** and figure **4.4** indicated that among the treatments the highest acidity percentage in coconut milk frozen dessert was observed in T_0 (0.21) followed by T_1 (0.19), T_3 (0.18) and T_2 (0.14). Since differences in the acidity percentage in samples of coconut milk frozen dessert were found significant, it indicated a significant influence of the treatments on these parameters.

4. It is evident from the table **4-C** that the difference in acidity content of control and treatments in coconut milk frozen dessert between (T_0, T_1), (T_0, T_2), (T_0, T_3) (T_1, T_2) and (T_1, T_3) but there was no significant difference between (T_2, T_3).

5. Nevertheless the mean acidity content in the samples of treatments was found significantly less than the control (0.21).

4.5 Over run in ice cream

The data regarding over run percentage in samples of coconut milk frozen dessert of control and treatments are presented in table **5-A** and ANOVA of the same is given in table **5-B.** The following observations were made:

Over run percentage in coconut milk frozen dessert samples of T_o, T_1, T_2 and T_3 ranged from 80 to 83, 80 to 83, 79 to 83 and 79 to 83 respectively.

The mean over run percentage in coconut milk frozen dessert samples of T_o, T_1, T_2 and T_3 was 81.30, 81.80, 81.20 and 80.30 respectively.

The difference in the overrun percentage of coconut milk frozen dessert samples between control and treatments were non significant **(Table5-B).**

The perusal of data on over run percentage in coconut milk frozen dessert samples contained in Table **5-A** and figure **4.5** indicated that the over run percentage in general, irrespective of treatment ranged from 79-83. The highest mean over run percentage of the ice-cream was observed in T_1 (81.8) followed by the coconut milk frozen dessert in T_0 (81.3), T_2 (81.2) and T_3 (80.3). Since differences in the over run percentage in samples of coconut milk frozen dessert were found significant, it indicated a significant influence of the treatments on this parameters.

It is therefore concluded from the table **5-C** that there was significant difference in overrun content of coconut milk frozen dessert between T_1, $T_2$and T_3 but it is interesting to note that over run percentage of the three treatments T_1, T_2 and T_3 were at par with control T_0 since there was no significant difference between them.

Nevertheless the coconut milk frozen dessert of T_1 registered significantly higher percentage of overrun than control (T_0) which indicated that coconut milk frozen dessert of this treatment was superior compared to that of control.

4.6 Standard plate count (SPC) in ice-cream

The data regarding SPC in samples of coconut milk frozen dessert of control and treatments are presented in table **6-A** and ANOVA of the same is given in table **6-B**. The following observations were made

SPC in coconut milk frozen dessert samples of T_o, T_1, T_2 and T_3 ranged from 20 to 24, 24 to 24, 25 to 29 and 24 to 28 respectively.

The mean of SPC in coconut milk frozen dessert samples of T_o, T_1, T_2 and T_3 was 21.80, 26.60, 26.90 and 26.10 respectively.

The difference in SPC of coconut milk frozen dessert samples between control and treatments were significant **(Table 6-B)**.

The perusal of data on SPC in coconut milk frozen dessert samples contained in Table **6-A** and figure **4.6** indicated that among the treatment the highest SPC in ice-cream was observed in T_2 (26.90) followed by the coconut milk frozen dessert in T_1 (26.60), T_3 (26.10) and T_0 (21.80). Since differences in the SPC in samples of coconut milk frozen dessert were found significant, it indicated a significant influence of the treatments on this parameter.

It is evident from the table **6-C** that the difference in the scores for SPC of ice-cream coconut milk frozen dessert was significant between (T_0, T_1), (T_0, T_2) and (T_0, T_3) but there was no significant difference between (T_1, T_2) and (T_1, T_3) and (T_2, T_3).

Nevertheless the coconut milk frozen dessert of T_1 registered significantly higher content of overrun than control (T_0) which indicated that coconut milk frozen dessert of this treatment was superior compared to that of control.

4.7 Coliform test

It is evident from the Table **7-A** that the coliform test control and experimental coconut milk frozen dessert sample was 100 percent negative. Table **4.7(B)** shows gram-ve (Gram negative bacteria) result, which mean that strict hygienic procedure was observed during it preparation.

4.8 Colour and appearance in ice-cream

The data regarding colour and appearance scores in samples of coconut milk frozen dessert of control and treatments are presented in table **8-A** and ANOVA of the same is given in table **8-B**. From the data on colour and appearance scores of the coconut milk frozen dessert samples in table 8-A and figure **4.8**. It is evident that the colour and appearance score in general,

irrespective of treatment, ranged from 7.6-8.6. The highest mean colour and appearance score of the coconut milk frozen dessert was observed in T_3 (8.19) followed by the ice-cream in T_2 (8.17), T_1 (7.97) and T_0 (7.90).

Since differences in these values of colour and appearance score were found significant it indicated a significant influence of the treatments on this parameter. However differences in the colour and appearance score between T_o, T_2 and T_3 were not significant. It indicated that the coconut milk frozen dessert of control was found at par with the coconut milk frozen dessert samples of T_1. It is interesting to note that the colour and appearance score of T_1 were found at par with the score of colour and appearance with T_2 because the differences in these where not significant. Further it may be noted that the colour and appearance scores of T_2 were found at par with the score of colour and appearance with T_3 because the differences in these were not significant. Nevertheless the ice-cream of T_3 and T_2 registered significantly high scores of colour and appearance than control T_0 which indicated that coconut milk frozen dessert of this treatment was superior compared to that of control.

4.9 Body and texture in ice-cream

The data regarding body and texture score in coconut milk frozen dessert samples of different treatments are presented in table **9-A** and analysis of variance (ANOVA) for the same in given in table **9-B**. From the data on body and texture scores of the coconut milk frozen dessert samples in table **9-A** and figure **4.9** it is evident that the Body and texture score in general, irrespective of treatments ranged from 7.10-8.60. The highest mean body and texture score of the coconut milk frozen dessert was observed in T_3 (8.04) followed by the coconut milk frozen dessert in T_2 (7.89), T_1 (7.71) and T_0 (7.60). Since differences in these values of Body and texture score were found significant it indicated a significant influence of the treatments on this parameter. However differences in the body and texture score between T_0, and T_1 were not significant which indicated that the coconut milk frozen dessert of control was found at par with the coconut milk frozen dessert samples of T_1. It is interesting to note that the body and texture scores of T_1 were found at par with the score of body and texture with T_2 because the differences in these were not significant. It is also interesting to

note that the Body and texture scores of T_2 were found at par with the score of Body and texture with T_3 because the differences in these where not significant. Nevertheless the ice-cream of T_3 and T_2 registered significantly high scores of body and texture than control T_0 which indicated that coconut milk frozen dessert of this treatment was superior compared to that of control.

4.10 Flavour in ice-cream

The data regarding flavour and taste score in coconut milk frozen dessert samples of different treatments are presented in table **10-A** and analysis of variance (ANOVA) for the same in given in table **10-B**. From the data on flavour scores of the coconut milk frozen dessert samples in table **10-A** and figure **4.10** it is evident that the flavour score in general, irrespective of treatments ranged from 7.00 to 8.60. The highest mean flavour score of the coconut milk frozen dessert was observed in T_3 (8.24) followed by the ice-cream in T_2 (8.22), T_1 (7.78) and T_0 (7.62). Since differences in this values of flavour score were found significant it indicated a significant influence of the treatments on this parameter. It is therefore concluded from the table **10-C** that there was significant difference in the scores for flavor and taste of coconut milk frozen dessert between (T_0, T_2), (T_0, T_3), (T_1, T_2) and (T_1, T_3) but there was no significant difference between (T_0, T_1) and (T_2, T_3).

Nevertheless the coconut milk frozen dessert of T_2 and T_3 registered significantly high score for flavor and taste than control (T_0) which indicated that coconut milk frozen dessert of these treatments was superior compared to that of control.

4.11 Melting resistance in ice cream

The data regarding melting resistance scores in samples of coconut milk frozen dessert of control and treatments are presented in table **11-A** and ANOVA of the same is given in table **11-B**. From the data on melting resistance scores of the coconut milk frozen dessert samples in table **11-A** and figure **4.11**. It is evident that the melting resistance score in general irrespective of treatment, ranged from 7.1-8.8. The highest mean melting resistance score of the coconut milk frozen dessert was observed in ice-cream of T_3 (7.92) followed by the ice-cream in T_2 (7.82), T_1 (7.64) and T_0 (7.40).

Since differences in these values of melting resistance score were found significant it indicated a significant influence of the treatments on this parameter. However differences in the melting resistance score between T_o, T_1 were not significant which indicated that the coconut milk frozen dessert of control was found at par with the coconut milk frozen dessert samples of T_1. It is interesting to note that the melting resistance score of T_1 were found at par with the score of melting resistance with T_2 because the differences in these where not significant. Further it may be noted that the melting resistance scores of T_2 were found at par with the score of melting resistance with T_3 because the differences in these were not significant. Nevertheless the coconut milk frozen dessert of T_3 registered significantly high scores of melting resistance than control (T_0) which indicated that ice-cream of this treatment was superior compared to that of control.

TABLE NO. 1

Average data of chemical analysis, Microbiological and orgaonoleptic scores of different treatments

Parameters	Treatments			
	T_0	T_1	T_2	T_3
1. Chemical analysis				
Fat percent	10.28	10.56	10.75	10.88
Total solids percent	37.26	37.52	37.84	38.11
Protein percent	3.45	4.01	3.99	3.99
Acidity percent	0.21	0.19	0.14	0.18
Overrun percent	81.30	81.80	81.20	80.30
2. Microbial analysis				
Standard plate count (SPC)	21.80	26.60	26.90	26.10
Coliform test	N	N	N	N
3. orgaonoleptic scores				
Colour & appearance	7.90	7.97	8.17	8.19
Body & texture	7.60	7.60	7.89	8.04
Flavour & taste	7.62	7.78	8.22	8.24
Melting resistance	7.40	7.64	7.82	7.92

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TABLE NO. 1-A

Fat percentage in samples of control & Coconut milk frozen dessert of different treatments

Replications	Treatments			
S.I. No.	T_0	T_1	T_2	T_3
	Fat percent in ice-cream			
1	10.00	10.90	10.00	10.40
2	9.90	11.20	11.20	11.20
3	11.50	10.00	11.60	10.70
4	10.80	10.60	10.00	10.30
5	9.80	11.90	10.40	11.90
6	10.00	10.20	12.10	10.20
7	10.20	10.10	10.20	11.80
8	10.20	10.40	10.10	10.40
9	9.80	10.20	10.30	11.40
10	10.60	10.10	11.60	10.50
Average	**10.28**	**10.56**	**10.75**	**10.88**
Range	**9.80-11.50**	**10.00-11.90**	**10.00-12.10**	**10.20-11.90**

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TABLE NO.1- B

Analysis of variance (ANOVA) for percentage fat in control & Coconut milk frozen dessert of different treatments

Source of variation	D.F	S.S	M.S.S	'F' Value		Result
				Cal	Tab. at 5%	
Due to replication	9	2.4352	0.2705	0.5669	2.225	NS
Due to treatment	3	2.0367	0.6789	1.4225	2.96	NS
Due to error	27	12.8857	0.4772			
Total	39	17.3577				

NS- Non –Significant

TABLE NO. 1-C

Critical difference in score for Fat Percentage of control & Coconut milk frozen dessert

Treatment Means	Average	T_0 (10.28)	T_1 (10.56)	T_2 (10.75)	T_3 (10.88)
T_0	10.28		0.28	0.47	0.6
T_1	10.56			0.19	0.32
T_2	10.75				0.13
T_3	10.88				

C.D= 0.62

***Significant at 5% level**

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TABLE NO. 2-A

Total solids percentage in samples of control & Coconut milk frozen dessert of different treatments

Replications	Treatments			
S.I. No.	T_0	T_1	T_2	T_3
	Total solid percent			
1.	37.30	37.40	37.80	38.00
2.	37.10	37.50	37.70	38.10
3.	37.20	37.30	37.90	37.90
4.	37.50	37.40	37.80	37.80
5.	37.40	37.40	38.00	38.20
6.	37.30	37.60	37.90	38.30
7.	37.10	37.80	37.80	38.20
8.	37.20	37.70	38.00	38.00
9.	37.50	37.50	37.60	38.20
10.	37.00	37.60	37.90	38.40
Average	**37.26**	**37.52**	**37.84**	**38.11**
Range	**37.10-37.50**	**37.30-37.80**	**37.60-38.00**	**37.80-38.40**

TABLE NO. 2-B

Analysis of variance (ANOVA) for total solid percentage in control & Coconut milk frozen dessert of different treatments

Source of variation	D.F	S.S	M.S.S	'F' Value		Result
				Cal	Tab. at 5%	
Due to replication	9	0.1752	0.0194	0.6938	2.225	NS
Due to treatment	3	4.1247	1.3749	48.990	2.96	S
Due to error	27	0.7577	0.0280			
Total	39	5.0577				

S - *Significant

TABLE NO. 2-C

Critical difference in score for Total Solids of control & Coconut milk frozen dessert of different treatments

Treatment Means	Average	T_0 (37.26)	T_1 (37.52)	T_2 (37.84)	T_3 (8.11)
T_0	37.26		0.26	0.58	0.85
T_1	37.52			0.32	0.59
T_2	37.84				0.27
T_3	38.11				

C.D= 0.15 ***Significant at 5% level**

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TABLE NO. 3-A

Protein percentage in samples of control & Coconut milk frozen dessert of different treatments

Replications	Treatments			
S.I. No.	T_0	T_1	T_2	T_3
	Protein percent in ice-cream			
1.	3.30	3.90	3.70	3.60
2.	3.20	4.00	3.90	4.10
3.	3.60	3.80	3.90	3.60
4.	3.40	4.20	4.10	4.00
5.	3.70	3.90	3.80	3.80
6.	3.50	4.10	4.20	4.00
7.	3.30	3.70	3.80	4.00
8.	3.80	3.90	3.80	4.20
9.	3.30	4.20	4.10	4.40
10.	3.50	4.40	4.60	4.20
Average	**3.45**	**4.01**	**3.99**	**3.99**
Range	**3.20-3.80**	**3.70-4.40**	**3.70-4.60**	**3.60-4.40**

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TABLE NO. 3-B

ANOVA for protein percentage of control & Coconut milk frozen dessert of different treatments

Source of variation	D.F	S.S	M.S.S	'F' Value	Result	
				Cal	Tab. at 5%	
Due to replication	9	1.001	0.1112222	2.857288	2.225	S
Due to treatment	3	2.244	0.748	19.215985	2.96	S
Due to error	27	1.051	0.0389259			
Total	39	4.296				

S - *Significant

TABLE NO. 3-C

Critical difference in score for Protein percentage control & Coconut milk frozen dessert of different treatments

Treatment Means	Average	T_0 (3.45)	T_1 (4.01)	T_2 (3.99)	T_3 (3.99)
T_0	3.45		0.56	0.54	0.54
T_1	4.01			0.02	0.02
T_2	3.99				0.00
T_3	3.99				

C.D= 0.177

***Significant at 5% level**

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TABLE NO. 4-A

Acidity percentage of control & Coconut milk frozen dessert of different treatments

Replications	Treatments			
S.I. No.	T_0	T_1	T_2	T_3
	Acidity percent in ice-cream			
1.	0.215	0.187	0.145	0.180
2.	0.218	0.192	0.143	0.179
3.	0.206	0.182	0.144	0.177
4.	0.212	0.185	0.143	0.180
5.	0.198	0.188	0.146	0.176
6.	0.208	0.187	0.146	0.181
7.	0.218	0.187	0.148	0.180
8.	0.215	0.186	0.143	0.179
9.	0.216	0.188	0.149	0.177
10.	0.213	0.189	0.140	0.179
Average	**0.21**	**0.19**	**0.14**	**0.18**
Range	**0.206-0.218**	**0.182-0.192**	**0.140-0.149**	**0.176-0.181**

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TABLE NO. 4-B

ANOVA for Acidity of the products of control & Coconut milk frozen dessert of different treatments

Source of variation	D.F	S.S	M.S.S	'F' Value		Result
				Cal	Tab. at 5%	
Due to replication	9	0.0001	1.88E-05	1.5241	2.225	NS
Due to treatment	3	0.02314	0.0077	623.763	2.96	S
Due to error	27	0.0003	1.24E-05			
Total	39	0.0236				

S - *Significant

TABLE NO. 4-C

Critical difference in score for Acidity of control & Coconut milk frozen dessert of different treatments

Treatment Means	Average	T_0 (0.21	T_1 (0.19)	T_2 (0.14)	T_3 (0.18)
T_0	0.21		0.02	0.07	0.03
T_1	0.19			0.05	0.01
T_2	0.14				0.04
T_3	0.18				

C.D= 0.0031

***Significant at 5% level**

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TABLE NO. 5-A

Overrun of control & Coconut milk frozen dessert of different treatments

Replications	Treatments			
S.I. No.	T_0	T_1	T_2	T_3
	Overrun percent in ice-cream			
1.	80.00	82.00	79.00	81.00
2.	82.00	81.00	80.00	82.00
3.	80.00	82.00	81.00	80.00
4.	81.00	83.00	82.00	81.00
5.	82.00	80.00	81.00	80.00
6.	82.00	82.00	83.00	81.00
7.	82.00	81.00	82.00	79.00
8.	81.00	82.00	83.00	79.00
9.	80.00	83.00	81.00	79.00
10.	83.00	82.00	80.00	81.00
Average	**81.30**	**81.80**	**81.20**	**80.30**
Range	**80 – 83**	**80 - 83**	**79 - 83**	**79 - 82**

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TABLE NO. 5-B

ANOVA for Overrun of the products of control & Coconut milk frozen dessert of different treatments

Source of variation	D.F	S.S	M.S.S	'F' Value		Result
				Cal	Tab. at 5%	
Due to replication	9	8.6	0.9555556	0.7413793	2.225	NS
Due to treatment	3	11.7	3.9	3.0258621	2.96	S
Due to error	27	34.8	1.2888889			
Total	39	55.1				

S - *Significant

TABLE NO. 5-C

Critical difference for Overrun of control & Coconut milk frozen dessert of different treatments

Treatment Means	Average	T_0 (81.30)	T_1 (81.80)	T_2 (81.20)	T_3 (80.30)
T_0	81.30		0.50	0.10	1.00
T_1	81.80			0.60	1.50
T_2	81.20				1.10
T_3	80.30				

C.D= 1.02

***Significant at 5% level**

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TABLE NO. 6-A

Average SPC in 10^3/ml of control ice cream and experimental frozen desert recombined sample.

Replication	Treatments			
S.I. No.	T_0	T_1	T_2	T_3
1.	21	27	25	24
2.	24	26	27	26
3.	23	24	27	25
4.	20	28	28	24
5.	22	27	26	26
6.	23	26	28	27
7.	21	28	29	28
8.	23	26	27	27
9.	20	25	26	28
10.	21	29	26	26
Average	**21.80**	**26.60**	**26.90**	**26.10**
Range	**20 – 24**	**24 - 29**	**25 - 29**	**24 – 28**

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TABLE NO 6-B

ANOVA for SPC of the products of control & Coconut milk frozen dessert of different treatments

Source of variation	D.F	S.S	M.S.S	'F' Value		Result
				Cal	Tab. at 5%	
Due to replication	9	16.6	1.844444	0.93609	2.225	NS
Due to treatment	3	171.3	57.1	28.9793	2.96	S
Due to error	27	53.2	1.9703704			
Total	39	241.1				

S - *Significant

TABLE NO. 6-C

Critical difference for SPC of control & Coconut milk frozen dessert of different treatments

Treatment Means	Average	T_0 (21.80)	T_1 (26.60)	T_2 (26.90)	T_3 (26.10)
T_0	21.80		4.8	5.1	4.3
T_1	26.60			0.30	0.50
T_2	26.90				0.80
T_3	26.10				

C.D= 1.261909

***Significant at 5% level**

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TABLE NO. 7-A

Shows that the result of coliform test of control & Coconut milk frozen dessert of different treatments

.Replication	Treatments			
S.I. No.	T_0	T_1	T_2	T_3
1.	N	N	N	N
2.	N	N	N	N
3.	N	N	N	N
4.	N	N	N	N
5.	N	N	N	N
6.	N	N	N	N
7.	N	N	N	N
8.	N	N	N	N
9.	N	N	N	N
10.	N	N	N	N

N = Negative

It is evident from the table that the coliform test control and experimental sample were 100 percent negative.

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TABLE NO. 8-A

The Average coloure and appearance of control ice cream & experimental frozen dessert samples

Replications	Treatments			
S.I. No.	T_0	T_1	T_2	T_3
	Colour and appearance score			
1.	8.20	7.60	8.0	8.40
2.	7.60	8.20	8.6	8.60
3.	7.60	8.20	8.20	8.20
4.	7.80	7.80	7.80	7.80
5.	8.0	8.0	8.40	8.40
6.	7.90	8.10	7.90	7.90
7.	8.10	7.90	8.10	8.10
8.	7.70	7.70	8.0	8.0
9.	7.90	8.0	8.20	8.20
10.	8.20	8.20	8.30	8.30
Average	**7.90**	**7.97**	**8.17**	**8.19**
Range	**7.6-8.2**	**7.6-8.2**	**7.9-8.6**	**7.8-8.6**

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TABLE NO. 8-B

ANOVA for Coloure and Appearance score for control & Coconut milk frozen dessert of different treatments

Source of variation	D.F	S.S	M.S.S	'F' Value		Result
				Cal	Tab. at 5%	
Due to replication	9	0.64025	0.071139	1.5864	2.225	NS
Due to treatment	3	0.62675	0.208917	4.6588	2.96	S
Due to error	27	1.21075	0.044843			
Total	39	2.47775				

S – *Significant

TABLE NO. 8-C

Critical difference in score for Coloure and Appearance of control & Coconut milk frozen dessert of different treatments

Treatment Means	Average	T_0 (7.90)	T_1 (7.97)	T_2 (8.17)	T_3 (8.19)
T_0	7.90		0.09	0.27	0.29
T_1	7.97			0.20	0.22
T_2	8.17				0.02
T_3	8.19				

C.D= 0.19

***Significant at 5% level**

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TABLE NO. 9-A

Body and texture score for control ice cream & experimental frozen dessert samples

Replications	Treatments			
S.NO.	T_0	T_1	T_2	T_3
	Body and texture score			
1.	8.20	7.40	8.00	7.80
2.	7.20	8.00	7.80	8.40
3.	7.40	8.00	8.00	7.60
4.	8.00	7.50	7.90	8.60
5.	7.80	7.60	8.00	8.30
6.	7.20	7.10	7.60	7.80
7.	8.00	7.80	7.90	8.20
8.	7.50	8.00	8.10	8.00
9.	7.40	7.50	7.60	7.90
10.	7.30	8.20	8.00	7.80
Average	**7.60**	**7.71**	**7.89**	**8.04**
Range	**7.20 – 8.20**	**7.10 – 8.20**	**7.60 – 8.10**	**7.60 – 8.60**

TABLE NO. 9-B

ANOVA for Body and Texture score of control & Coconut milk frozen dessert of different treatments

Source of variation	D.F	S.S	M.S.S	'F' Value		Result
				Cal	Tab. at 5%	
Due to replication	9	1.136	0.1262	1.4526	2.225	NS
Due to treatment	3	1.134	0.378	4.3503	2.96	S
Due to error	27	2.346	0.0868			
Total	39	4.616				

S - *Significant

TABLE NO. 9-C

Critical difference in score for Body and Texture of control & Coconut milk frozen dessert of different treatments

Treatment Means	Average	T_0 (7.60)	T_1 (7.71)	T_2 (7.89)	T_3 (8.04)
T_0	7.60		0.11	0.29	0.44
T_1	7.71			0.18	0.33
T_2	7.89				0.15
T_3	8.04				

C.D= 0.26

***Significant at 5% level**

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TABLE NO. 10-A

Favour and taste score for control ice cream & experimental frozen dessert samples

Replications	Treatments			
S.I. No.	T_0	T_1	T_2	T_3
	Flavour and taste score			
1.	8.10	8.00	8.20	8.20
2.	7.20	8.00	8.10	8.00
3.	7.60	7.50	8.00	8.80
4.	7.00	7.80	8.40	7.80
5.	7.50	7.80	8.40	8.00
6.	8.00	7.60	8.30	8.60
7.	7.70	8.10	8.20	8.30
8.	7.60	7.90	8.50	7.90
9.	7.50	7.50	8.10	8.30
10.	8.00	7.60	8.00	8.50
Average	**7.62**	**7.78**	**8.22**	**8.24**
Range	**7.00-8.10**	**7.50-8.10**	**8.00-8.50**	**7.80-8.60**

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TABLE NO. 10-B

ANOVA for Flavour and Taste score of control & Coconut milk frozen dessert of different treatments

Source of variation	D.F	S.S	M.S.S	'F' Value		Result
				Cal	Tab. at 5%	
Due to replication	9	0.591	0.0656	0.812	2.225	NS
Due to treatment	3	2.939	0.9796	12.127	2.96	S
Due to error	27	2.181	0.0807			
Total	39	5.711				

S – *Significant

TABLE NO. 10-C

Critical difference in score for Flavor and Taste of control & Coconut milk frozen dessert of different treatments

Treatment Means	Average	T_0 (7.62)	T_1 (7.78)	T_2 (8.22)	T_3 (8.24)
T_0	7.62		0.16	0.6	0.62
T_1	7.78			0.44	0.46
T_2	8.22				0.02
T_3	8.24				

C.D= 0.25

***Significant at 5% level**

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TABLE NO. 11-A

Melting resistance score for control ice cream & experimental frozen dessert samples

Replications	Treatments			
S. No.	T_0	T_1	T_2	T_3
	Melting resistance score			
1.	7.40	7.60	7.80	8.80
2.	7.0	7.60	8.20	7.20
3.	7.80	7.20	7.20	8.0
4.	7.60	8.0	7.80	8.20
5.	7.60	7.60	7.60	7.50
6.	7.10	7.30	7.90	7.40
7.	7.10	7.50	7.80	7.50
8.	7.70	7.90	8.10	7.90
9.	7.40	8.00	7.80	8.40
10.	7.30	7.70	8.0	8.30
Average	**7.40**	**7.64**	**7.82**	**7.92**
Range	**7.1-7.8**	**7.2-8.00**	**7.2-8.2**	**7.2-8.8**

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TABLE NO. 11-B

ANOVA for Melting Resistance score for control & Coconut milk frozen dessert of different treatments

Source of variation	D.F	S.S	M.S.S	'F' Value		Result
				Cal	Tab. at 5%	
Due to replication	9	1.519	0.168	1.573	2.225	NS
Due to treatment	3	1.563	0.521	4.855	2.96	S
Due to error	27	2.897	0.1072			
Total	39	5.979				

S – *Significant

TABLE NO. 11-C

Critical difference score for Melting Resistance of control & Coconut milk frozen dessert of different treatments

Treatment Means	Average	T_0 (7.40)	T_1 (7.64)	T_2 (7.82)	T_3 (7.92)
T_0	7.40		0.24	0.42*	0.52*
T_1	7.64			0.18	0.28
T_2	7.82				0.1
T_3	7.92				

C.D= 0.29

***Significant at 5% level**

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TABLE NO. 12-A

(a). Ingredient cost of control ice cream (T_0) for preparation of 1kg. mix

Ingredient	Amount required For 1kg mix (in gm.)	Rate in Rs/kg	Cost in Rs.
Whole milk	573	24	13.75
Cream	180	100	18
Skim milk powder	90	190	17.10
Stabilizer	03	7500	22.50
Emulsifier	02	120	0.24
Sugar	150	18	2.70
Colour	01	490	1.06
Flavour	01	1060	0.49
Total cost			75.84

Cost of Per kg. Ice cream mix Rs. 75.84

(b).Ingredient cost of experimental coconut milk frozen dessert (T_1) for preparation of 1kg. Mix.

Ingredient	Amount required For 1kg mix (in gm.)	Rate in Rs/kg	Cost in Rs.
Coconut milk	724	17.5	12.67
Skim milk powder	93	190	17.67
Stabilizer	3	7500	22.50
Emulsifier	2	120	0.24
Sugar	150	18	2.70
Colour	1	1060	1,06
Shredded coconut	2	60	0.12
Total cost Shredded coconut	100	60	56.96 - 06.00
Grand total			50.96

Cost of Per kg. Ice cream mix Rs. 50.96

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(c). Ingredient cost of experimental coconut milk frozen dessert (T_2) for preparation of 1kg. Mix.

Ingredient	Amount required For 1kg mix (in gm.)	Rate in Rs/kg	Cost in Rs.
Coconut milk	724	17.5	12.67
Skim milk powder	93	190	17.67
Stabilizer	3	7500	22.50
Emulsifier	2	120	0.24
Sugar	150	18	2.70
Colour	1	1060	1,06
Shredded coconut	4	60	0.24
Total cost Shredded coconut	100	60	57.08 - 06.00
Grand total			**51.08**

Cost of Per kg. Ice cream mix Rs. 51.08

(d).Ingredient cost of experimental coconut milk frozen dessert (T_3) for preparation of 1kg. Mix.

Ingredient	Amount required For 1kg mix (in gm.)	Rate in Rs/kg	Cost in Rs.
Coconut milk	724	17.5	12.67
Skim milk powder	93	190	17.67
Stabilizer	3	7500	22.50
Emulsifier	2	120	0.24
Sugar	150	18	2.70
Colour	1	1060	1,06
Shredded coconut	6	60	0.36
Total cost Shredded coconut	100	60	57.20 - 06.00
Grand total			**51.20**

Cost of Per kg. Ice cream mix Rs. 51.20

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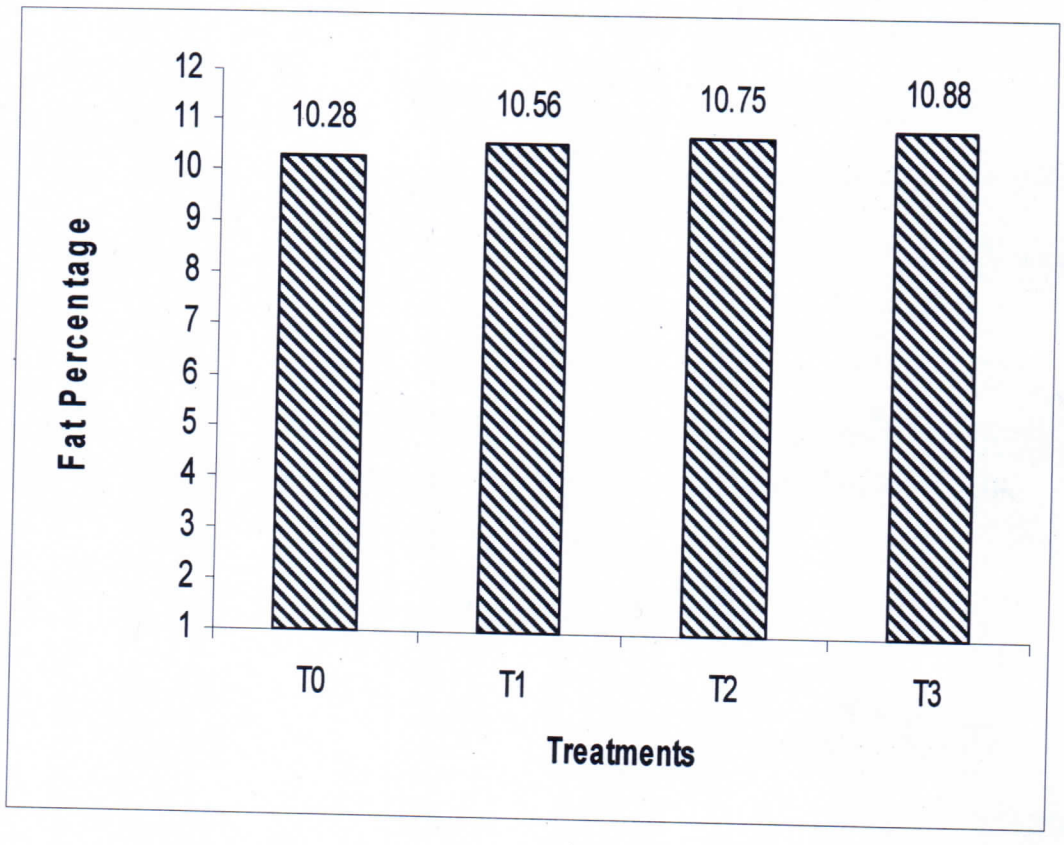
Fig 4.1

Average fat percentage of the product in control and coconut milk frozen dessert with different treatment



T_0: control ice cream with cream and milk

T_1: coconut milk frozen dessert with 0.2% shredded coconut

T_2: coconut milk frozen dessert with 0.4% shredded coconut

T_3: coconut milk frozen dessert with 0.6% shredded coconut

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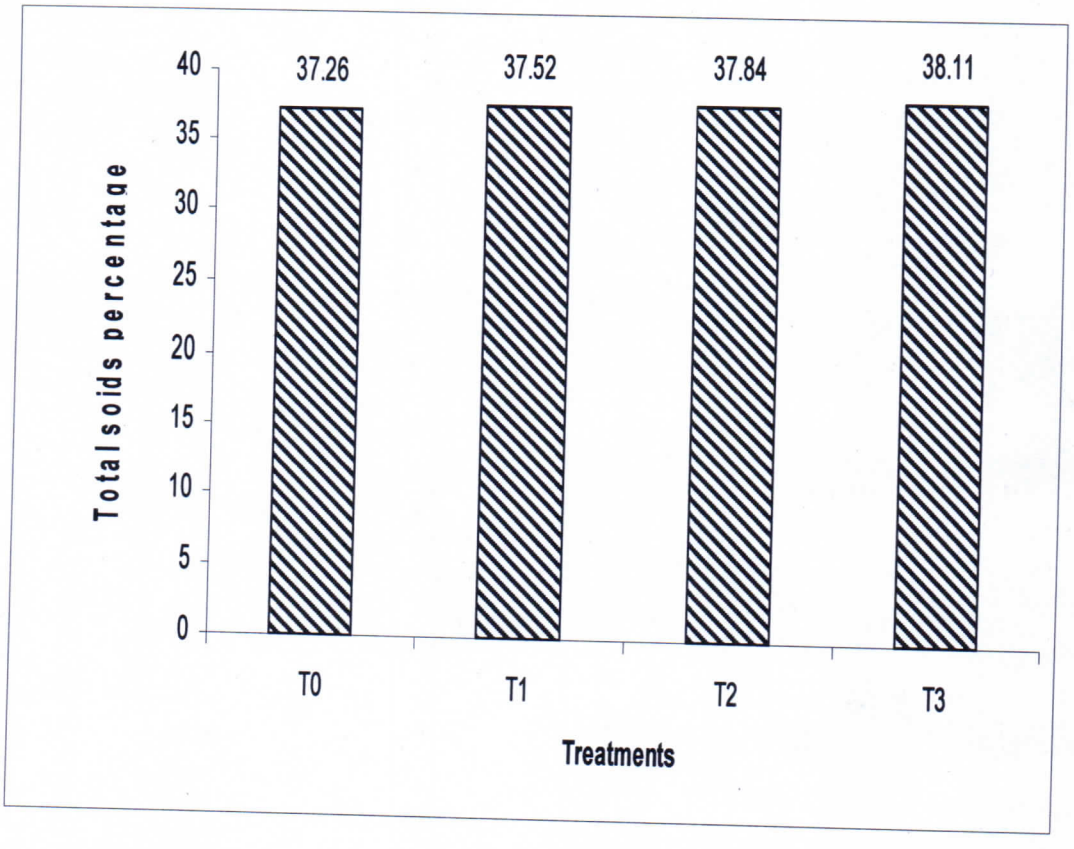
Fig 4.2

Average total solid percentage for control and coconut milk frozen dessert with different treatment



T_0: control ice cream with cream and milk

T_1: coconut milk frozen dessert with 0.2% shredded coconut

T_2: coconut milk frozen dessert with 0.4% shredded coconut

T_3: coconut milk frozen dessert with 0.6% shredded coconut

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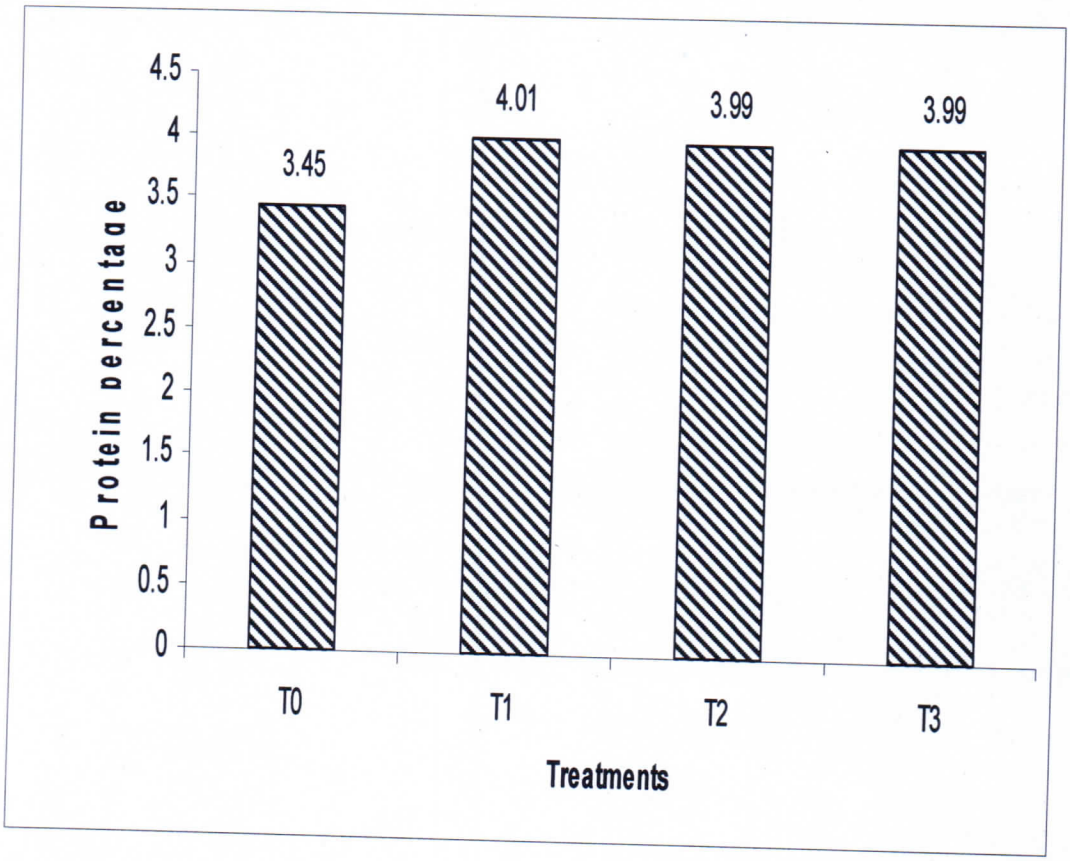
Fig 4.3

Average protein percent for control and coconut milk frozen dessert with different treatment



T_0: control ice cream with cream and milk

T_1: coconut milk frozen dessert with 0.2% shredded coconut

T_2: coconut milk frozen dessert with 0.4% shredded coconut

T_3: coconut milk frozen dessert with 0.6% shredded coconut

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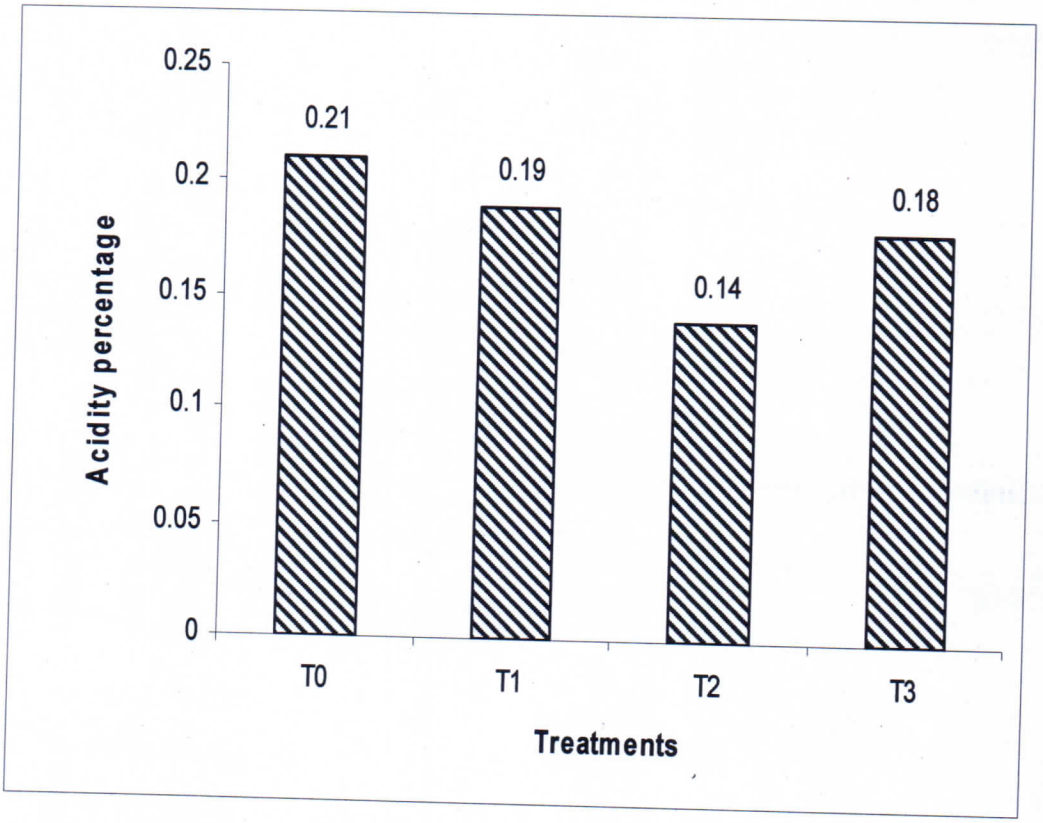
Fig 4.4

Average acidity percentage for control and coconut milk frozen dessert with different treatment



T_0: control ice cream with cream and milk

T_1: coconut milk frozen dessert with 0.2% shredded coconut

T_2: coconut milk frozen dessert with 0.4% shredded coconut

T_3: coconut milk frozen dessert with 0.6% shredded coconut

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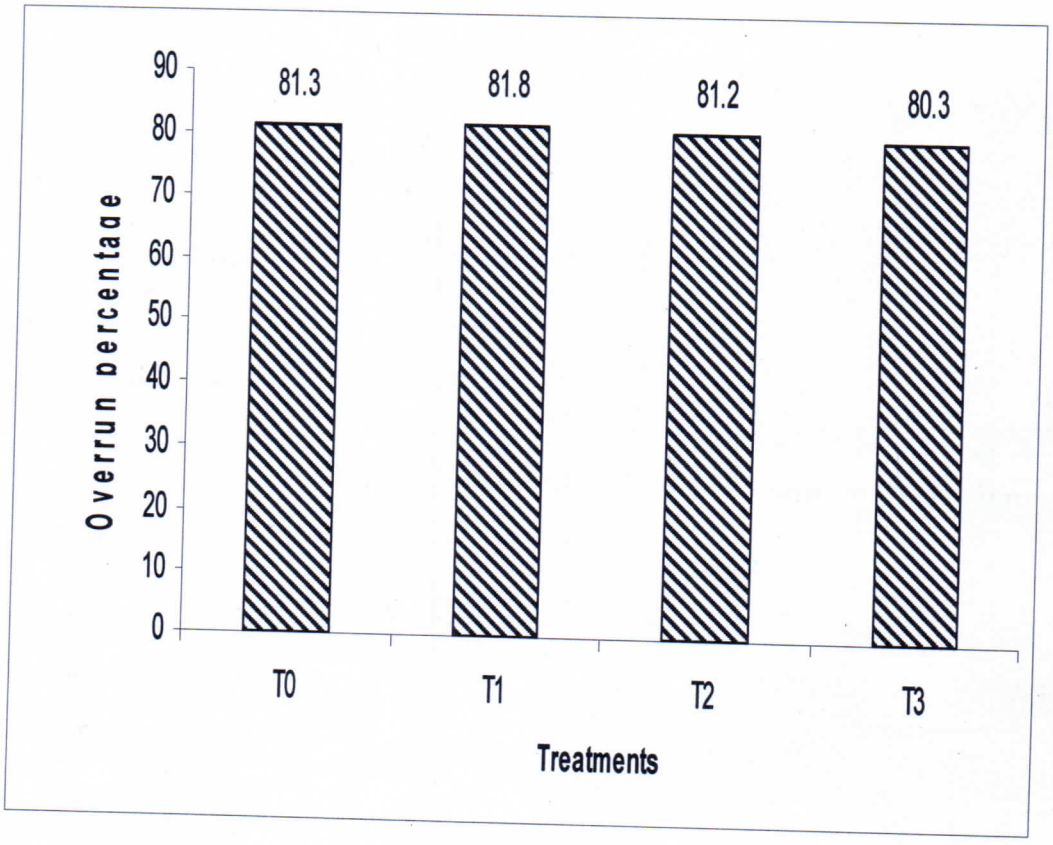
Fig 4.5

Average Overrun percentage for control and coconut milk frozen dessert with different treatment



T_0: control ice cream with cream and milk

T_1: coconut milk frozen dessert with 0.2% shredded coconut

T_2: coconut milk frozen dessert with 0.4% shredded coconut

T_3: coconut milk frozen dessert with 0.6% shredded coconut

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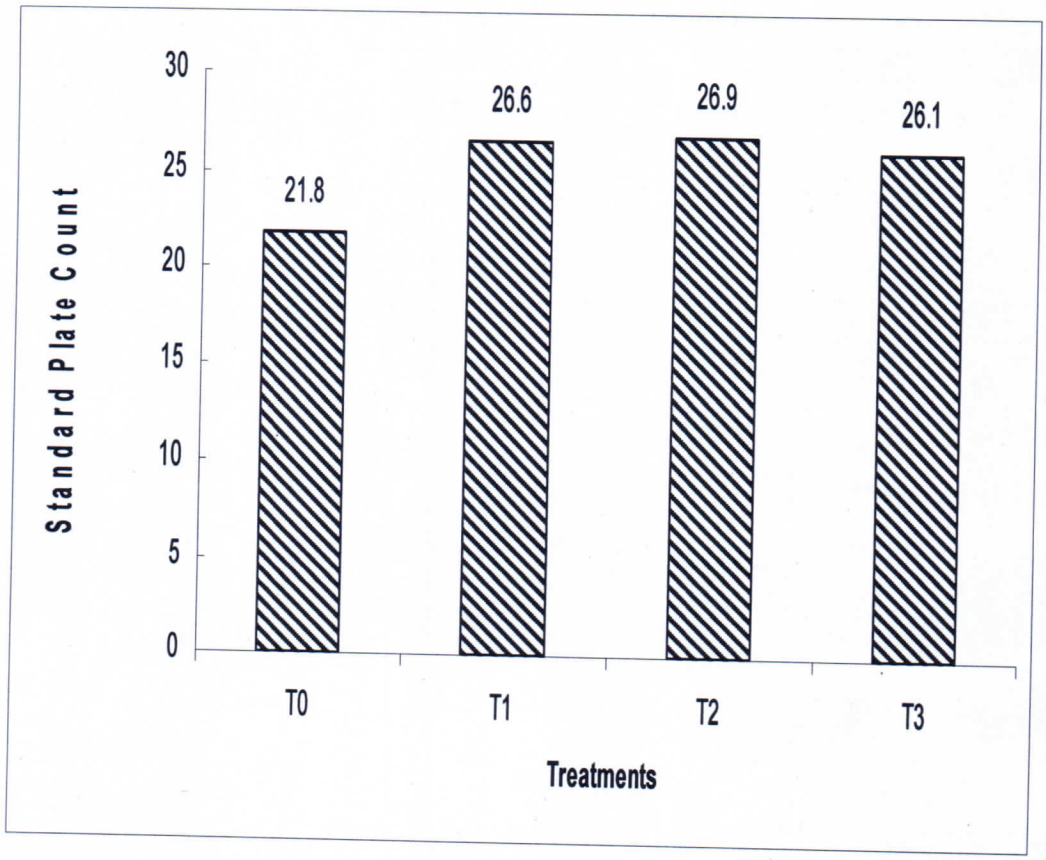
Fig 4.6

Average standard plate count of the product in control and coconut milk frozen dessert with different treatment,



T_0: control ice cream with cream and milk

T_1: coconut milk frozen dessert with 0.2% shredded coconut

T_2: coconut milk frozen dessert with 0.4% shredded coconut

T_3: coconut milk frozen dessert with 0.6% shredded coconut

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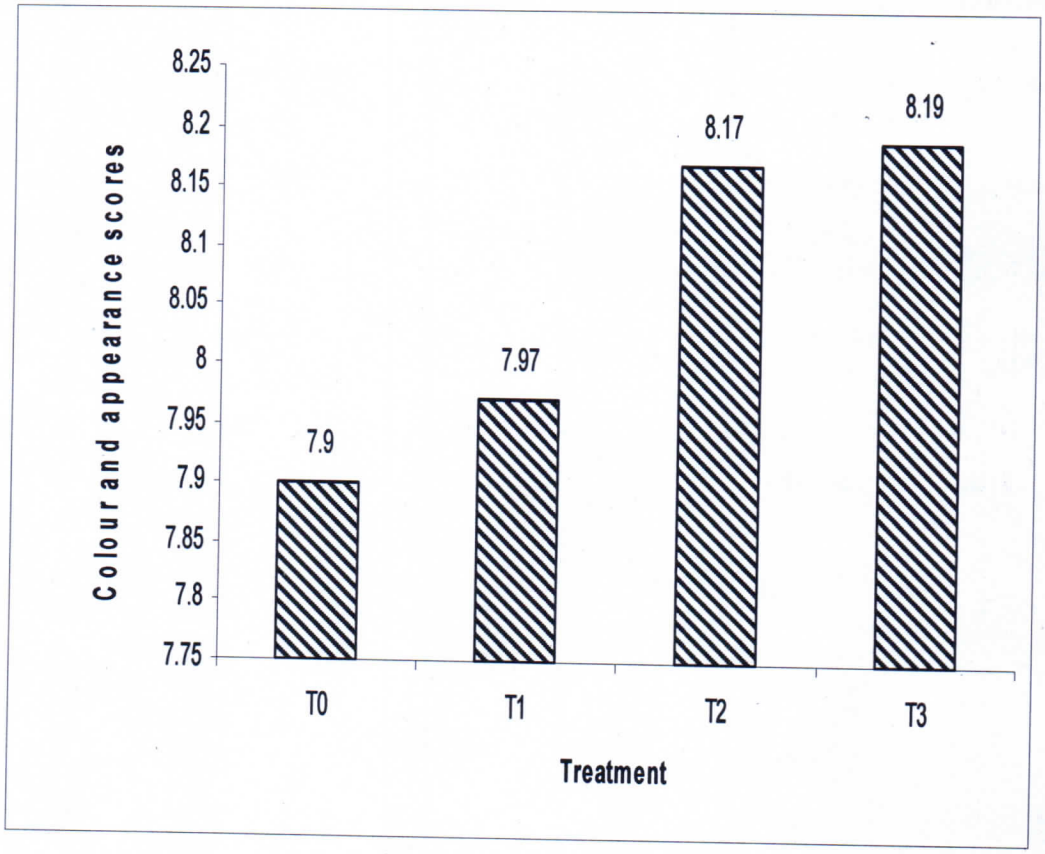
Fig 4.7

Average colour and appearance score for control and coconut milk frozen dessert with different treatment



T_0: control ice cream with cream and milk

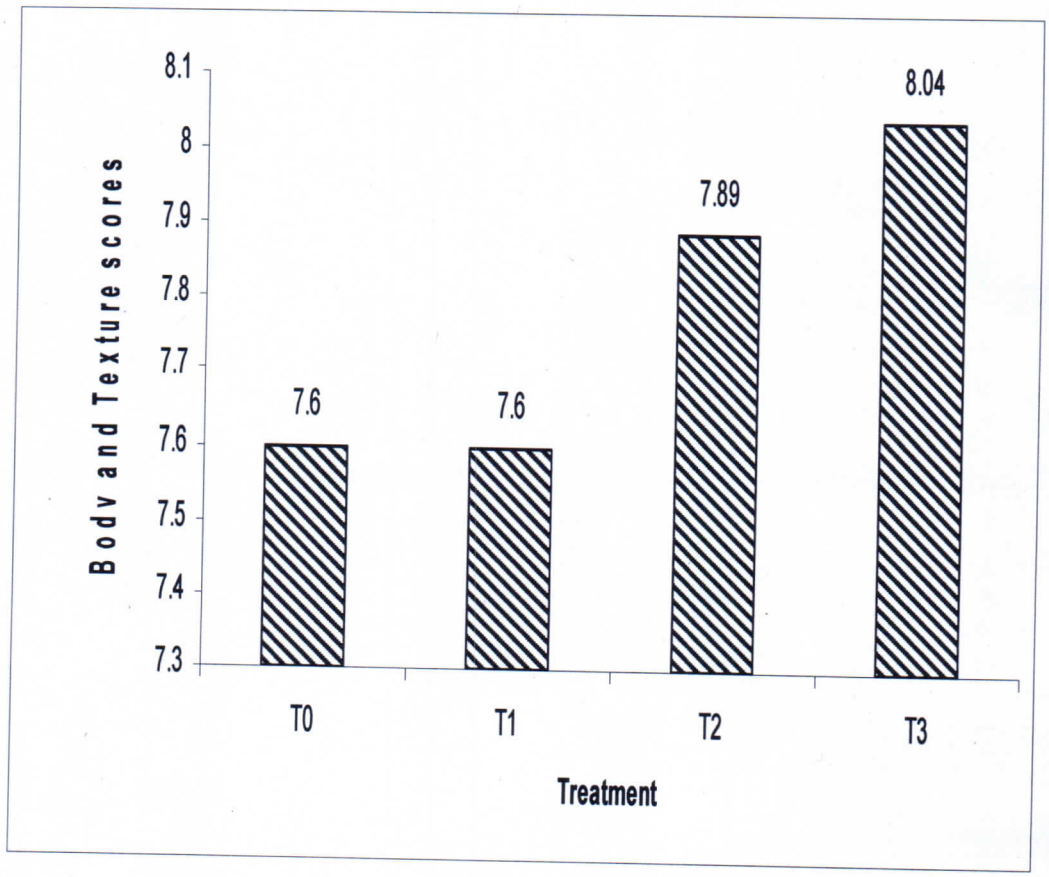
T_1: coconut milk frozen dessert with 0.2% shredded coconut

T_2: coconut milk frozen dessert with 0.4% shredded coconut

T_3: coconut milk frozen dessert with 0.6% shredded coconut

Fig 4.8

Average body and texture score in control and coconut milk frozen dessert with different treatment



T_0: control ice cream with cream and milk

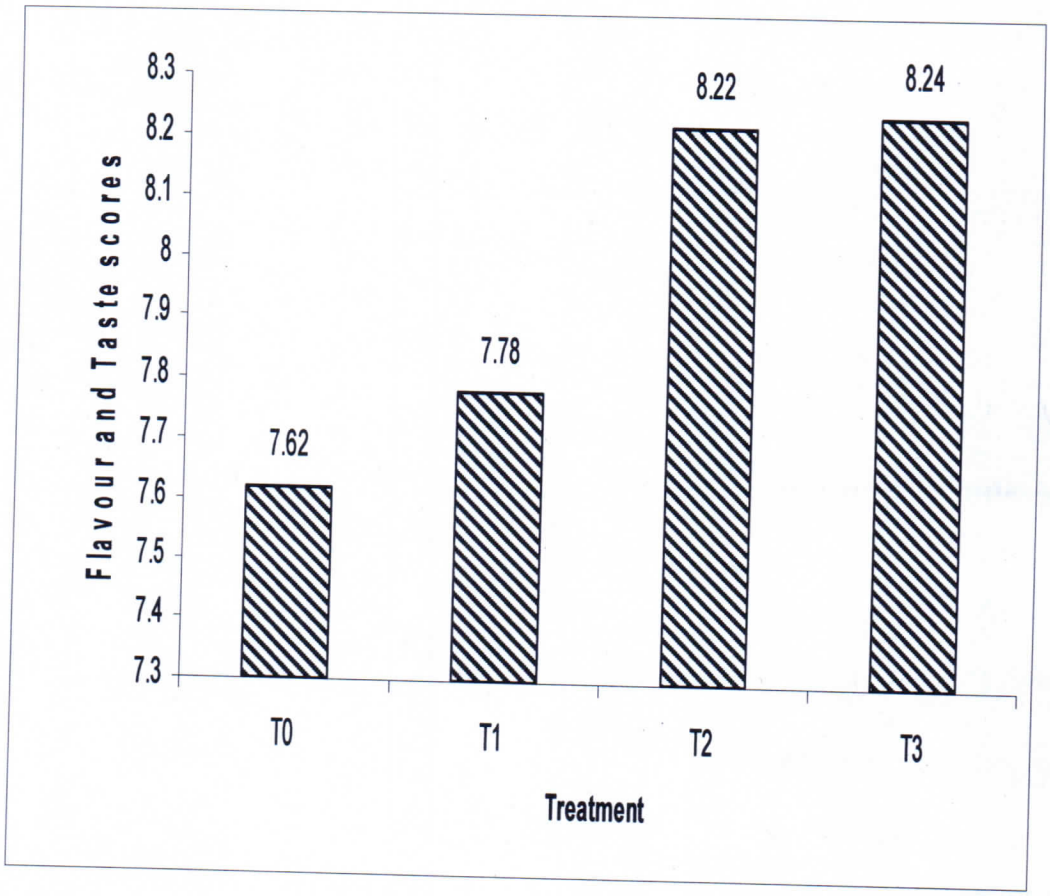
T_1: coconut milk frozen dessert with 0.2% shredded coconut

T_2: coconut milk frozen dessert with 0.4% shredded coconut

T_3: coconut milk frozen dessert with 0.6% shredded coconut

Fig 4.9

Average flavour and taste score for control and coconut milk frozen dessert with different treatment



T_0: control ice cream with cream and milk

T_1: coconut milk frozen dessert with 0.2% shredded coconut

T_2: coconut milk frozen dessert with 0.4% shredded coconut

T_3: coconut milk frozen dessert with 0.6% shredded coconut

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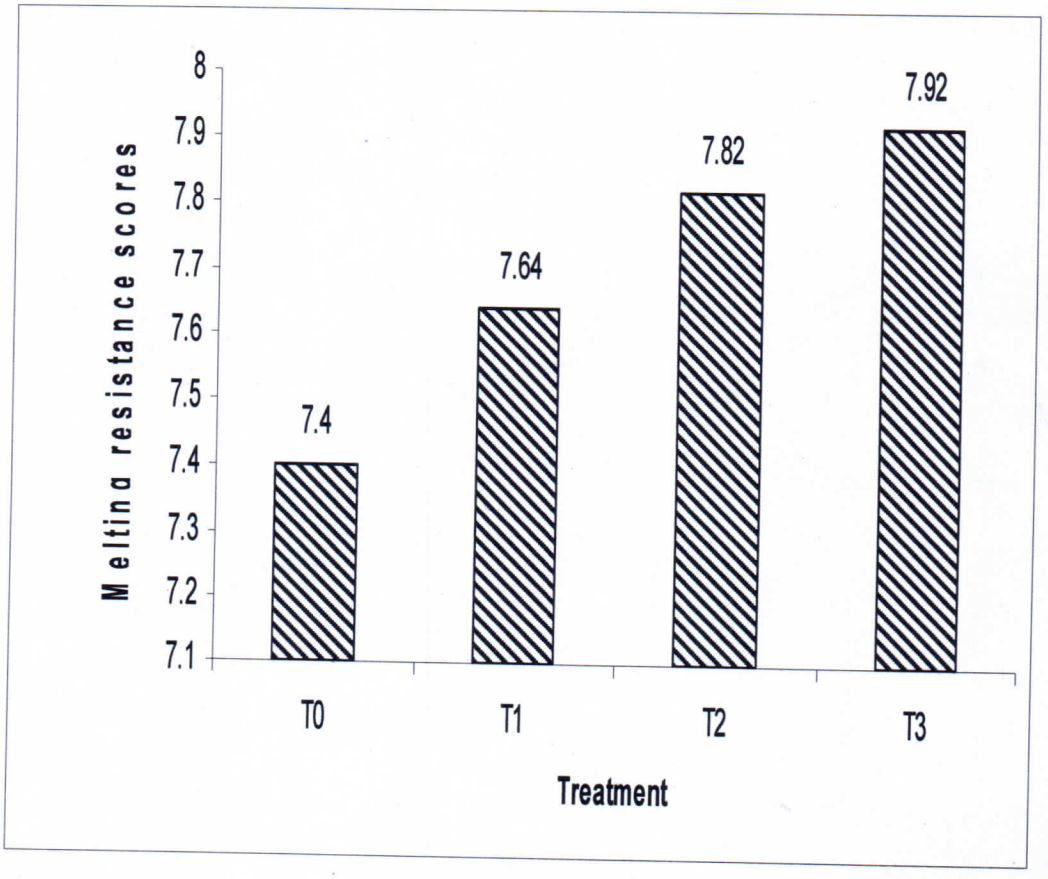
Fig 4.10

Average melting point score for control and coconut milk frozen dessert with different treatment



T_0: control ice cream with cream and milk

T_1: coconut milk frozen dessert with 0.2% shredded coconut

T_2: coconut milk frozen dessert with 0.4% shredded coconut

T_3: coconut milk frozen dessert with 0.6% shredded coconut

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SUMMARY AND CONCLUSION

Keeping the health consciousness of consumers, the food industry is gearing up to bring innovative functional products in the market. With this in view, the present study was made with an attempt to manufacture "fibre enriched coconut milk frozen dessert" with following objectives.

