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Fig. 1: Total solids content of jackfruit flavoured milk (per cent)

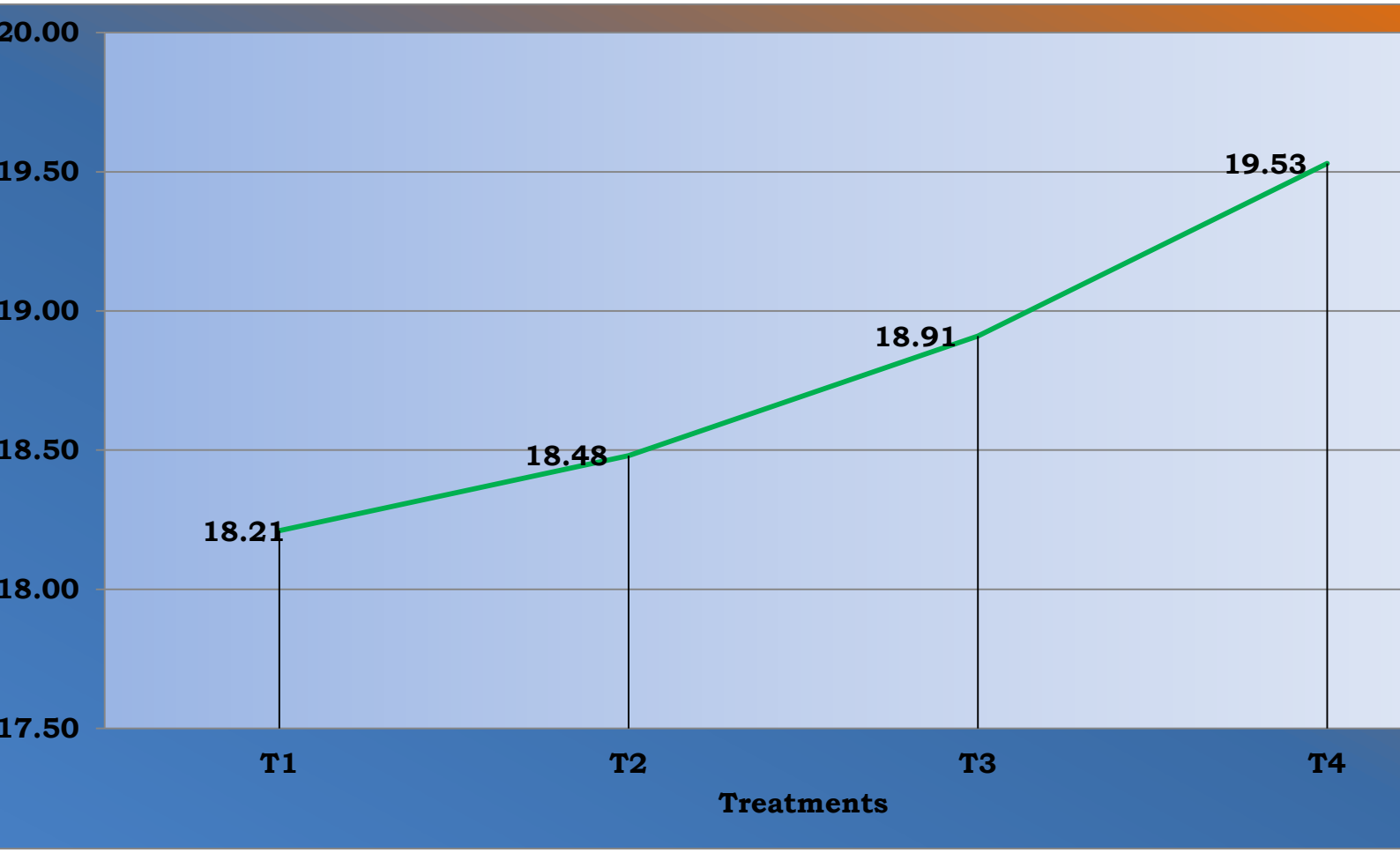


Fig. 2: Fat content of jackfruit flavoured milk (per cent)

Fig. 3: Protein content of jackfruit flavoured milk (per cent)

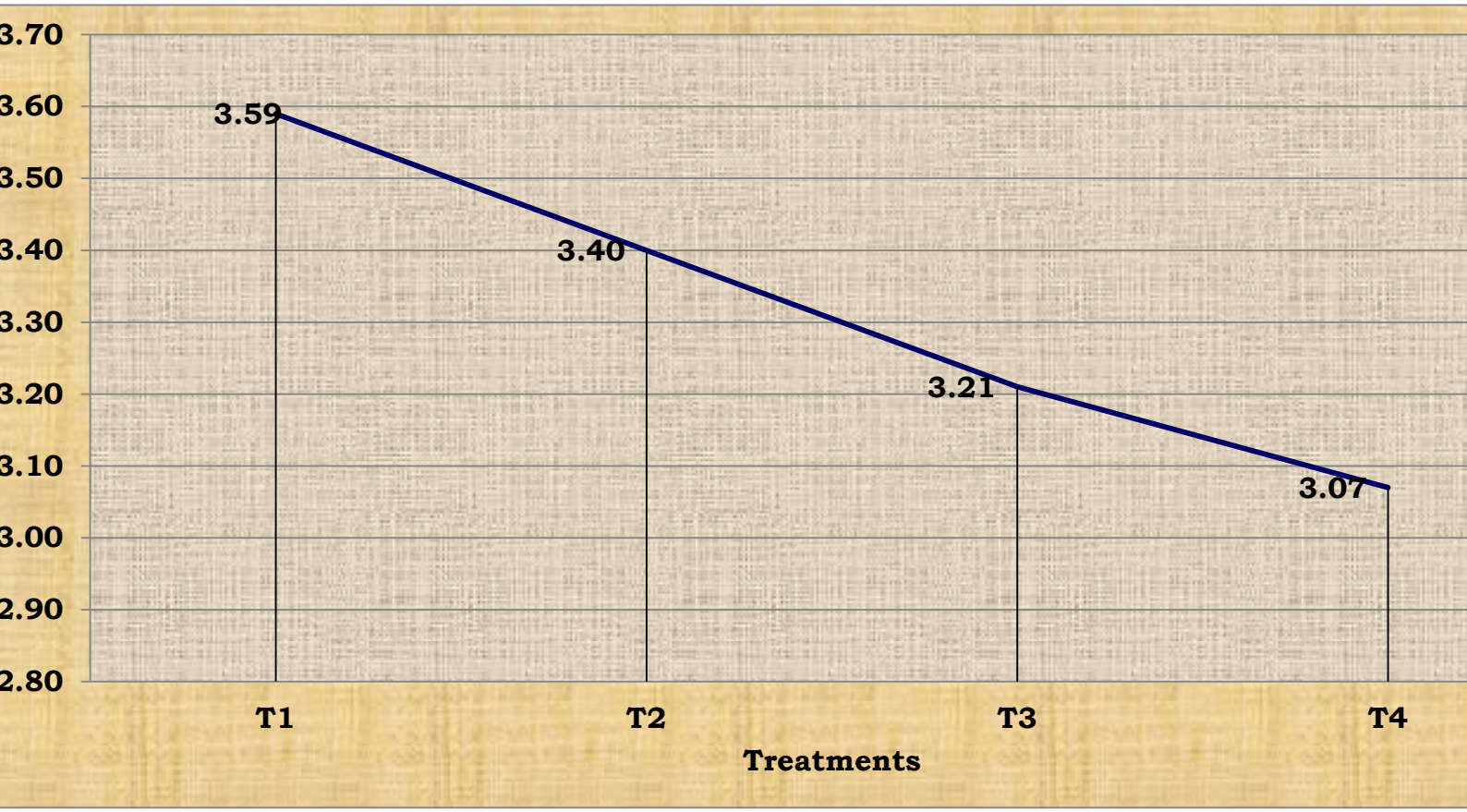


Fig. 4: Ash content of jackfruit flavoured milk (per cent)

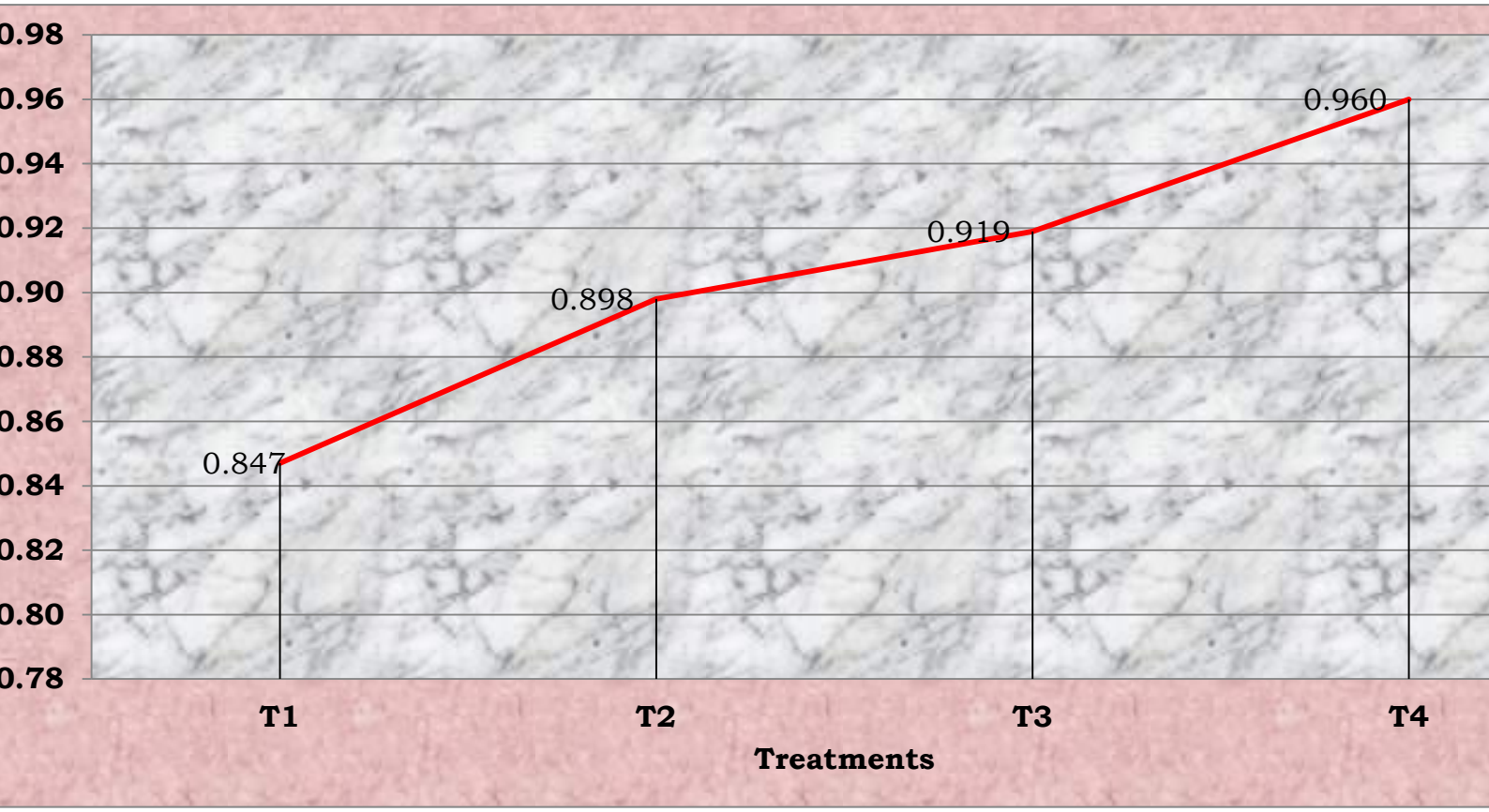


Fig. 5: Total sugar content of jackfruit flavoured milk (per cent)

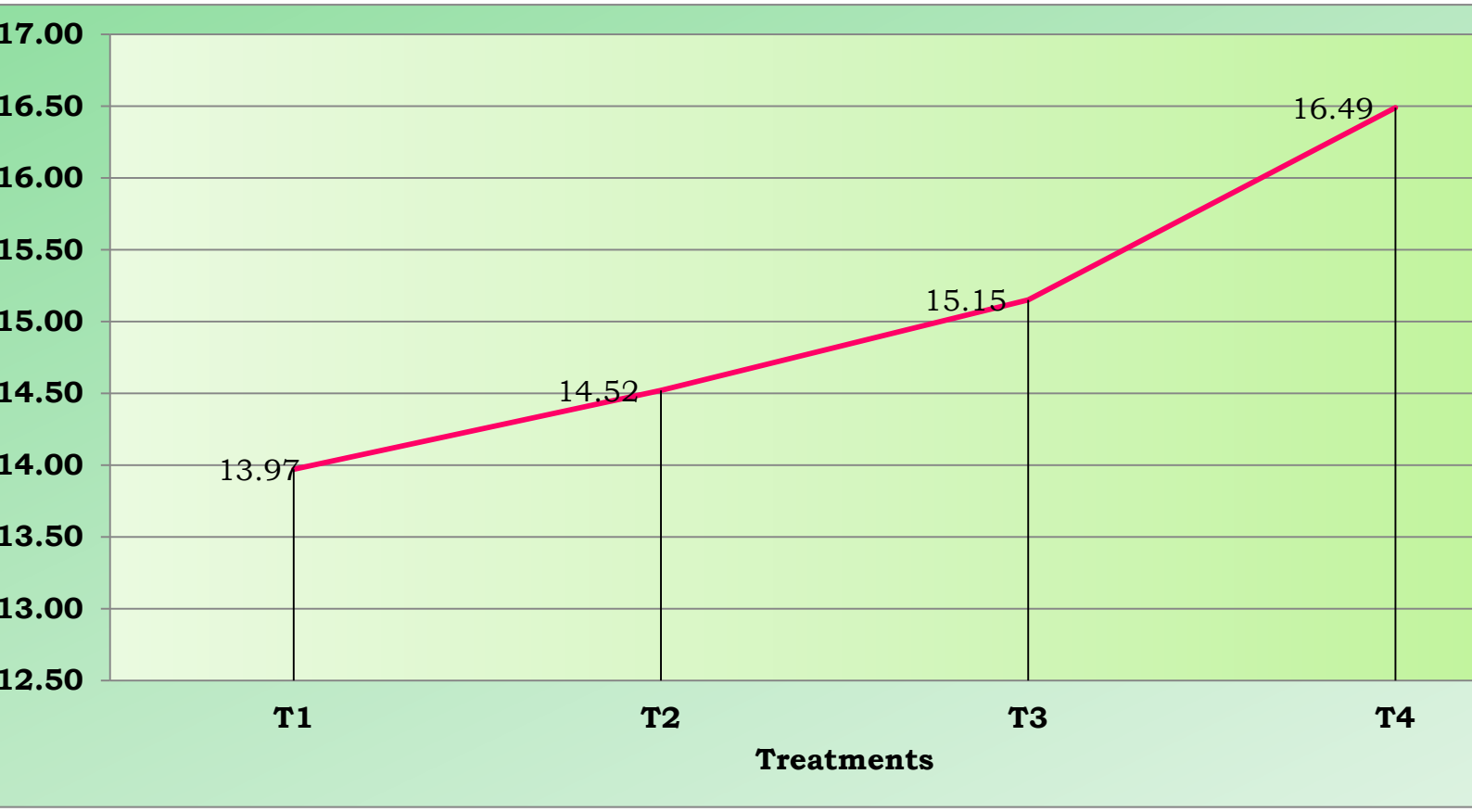


Fig. 6: Titratable acidity of jackfruit flavoured milk (per cent)

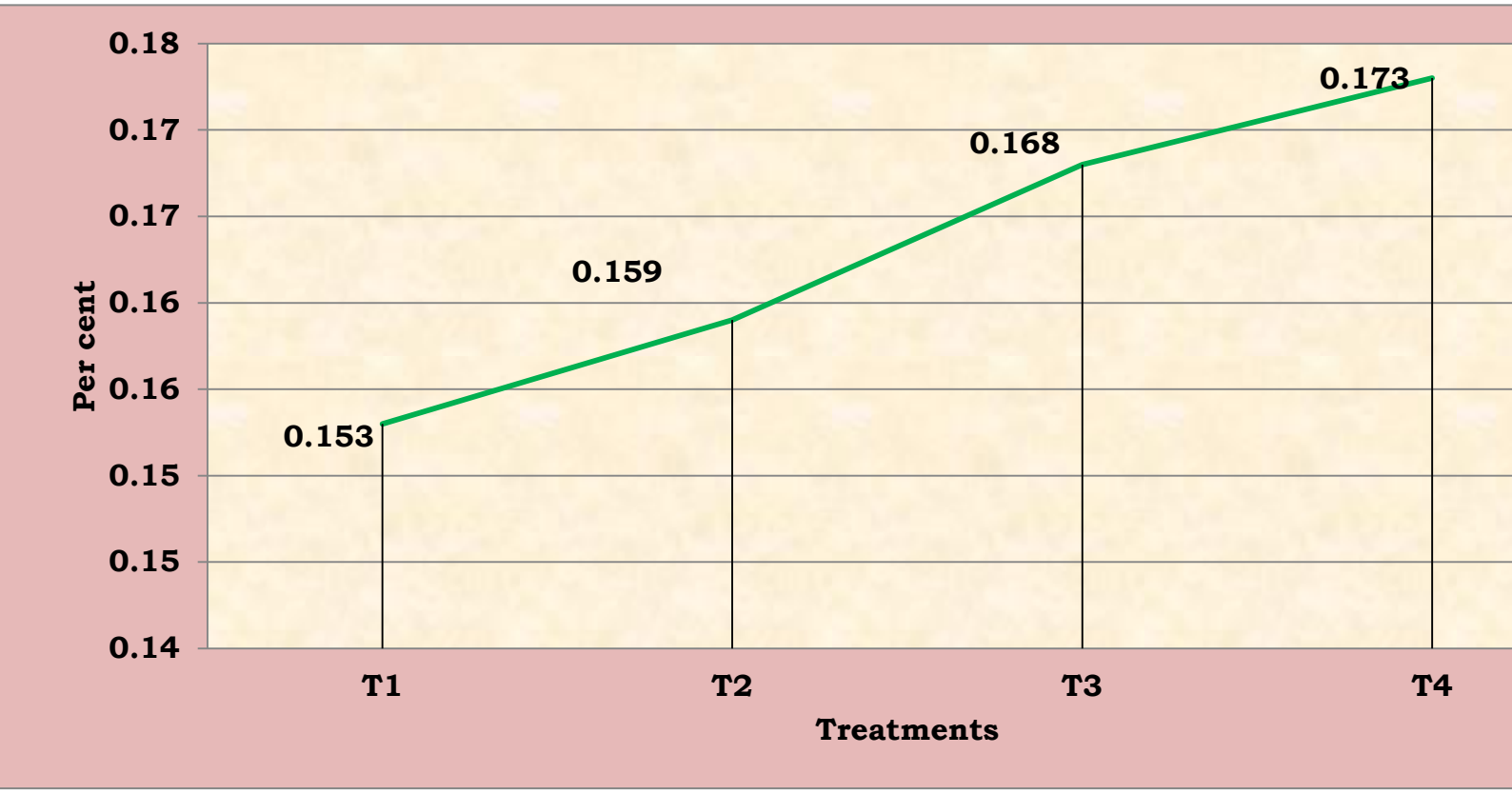


Fig.7: Score for colour and general appearance of jackfruit flavoured milk (out of '9')

Fig. 8: Score for flavour of jackfruit flavoured milk (out of '9')

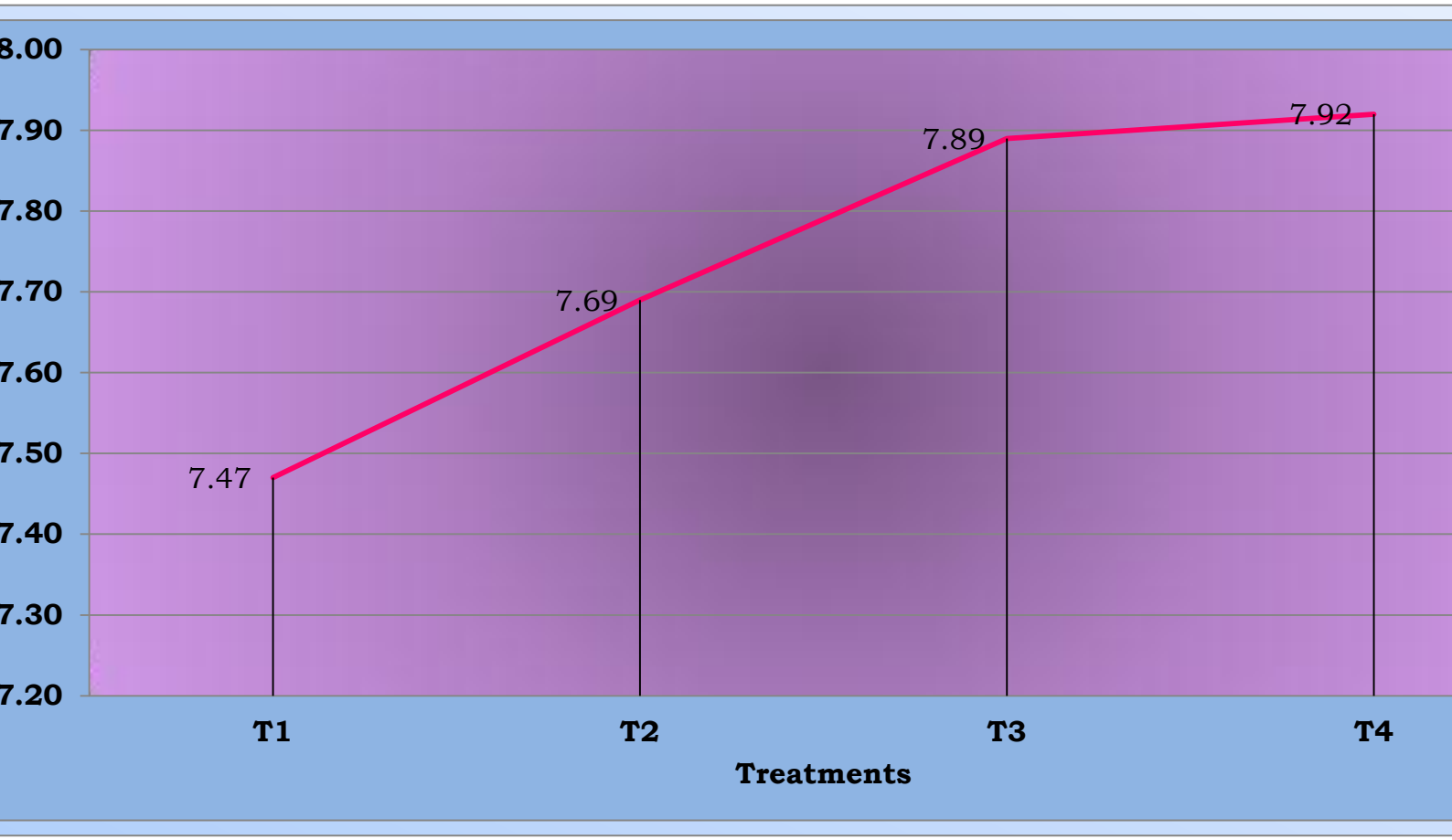


Fig. 9: Score for consistency of jackfruit flavoured milk (out of '9')

Fig. 10: Score for overall acceptability of jackfruit flavoured milk (out of '9')

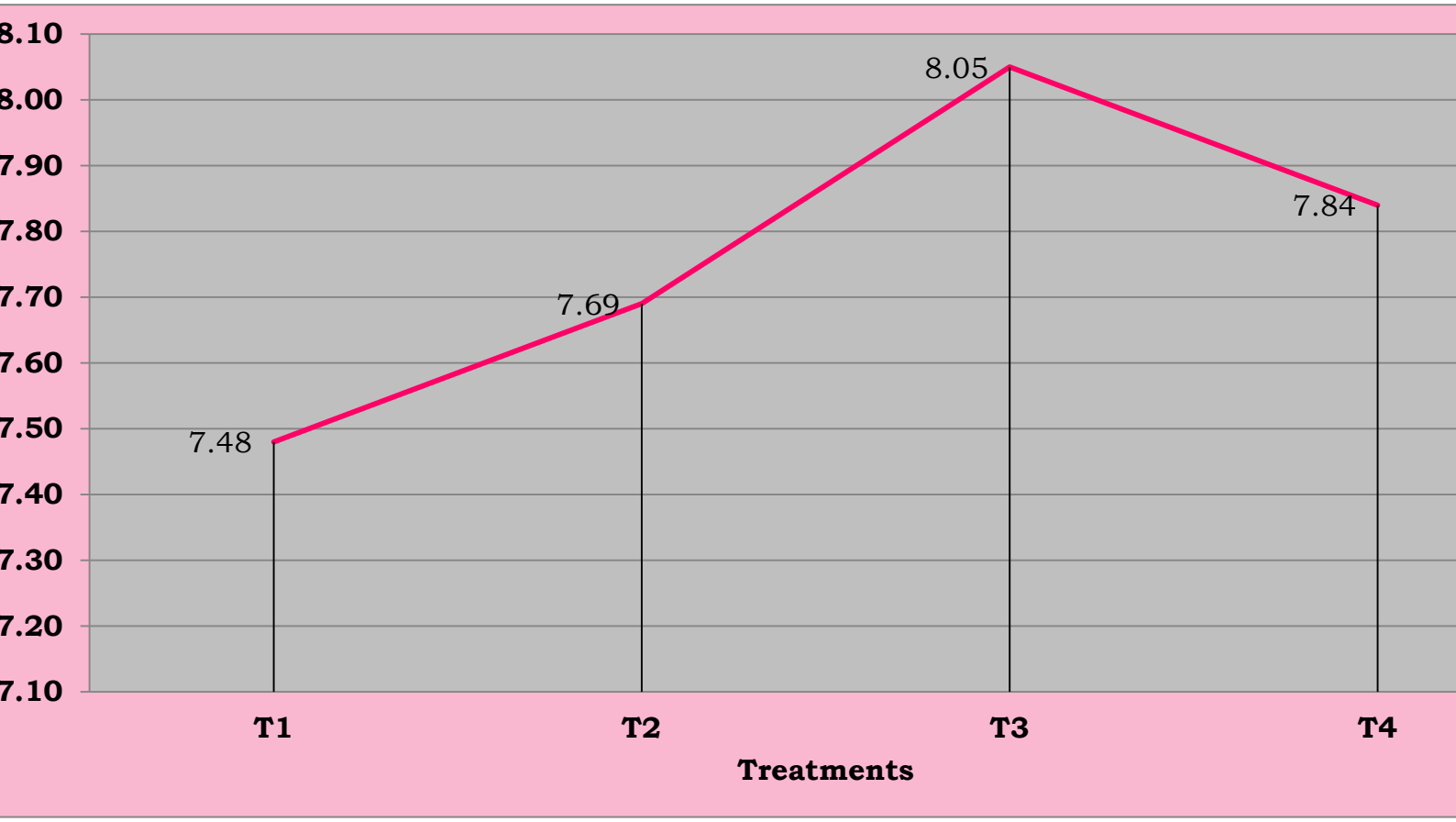
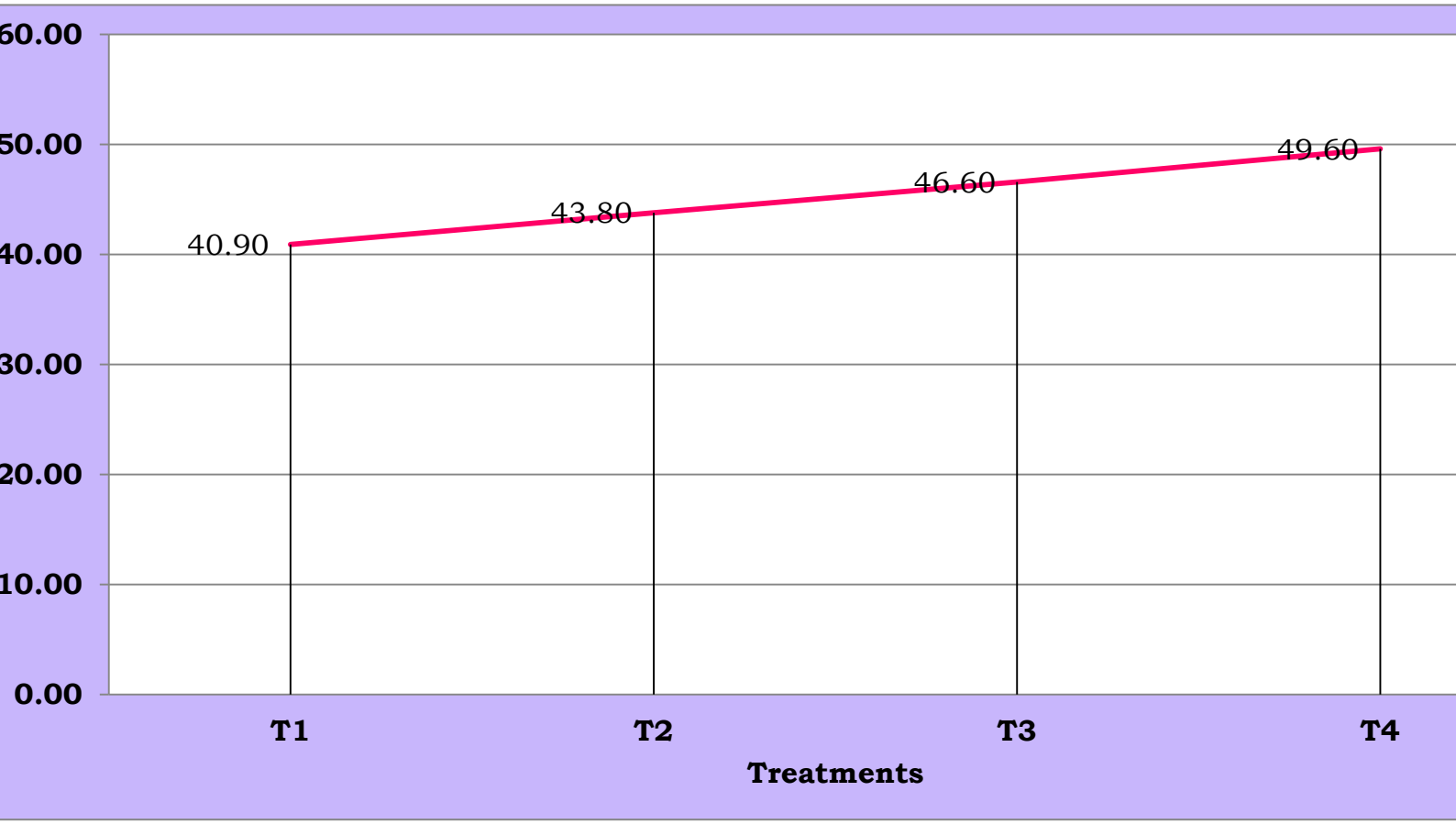