1. To standardize a technique for the manufacture of fiber enriched coconut milk frozen dessert.
2. To find out the rate of addition of coconut residue for fiber enrichment of coconut milk frozen dessert in order to produce most acceptable frozen dessert.
3. To evaluate frozen dessert for its Orgaonoleptic, Chemicals, Microbiological quality.
4. To study the cost of production.

The following were the treatments

T_0(control) → Ice cream mix, standardized to 10% milk fat, serum solids 12%, sugar 15%, carrageenan 0.3% and emulsifier (GMS) 0.2%.

T_1→ Frozen dessert mix was standardized to 10% fat from coconut milk, 12% serum solids from coconut milk & SMP, 15% sugar, 0.3% carrageenan and 0.2% emulsifiers (GMS). Dessert was prepared with the addition of 0.2% shredded coconut for fibre enrichment.

T_2→ Frozen dessert mix was standardized to 10% fat from coconut milk, 12% serum solids from coconut milk & SMP, 15% sugar, 0.3% carrageenan and 0.2% emulsifiers (GMS). Dessert was prepared with the addition of 0.4% shredded coconut for fibre enrichment.

T_3→ Frozen dessert mix was standardized to10% fat from coconut milk, 12% serum solids from coconut milk & SMP, 15% sugar, 0.3% carrageenan and 0.2% emulsifiers (GMS). Dessert was prepared with the addition of 0.6% shredded coconut for fibre enrichment

The coconut milk frozen dessert samples of different treatments were analyzed for total solids, fat percentage, protein, acidity, over run and orgaonoleptic tests (flavour, body, texture, colour, appearance and melting resistance). The data obtained on various parameters were statistically analyzed and the results are summarized as follows.

Sl.No	Parameter	Decreasing order of treatment based on mean values of scores of parameters			
1.	Fat Percent	$T_3(10.88)^a$	$T_2(10.75)^a$	$T_1(10.56)^a$	$T_0(10.28)^a$
2.	T.S Percent	$T_3(38.11)^c$	$T_2(37.84)^c$	$T_1(37.52)^b$	$T_0(37.26)^a$
3.	Protein Percent	$T_1(4.01)^b$	$T_2(3.99)^b$	$T_3(3.99)^b$	$T_0(3.45)^a$
4.	Acidity Percent	$T_0(0.21)^a$	$T_1(0.19)^b$	$T_3(0.18)^c$	$T_2(0.14)^c$
5.	Over-Run percent	$T_1(81.8)^{ab}$	$T_0(81.3)^a$	$T_2(81.2)^{ac}$	$T_3(80.3)^{ad}$
6.	Cost (Rs)	$T_3(51.20)^b$	$T_2(51.08)^b$	$T_1(50.96)^b$	$T_0(75.84)^a$
7.	SPC/ ml	$T_3(38.11)^a$	$T_2(37.84)^a$	$T_1(37.52)^a$	$T_0(37.26)^a$
8.	Coliform / ml	$T_3(N)^a$	$T_2(N)^a$	$T_1(N)^a$	$T_0(N)^a$
9.	Flavour score	$T_3(8.24)^{bd}$	$T_2(8.22)^{bd}$	$T_1(7.78)^a$	$T_0(7.62)^a$
10.	Body &Texture score	$T_3(8.04)^b$	$T_2(7.89)^{bc}$	$T_1(7.71)^{ac}$	$T_0(7.60)^a$
11.	Colour&Appearance score	$T_3(8.19)^b$	$T_2(8.17)^b$	$T_1(7.97)^a$	$T_0(7.90)^a$
12.	Melting resistance score	$T_3(7.92)^b$	$T_2(7.82)^b$	$T_1(7.64)^{ab}$	$T_0(7.40)^a$

Similar alphabets on values indicate non significant differences

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The highest mean fat score was recorded in control T_3 (10.88), T_2 (10.75), T_1 (10.56) and T_0 (10.28). The differences between T_0, T_1, T_2 & T_3 were non-significant.

The highest mean T.S score was recorded in control T_3 (38.11) followed by T_2 (37.84), T_1 (37.52) and T_0 (37.26). The differences in these values of T.S score T_0, T_1, T_2 were significant T_2, and T3 were non-significant.

The highest mean protein percentage was recorded in T_1 (4.01), T_2 (3.99), T_3 (3.99) and T_0 (3.45). The differences in these values of protein percent of T_0, T_1, T_2, and T_3 were significant and T_1, T_2 & T_3 were non-significant.

The highest mean acidity percentage was recorded in control T_0 (0.21), T_1 (0.19), T_3 (0.18) and T_2 (0.14). The differences in these values of acidity percent of T_0, T_1, T2, and T3 were significant and T_2 & T_3 were non-significant.

The highest mean over run score was recorded in T_1 (81.8) followed by T_0 (81.3) and T_2 (81.2) and T_3 (80.3). The difference in these values of over run of T_1, T_2, and T_3, were significant and T_0, T_1, T_2 and T_3 were non-significant.

The highest mean SPC score was recorded in T_2 (26.90) followed by T_1 (26.60) and T_3 (26.10) and T_0 (21.80)

The highest cost of ice cream per litre was observed in T_0 (75.84) followed by T_3 (51.20), T2 (51.08), and T_1 (50.96)

Orgaonoleptic parameters

The highest mean flavour score was recorded in T_3 (8.24) followed by T_2 (8.22), T_1 (7.78) and T_0 (7.62) the difference in the latter three (T_1, T_2, T_3) were non significantly higher flavour score than T_0.

The highest mean body &texture score was observed in T_3 (8.04) followed by T_2 (7.89), T_1 (7.71) and T_0 (7.60). T_0 was at par with T_0, $T_1$and T_2, but registered significantly higher score than T_0. The latter was also at par with T_2.

The highest mean score of colour and appearance of coconut milk frozen dessert was observed in T_3 (8.19) followed by T_2 (8.17), T_1 (7.97) and T_0 (7.90). The latter treatments although was at par with T_0 and T_3, but registered significantly high score colour and appearance of ice cream than T_0. The difference in the score colour and appearance between T_0, T_1, and T_2 were significant.

The highest mean score of melting resistance of coconut milk frozen dessert was observed in T_3 (7.92) followed by T_2 (7.82), T_1 (7.64) and T_0 (7.40). The difference in these values of melting resistance of T_2, and T_3, were significant and T_0, T_1, and T_2 were non-significant.

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REPORT

ON

"DEVELOPMENT OF TECHNOLOGY TO MANUFACTURE HERBAL KULFI BY UTILIZING DIFFERENT COMBINATIONS OF (*Ocimum basilicum*) BASIL"

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LIST OF CONTENT

ABSTRACT

In the new millennium we are witnessing the upward trend in nutritional and health awareness which has increased the consumer demand for functional foods. Keeping this in view industry is forced to bring herbal products in the market with acceptable sensory characteristics. The present investigation was made with an attempt to develop a herbal kulfi by partial addition with different level of Ocimum basilicum, evaluate the effect on microbial quality by addition of basil extract. For control kulfi mix was standardized to 10% milk fat, 15% sugar & 0.3% stabilizer & emulsifier, to obtain 37% total solids and treatment T_1 was standardized to 10% fat, and partial addition of basil extract 4% and 0.1% stabilizer and 0.2%emulsifier, T_2 was standardized to 10% fat and 15% sugar and 0.1% stabilizer and 0.2% emulsifier basil extract 6% & T_3 was standardized to 10% fat and partial addition of basil extract 8% and 0.1% stabilizer and 0.2% emulsifier. The total solid in control and treatment were adjusted to 37% total solid by the addition of skim milk powder. The kulfi samples of different treatments and control Physico-chemical analysis fat percentage, total solids, acidity, protein, moisture, ash, melting resistance was done for estimating its nutritional content and safety and Organoleptic characteristics like (flavour and taste, body and texture, colour and appearance)by trained panellist using 9 point hedonic scale. The treatments containing 8% level basil extract score the highest value. Microbiological analysis was carried out to assess the shelf life of the best treatments T_2checked through SPC, yeast and mould count, and presumptive coli form test. The results revealed less than 100/g (standard value) yeast and mould count and negative coli form test when compared with the standards given by PFA. Thus as for as product acceptability judged by Organoleptic evaluation and therapeutic value is concern, the treatment can be rated as $T_2>T_0>T_1>T_3$.

1.INTRODCUTION

The word Kulfi derives its origin from the Hindustani kulaf, which means a "lock" or "container" that has to be unlocked. Kulfi finds mention in **"aini-akbari" a** 16th centurchronicle, documenting court life. It was prepared regularly forthe grandest of all mughals to bring relief during thescorching summer. Kulfi also known as Malai Kulfi/ Malai-ka-burf is an indigenous frozen dairy product, whichclosely resembles ice cream in composition. In recent years, the consumption of ice cream in India has increased considerably in bigcities and towns. After a long time it was realized that there is a need to develop the indigenous product, as they have ready market in India. **(Aneja et.al 2002)**

Kulfi is a frozen dairy product made by suitable blending and processing of SMP and other milk products, together with sugar and flavour, with or without stabilizer or colour and with the incorporation of air during the freezing process. A typical compositional range for the components used in Kulfi mix is milk fat 10-16%, milk solids not fat 9-12%, sucrose 9-12%, corn syrup solids 4-6%, stabilizers/emulsifiers 0-0.5%, total solids 36-45% and water 55-64%. Kulfi is often described in terms of two phases; continuous and dispersed. The continuous phase is a combination of an unfrozen solution, an emulsion and a suspension of solids in liquid. Water, sugar, hydrocolloids, milk proteins and other soluble make up the unfrozen solution suspended in the aqueous phase are insoluble solids, including ice crystals, lactose crystals and milk solids. The aqueous phase also forms an emulsion with dispersed milk fat globules. The complex physical structure of ice cream presents a challenge for food technologists. Simple stated, overall goal of designing the ice cream is to incorporate several different insoluble's (air bubbles, ice crystals and fat globules) into an aqueous phase in the smallest sizes and in the greatest number possible.**Sharma and Hissaria.(2009)**

The health promoting foods are commonly referred to as functional foods, designer foods, pharma foods or neutraceuticals. The dairy industry in the western countries has responded to consumer preferences by marketing herbal dairy products. Nutritionally improved foods with at least one nutritional improvement over their conventional counterparts have been successful in the marketplace.

Kulfi has nutritional significance but possess no therapeutic properties. The growing interest of consumers towards therapeutic products .**(Hekmat and Mcmohan, 1991).**

Basil (*Ocimum basilicum*), belonging to the Lamiaceae family, is one of the most popular plants grown extensively in many continents around the world, especially in Asia,

Europe and North America. Basil is believed to have originated in Iran and/or India. At least 150 species of the genus many regions, the species *O. basilicum* is the most cultivated variety in the world. Basil has been planted as a popular culinary and medicinal herb from ancient time until now and the leaves and flowers have been used for the treatment of headaches, coughs, diarrhea, worms and kidney malfunctions, as well as for its carminative, galactagogue, stomachic and antispasmodic properties. Basil contains a wide range of phenolic compounds displaying various antioxidant activities, depending on the basil species and cultivars. The extracts of basil obtained by different methods are considered to be antimicrobial, insecticidal and useful in a number of medical treatments. The essential oils of basil are used in the flavoring of food and in perfumery because of their aromatic properties.

Justification: Basil leaves were reported to have high antioxidant effects the leaves possess antibacterial properties and are beneficial in the treatment of purulent arodontosis in the form of a collvtory made of the juice or extract. The addition betel leaves distillate in which contain active ingredients. Like chavicol and eugenol provides preventives and curative properties to the products. If increases the storage stability of the product.Therefore, this investigation focuses for the utilization of different level of basil leave extract for manufacturing therapeutic of kulfi.

Objectives:

The present investigation is an alternate to manufacture acceptable quality of Herbal Kulfi using different levels of basil with the following objectives:

1. To optimize the process of manufacturing Herbal Kulfi.
2. To assess the Organoleptic, Physico-chemical and Microbiological quality of the new formulation Herbal Kulfi.
3. To evaluate the cost of formulation of improved Herbal Kulfi.

Hypothesis

1. Basil extract obtained from basil leaves will improve the flavour perception in the new formulated Herbal Kulfi.

2.REVIEW OF LITERATURE

The review of literature is broadly presented under the following sub heading:

2.1 History of Kulfi

2.2 PFA standards for Kulfi

2.2.1 Ice Cream, Kulfi, Chocolate Ice Cream or Softy Ice Cream

2.3 Herbal Kulfi

2.4 Codex standards

2.5 Basil

2.5.1 Basil extract:

2.5.2 Basil in traditional use

2.5.3 Pharmacological effect

2.5.4 Nutrional standard for Basil

2.6 Stabilizers

2.7 GMP & GRAS status of added ingredients.

2.8 Physico-chemical, Organoleptic & microbiological standards of similar products.

2.1 History of Kulfi

Shannon (1980) reported that Kulfi, when eaten frequently between meals, is a potential dental hazard. A significant accomplishment in dental prevention would be the decreased use of Kulfi as a between meal snack and its increased use, if so desired, as a meal time dessert. It is the frequent exposure of children to sticky, high-sugar material between meals that is primarily responsible for the deplorable state of dental health in the United States.

Erland (1991)studied that this is a shortened version of a history of ice cream compiled to mark the 25th anniversary of A/L Iskrem, Norway. Preparation of cryohydrates probably originated in China. In ancient Greece and Rome the rich were partial to frozen desserts.

They disappeared, then reappeared in the middle ages in Italy, from where they spread across Europe. Ice cream was probably introduced to the French court of Henry II by Catherine de Medici around 1550. The first of many ice cream parlours opened in Paris, France, in 1651, and a household recipe was published in the UK in 1796 and a New York (USA) advertisement even earlier. Italian ice cream carts finally reached Nordic countries. Development into an industry was slow. Varchaug Dairy was the first in Norway to introduce technology, in 1927. The first Norwegian ice cream factory, Diplomis Oslo, started up in 1930. Dry ice became available in 1934. The Diplomis brand-name was adopted by the Norwegian Dairy Ice Cream Association, formed in 1951.

Wilson *et.al.* (1997) stated that a survey of unopened Kulfi, Kulfi in use, and Kulfi-scoop water (n = 91) was conducted to determine the effect of scoop water hygiene on the microbiological quality of Kulfi. An aerobic plate count around 10(6) c.f.u. ml-1 was the modal value for scoop waters. Unopened ice creams generally had counts around 10(3)-10(4) c.f.u. ml-1 and this increased by one order of magnitude when in use. Many scoop waters had low coli form counts, but almost half contained > 100 c.f.u. ml-1. E. coli was isolated in 18% of ice creams in use, and in 10% of unopened ice creams. S. aureus was not detected in any sample. Statistical analysis showed strong associations between indicator organisms and increased counts in ice cream in use. EC guidelines for indicator organisms in Kulfi were exceeded by up to 56% of samples.

Sharma & Hissaria (2007)suggested that our love affair with ice cream is centuries old. The ancient Greeks, Romans and Jews were known to chill wines and juices. This practice evolved into fruit ices and, eventually, frozen milk and cream mixtures. In the first century, Emperor Nero reportedly sent messengers to the mountains to collect snow so that his kitchen staff could make mixtures flavored with fruit and honey. Twelve centuries later, Marco Polo introduced Europe to a frozen milk dessert similar to the modern sherbet that he had enjoyed in the Far East. The Italians were especially fond of the frozen confection, which, by the sixteenth century, was being called ice cream. In 1533, m the young Italian princess, Catherine de Medici went to France as the bride of the future King Henry II. She was having recipes for frozen desserts included in her gifts. Ice cream is often described in terms of two phases: continuous and dispersed. The continuous phase is a combination of an unfrozen solution, an emulsion and a suspension of solids in liquid. Water, sugar, hydrocolloids, milk proteins and other solubles make up the unfrozen solution. Suspended in the aqueous phase

are insoluble solids, including ice crystals, lactose crystals and milk solids. The aqueous phase also forms an emulsion with dispersed milk fat globules. The complex physical structure of ice cream presents a challenge for food technologists. Simply stated, overall goal of designing the ice cream is to incorporate several different insoluble (air bubbles, ice crystals and fat globules) into an aqueous phase in the smallest sizes and in the greatest numbers possible.

2.2 PFA standards for Kulfi:

ICE CREAM, KULFI AND CHOCOLATE ICECREAM mean the frozen product obtained from cow or buffalo milk or a combination thereof or from cream, and/or other milk products, with or without the addition of cane sugar, [1][dextrose, liquid glucose and dried liquid glucose]. maltodextrin, eggs, fruits, fruit juice, preserved fruits, nuts, chocolate, edible flavours and permitted food colours. It may contain permitted stabilizer and emulsifiers not exceeding 0.5 per cent by weight. The mixture shall be suitably heated before freezing. The product shall contain not less than 10.0 per cent milk fat, 3.5 per cent protein and 36.0 per cent total solids.Omitted [1][Starch may be added to a maximum extent of 5.0 per cent under a declaration on a label as specified in sub-rule (2) of Rule 43. The standards foe ice cream shall also apply to softy ice-cream]. [4][In case of ice-cream, where the chocolate or like covering portion forms a separate layer, only the ice cream portion shall conform to the standards of ice-cream.

2.2.1 Ice Cream, Kulfi, Chocolate Ice Cream or Softy Ice Cream means the product obtained by freezing a pasteurized mix prepared from milk and / or other products derived from milk with the addition of natural sweetening agents i.e. sugar, Dextrose, Fructose, Liquid glucose, Dried liquid glucose, maltodextrin, high maltose cam syrup, honey, fruit and fruit products, eggs and egg products, such as Cake, or Cookies as separate layer and / or coating. It may be frozen hard of frozen to a soft consistency. It shall be free from artificial sweetener. It shall have pleasant taste and smell free from off flavour ads acidity. It may contain food additives permitted in Appendix C. It shall conform to the microbiological requirements prescribed in Appendix D. It shall conform to the following requirements. **(PFA, 2004).**

Table 2.2 A/c to PFA standard, Ice Cream, Kulfi, Chocolate Ice Cream or Softy Ice Cream composition derived as:

Requirements	Ice Cream	Medium fat Ice Cream	Low fat Ice Cream
Total solids	Not less than 36.0 percent	Not less than 30.0 percent	Not less than 26.0 percent
Wt / Vol. (gms/l)	Not less than 525	Not less than 475	Not less than 475
Milk Fat	Not less than 10.0 percent	Not less than 5.0 percent	Note less than 2.5 percent
Milk Protein (Nx6.38)	Not less than 3.5 percent	Not less than 3.5 percent	Not less than 2.5 percent

Note: - in case where chocolate, cake or similar food coating, base or layer forms a separate part of the product only the ice cream portion shall conform to the requirements given above.

2.3 Codex standards

Table 2.3.a: Standards for Ice Cream, Kulfi, Chocolate Ice Cream or Softy Ice Cream composition derived as:

Requirements	Frozen Confection	MediumFatFrozenconfection	Low Fat Frozen confection
Total Solids	Not less than 36.0 percent	Not less than 30.0 percent	Not less than 26.0 percent
Weight Volume (gms/1)	Not less than 525.	Not less than 475.	Not less than 475.
Total Fat	Not less than 10.0 percent	Not less than 5.0 percent	Not less than 2.5, percent
Total Protein (N*6.25)	Not less than 3.5 percent	Not less than 3.5 percent	Not less than 2.5 percent

Source- Appendix II. Proposed Draft Standard for Aqueous Coconut Products (Advanced To Step 5 of the Codex Procedure)

Table 2.3.b: Standards for Microbiological Ice Cream, Kulfi, Chocolate Ice Cream or Softy Ice Cream composition derived as:

Requirements	Frozen Confection	Medium Fat Frozen confection	Low Fat Frozen confection
Total Solids	Not less than 36.0	Not less than 30.0	Not less than 26.0

	percent	percent	percent
Weight Volume (gms/1)	Not less than 525.	Not less than 475.	Not less than 475.
Total Fat	Not less than 10.0 percent	Not less than 5.0 percent	Not less than 2.5, percent
Total Protein (N*6.25)	Not less than 3.5 percent	Not less than 3.5 percent	Not less than 2.5 percent

2.4 Herbal Kulfi

Pinto, S.V. et al., (2010), concluded that the different forms of ginger at levels standardized previously i.e. ginger juice @ 4% (J), ginger shreds @ 4% (S), sugar syrup treated ginger shreds (T) @ 6% and ginger powder @ 1% (P) were used to prepare "ginger flavoured herbal kulfi" in an 'ice and salt type' freezer. The experimental ice creams werecompared with control (C) made using vanilla flavouring. The basic kulfi mix had 12% milk fat, 11% MSNF, 15% sucrose, 0.25% sodium alginate and 0.15% glycerol mono-stearate. Incorporation of ginger in any form resulted in slight decrease in all of the compositional attributes (fat, protein, sugar, total solids), except for acidity which increased. Ginger as flavouring tended to increase the viscosity of kulfi mixes and melting resistance of kulfi; however, barring for sample P, it had an adverse effect on the whipping ability of mixes. This led to decrease in overrun in all of the experimental kulfi. Sensorily, the order of preference for kulfi was: J > S > T > C > P; J and S were at par statistically. Incorporation of ginger juice or shreds at the rate of 4% by weight of mix is advocated for preparing "Ginger flavoured herbal kulfi".

2.5 Basil

2.5.1 Basil extract:-

Govindarajan *et al.*, (1982) reported that Fresh basil contains 80.9% moisture, 2.3% protein, 0.9% fat, 1.2% minerals, 2.4% fiber and 12.3% carbohydrates. The minerals present in basil are iron, calcium and phosphorous. It also contains vitamins such as thiamine, riboflavin, niacin and vitamin C. The composition varies with the type, variety, agronomic conditions, curing methods, drying and storage conditions.

Kuma *et al.*, (2005) investigated that use of basil extract makes it possible to synergistically achieve promotion of the growth of the lactic acid bacteria and an improvement in its viability.

2.5.2 Basil in Traditional Use

Tyler *et al.*, (1981) studied that Basil is an essential ingredient in many traditional Chinese medicines and has been used since the 4th century BC. Africans and West Indians also use basil medicinally and the Greeks and Romans use it as spice6.

Langner *et al.*, (1998) studied that basil (Zingiber officinale) belongs to Zingiberaceae family. The part of the plant used is rhizome. The plant produces an orchid like flower with petals that are greenish yellow streaked with purple colour. Basil is cultivated in areas of abundant rainfall. Even though it is native to southern Asia, basil is cultivated in tropical areas also such as Jamaica, China, Nigeria and Haiti. It is an important spice crop in India. About 9000 metric ton (MT) of basil valued at 4.5 crores was exported in 2001. It is mainly cultivated in Karla, Karnataka, and Tamil Nadu and North Eastern states. In Sanskrit, basil is known as Sringavera which has given way to Zingiberi in Greek and to the Latin Zingiber. Basil has been used as medicine from Vedic period and is called "maha aushadhi", means the great medicine. In traditional medicine, it was used as a carminative or antiflatulent. The Greek physician Galen used basil as a purificant of body. He used basil to treat conditions caused by imbalances in body.

Warrier *et al.*,(1989) studied that in Ayurveda, basil has been recommended for use as carminative, diaphoretic, antispasmodic, expectorant, peripheral circulatory stimulant, astringent, appetite stimulant, anti-inflammatory agent, diuretic and digestive aid.

3.MATERIALS AND METHODS

The experiment "Development of technology to manufacture herbal kulfi by utilizing different combinations of (*Ocimum basilicum*) basil" was carried out in the Lab of Dairy Science, Faculty of Agriculture, Shri Ram college, Muzaffarnagar (U.P.).

The control and experimental Kulfi samples was tested and statistically analyzed. The details of experimental techniques employed during the course of present investigation are under the following heading:

3.1 Material required for preparation of control & experimental Kulfi.

3.2 Procurement and collection of ingredients.

3.3 Treatments.

3.4 Detailed procedure for manufacturing control & experimental Kulfi.

3.5 Flow Diagram adopted for manufacturing control & experimental Kulfi.

3.6 Testing of control and experimental product.

3.7 Physico-chemical analysis of control and experimental Kulfi.

3.8 Organoleptic analysis of control and experimental Kulfi.

3.9 Microbiological analysis control and experimental Kulfi.

3.10 Statistical analysis of control and experimental Kulfi.

3.1 Material required

1. Milk
2. Sugar
3. Basil
4. Stabilizer and emulsifiers
5. Skim milk powder.
6. Nuts

3.2 Procurement and collection of ingredients

Skimmed milk powder: - Skimmed milk powder Brand Anik spray was obtained from the local market of Muzaffarnagar.

Sugar: - It was procured from the local market of Muzaffarnagar.

Stabilizer: - Sodium alginate was obtained from scientific cooperation, Muzaffarnagar.

Emulsifier:-Monoglycerides was obtained from scientific cooperation, Muzaffarnagar.

Nuts:-cashew nut was procured from local market Muzaffarnagar.

Basil leaf: - was procured from local area of Muzaffarnagar.

3.3 Treatments

Treatment	Milk fat	Cane sugar	Skim milk powder	Stabilizer	Emulsifier	Basil leaf extract	Total solids
T_0	10	15	9.6	0.1	0.2	—	37
T_1	10	15	9.6	0.1	0.2	4 %	37
T_2	10	15	9.6	0.1	0.2	6 %	37
T_3	10	15	9.6	0.1	0.2	8 %	37

T_0 Kulfi mix was standardized to 10% fat, milk solids not fat 12%, sugar 15%, 0.3 % of stabilizer and 0.2% emulsifiers.

T_1 Kulfi mix was standardized to 10% fat, milk solids not fat 12%, 0.3% of stabilizer, 0.2 % emulsifiers, the rate of addition of sugar 15% with 3% Basil leaf extract, Skim milk powder was added as a source of MSNF as required so that the formulation contains 37 % total solids.

T_2 Kulfi mix was standardized to 10% fat, milk solids not fat 12%, 0.3% stabilizer, 0.2% emulsifiers, 15 % sugar with 5% Basil leaf extract, and Skim milk powder was added as a source of MSNF as required so that the formulation contains 37 % total solids.

T_3 Kulfi mix was standardized to 10% fat, milk solids not fat 12%, 0.3% of stabilizer, 0.2% emulsifiers, the rate of addition/ of sugar 15% with 7% Basil leaf extract, Skim milk powder was added as a source of MSNF as required so that the formulation contains 37 % total solids.

3.4 Detail procedure adopted for manufacturing Kulfi

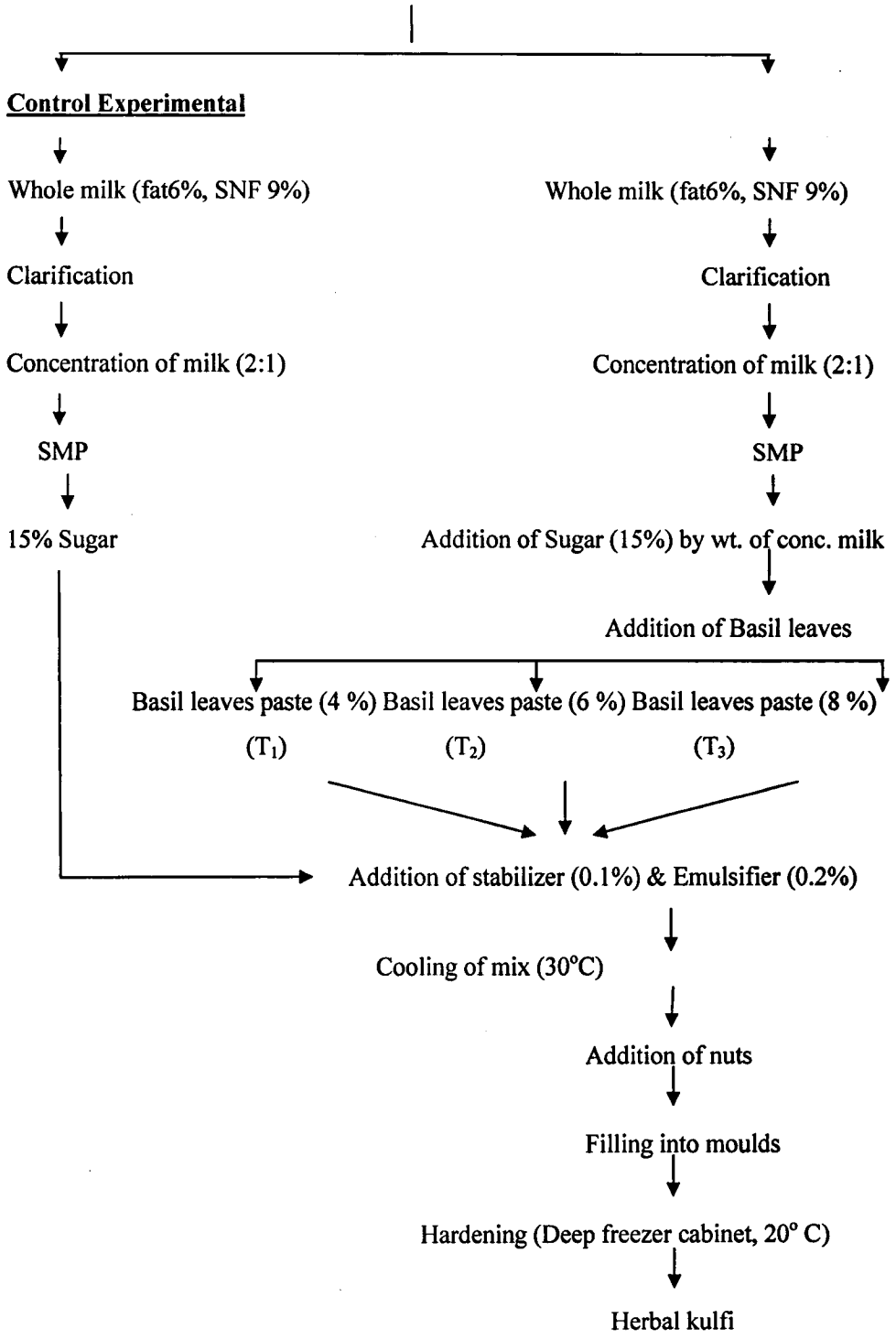
The control Kulfi was prepared by following the standard procedure of **Salooja, *et al*** (1982).with slight modification Here, 2 Kgs of standard milk with 4.5% fat and 8.5% msnf

was placed in a steel pan with a wooden plunger and heated by placing pan in a container containing water (double jacketed vat arrangement) over direct fire. The milk was condensed to (2:1) ratio Kulfi mix was standardized by adding calculated amount of liquid ingredients like condensed milk and cream and dry ingredient like, sugar, stabilizer and emulsifier to obtain total solids of 37% in the final mix The mix was held at 68 °C for 30 minutes to fulfill the PFA requirement of pasteurization .During holding 0.3 and 0.2 percent Stabilizer and Emulsifier was added. Then the mix was cooled immediately to 5 °C, and other ingredients such as flavour colour and cashew nuts were added. The mix will subsequently Frozen in a batch freezer and subsequently be transferred into Kulfi moulds and hardened at -20^{0}c over night.

For experimental Kulfi mix

Here, 1 Kg of whole milk with 6% fat and 9.0% msnf was placed in a steel pan with a wooden plunger and heated by placing pan in a container containing water (double jacketed vat arrangement) over direct fire. The milk was condensed to (2:1) ratio calculated amount of liquid ingredients like condensed milk and cream and dry ingredient like, sugar, stabilizer and emulsifier was added as per the requirement in treatments T_1, T2, and T_3 .Then mix was held at 68 °C for 30 minutes to fulfill the PFA requirement of pasteurization and cooled to 42°C and Basil leaf extract in different variation. Then the mix was cooled to 5 °C, and other ingredient such as cashew nuts was added. The mix will subsequently Frozen in a batch freezer and subsequently transferred into Kulfi moulds and hardened at -20^{0}c over night.

3.5(A) Flow chart for manufacturing Herbal Kulfi



T_o = Whole milk + 15% sugar (Control Kulfi).

T_1 = Herbal Kulfi with whole milk + 15% sugar + Basil leaves (4 %).

T_2 = Herbal Kulfi with whole milk + 15% sugar + Basil leaves (6 %).

T_3 = Herbal Kulfi with whole milk + 15% sugar + Basil leaves (8 %).

(B) Flow diagram for basil leaves extract:

Basil leaves (100 g)

↓

Washing

↓

Cutting

↓

Grinding with water (10 ml water)

↓

Basil leaves paste

↓

Boiling with water (20 ml water)

↓

Squeeze

↓

Filter

↓

Basil leaves extract (50 ml.)

↓

Stored at refrigerated temp (at 7^0C)

3.6 Testing of control and experimental Kulfi:

3.6.1 Sampling

According to Codex General Guidelines on Sampling

Sampling of Kulfi

The technique followed for sampling of ice cream and frozen dessert for analysis was as per I.S.2802 (1964).

3.7 Physico-Chemical Analysis:

Fat percent in frozen dessert-The fat percent in Kulfi was determined as per **I.S.2802 (1964)**

Determination of total solids -Total solids in plain Kulfi and probiotic Kulfi was determined gravimetrically as per the procedure laid down in dairy chemistry manual, ICAR Publication and in **IS:1479,Part: II, 1961(20)**

Determination of moisture-The moisture percentage in Kulfi was determined as per procedure laid down in **IS.1165 (1957).**

Moisture percentage in skim milk powder-The moisture percent in skim milk powder will determined as per **I.S.1165 (1957).**

Percentage of Acidity-Titratable acidity of Plain Kulfi and probiotic Kulfi samples (expressed as lactic acid) was determined as per the procedure laid down in **IS: 1479, Part: I. (1960)**

Freezing time-The total time taken for freezing was determined by noting time when freezing was started up to the time the mixture was taken out from the freezer and then taking their difference.

Melting resistance of Kulfi-Melting quality of ice cream/Kulfi was observed by placing a scoopful of the sample on a dish and noting its response to melting from time to time as the other qualities of Kulfi was being examined. **(Nelson and Trout, 1951)**

3.8 Organoleptic evolution-The Kulfi samples of different treatments was analyzed for organoleptic Quality (flavour, body, texture, colour, appearance and melting resistance). Attributes was rated on nine point Hedonic scale **(Nelson and Trout, 1964)**

Judging panel: Five experienced staff members of the Dairy Technology Department was served as a judging team and was evaluated the samples of control and experimental probiotic Kulfi. Numerical scores were allocated for flavor, body and texture, melting quality and color of the probiotic Kulfi. The numerical score was used as an indication of the quality. The Judges was also identifying qualities and they will consider to unsatisfactory or satisfactory.

3.9 Microbiological Analysis:

- Total viable count (SPC)
- Coli form test
- Yeast & Moulds

Viability of micro organisms:

Microbiological analyses were conducted on probiotic kulfi by using MRS maltose & MRS sorbitol respectively.

11 grams of curd samplewas mixed with 99 grams of ringer solution and serial dilution was made up to 10^5 to 10^7. One ml from the dilution of 10^5 to 10^7 was spread on MRS maltose & MRS sorbitol the plates were then incubated at 37^0C for 72 hours anaerobic condition.

Coli form count:

Coliform count of probiotic Kulfi was determined as per the procedure given in "Manual in Dairy Bacteriology." **ICAR, (1972).**

3.10 STATISTICAL ANALYSIS:

The data was analyzed statistically by analysis of variance at 5% level of significance.

Number of treatments	-	4
Number of replications	-	5
Total number of samples	-	20

Data obtained from the organoleptic, physico-chemical analysis and microbiological analysis data were statistically analyzed by using analysis of variance-two way classification, critical difference and t-test (Appendix-D)

4.RESULTS AND DISCUSSION

The present study was based to evolve "Development of technology to manufacture herbal kulfi by utilizing different combination of (*Ocimum basilicum*) basil". The data collected on different aspects were tabulated & analyzed statistically using the methods of analysis of variance & critical difference. The significant & non-significant differences observed have been analyzed critically within & between the treatment combinations.

The results obtained from the analysis are presented in this chapter under the following headings:

- ✓ Physico-chemical characteristics of Herbal Kulfi.
- ✓ Organoleptic characteristics of Herbal Kulfi.
- ✓ Microbiological characteristics of Herbal Kulfi.
- ✓ Cost of production of Herbal Kulfi.

The different parameters of control and experimental Herbal kulfi:

Parameter	Increasing order of scores /values based on mean values of different parameters of treatment			
1. Chemical analysis (in percentage)				
Fat	T_0 (10.14)	T_1 (10.12)	T_2 (10.06)	T_3 (10.00)
Total solids	T_0 (37.36)	T_1 (37.24)	T_2 (37.24)	T_3 (37.16)
Acidity	T_3 (0.24)	T_2 (0.23)	T_1(0.23)	T_0(0.22)
Protein	T_3 (3.76)	T_2 (3.72)	T_1 (3.64)	T_0 (3.58)
Moisture	T_3 (62.84)	T_2 (62.76)	T_1 (62.76)	T_0 (62.64)
pH	T_3(6.25)	T_1 (6.21)	T_0 (6.15)	T_1 (6.14)
Ash	T_3(0.71)	T_2 (0.67)	T_3 (0.60)	T_0 (0.53)
2. Physical analysis				
Melting resistant (In minutes)	T_1(6.09)	T_2 (6.06)	T_3 (6.6)	T_0 (5.12)
3. Organoleptic scores (9 point hedonic scale)				

Colour&Appearance	T_2 (8.50)	T_3 (8.50)	T_1 (8.26)	T_0(8.14)
Body &Texture	T_2 (8.60)	T_1 (8.00)	T_0 (8.12)	T_3 (7.82)
Flavour & taste	T_2(8.58)	T_0 (8.38)	T_1 (8.36)	T_3 (8.27)
Melting resistance	T_2(8.58)	T_0 (8.30),	T_3 (8.14)	T_1 (8.00)
4. Microbiological analysis				
SPC (cfu/g)	T_2 (8.50)	T_3 (8.50)	T_1 (8.26)	T_0 (8.14)
Coliform (cfu^2/g)	G-Ve	G-Ve	G-Ve	G-Ve
Yeast & Moulds (per g)	T_0 (20.66)	T_3 (15.33)	T_1 (13.33)	T_2 (11.33)
5. Cost				
kulfi (in rupees/kg)	T_3 (54.68)	T_2(52.68)	T_1(50.68)	T_0(46.68)

Similar alpha bets represent N.S. differences

4.1 Physico-chemical characteristics of Herbal Kulfi:

4.1.1. Fat percentage in Herbal Kulfi

The data regarding fat percentage in Herbal Kulfi sample of different treatments are presented in table 4.1.a. and figure 4.1

4.1.a: Percentage Fat in control and experimental Herbal Kulfi .

Replication		Treatments			
		T_0	T_1	T_2	T_3
R_1		10.10	10.00	10.10	10.10
R_2		10.30	10.20	9.90	10.30
R_3		10.20	10.30	10.20	9.40
R_4		10.00	10.10	10.10	10.00
R_5		10.10	10.00	10.00	10.20
	Mean	**10.14**	**10.12**	**10.06**	**10.00**
Range	**Minimum**	10.00	10.00	9.90	9.40
	Maximum	10.30	10.30	10.20	10.30
F- test		NS			
S. Ed. (±)		0.144			

C.D. at 5% level	0.311

1. From perusal of data on fat percentage in Herbal Kulfi samples of different treatments and control, the highest mean fat percentage was recorded in the Herbal Kulfi sample of T_1 (10.12) followed by T_0 (10.14), T_2 (10.06) and T_3 (10.00).

Table 4.1.b: ANOVA for Percentage Fat in control and experimental Herbal Kulfi

Source	d. f.	S.S.	M.S.S.	F. Cal.	F.Tab.at5%	Result
Replication	4	0.0520	0.0130	0.25	3.26	NS
Treatment	3	0.0600	0.0200	0.39	3.49	NS
Error	12	0.6200	0.0517	-	-	-
TOTAL	19	0.7320	-			-

**No significant

2. As evident from the result of ANOVA given in Table 4.1.b., the F (Cal)value (0.39) wassmaller than the table value of F (3.49) at 5% level of significance.Therefore; the difference was non-significant, indicating no significant effect of treatments on fat percentage,which may be ascribed to proper standardization of Herbal Kulfi mix.

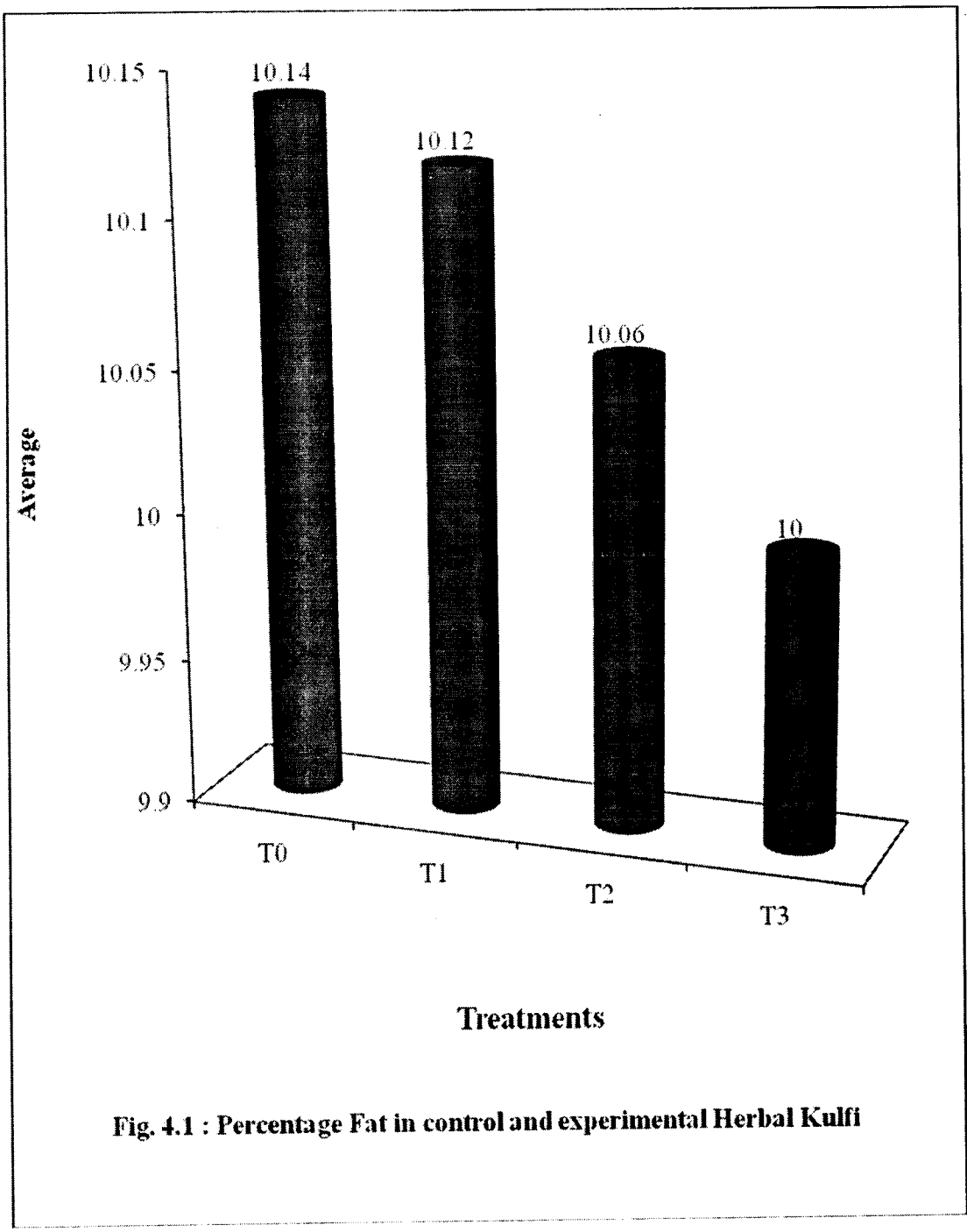


Fig. 4.1 : Percentage Fat in control and experimental Herbal Kulfi

T_0 = Whole milk + SMP + 15% sugar (Control Kulfi).

T_1 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (4 %).

T_2 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (6 %).

T_3 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (8 %).

4.1.2. Total solids percentage in Herbal Kulfi

The data regarding total solid percentage in Herbal Kulfi sample of different treatments are presented in table 4.2.a and figure 4.2.

Table 4.2.a: Percentage Total solids in control and experimental Herbal Kulfi

Replication		Treatments			
		T_0	T_1	T_2	T_3
R_1		37.20	37.20	37.20	37.10
R_2		37.40	37.20	37.30	37.20
R_3		37.50	37.30	37.30	37.10
R_4		37.40	37.30	37.20	37.20
R_5		37.30	37.20	37.20	37.20
	Mean	**37.36**	**37.24**	**37.24**	**37.16**
Range	**Minimum**	37.20	37.20	37.20	37.10
	Maximum	37.50	37.30	37.30	37.20
F- test		S			
S. Ed. (±)		0.040			
C.D. at 5% level		0.086			

1. From perusal of data on Total solid percentage in Herbal Kulfi samples of different treatments and control, the highest mean was recorded in the Herbal Kulfi sample of T_1-T_2 (37.24) followed by T_0 (37.36) and T_3 (37.16).

Table 4.2.b: ANOVA for Percentage Total solids in control and experimental Herbal Kulfi

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. At 5%	Result
Replication	4	0.0400	0.0100	2.50	3.26	**NS**
Treatment	3	0.1020	0.0340	8.50	3.49	**S**
Error	12	0.0480	0.0040	-	-	-
TOTAL	19	0.1900	-			-

*Significant

2. As evident from the result of ANOVA given in Table 4.2.b., the F (Cal)value (8.50) wasgreater than the table value of F (3.49) at 5% level of significance. Therefore; the difference was significant, indicating significant effect of treatments on total solid percentage.

3. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.2.c

Table 4.2.c:Critical difference in percentage Total solids in control and experimental Herbal Kulfi

Treatments	Average	T_0	T_1	T_2	T_3
		37.36	37.24	37.24	37.16
T_0	37.36		0.12*	0.120*	0.20*
T_1	37.24			0.000	0.08
T_2	37.24				0.08
T_3	37.16				

C.D. = 0.086

The following observations were made:

The difference between the mean values of T_0-T_1 (0.12) was greater than the C.D. value, 0.086.Therefore, the difference was significant.

The difference between the mean values of T_0-T_2 (0.120) was greater than the C.D. value, 0.086.Therefore, the difference was significant.

The difference between the mean values of T_0-T_3 (0.20) was greater than the C.D. value, 0.086.Therefore, the difference was significant..

The difference between the mean values of T_1-T_2 (0.00) was smaller than the C.D. value, 0.086.Therefore, the difference was non-significant.

The difference between the mean values of T_1-T_3 (0.08) was smaller than the C.D. value, 0.086.Therefore, the difference was non-significant.