8.10
8.00
7.90
7.80
7.70
7.60
7.50
7.40
7.30
7.20
7.10
7.48
7.69
8.05
7.84
T1
T2
T3
T4
Treatments

Fig. 11: cost of production of Jackfruit flavoured milk per kg (Rs)



Refreshing, thunder jackfruit flavoured

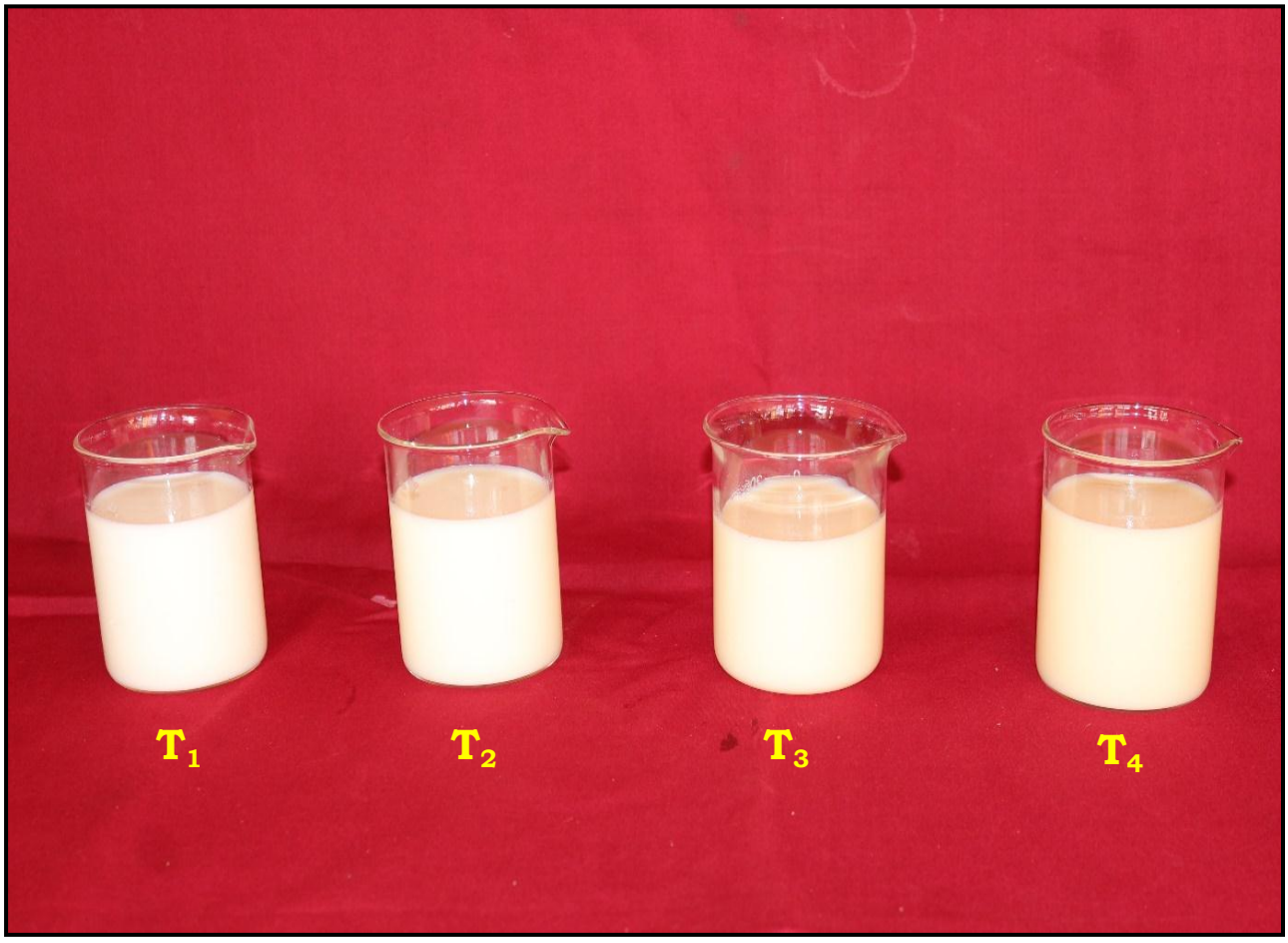
Plate I

Refreshing, thunder jackfruit flavoured milk

Plate II

Jackfruit tree

Plate IV



Jackfruit flavoured milk (treatments)

T_1 : Flavoured milk with 2.5 per cent jackfruit pulp

T_2 : Flavoured milk with 5 per cent jackfruit pulp

T_3 : Flavoured milk with 7.5 per cent jackfruit pulp

T_4 : Flavoured milk with 10 per cent jackfruit pulp

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ABBREVIATIONS USED

%	Per cent	Psi	Per square inch
**	Significant at 5 %	w/w	Weight by weight
/	Per	Cal	Calories
°C	Degree Celsius	Temp.	Temperature
°F	Degree of Fahrenheit	Mg	Milligram
ANOVA	analysis of variance	Sig.	Significance
CD	Critical difference	SS	Sum of squares
DF	Dietary fiber	N.S.	Non-significant
D.F.	Degree of freedom	Rep.	Replication
DM	Dry matter	IS	Indian Standards
et al.	And others	SNF	Solids not fat
Etc	etcetera (and other things)	Kg	Kilogram
Fig.	Figure	Hrs	hour(s)
G	Gram	SMP	Skim milk powder
RBD	Randomized Block Design	@	At the rate of
i.e.	id est (that is)	WPC	Whey protein concentrate
A.O.A.C.	Association of Official Analytical chemists	PFA	Prevention of food Adulteration act
Max.	Maximum	*viz.*,	Namely
Min.	Minimum	Lit.	Litre
min.	Minute (s)	Cm	Centimeter
Ml	Milliliter	WMP	Whole milk powder
MSS	Mean Sum of Squares	Ppm	Parts per million
MT	Million tones	Kcal	Kilocalories
`	Rupees	e.g.	For example
TS	Total solids	IU	International unit
B.I.S.	Bureau of Indian Standards	ISI	Indian Standards Institution
S.E.	Standard error	hr.	Hour

Acknowledgement

!! Shree Ganeshay Namah !!

Gratitude unlocks the fullness of life. It turns what we have into enough and more. It turns denial into acceptance, chaos into orde, and confusion into clarity…. It turns problems into gifts, failures into success, the unexpected into perfect timing and mistakes into important events. Gratitude makes sense of our past, brings peace for today and creates a vision for tomorrow. My acknowledgements are many times more than what I am expressing here.

As Jospeph Addison says," If you wish success in life, make perseverance your bosom friend, experience your wise counselor, caution your elder brother, and hope your guardian genius".

Two years ago, I took the first step on the journey towards my post graduation. Today I take the final step. I ponder about this journey of self discovery, a journey in search of knowledge. Any tedious task is made light and smooth by GOD's grace. At this moment, I would remember ***'Shree Ganesh'****, who has made each impossible work a reality in my life. The fruit of which, I am expressing here.*

Real life isn't always going to be perfect or go our way, but the recurring acknowledgment of what is working in our lives can help us not only to survive but surmount our difficulties. I feel so thankful to ***God*** *that I am able to be a part of something that I love to wake up and run to work every day. Today, I am finishing my research project. It was really an unique experience, I earned and I experienced during last two years, the fact that any successful achievement is not possible without support, help, guidance and encouragement of many helping hands, inspiring minds and guiding brains and the same is true with me.*

No individual can travel without a sign board, a map or leading light to guide the way. For me, this leading light took the form of ***Prof. S. V. Joshi****, Hon. Chairman of my Advisory Committee and Associate Professor, Department of Animal Husbandry and Dairy Science, College of Agriculture, Dapoli, who gave encouragement, enthusiastic interest, constructive advice and parentally treatment throughout the investigation. An incessant guidance from a divine personality had led my research journey towards a beautiful destination.*

It is my ethereal pleasure to express my deepest feelings of gratitude to the members of my Advisory committee, ***Dr. V. S. Dandekar,*** *Associate Professor, Department of Animal Husbandry and Dairy Science,* ***Dr. A. J. Mayekar*** *Assistant*

*Professor Animal Husbandry and Dairy Science and **Prof. R. V. Dhopavkar**, Assistant Professor, Department of Soil Science and Agricultural Chemistry, College of Agriculture, Dapoli, for their unceasing interest and inspiring guidance as the members of my advisory committee.*

I show my indebtedness thanks to Dr. R. G. Burte, Head, Department of Animal Husbandry and Dairy Science and also special thanks to Dr. B. G. Desai, Associate Professor and Prof. D. J. Bhagat, Dr. R. M. Kadam, Dr. S. S. Ramod Dept. of Animal Husbandry and Dairy Science, College of Agriculture, Dapoli and also thanks to Smt. Laxmibai Gorivale, Mr. Gimhavnekar, Mr. Vanarkar, Mr. Kakade, Mr. Shid , Mr. Jillha, and all the staff members of Department of Animal Husbandry and Dairy Science, College of Agriculture, Dapoli.

I express my deep sense of honour to Dr. Tapas Bhattacharya, Hon. Vice-Chancellor, Dr.B.S.K.K.V, Dapoli and Dr. R.G. Burte. Dean, Faculty of Agriculture, Dr.B.S.K.K.V., Dapoli for providing necessary facilities and administrative help during the entire course of study.

I extend my heartfelt thanks to Shri. Dolas, Assistant Registrar, Shri. Jalgoankar, Mrs. Joshi, Shri Jadhav, Shri. Shinde and all other staff members of the education branch of College and University for their whole hearted co-operation during post-graduation studies.

*George Eliot has well said, "Friendship is feeling safe with a person having neither to weight thoughts nor measure words." With all my friends, I could be myself; I could share my feelings, experiences and my deepest thoughts. Words in my command are inadequate to express my gratitude to my best friend's **Shamika**, **Sachin**, **Anokha, Santosh, Paresh, Vrushali and Abhijeet** to hold my spirits high, with their excellent and joyful company and cheerful encouragement.*

*In my daily work I have been blessed with cheerful group of senior friends, I am indeed thankful to Poonam Madam, Snehal Madam, Meenal Madam, Nikhil sir, Haresh sir, Vikas sir, Sachin sir, Prasade sir**,** Weldi sir, Bello sir, Shalu Kumar sir and my all friends for their kind co-operation and encouragement. I wish to express my thanks to my friends, Karan, Mayur, Mahadev, Ajay, Suresh, Datta, Vivek, Pravin, Mahesh, Samir, Sachin, Rahul, Roshan, Tushar, Ananta, Pritim and my juniors Rasika, Shweta, Pradnya, Sachin, Mrunali, Suhas and Pallavi for their timely and valuable cooperation and to increase my confidence.*

*God is invisible parent and parents are the visible god. Any vocabulary will be insufficient to express my deepest sence of respect and gratitude towards my Parents. God gifted me two angels and he named them as **Aai** and **Baba.** My*

words are really insufficient to express my deepest sense of respect and gratitude towards my Baba ***Mr. Vilas Yashwant Sonwalkar*** *and my Aai* ***Sau. Laxmi Vilas Sonwalkar.***

For catching me when I fall……For believing in me,
For making me stand my ground…..For listening to me,
For knowing inside out……For forever trying to lift my spirits.
You hear my pain when everyone goes deaf…
You always make me smile when I think I can't…
You listen to my secrets and make them yours…
You give me a hug when I can't find my voice…
You mean more to me than you will ever know…
You wipe away the tears that the world makes me weep…
You are my guardian angel ever and forever…

Some persons are like unmentioned bonds that are whenever, wherever always there, on whom we lean on no matter what comes. My sisters Rupali Tai, Manisha Tai, Sarika, Sonali, Amruta dear brothers Hindraj and Rajesh and dear kaki Sapna are the persons in my life in the form of such bonds.

I take this opportunity to express my deepest feelings, love and inspiration for my dearest friends, relatives and family members who are close to my heart Shital, Anil shinde, Dr. Ganesh shendge Manisha kaki, Vyankatrao kaka, Ankush kaka, Raju mama, Shankar kaka and Bhaghwan kaka for their support and continuous encouragement.

I want to express my heartfelt gratitude to my beloved grandparents Smt. ***Gangubai Sonwalkar*** *Late Shri.* ***Yashwant Sonwalkar*** *who were served an inexhaustible source of inspiration and encouragement to me and whose long cherished dreams come into reality in the form of this dissertation. Their encouragement and kind blessings could lead my difficult task to see this achievement and satisfaction. I also thankful to my relatives and well wishers who rendered their help directly and indirectly to build up my educational career.*

At the end I wish to thanks all those who have directly or indirectly played pivotal role in the successful completion of my post-graduation and this manuscript.

Place*: Dapoli*
Date*:*

(MR. BALASAHEB VILAS SONWALKAR)

CHAPTER III
MATERIAL AND METHODS

The present study on "Preparation of flavoured milk blended with jackfruit pulp" was undertaken in the Department of Animal Husbandry and Dairy Science, College of Agriculture, Dapoli (Dist. Ratnagiri) during the year 2016-2017. The details of material used and methods followed are as below.

3.1 Material:

3.1.1 Milk

Buffalo milk was collected from the dairy farm of College of Agriculture, Dapoli.

3.1.2 Ingredients

Cane sugar, stabilizer, canned jackfruit pulp were purchased from local market.

3.2 Preparation of fruit flavoured milk:

The flavoured milk was prepared as per procedure given by De (2015) with slight modifications:

Flow diagram

Buffalo Milk

↓

Pre-heating (35-40 °C)

↓

Filtration

↓

Pre-heating (60 °C)

↓

Separation ⟶ Cream

↓

Skim milk

↓

↓

Addition of sugar @ 8 %, stabilizer @ 0.5 %

↓

Mixing

↓

Heating (71±2°C to 30 min.)

↓

Cooling (at ambient temperature)

↓

Addition of jackfruit pulp as per treatments

↓

Speed mixing

↓

Straining

↓

Storage (5°C)

3.3 Treatments:

1) T_1:- Addition of jackfruit pulp @ 2.5 % of buffalo skim milk
2) T_2:- Addition of jackfruit pulp @ 5 % of buffalo skim milk
3) T_3:- Addition of jackfruit pulp @ 7.5 % of buffalo skim milk
4) T_4:- Addition of jackfruit pulp @ 10 % of buffalo skim milk

3.4 Replication: The trial was conducted with six replications

3.5 Chemical Analysis

3.5.1 Skim Milk

3.5.1.1 Total solids

The total solids content was determined by Gravimetric method as per IS: 1479 (Part - II), 1961.

3.5.1.2 Fat

Fat content was determined by using the standard Gerber method as described in IS: 1224 (Part - I), 1977.

3.5.1.3 Protein

The protein content was determined by micro-kjeldhal method as per IS: 1479 (Part - I), 1960.

3.5.1.4 Ash

The ash content was determined by the method described in A.O.A.C, (1975).

3.5.1.5 Titratable acidity

The acidity of milk was estimated according to IS: 1479 (Part- I), 1960.

3.5.2 Flavoured milk

3.5.2.1 Total solids

The total solids content was determined by Gravimetric method as per IS: 1479 (Part - II), 1961.

3.5.2.2 Fat

The fat content was determined by using the standard Gerber method as described in IS: 1224 (Part - I), 1977.

3.5.2.3 Protein

The protein content was determined by micro-kjeldhal method as per IS: 1479 (Part - I), 1960.

3.5.2.4 Ash

The ash content was determined by the method described in A.O.A.C, (1975).

3.5.2.5 Titratable Acidity

The acidity of flavoured milk was determined according to IS: 1479 (Part-I), 1960.

3.5.3. Jackfruit pulp

The total solids, fat, protein, ash and titratable acidity of jackfruit pulp were determined as per the procedure given in A.O.A.C. (1975).

3.6 Sensory Evaluation

The fresh samples of flavoured milk were subjected to organoleptic evaluation by panel of an average ten semi-trained judges. The panel evaluated the product for sensory characteristics like as colour and general appearance, flavour, consistency and overall acceptability.

Nine point hedonic scale given by Amerine *et. al*. (1965) was used for qualitative organoleptic evaluation by the panel of judges. The acceptability statement and marks used were as follows:

Sr. No.	Remarks	Score
1.	Like extremely	9
2.	Like very much	8
3.	Like moderately	7
4.	Like slightly	6
5.	Neither like nor dislike	5

6.	Dislike slightly	4
7.	Dislike moderately	3
8.	Dislike very much	2
9.	Dislike extremely	1

3.7 Economics:

The production cost of flavoured milk under different treatments was worked out using prevailing market rates of ingredients used only.

3.8 Statistical Analysis:

For present investigation, Randomized Block Design (RBD) was employed using five treatments with six replications. The data were tabulated and statistically analyzed according to Snedecor and Cochran (1994).

DR. BALASAHEB SAWANT KONKAN KRISHI VIDYAPEETH, DAPOLI

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Research Guide	**:**	Prof. S. V. Joshi
Members	**:**	Dr. V. S. Dandekar Dr. A. J. Mayekar Prof. R.V. Dhopavkar
Title of Thesis	**:**	PREPARATION OF FLAVOURED MILK BLENDED WITH JACKFRUIT (*Artocarpus heterophyllus* L.) PULP.

ABSTRACT

Flavoured milks are milks to which some flavours have been added. Flavoured milk is one of the special milks prepared which contains all the constituents of milk like proteins, carbohydrates and minerals. Besides, sugar, flavouring agents, colouring matter are also present in this beverage. Flavoured milk provides energy, water to digest food, regulates body temperature and prevents dehydration. From economic point of view flavoured milks are important because it makes milk more palatable to those who don't relish it as such. People who do not like to consume it as such, they may like to consume, if it is flavoured with some appealing natural fruit flavour. Jackfruit (*Artocarpus heterophyllus* L.) is commonly grown fruit crop in Konkan region of Maharashtra. It is a good source of Vitamin A and C and also the minerals. Thus, considering nutritive value and peculiar flavour of jackfruit, the study aimed to explore the possibility of utilizing jackfruit pulp in the preparation of flavoured milk.

In present study, flavoured milk was prepared from buffalo skim milk. Jackfruit pulp was added at different levels *viz.* of 2.5, 5, 7.5 and 10 per cent of milk. *Barka* (soft flesh) type jackfruit pulp was used. Sugar was added at the rate 8 per cent of milk.

From the results of present study, it was concluded that jackfruit pulp could be successfully utilized for preparation of flavoured milk. Addition of jackfruit pulp

in flavoured milk improved sensory quality and acceptability of the product. The most acceptable quality flavoured milk could prepared by using jackfruit pulp at the rate of 7.5 per cent of the buffalo skim milk and it contained total solids, fat, protein, ash, total sugar and titratable acidity as 18.91, 0.52, 3.21, 0.919, 15.15 and 0.168 per cent, respectively.

PREPARATION OF FLAVOURED MILK BLENDED WITH JACKFRUIT (*Artocarpus heterophyllus* L.) PULP

By

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FEBRUARY, 2017

PREPARATION OF FLAVOURED MILK BLENDED WITH JACKFRUIT (*Artocarpus heterophyllus* L.) PULP

A thesis submitted to the

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MASTER OF SCIENCE (AGRICULTURE)

in

DAIRY SCIENCE

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C E R T I F I C A T E

This is to certify that the thesis entitled "**PREPARATION OF FLAVOURED MILK BLENDED WITH JACKFRUIT (*Artocarpus heterophyllus* L.) PULP"** submitted to the Faculty of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra State in the partial fulfilment of the requirements for the degree of **MASTER OF SCIENCE (AGRICULTURE)** in **Dairy Science,** embodies the results of a piece of *bona-fide* research carried out by **MR. BALASAHEB VILAS SONWALKAR** under my guidance and supervision and that no part of the thesis has been submitted for any other degree or diploma or published in other form. All the assistance and help received during the course of investigation and the sources of literature have been duly acknowledged by him.

Place: Dapoli

Date:

(S. V. Joshi)

Chairman,

Advisory Committee and

Research Guide

CHAPTER I

INTRODUCTION

Milk is regarded as rich source of nutrients as it contains high quality proteins, lactose, flavour enriching fat. The perfect composition of milk not only recommends itself for growing children but also suited to satisfy energy needs of adult. Milk also provides protection against ill health and promotes good health.

Dairy sector is important not only as the producer of highly nutritious food products, but also for the sustenance of poor farmers and all over prosperity of the farming community. Annual milk production of India is estimated as 146.3 million tonnes during the year 2014-15. It is a matter of great pride that a nation which was deficit in milk has now become the leading milk producer in the world.

Today Indian consumer is more open to new ideas, more conscious towards health and balanced nutrition and has desire for better quality and convenient food products. The demand for milk and milk products is increasing rapidly due to growth in population, changing in its demographic pattern, socio-economic status, income, distribution, taste and preference of the people. The biggest chunk of milk and milk product is consumed by the domestic sector, as large percentage of Indian's are vegetarians and milk forms an integral part of their diet.

Out of total milk produced in India about 46% is used as market milk, whereas about 47% is converted into various milk products and remaining 7% is used as western milk products (FAO 2012-13). Amongst Indigenous milk products khoa, dahi and chhana are termed as "principle products" because for variety of other milk products, these products are used as base.

Indigenous milk products have been woven into the fabric of our culture and therefore, they must be listed in the priorities. This would add additional dimensions to the planning as it calls for application of appropriate technology for large scale production of traditional products. The important traditional dairy product that have commercial significance are ghee, khoa, paneer, chhana, dahi, kulfi, shrikhand and several milk confections prepared from khoa and chhana such as burfi, peda, gulabjamun, milk cake, kalakand, rasogolla, sandesh etc. In addition, there are many regions having specific traditional products like rabri, basundi,

kunda, kheer, payasam etc. Each of these products has its unique flavor, texture and appearance.

A practice of converting milk into various milk products has developed ages ago. The Indian milk production system is getting a poll according to the demands of the segmented milk products market. It is estimated that 46 per cent milk is used as fluid milk while 54 per cent of total milk is converted into milk products like dahi, butter, chhana, khoa, ice cream, flavoured milk etc. Thus, the conversion of milk into various milk products has become the golden mean between supply and demand of milk.

In order to increase milk consumption and encourage young generation to drink milk, it has been common practice to impart flavour to the milk and then market it. This practice has given beneficial results in increasing the market value. The consumption of flavoured milk is constantly increasing. Many of the people do not like the normal taste of milk but easily accept when it is blended with some good flavours.

Flavoured milks are milks to which some flavours have been added. When the term 'milk' is used, the product should contain a milk fat percentage at least equal to the minimum legal requirement for market milk. But when the fat level is lower (1-2%) then the term ‘drink’ is used. Flavoured milk is one of the special milks prepared which contains all the constituents of milk like proteins, carbohydrates and minerals. Besides, sugar, flavouring agents, colouring matter are also present in this beverage. Flavoured milk provides energy, water to digest food, regulates body temperature and prevents dehydration. From economic point of view flavoured milks are important because it makes milk more palatable to those who don't relish it as such.

Incorporation of fruit and fruit products in the milk products helps to render good flavour and increases its palatability and nutritive value. With the advent of new techniques in manufacturing, processing, packaging, transportation and preservation, food technologists show interest in innovating the new combination of fruits and fruit products with popular milk product.

The fruits which are popular among the Indians , if added to the milk shake, not only improves its acceptability among average Indian people, but also improves its nutritional quality with the addition of essential vitamins and minerals. At the same time, it will give good market to the preserved food products which is ultimately going to help the farming community engaged in fruit production, preservation and also dairy production.

India is the country of tropical zone and Konkan region of Maharashtra is included in the humid western coastal track. Jackfruit is a crop found commonly in this region mostly dispersed in various plantations and near household gardens. Jackfruit (*Artocarpus heterophyllus* L.) is an evergreen monocious, small to medium, tropical tree native to India. It is known by different names *viz.*, kathal, kentakphal, phanas, mridangaphal etc. in various parts of the country. It is mainly of two types, Kapa (firm flesh) and Barka (soft flesh). The ripe jackfruit pulp has high nutritive value as well as peculiar taste. The chemical composition of soft flesh jackfruit pulp as fat 0.22 per cent, total solids 23.69 per cent, moisture 76.31 per cent, protein 1.75, ash 0.93 per cent and acidity 0.25 per cent (Naik, 2013).

Thus, considering nutritive value and peculiar flavour of jackfruit, the research topic entitled “Preparation of flavoured milk blended with jackfruit (*Artocarpus heterophyllus* L.) pulp”, was selected with the following objectives.

1. To standardize the manufacturing technology of flavoured milk blended with jackfruit pulp.
2. To find out the optimum level of jackfruit pulp for incorporation in flavoured milk.
3. To study the physico-chemical and sensory quality of flavoured milk blended with jackfruit pulp.
4. To work out the production cost of flavoured milk.

LITERATURE CITED

Ahmed, N.S.; Abdard, F.H. and Hassan, F.A.M. (1995). Preparation of low fat beverage from goat milk. *Dairy Sci. Abstr*. **57**(1): 124.

A1-Haq, M.I. and Mohyuddin, G. (1995). Commercial manufacture of pasteurized mango fruit flavoured milk-based beverages. *Dairy Sci. Abstr.* **57**(4): 1958.

Alizadeh, M.; Azizi-Lalabadi, M.; Hojat-Ansari, H. and Kheirouri, S. (2014). Effect of Stevia as a substitute for sugar on physicochemical and sensory properties of fruit based milk shake. *J. Sci. Res. and Reports* **3**(11) pp. 1421-1429.

Al-Jebreen, D.H. (2013). Nutritional properties of commercial flavored milk. *J. Agric. Sci. technol*., **3**(3) pp: 211-212.

Amerine, M.A.; Panghorn, R.M. and Rossier, R.B. (1965). Principles of sensory evaluation of food. American Press, London.

Anonymous, (1980). Dairy Handbook (processing); National Dairy Research Institute (ICAR), Karnal, Haryana pp.10.

Antarkar, A.V. (1991). Physico-chemical composition of jackfruit and reported the chemical composition of ripe soft flesh jackfruit, (Unpublished) M.Sc. (Agri.) thesis submitted to Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli (M.S.).

A.O.A.C. (1975). Official methods of analysis, 11th Ed. Association of Official Analytical Chemist. Washington D.C., U.S.A.

Asl, A.K. (1999). Production of flavoured and coloured milks using fruit and vegetable juices. *Agric. Sci. Technol*., **13**(1): 67-74.

Badrie, N.; Gangaprasad, S.; Wickham, L.D. and Donawa, A. (1998). Production of pineapple flavoured fermented milk to suit Caribbean taste. *J. Food. Sci. Technol., Mysore,* **35**(6): 515-517.

Baudach, G. (1984). Milk shake and processors for producing it as well as milk shake base. *Dairy Sci. Abstr*. **46**(4): 1994.

Bhandari, V.; Ladkani, B.G. and Mulay, C.A. (1976). Utilization of filled milk in flavoured milk production. *J. Food sci. Technol*., **13**(4): 199.

Bhardwaj P.K. and Beniwal B.S. (2009). Technology Development and Calorie Reproduction in Flavoured milk. *J. Dairying, Foods Home Sci*., **28**(3/4): 190-193.

Bhatia, B.S.; Siddapa, G.S. and Lal, G. (1955). Composition and nutritive value of jackfruit. *Indian J. Agric. Sci.,* **55**(4): 303-305.

Bhavsagar, M.S.; Hassan Bin Awaz and Patange U.L. (2010). Manufacture of Pineapple Flavoured Beverage from Chhana Whey. *J. Dairying, Foods Home*. *Sci*., **29**(2): 110-113.

Bhore, D.P.; Ghunke, S.M. and Shelke, V.G. (1980). A promising type of jackfruit (*Artocarpus heterophyllus* L.). *J. Maharashtra Agric. Universities.* **5**(1): 81-82.

Borgstrom, G. (1991). Infusion technique for the production of new sweedish chocolate beverage. *Dairy Sci*. *Abstr*. **53**(10): 6646.

Choi, H.S. and Kosikowaski, F.V. (1985). Sweetened plain Flavoured Carbonated Yoghurt Beverages. *J. Dairy Sci*., **68**(3):613-619.

Dalim, M.; Khasheli, M.; Baloch, M. H.; Soomro, A. H.; Khasheli,G. B.; Mangsi, A. S. and Barham, G. S. (2012). Production and composition of banana and chiko flavored milk-based beverages. *Pakistan J. Nutri*., **11**(6) pp. 600-604.

De, S. (2015). Outlines of Dairy Technology 40th edition oxford university press. New Delhi. pp. 463-464.

Dressel-PF; Bowen-R.D., Jr.; ellis-LD; bonner-MD and Dressel-PC (1994). Homogenous, Stable flavoured milk and process. United-State-Patent, US b 290-582 pp.

Gopalan, C.; Ramashastri, B.V. and Balsubramaniyan, S.C. (1982). Nutritive

Value of Indian foods. National Institute of Nutrition, ICMM, Hyderabad: 88.

Grewal, K.S. and Jain, S.C. (1982). Studies on feasibility of incorporating preserved mango pulp in preparing milk mango shake. *Indian Food Packer*. **36**(4): 95.

Guleria, S.P. and Jain, S.C. (1980). Development of milk based fruit juice beverage using buffalo milk. *Dairy Sci. Abstr*. **42**(1): 110.

Hassan, M. and Ahmed, J. (1998). Physico-chemical and sensory characteristics of mango milk beverage. *Indian Food Packer.* **52** (2): 32.

Hoang, A. (1992). Manufacture of drink for humans from whole milk, skim milk and sweetened condensed milk. *French Patent Application,* FR2 665-666, At 4 pp. (Fr.).

Holmukhe, A.P. (2002). Utilization of jackfruit pulp in the manufacture of milk pudding. Thesis submitted to Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli.

Hu YongJin; Zhu RenJun and Wu Yue. (2010). Processing technology of a fermented rice-milk beverage. *Modern Food Sci. Technol*., **26**(4): pp. 396-399.

Ibrahim, M.K.E.; El-Abd, M.M.; Mehriz, A.M. and Ramadan (1994a). Preparation and properties of guava milk beverage. *Dairy Sci. Abstr*. **56**(1): 167.

Ibrahim, M.K.E.; El-Abd, M.M.; Mehriz, A.M. and Ramadan (1994b). Preparation and properties of mango milk beverage. *Dairy Sci. Abstr*. **56**(1): 168.

IS: 1479 (Part –I) (1960). Methods for test for dairy industry. Rapid examination of milk. Indian Standards Institution (ISI), Manak Bhavan, New Delhi.