The difference between the mean values of T_2-T_3 (0.08) was less than the C.D. value, 0.086.Therefore, the difference was non-significant.

It is therefore concluded that there was non-significant difference b/w the T_0-T_1, T_1-T_2, T_1-T_3& T_2 –$T_3$and there was significant difference b/w the all other treatments which may be ascribed to addition of different level of basil leaves extract in treatments.

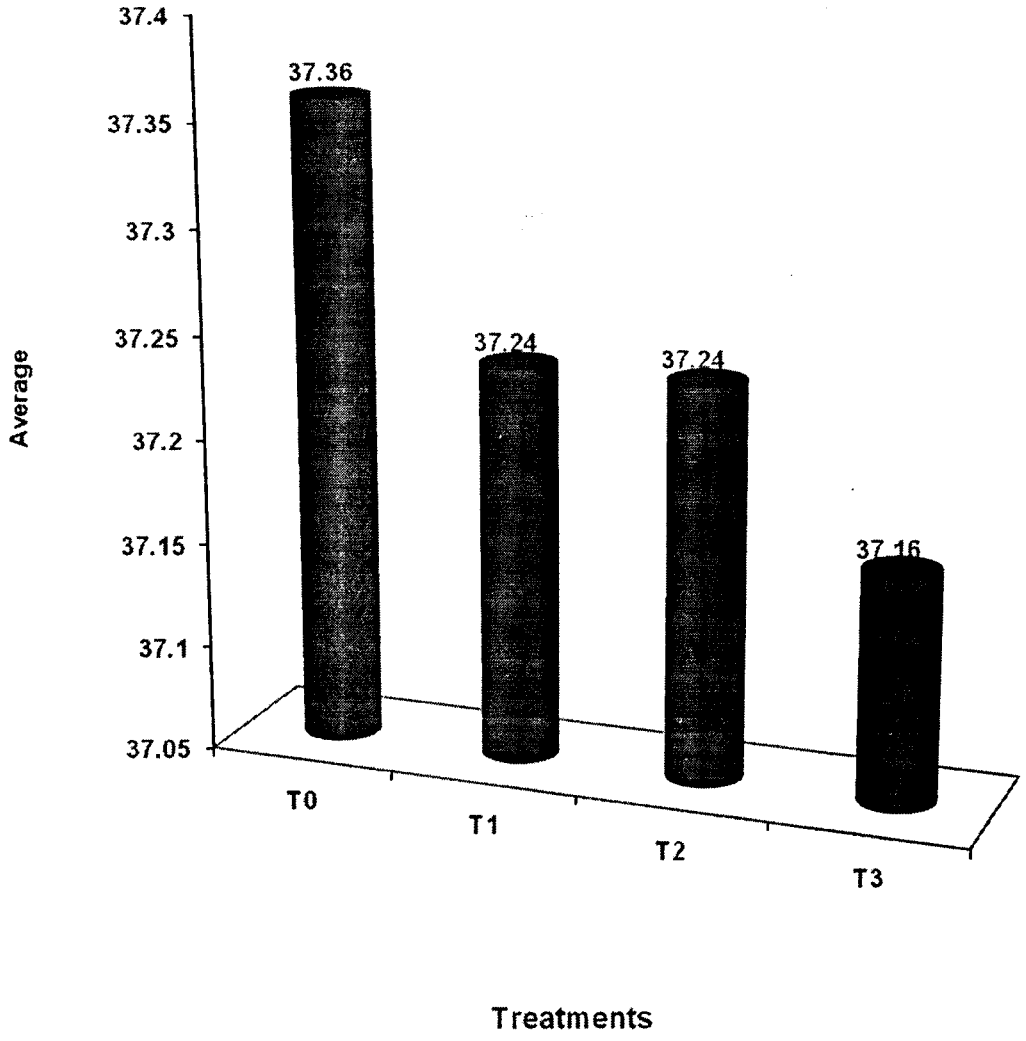


Fig. 4.2 :Percentage Total solids in control and experemental Herbal Kulfi.

T_0 = Whole milk + SMP + 15% sugar (Control Kulfi).

T_1 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (4 %).

T_2 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (6 %).

T_3 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (8 %).

4.3. Acidity (Lactic acid) percent in Herbal Kulfi

The data regarding Lactic acid percent in Herbal Kulfi sample of different treatments are presented in table 4.3.a and figure 4.3

Table 4.3.a: Percentage lactic acid in control and experimental Herbal Kulfi

Replication		Treatments			
		T_0	T_1	T_2	T_3
R_1		0.20	0.23	0.26	0.26
R_2		0.24	0.24	0.20	0.25
R_3		0.25	0.25	0.25	0.24
R_4		0.21	0.21	0.24	0.22
R_5		0.19	0.20	0.22	0.24
	Mean	**0.22**	**0.23**	**0.23**	**0.24**
Range	**Minimum**	0.19	0.20	0.20	0.22
	Maximum	0.25	0.25	0.25	0.26
F- test		NS			
S. Ed. (±)		0.012			
C.D. at 5% level		0.026			

1. From the perusal of data of Lactic acid percentage in Herbal Kulfi samples of different treatments and control, that highest mean Lactic acid percentage was recorded in the Herbal Kulfi sample of T_3 (0.24), followed by T_2 (0.23), T_1 (0.23) and T_0 (0.22).

Table 4.3b: ANOVA for Percentage of lactic acid in control and experimental Herbal Kulfi

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. 5%	Result
Replication	4	0.0031	0.0008	2.07	3.26	**NS**

Treatment	3	0.0016	0.0005	1.42	3.49	**NS**
Error	12	0.0045	0.0004	-	-	-
TOTAL	19	0.0092	-			-

**Significant

2. As evident from the result of ANOVA given in Table 4.3.b., the F (Cal)value (1.42) wassmaller than the table value of F (3.49) at 5% level of significance. Therefore; the difference was no significant, indicating no significant effect of treatments on Lactic acid percentage, which may be ascribed to addition of different level of basil leaves extract in treatments.

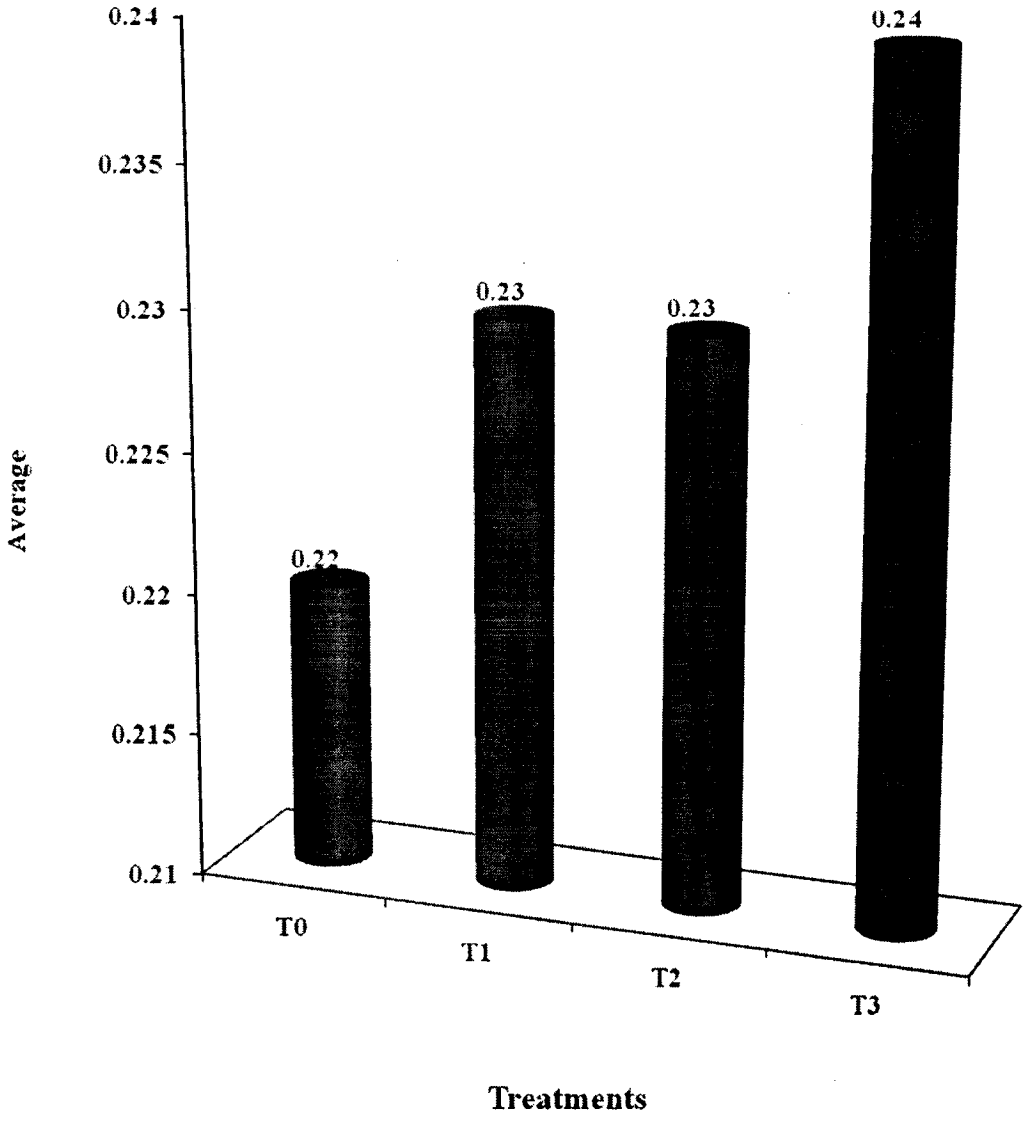


Fig. 4.3 : Percentage lactic acid in control and experimental Herbal Kulfi

T_0 = Whole milk + SMP + 15% sugar (Control Kulfi).

T_1 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (4 %).

T_2 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (6 %).

T_3 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (8 %).

4.4. Protein percent in Herbal Kulfi

The data regarding in protein percent in Herbal Kulfi sample of different treatments are presented in table 4.4.a and figure 4.4.

Table 4.4.a: Percentage protein in control and experimental Herbal Kulfi

Replication		Treatments			
		T_0	T_1	T_2	T_3
R_1		3.60	3.60	3.70	3.70
R_2		3.50	3.70	3.80	3.80
R_3		3.60	3.80	3.70	3.80
R_4		3.60	3.40	3.70	3.70
R_5		3.60	3.70	3.70	3.80
	Mean	**3.58**	**3.64**	**3.72**	**3.76**
Range	**Minimum**	3.50	3.50	3.70	3.70
	Maximum	3.60	3.80	3.80	3.80
F- test		S			
S. Ed. (±)		0.052			
C.D. at 5% level		0.112			

1. From the perusal of data on protein percent in Herbal Kulfi samples of different treatments and control,the highest mean protein percent was recorded in the Herbal Kulfi sample of T_3 (3.76) , T_2 (3.72) followed by T_1 (3.64) and T_0 (3.58).

Table 4.4.b: ANOVA for percentage of protein in samples of control and experimental Herbal Kulfi mix of different treatments

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. At 5%	Result
Replication	4	0.0400	0.0100	1.50	3.26	**NS**

Treatment	3	0.0975	0.0325	4.88	3.49	**S**
Error	12	0.0800	0.0067	-	-	-
TOTAL	19	0.2175	-			-

*Significant

2. As evident from the result of ANOVA given in Table 4.4.b., the F (Cal) value (4.88) was greater than the table value of F (3.49) at 5% level of significance. Therefore; the difference was significant, indicating significant effect of treatments on protein percentage.

3. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.4.c

Table 4.4.c: Critical difference in percentage protein in samples of control and experimental Herbal Kulfi

Treatments	**Average**	**T_0**	**T_1**	**T_2**	**T_3**
		3.58	**3.64**	**3.72**	**3.76**
T_0	3.58		0.06	0.140*	0.18*
T_1	3.64			0.080	0.12*
T_2	3.72				0.04
T_3	3.76				

C.D. = 0.112

Following observations were made:

The difference between the mean values of T_0-T_1 (0.06) was smaller than the C.D. value, 0.112.Therefore, the difference was non-significant.

The difference between the mean values of T_0-T_2 (0.14) was greater than the C.D. value, 0.112.Therefore, the difference was significant.

The difference between the mean values of T_0-T_3 (0.18) was greater than the C.D. value, 0.112.Therefore, the difference was significant.

The difference between the mean values of T_1-T_2 (0.08) was smaller than the C.D. value, 0.112.Therefore, the difference was non-significant.

The difference between the mean values of T_1-T_3 (0.12) was greater than the C.D. value, 0.112.Therefore, the difference was significant.

The difference between the mean values of T_2-T_3 (0.04) was smaller than the C.D. value, 0.112.Therefore, the difference was non-significant.

It is therefore concluded that there was non-significant difference b/w the T_0-T_1, T_1 –T_2, T_2 – T_3 .and there was significant difference b/w the all other treatments which may be ascribed to addition of different level of basil leaves extract in treatments.

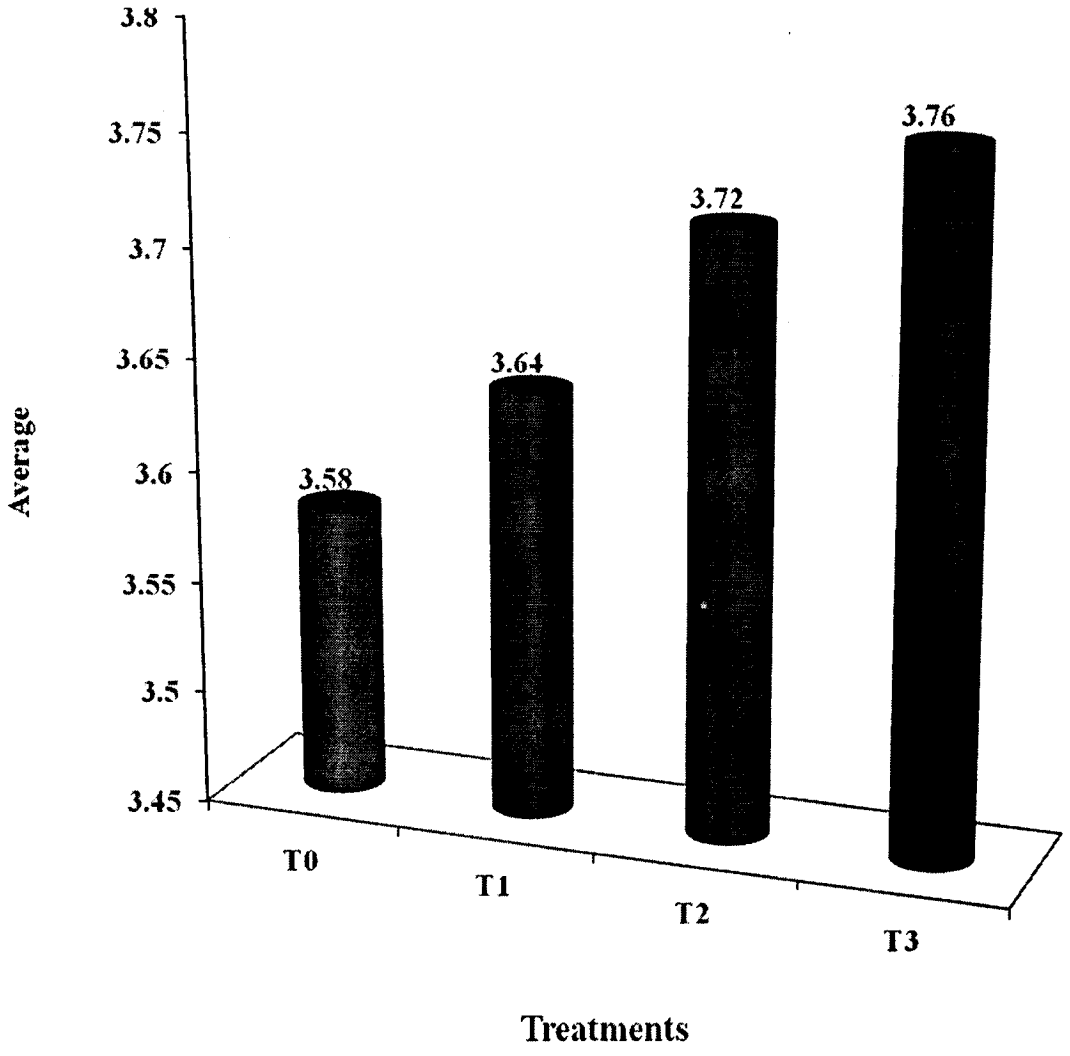


Fig. 4.4 : Percentage protein in samples of control and experimental Herbal Kulfi.

T_0 = Whole milk + SMP + 15% sugar (Control Kulfi).

T_1 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (4 %).

T_2 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (6 %).

T_3 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (8 %).

4.5: Moisture percent in Herbal Kulfi:

The data regarding moisture percent in Herbal Kulfi sample of different treatments are presented in table 4.5.a and figure 4.5.

Table 4.5.a: Percentage moisture in control and experimental Herbal Kulfi

Replication		Treatments			
		T_0	T_1	T_2	T_3
R_1		62.80	62.80	62.90	63.00
R_2		62.60	62.80	62.60	62.80
R_3		62.50	62.70	62.70	62.90
R_4		62.60	62.60	62.80	62.70
R_5		62.70	62.90	62.80	62.80
	Mean	**62.64**	**62.76**	**62.76**	**62.84**
Range	**Minimum**	62.50	62.60	62.60	62.70
	Maximum	62.80	62.90	62.90	63.00
F- test		S			
S. Ed. (±)		0.056			
C.D. at 5% level		0.120			

1. From the perusal of data on moisture percent in Herbal Kulfi samples of different treatments and control the highest mean moisture percent was recorded in the Herbal Kulfi sample of T_3 (62.84) followed by T_2 (62.76), T_1 (62.76) and T_0 (62.64).

Table 4.5b: ANOVA for percentage of moisture in samples of control and experimental Herbal Kulfi

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. At 5%	Result
Replication	4	0.1150	0.0288	3.71	3.26	**S**
Treatment	3	0.1020	0.0340	4.39	3.49	**S**

Error	12	0.0930	0.0077	-	-	-
TOTAL	19	0.3100	-			-

*Significant

2. As evident from the result of ANOVA given in Table 4.5.b., the F (Cal) value (4.39) was greater than the table value of F (3.49) at 5% level of significance. Therefore; the difference was significant, indicating significant effect of treatments on moisture percentage.

3. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.5.c

Table 4.5.c:Critical difference in percentage of moisture in samples of control and experimental Herbal Kulfi of different treatments

Treatments	**Average**	**T_0**	**T_1**	**T_2**	**T_3**
		62.64	**62.76**	**62.76**	**62.84**
T_0	62.64		0.12	0.120	0.20*
T_1	62.76			0.000	0.08
T_2	62.76				0.08
T_3	62.84				

C.D. = 0.120

Following observations were made:

The difference between the mean values of T_0-T_1 (0.12) was similar than the C.D. value, 0.120.Therefore, the difference was significant.

The difference between the mean values of T_0-T_2 (0.12) was similar than the C.D. value, 0.120.Therefore, the difference was significant.

The difference between the mean values of T_0-T_3 (0.00) was smaller than the C.D. value, 0.120.Therefore, the difference was non-significant.

The difference between the mean values of T_1-T_2 (0.00) was smaller than the C.D. value, 0.120.Therefore, the difference was non-significant.

The difference between the mean values of T_1-T_3 (0.08) was smaller than the C.D. value, 0.120.Therefore, the difference was non-significant.

The difference between the mean values of T_2-T_3 (0.08) was smaller than the C.D. value, 0.120.Therefore, the difference was non-significant.

It is therefore concluded that there was significant difference b/w the T_0-T_1, T_0-T_2,and there was non-significant difference b/w the all other treatments which may be ascribed to addition of different level of basil leaves extract in treatments.

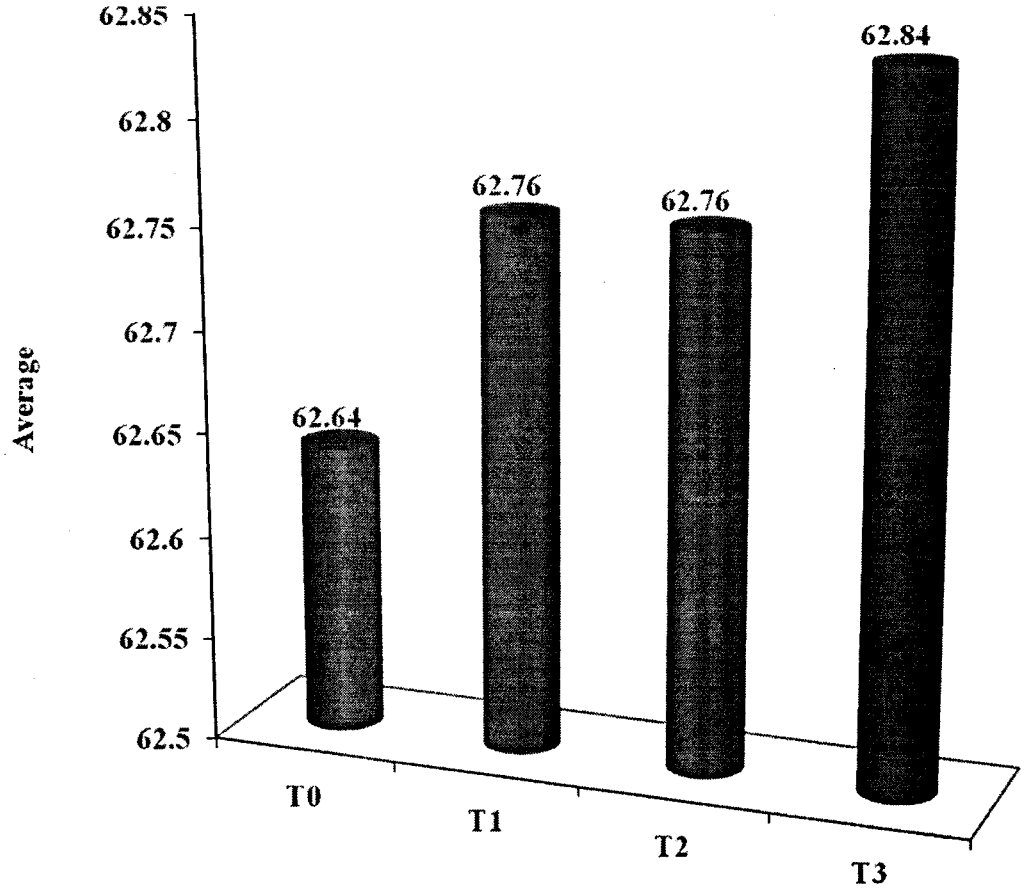


Fig. 4.5 : Percentage moisture in control and experimental Herbal Kulfi.

T_0 = Whole milk + SMP + 15% sugar (Control Kulfi).

T_1 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (4 %).

T_2 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (6 %).

T_3 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (8 %).

4.6. pH percent in Herbal Kulfi:

The data regarding pH percent in Herbal Kulfi sample of different treatments are presented in table 4.6.a and figure 4.6.

Table 4.6.a: Percentage pH in control and experimental Herbal Kulfi

Replication		Treatments			
		T_0	T_1	T_2	T_3
R_1		6.15	6.20	6.21	6.25
R_2		6.12	6.21	6.20	6.20
R_3		6.18	6.18	6.09	6.28
R_4		6.17	6.22	6.00	6.29
R_5		6.14	6.23	6.22	6.25
	Mean	**6.15**	**6.21**	**6.14**	**6.25**
Range	**Minimum**	6.12	6.18	6.09	6.20
	Maximum	6.18	6.23	6.22	6.29
F- test		S			
S. Ed. (±)		0.037			
C.D. at 5% level		0.080			

1. From the perusal of data on pH percent in Herbal Kulfi samples of different treatments and control, the highest mean pH percent was recorded in the Herbal Kulfi sample of T_3 (6.25) followed by T_1 (6.21), T_0 (6.15) and T_1 (6.14).

Table 4.6.b: ANOVA for percentage of pH in s control and experimental Herbal Kulfi

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. At 5%	Result
Replication	4	0.0043	0.0011	0.31	3.26	**NS**
Treatment	3	0.0399	0.0133	3.86	3.49	**S**

Error	12	0.0413	0.0034	-	-	-
TOTAL	19	0.0855	-			-

*Significant

2. As evident from the result of ANOVA given in Table 4.6.b., the F (Cal) value (3.860) was greater than the table value of F (3.49) at 5% level of significance. Therefore; the difference was significant, indicating significant effect of treatments on pH percentage.
3. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.6.c

Table 4.6.c: Critical difference in percentage pH in samples of control and experimental Herbal Kulfi

Treatments	**Average**	T_0	T_1	T_2	T_3
		6.15	**6.21**	**6.14**	**6.25**
T_0	6.15		0.06	0.001	0.10*
T_1	6.21			0.07	0.04
T_2	6.14				0.11*
T_3	6.25				

C.D. = 0.080

Following observations were made:

The difference between the mean values of T_0-T_1 (0.06) was smaller than the C.D. value, 0.080.Therefore, the difference was non-significant.

The difference between the mean values of T_0-T_2 (0.01) was smaller than the C.D. value, 0.080.Therefore, the difference was non-significant.

The difference between the mean values of T_0-T_3 (0.10) was greater than the C.D. value, 0.080.Therefore, the difference was significant.

The difference between the mean values of T_1-T_2 (0.07) was smaller than the C.D. value, 0.080.Therefore, the difference was non-significant.

The difference between the mean values of T_1-T_3 (0.04) was smaller than the C.D. value, 0.080.Therefore, the difference was significant.

The difference between the mean values of T_2-T_3 (0.11) was greater than the C.D. value, 0.080.Therefore, the difference was significant.

It is therefore concluded that there was significant difference b/w the T_1-T_3andT_2 – T_3 .and there was non-significant difference b/w the all other treatmentswhich may be ascribed to addition of different level of basil leaves extract in treatments.

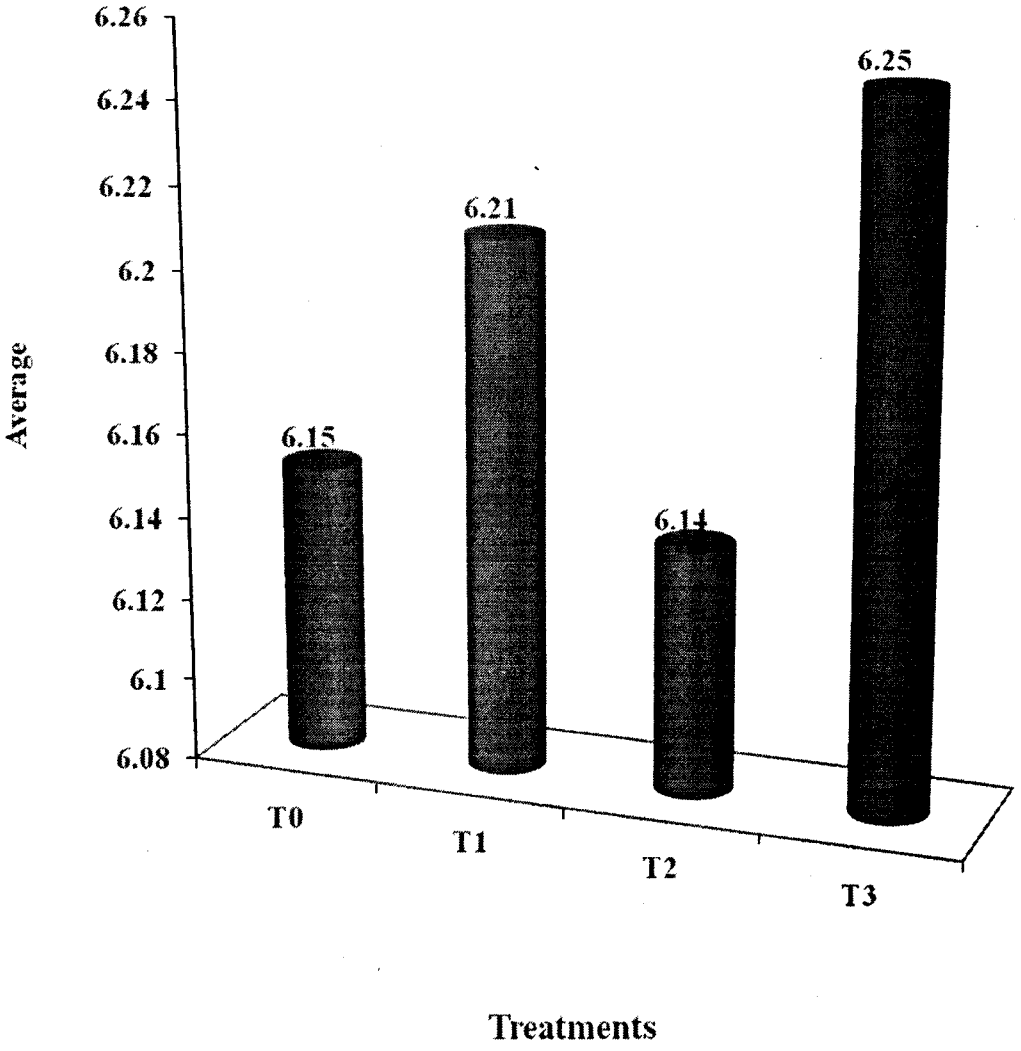


Fig. 4.5 : Percentage pH in samples of control and experimental Herbal Kulfi

T_0 = Whole milk + SMP + 15% sugar (Control Kulfi).

T_1 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (4 %).

T_2 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (6 %).

T_3 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (8 %).

4.7. Ash percent in Herbal Kulfi:

The data regarding ash percent in Herbal Kulfi sample of different treatments are presented in table 4.7.a and figure 4.7.

Table 4.7.a: Percentage ash in control and experimental Herbal Kulfi

Replication		Treatments			
		T_0	T_1	T_2	T_3
R_1		0.50	0.60	0.62	0.73
R_2		0.55	0.59	0.65	0.68
R_3		0.52	0.60	0.70	0.71
R_4		0.58	0.62	0.68	0.74
R_5		0.51	0.61	0.69	0.70
	Mean	**0.53**	**0.60**	**0.67**	**0.71**
Range	**Minimum**	0.50	0.59	0.72	0.68
	Maximum	0.58	0.62	0.70	0.74
F- test		S			
S. Ed. (±)		0.015			
C.D. at 5% level		0.033			

1. From the perusal of data on ash percent in Herbal Kulfi samples of different treatments and control the highest mean ash percent was recorded in the Herbal Kulfi sample of T_3 (0.71) followed by T_3 (0.60), T_2 (0.67) and T_0 (0.53).

Table 4.7.b: ANOVA for percentage ash in control and experimental Herbal Kulfi

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. At 5%	Result

Replication	4	0.0044	0.0011	1.88	3.26	**NS**
Treatment	3	0.0922	0.0307	52.85	3.49	**S**
Error	12	0.0070	0.0006	-	-	-
TOTAL	19	0.1036	-			-

*Significant

2. As evident from the result of ANOVA given in Table 4.7.b., the F (Cal) value (52.85) was greater than the table value of F (3.49) at 5% level of significance. Therefore; the difference was significant, indicating significant effect of treatments on ash percentage.

3. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.7.c

Table 4.7c: Critical difference in percentage of ash in samples of control and experimental Herbal Kulfi

Treatments	**Average**	T_0	T_1	T_2	T_3
		0.53	**0.60**	**0.67**	**0.71**
T_0	0.53		0.07*	0.136*	0.18*
T_1	0.60			0.064*	0.11*
T_2	0.67				0.04*
T_3	0.71				

C.D. = 0.033

The following observations were made:

The difference between the mean values of T_0-T_1 (0.07) was greater than the C.D. value, 0.033.Therefore, the difference was significant.

The difference between the mean values of T_0-T_2 (0.136) was greater than the C.D. value, 0.033.Therefore, the difference was significant.

The difference between the mean values of T_0-T_3 (0.18) was greater than the C.D. value, 0.033Therefore, the difference was significant.

The difference between the mean values of T_1-T_2 (.064) was greater than the C.D. value, 0.033.Therefore, the difference was significant.

The difference between the mean values of T_1-T_3 (0.11) was greater than the C.D. value, 0.033.Therefore, the difference was significant.

The difference between the mean values of T_2-T_3 (0.04) was greater than the C.D. value, 0.033.Therefore, the difference was significant.

It is therefore concluded that there was significant difference b/w the T_0-T_1, T_0-T_2, T_0-T_3, T_1 – T_2, T_1-T_3 T_2 – T_3 which may be ascribed to addition of different level of basil leaves extract in treatments.

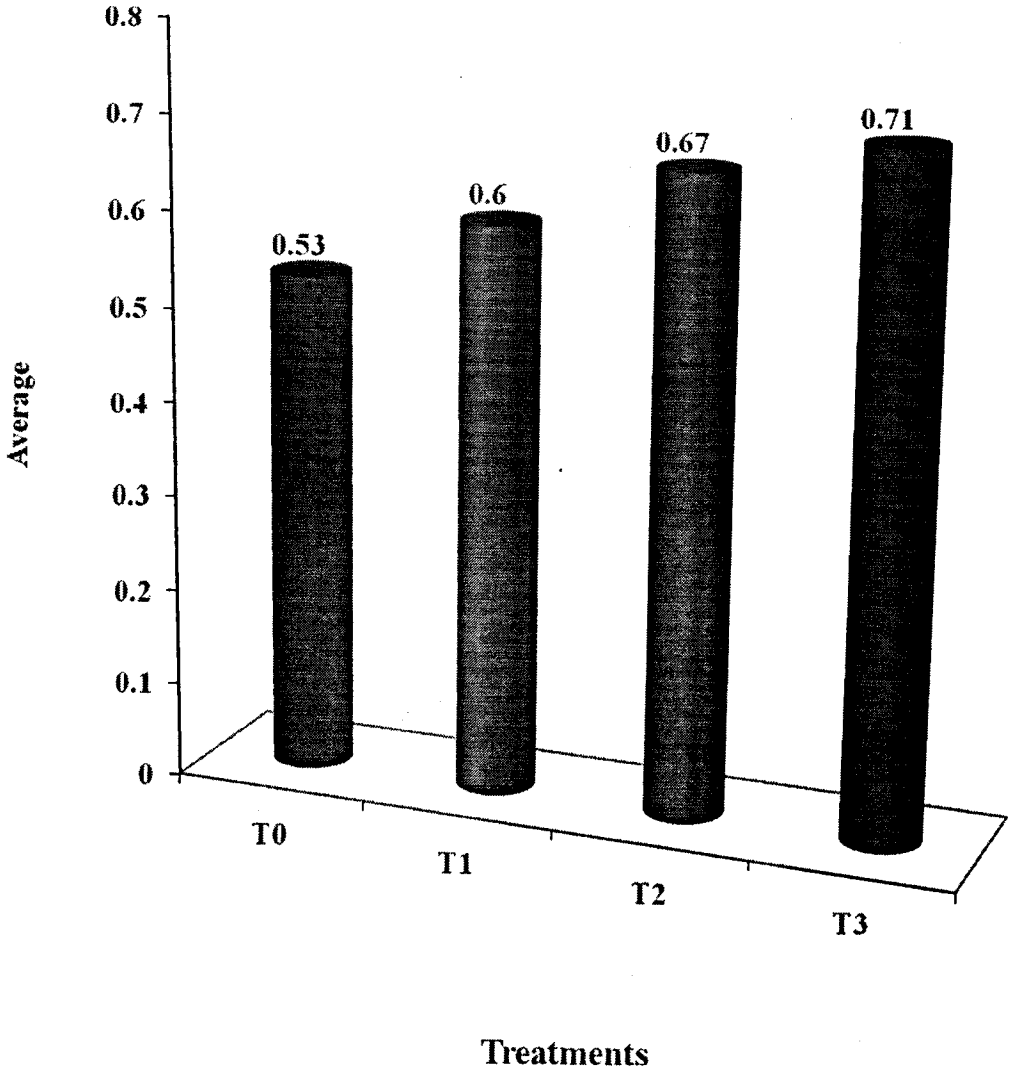


Fig. 4.7 : Percentage ash in control and experimental Herbal Kulfi

To = Whole milk + SMP + 15% sugar (Control Kulfi).

T1 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (4 %).

T2 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (6 %).

T3 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (8 %).

4.8. Melting resistance (in mins.) in Herbal Kulfi:

The data regarding melting resistance (in mins.)in Herbal Kulfi sample of different treatments are presented in table 4.8.a and figure 4.8.

Table 4.8.a: Melting resistance (mins.) in control and experimental Herbal Kulfi

Replication		Treatments			
		T_0	T_1	T_2	T_3
R_1		5.20	6.10	6.05	6.15
R_2		5.10	6.05	6.02	6.03
R_3		5.05	6.15	6.00	6.02
R_4		5.08	6.07	6.15	6.07
R_5		5.15	6.08	6.10	6.03
	Mean	**5.12**	**6.09**	**6.06**	**6.06**
Range	**Minimum**	5.05	6.05	6.00	6.02
	Maximum	5.20	6.15	6.15	6.15
F- test		S			
S. Ed. (±)		0.032			
C.D. at 5% level		0.070			

1. From the perusal of data on melting resistance (in mins.) in Herbal Kulfi samples of different treatments and control, the highest mean melting resistance (in min.) was recorded in the Herbal Kulfi sample of T_1(6.09) followed by T_2 (6.06), T_3 (6.6) and T_0 (5.12).

Table 4.8.b: ANOVA for melting resistance (mins) in control and experimental Herbal Kulfi

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. At 5%	Result

Replication	4	0.0151	0.0038	1.45	3.26	**NS**
Treatment	3	3.4251	1.1417	437.16	3.49	**S**
Error	12	0.0313	0.0026	-	-	-
TOTAL	19	3.4716	-			-

*Significant

2. As evident from the result of ANOVA given in Table 4.8.b., the F (Cal) value (437.16) was greater than the table value of F (3.49) at 5% level of significance. Therefore; the difference was significant, indicating significant effect of treatments on melting resistance (mins) percentage.

3. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.8.c

Table 4.8.c: Critical difference for melting resistance (mints) in control and experimental Herbal Kulfi

Treatments	**Average**	**T_0**	**T_1**	**T_2**	**T_3**
		5.12	**6.09**	**6.06**	**6.06**
T_0	5.12		0.97*	0.948*	0.94*
T_1	6.09			0.026	0.03
T_2	6.06				0.00
T_3	6.06				

C.D. = 0.070

The following observations were made:

The difference between the mean values of T_0-T_1 (0.97) was greater than the C.D. value, 0.070.Therefore, the difference was significant.

The difference between the mean values of T_0-T_2 (0.948) was greater than the C.D. value, 0.070.Therefore, the difference was significant.

The difference between the mean values of T_0-T_3 (0.94) was greater than the C.D. value, 0.070.Therefore, the difference was significant.

The difference between the mean values of T_1-T_2 (0.026) was smaller than the C.D. value, 0.120.Therefore, the difference was non-significant.

The difference between the mean values of T_1-T_3 (0.03) was smaller than the C.D. value, 0.070.Therefore, the difference was non-significant.

The difference between the mean values of T_2-T_3 (0.00) was smaller than the C.D. value, 0.070.Therefore, the difference was non-significant.

It is therefore concluded that there was non-significant difference b/w the T_1-T_2, T_1-T_3, T_2-T_3 and there was significant difference b/w the all other treatments which may be ascribed to addition of basil leaf extract in the experimental treatments of Herbal Kulfi.

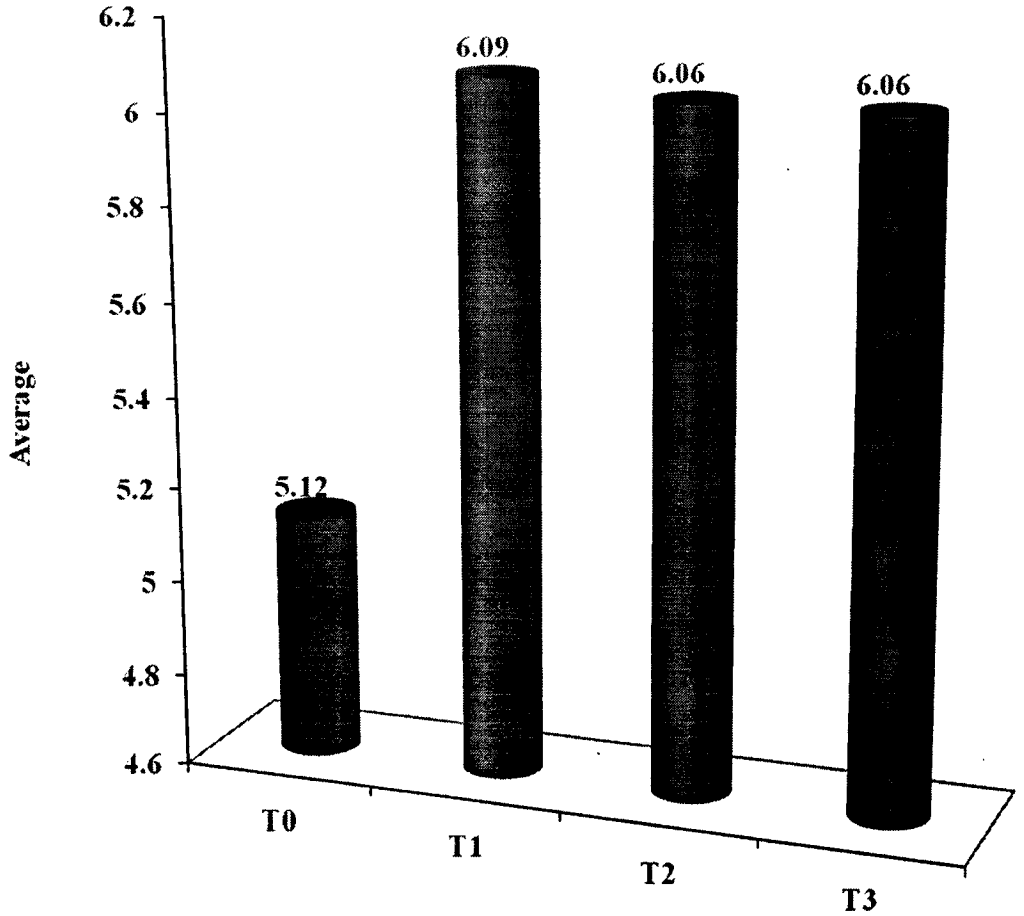


Fig. 4.8 : Melting resistance (min.) in control and experimental Herbal Kulfi.

T_0 = Whole milk + SMP + 15% sugar (Control Kulfi).

T_1 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (4 %).

T_2 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (6 %).

T_3 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (8 %).

Organoleptic characteristics of Herbal Kulfi

4.9 Colour & appearance in Herbal Kulfi

The data regarding colour & appearance score in Herbal Kulfi sample of different treatments are presented in table 4.9.a and figure 4.9

Table 4.9.a: The average score of colour and appearance of control and experimental Herbal kulfi

Replication		Treatments			
		T_0	T_1	T_2	T_3
R_1		7.80	8.20	8.60	8.00
R_2		8.02	8.20	8.50	8.20
R_3		8.00	8.30	8.50	8.40
R_4		8.40	8.30	8.60	8.40
R_5		8.50	8.30	8.30	8.40
	Mean	**8.14**	**8.26**	**8.50**	**8.28**
Range	**Minimum**	7.80	8.20	8.30	8.00
	Maximum	8.50	8.30	8.60	8.40
F- test		S			
S. Ed. (±)		0.108			
C.D. at 5% level		0.234			

1. From the perusal of data on colour & appearance score in Herbal Kulfi samples of different treatments and control the highest mean colour & appearance score recorded in the Herbal Kulfi sample of T_2(8.50) followed by T_3 (8.50), T_1 (8.26) & T_0(8.14).

Table 4.9.b: ANOVA for average score of colour and appearance of control and experimental Herbal kulfi

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. At 5%	Result
Replication	4	0.1943	0.0486	1.65	3.26	**NS**
Treatment	3	0.3314	0.1105	3.76	3.49	**S**

Error	12	0.3524	0.0294	-	-	-
TOTAL	19	0.8781	-			-

*Significant

2. As evident from the result of ANOVA given in Table 4.9.b., the F (Cal) value (3.76) was greater than the table value of F (3.49) at 5% level of significance. Therefore; the difference was significant, indicating significant effect of treatments on colour & appearance score.

3. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.9.c

Table 4.9.c: Critical difference in average score of colour and appearance of control and experimental Herbal kulfi

Treatments	**Average**	**T_0**	**T_1**	**T_2**	**T_3**
		8.14	**8.26**	**8.50**	**8.28**
T_0	8.14		0.12	0.356*	0.14
T_1	8.26			0.240*	0.02
T_2	8.50				0.22
T_3	8.28				

C.D. = 0.234

The following observations were made:

The difference between the mean values of T_0-T_1 (0.12) was smaller than the C.D. value, 0.234.Therefore, the difference was non-significant.

The difference between the mean values of T_0-T_2 (0.356) was greater than the C.D. value, 0.234.Therefore, the difference was significant.

The difference between the mean values of T_0-T_3 (0.14) was smaller than the C.D. value, 0.234. Therefore, the difference was non-significant.

The difference between the mean values of T_1-T_2 (0.240) was greater than the C.D. value, 0.234.Therefore, the difference was significant.

The difference between the mean values of T_1-T_3 (0.14) was smaller than the C.D. value, 0.234. Therefore, the difference was non-significant.

The difference between the mean values of T_2-T_3 (0.22) was smaller than the C.D. value, 0.234. Therefore, the difference was non-significant.

It is therefore concluded that there was non-significant difference b/w the T_0-T_2, T_0-T_3, T_1-T_3, T_2-T_3, and there was significant difference b/w the all other treatments which may be ascribed to addition of basil leaf extract in the experimental treatments of Herbal Kulfi.

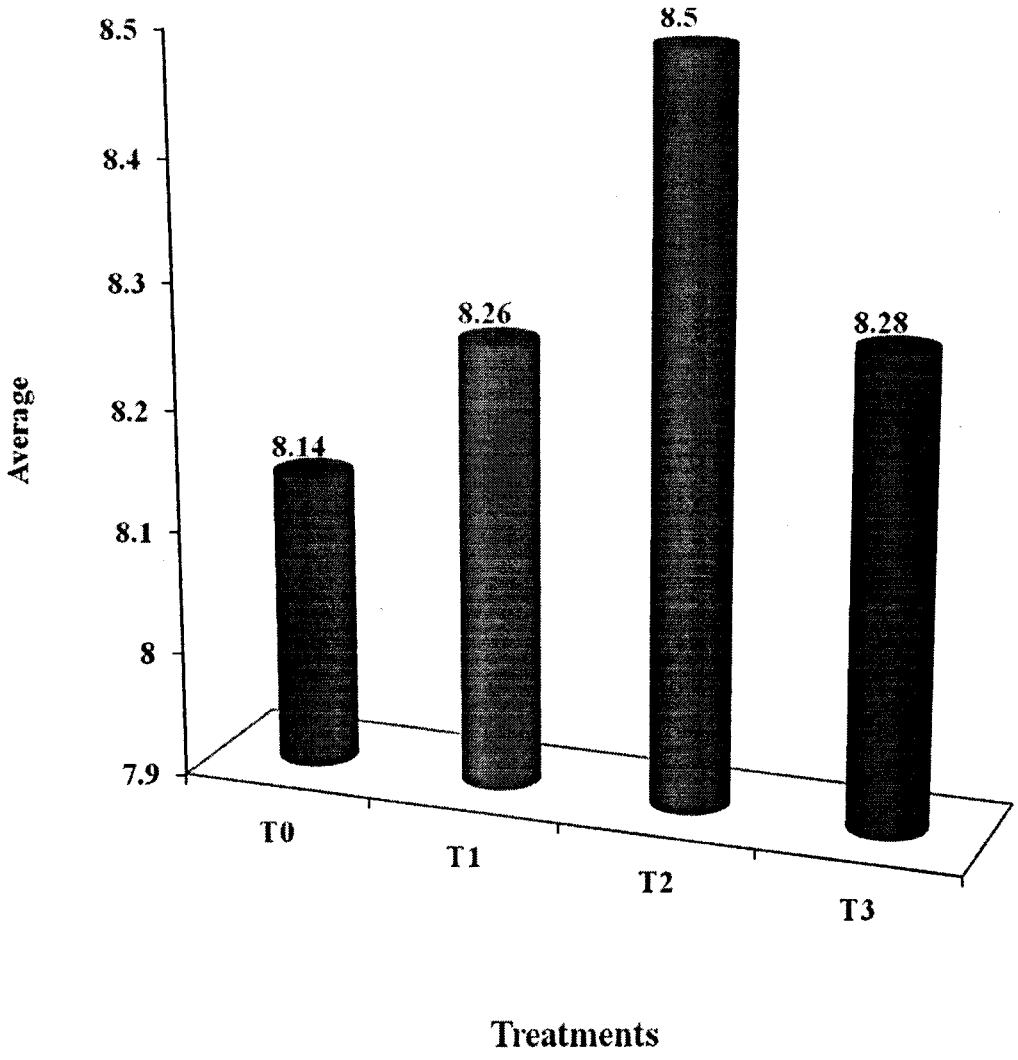


Fig. 4.9 : The average score of colour and appearance of control and experimental Herbal kulfi

T_0 = Whole milk + SMP + 15% sugar (Control Kulfi).

T_1 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (4 %).

T_2 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (6 %).

T_3 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (8 %).

4.10. Body & texture score in Herbal Kulfi

The data regarding body and texture score in Herbal Kulfi sample of different treatments are presented in table 4.10.a and figure 4.10

Table 4.10.a: Average score of body and texture for control and experimental Herbal Kulfi samples.

Replication		Treatments			
		T_0	T_1	T_2	T_3
R_1		7.80	7.20	8.50	7.30
R_2		8.20	7.50	8.40	7.90
R_3		7.90	7.90	8.60	8.20
R_4		8.30	8.80	8.70	8.00
R_5		8.40	8.60	8.80	7.70
	Mean	**8.12**	**8.00**	**8.60**	**7.82**
Range	**Minimum**	7.80	7.20	8.40	7.30
	Maximum	8.40	8.80	8.80	8.20
F- test		S			
S. Ed. (±)		0.206			
C.D. at 5% level		0.446			

1. From the perusal of data on body and texture score in Herbal Kulfi samples of different treatments and control the highest mean body and texture score was recorded in the Herbal Kulfi sample of T_2(8.60) followed by T_1 (8.00), T_0 (8.12) and T_3 (7.82).

Table 4.10.b: ANOVA for average score of Body and texture for control and experimental Herbal Kulfi

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. At 5%	Result
Replication	4	1.4580	0.3645	3.42	3.26	**S**

Treatment	3	1.6695	0.5565	5.23	3.49	**S**
Error	12	1.2780	0.1065	-	-	-
TOTAL	19	4.4055	-			-

*Significant

2. As evident from the result of ANOVA given in Table 4.10.b. the F (Cal) value (5.23) was greater than the table value of F (3.49) at 5% level of significance. Therefore; the difference was significant, indicating significant effect of treatments on body and texture score.

3. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.10.c

Table 4.10.c: Critical difference in average score of Body and texture for control and experimental Herbal Kulfi

Treatments	**Average**	**T_0**	**T_1**	**T_2**	**T_3**
		8.12	**8.00**	**8.60**	**7.82**
T_0	8.12		0.12	0.480*	0.30
T_1	8.00			0.600*	0.18
T_2	8.60				0.78
T_3	7.82				

C.D. = 0.446

The following observations were made:

The difference between the mean values of T_0-T_1 (0.12) was smaller than the C.D. value, 0.446. Therefore, the difference was non-significant.

The difference between the mean values of T_0-T_2 (0.480) was greater than the CD value, 0.446. Therefore the difference was significant.

The difference between the mean values of T_0-T_3 (0.30) was smaller than the C.D. value, 0.446. Therefore, the difference was non-significant.

The difference between the mean values of T_1-T_2 (0.60) was greater than the C.D. value, 0.446. Therefore, the difference was significant.

The difference between the mean values of T_1-T_3 (0.18) was smaller than the C.D. value, 0.446. Therefore, the difference was non-significant.

The difference between the mean values of T_2-T_3 (0.78) was greater than the C.D. value, 0.446. Therefore the difference was non-significant.

It is therefore concluded that there was non-significant difference b/w the T_0-T_1, T_0-T_3, T_1-T_3 and there was significant difference b/w the all other treatments which may be ascribed to addition of basil leaf extract, in the experimental treatments of Herbal Kulfi.

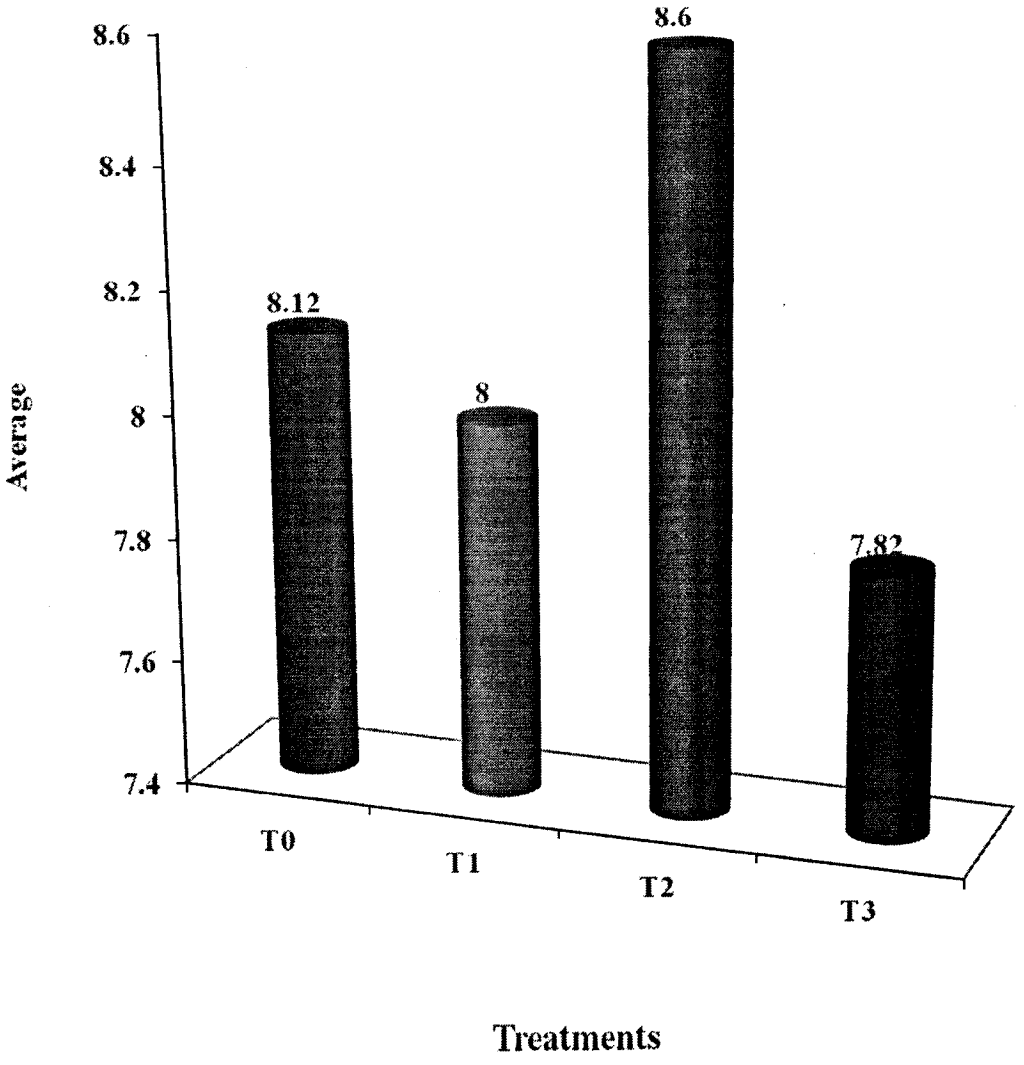


Fig. 4.10 : The average score of Body & Texture of control and experimental Herbal kulfi.

T_0 = Whole milk + SMP + 15% sugar (Control Kulfi).

T_1 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (4 %).

T_2 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (6 %).

T_3 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (8 %).

4.11. Flavour & taste score in Herbal Kulfi

The data regarding Flavour and taste score in Herbal Kulfi sample of different treatments are presented in table 4.11.a and figure 4.11.

Table 4.11.a: Average score of Flavour and t of different treatments

Replication		Treatments			
		T_0	T_1	T_2	T_3
R_1		8.60	8.40	8.50	8.20
R_2		8.50	8.20	8.60	8.30
R_3		8.30	8.40	8.70	8.50
R_4		8.10	8.30	8.60	8.25
R_5		8.40	8.50	8.50	8.10
	Mean	**8.38**	**8.36**	**8.58**	**8.27**
Range	**Minimum**	8.10	8.20	8.50	8.10
	Maximum	8.60	8.40	8.70	8.50
F- test		S			
S. Ed. (±)		0.093			
C.D. at 5% level		0.200			

1. From the perusal of data on Flavour and taste score in Herbal Kulfi samples of different treatments and control the highest mean Flavour and taste score was recorded in the Herbal Kulfi sample of T_2(8.58) followed by T_0 (8.38), T_1 (8.36) and T_3 (8.27).

Table 4.11.b: ANOVA for average score of Flavour and taste for control and experimental Herbal Kulfi

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. At 5%	Result

Replication	4	0.0580	0.0145	0.67	3.26	**NS**
Treatment	3	0.2564	0.0855	3.97	3.49	**S**
Error	12	0.2580	0.0215	-	-	-
TOTAL	19	0.5724	-			-

*Significant

2. As evident from the result of ANOVA given in Table 4.11.b. the F (Cal) value (3.97) was greater than the table value of F (3.49) at 5% level of significance. Therefore; the difference was significant, indicating significant effect of treatments on Flavour and taste score.

3. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.11.c

Table 4.11.c: Critical difference in average score of flavour and taste for control and experimental Herbal Kulfi

Treatments	**Average**	T_0	T_1	T_2	T_3
		8.38	**8.36**	**8.58**	**8.27**
T_0	8.38		0.02	0.200*	0.11
T_1	8.36			0.220*	0.09
T_2	8.58				0.31
T_3	8.27				

C.D. = 0.200

The following observations were made:

The difference between the mean values of T_0-T_1 (0.02) was smaller than the C.D. value, 0.200.Therefore, the difference was non-significant.

The difference between the mean values of T_0-T_2 (0.200) was similar than the C.D. value, 0.200.Therefore, the difference was significant.

The difference between the mean values of T_0-T_3 (0.22) was greater than the C.D. value, 0.200.Therefore, the difference was significant.

The difference between the mean values of T_1-T_2 (0.220) was greater than the C.D. value, 0.200.Therefore, the difference was significant.

The difference between the mean values of T_1-T_3 (0.11) was smaller than the C.D. value, 0.200.Therefore, the difference was non-significant.

The difference between the mean values of T_2-T_3 (0.31) was greater than the C.D. value, 0.200. Therefore, the difference was significant.

It is therefore concluded that there was non-significant difference b/w the T_0-T_1, & T_1-T_3, and there was significant difference b/w the all other treatments which may be ascribed to proper standardization of Herbal Kulfi.

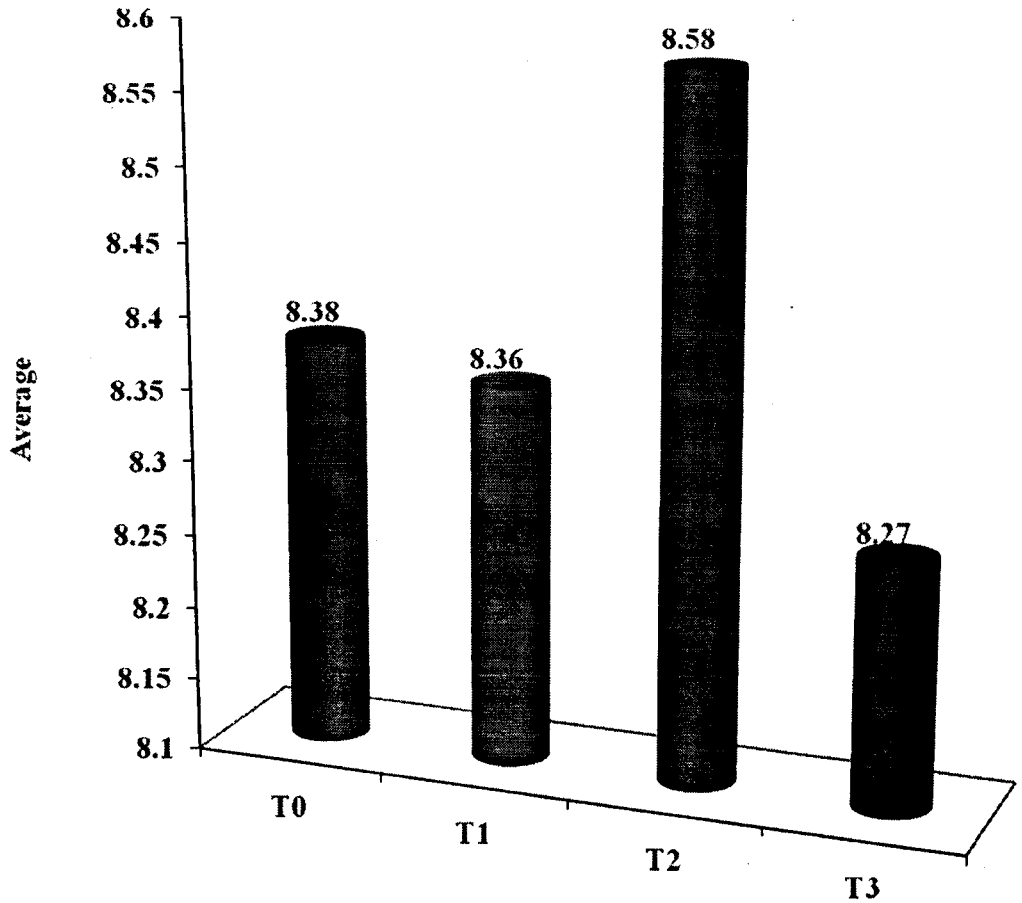


Fig. 4.11 : Average score of Flavour and taste for control and experimental Herbal Kulfi.

T_0 = Whole milk + SMP + 15% sugar (Control Kulfi).

T_1 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (4 %).

T_2 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (6 %).

T_3 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (8 %).

4.12.Melting resistance in Herbal Kulfi

The data regarding Melting resistancein Herbal Kulfi sample of different treatments are presented in table 4.12.a and figure 4.12.

Table 4.12.a: Melting resistance for control and experimental kulfi

Replication		Treatments			
		T_0	T_1	T_2	T_3
R_1		8.40	7.80	8.50	8.10
R_2		8.30	7.90	8.60	8.00
R_3		8.50	8.00	8.70	7.90
R_4		8.10	8.20	8.60	8.40
R_5		8.40	8.10	8.50	8.30
	Mean	**8.34**	**8.00**	**8.58**	**8.14**
Range	**Minimum**	8.10	7.80	8.50	7.90
	Maximum	8.50	8.20	8.70	8.40
F- test		S			
S. Ed. (±)		0.105			
C.D. at 5% level		0.226			

1. From the perusal of data on Melting resistancein Herbal Kulfi samples of different treatments and control the highest mean Melting resistancewas recorded in the Herbal Kulfi sample of T_2(8.58) followed by T_0 (8.30), T_3 (8.) 14 and T_1 (8.00).

Table 4.12.b: ANOVA for melting resistance in samples of control and experimental Herbal Kulfi

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. At 5%	Result
Replication	4	0.0630	0.0157	0.57	3.26	**NS**

Treatment	3	0.9535	0.3178	11.59	3.49	S
Error	12	0.3290	0.0274	-	-	-
TOTAL	19	1.3455	-			-

*Significant

2. As evident from the result of ANOVA given in Table 4.12.b. the F (Cal) value (11.59) was greater than the table value of F (3.49) at 5% level of significance. Therefore; the difference was significant, indicating significant effect of treatments on Melting resistance.

3. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.12.c

Table 4.12.c: Critical difference for melting resistance (mints) in samples of control and experimental Herbal Kulfi

Treatments	**Average**	T_0	T_1	T_2	T_3
		8.34	**8.00**	**8.58**	**8.14**
T_0	8.34		0.34	0.240	0.20
T_1	8.00			0.580	0.14
T_2	8.58				0.44
T_3	8.14				

C.D. =0.226

The following observations were made:

The difference between the mean values of T_0-T_1 (0.34) was greater than the C.D. value, 0.226.Therefore, the difference was significant.

The difference between the mean values of T_0-T_2 (0.240) was smaller than the C.D. value, 0.226.Therefore, the difference was non-significant.

The difference between the mean values of T_0-T_3 (0.20) was smaller than the C.D. value, 0.226.Therefore, the difference was non-significant.

The difference between the mean values of T_1-T_2 (0.580) was greater than the C.D. value, 0.226.Therefore, the difference was significant.

The difference between the mean values of T_1-T_3 (0.14) was smaller than the C.D. value, 0.226.Therefore, the difference was non-significant.

The difference between the mean values of T_2-T_3 (0.44) was greater than the C.D. value, 0.200. Therefore, the difference was significant.

It is therefore concluded that there was non-significant difference b/w the T_0-T_2,T_0-T_3, T_1-T_3, and there was significant difference b/w the all other treatments which may be ascribed to proper standardization of Herbal Kulfi.

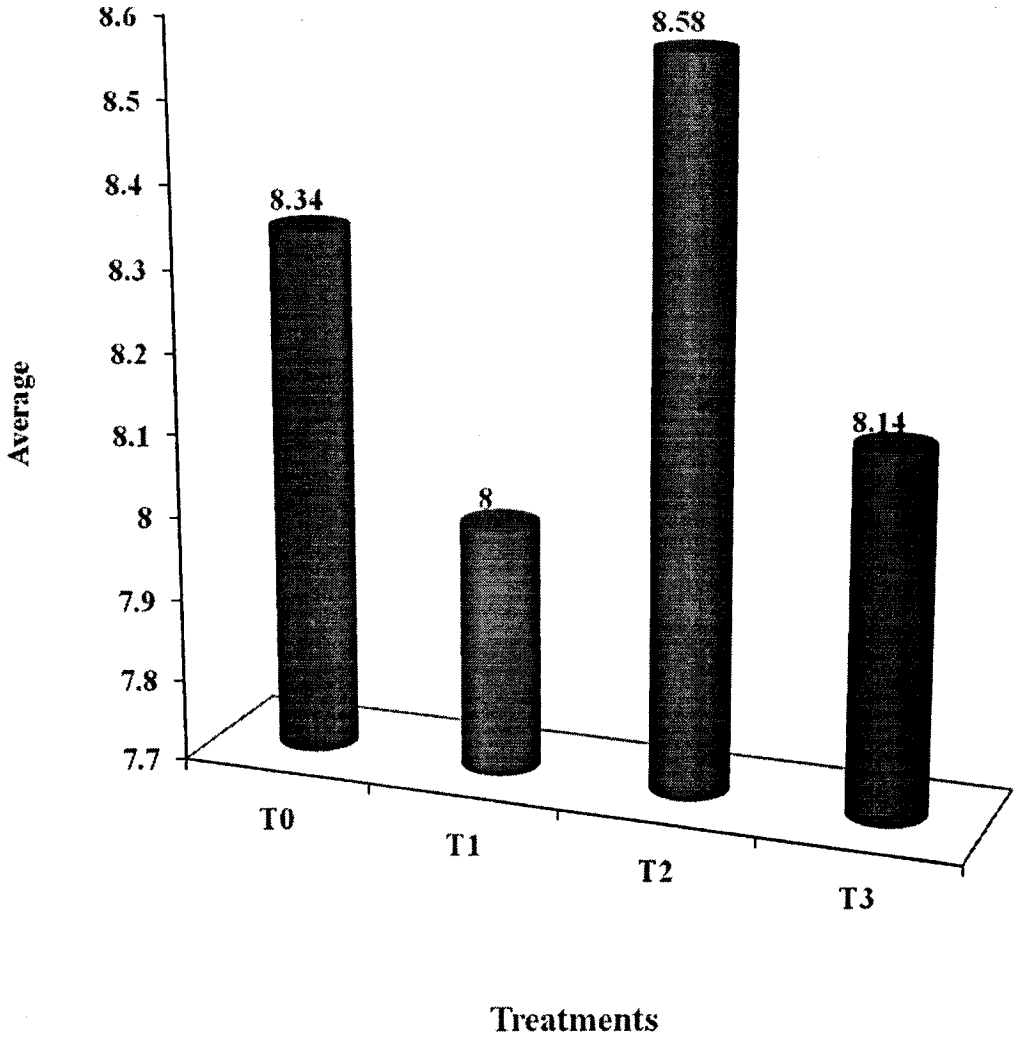


Fig. 4.12 : Average of melting resistance for control and experimental Herbal Kulfi

T_0 = Whole milk + SMP + 15% sugar (Control Kulfi).

T_1 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (4 %).

T_2 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (6 %).

T_3 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (8 %).

Microbiological characteristics of Herbal Kulfi

4.13. Standard Plate Count in Herbal Kulfi mix

The data regarding SPC in Herbal Kulfi sample of different treatments are presented in table 4.13.a and analysis figure 4.13.

Table 4.13.a:The average of SPC in samples of control and experimental Herbal Kulfi

Replication		Treatments			
		T_0	T_1	T_2	T_3
R_1		920.00	905.00	940.00	945.00
R_2		915.00	915.00	930.00	950.00
R_3		905.00	890.00	932.00	956.00
R_4		895.00	895.00	925.00	955.00
R_5		910.00	920.00	914.00	940.00
	Mean	**909.00**	**905.00**	**928.20**	**949.20**
Range	**Minimum**	895.00	890.00	914.00	940.00
	Maximum	920.00	920.00	940.00	956.00
F- test		S			
S. Ed. (±)		6.462			
C.D. at 5% level		13.958			

1. From the perusal of data on SPC in Herbal Kulfi samples of different treatments and control the highest mean SPC was recorded in the Herbal Kulfi sample of T_3(949.00) followed by T_2 (928.00), T_0 (909.00) and T_1 (905.00).

Table 4.13.b: ANOVA for the average of SPC in samples of control and experimental Herbal Kulfi

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. At 5%	Result
Replication	4	318.8000	79.7000	0.76	3.26	**NS**
Treatment	3	6166.9500	2055.6500	19.69	3.49	**S**
Error	12	1252.8000	104.4000	-	-	-

TOTAL	19	7738.5500	-	-

*Significant

2. As evident from the result of ANOVA given in Table 4.13.b. the F (Cal) value (19.69) was greater than the table value of F (3.49) at 5% level of significance. Therefore; the difference was significant, indicating significant effect of treatments on SPC.

3. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.13.c

Table 4.13.c: Critical difference in the average of SPC in samples of control and experimental Herbal Kulfi

Treatments	**Average**	**T_0**	**T_1**	**T_2**	**T_3**
		909.00	**905.00**	**928.20**	**949.20**
T_0	909.00		4.00	19.200*	40.20*
T_1	905.00			23.200*	44.20*
T_2	928.20				21.00*
T_3	949.20				

C.D. = 13.958

The following observations were made:

The difference between the mean values of T_0-T_1 (4.00) was smaller than the C.D. value, 13.958. Therefore, the difference was non-significant.

The difference between the mean values of T_0-T_2 (19.200) was greater than the C.D. value, 13.958. Therefore, the difference was significant.

The difference between the mean values of T_0-T_3 (40.20) was greater than the C.D. value, 13.958. Therefore, the difference was significant.

The difference between the mean values of T_1-T_2 (23.200) was greater than the C.D. value, 13.958. Therefore, the difference was significant.

The difference between the mean values of T_1-T_3 (44.20) was greater than the C.D. value, 13.958. Therefore, the difference was significant.

The difference between the mean values of T_2-T_3 (21.00) was greater than the C.D. value, 13.958. Therefore, the difference was significant.

It is therefore concluded that there was non-significant difference b/w the T_0-T_1 and there was significant difference b/w the all other treatments which may be ascribed to proper standardization of Herbal Kulfi.

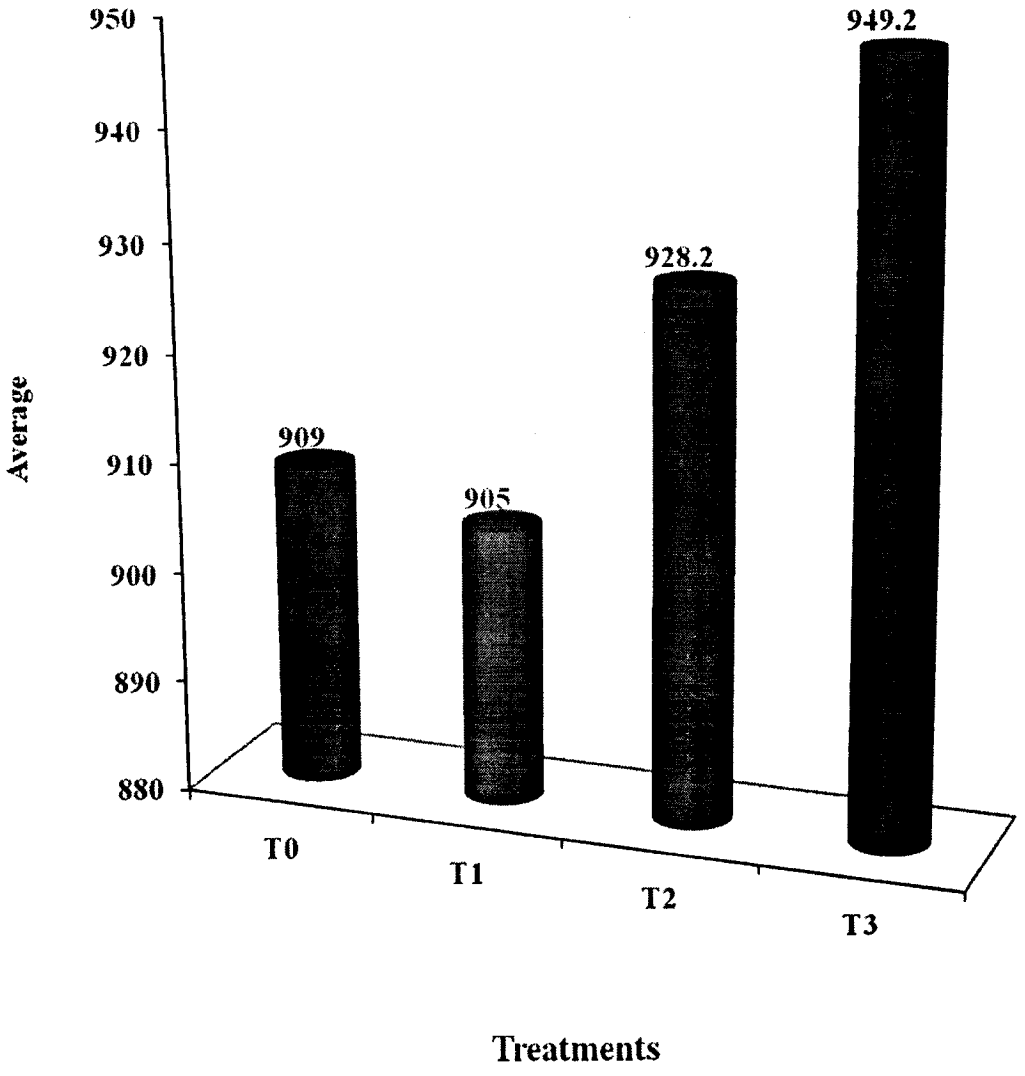


Fig. 4.13 : Average of SPC for control and experimental Herbal Kulfi

T_0 = Whole milk + SMP + 15% sugar (Control Kulfi).

T_1 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (4 %).

T_2 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (6 %).

T_3 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (8 %).

4.14. Yeast & mould Count in Herbal Kulfi mix

The data regarding yeast & mould count in Herbal Kulfi sample of different treatments are presented in table 4.14.a and figure 4.14.

Table 4.14.a:The average of Yeast & mould count in samples of control and experimental Herbal Kulfi

Replication		Treatments			
		T_0	T_1	T_2	T_3
R_1		19.00	14.00	11.00	14.66
R_2		21.00	13.00	12.00	16.00
R_3		20.30	13.66	11.00	15.00
R_4		21.00	13.00	11.66	15.00
R_5		22.00	13.00	11.00	16.00
	Mean	**20.66**	**13.33**	**11.33**	**15.33**
Range	**Minimum**	19.00	13.00	11.00	14.66
	Maximum	22.00	14.00	12.00	16.00
F- test		S			
S. Ed. (±)		0.456			
C.D. at 5% level		0.984			

1. From the perusal of data on yeast & mould count in Herbal Kulfi samples of different treatments and control the highest mean yeast & mould count was recorded in the Herbal Kulfi sample of T_0(20.66) followed by T_3(15.33), T_1(13.33) and T_2(11.33).

Table 4.14.b: ANOVA for the average of yeast & mould count in samples of control and experimental Herbal Kulfi mix of different treatments.

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. At 5%	Result
Replication	4	2.0203	0.5051	0.97	3.26	**NS**

Treatment	3	241.3734	80.4578	155.10	3.49	**S**
Error	12	6.2252	0.5188	-	-	-
TOTAL	19	249.6189	-			-

*Significant

2. As evident from the result of ANOVA given in Table 4.14.b. the F (Cal) value (155.10) was greater than the table value of F (3.49) at 5% level of significance. Therefore; the difference was significant, indicating significant effect of treatments on yeast & mould count.

3. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.14.c

Table 4.14.c: Critical difference in the average of yeast & mould count in samples of control and experimental Herbal Kulfi

Treatments	**Average**	**T_0**	**T_1**	**T_2**	**T_3**
		20.66	**13.33**	**11.33**	**15.33**
T_0	20.66		7.33	9.328	5.33
T_1	13.33			2.000	2.00*
T_2	11.33				4.00*
T_3	15.33				

C.D. =0.984

The following observations were made:

The difference between the mean values of T_0-T_1 (7.33) was greater than the C.D. value, 0.984. Therefore, the difference was significant.

The difference between the mean values of T_0-T_2 (9.328) was greater than the C.D. value, 0.984. Therefore, the difference was significant.

The difference between the mean values of T_0-T_3 (5.33) was greater than the C.D. value, 0.984. Therefore, the difference was significant.

The difference between the mean values of T_1-T_2 (2.000) was greater than the C.D. value, 0.984. Therefore, the difference was significant.

The difference between the mean values of T_1-T_3 (2.00) was greater than the C.D. value, 0.984. Therefore, the difference was significant.

The difference between the mean values of T_2-T_3 (4.00) was greater than the C.D. value, 0.984. Therefore, the difference was significant.

It is therefore concluded that there was significant difference b/w the all other treatments which may be ascribed to proper standardization of Herbal Kulfi.

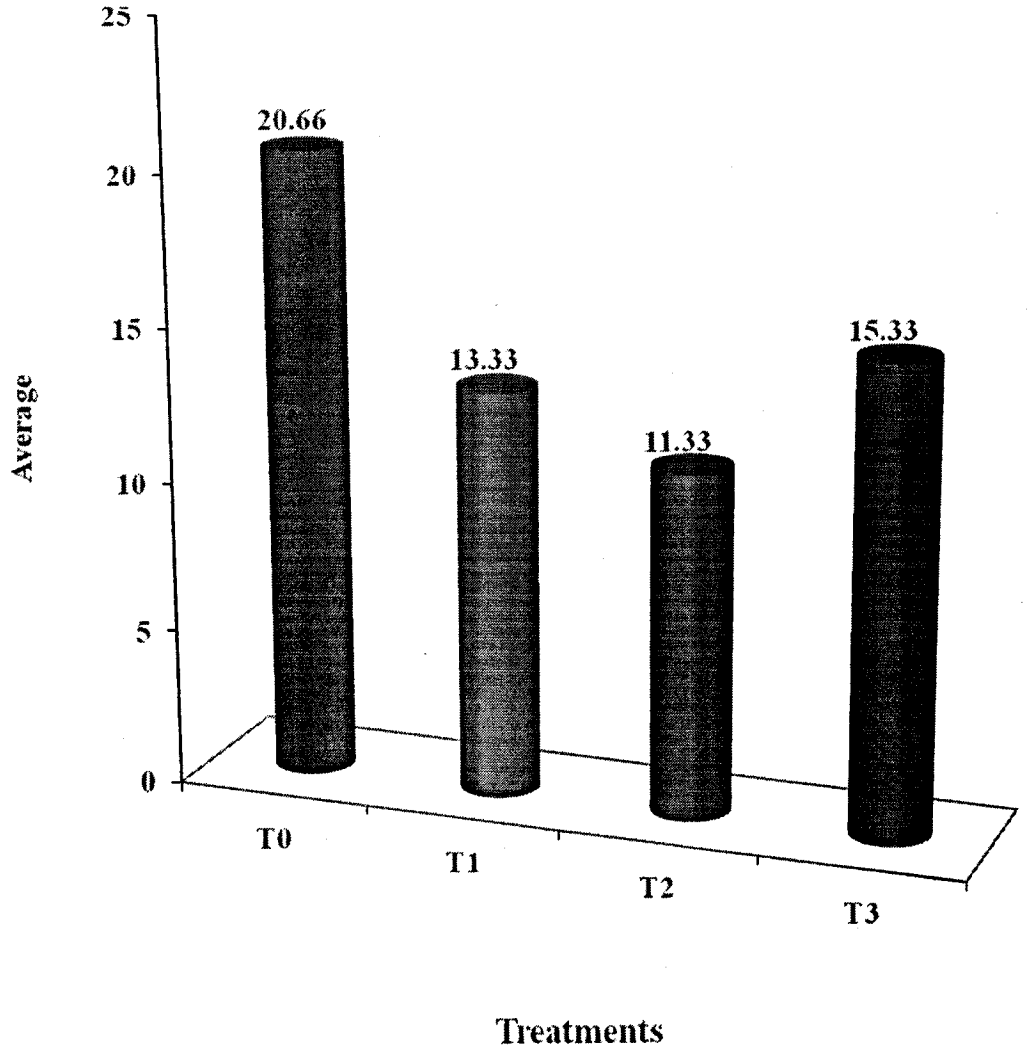


Fig. 4.14 : The average of Yeast & mould count in samples of control and experimental Herbal Kulfi

T_0 = Whole milk + SMP + 15% sugar (Control Kulfi).

T_1 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (4 %).

T_2 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (6 %).

T_3 = Herbal Kulfi with whole milk + SMP + 15% sugar + Basil leaves extract (8 %).

4.15:Coliform test

It is evident from the Table 4.15 that the coliform test control and experimental kulfi sample was 100 percent negative.

It shows gram-ve (Gram negative bacteria) result, which mean that strict hygienic procedure was observed during it preparation.

Table 4.15: Shows that the results of coliform test of control and experimental Herbal Kulfi

Replications	Treatments				
	T_0	T_1	T_2	T_3	T_4
S.I. No.	10^2cfu/ml				
1	G-Ve	G-Ve	G-Ve	G-Ve	G-Ve
2	G-Ve	G-Ve	G-Ve	G-Ve	G-Ve
3	G-Ve	G-Ve	G-Ve	G-Ve	G-Ve
4	G-Ve	G-Ve	G-Ve	G-Ve	G-Ve

G-Ve = Negative

It is evident from the table that the coliform test control and experimental sample were 100 percent negative.

4.16: Cost analysis of Kulfi mix (/litre) and Herbal Kulfi

The data regardingcost (Rs) of kulfi mix, Herbal Kulfi and therapeutic value of kulfi products sample of different treatments are presented in table 4.16 and following observations were made:

1. From the perusal of data of cost (Rs) in Herbal Kulfi samples of different treatments and control furnished in table 4.17 and figure 4.17, it was noted that highest mean cost (Rs) was recorded in the Herbal Kulfi sample of T_3(18.44), T_2(16.77) , T_1 (15.09) , followed by T_0 (11.77).

Table 4.16: Cost analysis of kulfi mix and Herbal Kulfi

Particulars	Treatments			
	T_0	T_1	T_2	T_3
Conversion of 250 gms Herbal Kulfi into ml.	180	180	180	180
Cost of mix/lit (Rs.)	**11.77**	**15.09**	**16.77**	**18.44**

Table 4.17: The average data of Physico- chemical analysis, microbiological and Organoleptic scores of different treatments of Herbal Kulfi

Parameters	Treatments				
	T_0	T_1	T_2	T_3	C.D. Value
1. Chemical analysis (in percent)					
Fat	10.04	10.12	10.06	10.00	0.311
Total solids	37.36	37.24	37.24	37.16	0.086
Acidity	0.22	0.23	0.23	0.24	0.026
Protein	3.58	3.64	3.72	3.76	0.112
pH	6.15	6.21	6.14	6.25	0.080
Moisture	62.64	62.76	62.76	62.84	0.120
Ash	0.53	0.60	0.67	0.71	0.033
2. Physical analysis					
Melting resistance (in minutes)	5.12	6.09	6.06	6.06	0.070
3. Organoleptic scores (9 point hedonic scale)					
Colour & appearance	8.14	8.26	8.50	8.28	0.234
Body & texture	8.12	8.00	8.60	7.82	0.446
Flavour & taste	8.38	8.36	8.28	8.27	0.200
Melting resistance	8.34	8.00	8.58	8.14	0.226
4. Microbial analysis					
SPC (cfu/g)	909.00	905.00	928.00	949.00	13.958
Coliform test (cfu^2/g)	N	N	N	N	___
Yeast & mould count (per)	20.66	13.33	11.33	15.33	0.984
5. Cost					
kulfi (in rupees)	46.68	50.68	52.68	54.68	___

5.SUMMARY & CONCLUSION

The present investigation effect of betel leaves extract on the keeping quality of whey based pineapple beverage was planned and carried out in dairy technology department, SHIATS, Allahabad.

5.1 The different parameters of control and experimental Herbal Kulfi

Parameters	Treatments				
	T_0	T_1	T_2	T_3	C.D. Value
1. Chemical analysis (in percent)					
Fat	10.04	10.12	10.06	10.00	0.311
Total solids	37.36	37.24	37.24	37.16	0.086
Acidity	0.22	0.23	0.23	0.24	0.026
Protein	3.58	3.64	3.72	3.76	0.112
pH	6.15	6.21	6.14	6.25	0.080
Moisture	62.64	62.76	62.76	62.84	0.120
Ash	0.53	0.60	0.67	0.71	0.033
2. Physical analysis					
Melting resistance (in minutes)	5.12	6.09	6.06	6.06	0.070
3. Organoleptic scores (9 point hedonic scale)					
Colour & appearance	8.14	8.26	8.50	8.28	0.234
Body & texture	8.12	8.00	8.60	7.82	0.446
Flavour & taste	8.38	8.36	8.28	8.27	0.200
Melting resistance	8.34	8.00	8.58	8.14	0.226
4. Microbial analysis					
SPC (cfu/g)	909.00	905.00	928.00	949.00	13.958
Coli form test (cfu^2/g)	N	N	N	N	___
Yeast & mould count (per)	20.66	13.33	11.33	15.33	0.984
5. Cost					
kulfi (in rupees)	46.68	50.68	52.68	54.68	___

5.2. Physico- chemical parameters

Fat

The highest mean of fat percentage was recorded in the Herbal kulfi sample of T_0 (10.14), T_1 (10.12) followed by T_2 (10.06) and T_3 (10.00). The differences in these values of Fat percent T_0-T_1, T_0-T_2 T_0-T_3, T_1-T_2 T_1-T_3 T_3 –T_3were non-significant.

Total Solids

The highest mean of total solids percentage was recorded in the Herbal kulfi sample of T_0 (37.36), T_1 (37.24) followed by T_2 (37.24), and T_3 (37.16). The differences in these values of total solid percent T_0-T_1, T_1-T_2, T_1-T_3& T_2 –T_3 were non-significant and T_0-T_2& T_0-T_2 were significant.

Lactic acid

The highest mean of Lactic acid percentage was recorded in the Herbal kulfi sample of T_3 (0.24), followed by T_2 (0.23),T_1(0.23) and T_0 (0.22). The differences in these values of acidity percent T0- T_0-T_1, T_0-T_2 T_0-T_3, T_1-T_2, T_1-T_3& T_2 –T_3,were non-significant.

Protein

The highest mean of protein percentage was recorded in the Herbal kulfi sample of T_3 (3.76), T_2 (3.72) followed by T_1 (3.64) and T_0 (3.58). The differences in these values of protein percent T_0-T_1, T_1 –T_2, & T_2 – T_3were non-significant and T_0-T_2 T_0-T_3& T_1-T_3 were significant.

Moisture

The highest mean of moisture percentage was recorded in the Herbal kulfi sample of T_4 (62.84) followed by T_2 (62.76), T_1 (62.76) and T_0 (62.64). The differences in these values of moisture percent T_0-T_3, T_1 –T_2, T_1 – T_3 & T_2 – T_3 were non-significant and T_0-T_1, T_0-T_2, was significant.

pH

The highest mean of pH percentage was recorded in the Herbal kulfi sample of T_4 (6.25) followed by T_1 (6.21), T_0 (6.15) and T_1 (6.14).The differences in these values of pH percent $T0-T_1$, T_0-T_2,T_1-T_2, & T_1-T_3were non-significant and T_0-T_3, & T_2-T_3 were significant.

Ash

The highest mean of ash percentage was recorded in the Herbal kulfi sample of T_4(0.71) followed by T_3 (0.60), T_2 (0.67) and T_0 (0.53). The differences in these values of ash percent T_0-T_1, T_0-T_2, T_0-T_3, T_1-T_2, T_1-T_3& T_2-T_3 were significant.

Melting resistance (in mins.)

The highest mean of melting resistance (in min.) was recorded in the Herbal kulfi sample of T_1 (6.09) followed by T_2 (6.06), T_3 (6.6) and T_0 (5.12). The differences in these values of melting resistance (in min.) T_1-T_2, T_1-T_3, &T_2-T_3 were non-significant and T_0-T_1, T_0-T_2, &T_0-T_3 were significant.

5.3. Organoleptic parameters

Colour & Appearance

The highest mean of colour & appearance score recorded in the Herbal kulfi sample of T_2 (8.50) followed by T_3 (8.50), T_1 (8.26) & T_0(8.14). The differences in these values of colour & appearance score, T_0-T_2, T_0-T_3, T_1-T_3, and T2-T_3 were non-significant andT_0-T_1andT_1-T_2 were significant.

Body & Texture

The highest mean of body & texture score was recorded in the Herbal kulfi sample of T_2 (8.60) followed by T_1 (8.00), T_0 (8.12) and T_3 (7.82). The differences in these values of body & texture scoreT_0-T_2, T_1-T_2 & $T_2-T_3$was significant and there was non-significant difference b/w the all other treatments.

Flavour & Taste

The highest mean of Flavour & taste score was recorded in the Herbal kulfi sample of T_2(8.58) followed by T_0 (8.38), T_1 (8.36) and T_3 (8.27). The differences in these values of Flavour & taste score T_0-T_1, &T_1-T_3, were non-significant and T_0-T_2, T_0-T_3, T_1-T_2&T_2-T_3 were significant.

Melting resistance

The highest mean of melting resistance was recorded in the Herbal kulfi sample of T_2(8.58) followed by T_0 (8.30), T_3 (8.14) and T_1 (8.00).The differences in these values of melting resistanceT_0-T_2, T_0-T_3 &T_1-T_3were non-significant andT_0-T_1, T_1-T_2 &T_2-T_3 were significant.

5.4. Microbiological parameters

SPC

The highest mean of SPC recorded in the Herbal kulfi sample of T_2 (8.50) followed by T_3 (8.50), T_1 (8.26) & T_0 (8.14). The differences in these values of SPC T_0-T_1 were non-significant andT_0-T_2, T_0-T_3, T_1-T_2, T_1-T_3, & T_2-T_3 were significant.

Yeast & Mould

The highest mean of yeast & mould count was recorded in the Herbal kulfi sample of T_0 (20.66) followed by T_3 (15.33), T_1 (13.33) and T_2 (11.33). The differences in these values of yeast & mould count T_0-T_1, T_0-T_2 T_0-T_3 T_1-$T_2$$T_1$-$T_3$ & T_2- T_3 were significant.

Coliform

It is evident from the experiment that the coli form test control and experimental sample were 100 percent negative.

CONCLUSION

In view of the experimental results obtained during the present investigation, it may be concluded that the Herbal kulfi made from whole milk + 15% sugar + Basil leaves extract (6%), i.e. T_2 received highest score and was liked very much by the panel of judges us focus Organoleptic evaluation is concerned, best in chemical characteristics (maximum total solids, acidity, protein, carbohydrate and ash), best in microbial analysis (minimum yeast and mould count; and Gram negative in coli form test) thereby indicating good stability of Herbal Kulfi. The cost of preparation of beverage in treatment T_2 was Rs. **82.68** per kg of mix. However, since this is based on one-time experiment, further trials may be needed to substantiate the results.

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REPORT

ON

"Effect of Traditional Indian Sweetener (Date & Sugarcane Jaggery) On Rheological Properties of Ice Cream"

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LIST OF CONTENT

ABSTRACT

In the new millennium we are witnessing the upward trend in nutritional and health awareness which has increased the consumer demand for functional foods. Keeping this in view industry is forced to bring frozen products in the market with acceptable sensory characteristics. The present investigation was made with an attempt to develop an ice-cream by partial addition with different level of date & sugarcane jaggery, evaluate the effect on microbial quality by addition of jaggery. For control ice-cream mix was standardized to 10% milk fat, 15% sugar, cream, SMP & 0.3% stabilizer & emulsifier, to obtain 42% total solids and treatment T_1 was standardized to 10% fat, and partial addition of sugarcane jaggery 18% and 0.1% stabilizer and 0.2%emulsifier, T_2 was standardized to 10% fat and 15% sugar and 0.1% stabilizer and 0.2% emulsifier sugarcane jaggery 20%, T_3 was standardized to 10% fat and partial addition of date jaggery 18% and 0.1% stabilizer and 0.2% emulsifier & T_4 was standardized to 10% fat and partial addition of date jaggery 20% and 0.1% stabilizer and 0.2% emulsifier. The total solid in control and treatment were adjusted to 42% total solid by the addition of skim milk powder. The ice-cream samples of different treatments and control Physico-chemical analysis fat percentage, total solids, acidity, protein, moisture, ash, melting resistance was done for estimating its nutritional content and safety and Organoleptic characteristics like (flavour and taste, body and texture, colour and appearance) by trained panellist using 9 point hedonic scale. The treatments containing 20% level jaggery score the highest value. Microbiological analysis was carried out to assess the shelf life of the best treatments T_2 checked through SPC, yeast and mould count, and presumptive coli form test. The results revealed less than 100/g (standard value) yeast and mould count and negative coli form test when compared with the PFA standards. Thus as for as product acceptability judged by Organoleptic evaluation and therapeutic value is concern, the treatment can be rated as $T_2>T_0>T_1>T_4>T_3$.

1.INTRODUCTION

Ice cream is a frozen dairy product made by suitable blending and processing of cream and other milk products, together with sugar and flavour, with or without stabilizer or colour and with the incorporation of air during the freezing process **(sukumar,1980)** Ice cream is often described in terms of two phases; continuous and dispersed. The continuous phase is a combination of an unfrozen solution, an emulsion and a suspension of solids in liquid. Water, sugar, hydrocolloids, milk proteins and other soluble make up the unfrozen solution suspended in the aqueous phase are insoluble solids, including ice crystals, lactose crystals and milk solids. The aqueous phase also forms an emulsion with dispersed milk fat globules. The complex physical structure of ice cream presents a challenge for food technologists. Simple stated, overall goal of designing the ice cream is to incorporate several different insoluble's (air bubbles, ice crystals and fat globules) into an aqueous phase in the smallest sizes and in the greatest number possible **(Sharma and Hissaria, 2009)**

Now a day's variety of sweeteners is used in the field of food processing to satisfy the consumers. A sweet ice cream is generally desired by the public, sugars, are important as an ingredient in ice cream other than for their sweetness because of the physical properties of the sugars and their solution and their effect upon the freezing point of the mix. In addition to providing sweetness, sugars affect the properties of the mix and the finished product. Sugars depress the freezing point of the mix, produce a thinner mix with a slower whipping rate, and as ice cream with a smoother body and texture with faster melting qualities. Sugar blends may be expected to affect mix and finished product qualities in accordance with the proportion of the kind of sugars in the blend. Sucrose may be used as the sole source of added sweetener solids in ice cream with excellent results. It is not satisfactory as the only source of sugar in ice cream since it may crystallize out at her surface. **(Arbuckle, 1972)**

Sweeteners are the compounds that interact with taste buds that evoke a characteristic. Sweeteners therefore have ability to impart sweet taste by masking the taste material in which it is added. Ideally sweeteners should be able to mask the taste at lower concentration and it should be free from harmful side effects and suitable for long term use. It should remain stable at wide range of temperature and pH conditions. Sugar is extensively used as a sweetener in various Indian milk products.

Generally used as a macronutrient ingredient, sugar imparts a number of other properties to the products. Possessing multi-faceted functionality sugar is used as a bulking agent, stabilizer, fermentation, substrate flavour carrier, preservative, texture humectants, dispersing agent, browning agent and decorative agent. Brown sugar and molasses provide additional flavours (**Anaja *et al.* 2002).**

Besides sugarcane, juices from khajur (date) and tala (palmyra palm tree) are highly valued for production of gur. Jiggery (gur), unrefined sweeteners is mainly used by rural folks these products are valued in traditional milk product formulation for their characteristic flavour texture, and colour and also for providing vitamins, iron, calcium and carbohydrates, gur is considered as the most nutritive sweeteners. It issued by hallways at the cottage level in preparation of traditional sweets where a dark brown sugar is also desirable. Jiggery is crude type of raw sugar made by the heat desiccation of sugarcane juice. It's hygroscopic and is produced in the form of lumps of varying size. (**Anaja *et al.* 2002**). Compared to sugar, jaggery is a wholesome diet. It contains 0.6%-1.0% minerals[12]; important among them are iron (11mg %), calcium (0.4%), magnesium and phosphorous (0.045%). Jaggery also contains reducing sugars including glucose and fructose (10-15%), protein (0.25%) and fat (0.05%). (**Rao *et al.* 2007**)

Justification - At the time of production of sugar it requires a mix up of chemicals like sulphure-dioxide, lime, phosphoric-acid, and formic-acid and bleaching agents, and that is why all the contents of sugarcane cannot be found is sugar, where as gur has all the contents and even the scientists have proved that all the essential vitamins and minerals are missing from sugar as compared to gur. In Ayurvedic way of medicine it is used as medicine, blood purifier and also it prevents disorders of bile. **(Amit, 2010)**

Keeping in mind the above statement it was planned to manufacture an Ice cream by substituting cane sugar with date & sugarcane Jaggery. The experiment aims to formulate a nutritional improved ice cream with the following **objectives.**

1. **To develop and formulate an ice cream by substitution of cane sugar with jaggery obtained from sugarcane and juices from khajur (date)**
2. **To evaluate the effect of ice cream obtained from this formulation on rheological properties of ice cream.**
3. **To assess the Organoleptic, Physico-chemical and microbiological quality of the new formulation.**

4. To evaluate the cost of formulation of jaggery ice cream.

Hypothesis

1. Jaggery obtained from sugarcane and juices from khajur (date) will improve the flavour perception of the new formulated ice cream
2. The distinct flavour and colour of jaggery obtained from different sources would synergies with chocolate flovour and colour.
3. Substitution of cane sugar with jaggery will not have adverse effect on its rheological properties of ice cream.

2.REVIEW OF LITERATURE

The review of literature is broadly presented under the following sub heading:

1. History of ice-cream
2. PFA standards for Ice-cream
   - **2.1** Ice Cream, Chocolate Ice Cream or Softy Ice Cream
   - **2.2** PFA standard, Ice Cream, Kulfi, Chocolate Ice Cream or Softy Ice Cream composition
   - **2.3** The Prevention of Food Adulteration Act & Rules
3. Codex standards
4. Ice-cream
   - **4.1** Storage
   - **4.2** Over run
5. Stablizer
6. Jaggery
   - **6.1** Jaggery Vs Sugar
   - **6.2** Health benefit
   - **6.3** Composition
   - **6.4** Production
   - **6.5** Quality of jaggery
   - **6.6** Storage
7. Health benefit of Cocoa powder & Chocolate liquor
8. GMP & GRAS status of added ingredients.
9. Physico-chemical, Organoleptic & microbiological standards of similar products.

1. History of Ice-cream

Sharma & Hissaria (2007) reported that Our love affair with ice cream is centuries old. The ancient Greeks, Romans and Jews were known to chill wines and juices. This practice evolved into fruit ices and, eventually, frozen milk and cream mixtures. In the

first century, Emperor Nero reportedly sent messengers to the mountains to collect snow so that his kitchen staff could make mixtures flavored with fruit and honey. Twelve centuries later, Marco Polo introduced Europe to a frozen milk dessert similar to the modern sherbet that he had enjoyed in the Far East. The Italians were especially fond of the frozen confection, which, by the sixteenth century, was being called ice cream. In 1533, m the young Italian princess, Catherine de Medici went to France as the bride of the future King Henry II. She was having recipes for frozen desserts included in her gifts. Ice cream is often described in terms of two phases: continuous and dispersed. The continuous phase is a combination of an unfrozen solution, an emulsion and a suspension of solids in liquid. Water, sugar, hydrocolloids, milk proteins and other solubles make up the unfrozen solution. Suspended in the aqueous phase are insoluble solids, including ice crystals, lactose crystals and milk solids. The aqueous phase also forms an emulsion with dispersed milk fat globules. The complex physical structure of ice cream presents a challenge for food technologists. Simply stated, overall goal of designing the ice cream is to incorporate several different insoluble (air bubbles, ice crystals and fat globules) into an aqueous phase in the smallest sizes and in the greatest numbers possible.

Wilson *et.al.* (1997) stated that a survey of unopened ice cream, ice cream in use, and ice-cream-scoop water (n = 91) was conducted to determine the effect of scoop water hygiene on the microbiological quality of ice cream. An aerobic plate count around 10(6) c.f.u. ml-1 was the modal value for scoop waters. Unopened ice creams generally had counts around 10(3)-10(4) c.f.u. ml-1 and this increased by one order of magnitude when in use. Many scoop waters had low coliform counts, but almost half contained > 100 c.f.u. ml-1. E. coli was isolated in 18% of ice creams in use, and in 10% of unopened ice creams. S. aureus was not detected in any sample. Statistical analysis showed strong associations between indicator organisms and increased counts in ice cream in use. EC guidelines for indicator organisms in ice cream were exceeded by up to 56% of samples.

Erland (1991) concluded that this is a shortened version of a history of ice cream compiled to mark the 25th anniversary of A/L Iskrem, Norway. Preparation of cryohydrates probably originated in China. In ancient Greece and Rome the rich were partial to frozen desserts. They disappeared, and then reappeared in the middle ages in

Italy, from where they spread across Europe. Ice cream was probably introduced to the French court of Henry II by Catherine de Medici around 1550. The first of many ice cream parlours opened in Paris, France, in 1651, and a household recipe was published in the UK in 1796 and a New York (USA) advertisement even earlier. Italian ice cream carts finally reached Nordic countries. Development into an industry was slow. Varchaug Dairy was the first in Norway to introduce technology, in 1927. The first Norwegian ice cream factory, Diplomis Oslo, started up in 1930. Dry ice became available in 1934. The Diplomis brand-name was adopted by the Norwegian Dairy Ice Cream Association, formed in 1951.

Shannon (1980) reported that ice cream, when eaten frequently between meals, is a potential dental hazard. A significant accomplishment in dental prevention would be the decreased use of ice cream as a between meal snack and its increased use, if so desired, as a meal time dessert. It is the frequent exposure of children to sticky, high-sugar material between meals that is primarily responsible for the deplorable state of dental health in the United States.

2. PFA standards forIce-cream

ICE CREAM,Ice-cream AND CHOCOLATE ICECREAM mean the frozen product obtained from cow or buffalomilk or a combination thereof or from cream, and/or other milk products, with or without the addition of cane sugar, [1][dextrose,liquid glucose and dried liquid glucose]. [3]maltodextrin, eggs, fruits, fruit juice, preserved fruits, nuts, chocolate, edible flavours and permitted food colours. It may contain permitted stabilizer and emulsifiers not exceeding 0.5 per cent by weight. The mixture shall be suitably heated before freezing. The product shall contain not less than 10.0 per cent milk fat, 3.5 per cent protein and 36.0 per cent total solids. [3]Omitted [1][Starch may be added to a maximum extent of 5.0 per cent under a declaration on a label as specified in sub-rule (2) of Rule 43. The standards foe ice cream shall also apply to softy ice-cream]. [4][In case of ice-cream, where the chocolate or like covering portion forms a separate layer, only the ice cream portion shall conform to the standards of ice-cream.

2.1. Ice Cream,Ice-cream, Chocolate Ice Cream or Softy Ice Cream

means the product obtained by freezing a pasteurized mix prepared from milk and / or other products derived from milk with the addition of natural sweetening agents i.e. sugar, Dextrose, Fractose, Liquid glucose, Dried liquid glucose, maltodextrin, high maltose cam syrup, honey, fruit and fruit products, eggs and egg products, such as Cake, or Cookies as separate layer and / or coating. It may be frozen hard of frozen to a soft consistency. It shall be free from artificial sweetener. It shall have pleasant taste and smell free from off flavour adds acidity. It may contain food additives permitted in Appendix C. It shall conform to the microbiological requirements prescribed in Appendix D. It shall conform to the following requirements. **(PFA, 2004)**

2.2 A/c to PFA standard, Ice Cream, Kulfi, Chocolate Ice Cream or Softy Ice Cream composition derived as:

Requirements	**Ice Cream**	**Medium fat Ice Cream**	**Low fat Ice Cream**
(1) Total solids	Not less than 36.0 percent	Not less than 30.0 percent	Not less than 26.0 percent
(2) Wt / Vol (gms/l)	Not less than 525	Not less than 475	Not less than 475
(3) Milk Fat	Not less than 10.0 percent	Not less than 5.0 percent	Note less than 2.5 percent
(4) Milk Protein (Nx6.38)	Not less than 3.5 percent	Not less than 3.5 percent	Not less than 2.5 percent

Note:- in case where chocolate, cake or similar food coating, base or layer forms a separate part of the product only the ice cream portion shall conform to the requirements given above.