IS: 1224 (part -I) (1977) Determination of fat by Gerber's method (revised) Indian Standards Institution (ISI), Manak Bhavan, New Delhi.

IS: 1479 (Part – II) (1961). Methods of test for dairy industry. Chemical analysis of milk. Indian Standards Institution (ISI), Manak Bhavan, New Delhi, India.

Jadhav Sonali (2012). Studies on preparation of ginger (*Zingiber officinale* L.) milk shake. M.Sc. (Agri.) thesis submitted to Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli (M.S.).

Jadhav V.S.; Awaz H.B.; Patil G.R. and Thombre, B.M. (2003). Studies on preparation of sapota milk shake. *J. of Maharashtra Agril. Universities,* Pune. **27**(3): 306-308.

Jangale, D. M. (2009). Studies on utilization of custard apple (*Annona squamosa)* for lassi preparation. M.Sc. Thesis submitted to Dr. P.D.K.V., Akola (M.S.).

Kadav, V.B. (2001). Preparation of fruit flavoured milk shake. M.Sc. (Agri.) thesis submitted to Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli (M.S.).

Kashid U.B, Sontakke A.T. and Shinde, D.B. (2007). Manufacture of golden milk shake from cow milk blended with safflower milk. *J. Dairying, Foods and H.S.* **26**(3/4): 159-163.

Khamrui, K. and Rajorhia, G.S. (1998). Formulation of ready-to-serve whey based kinnow juice beverage. *Indian J. Dairy Sci*., **51**(6): 413-19.

Kotecha, P.M.; Adsule, R.N. and Kadam, S.S. (1995). Processing of custard apple preparation of ready to serve beverage and wine. *Indian Food Packer*. **49**(4): 5-7.

Kshirsagar, D.V. (1996). Studies on blending of milk shake with different fruit flavouring agents (Unpublished). M.Sc. (Agri.) thesis submitted to Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli (M.S.).

Lederer, C.L.; Bodyfelt, F.W. and McDaniel, M.R. (1991). The effect of carbonation level on the sensory properties of flavoured milk beverages. *J. Daily Sci*., **84**(7): 2100-2118.

Mangas, J.J. and Mangnen, C. (1992). Milk based drink and process for manufacture. French Patent Application, FR 2670,365, At 15 pp.

Muhammad Hanif; Jan Mohammad; Bakhtiar Hussain; Mohammad Ayub and Alizai, N.A. (1996). Acceptability of cow and buffalo flavoured milk.

Sarad J. Agriculture, **12**(4): 463-470.

Murphy, M.M.; Douglass, J.S.; Johnson, R.K. and Spence, L. A. (2008). Drinking flavored or plain milk is positively associated with nutrient intake and is not associated with adverse effects on weight status in US children and adolescents. *J. American Dietetic Association*, **108**(4) pp. 631-639.

Nadkarni (1985). Average chemical composition of jackfruit pulp. *J. food sci. technol.* **7**(5): 207-2012.

Naik; Poonam (2013). Studies on utilization of jackfruit pulp in the manufacture of basundi, (Unpublished) M.Sc. (Agri.) thesis submitted to Dr. B. S. Konkan Krishi Vidhyapeeth, Dapoli, Dist. Ratnagiri (M.S.).

Nakaya, T.; Karasawa, T.; Kihara, N.; Wada, Y. and Kiyota, M. (1991). Milk shake and manufacturing method thereof. *Dairy Sci. Abstr*. **53**(7): 4302.

Nicklas, T. A.; O'Neil, C. E. and Fulgoni, V. L., (2013). Nutritional role of flavored and white milk in the diets of children. *J. School Health* **83**(10) pp. 728-733.

Pakalwad S.T.; Awaz H.B.; Pawar S.L. and Poul S.P. (2010). Preparation and sensory evaluation of papaya milk shake. *Veterinary World*, **3**(4): 185-187.

Palthur Sailaja; Anuradha C.M.; Devanna N. (2014). Development and evaluation of ginger flavored herbal milk. *Res. J. Agr. Env. Sci .*, **1**(2)**:** 54-59.

Pelsmaeker; S.de; Schouteten, J. and Gellynck, X. (2013). The consumption of flavored milk among a children population. The influence of beliefs and the association of brands with emotions. *Appetite* **71** pp. 279-286.

Prabhudessai, S. M. (2010). Studies on preparation of low fat, low calorie and sugar free shrikhand. M.Sc. (Agri.) thesis submitted to Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli (M.S.).

Prakash, S.; Huppertz, T.; Karvchuk, O. and Deeth, H.(2010). Ultra-high-temperature processing of chocolate flavoured milk. *J. Food Engineering*, **96**(2) pp. 179-184.

Rajeshkumar, Patil G.R. and Rajor, R.B. (1989). Development on formulation of flavoured milk like beverage from cheese whey. *Asian J. Dairy Res*., **6**(3): 121-279.

Ramasamy, D.; Abraham, R.J.J. and Manoharan, A. (2005). Organoleptic Study on Naturally Colored and Flavoured Sterilized Milk with Extracts of Plant. *J. Vet. Pub. Hith*. **3**(2): 115-117.

Ramírez-Sucre, M.O. and Vélez-Ruiz, J.F. (2011). Physico-chemical and rheological properties of a milk drink flavoured with *cajeta*, a Mexican caramel jam. *International J. Dairy Technol*., **64**(2) pp. 294-304.

Ravindra, M. R.; Rao, K. J.; Nath, B. S. and Chand Ram. (2014). Extended shelf life of flavoured dairy drink using dissolved carbon dioxide. *J. Food Sci. Technol. (Mysore)* **51**(1) pp. 130-135.

Repate, K.C.; Kamble,V.J.; Hassan Bin Awaz and Thombre, B.M. (2010). Studies on preparation of flavoured milk from cow milk blended with safflower milk. *J. Dairying, Foods and Home Sci.*, **29**(2): 92-96.

Salunkhe, R.R. (2002). Preparation of milk shake fortified with fruit flavours. M.Sc (Agri.) thesis submitted to Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli (M.S.).

Sharma, A.K. and Gupta, S.K. (1978). Manufacture of milk shake. *Indian Dairyman*. **30**(8): 585.

Shelke, M.A.; Patil S.R.; Bhagat, A.A.; Walkunde, T.R; Shinde, S.D. and Patil, K.P. (2008). Chemical Composition and cost structure of the Flavoured Milk. *RVJI, Vol.* **4**(I): 57-58.

Shenkenberg, D.R.; Charg, G.C. and Edomondsen, L.D. (1997). Milk fruit juice beverage and process for preparing same. *Dairy Sci. Abstr*. **35**(4): 1142.

Shipurkar, S.R. (1999). Studies on preparation of Shrikhand fortified with jackfruit pulp (Unpublished) M.Sc. (Agri.) thesis submitted to Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli (M.S.).

Shukla, F.C. and Sharma, A. (2002). Studied on the development of beverage

using milk by-product and fruit juice. 31st Dairy Industry conference. 7-9 Feb. 2002. Mumbai (M.S.), India.

Shukla, F.C.; Sharma, A. and Singh, B. (2003). Studies on the development of beverages using fruit juice/pulp separated milk and reconstituted skim milk. *International Journal of Dairy Technol*., **56**(4): 243-246.

Silva, W.B.; Sousa, S.H.B.; Lima, L.G.B.; Lourenço Junior, J.B. and Náhum, B. S. (2014). Quality of buffalo milk flavoured with carrot, honey, linseed. Magistra **26**.,CBPFH pp.1618-1621.

Singh,C. Grewal, K. S. and Sharma, H. K. (2006). Effect of incorporation of carrot juice in the preparation of flavoured milk. *Journal Food Science and Technology* (Mysore) **43** No.1 pp. 80-82.

Singh, R. (2006). Characteristics and technology of traditional Indian cultured dairy products. *Indian Dairyman*, **58**, 11: 49-55.

Singh, S.; Ladkani, B.G.; Kumar, A. and Mathur, B.M. (1994). Development of whey based beverage. *Indian J. Dairy Sci*. **52** (5): 268.

Singh, W.; Kapoor, C.M. and Srivastava, D.N. (1999). Standardization of technology for the manufacture of guava whey beverage. *Indian J. Dairy Sci*. **52**(5):268.

Snedecor, V.G. and Cochran, G.W. (1994). Statistical methods, East-West. Prees pvt. Ltd., New Delhi.

Steinhart, H.; Parat-Wilhelms, M.; Hoffmann, W.; Borcherding, K.; Gniechwitz, D. and Denkar, M. (2007). Flavour perception of coffee beverages-influence of milk processing. *21st International Conference on Coffee Science, Montpellier, France*, pp. 408-412.

Tranjan, B.C.; Cruz, A.G.; Walter, E.H.M.; Faria, J.A.F.; Bolini, H.M. A.; Moura, M.R.L. and Carvalho, L.M.J. (2009). Development of goat cheese whey-flavoured beverages. *International J. Dairy Technol*., **62**(3) pp. 438-443.

Ubale, P.J; Hembade A.S and Choudhari, D.M (2014) sensory and chemical quality of sapota milk shake. *Res. J. of Ani. Hus. and D. Sci.,* **5**(2): 116-121.

Vandana; Dhaka, R.S.; Dabur and Jyotika (2002). Utilization of whey for preparation of coffee drink. *Indian J. Dairy Sci*. **55**(2): 86-87.

Varpe, N.K. (1992). Studies on blending of milk shake with different fruit pulp (Unpublished). M.Sc. (Agri.) thesis submitted to Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli (M.S.).

Vesvikar S.S. (1999). Studies on preparation of ice-cream fortified with jackfruit pulp and reported that incorporation of jackfruit pulp, (Unpublished) M.Sc. (Agri.) thesis submitted to Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli (M.S.).

Vijayalakshmi R. and Tamilarasi Murugeson (2001). Shelf-life and microbiological quality of selected dairy product. *J. Food Sci. Technol.,* **38** (4): 385.

Waghmode B.M (2015). Utilization of ginger (*Zingiber officinale* L.) juice in the manufacture of flavoured milk. M.Sc. (Agri.) thesis submitted to Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli (M.S.).

Watharkar,R.B. and Devshete N.G. (2012). Chemical quality of flavoured youghurt by using litchi fruit (*Litchie chiensis* L.). *Food Sci*. *Reseach J*. Volume **3**: 196-197.

Watt, B.K. and Merill, A.L. (1963). Composition of foods; raw, processed, prepared, reed. Agriculture Handbook No.8, U.S. Dept. Agric. Washington.

YanZhenZhang; Zhou HuiMing; and Wei Sheng Long. (2013). Processing technology of healthy beverage from soybean milk and corn juice fermented by *Lyophyllumdecas*.*China Brewing* **32**(10): pp. 135-137.

Yousif-A.K; Alghamdi-A.S; Hamad-A.and Mustafa-A.I (1996). Processing and evaluation of date juice-milk drink. *Egyptian-Journal of Dairy Sci*. **24**(2): 277-288:18 ref.

Yukalo, V.G.; Shulyak, T.L.; Shaparko, M.D. and Vasilenko, Z.V. (1991). Production of cultured milk beverage. *Dairy Sci. Abstr*. **53**(4): 2178.

CHAPTER IV
RESULTS AND DISCUSSION

In order to evaluate the quality as well as acceptability of flavoured milk fortified with jackfruit pulp. The chemical composition and sensory evaluation of flavoured milk had been carried out in present study. Similarly, the skim milk and jackfruit pulp used for manufacture of flavoured milk was analysed for its chemical quality. The cost of production of flavoured milk was calculated on the basis of cost of different ingredients only.

The results of the present research work are tabulated, presented and discussed under following sub-heads

4.1 Chemical analysis of buffalo skim milk

4.2 Chemical analysis of jackfruit pulp

4.3 Chemical analysis of flavoured milk

4.4 Sensory evaluation of flavoured milk

4.5 Production cost of flavoured milk

4.1 Chemical analysis of buffalo skim milk:

The buffalo skim milk used for flavoured milk preparation was analysed for its chemical composition. The results are tabulated in Table 4.1.

Table 4.1: Average chemical analysis of buffalo skim milk

Sr. No.	Constituents	(%)
1	Total Solids	9.53
2	Fat	0.55
3	Protein	3.62
4	Ash	0.83
5	Acidity (% lactic acid)	0.15

The figures tabulated in table 4.1 revealed that, the buffalo skim milk used in present investigation was of good quality. It is evident from these average figures that total solids, fat, protein, ash and acidity lie within the limit of legal standards for skim milk in Maharashtra state as prescribed by PFA rules, 1976 cited by De (2015). The figures are also in agreement with the figures mentioned by Jangale (2009), Prabhudesai (2010), De (2015) and Waghmode (2015).

Jangale (2009) reported the average chemical composition of skim milk as fat 0.48 per cent, protein 3.41 per cent, total solids 9.21 per cent and acidity 0.14 per cent and it is in close agreement with the values observed during the present investigation.

Prabhudesai (2010) stated that buffalo skim milk contained an average total solids 9.15 per cent, fat 0.45 per cent, protein 3.46 per cent and acidity 0.15 per cent.

De (2015) mentioned an average chemical composition of skim milk as moisture 90.6 per cent, fat 0.1 per cent, protein 3.6 per cent, lactose 5.0 per cent and ash 0.7 per cent.

Waghmode (2015) stated a chemical quality of buffalo skim milk as: total solids-9.31 per cent, fat-0.55 per cent, protein-3.53 per cent, ash-0.81 per cent and acidity 0.15 per cent.

4.2 Chemical analysis of jackfruit pulp:

The average chemical composition of jackfruit pulp used in the present study is presented in Table 4.2.

Table 4.2 Chemical quality of jackfruit pulp used for flavoured milk making (%)

Sr. No.	Constituents	(%)
1	Total Solids	23.57
2	Fat	0.28
3	Protein	1.88
4	Ash	0.95
5	Acidity (% lactic acid)	0.24
6	Total sugar	17.78

Average chemical composition of jackfruit pulp reported by Antarkar (1991) for soft flesh jackfruit pulp was as total solids 25.37 per cent, fat 0.24 per cent, acidity 0.23 per cent, protein 1.54 per cent and total sugar 16.20 per cent. The figures tabulated in Table 4.2 are quite close in agreement with these figures.

Shipurkar (1999) reported the chemical composition of soft flesh jackfruit pulp as fat 0.21 per cent, total solids 24.37 per cent, moisture 75.63 per cent and acidity 0.24 per cent.

Naik (2013) observed chemical composition of soft flesh jackfruit pulp as fat 0.22 per cent, total solids 23.69 per cent, moisture 76.31 per cent, protein 1.75, ash 0.93 per cent and acidity 0.25 per cent.

The results obtained on chemical composition of jackfruit pulp used in present investigation are comparable with the results reported by above mentioned investigators.

4.3 Chemical analysis of flavoured milk:

4.3.1 Total solids:

The importance of total solids in dairy products is highly regarded because it plays an important role for adding taste and bulk to the product. Hence, the observations on total solids content of the flavoured milk as influenced by different levels of jackfruit pulp have been recorded and statistically analyzed to arrive at definite conclusions.

The observations in respect of total solids content of flavoured milk as influenced by different levels of jackfruit pulp are presented in Table 4.3 and graphically illustrated in Fig. 1.

Table 4.3: Total solid content of flavoured milk (per cent)

Treatments	Replications						Mean
	R-I	R-II	R-III	R-IV	R-V	R-VI	
T_1	18.06	17.32	19.66	17.42	18.32	18.48	**18.21**
T_2	19.66	18.16	19.86	17.24	18.53	17.43	**18.48**
T_3	18.80	19.64	19.86	17.83	19.12	18.21	**18.91**
T_4	19.66	19.13	20.00	19.82	19.18	19.39	**19.53**
Mean	19.04	18.56	19.84	18.07	18.78	18.37	**18.78**

ANOVA:

SV	DF	SS	MSS	Fcal	T value	Result
Repli.	5	7.63	1.53	3.94		
Treat.	3	5.97	1.99	5.13	2.87	SIG
Error	15	5.81	0.39			
Total	23	19.41				

CD = 0.75, **CF** = 8466.78, **SEM** = 0.25

It is evident from Table 4.3 that total solids content of flavoured milk under different treatments remained as 18.21, 18.48, 18.91 and 19.53 per cent for T_1, T_2, T_3 and T_4 treatments, respectively. It is observed that T_4 treatment (10 per cent) had highest (19.53) total solids and T_1 (addition of 2.5 % jackfruit pulp) treatment had lowest (18.21 %) total solids in comparison to other treatments. There was linear increase in total solids content of flavoured milk as quantity of jackfruit pulp increased.

The results presented in Table 4.3 and Fig. 1 indicates that irrespective of jackfruit pulp levels, total solids content of flavoured milk varied significantly among different levels of jackfruit pulp. The total solids content was gradually increased from 18.21 to 19.53 per cent with the raising levels of jackfruit pulp as the pulp contains higher amount of total solids (23.57 per cent) as compared to skim milk (9.53 per cent). The results of present investigation corroborate well with the findings of shelke *et al.* (2008), Repate *et al*. (2010) and Waghmode (2015).

Shelke *et al.* (2008) studied the effect of different flavours on the physico-chemical properties and acceptability of flavoured milk. Considering all treatments he found mean total solids content of flavoured milk as an average 19.94 per cent.

Repate *et al.* (2010) prepared flavoured milk from cow milk blended with safflower and they found 15.21 per cent total solids at T_0 treatment *i.e.* flavoured milk prepared from cow milk and safflower milk in the proportion of 1:2.

Waghmode (2015) utilized ginger juice in the manufacture of flavoured milk. He concluded that flavoured milk without ginger juice contained 15.99 per cent total solids which decreased simultaneously as 15.93, 15.86 and 15.14 per cent

with the addition of ginger juice @ 2, 4 and 6 per cent of milk.

4.3.2 Fat:

Data on fat content of flavoured milk as influenced by different levels of jackfruit pulp are presented in Table 4.4 and Fig. 2.

Table 4.4: Fat content of jackfruit flavoured milk (per cent)

Treatments	Replications						Mean
	R-I	R-II	R-III	R-IV	R-V	R-VI	
T_1	0.54	0.53	0.55	0.53	0.53	0.53	0.54
T_2	0.53	0.51	0.54	0.52	0.52	0.54	0.53
T_3	0.52	0.53	0.52	0.53	0.51	0.52	0.52
T_4	0.53	0.51	0.50	0.52	0.52	0.53	0.52
Mean	0.53	0.52	0.52	0.52	0.52	0.53	0.52

ANOVA:

SV	DF	SS	MSS	Fcal	T value	Result
Repli.	5	0.000337	6.7E-05			
Treat.	4	1.326047	0.33151	3869.79	2.87	SIG
Error	20	0.001713	8.6E-05			
Total	29	1.328097				

CD = 0.011, **CF** = 5.3004, **SEM** = 0.003

It could be observed from Table 4.4 that different levels of jackfruit pulp significantly differed in their influence on the fat content of flavoured milk. The fat content decreased significantly with the increase in the level of pulp. The average fat per cent of flavoured milk at 2.5, 5, 7.5 and 10 per cent level of pulp was 0.54, 0.53, 0.52 and 0.52 per cent, respectively. It would be seen from the data that the fat content of flavoured milk varied with the level of jackfruit pulp. Differences in fat content of flavoured milk due to level of pulp were statistically significant. This decrease in the fat content of flavoured milk may be attributed to the fact that fat content of jackfruit pulp is lower (0.28 %) than that of skim milk (0.55) used for flavoured milk preparation. So obviously when level of pulp increases there was linear decrease in fat

content of finished product. The values of fat corroborate well with the values reported by Waghmode (2015) for fat content of ginger flavoured milk.

Waghmode (2015) prepared ginger flavoured milk from buffalo skim milk and found on an average 0.531 per cent fat.

4.3.3 Protein:

The observations pertaining to the protein content of flavoured milk prepared with different levels of jackfruit pulp are tabulated in Table 4.5 and Fig. 3.

Table 4.5: Protein content of flavoured milk (per cent)

Treatments	Replications						Mean
	R-I	R-II	R-III	R-IV	R-V	R-VI	
T_1	3.62	3.57	3.68	3.47	3.65	3.55	**3.59**
T_2	3.20	3.40	3.35	3.58	3.48	3.39	**3.40**
T_3	3.29	3.30	3.28	3.01	3.18	3.23	**3.21**
T_4	3.20	3.14	3.20	2.90	2.98	3.03	**3.07**
Mean	3.32	3.35	3.37	3.24	3.32	3.32	**3.32**

ANOVA:

SV	DF	SS	MSS	Fcal	T value	Result
Repli.	5	0.03592	0.00718			
Treat.	4	53.8096	13.4524	1268.02	2.87	SIG
Error	20	0.21218	0.01061			
Total	29	54.0577				

CD = 0.12368, **CF** = 211.63, **SEM** = 0.04205

Protein content of flavoured milk was decreased due to increase in the level of jackfruit pulp with values of 3.59, 3.40, 3.21 and 3.07 per cent at 2.5, 5, 7.5 and 10 per cent, respectively. This decrease may be attributed to the low protein content of the jackfruit pulp (1.88 per cent) as compared to basic ingredient *i.e.* skim milk (3.63 per cent). The values for protein of present investigation are well comparable reported by Repate *et al.* (2010), Paltur *et al.* (2014) and Waghmode (2015).

Repate *et al*. (2010) prepared flavoured milk using cow milk and safflower milk in different proportion. He observed protein content of flavoured milk which ranges from 2.65 to 3.20 per cent.

Palthur *et al*. (2014) worked on ginger flavoured milk herbal milk and he found on an average 3.48±0.017 per cent protein in finished product.

Waghmode (2015) conducted studied on ginger flavoured milk and he stated that protein content of flavoured milk ranged from 3.01 to 3.35 per cent.

4.3.4 Ash:

Data on ash content of jackfruit flavoured milk as influenced by different levels of jackfruit pulp are depicted in Table 4.6 and illustrated in Fig. 4.

Table 4.6: Ash content of flavoured milk (per cent)

Treatments	Replications						Mean
	R-I	R-II	R-III	R-IV	R-V	R-VI	
T_1	0.870	0.816	0.824	0.883	0.881	0.810	**0.847**
T_2	0.902	0.891	0.913	0.887	0.898	0.897	**0.898**
T_3	0.923	0.900	0.895	0.931	0.972	0.893	**0.919**
T_4	0.954	0.979	0.981	0.961	0.928	0.957	**0.960**
Mean	0.912	0.896	0.903	0.915	0.919	0.889	**0.906**

ANOVA:

SV	DF	SS	MSS	Fcal	T value	Result
Repli.	5	0.00	0.00	0.84		
Treat.	3	0.04	0.01	19.93	2.87	SIG
Error	15	0.01	0.00			
Total	23	0.05				

CD = 0.03, **CF** = 19.70, **SEM** = 0.01

The results presented in Table 4.6 and Fig. 4 indicates that ash content of flavoured milk varied significantly among different levels of jackfruit pulp. The ash content was gradually increased from 0.847 to 0.960 per cent with the raising levels of jackfruit pulp. The highest ash content was noticed at 10 per cent level of jackfruit pulp (0.960 per cent).

The perusal of data revealed that increase in the level of jackfruit pulp resulted in significant increase in ash content of flavoured milk. This may be due to slight higher ash content of jackfruit pulp (0.95 per cent) as compared to ash content of skim milk (0.83 per cent). The average ash content of flavoured milk at 2.5, 5, 7.5 and 10 per cent added pulp was 0.847, 0.898, 0.919 and 0.960 per cent, respectively.

Repate *et al.* (2010) studied on preparation of flavoured milk from cow milk blended with safflower milk and they found 0.72 per cent ash at treatment T_0 *i.e.* flavoured milk prepared from cow and safflower milk in the proportion of 1:2. The values for ash content of present investigation ranges from 0.847 to 0.960 which were slightly higher than the values reported by Repate *et al*. (2010) as in present investigation the flavoured milk prepared from buffalo milk by incorporation of jackfruit pulp which contain 0.83 and 0.95 per cent ash, respectively and these values are higher than the ash content of cow milk and safflower milk *i.e.* 0.72 and 0.56 per cent, respectively.

4.3.5 Total sugar:

The observations in respect of total sugar content of flavoured milk as influenced by different levels of jackfruit pulp are presented in Table 4.7 and illustrated in Fig. 5.

Table 4.7: Total sugar content of flavoured milk (per cent)

Treatments	Replications						Mean
	R-I	R-II	R-III	R-IV	R-V	R-VI	
T_1	14.38	13.87	13.98	13.80	14.27	13.52	**13.97**
T_2	14.87	14.43	15.03	14.12	14.29	14.38	**14.52**
T_3	15.17	14.91	14.91	14.88	15.21	15.82	**15.15**
T_4	16.40	16.89	16.73	16.53	15.97	16.42	**16.49**
Mean	15.20	15.02	15.16	14.83	14.93	15.03	**15.03**

ANOVA:

SV	DF	SS	MSS	Fcal	T value	Result
Repli.	5	0.38	0.08	0.61		
Treat.	3	21.18	7.06	56.28	2.87	SIG
Error	15	1.88	0.13			
Total	23	23.44				

CD = 0.43, **CF** = 5423.43, **SEM** = 0.14

The highest total sugar content was observed at 10 per cent level of jackfruit pulp (16.49 per cent) which was significantly decreased at 7.5, 5.0 and 2.5 per cent level of jackfruit pulp to 15.15, 14.52 and 13.97 per cent, respectively. The addition of jackfruit pulp resulted in significant increase in the total sugar content of flavoured milk.

Irrespective of levels of jackfruit pulp, the total sugar content in flavoured milk showed the gradual increase from 13.97 to 16.49 per cent with the increasing level of jackfruit pulp. The increase in the total sugar content of flavoured milk may be due to higher amount of total sugar content in jackfruit pulp (17.78 per cent).

4.3.6 Titratable acidity:

Presence of acidity in any milk product has its own significance. Acidity may be "natural" or "developed". Natural acidity is inherent acidity having specific range for that particular product. Any figure more than that may attribute to addition of other substance having acidity or microbial proliferation.

The observations in respect of titratable acidity of flavoured milk as influenced by addition of jackfruit pulp are given in Table 4.8 and illustrated in Fig. 6.

Table 4.8: Titratable acidity content of flavoured milk (per cent)

Treatments	Replications						Mean
	R-I	R-II	R-III	R-IV	R-V	R-VI	
T_1	0.148	0.150	0.158	0.160	0.149	0.153	**0.153**
T_2	0.156	0.163	0.165	0.150	0.167	0.153	**0.159**
T_3	0.168	0.177	0.176	0.165	0.160	0.162	**0.168**
T_4	0.168	0.178	0.178	0.166	0.177	0.171	**0.173**
Mean	0.160	0.167	0.169	0.160	0.163	0.159	**0.163**

ANOVA:

SV	DF	SS	MSS	Fcal	T value	Result
Repli.	5	0.0003	0.0001	2.25		
Treat.	3	0.0014	0.0005	16.55	2.87	SIG
Error	15	0.0004	0.0000			
Total	23	0.0022				

CD = 0.01, **CF** = 0.64, **SEM** = 0.00

It is evident from Table 4.8 that acidity of flavoured milk under different treatments was 0.153, 0.159, 0.168 and 0.173 per cent for T_1, T_2, T_3 and T_4, respectively. There was linear increase in acidity of flavoured milk with the addition of jackfruit pulp.

This increase in the acidity of flavoured milk due to increase in the level of jackfruit pulp. This may be due to high level of acidity in the original jackfruit pulp (0.24 per cent) as compared to skim milk (0.15 per cent).

The acidity of any finished milk product depends upon acidity of ingredients used for its preparation and manufacturing techniques adopted. Heating and/or pasteurization results in inhibition of microbial fermentation, thus cessation of further acidity development is observed. However the acidity developed before application of such process remains intact.

The higher acidity (0.173 per cent) of flavoured milk was observed at treatment T_4 *i.e.* addition of 10 per cent jackfruit pulp whereas lowest (0.153 per cent) acidity at treatment T_1 *i.e.* addition of 2.5 per cent jackfruit pulp. The variation in acidity content of flavoured milk to different treatments was found to be significant.

Waghmode (2015) utilized ginger juice in the manufacture of flavoured milk. He observed that acidity of flavoured milk ranges from 0.149 to 0.164 per cent. The results of present investigation are in close agreement with the results of Waghmode (2015).

4.4 Sensory evaluation of jackfruit pulp flavoured milk:

Conversion of milk into flavoured milk is a recognized form of its marketing. The product is similar to bottled pasteurized milk except that it is flavoured and sweetened to taste. It has consumer acceptability and sale appeal.

Sensory evaluation of any consumable product is best method of judging the acceptability of the product by the consumers. The assessment was done by studying the characters like colour and general appearance, flavour, consistency and overall acceptability of the product by the panel of an average ten semi-trained judges by using "Nine Point Hedonic Scale" score card. Each sample was bearing a code number so as to avoid its identity & have impartial results.

4.4.1 Colour and General Appearance:

Colour and appearance is important sensory attribute of milk product. Acceptance of any milk product by customers largely depends upon colour and appearance of the product.

The data pertaining to sensory score for colour and general appearance at different treatments are given in Table 4.9 and Fig. 7.

Table 4.9: Score for Colour and General Appearance of flavoured milk: (out of 'nine")

Treatments	Replications						Mean
	R-I	R-II	R-III	R-IV	R-V	R-VI	
T_1	7.80	8.00	7.85	8.05	7.80	7.79	**7.88**
T_2	7.90	7.79	7.42	7.32	7.20	8.21	**7.64**
T_3	7.45	8.36	7.88	7.55	7.95	8.14	**7.89**
T_4	7.75	8.21	8.15	8.10	8.25	8.29	**8.13**
Mean	30.90	32.36	31.30	31.02	31.20	32.43	**7.88**

ANOVA:

SV	DF	SS	MSS	Fcal	T value	Result
Repli.	5	0.58	0.12	1.69		
Treat.	3	0.71	0.24	3.41	2.87	SIG
Error	15	1.04	0.07			
Total	23	2.32				

SE± 0.11 **CD** =0.32 Significant at 5% percent level of significance

The colour of flavoured milk should be normal, pleasing attractive and uniform. Intensity of colour depends upon flavour addition. The product should not show any signs of visible foreign matter.

The perusal of Table 4.9 shows that the flavoured milk prepared by using 10 per cent jackfruit pulp was superior amongst all the treatments in colour & appearance which recorded the maximum score T_4 (8.13) *i.e.* flavoured milk with 10 per cent jackfruit pulp followed by treatment T_3 (7.89) *i.e.* flavoured milk with 7.5 per cent jackfruit pulp. The lowest score was recorded by T_2 (7.64) *i.e.* flavoured milk with 5 per cent jackfruit pulp. Addition of jackfruit pulp significantly improved the colour & appearance of flavoured milk and ultimately acceptability of product. The increase in the score mainly due to natural appealing yellow colour of jackfruit pulp which was liked most by the judges. The reduction in score may be due to the effect of light dull yellow colour at lower level of jackfruit pulp which was not found acceptable.