3.MATERIALS AND METHODS

PLAN OF WORK:

The experiment **"Effect of traditional Indian sweetener (Date & sugarcane Jaggery) on rheological properties of ice cream"** was carried out in the lab of Dairy Science, Faculty of Agriculture, Shri Ram College, Muzaffarnagar. The details of experimental techniques to be employed during the course of investigation were studied under the following heading:

1. Procurement and collection of ingredients.
2. Treatments.
3. Flow Diagram adopted for manufacturing control & experimental Ice cream.
4. Detailed procedure for manufacturing control & experimental Ice cream.
5. Physico-chemical analysis of control and experimental Ice cream.
6. Organoleptic analysis of control and experimental Ice cream.
7. Microbiological analysis control and experimental Ice cream.
8. Statistical analysis of control and experimental Ice cream

1. Procurement and collection of ingredients.

a) **Skimmed milk powder: - Skimmed milk powder Brand Anik spray was obtained from the local market of Muzaffarnagar.**

b) **Sugar: -was procured from the local market of Muzaffarnagar.**

c) **Stabilizer: - Sodium alginate was obtained from scientific cooperation, Muzaffarnagar.**

d) **Emulsifier:-Monoglycerides was obtained from scientific cooperation, Muzaffarnagar.**

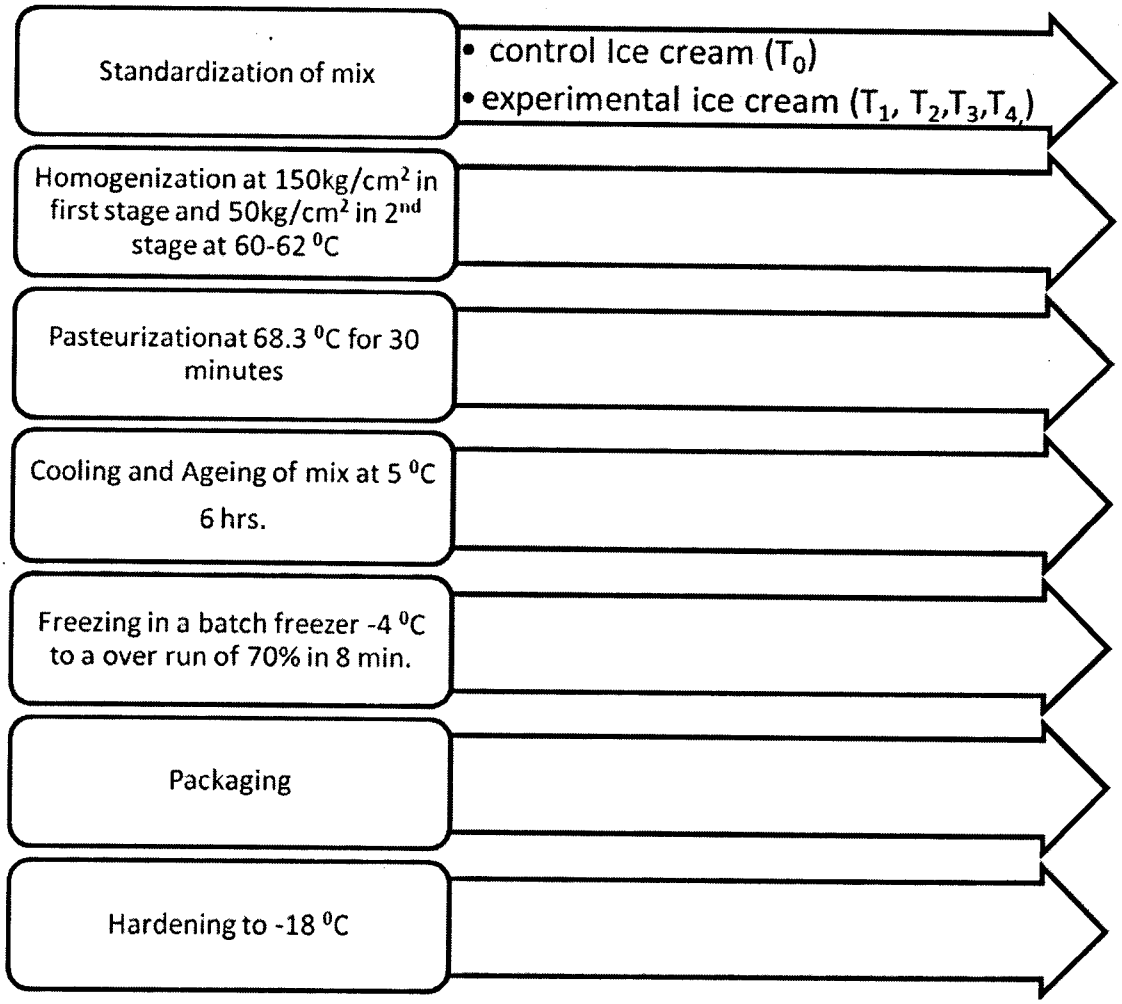
e) **Jaggery obtained from sugarcane, juices from khajur (date) was obtained from Gur Mandi, Muzaffarnagar [U.P]**

f) **cocoa powder: -was procured from the local market of Muzaffarnagar**

2) Treatment

Treatments	Milk fat (%)	Milk SNF (%)	Cane sugar (%)	Jaggery (Cane) (%)	Jaggery (Date) (%)	Stabilizer/ Emulsifier (%)	Cocoa (%)	Chocolate liquor (%)	Total Solids (%)
T_0	10	10	18	-	-	0.1/0.2	2.5	1.5	42.3
T_1	10	10	-	18	-	0.1/0.2	2.5	1.5	42.3
T_2	10	8	-	20	-	0.1/0.2	2.5	1.5	42.3
T_3	10	10	-	-	18	0.1/0.2	2.5	1.5	42.3
T_4	10	8	-	-	20	0.1/0.2	2.5	1.5	42.3

3) **Flow Diagram adopted for manufacturing control & experimental Ice cream.**



4) **Detailed procedure for manufacturing control & experimental Ice cream.**

For control – Mixing of liquid ingredients - A calculated amount of milk and cream will be placed in a stainless steel container and mixed with the help of wooden ladle and heated by placing the pan in a container containing water over direct fire (double jacketed vat arrangement) to 50 °C . **Mixing of solid ingredients-** Calculated amount of dry ingredient like skim milk powder, sugar and stabilizer will be mixed and will be added to liquid ingredients and thoroughly stirred with the help of wooden ladle.

For experimental –

Calculated amount of Jaggery from different sources will be first broken down into smaller particles and will be separately heated in a container over direct fire till liquid paste is obtained and will be added into calculated

amount of milk and cream as per calculation for T_1,T_2,T_3 and T_4 and heated to 50 °C

Mixing of solid ingredients- calculated amounts of dry ingredients like skim milk powder; stabilizer and emulsifier will be mixed and added to liquid ingredient and thoroughly stirred with the help of wooden ladle.

Homogenization: The ice cream mix for control and treatment will be homogenized at 150kg/cm² in first stage and 50kg/cm² in 2nd stage at 60-62 °C using a Nonton Gaulin two stage homogenization.

Pasteurization: The control and experimental frozen dessert mixes will be pasteurized at 68.3 °C for 30 minutes by batch method. Pasteurization was done after homogenization to avoid any contamination that could be caused by the homogenizer (Hammer 1948) and to avoid lipolysis of fat during ageing period (Trout 1950)

Cooling and Ageing – the mix will be immediately Cooled to 5 °C and held at that temperature for 4-6 hrs.

Freezing of ice-cream mixes- The mixes were frozen in a mechanically operated batch freezer without air injection system. Whipping and incorporation of air would be done naturally till the desired over run is achieved (70%).The ice cream will be **packaged** in a suitable container and **hardened** in a deep freezer at 18 °C

5) Physico-Chemical Analysis

Sampling of Ice-cream

The technique followed for sampling of ice cream and frozen dessert for analysis was as per I.S.2802 (1964).

Fat percent in frozen dessert-The fat percent in Ice-cream was determined as per **I.S.2802 (1964)**

Determination of total solids -Total solids in plain Ice-cream was determined gravimetrically as per the procedure laid down in dairy chemistry manual, ICAR Publication and in **IS:1479,Part: II, 1961(20)**

Determination of moisture-The moisture percentage in Ice-cream was determined as per procedure laid down in **IS.1165 (1957).**

Moisture percentage in skim milk powder-The moisture percent in skim milk powder will determined as per **I.S.1165 (1957).**

Percentage of Acidity-Titratable acidity of Plain Ice-cream samples (expressed as lactic acid) was determined as per the procedure laid down in **IS: 1479, Part: I. (1960)**

Freezing time-The total time taken for freezing was determined by noting time when freezing was started up to the time the mixture was taken out from the freezer and then taking their difference.

Melting resistance of Ice-cream -Melting quality of ice cream was observed by placing a scoopful of the sample on a dish and noting its response to melting from time to time as the other qualities of Ice-cream was being examined. **(Nelson and Trout, 1951)**

6) **Rheological properties**

(a). Hardness of ice-cream

(b). Property of mix

7) **Organoleptic evolution-**The Ice-cream samples of different treatments was analyzed for organoleptic Quality (flavour, body, texture, colour, appearance and melting resistance). Attributes was rated on nine point Hedonic scale **(Nelson and Trout, 1964)**

Judging panel: Five experienced staff members of the Dairy Technology Department was served as a judging team and was evaluated the samples of control and experimental Ice-cream. Numerical scores will be allocated for flavor, body and texture, melting quality and color of the Ice-cream. The numerical score was used as an indication of the quality. The Judges was also identifying qualities and they will consider to unsatisfactory or satisfactory.

8) **Microbiological Analysis**

- Coliform test
- SPC

of Ice-cream was determined as per the procedure given in "Manual in Dairy Bacteriology." **ICAR, (1972).**

9). STATISTICAL ANALYSIS:-

The data was analyzed statistically by analysis of variance at 5% level of significance.

Number of treatments	-	5
Number of replications	-	4
Total number of samples	-	20

4.RESULTS AND DISCUSSION

The present study was based to evolve "Effect of traditional Indian sweetener (Date & sugarcane Jaggery) on rheological properties of ice cream" The data collected on different aspects were tabulated & analyzed statistically using the methods of analysis of variance & critical difference. The significant & non-significant differences observed have been analyzed critically within & between the treatment combinations. The results obtained from the analysis are presented in this chapter under the following headings:

4.1 Physico-chemical & rheological properties characteristics of ice cream mix.

4.2 Organoleptic characteristics of ice cream mix.

4.3 Microbiological characteristics of ice cream mix.

4.4 Coli form test

4.5 Cost of production of ice cream mix.

The different parameters of control and experimental Ice-cream:

Parameters	Treatments					
	T_0	T_1	T_2	T_3	T_4	CD Value
1. Chemical analysis (in percent)						
Fat	10.20	10.10	10.08	10.00	10.22	0.544
Total solids	4242	42.68	42.24	42.90	42.80	1.425
Acidity	0.22	0.24	0.24	0.28	0.30	0.018
Protein	4.76	4.84	4.13	4.83	4.12	0.030
pH	6.15	6.21	6.14	6.15	6.16	0.101
Moisture	57.58	57.32	57.56	57.10	57.20	1.489
Ash	0.53	0.62	0.67	0.69	0.57	0.57
2. Physical analysis						
Melting resistance (in minutes)	7.66	7.24	7.36	7.46	7.30	0.568
3. Organoleptic scores (9 point hedonic scale)						
Colour & appearance	8.04	7.72	7.58	7.84	7.73	0.509
Body & texture	.81	7.75	7.30	7.08	7.08	0.496
Flavour & taste	8.15	7.88	7.45	7.44	7.36	0.431
4. Rheological properties						
Hardness (+/-S.D.)(g)	1468.78	2170.72	1267.44	2557.18	2650.35	88.668
Firmness (+/-S.D.)(g)	24.692	26.414	28.252	31.122	32.042	1.519
Consistency (+/- S.D.) (g s)	543.352	605.556	602.824	647.691	715.626	11.324
Cohesiveness (+/-S.D.)(g)	-32.157	-38.358	-49.728	-49.957	-56.618	2.448
Index of viscosity /consistency (+/- S.D.) (g s)	-34.281	-65.753	-93.92	-92.219	-118.575	2.448
5. Microbial analysis						
SPC (cfu/g)	909.00	905.00	928.00	949.00	942.00	17.104

Coli form test (cfu 10^2/g)	N	N	N	N	N	
Yeast & mould count (per g)	20.66	13.33	11.33	15.33	14.52	1.078
1. Cost						
Ice-cream (in rupees/kg)	**34.33**	**38.18**	**39.70**	**41.22**	**42.74**	

Similar alphabets represent N.S. differences

Physico-chemical characteristics of ice cream mix

4.1 Fat percent in ice cream mix

The data regarding fat percentage in Herbal Kulfi sample of different treatments are presented in table 4.1.a. and figure 4.1

Table 4.1a: Percentage Fat in control and experimental Ice-cream

Replication		Treatments				
		T_0	T_1	T_2	T_3	T_4
R_1		10.20	10.00	9.90	9.70	10.80
R_2		9.80	9.90	10.30	10.30	10.10
R_3		10.90	9.80	10.20	9.90	10.90
R_4		9.90	10.00	9.80	9.80	9.50
R_5		10.20	10.80	10.20	10.30	9.80
	Mean	**10.20**	**10.10**	**10.08**	**10.00**	**10.22**
Range	Minimum	9.80	9.80	9.80	9.70	9.50
	Maximum	10.90	10.80	10.30	10.30	10.90
F- test		NS				
S. Ed. (±)		0.252				
C. D. (p = 0.05)		0.544				

1. From the perusal of data on fat percentage in ice cream mix samples of different treatments and control the highest mean fat percentage was recorded in the ice

cream mix sample of T_0 (10.20) T_4 (10.22), followed by T_3 (10.00), T_2 (10.08) and T (10.10).

Table 4.1.b: ANOVA for Percentage Fat in control and experimental Ice-cream

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. 5%	Result
Replication	4	0.8600	0.2150	1.36	3.01	NS
Treatment	4	0.1640	0.0410	0.26	3.01	NS
Error	16	2.5360	0.1585	-	-	-
TOTAL	24	3.5600	-			-

**No significant

2. As evident from the result of ANOVA given in Table 4.1.b., the F (Cal) value (0.26) was smaller than the table value of F (3.01) at 5% level of significance. Therefore; the difference was non-significant, indicating no significant effect of treatments on fat percentage, which may be ascribed to proper standardization of ice cream mix.

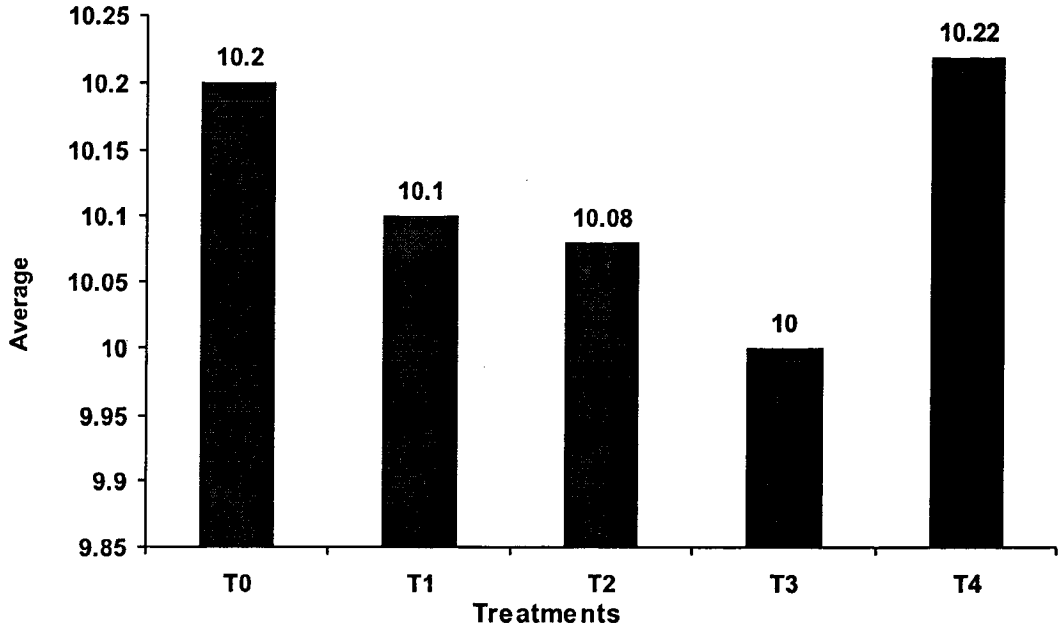


Fig. 4.1 : Fat percentage in samples of control and experimental probiotics Ice-cream mix of different treatments.

T_0 – Control ice-cream

T_1 – Ice cream mix with 18% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_2 – Ice cream mix with 20% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_3 – Ice cream mix with 18% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor.

T_4 – Ice cream mix with 20% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

4.2 Total solids percent in ice cream

The data regarding total solid percent ice cream sample of different treatments are presented in table 4.2.a and figure 4.2

Table 4.2.a: Percentage Total solids in control and experimental ice cream

Replication		Treatments				
		T_0	T_1	T_2	T_3	T_4
R_1		41.50	42.90	42.41	42.90	41.70
R_2		43.50	41.80	43.70	41.70	43.60
R_3		43.20	43.90	40.90	43.90	41.90
R_4		41.70	40.90	41.90	43.10	42.90
R_5		42.20	43.90	42.30	42.90	43.90
	Mean	**42.42**	**42.68**	**42.24**	**42.90**	**42.80**
Range	Minimum	41.50	40.90	40.90	41.70	41.70
	Maximum	43.50	43.90	43.70	43.90	43.90
F- test		NS				
S. Ed. (±)		0.660				
C. D. (p = 0.05)		1.425				

1. From the perusal of data on total solids percentage in ice cream mix samples of different treatments and control the highest mean total solids percentage

was recorded in the ice cream mix sample of T_1(42.68) , T_2 (42.24), T3 (42.90), T4 (42.80) followed by T_0 (42.42).

Table 4.2.b: ANOVA for Percentage Total solids in control and experimental ice cream

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. 5%	Result
Replication	4	3.1879	0.7970	0.73	3.01	NS
Treatment	4	1.4831	0.3708	0.34	3.01	NS
Error	16	17.4034	1.0877	-	-	-
TOTAL	24	22.0743	-			-

**No significant

2. As evident from the result of ANOVA given in Table 4.2.b., the F (Cal) value (0.34) was less than the table value of F (3.01) at 5% level of significance. Therefore; the difference was no significant, indicating no significant effect of treatments on total solid percentage.

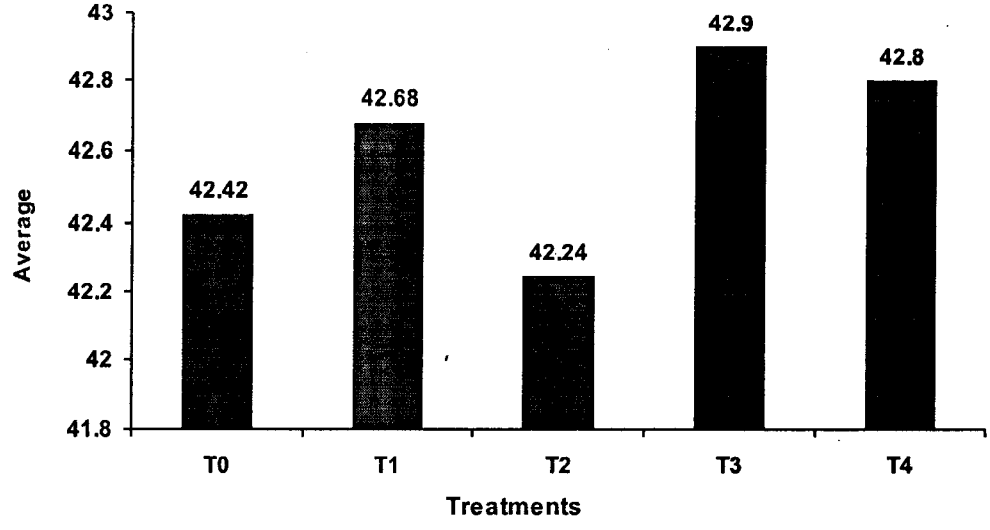


Fig. 4.2 : Total solids percentage in samples of control and experimental probiotics Ice-cream mix of different treatments.

T_0 – Control ice-cream

T_1 – Ice cream mix with 18% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_2 – Ice cream mix with 20% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_3 – Ice cream mix with 18% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor.

T_4 – Ice cream mix with 20% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

4.3 Lactic acid percent in Ice cream mix

The data regarding Lactic acid percent in ice cream mix sample of different treatments are presented in table 4.3.a and figure 4.3.

Table 4.3.a: Percentage lactic acidity in control and experimental ice cream

Replication		Treatments				
		T_0	T_1	T_2	T_3	T_4
R_1		0.20	0.23	0.24	0.29	0.30
R_2		0.22	0.24	0.23	0.28	0.28
R_3		0.21	0.23	0.25	0.26	0.32
R_4		0.22	0.25	0.24	0.27	0.31
R_5		0.24	0.24	0.23	0.28	0.29
	Mean	**0.22**	**0.24**	**0.24**	**0.28**	**0.30**
Range	Minimum	0.20	0.23	0.23	0.26	0.28
	Maximum	0.24	0.25	0.25	0.29	0.32
F- test		S				
S. Ed. (±)		0.008				
C. D. (p = 0.05)		0.018				

1. From the perusal of data of Lactic acid percentage in ice cream mix samples of different treatments and control the mean Lactic acid percentage was recorded in

the ice cream mix sample of T1 (.24), T_2 (0.24), T_3 (0.28), T_4 (0.30) followed by T_0(0.22)

Table 4.3.b: ANOVA for lactic acid percentage in samples of ice cream

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. 5%	Result
Replication	4	0.0002	0.0000	0.29	3.01	NS
Treatment	4	0.0220	0.0055	31.94	3.01	S
Error	16	0.0028	0.0002	-	-	-
TOTAL	24	0.0250	-			-

*Significant

1. As evident from the result of ANOVA given in Table 4.3.b., the F (Cal) value (31.94) was greater than the table value of F (3.01) at 5% level of significance. Therefore; the difference was significant, indicating significant effect of treatments on Lactic acid percentage.

2. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.3.c

Table 4.3.c: Critical difference in lactic acidity in samples of control and experimental ice cream

Treatments	Average	T_1	T_2	T_3	T_4	T_5
		0.22	0.24	0.24	0.28	0.30
T_0	0.22		0.02	0.02	0.06	0.08
T_1	0.24			0.00	0.04	0.06
T_2	0.24				0.04	0.06
T_3	0.28					0.02
T_4	0.30					

C.D.= 0.018

The following observations were made:

The difference between the mean values of T_0-T_1 (0.02) less than C.D. value, 0.018 therefore difference was non significant.

The difference between the mean values of T_0-T_2 (0.02) was greater than the C.D. value, 01018 therefore, the difference was significant.

The difference between the mean values of T_0-T_3 (0.06) was greater than the C.D. value, 0.018.Therefore, the difference was significant.

The difference between the mean values of T_0-T_4 (0.08) was greater than the C.D. value, 88.668.Therefore, the difference was significant.

The difference between the mean values of T_1-T_2 (0.00) was less than the C.D. value, 0.018.Therefore, the difference was non significant.

The difference between the mean values of T_1-T_3 (0.04) was greater than the C.D. value, 0.018.Therefore, the difference was significant.

The difference between the mean values of T_1-T_4 (0.06) was greater than the C.D. value, 0.018.Therefore, the difference was significant.

The difference between the mean values of T_2-T_3 (0.04) was greater than the C.D. value, 0.018.Therefore, the difference was significant.

The difference between the mean values of T_2-T_4 (0.06) was greater than the C.D. value, 0.018.Therefore, the difference was significant.

The difference between the mean values of T_3-T_4 (0.02) was greater than the C.D. value, 0.018.Therefore, the difference was significant.

It is therefore concluded that there was non significant difference b/w the $T_3 - T_4$ and there was significant difference b/w the all other treatments which may be ascribed to addition of different level of jaggery in the experimental treatments of ice cream mix.

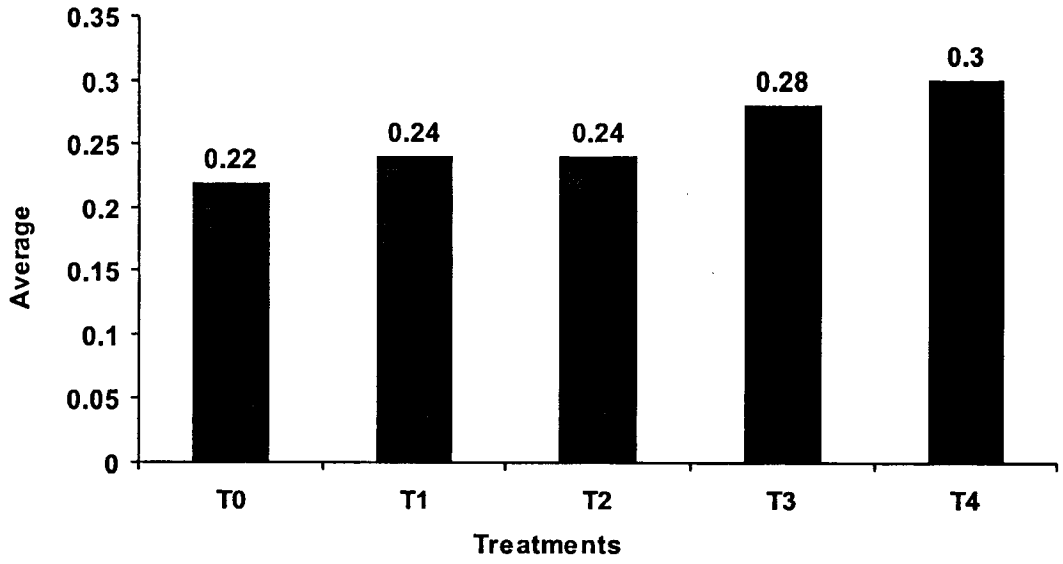


Fig. 4.3 : Percentage of lactic acidity in samples of control and experimental ice cream mix of different treatments.

T_0 – Control ice-cream

T_1 – Ice cream mix with 18% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_2 – Ice cream mix with 20% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_3 – Ice cream mix with 18% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor.

T_4 – Ice cream mix with 20% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

4.4 Melting resistance (mins.)

The data regarding melting resistance in ice cream mix sample of different treatments are presented in table 4.4.a and figure 4.4

Table 4.4.a: Melting resistance (mints) in control and experimental ice cream

Replication		Treatments				
		T_0	T_1	T_2	T_3	T_4
R_1		7.80	7.20	7.40	7.60	7.60
R_2		7.40	7.60	7.80	8.60	7.60
R_3		7.80	7.40	6.80	7.40	7.20
R_4		7.80	6.80	7.80	7.40	7.60
R_5		7.50	7.22	7.02	6.30	6.50
	Mean	**7.66**	**7.24**	**7.36**	**7.46**	**7.30**
Range	Minimum	7.40	6.80	6.80	6.30	6.50
	Maximum	7.80	7.60	7.80	8.60	7.60
F- test		NS				
S. Ed. (±)		0.263				
C. D. (p = 0.05)		0.568				

1. From the perusal of data on melting resistance in ice cream mix samples of different treatments and control the highest mean melting resistance was recorded in the ice cream mix sample of T_1(7.24), T_2(7.36), T_3(7.46), T_4 (7.30) followed by T_0 (7.66)

Table 4.4.b: ANOVA for melting resistance (mins) in samples of control and experimental ice cream

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. 5%	Result
Replication	4	2.1455	0.5364	3.10	3.01	S
Treatment	4	0.5334	0.1333	0.77	3.01	NS
Error	16	2.7671	0.1729	-	-	-
TOTAL	24	5.4460	-			-

*Significant

3. As evident from the result of ANOVA given in Table 4.2.b., the F (Cal) value (8.50) was greater than the table value of F (3.01) at 5% level of significance.

Therefore; the difference was significant, indicating significant effect of treatments on total solid percentage.

4. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.2.c

Table 4.4c: Critical difference for melting resistance (mints) in samples of control and experimental ice cream

Treatments	Average	T_1	T_2	T_3	T_4	T_5
		7.66	7.24	7.36	7.46	7.30
T_0	7.66		0.42	0.30	0.20	0.36
T_1	7.24			0.12	0.22	0.06
T_2	7.36				0.10	0.06
T_3	7.46					0.16
T_4	7.30					

C.D.= 0.568

The following observations were made:

The difference between the mean values of T_0-T_1 (0.42) was less than the C.D. value, 0.568.Therefore, the difference was non-significant.

The difference between the mean values of T_0-T_2 (0.30) was less than the C.D. value, 0.568.Therefore, the difference was non-significant.

The difference between the mean values of T_0-T_3 (0.20) was less than the C.D. value, 0.568.Therefore, the difference was non significant.

The difference between the mean values of T_0-T_4 (0.36) was less than the C.D. value, 0.568.Therefore, the difference was non significant.

The difference between the mean values of T_1-T_2 (0.12) was less than the C.D. value, 0.568.Therefore, the difference was non significant.

The difference between the mean values of T_1-T_3 (0.22) was less than the C.D. value, 0.568.Therefore, the difference was non significant.

The difference between the mean values of T_1-T_4 (0.06) was less than the C.D. value, 0.568.Therefore, the difference was non significant.

The difference between the mean values of T_2-T_3 (0.10) was less than the C.D. value, 0.568.Therefore, the difference was non significant.

The difference between the mean values of T_2-T_4 (0.06) was less than the C.D. value, 0.568.Therefore, the difference was non significant.

The difference between the mean values of T_3-T_4 (0.16) was less than the C.D. value, 0.568.Therefore; the difference was non- significant.

It is therefore concluded that there was non- significant difference b/w the average melting resistance percentage of T_0-T_1, T_0-T_2, T_0-T_3, T_0-T_4, T_1-T_2, T_1-T_3, T_1-T_4, T_2-T_3, T_2-T_4 and T_3-T_4 treatments which may be ascribed to addition of different level of jaggery in the experimental treatments of ice cream mix.

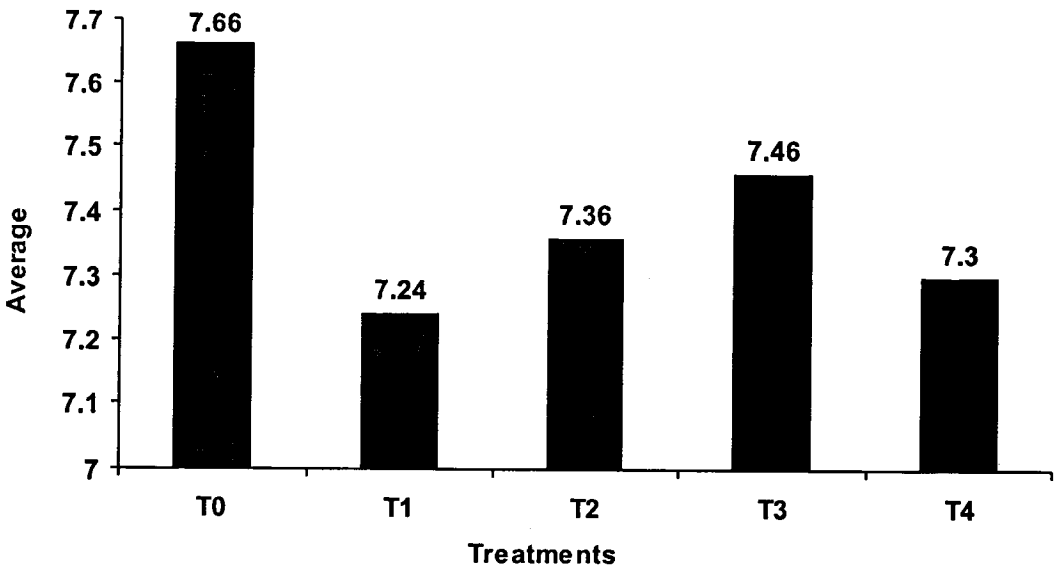


Fig. 4.4 : Melting resistance (mints) in samples of control and experimental ice cream mixl.

T_0 – Control ice-cream

T_1 – Ice cream mix with 18% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_2 – Ice cream mix with 20% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_3 – Ice cream mix with 18% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor.

T_4 – Ice cream mix with 20% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

4.5 Overrun percentage

The data regarding overrun percentage in ice cream mix sample of different treatments are presented in table 4.5.a figure 4.5

Table 4.5.a: Percentage over run in control and experimental ice-cream

Replication		Treatments				
		T_0	T_1	T_2	T_3	
R_1		80.00	78.00	74.00	75.00	70.00
R_2		81.00	79.00	76.00	78.00	75.00
R_3		82.00	77.00	72.00	73.00	68.00
R_4		83.00	79.00	75.00	76.00	69.00
R_5		82.00	78.00	76.00	77.00	72.00
	Mean	**81.60**	**78.20**	**74.60**	**75.80**	**70.80**
Range	Minimum	80.00	77.00	72.00	73.00	68.00
	Maximum	83.00	79.00	76.00	78.00	75.00
F- test		S				
S. Ed. (±)		0.854				
C. D. (p = 0.05)		1.846				

1. **From the perusal of data on overrun percentage in ice cream mix samples of different treatments and control the highest mean overrun percentage was recorded in the ice cream mix sample of T_0 (81.60) followed by T_1 (78.20), T_3 (75.80), T_2 (74.60) T_4 (70.66)**

Table 4.2b: ANOVA for overrun percentage in samples of control and experimental ice-cream

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. 5%	Result
Replication	4	35.6000	8.9000	4.88	3.01	S
Treatment	4	325.2000	81.3000	44.55	3.01	S
Error	16	29.2000	1.8250	-	-	-
TOTAL	24	390.0000	-			-

*Significant

2. As evident from the result of ANOVA given in Table 4.2.b., the F (Cal) value (44.55) was greater than the table value of F (3.01) at 5% level of significance. Therefore; the difference was significant, indicating significant effect of treatments on overrun percentage.

3. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.2.c

Table 4.2c: Critical difference in overrun percentage in samples of control and experimental ice-cream

Treatments	Average	T_1	T_2	T_3	T_4	T_5
		81.60	78.20	74.60	75.80	70.80
T_0	81.60		-3.40	-7.00	-5.80	-10.80
T_1	78.20			-3.60	-2.40	-7.40
T_2	74.60				1.20	-3.80
T_3	75.80					-5.00
T_4	70.80					

C.D.= 1.846

The following observations were made:

The difference between the mean values of T_0-T_1 (3.40) was greater than the C.D. value, 1.846.Therefore, the difference was significant.

The difference between the mean values of T_0-T_2 (7.00) was greater than the C.D. value, 1.846.Therefore, the difference was significant.

The difference between the mean values of T_0-T_3 (5.80) was greater than the C.D. value, 1.846.Therefore, the difference was significant.

The difference between the mean values of T_0-T_4 (1.80) was less than the C.D. value, 1.846.Therefore, the difference was non-significant.

The difference between the mean values of T_1-T_2 (3.60) was greater than the C.D. value, 1.846.Therefore, the difference was significant.

The difference between the mean values of T_1-T_3 (2.40) was greater than the C.D. value, 1.846.Therefore, the difference was significant.

The difference between the mean values of T_1-T_4 (7.40) was greater than the C.D. value, 1.846.Therefore, the difference was significant.

The difference between the mean values of T_2-T_3 (1.20) was less than the C.D. value, 1.846.Therefore, the difference was non significant.

The difference between the mean values of T_2-T_4 (3.80) was greater than the C.D. value, 1.846.Therefore, the difference was significant.

The difference between the mean values of T_3-T_4 (5.00) was greater than the C.D. value, 1.846.Therefore, the difference was significant.

It is therefore concluded that there was significant difference b/w T_2-T_3 treatments and there was non significant difference b/w the all other treatments which may be ascribed to addition of different level of jaggery in the experimental treatments of ice cream mix.

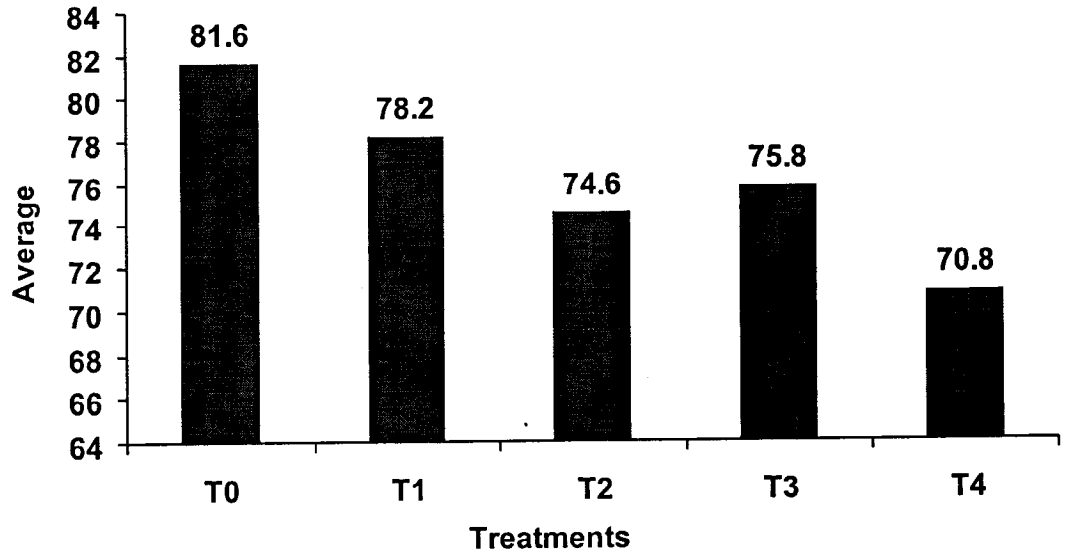


Fig. 4.5 : Percentage of overrun in samples of control and experimental Ice-cream of different treatments.

T_0 – Control ice-cream

T_1 – Ice cream mix with 18% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_2 – Ice cream mix with 20% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_3 – Ice cream mix with 18% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor.

T_4 – Ice cream mix with 20% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

4.1.6 pH percentage

The data regarding pH percentage in ice cream mix sample of different treatments are presented in table 4.6.a and figure 4.6.

Table 4.6a: Percentage pH in control and experimental Ice-cream

Replication		Treatments				
		T_0	T_1	T_2	T_3	T_4
R_1		6.15	6.20	6.21	6.30	6.20
R_2		6.12	6.21	6.24	6.05	6.15
R_3		6.18	6.18	6.05	6.24	6.18
R_4		6.17	6.22	6.00	6.12	6.12
R_5		6.14	6.23	6.22	6.06	6.14
	Mean	**6.15**	**6.21**	**6.14**	**6.15**	**6.16**
Range	Minimum	6.12	6.18	6.00	6.05	6.12
	Maximum	6.18	6.23	6.24	6.24	6.18
F- test		NS				
S. Ed. (±)		0.047				
C. D. (p = 0.05)		0.101				

1. **From the perusal of data on pH percentage in ice cream mix samples of different treatments and control the highest mean pH percentage was recorded in the ice cream mix sample of T_1 (6.21) followed by T_4 (6.16), T_0 (6.15) T_3 (6.15), T_2 (6.14)**

Table 4.6b: ANOVA for percentage of pH in samples of control and experimental Ice-cream

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. 5%	Result
Replication	4	0.0194	0.0049	0.89	3.01	NS
Treatment	4	0.0131	0.0033	0.60	3.01	NS
Error	16	0.0869	0.0054	-	-	-
TOTAL	24	0.1193	-			-

**No significant

2. As evident from the result of ANOVA given in Table 4.6.b., the F (Cal) value (8.50) was less than the table value of F (3.01) at 5% level of significance. Therefore; the difference was no significant, indicating no significant effect of treatments on pH percentage.

3. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.6.c

Table 4.6.c: Critical difference in percentage of pH in samples of control and experimental Ice-cream

Treatments	Average	T_1	T_2	T_3	T_4	T_5
		6.15	6.21	6.14	6.15	6.16
T_0	6.15		0.06	0.01	0.00	0.01
T_1	6.21			0.06	0.05	0.05
T_2	6.14				0.01	0.01
T_3	6.15					0.00
T_4	6.16					
C.D.=	**0.101**					

The following observations were made:

The difference between the mean values of T_0-T_1 (0.06) was greater than the C.D. value, 0.101.Therefore, the difference was significant.

The difference between the mean values of T_0-T_2 (0.01) was less than the C.D. value, 0.101.Therefore, the difference was non-significant.

The difference between the mean values of T_0-T_3 (0.00) was less than the C.D. value, 0.101.Therefore, the difference was non significant.

The difference between the mean values of T_0-T_4 (0.01) was less than the C.D. value, 0.101.Therefore, the difference was non significant.

The difference between the mean values of T_1-T_2 (0.06) was less than the C.D. value, 0.101.Therefore, the difference was non significant.

The difference between the mean values of T_1-T_3 (0.05) was less than the C.D. value, 0.101.Therefore, the difference was non significant.

The difference between the mean values of T_1-T_4 (0.05) was less than the C.D. value, 0.101.Therefore, the difference was non significant.

The difference between the mean values of T_2-T_3 (0.01) was less than the C.D. value, 0.101.Therefore, the difference was non significant.

The difference between the mean values of T_2-T_4 (0.01) was less than the C.D. value, 0.101.Therefore, the difference was non-significant.

The difference between the mean values of T_3-T_4 (0.00) was less than the C.D. value, 0.101.Therefore, the difference was non significant.

It is therefore concluded that there was non- significant difference b/w the average total solids percentage of T_0-T_2, T_0-T_3, T_0-T_4, T_1-T_2, T_1-T_3, T_1-T_4, T_2-T_3, T_2-T_4 and T_3-T_4 and there was significant difference b/w the all other treatments which may be ascribed to addition of different level of jaggery in the experimental treatments of ice cream mix.

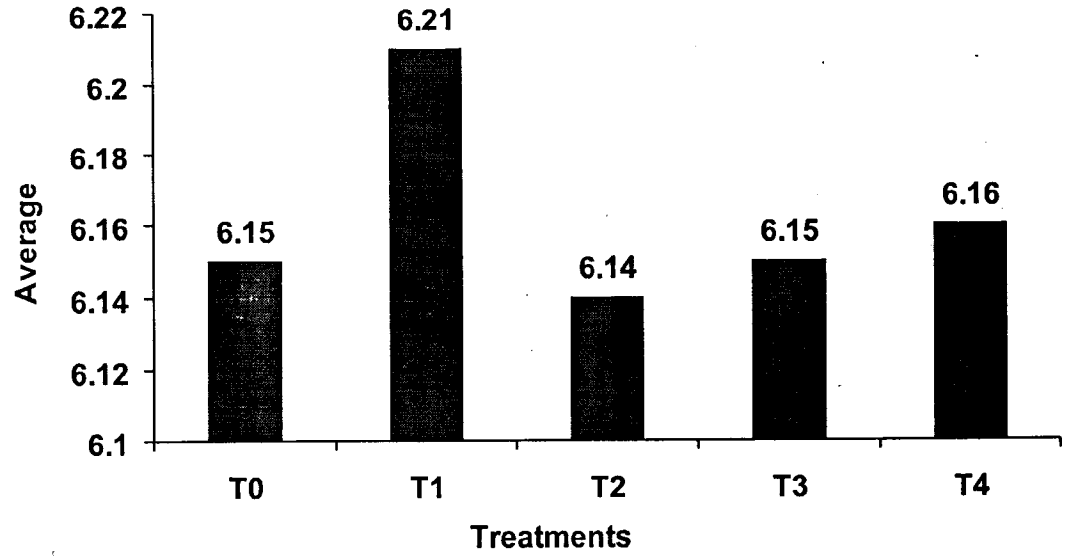


Fig. 4.6 : Percentage of pH in samples of control and experimental Ice-cream of different treatments.

T_0 – Control ice-cream

T_1 – Ice cream mix with 18% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_2 – Ice cream mix with 20% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_3 – Ice cream mix with 18% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor.

T_4 – Ice cream mix with 20% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

4.7 Hardness:

The data regarding hardness in ice cream sample of different treatments are presented in table 4.7.a and figure 4.7

Table 4.7.a: Average value of Hardness in samples of control and experimental Ice-cream

Replication	Treatments				
	T_0	T_1	T_2	T_3	T_4
R_1	1453.13	2161.38	1296.14	2544.84	2681.16

R_2		1450.12	2061.36	1280.42	2544.81	2580.16
R_3		1380.11	2090.32	1190.31	2445.70	2620.11
R_4		1580.21	2280.41	1180.22	2640.41	2780.10
R_5		1480.31	2260.11	1390.11	2610.11	2590.22
	Mean	**1468.78**	**2170.72**	**1267.44**	**2557.18**	**2650.35**
Range	Minimum	1450.12	2061.36	1180.22	2445.70	2580.16
	Maximum	1580.21	2280.41	1390.11	2640.41	2780.10
F- test		S				
S. Ed. (±)		41.050				
C. D. (p = 0.05)		88.668				

1. **From the perusal of data of hardness in ice cream samples of different treatments and control the highest mean hardness was recorded in the ice cream sample of T_4 (2650.35) , followed by T_3 (2557.18), T_1(2170.72), T_2 (1267.44) and T (1468.78)**

Table 4.7.b: ANOVA for Average value of Hardness in samples of control and experimental Ice-cream

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. 5%	Result
Replication	4	71434.2373	17858.5593	4.24	3.01	S
Treatment	4	7893834.3613	1973458.5903	468.45	3.01	S
Error	16	67403.7360	4212.7335	-	-	-
TOTAL	24	8032672.3346	-			-

*Significant

2. As evident from the result of ANOVA given in Table 4.7.b., the F (Cal) value (8.50) was greater than the table value of F (3.01) at 5% level of significance. Therefore; the difference was significant, indicating significant effect of treatments on hardness.

3. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.7.c

Table 4.7.c: Critical difference in Average value of Hardness in samples of control and experimental Ice-cream

Treatments	Average	T_1	T_2	T_3	T_4	T_5
		1468.78	2170.72	1267.44	2557.18	2650.35
T_0	1468.78		701.94	201.34	1088.40	1181.58
T_1	2170.72			903.27	386.46	479.64
T_2	1267.44				1289.73	1382.91
T_3	2557.18					93.18
T_4	2650.35					

C.D.= 88.668

The following observations were made:

The difference between the mean values of T_0-T_1 (701.94) greater than C.D. value, 88.668 therefore difference was significant.

The difference between the mean values of T_0-T_2 (201.34) was greater than the C.D. value, 88.668 therefore, the difference was significant.

The difference between the mean values of T_0-T_3 (1088.40) was greater than the C.D. value, 88.668.Therefore, the difference was significant.

The difference between the mean values of T_0-T_4 (1181.58) was greater than the C.D. value, 88.668.Therefore, the difference was significant.

The difference between the mean values of T_1-T_2 (903.27) was greater than the C.D. value, 88.668.Therefore, the difference was significant.

The difference between the mean values of T_1-T_3 (386.46) was greater than the C.D. value, 88.668.Therefore, the difference was significant.

The difference between the mean values of T_1-T_4 (479.64) was greater than the C.D. value, 88.668.Therefore, the difference was significant.

The difference between the mean values of T_2-T_3 (1289.73) was greater than the C.D. value, 88.668.Therefore, the difference was significant.

The difference between the mean values of T_2-T_4 (1382.91) was greater than the C.D. value, 88.668.Therefore, the difference was significant.

The difference between the mean values of T_3-T_4 (93.18) was greater than the C.D. value, 88.668.Therefore, the difference was non significant.

It is therefore concluded that there was non significant difference b/w the T_0 – T_2 and there was significant difference b/w the all other treatments which may be ascribed to addition of different level of jaggery in the experimental treatments of ice cream mix.

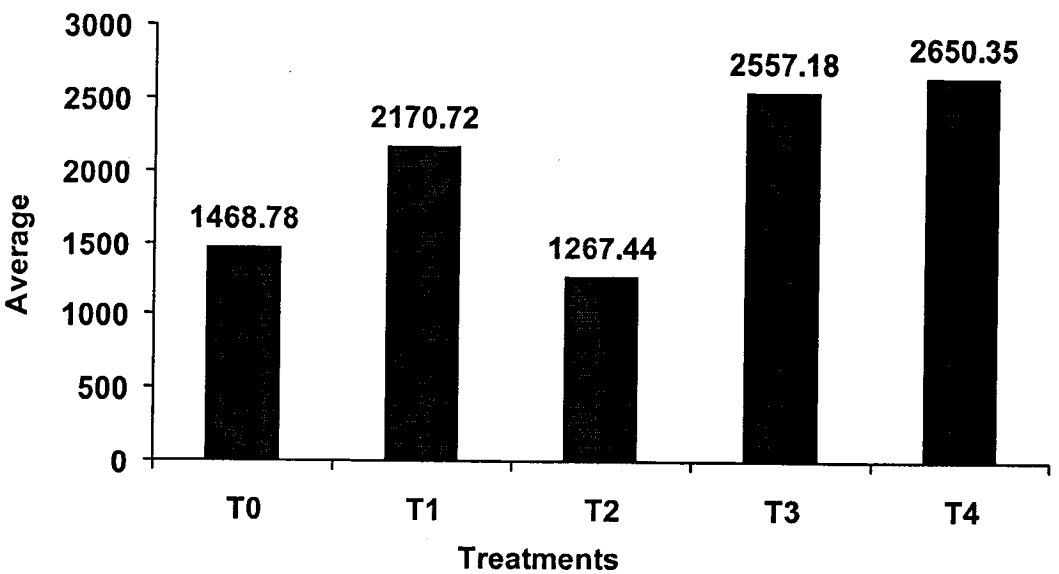


Fig. 4.7 : Average of hardness in samples of control and experimental Ice-cream of different treatments.

T_0 – Control ice-cream

T_1 – Ice cream mix with 18% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_2 – Ice cream mix with 20% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_3 – Ice cream mix with 18% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor.

T_4 – Ice cream mix with 20% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

Table 4.8: Average value of rheological properties of ice cream mix:

	Firmness	Consistency	Cohesiveness	Index of viscosity /consistenc y
T0	24.692	543.352	-32.157	-34.281
T1	26.414	605.556	-38.358	-65.753
T2	28.252	602.824	-49.728	-93.92
T3	31.122	647.691	-49.957	-92.219
T4	32.042	715.626	-56.618	-118.575
F- test	S	S	S	S
S. Ed. (±)	0.717	5.342	1.155	1.155
C. D. (P = 0.05)	1.519	11.324	2.448	2.448

- **Firmness:**

The data regarding hardness in ice cream sample of different treatments are presented in table 4.8 and figure 4.8

1. **From the perusal of data of hardness in ice cream samples of different treatments and control the highest mean hardness was recorded in the ice cream sample of T_4 (32.042) , followed by T_3 (31.122), T_2(28.252), T_1 (26.414) and T_0(24.692)**

ANOVA : Firmness

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. 5%	Result	S. Ed. (±)	C.D. at 5%
Replicatio n	2	2.44	1.22	1.59	4.46	NS	0.717	1.519
Treatment	4	121.07	30.27	39.28	3.84	S	0.717	1.519
Error	8	6.16	0.77	-	-	-	-	-

TOTAL	14	-	-	-	-	-	-

*Significant

2. 'As evident from the result of ANOVA given in Table 4.8., the F (Cal) value (39.28) was greater than the table value of F (3.01) at 5% level of significance. Therefore; the difference was significant, indicating significant effect of treatments on firmness.

3. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.8

Critical difference Firmness

Treatments	Average	T_0	T_1	T_2	T_3	T_4
		24.692	26.414	28252	31.122	32.042
T_0	24.692		1.722	3.56	6.43	7.35
T_1	26.414			1.838	4.708	5.628
T_2	28.252				2.87	3.79
T_3	31.122					0.92
T_4	32.042					

C.D.= 1.519

The following observations were made:

The difference between the mean values of T_0-T_1 (1.722) greater than C.D. value, 1.519 therefore difference was significant.

The difference between the mean values of T_0-T_2 (3.56) was greater than the C.D. value, 1.519 therefore, the difference was significant.

The difference between the mean values of T_0-T_3 (6.43) was greater than the C.D. value, 1.519.Therefore, the difference was significant.

The difference between the mean values of T_0-T_4 (7.35) was greater than the C.D. value, 1.519.Therefore, the difference was significant.

The difference between the mean values of T_1-T_2 (1.838) was greater than the C.D. value, 1.519.Therefore, the difference was significant.

The difference between the mean values of T_1-T_3 (4.708) was greater than the C.D. value, 1.519.Therefore, the difference was significant.

The difference between the mean values of T_1-T_4 (5.628) was greater than the C.D. value, 1.519.Therefore, the difference was significant.

The difference between the mean values of T_2-T_3 (2.87) was greater than the C.D. value, 1.519.Therefore, the difference was significant.

The difference between the mean values of T_2-T_4 (3.79) was greater than the C.D. value, 1.519.Therefore, the difference was significant.

The difference between the mean values of T_3-T_4 (0.092) was less than the C.D. value, 1.519.Therefore, the difference was non-significant.

It is therefore concluded that there was non significant difference b/w the $T_3 - T_4$ and there was significant difference b/w the all other treatments which may be ascribed to addition of different level of jaggery in the experimental treatments of ice cream mix.

- **Consistency:**

The data regarding hardness in ice cream sample of different treatments are presented in table 4.8 and figure 4.8

1. **From the perusal of data of hardness in ice cream samples of different treatments and control the highest mean hardness was recorded in the ice cream sample of T_4 (715.626) , followed by T_3 (647.691), T_1(605.556), T_2 (602.824) and T_0(543.352)**

ANOVA : Consistency

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. 5%	Result	S. Ed. (±)	C.D. at 5%
Replicatio	2	115.60	57.80	1.35	4.46	NS	5.342	11.324

n								
Treatment	4	48733.17	12183.29	284.66	3.84	S	5.342	11.324
Error	8	342.40	42.80	-	-	-	-	-
TOTAL	14		-	-	-	-	-	-

*Significant

2. As evident from the result of ANOVA given in Table 4.8, the F (Cal) value (284.66) was greater than the table value of F (3.01) at 5% level of significance. Therefore; the difference was significant, indicating significant effect of treatments on consistency.

3. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.8

Critical difference Consistency

Treatments	Average	T_0	T_1	T_2	T_3	T_4
		543.353	605.556	602.824	647.691	715.626
T_0	543.352		62.204	59.472	104.339	172.274
T_1	605.556			2.732	42.135	110.07
T_2	602.824				44.867	112.802
T_3	647.691					67.935
T_4	715.626					

C.D.= 11.324

The following observations were made:

The difference between the mean values of T_0-T_1 (62.204) greater than C.D. value, 11.324 therefore difference was significant.

The difference between the mean values of T_0-T_2 (59.472) was greater than the C.D. value, 11.324 therefore, the difference was significant.

The difference between the mean values of T_0-T_3 (104.339) was greater than the C.D. value, 11.324.Therefore, the difference was significant.

The difference between the mean values of T_0-T_4 (172.274) was greater than the C.D. value, 11.324.Therefore, the difference was significant.

The difference between the mean values of T_1-T_2 (2.732) was less than the C.D. value, 11.324.Therefore, the difference was non-significant.

The difference between the mean values of T_1-T_3 (42.135) was greater than the C.D. value, 11.324.Therefore, the difference was significant.

The difference between the mean values of T_1-T_4 (110.07) was greater than the C.D. value, 11.324.Therefore, the difference was significant.

The difference between the mean values of T_2-T_3 (44.867) was greater than the C.D. value, 11.324.Therefore, the difference was significant.

The difference between the mean values of T_2-T_4 (112.802) was greater than the C.D. value, 11.324.Therefore, the difference was significant.

The difference between the mean values of T_3-T_4 (67.935) was greater than the C.D. value, 11.324.Therefore, the difference was significant.

It is therefore concluded that there was non-significant difference b/w the $T_1 - T_2$ and there was significant difference b/w the all other treatments which may be ascribed to addition of different level of jaggery in the experimental treatments of ice cream mix.