4.4.2 Flavour:

The product shall conform to the designated flavour like chocolate milk, coffee milk and fruit flavoured milk etc. It shall have no off flavours. No visible sediment of the added natural flavouring materials is desirable. Flavour is combined effect of smell and taste. Flavour is an important criterion for acceptance of any food article. Every milk product has its typical flavour. In the present investigation jackfruit pulp was added to enhance its acceptability.

The data regarding sensory score for flavour are presented in Table 4.10 and Fig. 8.

Table 4.10: Score for flavour of Flavoured Milk: (out of 'nine')

Treatments	Replications						Mean
	R-I	R-II	R-III	R-IV	R-V	R-VI	
T_1	7.40	7.43	7.31	7.45	7.00	8.14	**7.46**
T_2	7.55	7.86	7.73	7.86	7.10	7.21	**7.55**
T_3	7.66	8.36	8.12	8.05	8.15	7.86	**8.03**
T_4	7.65	8.21	8.00	7.45	8.00	7.57	**7.81**
Mean	30.26	31.86	31.16	30.81	30.25	30.78	**7.71**

ANOVA:

SV	DF	SS	MSS	F cal	T value	Result
Repli.	5	0.46	0.09	0.90		
Treat.	3	1.23	0.41	4.02	2.87	SIG.
Error	15	1.53	0.10			
Total	23	3.22				

SE± 0.13 **CD =**0.38 Significant at 5% per cent level of significance

From Table 4.10, it was observed that the higher score was obtained by flavoured milk with 7.5 per cent jackfruit pulp (8.03) followed by 10 per cent jackfruit pulp (7.81). Increase or decrease in the level other than these showed lower acceptability by the judges. The reasons for low score may be due to deep aroma of pulp at higher level *i.e.* 10 per cent where as mild dull flavour at lower level *i.e.* 2.5 and 5.0 per cent which was not liked by the judges. Amongst all the treatments lowest score was obtained by T_1 (7.46). The differences in score obtained by all the treatments were found to be significant.

4.4.3 Consistency:

The data pertinent to sensory score for consistency at different treatments are depicted in Table 4.11 and Fig. 9

Table 4.11: Score for consistency of flavoured milk: (out of 'nine')

Treatments	Replications						Mean
	R-I	R-II	R-III	R-IV	R-V	R-VI	
T_1	7.50	7.10	7.42	7.50	7.15	8.14	**7.47**
T_2	7.40	7.43	7.65	8.14	7.90	7.64	**7.69**
T_3	7.55	7.89	7.92	7.92	7.85	8.21	**7.89**
T_4	7.95	8.21	7.96	7.86	7.70	7.86	**7.92**
Mean	30.40	30.63	30.95	31.42	30.60	31.85	**7.74**

ANOVA:

SV	DF	SS	MSS	Fcal	T value	Result
Repli.	5	0.39	0.08	1.10		
Treat.	3	0.79	0.26	3.70	2.87	SIG
Error	15	1.07	0.07			
Total	23	2.26				

SE± 0.11 **CD** =0.32 Significant at 5% per cent level of significance

The observed values for consistency of flavoured milk at 2.5, 5, 7.5 and 10 per cent level of jackfruit pulp was 7.47, 7.69, 7.89 and 7.92, respectively. The addition of jackfruit pulp had significant effect on consistency of flavoured milk. The highest score of 7.92 was recorded for 10 per cent jackfruit pulp indicating that the flavoured milk at 10 per cent jackfruit pulp was the best quality product with the required consistency followed by 7.5 per cent level of jackfruit pulp. The flavoured milk with lowest score at 2.5 per cent level of jackfruit pulp had comparatively thin consistency (7.47). The average score for jackfruit flavoured milk was 7.74 indicating that the consistency of all the samples was good irresptive of the treatments.

4.4.4 Overall acceptability

The effect of different levels of jackfruit pulp on overall acceptability of flavoured milk is tabulated in Table 4.12 and Fig. 10.

From the figures of overall acceptability in Table 4.12, it is seen that, flavoured milk prepared by using 7.5 per cent jackfruit pulp (T_3) scored highest points (8.05) followed by treatment T_4 *i.e.*(10) per cent jackfruit pulp (7.84). Lowest score was recorded for T_2 and T_1 *i.e.* 5.0 and 2.5 per cent addition of jackfruit pulp, respectively.

Table 4.12: Score for overall acceptability of Flavoured milk: (out of 'nine')

Treatments	Replications						Mean
	R-I	R-II	R-III	R-IV	R-V	R-VI	
T_1	7.53	7.36	7.49	7.55	6.80	8.14	**7.48**
T_2	7.85	7.80	7.73	7.77	7.00	8.00	**7.69**
T_3	7.83	8.33	7.85	7.95	8.10	8.21	**8.05**
T_4	7.55	7.90	8.17	7.45	7.70	8.29	**7.84**
Mean	7.69	7.84	7.81	7.68	7.4	8.16	**7.76**

ANOVA:

SV	DF	SS	MSS	Fcal	T value	Result
Repli.	5	1.25	0.25	3.51		
Treat.	3	1.04	0.35	4.85	2.87	SIG
Error	15	1.07	0.07			
Total	23	3.35				

SE± 0.11 **CD =**0.32 Significant at 5% per cent level of significance

From the average figures of overall acceptability, it is clear that flavoured milk prepared from 7.5 per cent jackfruit pulp scored highest points (8.05) followed by 10 per cent jackfruit pulp (7.84). The score was declined as 7.69 and 7.48 simultaneously at T_2 and T_1, respectively.

On the basis of results we can affirmatively state that amongst the different levels of jackfruit pulp, T_3 (7.5 % jackfruit pulp) treatment was found to be more acceptable by the judges *i.e.* best quality flavoured milk was obtained with addition of 7.5 per cent, jackfruit pulp.

From the results, overall acceptability scores indicates that flavoured milk incorporated with 7.5 per cent jackfruit pulp is superior over rest of treatments.

However, jackfruit pulp @10 per cent can produce good quality flavoured milk. Lower level than these (*i.e.* 5.0 and 2.5 per cent) showed reduction in sensory quality scores for flavoured milk (*i.e* 7.69 and 7.48, respectively).

4.13 Cost of production

While calculating the cost of production of flavoured milk the cost of materials based on added ingredients only are considered. All the expenditure is given in table 4.13 and Fig. 11. One of the main objectives of the present study was to study the effect of addition of jackfruit pulp on economics of flavoured milk prepared under various treatments. The treatment *i.e.* T_1 2.5 per cent jackfruit pulp produced flavoured milk with the lowest cost of ` 40.90 per kg whereas, the highest cost of ` 49.60 per kg flavoured milk was observed for treatment T_4 *i.e.* 10 per cent jackfruit pulp. The production cost of most acceptable level *i.e.* T_3 (7.5 per cent jackfruit pulp) is ` 46.60 per kg.

Table 4.13: Production cost of jackfruit flavoured milk (based on cost of ingredients only) (`)

Ingredients	Rate (`)	Treatments							
		T_1		T_2		T_3		T_4	
		Qty. (g)	Cost (`)	Qty. (g)	Cost (`)	Qty. (g)	Cost (`)	Qty. (g)	Cost (`)
1	2	3	4	5	6	7	8	9	10
Buffalo skim milk/Kg	32/-	487.5	15.60	475.00	15.20	462.5	14.80	450.00	14.40
Sugar/Kg	38/-	40	1.90	40	1.90	40	1.90	40	1.90
Jackfruit pulp/Kg	150/-	12.5	1.87	25	3.75	37.5	5.62	50	7.50
Stabilizers/Kg	1000/-	2.5	2.50	2.5	2.50	2.5	2.50	2.5	2.50
Total quantity and cost of flavoured milk (`)	-	534	21.87	532	23.35	532	24.82	530	26.30
Total cost of flavoured milk/100 g (`)	-	-	4.09	-	4.38	-	4.66	-	4.96
Total cost of flavoured milk/Kg	-	-	40.90	-	43.80	-	46.60	-	49.60

CHAPTER II

REVIEW OF LITERATURE

The study was undertaken to explore the possibility of utilising of jackfruit flavour for fortification while preparing flavoured milk. The literature pertaining to the study was reviewed and presented as under.

2.1 Technology

2.1.1 Flavoured milk

Dressel *et al.* (1994) made a stable flavoured milk product that meets the US code of federal standards for milk and powder regulations for use in the process. The product is a flavoured, nonagglomerated powder containing flavouring, colour, kappa and/or total carrageenan, casein and alpha-lactalbumin. It was claimed that the powder when added to water, makes a stabilized liquid with no foaming during processing. It was also claimed that addition of the stabilized liquid to milk requires less agitation than adding a powder directly to milk, thus resulting in less foaming and waste. The process for adding the stabilized liquid to milk prior to homogenization to produce a stable flavoured milk drink was also described.

Asl (1999) prepared three types of flavoured milk using carrot, strawberry or a mixture of strawberry and red beet juices as colouring and flavouring agents in the proportion of 15 per cent juice, 5 per cent sugar, 50 per cent milk and 0.2 per cent commercial pectin in the finished product. The ratio of red beet juice: strawberry juice in the samples containing the mixture of 2 juices was 1:2. The mixture was pasteurized at 75°C for 15 sec. and kept at 5°C overnight before they were given to a taste of panel composed of male and female of different ages. Analysis of preference scores by consumers on a 5 point hedonic scale showed no significant difference between flavoured milk samples containing carrot and strawberry juices.

Singh *et al.* (2006) studied the effect of incorporation of carrot juice in the preparation of flavoured milk. Skim milk from buffalo and cow in combination with 10, 20, and 30 per cent levels of carrot juice were used to prepare flavoured milk which was hot filled in glass bottles and stored at refrigerated temperature (4±1°C). Sensory scores of flavoured milk decreased significantly and no significant changes were observed in the viscosity and sediments of flavoured milk during storage for 4 days. The pH decrease in buffalo and cow flavoured milk was 6.7 to 6.6 and 6.5 to 6.4, respectively. The best flavoured milk was obtained from 20 per cent of carrot juice in either buffalo or cow milk.

Murphy *et al*. (2008) reported that drinking flavoured or plain milk is positively associated with nutrient intake and is not associated with adverse effects on weight status in US children and adolescents. Findings from this study suggest that consumption of either flavored or plain milk is associated with a positive influence on nutrient intakes by children and adolescents and is not associated with adverse effects on BMI measures.

Bhardwaj and Beniwal (2009) studied technology for low calorie flavoured milk developed by using artificial sweeteners and cream separation from buffalo milk. Three types of flavored milk *viz*. toned milk; doubled toned milk and skim milk were prepared using the developed standardized technology. A reduction in calorie of 30.09 per cent and 43.54 per cent was achieved from this milk, respectively in composition to flavoured milk prepared using sugar.

Prakash *et al.* (2010) studied on Ultra-high-temperature processing of chocolate flavoured milk. In the present study, Chocolate milk with different carrageenans (kappa and lambda) and sugar concentrations was heat treated indirectly at 145°C for 6 second using a bench-top UHT plant. The temperature of the milk in the preheating and sterilizer sections, and the milk flow rate were determined to evaluate the overall heat transfer coefficient (OHTC) for monitoring fouling during UHT processing. Kappa-carrageenan was more effective than lambda-carrageenan in providing stability against fouling during UHT processing.

By optimizing concentrations of κ-carrageenan and sugar, fouling could be minimized during UHT processing. The apparent viscosity and sedimentation of UHT-processed chocolate milk increased with increasing concentration of carrageenan and sugar.

Repate *et al.* (2010) studied on preparation of flavoured milk from cow milk blended with safflower milk. The preparation of flavoured milk from different proportion of cow milk blended with safflower milk 100:0 (T_0), 80:20 (T_1), 70:30 (T_2), 60:40 (T_3) and 50:50 (T_4) was prepared and studied the acceptability. Thus, this proved that the cost of flavoured milk could be minimized by using safflower milk and cow milk blended and blending could be done to the maximum proportion of 50:50.

Watharkar and Devshete (2012) reported the chemical quality of fruit flavoured yoghurt by using litchi fruit. Yoghurt fortified with fruit pulp or juice enriches its quality as well as gives appealing colour and pleasing flavour to product. The good quality fruit flavoured yoghurt can be prepared by fortifying with 4 per cent litchi juice.

Al-Jebreen (2013) studied nutritional properties of commercial flavored milk. About 40 per cent of the sugar in flavored milk is naturally occurring lactose beverages. Concerning laboratory analysis, one company considered as mislabelled since they stated on the package that the percentage of fat 1.1-1.2 and the lab analysis showed it contained 3.1 per cent. All companies were truthful about protein content. Moreover, for calcium, all companies have low calcium content than what has stated on the package except one company.

Ravindra *et al.* (2014) studied extended shelf life flavoured dairy drink using dissolved carbon dioxide. Cardamom flavoured dairy beverage prepared using standardized method was carbonated in glass bottles. Carbonation at 50 psi pressure for 30 seconds was recommended. The pasteurized flavoured drink carbonated or otherwise was evaluated for sensory, chemical and microbial quality during its refrigerated storage. The uncarbonated control samples were found to be sensory acceptable up to 14 days, while the carbonated beverage remained acceptable up to 30 days. Carbonation of drink significantly affected the pH and acidity of product without reducing its acceptability. Carbonation resulted in inhibition of microbes, the effect was pronounced on psychotropic count. There

was a linear but marginal increase in the pH of the carbonated samples till the 17th day of storage; the values diminished thereafter. The carbonated samples also had significantly reduced contents of FFA and soluble nitrogen compared to that of uncarbonated control samples as storage progressed beyond 10 days and this was attributed to inhibited microbial growth.

Silva *et al*. (2014) studied quality of buffalo milk yoghurt flavoured with carrot, honey, linseed. Two yoghurt formulations (F1 and F2) using buffalo milk were prepared with carrot, previously sanitized and crushed in a blender, sucrose, water, honey and flax in two concentrations. The prepared yoghurt is nutritious which can be distributed school or public initiatives for technology transfer, especially for the small property of Amazon Oriental.