- **Cohesiveness:**

The data regarding hardness in ice cream sample of different treatments are presented in table 4.8. and figure 4.8

1. **From the perusal of data of hardness in ice cream samples of different treatments and control the highest mean hardness was recorded in the ice cream sample of T_0 (-32.157) , followed by T_1 (-38.358), T_2(-49.728), T_3 (-49.957) and T_4(-56.618)**

ANOVA : Cohesiveness

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. 5%	Result	S. Ed. (±)	C.D. at 5%
Replication	2	10.00	5.00	2.50	4.46	NS	1.155	2.448
Treatment	4	1170.90	292.73	146.36	3.84	S	1.155	2.448
Error	8	16.00	2.00	-	-	-	-	-
TOTAL	14		-	-	-	-	-	-

*Significant

2. As evident from the result of ANOVA given in Table 4.8, the F (Cal) value (146.36) was greater than the table value of F (3.01) at 5% level of significance. Therefore; the difference was significant, indicating significant effect of treatments on cohesiveness.

3. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.8

Critical difference Cohesivness

Treatments	Average	T_0	T_1	T_2	T_3	T_4
		-32.157	-38.358	-49.728	-49.957	-56.618
T_0	-32.157		6.201	17.728	17.8	24.461
T_1	-38.358			11.37	11.599	18.26
T_2	-49.728				0.229	6.89
T_3	-49.957					6.661
T_4	-56.618					

C.D.= 2.448

The following observations were made:

The difference between the mean values of T_0-T_1 (6.201) greater than C.D. value, 2.448 therefore difference was significant.

The difference between the mean values of T_0-T_2 (17.728) was greater than the C.D. value, 2.4488 therefore, the difference was significant.

The difference between the mean values of T_0-T_3 (17.8) was greater than the C.D. value, 2.448.Therefore, the difference was significant.

The difference between the mean values of T_0-T_4 (24.461) was greater than the C.D. value, 2.448.Therefore, the difference was significant.

The difference between the mean values of T_1-T_2 (11.37) was greater than the C.D. value, 2.448.Therefore, the difference was significant.

The difference between the mean values of T_1-T_3 (11.599) was greater than the C.D. value, 2.448.Therefore, the difference was significant.

The difference between the mean values of T_1-T_4 (18.26) was greater than the C.D. value, 2.448.Therefore, the difference was significant.

The difference between the mean values of T_2-T_3 (0.229) was less than the C.D. value, 2.448.Therefore, the difference was non-significant.

The difference between the mean values of T_2-T_4 (6.89) was greater than the C.D. value, 2.448.Therefore, the difference was significant.

The difference between the mean values of T_3-T_4 (6.661) was greater than the C.D. value, 2.448.Therefore, the difference was significant.

It is therefore concluded that there was non-significant difference b/w the $T_2 - T_3$ and there was significant difference b/w the all other treatments which may be ascribed to addition of different level of jaggery in the experimental treatments of ice cream mix.

- **Viscocity:**

The data regarding hardness in ice cream sample of different treatments are presented in table 4.8 and figure 4.8

1. **From the perusal of data of hardness in ice cream samples of different treatments and control the highest mean hardness was recorded in the ice cream sample of T_0, (-34.281) , followed by T_1 (-65.753), T_3(-92.219), T_2 (-93.92) and T_4(-118.575)**

ANOVA : Index of viscosity /consistency

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. 5%	Result	S. Ed. (±)	C.D. at 5%
Replicatio	2	10.00	5.00	2.50	4.46	NS	1.155	2.448

n								
Treatment	4	12359.31	3089.83	1544.91	3.84	S	1.155	2.448
Error	8	16.00	2.00	-	-	-	-	-
TOTAL	14		-	-	-	-	-	-

*Significant

2. As evident from the result of ANOVA given in Table 4.8, the F (Cal) value (1544.91) was greater than the table value of F (3.01) at 5% level of significance. Therefore; the difference was significant, indicating significant effect of treatments on viscosity percentage.

3. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.8

Critical difference Index of viscosity /consistency

Treatments	Average	T_0	T_1	T_2	T_3	T_4
		-34.281	-65.753	-93.92	-92.219	-118.575
T_0	-34.281		31.472	59.639	57.938	84.294
T_1	-65.753			28.167	26.466	52.822
T_2	-93.92				1.701	24.655
T_3	-92.219					26.356
T_4	-118.575					

C.D.= 2.448

The following observations were made:

The difference between the mean values of T_0-T_1 (31.472) greater than C.D. value, 2.448 therefore difference was significant.

The difference between the mean values of T_0-T_2 (59.938) was greater than the C.D. value, 2.448 therefore, the difference was significant.

The difference between the mean values of T_0-T_3 (57.938) was greater than the C.D. value, 2.448.Therefore, the difference was significant.

The difference between the mean values of T_0-T_4 (84.294) was greater than the C.D. value, 2.448.Therefore, the difference was significant.

The difference between the mean values of T_1-T_2 (28.167) was greater than the C.D. value, 2.448.Therefore, the difference was significant.

The difference between the mean values of T_1-T_3 (26.466) was greater than the C.D. value, 2.448.Therefore, the difference was significant.

The difference between the mean values of T_1-T_4 (52.822) was greater than the C.D. value, 2.448.Therefore, the difference was significant.

The difference between the mean values of T_2-T_3 (1.701) was less than the C.D. value, 2.448.Therefore, the difference was non-significant.

The difference between the mean values of T_2-T_4 (24.655) was greater than the C.D. value, 2.448.Therefore, the difference was significant.

The difference between the mean values of T_3-T_4 (26.356) was greater than the C.D. value, 2.448.Therefore, the difference was significant.

It is therefore concluded that there was non significant difference b/w the $T_2 - T_3$ and there was significant difference b/w the all other treatments which may be ascribed to addition of different level of jaggery in the experimental treatments of ice cream mix.

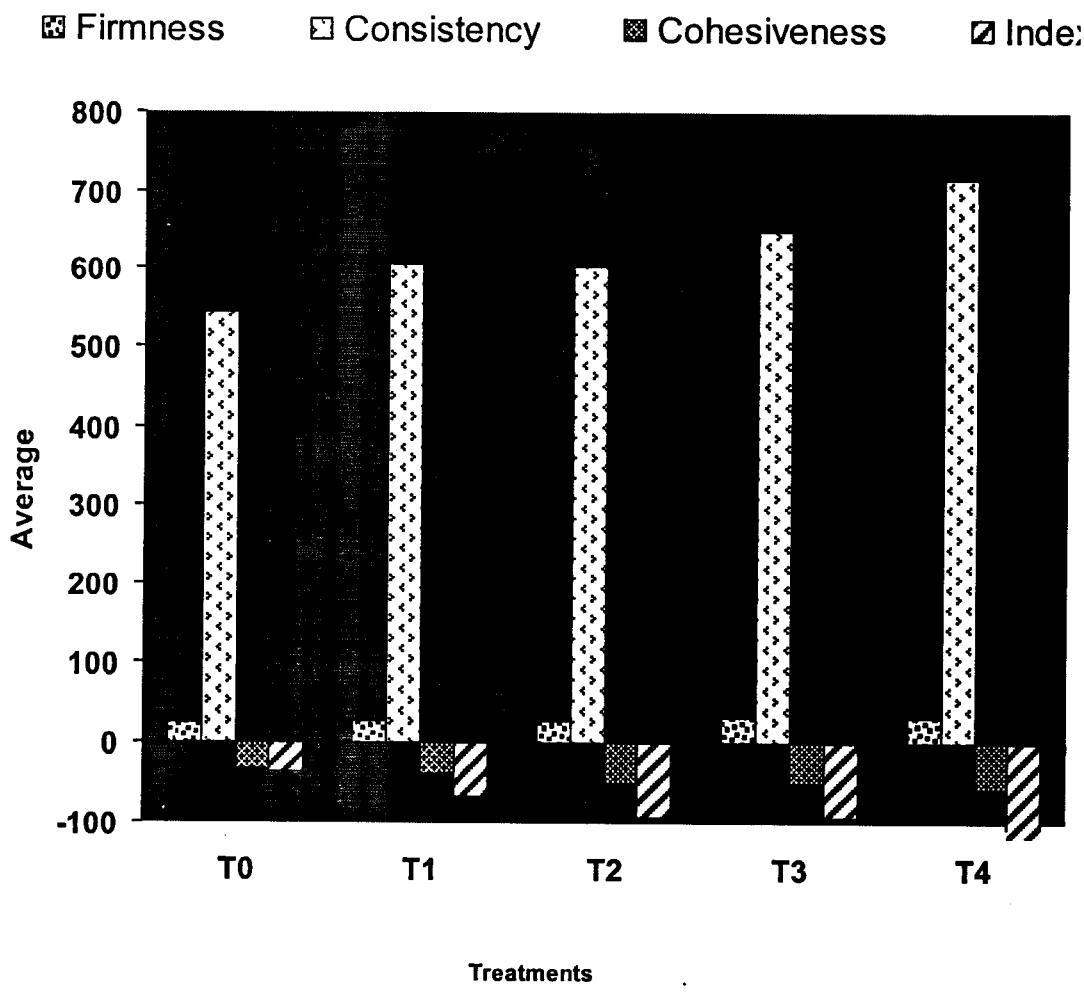


Fig. 4.8 Average value of rehological properties of ice cream

4.9 Moisture

The data regarding moisture percent in ice cream sample of different treatments are presented in table 4.9.a figure 4.9

Table 4.9.a: Percentage moisture in samples of control and experimental Ice-cream

Replication	Treatments				
	T_0	T_1	T_2	T_3	T_4
R_1	58.50	57.10	56.60	57.10	58.30

R_2		56.50	58.20	56.30	58.30	56.40
R_3		56.80	56.10	59.10	56.10	58.10
R_4		58.30	59.10	58.10	56.90	57.10
R_5		57.80	56.10	57.70	57.10	56.10
	Mean	**57.58**	**57.32**	**57.56**	**57.10**	**57.20**
Range	Minimum	56.50	56.10	56.30	56.10	56.10
	Maximum	58.50	59.10	59.10	58.30	58.30
F- test		NS				
S. Ed. (±)		0.689				
C. D. (p = 0.05)		1.489				

1. **From the perusal of data of moisture percentage in ice cream samples of different treatments and control the highest mean moisture percentage was recorded in the ice cream sample of T_0 (57.58), T_2, (57.56) , followed by T_1 (57.32),T_4(57.2) and T_3(57.20)**

Table 4.9b : Critical difference in percentage of moisture in samples of control and experimental Ice-cream mix of different treatments.

ANOVA :

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. 5%	Result
Replication	4	2.6984	0.6746	0.57	3.01	**NS**
Treatment	4	0.9144	0.2286	0.19	3.01	**NS**
Error	16	19.0096	1.1881	-	-	-
TOTAL	24	22.6224	-			-

**No significant

2. As evident from the result of ANOVA given in Table 4.9.b., the F (Cal) value (0.19) was smaller than the table value of F (3.01) at 5% level of significance. Therefore; the difference was non-significant, indicating no significant effect

of treatments on moisture percentage, which may be ascribed to which may be ascribed to addition of different level of basil leaves extract in treatments.

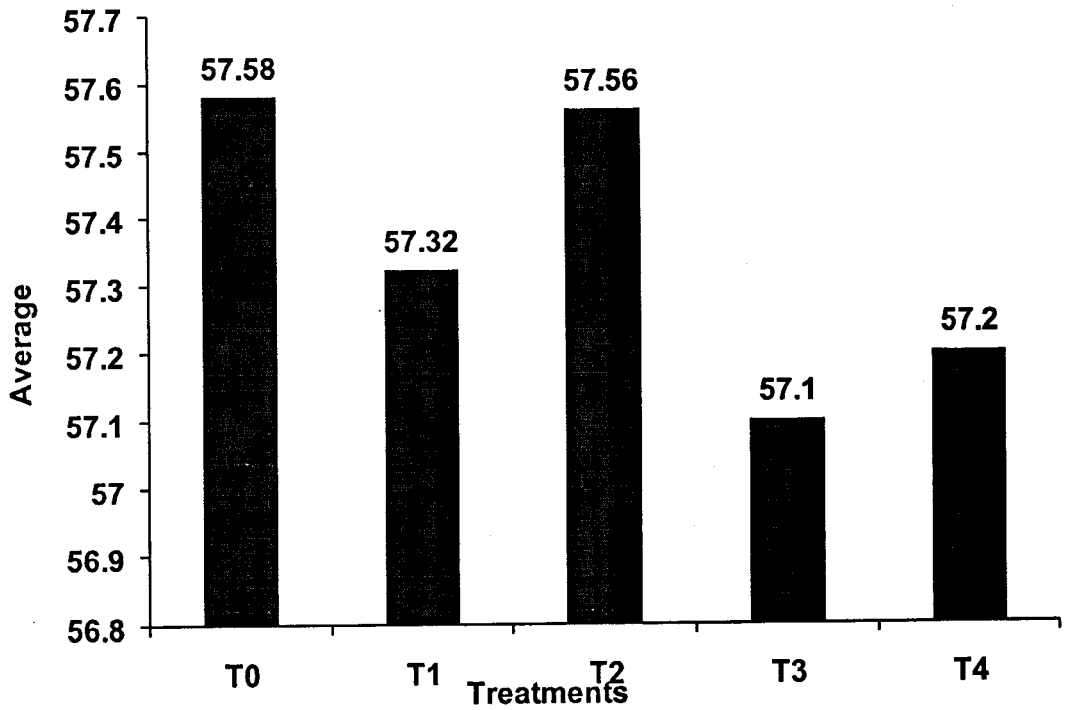


Fig. 4.9 : Percentage of moisture in samples of control and experimental Ice-cream of different treatments.

T_0 – Control ice-cream

T_1 – Ice cream mix with 18% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_2 – Ice cream mix with 20% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_3 – Ice cream mix with 18% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor.

T_4 – Ice cream mix with 20% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

4.10 Protein

The data regarding protein percent in ice cream sample of different treatments are presented in table 4.10.a and figure 4.10

Table 4.10.a: Percentage of protein in samples of control and experimental Ice-cream

Replication		Treatments				
		T_0	T_1	T_2	T_3	T_4
R_1		4.77	4.84	4.13	4.85	4.12
R_2		4.71	4.86	4.12	4.83	4.10
R_3		4.79	4.81	4.15	4.81	4.14
R_4		4.78	4.83	4.11	4.82	4.13
R_5		4.76	4.85	4.12	4.86	4.11
	Mean	**4.76**	**4.84**	**4.13**	**4.83**	**4.12**
Range	Minimum	41.71	4.81	4.11	4.81	4.10
	Maximum	4.79	4.86	4.15	4.86	4.14
F- test		S				
S. Ed. (±)		0.014				
C. D. (p = 0.05)		0.030				

1. **From the perusal of data of protein percentage in ice cream samples of different treatments and control furnished the highest mean protein percentage was recorded in the ice cream sample of T_1, (4.84), T_3, (4.83) , followed by T_0 (4.76), T_2 (4.13) and T_4 (4.12)**

Table 4.10.b: ANOVA for percentage protein in control and experimental Ice-cream

ANOVA :

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. 5%	Result
Replication	4	0.0011	0.0003	0.55	3.01	NS
Treatment	4	2.8612	0.7153	1445.05	3.01	S
Error	16	0.0079	0.0005	-	-	-
TOTAL	24	2.8702	-			-

*Significant

2. As evident from the result of ANOVA given in Table 4.10.b. the F (Cal) value (1445.05) was greater than the table value of F (3.01) at 5% level of significance. Therefore; the difference was significant, indicating significant effect of treatments on protein percentage.

3. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.10.c

Table 4.10.c : Critical difference in percentage of protein in samples of control and experimental Ice-cream mix of different treatments.

Treatments	Average	T_1	T_2	T_3	T_4	T_5
		4.76	4.84	4.13	4.83	4.12
T_0	4.76		0.08	0.64	0.07	0.64
T_1	4.84			0.71	0.00	0.72
T_2	4.13				0.71	0.01
T_3	4.83					0.71
T_4	4.12					

C.D.= 0.030

The following observations were made:

The difference between the mean values of T_0-T_1 (0.08) greater than C.D. value, 0.030 therefore difference was significant.

The difference between the mean values of T_0-T_2 (0.64) was greater than the C.D. value, 0.030 therefore, the difference was significant.

The difference between the mean values of T_0-T_3 (0.07) was greater than the C.D. value, 0.030.Therefore, the difference was significant.

The difference between the mean values of T_0-T_4 (0.64) was greater than the C.D. value, 0.030.Therefore, the difference was significant.

The difference between the mean values of T_1-T_2 (0.71) was greater than the C.D. value, 0.030.Therefore, the difference was significant.

The difference between the mean values of T_1-T_3 (0.00) was less than the C.D. value, 0.030.Therefore, the difference was non-significant.

The difference between the mean values of T_1-T_4 (0.72) was greater than the C.D. value, 0.030.Therefore, the difference was significant.

The difference between the mean values of T_2-T_3 (0.71) was greater than the C.D. value, 0.030. Therefore, the difference was significant.

The difference between the mean values of T_2-T_4 (0.01) was less than the C.D. value, 0.030.Therefore, the difference was non-significant.

The difference between the mean values of T_3-T_4 (0.71) was greater than the C.D. value, 0.030.Therefore, the difference was significant.

It is therefore concluded that there was non significant difference b/w the, T_1-T_3, and there was significant difference b/w the all other treatments which may be ascribed to addition of different level of jaggery in the experimental treatments of ice cream mix

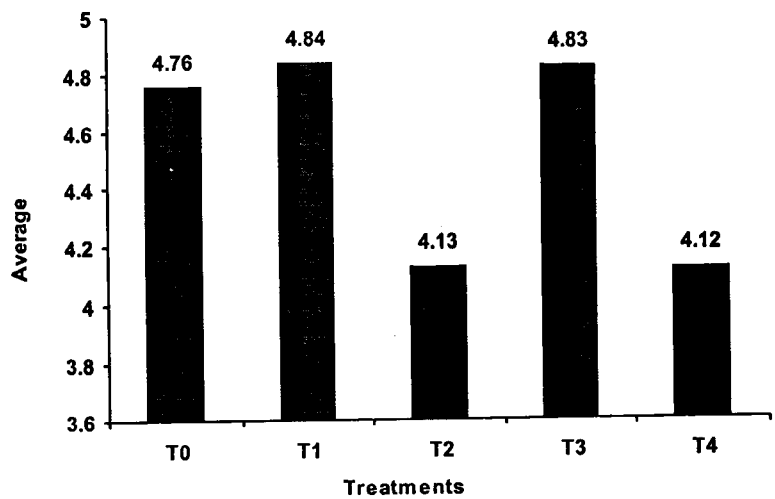


Fig. 4.10 : Percentage of protein in samples of control and experimental Ice-cream mix of different treatments.

T_0 – Control ice-cream

T_1 – Ice cream mix with 18% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_2 – Ice cream mix with 20% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_3 – Ice cream mix with 18% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor.

T_4 – Ice cream mix with 20% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

4.11 Ash

The data regarding ash percent in ice cream sample of different treatments are presented in table 4.11.a and figure 4.11

Table 4.11.a: Percentage ash in control and experimental Ice-cream

Replication		Treatments				
		T_0	T_1	T_2	T_3	T_4
R_1		0.50	0.66	0.62	0.73	0.61
R_2		0.55	0.59	0.65	0.65	0.64
R_3		0.52	0.62	0.71	0.72	0.51
R_4		0.58	0.62	0.68	0.68	0.53
R_5		0.51	0.61	0.69	0.69	0.55
	Mean	**0.53**	**0.62**	**0.67**	**0.69**	**0.57**
Range	Minimum	0.50	0.59	0.62	0.65	0.51
	Maximum	0.58	0.66	0.71	0.73	0.64
F- test		S				
S. Ed. (±)		0.026				
C. D. (p = 0.05)		0.057				

1. **From the perusal of data of ash percentage in ice cream samples of different treatments and control the highest mean ash percentage was recorded in the ice cream sample of T_3 (0.69), T_2, (0.67) , followed by T_1 (0.62), T_4(0.57) and T_0(0.53)**

Table 4.11.b: ANOVA for percentage ash in samples of control and experimental Ice-cream

ANOVA :

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. 5%	Result
Replication	4	0.0005	0.0001	0.07	3.01	NS
Treatment	4	0.0919	0.0230	13.33	3.01	S
Error	16	0.0276	0.0017	-	-	-
TOTAL	24	0.1199	-			-

*Significant

2. As evident from the result of ANOVA given in Table 4.11.b. the F (Cal) value (8.50) was greater than the table value of F (3.01) at 5% level of significance. Therefore; the difference was significant, indicating significant effect of treatments on ash percentage.

3. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.11.c

Table 4.11.c: Critical difference in percentage of ash in samples of control and experimental Ice-cream

Treatments	Average	T_1	T_2	T_3	T_4	T_5
		0.53	0.62	0.67	0.69	0.57
T_0	0.53		0.09	0.14	0.16	0.04
T_1	0.62			0.05	0.07	0.05
T_2	0.67				0.02	0.10
T_3	0.69					0.13
T_4	0.57					

C.D.= 0.057

The following observations were made:

The difference between the mean values of T_0-T_1 (0.09) greater than C.D. value, 0.057 therefore difference was significant.

The difference between the mean values of T_0-T_2 (0.14) was less than the C.D. value, 0.057 therefore, the difference was non-significant.

The difference between the mean values of T_0-T_3 (0.16) was greater than the C.D. value, 0.057.Therefore, the difference was significant.

The difference between the mean values of T_0-T_4 (0.04) was less than the C.D. value, 0.057.Therefore, the difference was non-significant.

The difference between the mean values of T_1-T_2 (0.05) was less than the C.D. value, 0.057.Therefore, the difference was non-significant.

The difference between the mean values of T_1-T_3 (0.07) was greater than the C.D. value, 0.057.Therefore, the difference was significant.

The difference between the mean values of T_1-T_4 (0.05) was less than the C.D. value, 0.057.Therefore, the difference was non-significant.

The difference between the mean values of T_2-T_3 (0.02) was less than the C.D. value, 0.057.Therefore, the difference was non-significant.

The difference between the mean values of T_2-T_4 (0.10) was greater than the C.D. value, 0.057.Therefore, the difference was significant.

The difference between the mean values of T_3-T_4 (0.13) was greater than the C.D. value, 0.057.Therefore, the difference was significant.

It is therefore concluded that there was no significant difference b/w T_0-T_1, T_0-T_4, T_1-T_2 & T_2-T_3 & significant difference b/w all other treatments which may be ascribed to addition of different level of jaggery in the experimental treatments of ice cream mix.

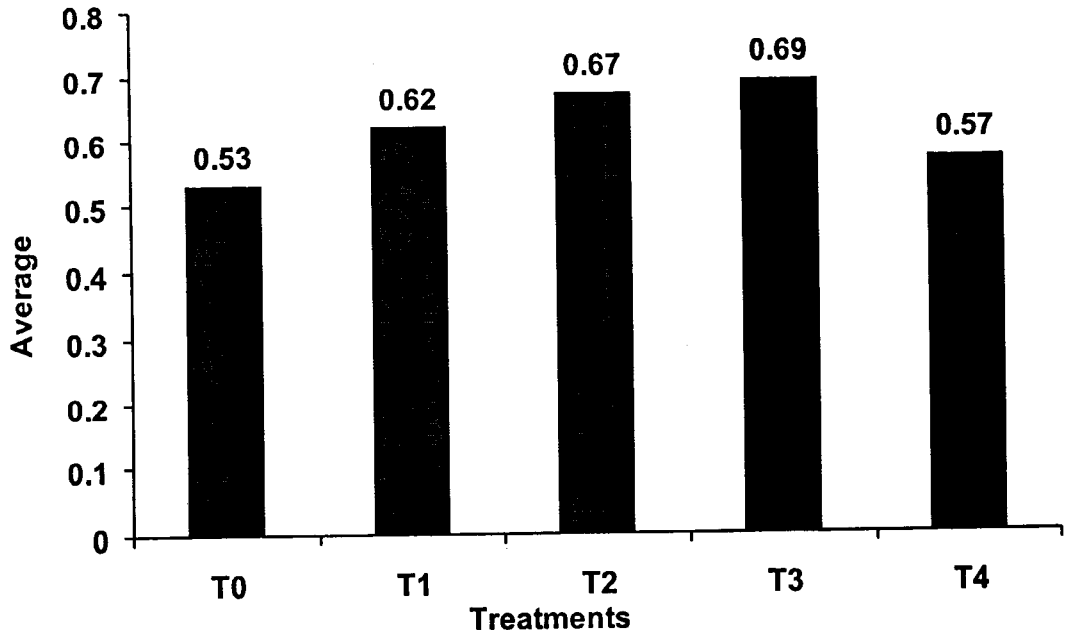


Fig. 4.11 : Percentage of ash in samples of control and experimental Ice-cream of different treatments.

T_0 – Control ice-cream

T_1 – Ice cream mix with 18% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_2 – Ice cream mix with 20% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_3 – Ice cream mix with 18% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor.

T_4 – Ice cream mix with 20% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

Organoleptic characteristics of ice cream mix

4.12 Colour & appearance in ice cream

The data regarding colour & appearance score in ice cream mix sample of different treatments are presented in table 4.12.a and figure 4.12

Table 4.12.a: The average colour and appearance of control and experimental Ice-cream

Replication		Treatments				
		T_0	T_1	T_2	T_3	T_4
R_1		8.00	7.60	7.00	7.80	8.00
R_2		7.60	7.20	7.60	8.00	8.00
R_3		8.00	8.40	8.20	8.00	7.40
R_4		8.60	7.60	7.40	8.00	7.80
R_5		8.00	7.80	7.72	7.40	7.44
	Mean	**8.04**	**7.72**	**7.58**	**7.84**	**7.73**
Range	Minimum	7.60	7.20	7.00	7.40	7.40
	Maximum	8.60	8.40	8.20	8.00	8.00
F- test		NS				
S. Ed. (±)		0.236				
C. D. (p = 0.05)		0.509				

1. From the perusal of data on colour & appearance score in ice cream mix samples of different treatments and control the highest mean colour & appearance score recorded in the ice cream mix sample of T_1 (7.72), T_2 (7.58), T3 (7.84), T4 (7.73) followed by T_0 (8.04)

Table 4.12.b: ANOVA for colour and appearance of control and experimental Ice-cream

ANOVA :

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. 5%	Result
Replication	4	0.4502	0.1125	0.81	3.01	**NS**
Treatment	4	0.5795	0.1449	1.04	3.01	**NS**
Error	16	2.2186	0.1387	-	-	-
TOTAL	24	3.2483	-			-

**No significant

As evident from the result of ANOVA given in Table 4.12.b. the F (Cal) value (0.39) was smaller than the table value of F (3.01) at 5% level of significance. Therefore; the difference was non-significant, indicating no significant effect of treatments on colour

and appearance score, which may be ascribed to addition of different level of basil leaves extract in treatments.

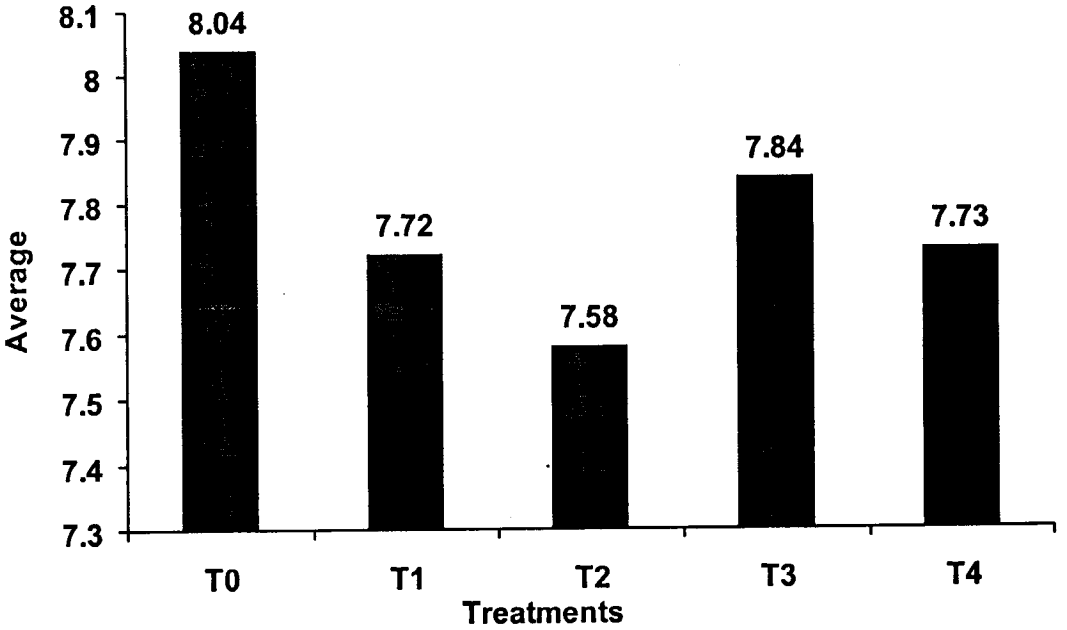


Fig. 4.12 : The average colour and appearance of control and experimental probitoic Ice-cream samples.

T_0 – Control ice-cream

T_1 – Ice cream mix with 18% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_2 – Ice cream mix with 20% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_3 – Ice cream mix with 18% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor.

T_4 – Ice cream mix with 20% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

4.13 Body & texture score in ice cream mix

The data regarding body and texture score in ice cream mix sample of different treatments are presented in table 4.13.a and figure 4.13

Table 4.13.a: Body and texture score for control and experimental ice cream

Replication		Treatments				
		T_0	T_1	T_2	T_3	T_4
R_1		7.60	7.20	6.80	7.60	7.40
R_2		8.60	8.40	8.00	7.00	7.60
R_3		7.60	8.00	7.00	6.80	6.40
R_4		8.00	7.80	7.60	7.60	7.40
R_5		7.24	7.34	7.10	6.40	6.60
	Mean	**7.81**	**7.75**	**7.30**	**7.08**	**7.08**
Range	Minimum	7.24	7.20	6.80	6.40	6.40
	Maximum	8.60	8.40	8.00	7.60	7.60
F- test		S				
S. Ed. (±)		0.230				
C. D. (p = 0.05)		0.496				

1. From the perusal of data on body and texture score in ice cream mix samples of different treatments and control the highest mean body and texture score was recorded in the ice cream mix sample of T_0 (7.81) followed by T_1 (7.75), T_2 (7.30) T_3 (7.08) and T_4 (7.08).

Table 4.13.b: ANOVA for Body and texture score for control and experimental ice cream

ANOVA :

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. 5%	Result
Replication	4	3.1402	0.7851	5.96	3.01	S
Treatment	4	2.5116	0.6279	4.77	3.01	S
Error	16	2.1071	0.1317	-	-	-
TOTAL	24	7.7589	-			-

*Significant

2. As evident from the result of ANOVA given in Table 4.13.b. the F (Cal) value (4.77) was greater than the table value of F (3.01) at 5% level of significance. Therefore; the difference was significant, indicating significant effect of treatments on Body and texture score.

3. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.13.c

Table 4.13.c: Critical difference in Body and texture score for control and experimental ice cream

Treatments	Average	T_1	T_2	T_3	T_4	T_5
		7.81	7.75	7.30	7.08	7.08
T_0	7.81		0.06	0.51	0.73	0.73
T_1	7.75			0.45	0.67	0.67
T_2	7.30				0.22	0.22
T_3	7.08					0.00
T_4	7.08					

C.D.= 0.496

The following observations were made

The difference between the mean values of T_0-T_1 (0.06) was less than the C.D. value, 0.496.Therefore, the difference was non-significant.

The difference between the mean values of T_0-T_2 (0.51) was greater than the CD value, 0.496 therefore the difference was significant.

The difference between the mean values of T_0-T_3 (0.73) was greater than the C.D. value, 0.496.Therefore, the difference was significant.

The difference between the mean values of T_0-T_4 (0.73) was greater than the C.D. value, 0.496.Therefore, the difference was significant.

The difference between the mean values of T_1-T_2 (0.45) was less than the C.D. value, 0.496.Therefore, the difference was non-significant.

The difference between the mean values of T_1-T_3 (0.67) was greater than the C.D. value, 0.496.Therefore, the difference was significant.

The difference between the mean values of T_1-T_4 (0.67) was greater than the C.D. value, 0.496. Therefore, the difference was significant.

The difference between the mean values of T_2-T_3 (0.22) was less than the C.D. value, 0.496. Therefore the difference was non-significant.

The difference between the mean values of T_2-T_4 (0.22) was less than the C.D. value, 0.496.Therefore, the difference was non-significant.

The difference between the mean values of T_3-T_4 (0.00) was less than the C.D. value, 0.496.Therefore, the difference was non-significant.

It is therefore concluded that there was non-significant difference b/w T_0-T_1, T_1-T_3 and T_2-T_3 and significant difference b/w all other treatments which may be ascribed to addition of different level of jaggery in the experimental treatments of ice cream mix.

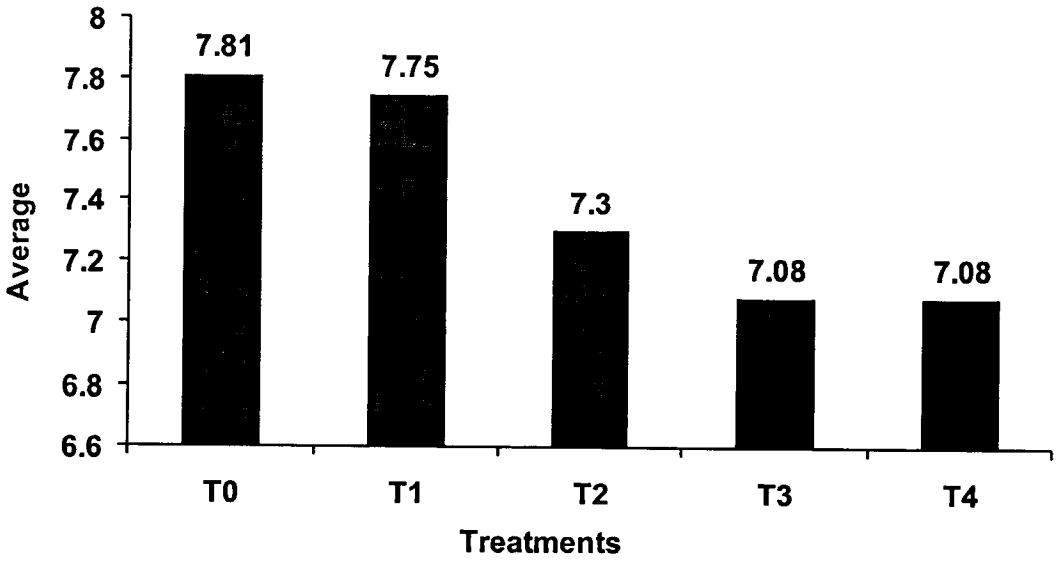


Fig. 4.11 : Body and texture score for control and experimental ice cream mix samples.

T_0 – Control ice-cream

T_1 – Ice cream mix with 18% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_2 – Ice cream mix with 20% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_3 – Ice cream mix with 18% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor.

T_4 – Ice cream mix with 20% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

4.14 Flavour & taste score in ice cream mix

The data regarding Flavour and taste score in ice cream mix sample of different treatments are presented in table 4.14.a and 4.14

Table 4.14.a: Flavour and taste score for control and experimental ice cream

Replication	Treatments				
	T_0	T_1	T_2	T_3	T_4
R_1	8.60	7.80	7.40	7.20	7.00
R_2	8.60	8.00	7.80	7.60	7.40

R_3		7.80	7.80	6.60	7.40	7.20
R_4		8.00	8.20	7.60	7.80	7.60
R_5		7.76	7.62	7.86	7.20	7.60
	Mean	**8.15**	**7.88**	**7.45**	**7.44**	**7.36**
Range	Minimum	**7.76**	**7.62**	**7.40**	**7.20**	**7.00**
	Maximum	8.60	8.20	7.86	7.80	7.60
F- test		S				
S. Ed. (±)		0.200				
C. D. (p = 0.05)		0.431				

1. From the perusal of data on Flavour and taste score in ice cream mix samples of different treatments and control the highest mean Flavour and taste score was recorded in the ice cream mix sample of T_0 (8.55) followed by T_1 (7.88), T_2 (7.45), T_3 (7.44) and T_4 (7.36).

Table 4.14.b: ANOVA for Flavour and taste score for control and experimental ice cream mix of different treatments.

ANOVA :

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. 5%	Result
Replication	4	0.8854	0.2213	2.22	3.01	NS
Treatment	4	2.3694	0.5923	5.94	3.01	S
Error	16	1.5959	0.0997	-	-	-
TOTAL	24	4.8507	-			-

*Significant

2. As evident from the result of ANOVA given in Table 4.14.b. the F (Cal) value (5.94) was greater than the table value of F (3.01) at 5% level of significance. Therefore; the difference was significant, indicating significant effect of treatments on Flavour and taste score

3. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.14.c

Table 4.14.c: Critical difference in flavour and taste score for control and experimental ice cream mix of different treatments.

Treatments	Average	T_1	T_2	T_3	T_4	T_5
		8.15	7.88	7.45	7.44	7.36
T_0	8.15		0.27	0.70	0.71	0.79
T_1	7.88			0.43	0.44	0.52
T_2	7.45				0.01	0.09
T_3	7.44					0.08
T_4	7.36					
C.D.=	**0.431**					

The following observations were made:

The difference between the mean values of T_0-T_1 (0.27) was less than the C.D. value, 0.431.Therefore, the difference was non-significant.

The difference between the mean values of T_0-T_2 (0.70) was greater than the C.D. value, 0.431.Therefore, the difference was significant.

The difference between the mean values of T_0-T_3 (0.71) was greater than the C.D. value, 0.431.Therefore, the difference was significant.

The difference between the mean values of T_0-T_4 (0.79) was greater than the C.D. value, 0.431.Therefore, the difference was significant.

The difference between the mean values of T_1-T_2 (0.43) was less than the C.D. value, 0.431.Therefore, the difference was non-significant.

The difference between the mean values of T_1-T_3 (0.44) was greater than the C.D. value, 0.431.Therefore, the difference was significant.

The difference between the mean values of T_1-T_4 (0.52) was greater than the C.D. value, 0.431. Therefore, the difference was significant.

The difference between the mean values of T_2-T_3 (0.01) was less than the C.D. value, 0.431. Therefore, the difference was non-significant.

The difference between the mean values of T_2-T_4 (0.09) was less than the C.D. value, 0.431.Therefore, the difference was non-significant.

The difference between the mean values of T_3-T_4 (0.08) was less than the C.D. value, 0.431.Therefore, the difference was non-significant.

It is therefore concluded that there was significant difference b/w T_0-T_2, T_0-T_3, T_0-T_4 & T_3-T_4 non-significant difference b/w the all other treatments which may be ascribed to addition of different level of date & sugarcane jaggery in the experimental treatments of ice cream mix.

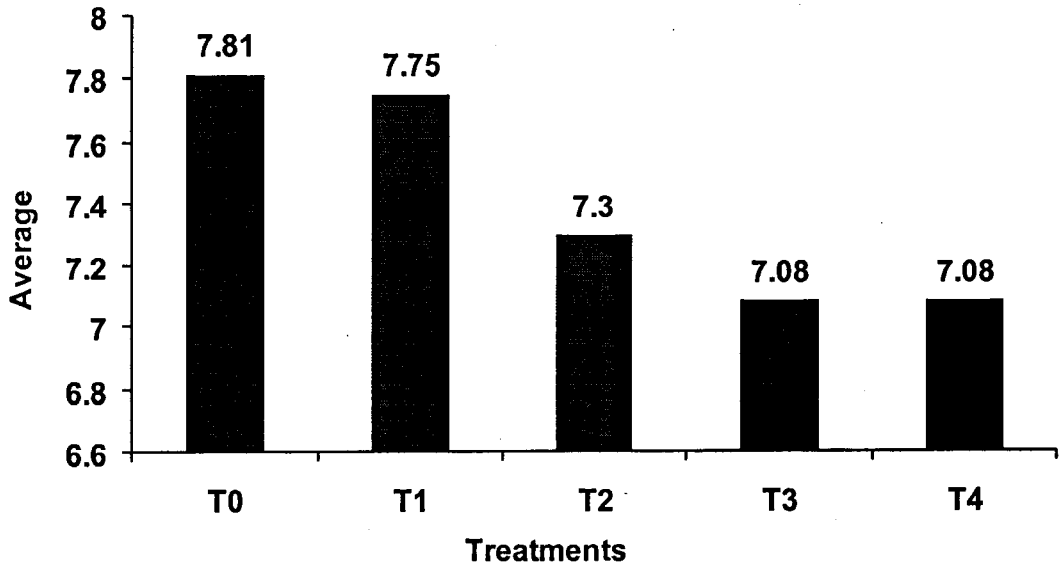


Fig. 4.11 : Body and texture score for control and experimental ice cream mix samples.

T_0 – Control ice-cream

T_1 – Ice cream mix with 18% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_2 – Ice cream mix with 20% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_3 – Ice cream mix with 18% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor.

T_4 – Ice cream mix with 20% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

Microbiological characteristics of ice cream mix

4.15 SPC

The data regarding SPC in ice cream mix sample of different treatments are presented in table 4.15.a and figure 4.15

Table 4.15.a: SPC cfu/g average value in samples of control and experimental ice-cream

Replication		Treatments				
		T_0	T_1	T_2	T_3	T_4
R_1		920.00	905.00	940.00	945.00	945.00
R_2		915.00	915.00	930.00	950.00	915.00
R_3		905.00	890.00	932.00	956.00	955.00
R_4		895.00	895.00	925.00	955.00	955.00
R_5		910.00	920.00	914.00	940.00	940.00
	Mean	**909.00**	**905.00**	**928.20**	**949.20**	**942.00**
Range	Minimum	895.00	890.00	914.00	940.00	915.00
	Maximum	920.00	920.00	940.00	956.00	955.00
F- test		S				
S. Ed. (±)		7.919				
C. D. (p = 0.05)		17.104				

1. **From the perusal of data on SPC in ice cream mix samples of different treatments and control the highest mean Flavour and taste score was**

recorded in the ice cream mix sample of T_3 (949.00) followed by T_4 (942.00), T_2 (928.00), T_0 (909.00) and T_1 (905.00).

Table 4.15b : ANOVA for SPC cfu/ml average value in samples of control and experimental ice-cream mix of different treatments.

ANOVA :

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. 5%	Result
Replication	4	143.4400	35.8600	0.23	3.01	NS
Treatment	4	7633.8400	1908.4600	12.17	3.01	S
Error	16	2508.1600	156.7600	-	-	-
TOTAL	24	10285.4400	-			-

2. As evident from the result of ANOVA given in Table 4.15.b. the F (Cal) value (12.17) was greater than the table value of F (3.01) at 5% level of significance. Therefore; the difference was significant, indicating significant effect of treatments on SPC

3. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.15.c

Table 4.15.c: Critical difference in SPC cfu/ml average value in samples of control and experimental ice-cream

Treatments	Average	T_1	T_2	T_3	T_4	T_5
		909.00	905.00	928.20	949.20	942.00
T_0	909.00		-4.00	19.20	40.20	33.00
T_1	905.00			23.20	44.20	37.00
T_2	928.20				21.00	13.80
T_3	949.20					-7.20
T_4	942.00					

C.D.= 17.104

The following observations were made:

The difference between the mean values of T_0-T_1 (4.00) was less than the C.D. value, 17.104.Therefore, the difference was non-significant.

The difference between the mean values of T_0-T_2 (19.20) was greater than the C.D. value, 17.104.Therefore, the difference was significant.

The difference between the mean values of T_0-T_3 (40.20) was greater than the C.D. value, 17.104.Therefore, the difference was significant.

The difference between the mean values of T_0-T_4 (33.00) was greater than the C.D. value, 17.104.Therefore, the difference was significant.

The difference between the mean values of T_1-T_2 (23.20) was greater than the C.D. value, 17.104.Therefore, the difference was significant.

The difference between the mean values of T_1-T_3 (44.20) was greater than the C.D. value, 17.104.Therefore, the difference was significant.

The difference between the mean values of T_1-T_4 (37.00) was greater than the C.D. value, 17.104. Therefore, the difference was non- significant.

The difference between the mean values of T_2-T_3 (21.00) was greater than the C.D. value, 17.104Therefore, the difference was significant.

The difference between the mean values of T_2-T_4 (13.80) was less than the C.D. value, 17.104.Therefore, the difference was non-significant.

he difference between the mean values of T_3-T_4 (7.20) was less than the C.D. value, 17.104.Therefore, the difference was non-significant.

It is therefore concluded that there was non- significant difference b/w the average SPC percentage of T_0-T_1, T_1-T_4, and T_3-T_4 treatments which may be ascribed to addition of different level of jaggery in the experimental treatments of ice cream mix.

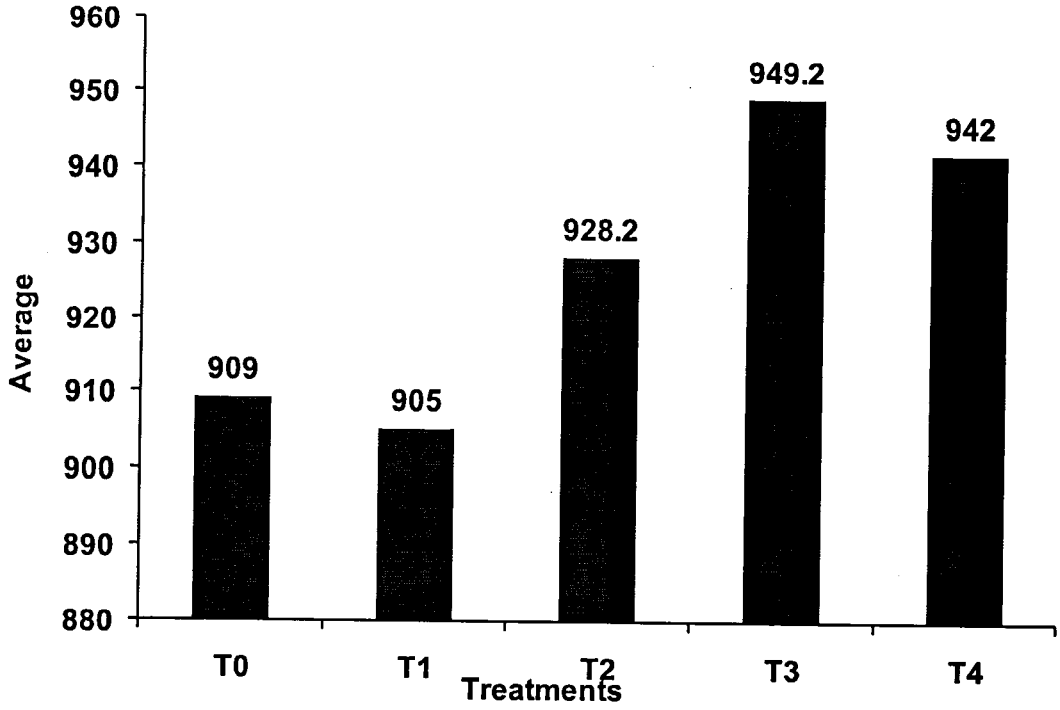


Fig. 4.15 : SPC for control and experimental ice cream mix samples.

T_0 – Control ice-cream

T_1 – Ice cream mix with 18% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_2 – Ice cream mix with 20% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_3 – Ice cream mix with 18% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor.

T_4 – Ice cream mix with 20% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

4.16 Yeast & mould count

The data regarding yeast & mould count in ice cream mix sample of different treatments are presented in table 4.16.a and figure 4.16

Table 4.16.a: Yeast and mould count in samples of control and experimental ice-cream

Replication		Treatments				
		T_0	T_1	T_2	T_3	T_4
R_1		19.00	14.00	11.00	14.66	14.12
R_2		21.00	13.00	12.00	16.00	16.10
R_3		20.30	13.66	11.00	15.00	15.14
R_4		21.00	13.00	11.66	15.00	13.13
R_5		22.00	13.00	11.00	16.00	14.11
	Mean	**20.66**	**13.33**	**11.33**	**15.33**	**14.52**
Range	Minimum	19.00	13.00	11.00	14.66	13.11
	Maximum	22.00	14.00	12.00	16.00	16.10
F- test		S				
S. Ed. (±)		0.499				
C. D. (p = 0.05)		1.078				

1. **From the perusal of data on yeast & mould count in ice cream mix samples of different treatments and control the highest mean yeast & mould count was recorded in the ice cream mix sample of T_0 (20.66) followed by T_3 (15.52), T_4 (15.52), T_1 (13.33) and T_2 (11.33).**

Table 4.16.b: ANOVA for Yeast and mould count in samples of control and experimental ice-cream

ANOVA :

Source	d. f.	S.S.	M.S.S.	F. Cal.	F. Tab. 5%	Result
Replication	4	3.4179	0.8545	1.37	3.01	NS
Treatment	4	243.0324	60.7581	97.52	3.01	S
Error	16	9.9685	0.6230	-	-	-
TOTAL	24	256.4188	-			-

*Significant

2. As evident from the result of ANOVA given in Table 4.16.b. the F (Cal) value (97.52) was greater than the table value of F (3.01) at 5% level of significance. Therefore; the difference was significant, indicating significant effect of treatments on yeast & mould count

3. The significant difference thus obtained was further analysed statistically to find out the C.D between and within the different treatment combinations. Result of C.D are presented in Table 4.16.c

Table 4.16.c: Critical difference in yeast and mould count in samples of control and experimental ice-cream mix of different treatments.

Treatments	Average	T_1	T_2	T_3	T_4	T_5
		20.66	13.33	11.33	15.33	14.52
T_0	20.66		-7.33	-9.33	-5.33	-6.14
T_1	13.33			-2.00	2.00	1.19
T_2	11.33				4.00	3.19
T_3	15.33					-0.81
T_4	14.52					
C.D.=	**1.078**					

The following observations were made:

The difference between the mean values of T_0-T_1 (7.33) was greater than the C.D. value, 1.078.Therefore, the difference was significant.

The difference between the mean values of T_0-T_2 (9.33) was greater than the C.D. value, 1.078.Therefore, the difference was significant.

The difference between the mean values of T_0-T_3 (5.33) was greater than the C.D. value, 1.078.Therefore, the difference was significant.

The difference between the mean values of T_0-T_4 (6.14) was greater than the C.D. value, 1.078.Therefore, the difference was significant.

The difference between the mean values of T_1-T_2 (2.00) was greater than the C.D. value, 1.078.Therefore, the difference was significant.

The difference between the mean values of T_1-T_3 (2.00) was greater than the C.D. value, 1.078.Therefore, the difference was significant.

The difference between the mean values of T_1-T_4 (1.19) was greater than the C.D. value, 1.078. Therefore, the difference was significant.

The difference between the mean values of T_2-T_3 (4.00) was greater than the C.D. value, 1.078. Therefore, the difference was significant.

The difference between the mean values of T_2-T_4 (3.19) was greater than the C.D. value, 1.078.Therefore, the difference was significant.

The difference between the mean values of T_3-T_4 (0.81) was less than the C.D. value, 1.078.Therefore, the difference was non-significant.

It is therefore concluded that there was non- significant difference b/w the average total solids percentage of T_3-T_4 & significant difference b/w all other treatments which may be ascribed to addition of different level of jaggery in the experimental treatments of ice cream mix

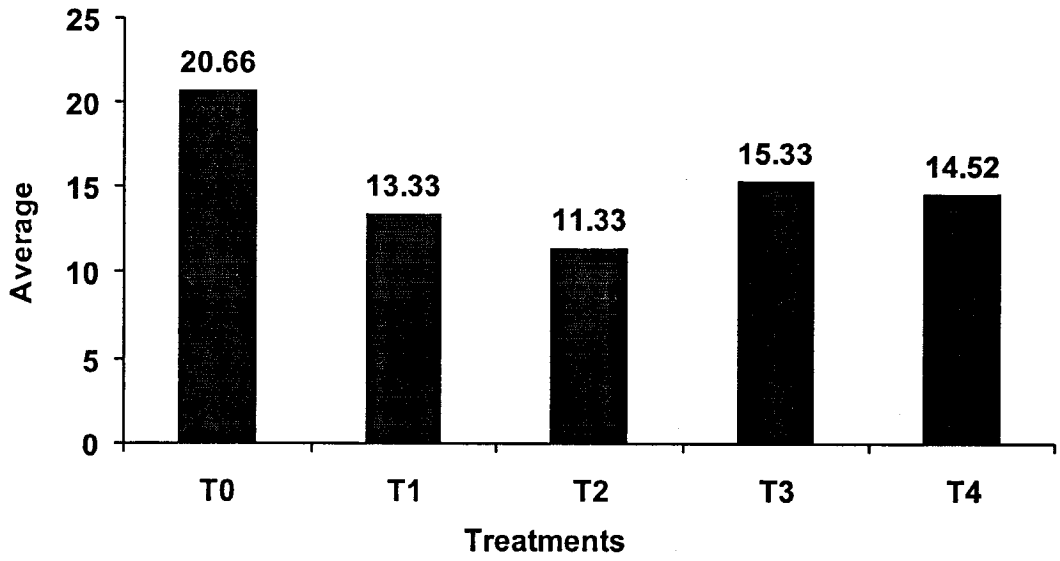


Fig. 4.14 : Yeast & moulds for control and experimental ice cream mix samples.

T_0 – Control ice-cream

T_1 – Ice cream mix with 18% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_2 – Ice cream mix with 20% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

T_3 – Ice cream mix with 18% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor.

T_4 – Ice cream mix with 20% Date jaggery, 2.5% cocoa powder & 1.5% chocolate liquor

4.17 Coli form test

It is evident from the Table 4.25 that the coli form test control and experimental Ice-cream sample was 100 percent negative.

It shows gram-ve (Gram negative bacteria) result, which mean that strict hygienic procedure was observed during it preparation.

Table 4.17: Shows that the result of coli form test of control and experimental ice cream mix different treatments during total exp.

Replications	Treatments				
	T_0	T_1	T_2	T_3	T_4
S.I. No.	10^2cfu/ml				
1	N	N	N	N	N
2	N	N	N	N	N
3	N	N	N	N	N
4	N	N	N	N	N

N= Negative

It is evident from the table that the coli form test control and experimental sample were 100 percent negative.

4.18 Cost analysis of Ice-cream mix (/litre) and ice cream mix

The data regarding cost (Rs) of Ice-cream mix, ice cream mix and therapeutic value of Ice-cream products sample of different treatments are presented in table 4

From the perusal of data of cost (Rs) in ice cream mix samples of different treatments and control furnished in table 4.26 and figure 4.24, it was noted the highest mean cost (Rs) was recorded in the ice cream mix sample of T_4(93.23), T_3(91.22), T_2(87.88) , T_1 (79.47) , followed by T_0 (45.86).

Table 4.18: Cost analysis of Ice-cream mix and ice cream mix.

Particulars	Treatments				
	T_0	T_1	T_2	T_3	T_4
Conversion of 1 kg ice cream mix into ml	633	633	633	633	633
Cost of mix/lit (Rs.)	**34.33**	**38.18**	**39.70**	**41.22**	**42.74**

Table 4.19: Ingredient cost of control & experimental ice cream mix for preparation of 1kg. Mix

Ingredient	Amount required For 1kg mix (in gm.)					Rate in Rs/kg	Cost in Rs.				
	T0	T1	T2	T3	T4		T0	T1	T2	T3	T4
Whole milk	633	633	633	633	633	34	21.53	21.53	21.53	21.53	21.53
Skim milk powder	40	40	20	40	20	190	7.60	7.60	3.80	7.60	3.80
Cocoa powder	25	25	25	25	25	675	27.68	27.68	27.68	27.68	27.68
Chocolate liquor	15	15	15	15	15	357.50	5.36	5.36	5.36	5.36	5.35
cream	102	102	102	102	102	170	17.34	17.34	17.34	17.34	17.34
Stabilizer	2	2	2	2	2	180	0.36	0.36	0.36	0.36	0.36
Emulsifier	3	3	3	3	3	200	0.40	0.40	0.40	0.40	0.40
Sugar	180	-	-	-	-	40	7.2				
jaggery (Cane)	-	180	200	-	-		-	7.2	8.0	-	-
Jaggery (date)	-	-	-	180	200		-	-	-	18.72	20.80
Total wt	**1000**	**1000**	**1000**	**1000**	**1000**	**Cost/kg**	**34.33**	**38.18**	**39.70**	**41.22**	**42.74**

5.SUMMARY & CONCLUSION

The present investigation effect of sugarcane and date jaggery on the keeping quality of Ice-cream was planned and carried out in Dairy Technology Department, SHIATS, Allahabad.

5.1 The different parameters of control and experimental ice-cream

Parameters	Treatments					
	T_0	T_1	T_2	T_3	T_4	CD Value
1. Chemical analysis (in percent)						
Fat	10.20	10.10	10.08	10.00	10.22	0.544
Total solids	4242	42.68	42.24	42.90	42.80	1.425
Acidity	0.22	0.24	0.24	0.28	0.30	0.018
Protein	4.76	4.84	4.13	4.83	4.12	0.030
pH	6.15	6.21	6.14	6.15	6.16	0.101
Moisture	57.58	57.32	57.56	57.10	57.20	1.489
Ash	0.53	0.62	0.67	0.69	0.57	0.57
2. Physical analysis						
Melting resistance (in minutes)	7.66	7.24	7.36	7.46	7.30	0.568
3. Organoleptic scores (9 point hedonic scale)						
Colour & appearance	8.04	7.72	7.58	7.84	7.73	0.509
Body & texture	.81	7.75	7.30	7.08	7.08	0.496
Flavour & taste	8.15	7.88	7.45	7.44	7.36	0.431
4. Rheological properties						
Hardness (+/-S.D.)(g)	1468.78	2170.72	1267.44	2557.18	2650.35	88.668
Firmness (+/-S.D.)(g)	24.692	26.414	28.252	31.122	32.042	1.519
Consistency (+/- S.D.) (g s)	543.352	605.556	602.824	647.691	715.626	11.324
Cohesiveness (+/-S.D.)(g)	-32.157	-38.358	-49.728	-49.957	-56.618	2.448
Index of viscosity /consistency (+/- S.D.) (g s)	-34.281	-65.753	-93.92	-92.219	-118.575	2.448

5. Microbial analysis						
SPC (cfu/g)	909.00	905.00	928.00	949.00	942.00	17.104
Coli form test (cfu 10^2/g)	N	N	N	N	N	
Yeast & mould count (per g)	20.66	13.33	11.33	15.33	14.52	1.078
6. Cost						
Ice-cream (in rupees/kg)	**34.33**	**38.18**	**39.70**	**41.22**	**42.74**	

5.2 Physico- chemical parameters

Fat

The highest mean fat percentage was recorded in the Ice-cream sample of T_0 (10.20) T_4 (10.22), followed by T_3 (10.00), T_2 (10.08) and T (10.10).There was non significant difference b/w the of T_0-T_1, T_0-T_2, T_0-T_3, T_0-T_4, T_1-T_2, T_1-T_3, T_1-T_4, T_2-T_3, T_2-T_4 and T_3-T_4 treatments.

Total solid

Highest mean total solids percentage was recorded in the Ice-cream sample of of of T_1(42.68) , T_2 (42.24), T3 (42.90), T4 (42.80) followed by T_0 (42.42). There was non significant difference b/w the T_0-T_1, T_0-T_2, T_0-T_3, T_0-T_4, T_1-T_2, T_1-T_3, T_1-T_4, T_2-T_3, T_2-T_4 and T_3-T_4.

Lactic acid

The highest mean Lactic acid percentage was recorded in the Ice-cream sample of T1 (.24), T_2 (0.24), T_3 (0.28), T_4 (0.30) followed by T_0 (0.22). The differences in these values of acidity percent T_0-T_1, T_0-T_2, T_0-T_3, T_0-T_4, T_1-T_2, T_1-T_3, T_1-T_4, T_2-T_3, T_2-T_4, were significant and T_3– T_4 were non-significant.

Melting resistance

Highest mean melting resistance percentage was recorded in the Ice-cream sample of T_1(7.24), T_2 (7.36), T_3 (7.46), T_4 (7.30) followed by T_0 (7.66). There was non significant difference between T_0-T_1, T_0-T_2, T_0-T_3, T_0-T_4, T_1-T_2, T_1-T_3, T_1-T_4, T_2-T_3, T_2-T_4 and T_3-T_4.

Over run

The highest mean overrun percentage was recorded in the Ice-cream sample of T_0(81.60) followed by T_1(78.20), T_3(75.80), T_2 (74.60) T_4 (70.66).There was non significant difference b/w the of T_0-T_1, T_0-T_2, T_0-T_3, T_0-T_4, T_1-T_2, T_1-T_3, T_1-T_4, T_2-T_3, T_2-T_4 and T_3-T_4 treatments.

pH

Highest mean pH percentage was recorded in the Ice-cream sample of of of T_1 (6.21) followed by T_4 (6.16), T_0 (6.15) T_3 (6.15), T_2 (6.14). There was non significant difference b/w the T_0-T_1, T_0-T_2, T_0-T_3, T_0-T_4, T_1-T_2, T_1-T_3, T_1-T_4, T_2-T_3, T_2-T_4 and T_3-T_4.

Moisture

Highest mean moisture percentage was recorded in the Ice-cream sample of T_0, (57.58), T_2, (57.56) , followed by T_1 (57.32),T_4(57.2) and T_3(57.20). There was non significant difference between all treatments.

Protein

The highest mean protein percent was recorded in the Ice-cream sample of T_1,(4.84), T_3, (4.83) , followed by T_0(4.76),T_2(4.13) and T_4(4.12). There was non significant difference b/w T_0-T_2, T_0-T_4, T_1-T_2, T_1-T_3, T_1-T_4, T_2-T_4 and T_3-T_4 and there was significant difference b/w the all other treatments.

Ash

Highest mean ash percentage was recorded in the Ice-cream sample of T_3, (0.69), T_2, (0.67) , followed by T_1 (0.62), T_4(0.57) and T_0(0.53). There was non significant difference between all treatments.

5.3. Rheological Properties

Hardness

The highest mean hardness was recorded in the Ice-cream sample of T_4 (2650.35) , followed by T_3 (2557.18), T_1(2170.72), T_2 (1267.44) and T (1468.78). There was non significant difference b/w T_0 – T_2 and there was significant difference b/w the all other treatments.

Firmness

The highest mean firmness was recorded in the Ice-cream sample of T_4 (32.042) , followed by T_3 (31.122), T_2(28.252), T_1 (26.414) and T_0(24.692). There was non significant difference b/w T_3 – T_4 and there was significant difference b/w the all other treatments.

Consistency

The highest mean consistency was recorded in the Ice-cream sample of T_4 (715.626) , followed by T_3 (647.691), T_1(605.556), T_2 (602.824) and T_0(543.352). There was non significant difference b/w T_1 – T_2 and there was significant difference b/w the all other treatments.

Cohesiveness

The highest mean cohesiveness was recorded in the Ice-cream sample of T_0 (-32.157) , followed by T_1 (-38.358), T_2(-49.728), T_3 (-49.957) and T_4(-56.618). There was non significant difference b/w T_2 – T_3 and there was significant difference b/w the all other treatments.

Viscosity

The highest mean viscosity was recorded in the Ice-cream sample of T_0 (-34.281) , followed by T_1 (-65.753), T_3(-92.219), T_2 (-93.92) and T_4(-118.575). There was non significant difference b/w T_2– T_3 and there was significant difference b/w the all other treatments.

5.4. Organoleptic parameters

Colour & Appearance

The highest mean colour & appearance score recorded in the Ice-cream sample of T_1 (7.72), T_2 (7.58), T3 (7.84), T4 (7.73) followed by T_0(8.04). There was non significant difference b/w the all treatments.

Body and Texture

The highest mean body and texture score was recorded in the Ice-cream sample of T_0 (7.81) followed by T_1 (7.75), T_2 (7.30) T_3 (7.08) and T_4 (7.08). There was significant difference b/w the T_0-T_4, T_2-T_3, T_3-T_4, and there was non significant difference b/w the all other treatments.

Flavour and Taste

The highest mean Flavour and taste score was recorded in the Ice-cream sample of T_0 (8.55) followed by T_1 (7.88), T_2 (7.45), T_3 (7.44) and T_4 (7.36), there was non significant difference b/w the all treatments.

5.5. Microbiological parameters

SPC

The highest mean SPC was recorded in the Ice-cream sample of T_3 (949.00) followed by T_4 (942.00), T_2 (928.00), T_0 (909.00) and T_1 (905.00).There was non significant difference b/w the T_0-T_1, T_1-T_4, and T_3-T_4treatments and significant difference b/w all other treatments.

Yeast & Mould Count

Highest mean yeast & mould count was recorded in the Ice-cream sample of T_0 (20.66) followed by T_3 (15.52), T_4 (15.52), T_1 (13.33) and T_2 (11.33)..There was non significant difference b/w T_0-T_1, T_0-T_2, T_0-T_3, T_0-T_4, T_1-T_2, and T_3-T_4, and significant difference b/w all other treatments.

Coliform Test

It is evident from the experiment that the coli form test control and experimental sample were 100 percent negative.

CONCLUSION

In view of the experimental results obtained during the present investigation, it may be concluded that the Ice-cream made from Ice cream mix with 20% Cane sugar jaggery, 2.5% cocoa powder & 1.5% chocolate liquor, i.e. T_2 received highest score and was liked very much by the panel of judges in the Organoleptic evaluation, best in chemical characteristics (maximum total solids, acidity, protein, carbohydrate and ash), best in microbial analysis (minimum yeast and mould count; and Gram negative in coli form test) thereby indicating good storage stability of Ice-cream. The cost of preparation of Ice-cream in treatment T_2 was Rs. **39.70** per kg of mix. However, since this is based on one-time experiment, further trials may be needed to substantiate the results.

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SHRI RAM COLLEGE

(Affiliated To CCS University, Meerut & Approved By NCTE) CIRCULAR ROAD, MUZAFFARNAGAR

'A' Grade Accredited by NAAC

DATE-9/04/2020

The Director

Uttam Sugar Mill Ltd.

PO. Khaikheri Uttar Pradesh

SUBJECT:TREATMENT OF SUGAR INDUSTRY WASTE WATER BYANAEROBIC SLUDGE BLANKET REACTOR AT PILOT SCALE.

As per our visit in your industry and discussions with you about analysis of water contamination by heavy metals from fertilizers released in water bodies, you have suggested a research project on determination of heavy metals concentration present in water bodies nearby Muzaffarnagar

Objective of the project work-

1. Training of students in Industrial based projects.
2. Estimation of heavy metals concentration in nearby water bodies.
3. Treatment of wastewater treatment in the sugar industry with Up-flow Anaerobic Sludge Blanket Reactor in experimental scale.
4. To obtain the parameters of a waste water sample before it is treated.
5. To obtain the parameters of a waste water sample after treatment.
6. To determine maximum COD removal efficiency of the reactor.
7. To determine the possibility of treating sugar industry waste water with anaerobic bacteria in an Up-flow anaerobic hybrid reactor.

Co-ordinator
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Muzaffarnagar

Chairman
IQAC, Shri Ram College,
Muzaffarnagar

Phone No.: 0131-2660738, 2620899, 9927028908
Web: www.srgcmzn.com E-mail: src_mzn@rediffmail.com

Timeline- the time period for this project is estimated approximately 1 year.

- **PHASE-1.** This time period is utilized in the literature survey of heavy metals in water bodies and their effects on human being, animals & plants and fertilizers will be introduced near selected sites.
- **PHASE-2.** sample collection from chosen 7 sites on Kali Nadi River,
- **PHASE-3.** Testing of heavy metals in collected samples from chemical labs.
- **PHASE-4.** Conclusion of test results and final report with graphical representations.

Enclosed: Detailed Project Proposed - 57,000

(Er. Rajdeep Saharawat)
Principle Investigator

Co-ordinator
IQAC, Shri Ram College
Muzaffarnagar

Chairman
IQAC, Shri Ram College,
Muzaffarnagar

PROPOSAL

PROPOSED RESEARCH TOPIC:

TREATMENT OF SUGAR INDUSTRY WASTEWATER BYANAEROBIC SLUDGE BLANKET REACTOR AT PILOT SCALE.

Sugar is made from sugarcane, and was discovered thousands of years ago in New Guinea. The route was then followed by India and Southeast Asia. India was the first producer of sugar following the process of pressing sugarcane to extract juice and boil it for crystals. The Indian government in 1950-51 made critical plans for industrial development and set many goals for the production and use of sugar. These government plans revealed that the sugar industry has enough energy and capacity to make investments in its five-year plans. India is known as the first home for sugar and sugarcane. India is the world second-largest producer of sugar. India shares in global sugar production by 2022 are projected at 15 percent to about 32 million tons. Sugar production in the 2015-16 season is estimated at about 26 million tons, about 2 million tons less than last year. The decline was due to extended dry weather in Maharashtra and Karnataka. Consumption in 2015-16 is estimated at 25 MT. The country had produced 28.1MT (Metric Tons) sugar by 2015. Maharashtra, the world leading producer of sugar, has revealed that sugar production will drop to 8.6MT in 2015-16. marketing year, compared to 10.5MT last year. There are about 380 sugar factories in India, 105 of which are in Uttar Pradesh.

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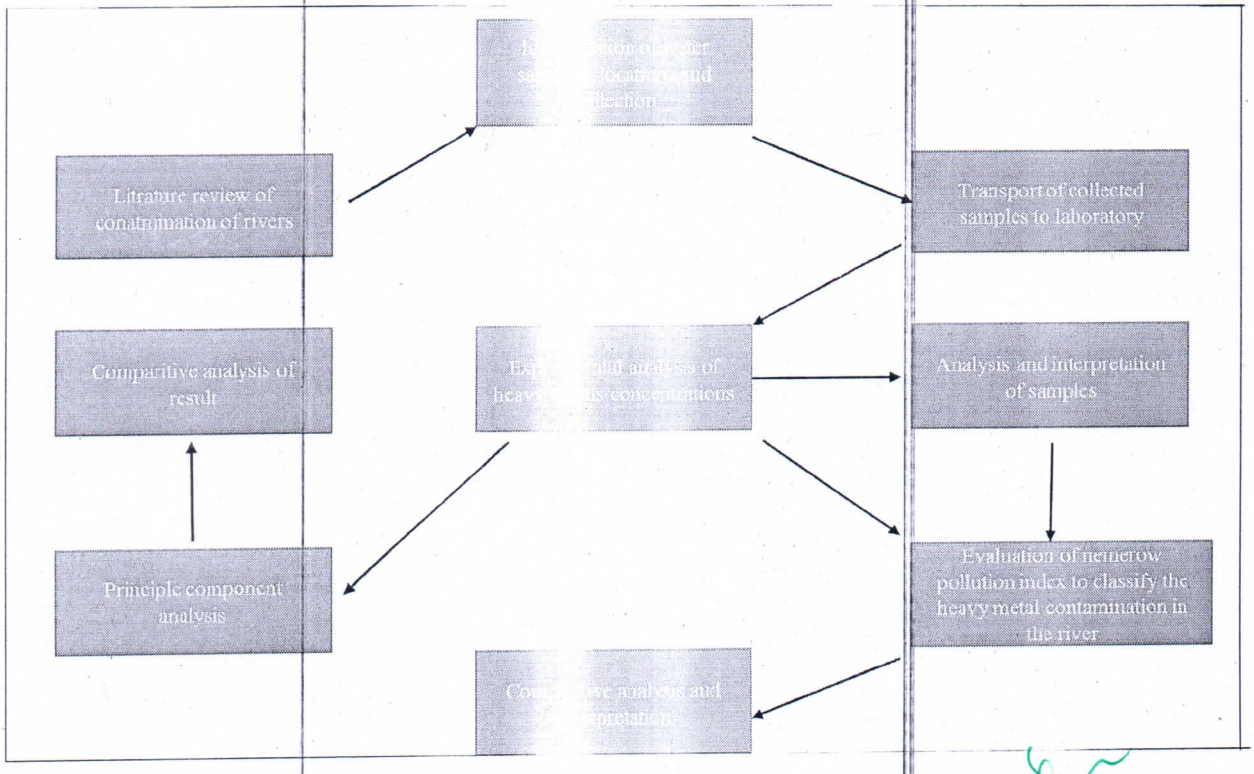
PROPOSED METHODOLOGY:

SAMPLE COLLECTION

Water and residues were taken as a sample in seven sockets along the river introduced by sewage, mining, industrial waste, human defrayals,. cultivation wastage agricultural activities for four different seasons in River Kali Nadi. Sample collection months were decided July, October, January, April from pre-decided seven sockets consecutively. Sample quantitatively preserved in 500 ml cuvettes & collected in chemistry lab Shri Ram College Muzaffarnagar.

LAB TESTING

The samples were analyzed for Iron, Lead, Copper, Cadmium and Arsenic using HPLC and AAS. Interpretation of results was conducted using Minitab statistical software and Excel spreadsheets.



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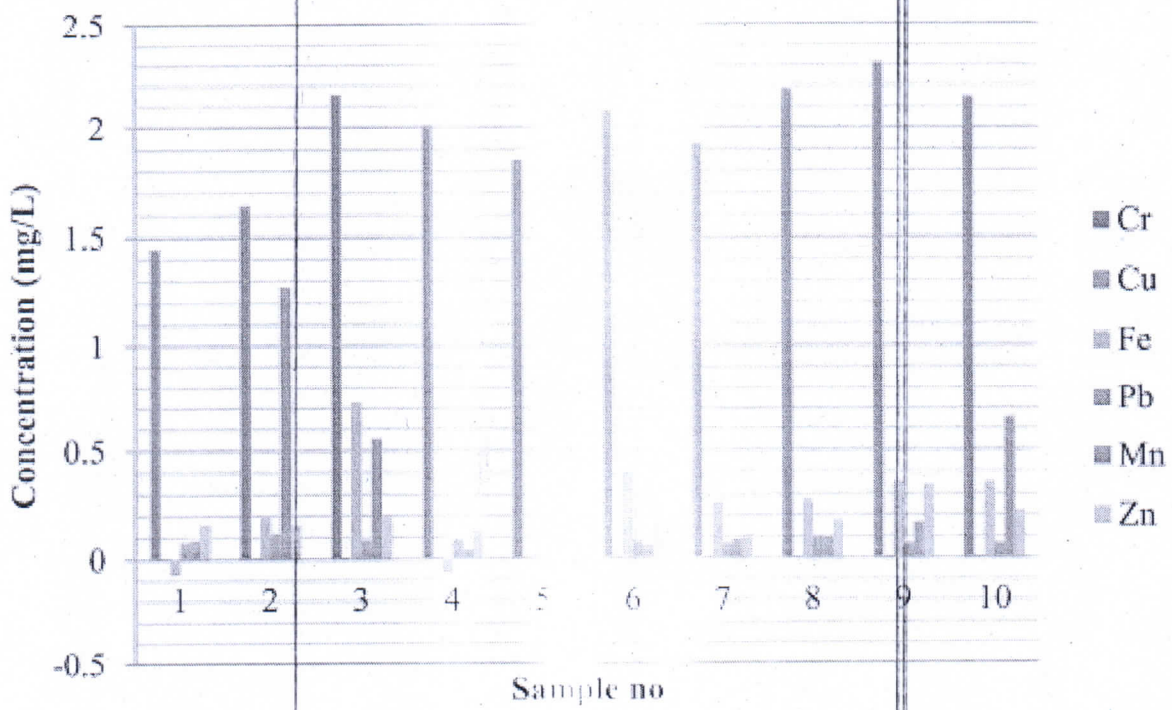
Probable outcome-The range of metals in water during the dry season was Fe (0.19-0.32) mg/l, Pb, Cu, Cd and As were below the detection limits. The range of metals in water during the short rain was Fe (0.12-1.25) mg/l and BDL for all other analysed metals. The range of metals in water during the long rain season was Fe (0.07-1.82) mg/l, Cu (0.08-0.11) mg/l and BDL for all the other analysed metals. The range of metals in sediments during dry season was Fe (0.13-1.44) ppm, Pb (0.08-0.54) ppm, and BDL for all other analysed metals. The range of metals in sediments during short rain season was Fe (0.23-1.73) ppm, Pb (0.12-0.27) ppm, and BDL for all other analysed metals. The range of metals in sediments during the long rain season was Fe (0.25-2.75) ppm, Pb (0.09-0.34) ppm, Cu (0.10-0.14) ppm, and BDL for all other analysed metals.



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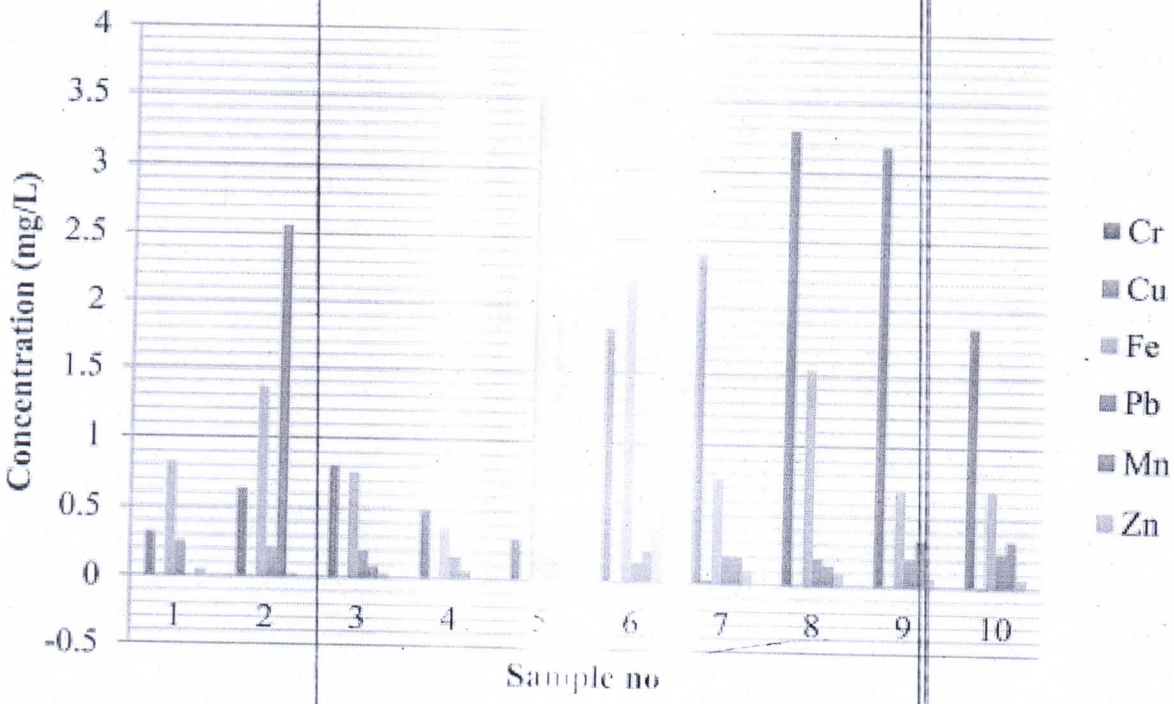

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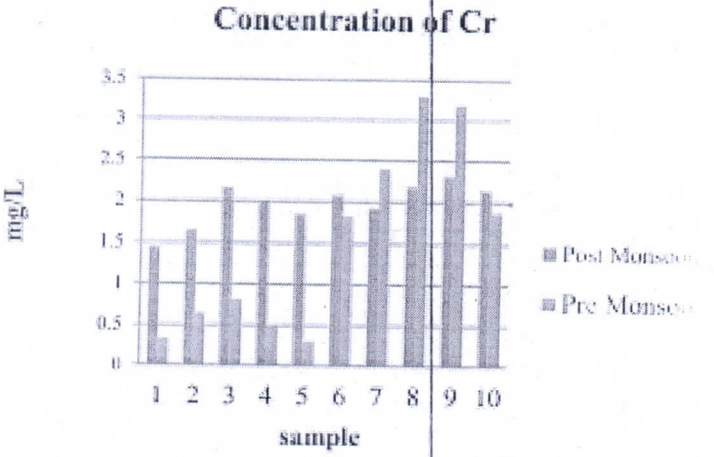

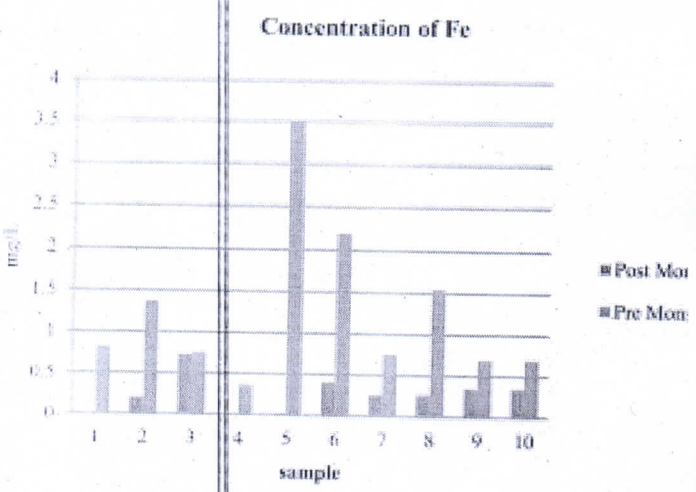

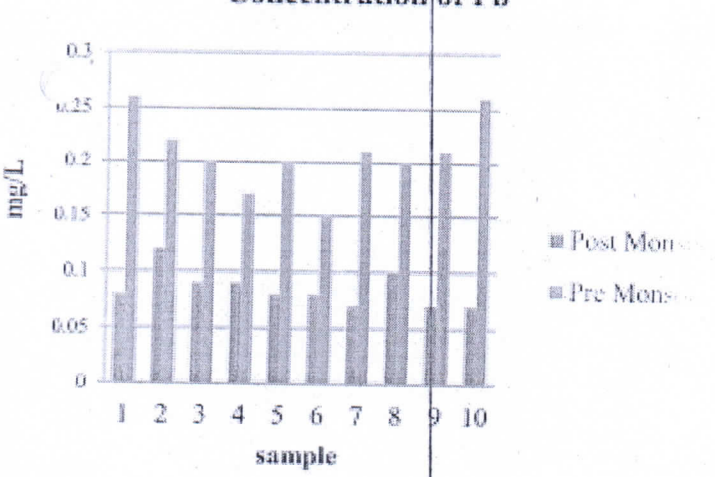

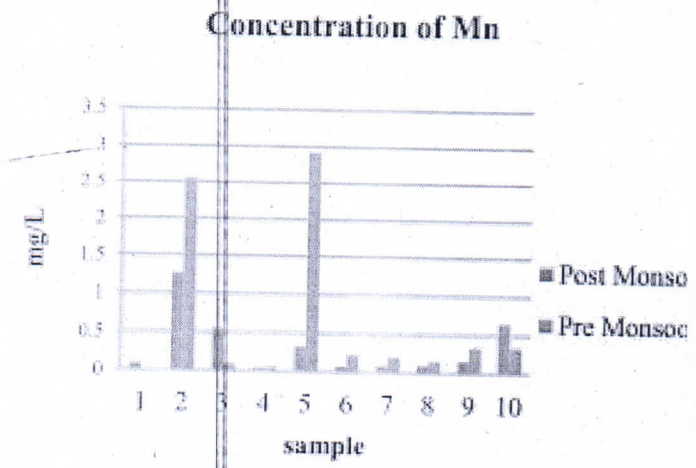

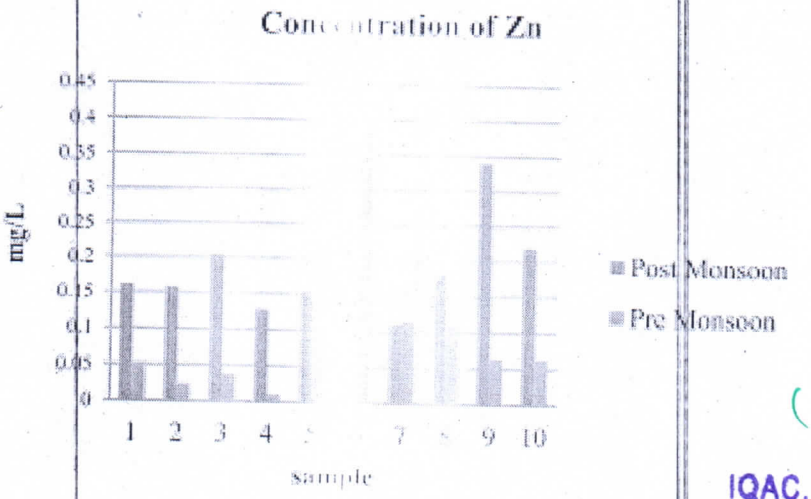

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Muzaffarnagar

BUDGET

PROJECTTITLE- TREATMENT OF SUGAR INDUSTRY WASTEWATER BYANAEROBIC SLUDGE BLANKET REACTOR AT PILOT SCALE

PROJECT PERIOD- 1 YEAR (12 MONTHS)

BUDGET & EXPENDITURES-

S. No.	Head(Expenses)	Requirement	Amount
1.	Manpower	3 students intern (@1000/- pm) 1 Principal Investigator)	6 months * 3 individuals =18,000/-
2.	Consumables	As per list attatched	39,004/-
		Total	57,004/-

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Muzaffarnagar

Consumables Chemicals-

S.No.	Items		Unit	Req	Rate	per	Amount
1	Absolute Alcohol		ml	4 x 500	549	500 ml	2196
2	Ammonia		litre	4 x 2.5	523	2.50 Ltr	1359
3	Anthracene		gram	5 x 500	749	100gm	5355
4	Benzene		litre	2 x 2.5	1225	2.50 Ltr	1529
5	Butane-2-ol		ml	2 x 500	564	500ml	733
6	Chloroform		ml	5 x 500	348	500ml	1131
7	Copper Acetate		gram	6 x 500	754	250gm	3920
8	Benzophenone		gram	3x500	891	500gm	1737
9	Erichrome Black –T		gram	1 x 25	234	25gm	152
10	Fuming Nitric Acid		litre	1 x 2.5	760	2.50ltr	494
11	Glycerol		ml	4 x 500	760	2.50 ltr	832
12	Lead Acetate		gram	2 x 500	432	500gm	561
13	Lead Carbonate		gram	2 x 500	518	500gm	673
14	Lead Chloride		gram	4 x 500	688	500gm	1788
15	Lead Nitrate		gram	6 x 500	493	500gm	1922
16	Manganese Chloride		gram	2 x 500	602	500gm	782
17	Methyl Alcohol		litre	2 x 2.5	549	2.50 ltr	713
18	Napthalene		gram	3 x 500	407	500gm	793
19	Napthol Alpha		gram	1 x 500	326	100gm	1059
20	Nesslar's reagent		ml	5 x 100	188	125ml	611
21	Nickel ammonium sulphate		gram	5 x 500	706	250gm	2753
22	p – Choloroanilene		gram	1 x 500	388	250gm	504
23	p – Nitroanilene		gram	1 x 500	246	100gm	799
24	potassium permegnatate		gram	2 x 500	509	500gm	661
25	Pthalic Anhydride		gram	2 x 500	354	500gm	690
26	Sodium Hydroxide		gram	2 x 500	694	500gm	213
27	Sodium Sulphate		gram	3 x 500	197	500gm	384
28	Stannous Chloride		gram	2 x 500	1532	250gm	1991
29	Sulphuric acid		litre	2 x 2.5	977	2.50ltr	1270
31	Zinc Chloride Anhydrous		gram	2 x 500	446	500gm	579
32	Zinc Sulphate		gram	4 x 500	255	500gm	663
33	Spirit		litre	1 x 10	268	500gm	174
						39004/-	Total

Co-ordinator
IQAC, Shri Ram College
Muzaffarnagar

Chairman
IQAC, Shri Ram College
Muzaffarnagar

Er. Rajdeep Saharawat
Principle Investigator
Shri Ram College Muzaffarnagar

05/07/2021

PROJECT ACCEPTANCE LETTER

To

Er. Rajdeep Saharawat

Assistant Professor

Shri Ram College

Muzaffarnagar

SUBJECT- Project confirmation letter of proposed project of treatment of sugar industry wastewater by anaerobic sludge blanket reactor at pilot scale in district Muzaffarnagar

With reference to the proposed project scope that you shared with us on 09/04/2020 after careful studying and consideration my team visit in your lab, we found spectrophotometer is already available according to which It is decided to accept the according to the term outline within.

Work will be commencing upon the delivery of 30,000 and the settlement of advance payment as per the project term and condition looking forward to completing the project as per the terms and conditions.

Yours

Co-ordinator
IQAC, Shri Ram College
Muzaffarnagar

Chairman
IQAC, Shri Ram College,
Muzaffarnagar

Director
Uttam Sugar Mill Ltd.

May, 9, 2020

PROJECT ACCEPTANCE LETTER

SUBJECT- Project confirmation letter of proposed project of treatment of sugar industry wastewater by anaerobic sludge blanket reactor at pilot scale in district Muzaffarnagar

To

Mr. Rajdeep Saharawat

Basic Science Department

(Shri Ram College Muzaffarnagar)

With reference to the proposed project scope that you shared with us on May,5 2020 after careful studying and consideration my team visit in your lab, we found spectrophotometer is already available according to which It is decided to accept the according to the term outline within.

Work will be commencing upon the delivery of 30,000 and the settlement of advance payment as per the project term and condition looking forward to completing the project as per the terms and conditions.

Yours sincere

Director Uttam Sugar Mill

Pvt. Ltd.

Co-ordinator
IQAC, Shri Ram College
Muzaffarnagar

Chairman
IQAC, Shri Ram College,
Muzaffarnagar

TREATMENT OF SUGAR INDUSTRY WASTEWATER BY ANAEROBIC SLUDGE BLANKET REACTOR AT PILOT SCALE

I. INTRODUCTION

Sugar is made from sugarcane, and was discovered thousands of years ago in New Guinea. The route was then followed by India and Southeast Asia. India was the first producer of sugar following the process of pressing sugarcane to extract juice and boil it for crystals. The Indian government in 1950-51 made critical plans for industrial development and set many goals for the production and use of sugar. These government plans revealed that the sugar industry has enough energy and capacity to make investments in its five-year plans. India is known as the first home for sugar and sugarcane. India is the world's second-largest producer of sugar. India's share in global sugar production by 2022 is projected at 15 percent to about 32 million tons. Sugar production in the 2015-16 season is estimated at about 26 million tons, about 2 million tons less than last year. The decline was due to extended dry weather in Maharashtra and Karnataka. Consumption in 2015-16 is estimated at 25 MT. The country had produced 28.1MT (Metric Tons) sugar by 2015. Maharashtra, the world's leading producer of sugar, has revealed that sugar production will drop to 8.6MT in 2015-16. marketing year, compared to 10.5MT last year. There are about 380 sugar factories in India, 105 of which are in Uttar Pradesh.

Process
Mill house
Boiling house
Boiler house (Blowdown)
Pump cooling water
Sulphur furnaces
Lime hydrator
Excess Condensate
Final effluent
Spray Pond over flow

Table 1: Effluent Generations In Various, Units Of Sugar Factory.

The Uttar Pradesh Sugar Industry is ranked first in terms of its contribution to sugar in the country's total sugar production. Uttar Pradesh ranks first in the country for sugarcane cultivation. The Uttar Pradesh Sugar Industry has about 120 sugar factories being distributed throughout the country.

Biological Wastewater Treatment Method.

At the surface, it appears easy as it uses herbal procedures to aid in the decomposition of organic substances, but it is a complicated, poorly understood manner at the intersection of biology and biochemistry. In biological treatments, bacteria, nematodes, and different small organisms are employed to break down organic wastes through herbal mobile processes. natural count in wastewater is generally found in rubbish, rubbish, and in part digested ingredients. There will also be pathogenic organisms, toxic metals, and pollution gift. The goal of biological wastewater treatment is to create a machine that makes it smooth to gather and dispose of decomposition products.

Aerobic and Anaerobic

It's important to define aerobic and anaerobic processes in biological processes. Aerobic means that there is air (oxygen) present, whereas anaerobic means that there is no oxygen present. These two words refer to the bacteria or microorganisms that cause environmental damage in contaminated water and under bioreactor operating conditions. As a result, aerobic treatment procedures take place in the air and rely on microorganisms (also known as aerobes) that combine organic contaminants with cellular / free oxygen, converting them to carbon dioxide, water, and biomass. In contrast, anaerobic treatment processes occur when there is no air (and hence no molecular / free oxygen) for those microorganisms (also known as anaerobes) that do not require air (molecular / free oxygen) to compensate for biological pollution. Methane and carbon dioxide gas, as well as biomass, are the final products of organic digestion in anaerobic treatment.

Hybrid Upflow Anaerobic Sludge Blanket (UASB) reactor

The Uttar Pradesh Sugar Industry is ranked first in terms of its contribution to sugar in the country's total sugar production. Uttar Pradesh is the world's 1st sugarcane grower. The Uttar Pradesh Sugar Industry has about 120 sugar factories being distributed throughout the country. Aerobic digester that combines UASB reactor with anaerobic filters. This compound is an advanced form that allows for improved duration of solid storage in wastewater treatment. This dirty water can be built up in the second chamber and must be removed daily or an explosion is imminent.

Upflow Anaerobic Sludge Blanket Reactor Wastewater Treatment is a biological waste disposal system that does not use air or oxygen. It aimed to remove biological pollutants from contaminated water, slurries and mud. Anaerobic microorganisms convert natural waste into "biogas" containing methane and carbon dioxide.

Statement of Problem

Sugar is one of India's most important agricultural-based industries. Because of its high levels of pollution, the safe treatment and disposal of wastewater in the sugar industry has been a source of worry for decades. Anaerobic therapy has gained importance in the effective treatment of wastewater in the sugar industry. Contaminated water in the sugar industry contains high levels of chemical compounds in the atmosphere (COD). According to the central pollution control board (CPCB) the standard COD standard is 250mg \ L and a pH of 5.5 to 9.0 for the purification of contaminated surface water. Considering all of the above problems with less expensive treatments is important in the sugar industry.

Objectives:

Treatment of wastewater treatment in the sugar industry with Upflow Anaerobic Sludge Blanket Reactor in experimental scale.

a) To obtain the parameters of a waste water sample before it is treated.

b) To obtain the parameters of a waste water sample after treatment.

c) To determine maximum COD removal efficiency of the reactor.

d) To determine the possibility of treating sugar industry waste water with anaerobic bacteria in an Upflow anaerobic hybrid reactor.

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II. METHODOLOGY

Laboratory scale Upflow Anaerobic sludge blanket reactor built. The total height of the reactor is 800mm. The working volume of the reactor is 3.26 liters and the working height is 504.8mm and the free board is 295.2mm.

Activated sludge was seeded to the reactor to generate bacteria in it. Sampling ports were given to the reactors as shown in the figure. The sampling ports were fixed at various levels of overall height of the reactor and they are placed at 510mm from top as well as 164.8mm distance from bottom to arrest the packing material and reduce the choking problems at inlet as well as outlet.

Packing material

According to literature review and previous studies use of packing materials has proven to be more efficient for treatment of wastewater. We have selected poly vinyl chloride (PVC) as packing material for the present study. The diameter of pall rings is 25mm and height is 12mm.

Details of the reactor

Total Height	800mm
Effective Height	504.8mm
Inner Diameter	94mm
Outer Diameter	100mm
Thickness	5mm
Diameter of PVC rings	25mm
Height of PVC rings	12mm

Table 2: Details of the design of the UASB Reactor

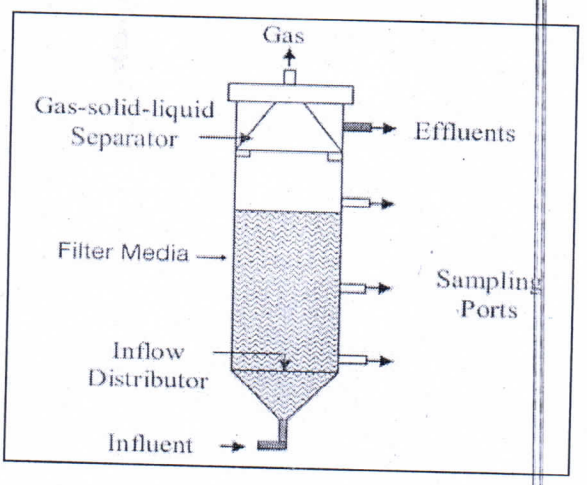

Fig 1: Schematic Diagram of UASB Reactor

III. RESULTS AND DISCUSSION

1) Parameters at dilution ratio 1/10.

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Days	pH	COD Inlet (mg/l)	COD Outlet (mg/l)		Efficiency (%)
1	5.16	2292.33	2014.29		12.128
2	5.35	2267.76	1984.61		12.48
3	5.63	2315.14	2013.23		13.04
4	5.77	2256.85	1914.33		15.176
5	5.89	2196.42	1833.90		16.50
6	5.95	2205.44	1802.81		18.25
7	6.01	2157.35	1735.10		19.572
8	6.23	2207.39	1715.86		19.29
9	6.29	2151.62	1715.86		20.25
10	6.35	2149.47	1707.78		20.544

Table 3: At 1/10 dilution ratio of wastewater

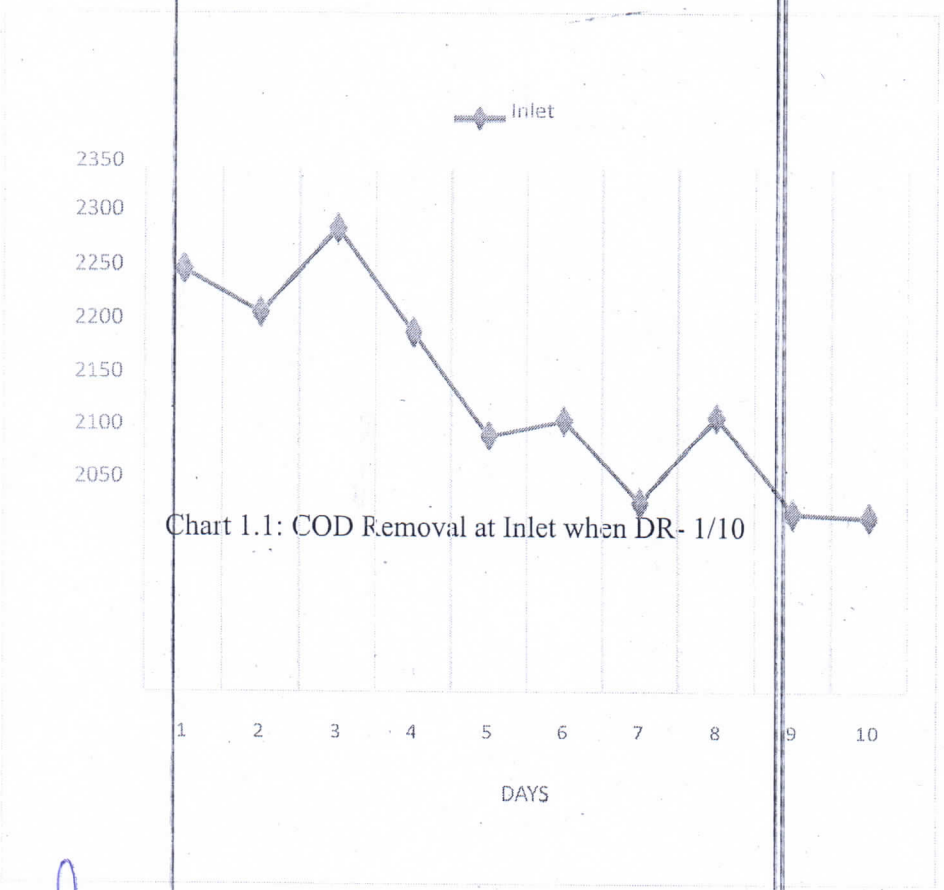

Chart 1.1: COD Removal at Inlet when DR- 1/10

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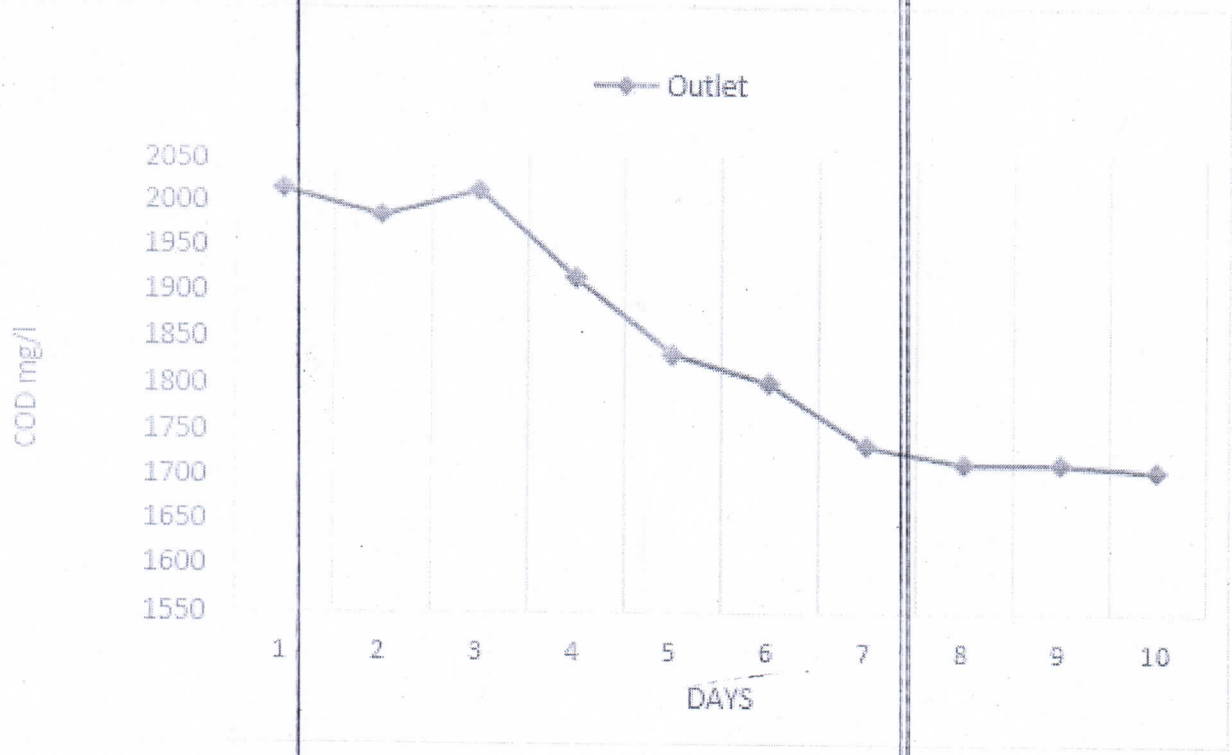

Chart 1.2: COD Removal at Outlet when DR- 1/10

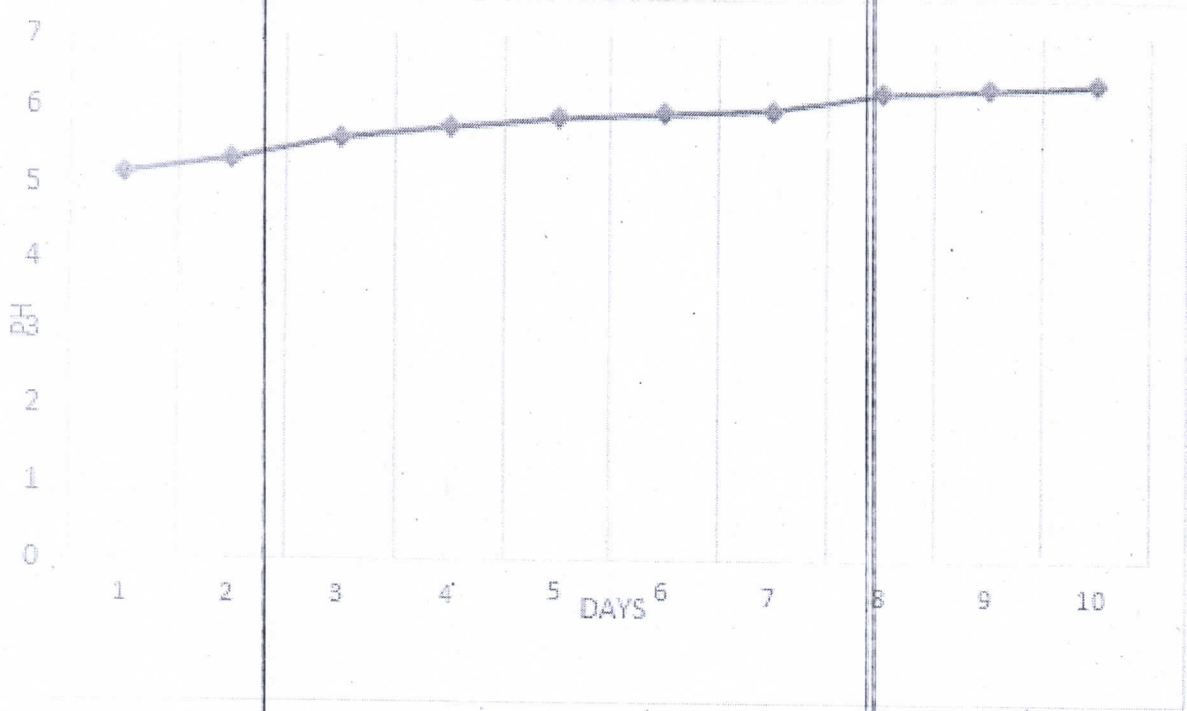

Chart 1.3: pH value when DR- 1/10

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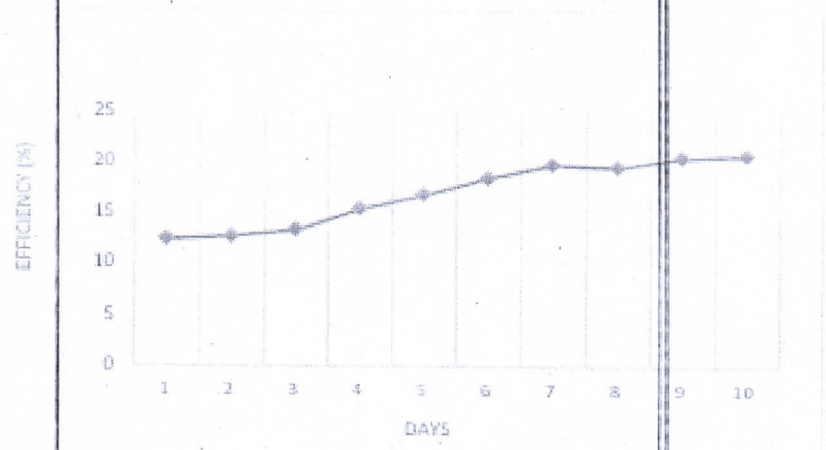

Chart 1.4: Efficiency when DR- 1/10

Table 4: At 1/6 dilution ratio of wastewater

Days	pH	COD Inlet (mg/l)	COD Outlet (mg/l)	Efficiency (%)
1	4.82	2506.69	1951.57	22.145
2	5.04	2451.77	1848.44	24.60
3	5.58	2405.16	1706.19	29.06
4	5.65	2493.19	1732.45	30.801
5	5.78	2342.25	1585.18	33.32
6	5.82	2374.60	1692.65	28.71
7	5.91	2360.63	1663.19	29.54
8	5.96	2389.64	1642.86	31.25
9	6.02	2379.20	1604.62	32.55
10	6.26	2336.83	1517.64	35.05

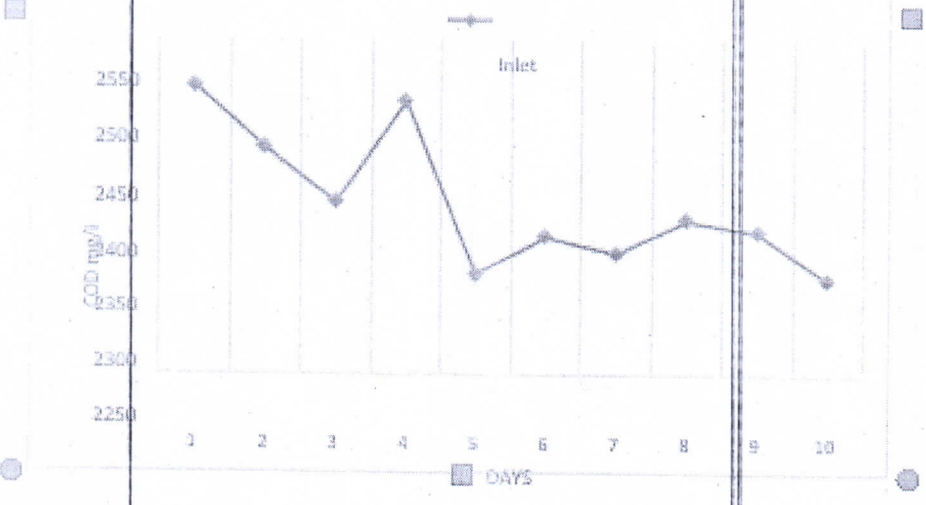

Chart 1.5: COD Removal at Inlet when DR- 1/6

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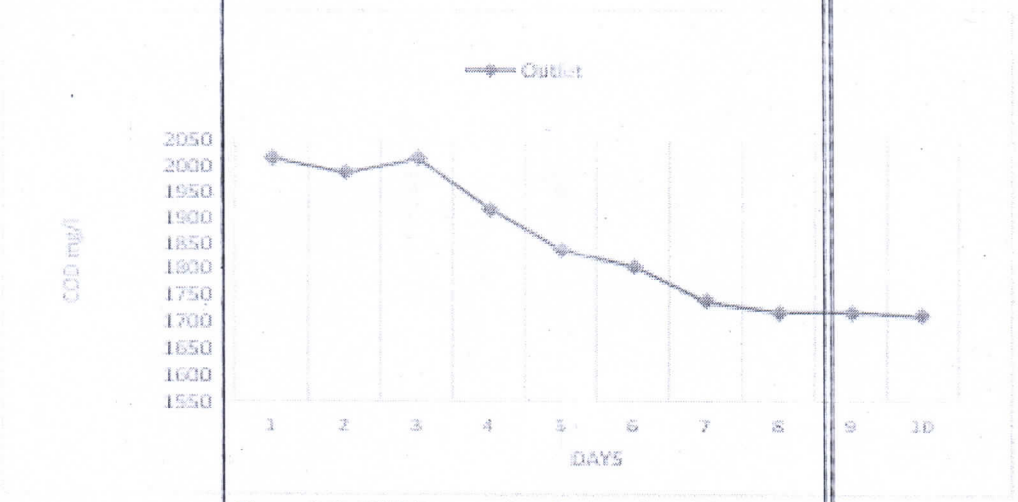

Chart 1.6: COD Removal at Outlet when DR- 1/6

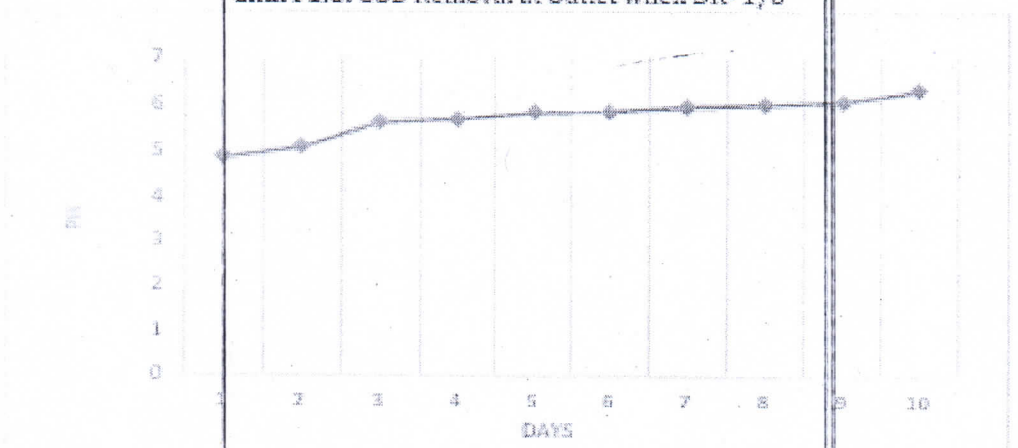

Chart 1.7: pH value when DR- 1/6

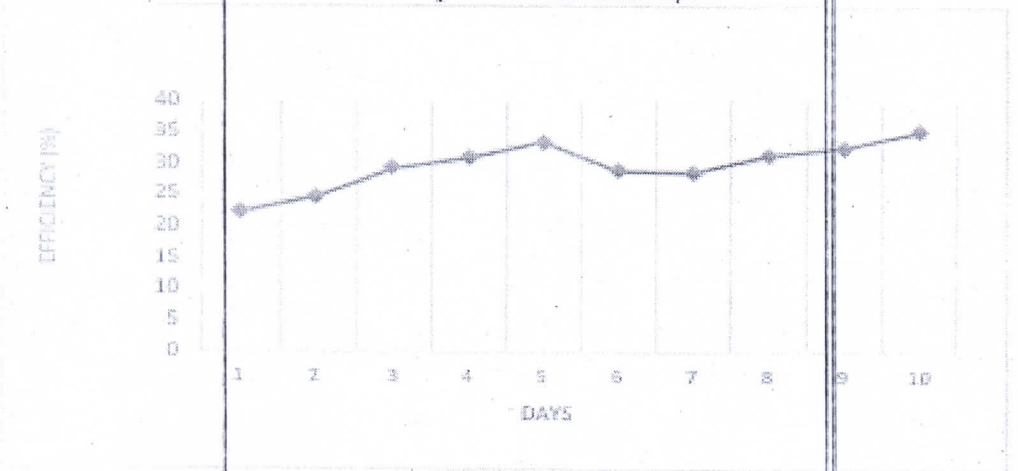

Chart 1.8: Efficiency when DR- 1/6

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Table 5: At 1/4 dilution ratio of wastewater

Days	pH	COD Inlet (mg/l)	COD Outlet (mg/l)	Efficiency (%)
1	4.98	2288.07	1450.43	36.60
2	5.04	2361.87	1503.85	36.32
3	5.13	2250.72	1375.98	38.86
4	5.20	2262.03	1308.29	42.164
5	5.18	2288.95	1985.24	39.48
6	5.25	2403.35	1213.47	49.50
7	5.30	2365.21	1187.19	49.80
8	5.27	2454.76	1209.59	50.72
9	5.40	2381.10	1164.56	48.90
10	5.49	2355.70	1084.06	46.01
11	5.60	2357.70	1060.74	55.03
12	5.79	2339.69	1017.12	56.52
13	5.77	2348.63	986.03	58.01
14	5.86	2349.48	984.94	58.07
15	5.89	2156.59	1042.06	56.42
16	5.92	2351.80	1030.27	56.19
17	5.96	2345.72	963.85	58.90
18	5.87	2334.61	948.42	59.41
19	5.91	2310.69	932.35	59.65
20	6.04	2296.85	874.75	61.91

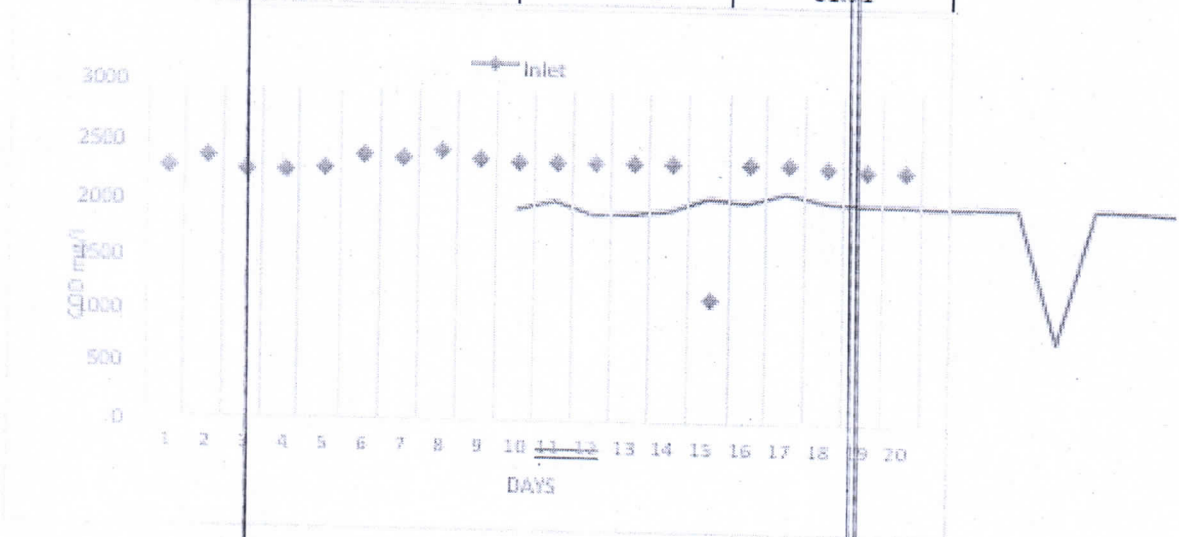

Chart 1.9: COD Removal at Inlet when DR- 1/4

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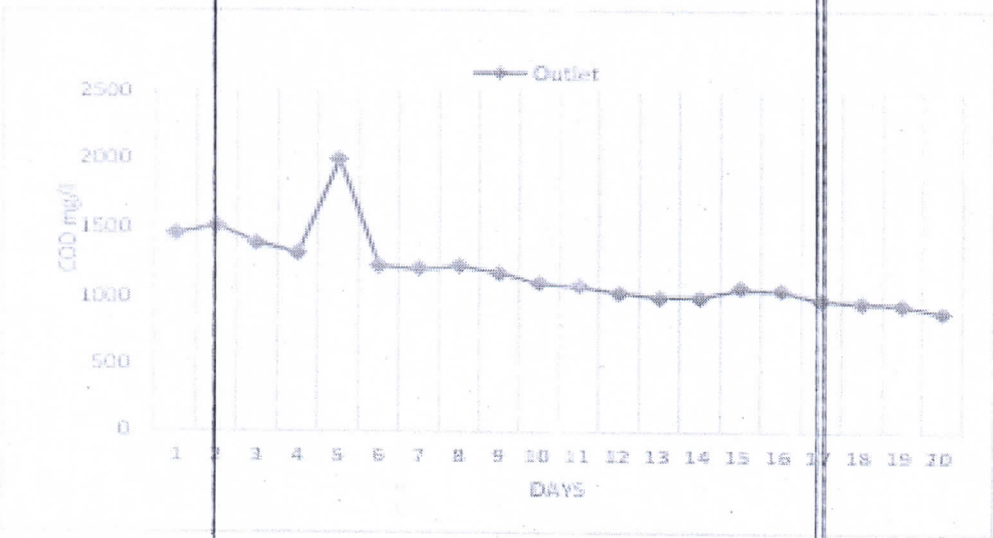

Chart 1.10: COD Removal at output when DR- 1/4

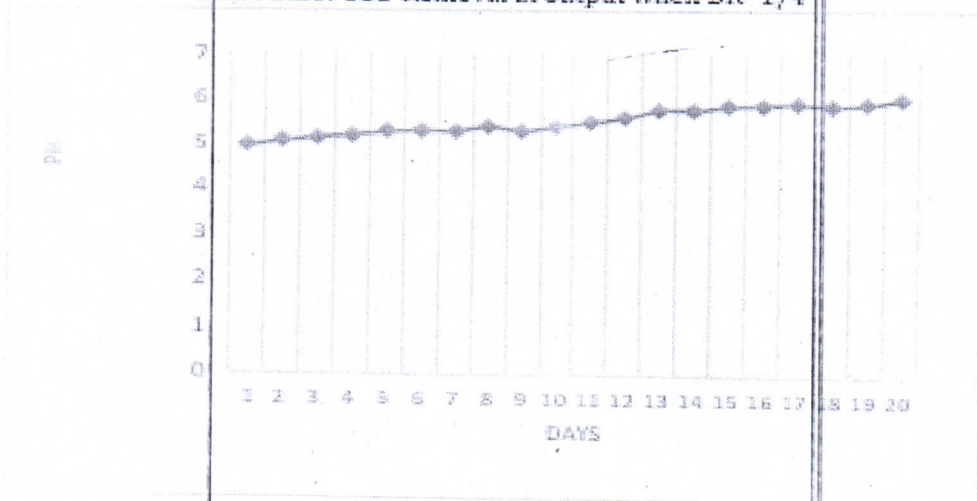

Chart 1.11: pH value when DR- 1/4

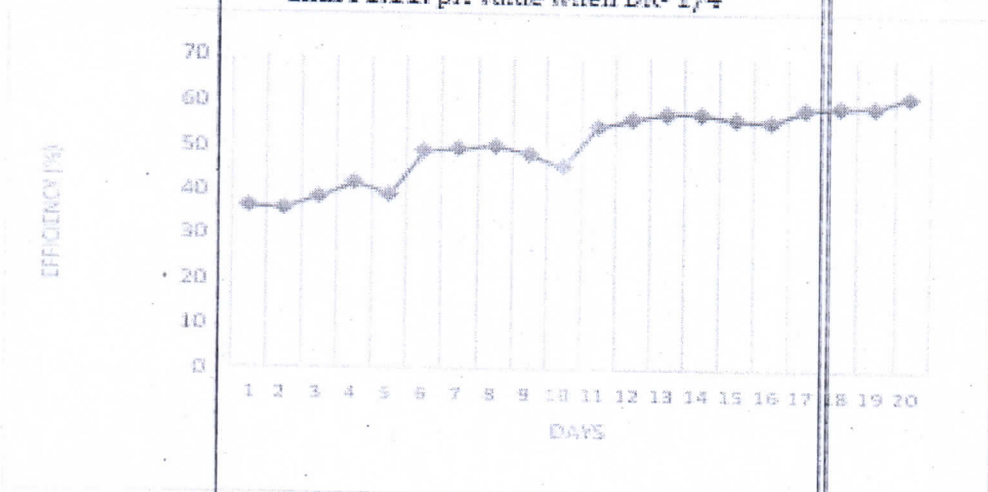

Chart 1.12: Efficiency when DR- 1/4

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Table 6: At 1/1 dilution ratio of wastewater

Days	pH	COD Inlet (mg/l)	COD Outlet (mg/l)	Efficiency (%)
1.	5.02	2768.84	2214.55	56.13
2.	5.23	2724.70	2173.42	56.93
3.	5.31	2713.28	2058.74	60.97
4.	5.39	2707.12	1993.62	63.29
5.	5.42	2573.84	2183.23	59.07
6.	5.46	2395.03	1927.50	61.27
7.	5.51	2228.64	1805.59	63.85
8.	5.60	2140.75	1768.72	64.09
9.	5.69	2146.56	1734.04	65.80
10.	5.72	2029.85	1648.83	68.03
11.	5.77	1981.39	1600.72	69.68
12.	5.82	1934.2	1578.82	70.07
13.	5.88	1913.55	1544.67	71.56
14.	6.02	1909.33	1509.34	73.32

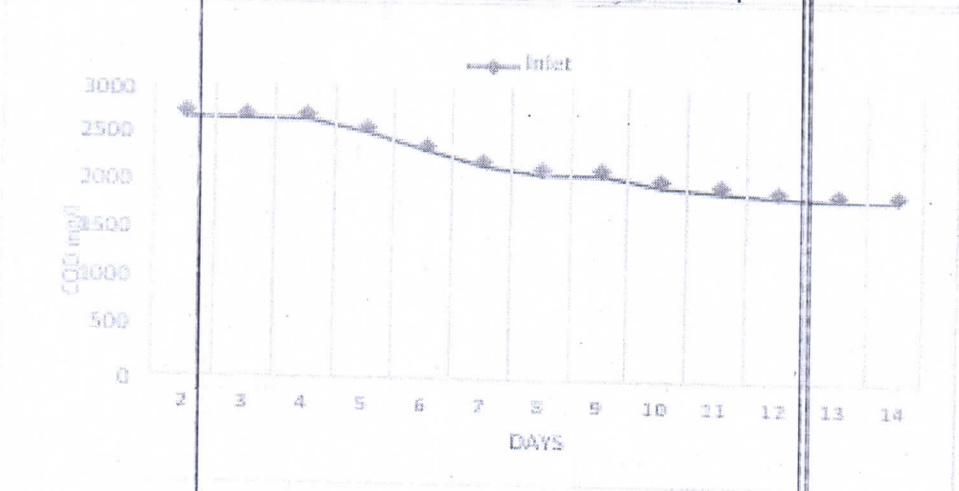

Chart 1.13: COD Removal at Inlet when DR- 1/1

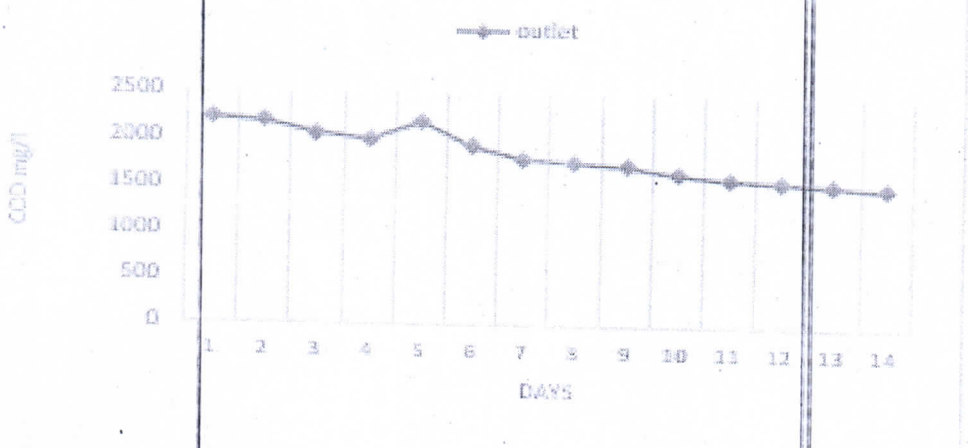

Chart 1.14: COD Removal at outlet when DR- 1/1

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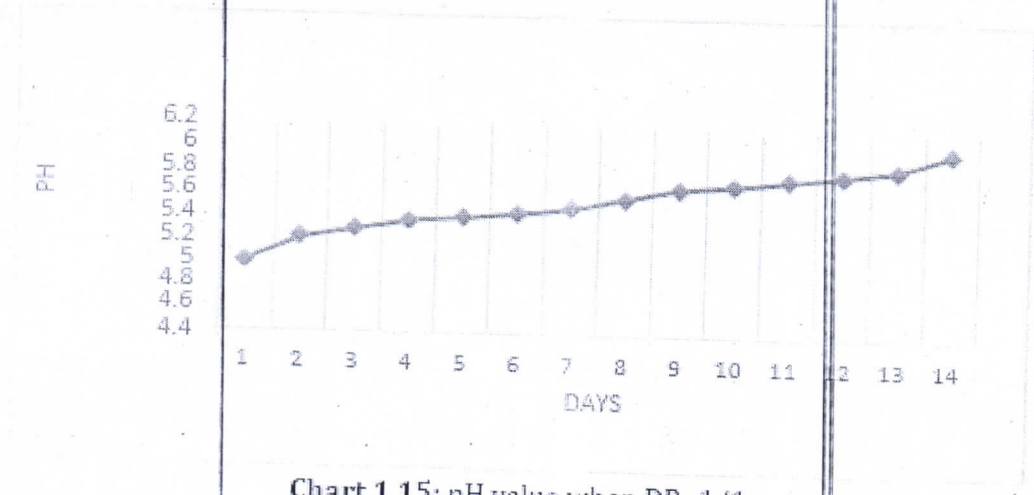

Chart 1.15: pH value when DR- 1/1

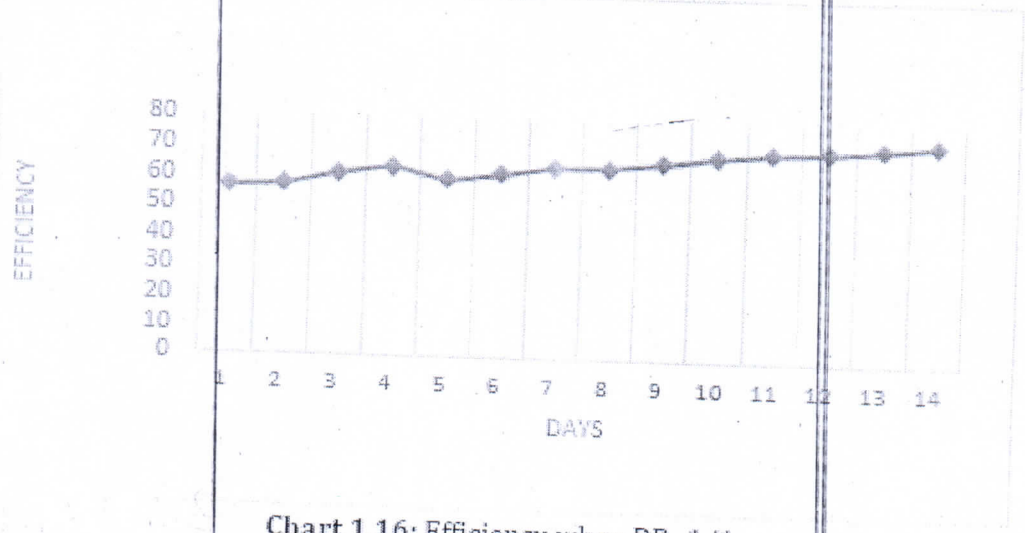

Chart 1.16: Efficiency when DR- 1/1

IV. CONCLUSION

In the UASB Reactor, industrial wastewater has been cleansed repeatedly on its own, indicating that it comprises a simple, dependable biological process. The UASB Reactor is an anaerobic reactor.

Following conclusions are drawn from the study-

- Achieved maximum COD removal efficiency upto 62.45%
- maximum phosphorus removal efficiency upto 39.58% of reactor throughout the period of treatment
- maximum BOD removal efficiency of reactor upto 76.007%.
- So, waste water from the sugar industry can be handled well by the UASB Reactor.

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Dated- 25/07/2021

To

Director

Bindals Papers Mills Ltd.

Muzaffarnagar

Subject- Acceptance letter for the proposal for a project

Dear Sir

I am beyond excited to write this response to your offer and firstly I would like to pay my gratitude on behalf of our department for having faith in our organization and sending us an offer. Bindals Papers Mills Ltd. has earned a big name in the marketplace havingdedication in the field of paper industry and we are glad you have reckoned it.

As I have reviewed your offer thoroughly and discussed with my superiors and we believe it is quite smoothly crafted. All the details are compatible with the service we canprovide thus we shall carry it out the way you want. Nonetheless, we would also like to bring this into your attention that all the proposed methods are subject to change as per the situation. However, our team will make sure to inform you prior to any amendments.

Hoping for a healthy relationship.

PANKAJ KAUSHIK

Assistant Professor

Department of Business Administration

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Muzaffarnagar

Chairman
IQAC, Shri Ram College,
Muzaffarnagar

Shri Ram College, Muzaffarnagar

Department of Business Administration

Industrial Project for Bindals Papers Mills Ltd, Muzaffarnagar titled

"A Study of Consumer Behavior towards the Products of Bindals papers Mills"

Summary Report

Introduction

Bindals Papers Mills Limited emerges as part of the extremely dynamic and rapid growing Bindal Group. Bindal's has a diversified Business Portfolio in Manufacturing of Cut pack A4 Copier paper, Writing & Printing grades, and its Notebooks. The ever-increasing demands of the consumer for high-quality products, supported by a strong service culture and affordable prices, determine the core business philosophy of the group. Bindals' significant Investment in the high-end Printing and Writing Paper sector in the year 2009 is a modern Greenfield plant in Muzaffarnagar, UP with a manufacturing capacity exceeding 1,00,000 TPY. More importantly, its participation is in Branded Copier Paper (cut-size) segment, the fast-growing High Bright SS Maplitho Paper (uncoated wood free paper) and Notebooks makes it a one-stop-shop paper group, enabling customers to source the widest range of papers and boards.

The installed technology is completely up to date and in line with the growing demands of the markets for high-quality, globally competitive papers. Backing this is an excellent network of distributors who offer customized services and solutions and a workforce that is both talented and dedicated.

The Company's Sales and Marketing is headquartered in New Delhi which clearly results in closer and more personalized service, being in the heart of the country's biggest and fastest growing market. The Team of sales and marketing professionals has the right blend of experience and youth who service the customers with utmost passion and humility.

The organization always seeks to improve itself through research projects, even with a vast customer base and overall good performance. For the fulfillment of this objective company joined hands with Shri Ram College to conduct research to find out the perception of consumer towards the products of Bindals Papers Ltd.

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RESEARCH OBJECTIVES

- To study the preferences and buying patterns of consumerswhile buying the products ofBindals Papers Ltd.
- To study the satisfaction level of consumers after using Bindals Papers products
- To know the attributes that a consumer keeps in mind while buying Bindals Papers products.

RESEARCH METHODOLOGY

Sampling: The sample of 120 consumers selected from Muzaffarnagar and Saharanpur districts by using simple random sampling method to select the sample.

Tools used for the study: The study is carried out with the help of both primary and secondary data. Primary data was collected through well-structured questionnaire provided to the consumers. Secondary data was collected from internet, Journals and articles. For scaling purpose Likert's5-point scale was used for certain questions. Chi-square has been used to analyze the questionnaire results.

NEED FOR THE STUDY

A consumer is a person who makes a financial payment for the item needed in order to purchase goods and services. In the market, consumers are essential. This study focuses on the variables encouraging consumers to buy Bindals Papers since happy customers are the ones who add value to the business.

HYPOTHESIS

H0: There is no significant difference between cost and utilization of the Bindals Papers products

H1: There is significant difference between cost and utilizationof the Bindals Papers products

FINDINGS

The data collected, through 120 questionnaires, is analyzed. Out of 120 users, dominant portion i.e. nearly 2/3rd of the users belongs to organizations.

□ Over 91% of the people have used Bindals Products

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- 78% people strongly agree that Bindals offers a variety of products while 12% people think that Bindals has not offered a large variety of products.
- 82% people believe that Bindals Papers offers good quality of product but 18% customers are not satisfied with the quality of product.
- 79% customer thinks that the price of Bindals Papersis fair but 21% customer thinks that the price of the product is not fair.
- 75% customer agree that Bindals Papers have more natural ingredients and 25% customersdoes not think so.
- 73% customers are satisfied with patanjali product while 27% customer are not satisfied with Bindalsproducts.
- 68% of the people came to know about Bindalsthrough retailersand recommendations while 32% on Self Exploration.

CONCLUSION

Bindals Papers faces challenges from marketers due to its unconventional marketing methods. Consumers' opinions are influenced by benefits and value. Most users are satisfied with Bindals Papers' offerings due to affordability and problem-solving. Customer retention is key, but Bindals Papers must maintain its advantages before competitors emerge. The company's hedonic value attracts brand-loyal customers, rather than price-conscious customers, ensuring customer satisfaction.

Recommendations

- To make a successful product, Bindals Papers marketing strategy should attract long-term customers.
- Most of the Bindals Papers consumer are facing problem like, products are not available in the market regularly.
- They can expand their avenues of distribution.
- They must focus back on product efficacy. Rising above the noise of advertising.
- They can expand their stores and outlets.
- Thus, Bindals Papers should boost output and ensure that the market would experience a product shortage.

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Project Completion Report

The project was funded by Bindals Papers Mills Ltd. Project was exclusively conducted for Bindals Papers. The Company had paid Rs.35000/- in advance and remaining Rs. 15000/- after the submission of the report. The project undertaken was started on08/08/2021 and it was completed on 21/02/2022. Seven students of BBA final year were involved to assist the principal investigator throughout the project.They collected primary data through questionnaire and also assisted from starting to the completion of the project.Students were also provided with reasonable stipend.People dedicated to the project were as follows-

Principal Investigator- Mr. Pankaj Kaushik (Asst. Prof., Department of Business Administration)

SN	Roll Number	Name of the student	Remuneration (in Rs.)	TA (in Rs.)
1	190855105045	HIMANI SHARMA	5500	1800
2	190855105057	LAKSHAY GOYAL	5500	1000
3	190855105062	MANJEET SINGH	5500	1800
4	190855105064	MILAN TYAGI	5500	1500
5	190855105088	NIKITA LAMBA	5500	1500
6	190855105036	DIKSHA BASIA	5500	1100
7	190855105118	SHIVAM SHARMA	5500	900
		Total	**38500**	**9600**

Remuneration Paid	Rs. 38500
Travelling Allowances Paid	Rs. 9600
Miscellaneous expenses	Rs. 2500
Total	**Rs. 50600/-**

PANKAJ KAUSHIK

Principal Investigator to the Project

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Muzaffarnagar

Shri Ram College, Muzaffarnagar

Department of Business Administration

Industrial Project for Bindals Papers Mills Ltd, Muzaffarnagar titled

"A study of consumers behavior about bindals papers products"

Dated-23/02/2021

List of students who have been involved throughout the project and details of the remuneration and travelling expenses provided to them.

SN	Roll Number	Name of the student	Remuneration (in Rs.)	TA	Total	Received by the student (Sign)
1	190855105045	HIMANI SHARMA	5500	1800	7300	Himani
2	190855105057	LAKSHAY GOYAL	5500	1000	6500	Lakshay Goyal
3	190855105062	MANJEET SINGH	5500	1800	7300	Manjeet Singh
4	190855105064	MILAN TYAGI	5500	1500	7000	Milan
5	190855105088	NIKITA LAMBA	5500	1500	7000	Nikita
6	190855105036	DIKSHA BASIA	5500	1100	6600	Diksha.
7	190855105118	SHIVAM SHARMA	5500	900	6400	S Sharma
		Total	**38500**	**9600**	48100	
	Miscellaneous			2500		

PANKAJ KAUSHIK

Principal Investigator to the Project

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(a) Strongly agree ( ) (b) Agree ( ) (c) Neutral ( ) (d) Disagree ( ) (e) Strongly disagree ( )

10) Do you agree the prices of the Bindals Papers Ltd products are fair?

(a) Strongly agree ( ) (b) Agree ( ) (c) Neutral ( )(d) Disagree ( ) (e) Strongly disagree ( )

11) Do you agree that the Bindals Papers Ltd products have appealing packaging?

(a) Strongly agree ( ) (b) Agree ( ) (c) Neutral ( ) (d) Disagree ( ) (e) Strongly disagree ( )

12) Do you agree that Bindals Papers Ltd products are ecofriendly?

(a) Strongly agree ( ) (b) Agree ( ) (c) Neutral ( ) (d) Disagree ( ) (e) Strongly disagree ( )

13) Do you agree that you are satisfied with the Bindals Papers Ltd product?

(a) Strongly agree ( ) (b) Agree ( ) (c) Neutral ( ) (d) Disagree ( ) (e) Strongly disagree ( )

15) Have you faced any problem while using the product?

(a) Yes ( ) (b) No ( )

16) Do you agree that Bindals Papers Ltd products are chemical-free?

(a) Strongly agree ( ) (b) Agree ( ) (c) Neutral ( ) (d) Disagree ( ) (e) Strongly disagree ( )

17) Do you agree that Bindals Papers Ltd products have made a good brand image?

(a) Strongly agree ( ) (b) Agree ( ) (c) Neutral ( ) (d) Disagree ( ) (e) Strongly disagree ( )

18) Please indicate the reason why you prefer Bindals Papers Ltd product?

(a) Convenient( ) (b) Affordable ( ) (c) Clean ( ) (d) Others ( )

19) How do you come to know about the product?

(a) Advertisement ( ) (b) Recommendation ( ) (c) Self Exploration ( )

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Department of Business Administration

Survey Project for Bindals Papers Ltd.

QUESTIONNAIRE:

1) Name.....

2) Age.....

(a) 15-20 ( ) (b) 20-25 ( ) (c) 25-35 ( ) (d) above 35 ( )

3) Gender

(a) Male ( ) (b) Female ( )

4) Qualification

(a) upto HSC ( ) (b) Graduation ( ) (c) Post Graduation ( ) (d) illiterate ( )

5) Marital Status

(a) Married ( ) (b) Unmarried ( )

6) Are you aware of Bindal Papers Products?

(a) Yes ( ) (b) No ( )

7) Have you used any product of Bindal Papers Ltd?

(a) Yes ( ) (b) No ( )

8) Do you agree Bindals Papers Ltd offers a large variety of products?

(a) Strongly agree ( ) (b) Agree ( ) (c) Neutral ( ) (d) Disagree ( ) (e) Strongly disagree ( )

9) Do you agree that Bindals Papers Ltd products are of high quality?

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AKHIL BHARTIY UDOOG VIYAPARI SURAKSHA MANCH JANPAD MUZAFFARNAGAR,

SPONSORED PROJECT

ON

"A STUDY ON IMPACT OF ONLINE SHOPPING ON SMALL TRADERS IN DISTRICT MUZAFFARNAGAR"

2021-2022

BY:

DEPARTMENT OF COMMERCE,

SHRI RAM COLLEGE, MUZAFFARNAGAR (UP)

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अखिल भारतीय उद्योग व्यापार सुरक्षा मंच
जनपद मुजफ्फरनगर

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दिनांकः 28–09–2021

आदरणीय प्रधानाचार्या

श्री राम कॉलेज

मुजफ्फरनगर.

महोदय,

अखिल भारतीय उद्योग व्यापार सुरक्षा मंच मुजफ्फरनगर का एक प्रसिद्ध एवं महत्तवपूर्ण व्यापारिक संगठन है इस संगठन के तत्वधान में पूर्व में आहुत की गई अनेक बैठको में आनलाइन खरीदारी के कारण मुजफ्फरनगर के छोटे एवं मंझले व्यापारियों पर पड़ने वाले प्रभाव के विषय में गहन विचार विमर्श किया जाता रहा है। ऑनलाइन बिक्री एवं खरीदारी का मुजफ्फरनगर के व्यापारियों पर पड़ने वाले प्रभाव का कोई डेटा उपलब्ध नहीं है जिस कारण इन प्रभावो को कम करने के लिए पूर्व में किसी प्रकार की योजना को क्रियानवित नहीं किया जा सका है। इसी के संदर्भ में व्यापार संघ श्री राम कॉलेज के माध्यम से कोई ऐसा शोध कराना चाहता है जो ऑनलाइन खरीदी के प्रत्यक्ष प्रभाव को छोटे एवं मझले व्यापारियों पर दिखा सके। अखिल भारतीय उद्योग व्यापार सुरक्षा मंच श्री राम कॉलेज से निवेदन करता है इस कार्य में सहायता कर अपने समाजिक दायित्वो के निर्वाह में एक कदम ओर बढ़ाए। इस शोध में आने वाले सभी खर्चों को वहन करने में व्यापार संघ सदैव तत्पर रहेगा।

उपरोक्त के संबंध में आपके उत्तर की प्रतीक्षा रहेगी।

Nishank Jain.

भवदीय;

(निशांक जैन)

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'A' Grade Accredited by NAAC

आदरणीय

दिनांक 05–10–2021

श्री निशांक जैन
जिला महामंत्री
अखिल भारतीय उद्योग व्यापार सुरक्षा मंच, मुजफ्फरनगर

महोदय,

आपके पत्र दिनांक 28–09–2021 का संदर्भ ग्रहण करते हुए, आपको सहर्ष सुचित किया जाता है कि डॉ अशफाक अली, एसोसिएट प्रोफेसर, वाणिज्य विभाग, श्री राम कॉलेज को इस शोध के लिए शोध समन्वयक नामित किया जाता है डॉ अशफाक अली, व्यापार संघ द्वारा कराई जा रही शोध में पूर्ण रूप से व्यापार संघ का सहयोग करेंगे एवं ऑनलाइन खरीदारी के छोटे व्यापारियों पर पड़ने वाले प्रभाव को उचित विश्लेषण कर उसका एक अख्ब्या आपको प्रेषित करेंगे। आप वाणिज्य विभाग से संपर्क कर शोध पर विचार विमर्श करे। शोध का अनुमानित बजट लगभग 50–55 हजार रु. एव अनुमानित समय 4 माह रहेगा।

अग्रिम शुभकामनाओं के साथ।

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दिनांक: 14–10–2021

डॉ अशफाक अली
शोध समन्वयक, वाणिज्य संकाय
श्री राम कॉलेज, मुजफ्फरनगर

श्री राम कॉलेज पत्रांक दिनांक 05–10–2021 के संबंध में आपको सूचित किया जाता है कि अखिल भारतीय उद्योग व्यापार सुरक्षा मंच जनपद मुजफ्फरनगर के द्वारा प्रस्तावित शोध के लिए 45000/– रु की धनराशि स्वीकृत की जाती है। इस शोध से अपेक्षा है कि ऑनलाइन खरीदारी और बिक्री का छोटे व मझले व्यापारियों पर पड़ने वाले प्रभाव का गहन एवं विस्तृत अध्ययन कर, छोटे एवं मझले व्यापारियो के लिए उत्पन्न चुनौतियों का सामना करने के उपायों की भी अनुशंसा करे ।

आपसे यह भी अपेक्षा की जाती है कि शोध की समाप्ति के पश्चात अनुमोदित धनराशि का लेखा जोखा, यथाशीघ्र आखिल भारतीय उद्योग व्यापार सुरक्षा मंच के कार्यालय में संबंधित आख्या के साथ जमा करना सुनिश्चित करेंगे।

आशा है कि यह शोध मुजफ्फरनगर के व्यापारियों के लिए एक मील का पत्थर साबित होगा ।

भवदीय; Nishank Jain.

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"A STUDY ON IMPACT OF ONLINE SHOPPING ON SMALL TRADERS IN DISTRICT MUZAFFARNAGAR"

Our goal in this research is to highlight how Muzaffarnagar's fixed shop vendors are impacted by the expanding trend of online shopping. A greater number of people depend on retailers, who make up a large share of the workforce. They now feel powerless and insecure due to the arrival of e-stores, which have attractive incentives and a wide range of products. The present study examines the diverse aspects of the impact on retail enterprises and the strategies they are devising to withstand the competition from e-commerce sites. This study also looks at how the increasing popularity of online shopping has affected different businesses' profitability. Even if the research is less common, a good effort has been made to clarify the situation and offer specific suggestions.

Keywords: *E-stores, fixed retailers, turnover, profit-margin, window-shopping.*

OVERVIEW OF RESEARCH:

Online shopping has become extremely popular recently due to the simplicity and convenience of purchasing goods and services from the comfort of one's home or place of business, as well as the reduction of the hassle of having to visit multiple stores to locate the perfect item. Online shopping, sometimes known as e-tail (also known as electronic retail or e-shopping), is a type of e-commerce that enables customers to make direct online purchases of goods and services via an online store. Currently, some of the top online retailers in India are Amazon, Flipkart, Snapdeal, Homeshop18, Myntra, and others.

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Selling products and services to clients via a variety of distribution channels is known as retail. Regardless of size, retail establishments generally follow the same model of "purchasing to sale." The retail industry has existed for as long as civilization and is the most fundamental type of company, with certain types of retail outlets emerging from it.

DEPARTMENTAL STORES:

A department store is a type of retail establishment that houses a variety of products for end users. In a department store, customers may find nearly anything they want to buy in one location.

DISCOUNT STORES:

Additionally, discount retailers provide a vast array of goods to customers at a reduced price. Comparing bargain stores to department stores, the selection is typically smaller and the quality may occasionally be a little lower.

SUPERMARKET:

A supermarket is a type of retail establishment that primarily offers food items and household goods that are neatly organized into designated divisions. A supermarket serves the needs of the consumer's home and is an improved version of small food stores.

KIRANA STORE:

Mom and Pop stores, also known as Kirana stores, are small businesses owned and operated by locals in the neighborhood that serve the requirements of the local customers on a daily basis. They are ill-organized and only offer a limited selection of things.

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MALLS:

A mall is made up of several retail establishments in one location. A mall would be made up of multiple retail stores, each offering their own goods on a shared platform. Compared to physical stores, the Internet is quite advantageous. First, selection. Amazon offers hundreds of thousands of variations for a given garment of the same size, while the neighborhoods fabric store or the corner bookstore rarely have more than 5,000 references on their stalls. Online merchants abound on the internet, offering tenfold or even a hundredfold more things than the typical retailer could ever hope to carry. having a significant effect on retail establishments. The expenses associated with keeping and referencing a product for an e-commerce website are quite low when compared to the costs associated with doing the same for "physical" retailers. Online shopping has a significant impact on retail shops in terms of customer happiness and service availability.

REVIEW OF LITERATURE

The following are a few research articles that were discovered throughout the investigation:

- A report on "Consumer perceptions of privacy and security risks for online shopping" was written by Anthony D. Miyazaki and Ana Fernandez, and it was published in the summer 2001 issue of the Journal of Consumer Affairs, volume 35, issues 1-3, pages 27–44.
- The impact of supercenters on traditional food retailers in four markets was the subject of a paper written by Kathleen Seiders, Douglas J. Tigert, and Constantine Simonides that was published in the International Journal of Retail & Distribution Management (ISSN: 0959-0552).
- The influence of Quick Response Technologies on Retail Store Attributes is

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the subject of a report written by Eunju Ko and Doris H. Kincade that was published in the "International Journal of Retail & Distribution Management."

- In the "Journal of Shopping Centre Research," Soyeon Shim, Mary Ann Eastlick, and Sherry Lotz wrote a report titled "Assessing the impact of internet shopping on store shopping among mall shoppers and internet users."
- Research titled "The impact of online shopping experience on risk perception and online purchase intention: Does product category matter?" was written by Bo Dia, Sandra Forsythe, and Wi-Suk Kwon and published in the Journal of "Electronic Commerce Research," Vol. 15, No. 1, 2014.

OBJECTIVES OF STUDY

The research has been conducted with the following objectives:

- To study the effect on profitability of retail stores due to the advent of e-stores;
- To analyze the effect upon pricing patterns of retail stores in recent times;
- To analyze the change in business pattern to achieve customer satisfaction.

METHODOLOGY OF STUDY

The research methodology comprises of the sources of data, methods adopted to collect such data, sampling techniques, statistical tools for analysis, data interpretation etc.

SOURCES OF DATA & SAMPLE SIZE AND SAMPLE TECHNIQUE:

Primary data sources were consulted in gathering the study's data. Primary information has been gathered via. The owners of several retail establishments in Muzaffarnagar were interviewed using the direct personal interview method. Lookup relevant information by going through the schedules at the different units. The creation is made up of all the Stores, Shops & Kirana stores located in the district of

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Muzaffarnagar, from which more than 1000 stores are arbitrarily chosen from different locations to be studied. In order to facilitate convenient sampling, a sample of 500 retail establishments was chosen for the study. To provide a more accurate picture of the impact of online shopping, a convenient sample procedure method that has a significant market share and is suitable for the information available has been used.

NEED OF THE STUDY:

This is extremely pertinent to the modern era since it will raise awareness of how e-stores affect traditional retail establishments. The unexpected increase in online sales and the degree to which consumers have adapted to it are serious concerns for the thousands of small-business owners who rely on their small storefronts selling a limited selection of goods for their livelihood. This study aims to investigate the threat that faces the different small-scale stores as well as to unearth the actual situation. This study aims to inform merchants about impending obstacles that are anticipated to impact their business in the near future, enabling them to make necessary preparations to address these issues. The current situation is based on dynamism, which means that anything that stays stagnant will be surpassed by others. It's time for the shops to give this issue careful thought and develop more sophisticated plans.

RESEARCH DURATION:

From November 2021 to February 2022, a total of 4 months were spent conducting the research. For some historical-based statistics, the three-year period between 2019 and 2021 is covered. Nevertheless, data derived from a lengthy period of store study was used to calculate the impact factor.

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LIMITATIONS OF THE STUDY

Despite all of the serious attempts, the study's methodology is not perfect. For the following reasons, it has a number of limitations.

- The study is limited to Muzaffarnagar city only.
- The detailed study has been conducted taking on 500 retail stores based upon convenientsampling.
- Data pertaining to the study has been collected for a period of only 4 years.
- Time is also a limiting factor as the study is conducted in a very short span of time.

DATA ANALYSIS AND INTERPRETATION

With the exception of a few superstores that altered their business practices, retail establishments typically operated in the traditional business sectors. However, the emergence of internet shopping has negatively impacted these establishments as they were losing ground on multiple fronts. The purpose of the study is to comprehend the factors that have affected the operations of different shops and have, in part, caused them to modify their tactics.

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PRESENTATION OF DATA

Table showing the analysis of the various aspects of the impact of online shopping upon retail trade

LIST OF QUESTIONS	YES (in %)	NO (in %)
Has there been any decrease in average turnover in the past three years	80	20
Is there any decrease in profit margin?	96	4
Have you made any increase in discount rates offered to customer in recent times?	76	24
Do customers ask for discount before making purchases?	95	5
Do you keep more variety of stock at your store now-a-days?	10	90
Do you provide after sale services of personalized nature to your customers?	72	28
Do you advertise about your enterprise?	54	46
Do you provide home delivery services to your customers?	24	76
Is there an increase in window shopping in recent times?	80	20

ANALYSIS AND INTERPRETATION

With a figure as high as 80%, the table illustrates that most businesses have seen a decline in turnover and 96% sample say yes to decrease their profit during last three years. Due to their increased customer discounts in an effort to drive up sales, the majority of retailers have also consented to a decline in recent years. It appears that more consumers are asking for discounts these days. Nowadays, retailers strive to keep a wide range of merchandise and offer a range of customer-focused services to attract and keep customers. The rise in window shopping, which explains why potential customers do not become actual customers, is concerning.

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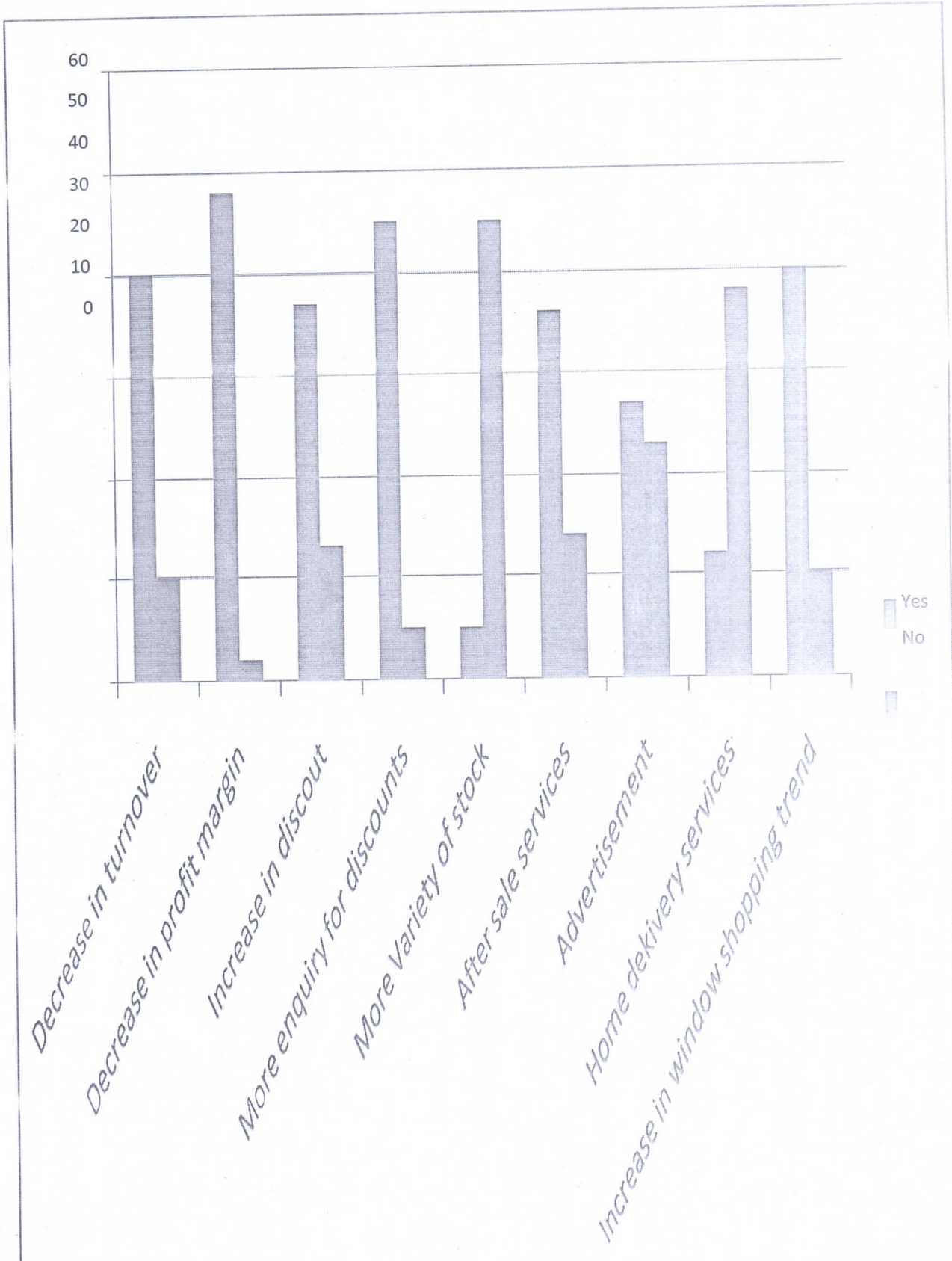
Diagram illustrating the several ways that internet buying has affected retail trade



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TURNOVER:

During the course of the three-year study, retailers have observed a significant decrease in their turnover when compared to previous years. Some have noted growth that is stagnant, if not declining, which is concerning for the business.

PROFIT MARGIN:

merchants are the primary victims of the pricing war that online merchants have introduced to the market. Most of these shops have tried lowering their prices in an effort to survive, but they have to give up some margin due to their high operating costs.

DISCOUNT:

shops are raising their discounts at an alarming rate to compete with internet shops who lure buyers in with fantastic deals. Even though they are unable to offer discounts on par with online retailers, merchants nonetheless need to reduce their prices somewhat in order to remain in business.

VARIETY OF STOCKS:

When it comes to product selection, online businesses outperform retailers by a significant margin. However, the majority of merchants, according to the poll, show little desire to compete with online stores in this area. It's accepted that they lost. Retailers cannot keep a lot of inventory on hand because that could negatively affect unsold inventory at the end of the year, perhaps resulting in significant losses for the company.

CUSTOMER SERVICES:

A growing number of firms are choosing to use customer services to foster loyalty. Retailers are doing everything they can to specialize in areas where online stores

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fall short, from installation and insurance to repair and maintenance. In the same vein as online retailers, retailers are now beginning to offer home delivery services. Additionally, smiling service is offered after the transaction.

WINDOW SHOPPING:

Customers are increasingly choosing to peruse merchandise in physical stores and then purchase it at a discount from an internet retailer. There are currently more potential consumers than existing ones for retailers.

ADVERTISEMENT:

In an effort to boost sales, retailers are investing more in advertising campaigns now than they have in the past. Retailers seize every opportunity to leverage the circumstance for company promotion. The table and the diagram highlight the fact about all these aspects and it shows that there is a negative trend on all these aspects with regard to the retailers.

FINDINGS, SUGGESTIONS AND CONCLUSIONS:

Findings;

The percentage of customer time and spending that goes towards e-commerce is steadily increasing. Customers purchase online for a variety of reasons, the main ones being affordability, ease of use, and a large selection of products. The following are the study's main conclusions:

a. Turnover and profit margin of the retailers has considerably decreased in the past few years.
b. Retail stores are now-a-days more engaged in services related to customer satisfaction.
c. Although the retailers are not able to keep a wide variety in their stock, they attempt to keep the best of them so as to affect more sales.

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d. Customers are seen to make window shopping at an alarming higher rate to have a physical look at the product and buy that product online at a reduced rate.

e. Retail stores are now starting up with home delivery services of their various products at the door step of their customers.

f. The consumers become more comfortable with the experience of purchasing online with the convenience and product range become relatively more important as a deciding factor for shopping online.

Suggestions;

As per analyzing this research some suitable suggestions can improve Muzaffarnagar local retailers' sales to compete online business. Retailers have to change their attitude towards the market. The priority in today's consumer-driven industry is ensuring the delight of customers. Customer satisfaction with the company is a must. Remarkably high standards for product quality, competitive pricing, and amiable post-purchase support are the fundamental areas in which the company must focus. It is recommended to offer supplementary services to customers in order to cultivate their trust and loyalty, so securing steady sales in the future. There should be government rules and regulations on these portals which restrict them to sell products to certain minimum costs. Even if it is under the name of a festival dhamaka or big sale on any new year or end of season sale, they cannot just sell the products at any cost, which attracts a crowd of consumers waiting to buy low-priced products under that offer.

Conclusion;

The retail industry has a new look. The main cause of this is the recent development of technology. Retailing now entails operating in malls, online, and on mobile devices. Somewhere in all of them, small retailers lose out. For all intents

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and purposes, however, the closest retailer is always the most crucial consideration. It must not only survive, but also thrive. All retail stores need to do is improve their business practices and have a more optimistic attitude towards the competitive environment. Both retail and online establishments must thrive; none at the expense of the other. It's not just about the thousands of people it provides a living for; it's also about the stability and convenience of a permanent retail location.

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Muzaffarnagar

Chairman
IQAC, Shri Ram College,
Muzaffarnagar

SHRI RAM COLLEGE

(Affiliated To CCS University, Meerut & Approved By NCTE) CIRCULAR ROAD, MUZAFFARNAGAR

'A' Grade Accredited by NAAC

Project Fund Utilisation Certificate

Date: 04-03-2022

1. Title of Project:

"Impact of Online Shopping on the Small Traders of District Muzaffarnagar"

2. Principal Investigator and Co-Investigator: **Dr. Ashfaq Ali & Dr. M S Khan, Department of Commerce, Shri Ram College, Muzaffarnagar.**
3. Implementing College and Sponsored Body: **Department of Commerce, Shri Ram College & Akhil Bhartiye Udyog Viyapari Suraksha Manch Janpad Muzaffarnagar**
4. Sanctioned Project Amount by Akhil Bhartiy Udoog Viyapari Suraksha Manch Janpad Muzaffarnagar: **Rs. 45,000/-**
5. Project Duration: **November 2021 to February 2022 (Four Months)**
6. Project Completion Date: **February 26th 2022**

Statement of Expenditure

Amount Received		**Rs. 45, 000/-**
Less Expenditure (Bills Attached):		
1. 10 Surveyor Stipends for one-month (Rs.3000*10)	30,000/-	
2. Stationeries	2,900/-	
3. Local Travelling	7,300/-	
4. Refreshments	3,050/-	
5. Printing& Typing	2,725/-	
6. Miscellaneous expenses	1,245/-	47,220/-
Balance Amount-		**- 2220/-**

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Muzaffarnagar

(Dr. Ashfaq Ali) 04/03/22
Coordinator, Research Project

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