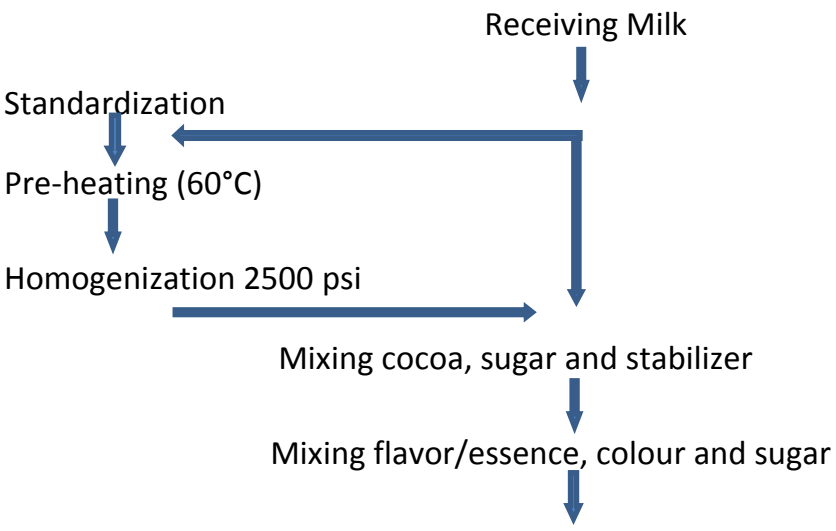
De (2015) mentioned that flavoured milks are milks to which some flavours have been added. When the 'milk' is used the product should contain a milk fat percentage at least equal to the minimum legal requirement for market milk. But when the fat level is lower (1-2 per cent) the term "drink" is used. Further, he suggested a formula for chocolate milks/drinks as-

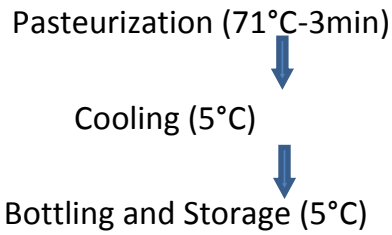
i) Cocoa pawder - 1 to 1.5%

ii) Sugar - 5 to 7%

iii) Stabilizer - 0.2%

The flow diagram of manufacture of flavoured milk given by him is as under:





2.1.2 Milk Drinks:

Hoang (1992) manufactured drink from whole milk, sweetened condensed evaporated cow or goat milk. They may be mixed or flavoured with vanilla, orange, pomegranate and banana and may be served as hot or cold.

Mangas and Mangnen (1992) prepared milk based drink in which a mixture of an acid and non-acid fraction obtained from milk was used as the basis for the manufacture of an acidified milk drink. The pH of the mixture was 2.4 - 3.9. The milk drink was flavoured with fruit based ingredients.

Yousif *et al*. (1996) produced milk drink by mixing date juice (prepared from ground dates and tap water) with milk. The drink was bottled and heated in boiling water for 30 min. A 60:40, date: milk mixture produced a more acceptable product than a 75: 25 or 45: 55 mixture. Optimum pH was 6.6. Nine cultivars of Saudi Arabian dates were assessed. Ruzeiz dates gave the best sensory scores. Mean composition of the drink prepared from Ruzeiz dates was compared with that of imported mango-milk drink. Ruzeiz date milk drink had a higher sugar content (17.97vs.11.15) composed of lactose, glucose and fructose compared with the mango milk drink which contained only lactose and sucrose. The date-milk drink was rich in calcium, phosphorus and magnesium and contained less sodium than the mango milk drink. Storage at 25°C for 16 weeks resulted in significant reductions in pH, sugar and moisture contents and an increase in colour intensity. However, flavour remained good.

Vandana *et al*. (2002) carried out the studies on manufacture of whey based coffee (WBG) drink. The effect of the different levels of whey, standardized milk, sugar and coffee was studied on the sensory attributes. A total of 15 formulations

were prepared and results revealed that in whey based coffee drink of 200 ml, a maximum of 120 ml, whey could be used as the basal ingredient. 0.5 g of coffee was found most appropriate and sugar up to 153 g was judged optimum.

Ramirez-Sucre and Velez-Ruiz (2011) studied the physico-chemical and flow properties of a milk drink with the inclusion of caramel jam in relation to formulation and storage. The systems were prepared, by following a Box Behnken experimental design, including fat, gum, and flavour as variables; drinks were successfully analysed through 3 weeks of storage. Density and moisture of drinks were stable through the storage time, in contrast to acidity, colour, pH, and flow properties.

2.1.3 Milk Beverage:

Borgstrom (1991) developed a new chocolate milk beverage. Dairy chocolate milk was blended with 1.5 per cent fat pasteurized milk and held overnight then preheated to 75°C and treated in an infusion chamber. It was then treated in a vaccum chamber at 73°C, homogenized using two stage process at 2500 psi, cooled to 25°C and packed in 200 ml tetra brick cartons.

Yukalo *et al*. (1991) showed a method of producing a cultured milk beverage. The method involves pasteurization of milk, homogenization, cooling to preliminary culturing temperature, introduction of a starter prepared from thermophilic lactic acid, culturing, mixing, cooling the coagulate, adding a fruit/ berry filler and sugar followed by bottling.

Ibrahim *et al.* (1994 a) prepared guava milk beverage by adding 6 to 11 per cent guava pulp and 3 , 4 or 5 per cent sugar to buffalo skim milk, filtering and pasteurizing at 75°C for 5 min. in to glass bottles. Flavour score increased with increasing guava pulp concentration up to 10 per cent at all sugar levels. When guava milk beverage made with 10 per cent guava pulp and 4 per cent sugar was sterilized at 120°C for 15 min., flavour score which decreased during storage for 90 days at room temperature, was enhanced by addition of 0.05 per cent

Carboxymethyl cellulose (CMC) or preferably 0.05 per cent carageenan as stabilizer.

Ibrahim *et al.* (1994 b) studied on preparation of mango milk beverage. They found that optimum concentration of mango pulp and sugar for use in pasteurized mango milk beverage prepared from standardized (1 %) cow milk was 20 and 2 per cent, respectively. Mango pulp concentration and mango pulp sugar concentration interaction had a significant effect ($P < 0.05$ and 0.01, respectively) on both flavour and sweetness score. When beverage made with 1, 1.5 or 2 per cent dried total milk protein, dried whey protein or dried soluble casein prior to pasteurization undesirable flavours was detected in all cases, except with 1 per cent total milk protein. Fortification with 1 per cent total milk protein resulted in higher total solids, total protein and ash content than in control and these values showed little change during storage for 22 days at 5°C.

Singh *et al.* (1994) utilized paneer and cheese whey for developing acceptable whey based mango, pineapple, lemon and banana beverages. Banana pulp was liquefied using 1 per cent (W/V) pectinase enzyme (pectinex ultra) at 40°C for 2 hrs. This treatment yielded 67 per cent banana juice. Composition of an acceptable beverage formulation varied with the type of fruit, its pulp/ juice content ranged from 5 per cent for lemon to 20 per cent for pineapple and banana. The whey content of the beverages ranged from 73 to 87 per cent. Total solids, fat and protein content in different fruit beverages varied from 13.3 - 16.2 per cent, 0.32 - 0.38 per cent and 0.51 - 0.61 per cent, respectively. Among the beverages, mango beverage was found to be preferred most. It contained 15 per cent mango pulp, 78 per cent paneer whey, 7 per cent cane sugar and pH 4.5.

Ahmed *et al.* (1995) prepared low fat beverage from goat milk. Three types of fruit preparation *viz.,* guava, orange and fig were used for fortification. Goat skim milk was used in order to prepare low fat beverage. The samples were analyzed during 10 days storage at 5±1°C. The beverage with 10 per cent guava

was the most acceptable followed by the beverage with 15 per cent orange and then the beverage with 10 per cent fig.

Al-haq and Mohyuddin (1995) manufactured pasteurized mango fruit flavoured milk based beverage which could be adopted for commercial production. Eighteen beverages were prepared using different levels of the pulp of "*Chausa*" variety of mango and three stabilizers *viz.,* Mexpectic, Carboxymethyl cellulose or Geodon S.M. After cold storage for first day, the beverages were evaluated by a panel. Beverage produced using mexpectin scored highest.

Kotecha *et al.* (1995) attempted to extract juice from custard apple and utilized the same for preparation of ready to serve (RTS) beverage and wine. It was observed that 0.2 per cent pectinase and 4 hours incubation period were found to be optimum conditions for extraction of juice from custard apple. The organoleptic evaluation of RTS beverage showed that the colour and appearance, body, taste, aroma and acceptability score increased with increase in the proportion of juice. The product prepared from 20 per cent juice was extremely liked by the panellists and had a flavour of custard apple.

Shenkenberg *et al.* (1997) described two alternative methods of producing a stable, free flowing non congealing, low viscosity, milk orange juice beverage. In the first, a dry mixture of sweetener and Sodium Carboxymethyl cellulose (CMC) is mixed with milk at < 900 F, the mixture allowed to stand for at least 10 min (causing the CMC to complex with the casein), fruit juice added and the mixture aged, pasteurized and homogenized. In the alternative method, the complexed mixture is pasteurized, homogenized, cooled and then combined with pasteurized fruit juice. The composition of the beverages recommended was 60 per cent whole milk, 35 per cent orange juice, 4.8 per cent sugar, 0.2 per cent CMC.

Hassan and Ahmed (1998) conducted a study to develop mango milk beverage by blending *'Dashehari'* variety mango pulp with different fat levels (1.5 per cent, 3 per cent, 4.5 per cent and 6 per cent) and milk. Mango milk blending produced a nutritionally rich ready to serve (RTS) beverage. Formulations of RTS

based on milk and mango pulp were studied. The beverage contained 15 per cent milk, 30-40 per cent mango pulp having a TSS of 20° Brix. The blended beverages were heat processed and stored at room temperature for a period of 6 months. The products were analysed chemically and organoleptically at an interval of 3 months and were highly acceptable up to 6 months storage.

Khamrui and Rajorhia (1998) studied utilization of cheese whey for edible purpose. A ready to serve beverage combining cheddar cheese whey and *kinnow* fruit juice was formulated. The various proportions tried included juice, whey and sugar content of the formulated beverages ranging from 15-50 per cent, 42-79 per cent and 6-8 per cent respectively. The formulation containing kinnow juice 40 per cent, whey 53 per cent, sugar 7 per cent, pectin 0.05 per cent, Carboxymethyl cellulose 0.15 per cent and pH 4.25 was found to be preferred most by the sensory panel. The estimated manufacturing cost of the beverages was Rs. 3.76/250 ml.

Singh *et al.* (1999) prepared a soft beverage from *paneer* whey and guava. The whey had on an average 0.31, 0.49 and 6.12 per cent protein, ash and total solid, respectively. Three types of guava viz. market grade, Lucknow-49 and Banarsisurkh and three types of edible colours viz. rose; orange and lemon were tried with different sugar levels. The guava extract and whey ratios were tried with different sugar levels. The guava whey ratios were tried at 1:5, 1:4 and 1:3. The guava whey beverage formulated by using Banarsisurkh variety of guava extract at 1:3 ratio with 8.0 per cent sugar level and lemon colour scored highest. The carbonation enhanced the acceptability of guava whey beverage. On an average, the finished product contained 11.68, 0.34 and 0.31 per cent total solids, carbohydrates and protein, respectively.

Shukla and Sharma (2002) prepared a beverage using milk by-products and fruit juices. The beverage was prepared by addition of fruit juices from mango, apple and guava in four different concentrations i.e. 10, 20, 30 and 40 per cent.

Sugar was added @ 10 per cent. The blend was thoroughly mixed, homogenized, pasteurized, filled into bottles and stored at low temperature.

Shukla *et al*. (2003) carried out studies on the development of beverages using fruit juice/pulp separated milk and reconstituted skim milk. Beverages were prepared by blending juice/pulp from apples, bananas, guavas, litchis and mangoes at four different concentrations (100, 200, 300 and 400 g/l) with separated and reconstituted skim milk. Organoleptic evaluation of the beverages showed that apple juice and guava pulp could be blended at up to 300 and 100 g/l of milk products, respectively. Banana and mango pulp could also successfully be used at up to 200 g/l in separated milk and reconstituted skim milk. Litchi juice could be blended up to 300 g/l in separated milk and 200 g /l in reconstituted skim milk.

Steinhart *et al.* (2007) studied flavour perception of white coffee beverages- influences of milk processing. They studied the odour, taste and retronasal odour perception by sensory evolutions and selected volatiles were analysed by static headspace GC/MS. The effect of varying fat content (3.5 and 1.5 per cent) and fat disoperation were studied. The milk with the lower fat content and with smaller fat globules, resulting from double homogenization (250/50bar each), induced a more intense coffee related retronasal odour perception whereas the milk-related impression was similar to the whole milk.

Tranjan *et al.* (2009) studied that development of goat cheese whey-flavoured beverages. The flavour acceptability was higher for the strawberry beverage than for the peach one (P=0.05). Positive purchase intent for strawberry flavoured beverage was reported by 76 per cent of the consumers, while 50 per cent affirmed a similar intention for the peach-flavoured product. The beverages produced showed potential for commercialization, serving as an additional alternative product derived from goat milk, with minimal additional cost to the dairy plant.

Bhavsagar *et al.* (2010) worked on manufacture of pineapple flavoured beverage from chhana whey. They found that the good quality pineapple flavoured beverage can be prepared by addition of 5 parts of pineapple pulp and 95 parts chhana whey with the addition of 8.0 per cent sugar.

Hu Yong Jin *et al*. (2010) studied processing technology of a fermented rice-milk beverage. *Lactobacillus acidophilus* and *Streptococcus thermophillus* were used as starter cultures. Orthogonal test showed that the optimum formula of fermented beverage was as follows: rice steep liquor-milk ratio of 2:3 (v/v), *L*. *acidophilus* to *S*. *thermophillus* ratio of 2:3, aspartame of 0.1 per cent, glucose of 6 per cent, and fermentation time of 10 hr., under which the products showed unique flavour, good taste and milky colour.

Dalim *et al.* (2012) studied on production and comparison of banana and chikoo flavoured milk-based beverages. Chemical composition of flavoured milk-based beverages was as an average fat content in chikoo flavoured and/or banana flavoured milk-based beverage found to be 0.12 ± 0.02 per cent and 0.18 ± 0.02 per cent, respectively. Protein content was found to be in banana flavoured milk-based beverage (4.14 ± 0.13 %) contrast to that of in chikoo flavoured milk-based beverage (3.56 ± 0.93 %). Average ash content (0.88 ± 0.10 %) in chikoo flavoured milk-based beverage was found to be slightly higher compared to that of found in banana flavoured milk-based beverage (0.82 ± 0.11 %).

Yan Zhen *et al*. (2013) studied processing technology of health beverage from soybean milk and corn juice fermented by Lyophyllumdecastes. In order to cut down cost and enhance the added value of Lyophyllumdecastes product, soybeans and corn flour as the main raw material were liquefied with neutral protease and α-amylase, respectively and then, Lyophyllumdecastes was inoculated and cultivated in soybean milk and corn juice, a kind of health beverage was developed using the whole broth. It showed that the basic ingredients of the beverage added in the beverage enhanced its aroma were: fermentative broth 40 per cent, citric acid 0.12 per cent, CMC 0.02 per cent, sugar 4 per cent, honey 1

per cent. Sensory quality score revealed that each combination has a significant difference and significant interaction.

2.1.4 Milk shake:

Sharma and Gupta (1978) prepared milk shake with several variables like fat (3.4 and 5 %), MSNF (12, 13 and 14 %) and with using spray dried and roller dried skim milk. Of these combinations, 4 per cent of milk fat and 13 per cent SNF with 10 per cent sugar and 0.4 per cent sodium alginate gave milk shake with good whipping ability, foam stability and sensory evaluation. Blending the powder with crushed ice gave milk shake with 28 per cent total solids but slight inferior to the fresh product as it was chalky and hard excessively with high crystal. It was spray dried to yield a powder, containing 3.3 per cent moisture 15.1 per cent fat and 17.7 per cent protein with carbohydrates and ash making up the rest of the portion.

The flow diagram of manufacture of milk shake given by them is as given below:

Flow Diagram

Cow milk

↓

Pre heating (40°C)

↓

Addition of skim milk powder (2-5 per cent)

↓

↓

Heating (70°C)

↓

Addition of sugar (10 per cent) and stabilizer (0.5 per cent)

↓

Mixing

↓

Filtration

↓

Pasteurization (71°C for 30 min)

↓

Cooking and ageing (10 °C for 2-3 hrs.)

↓

Addition of proportionate levels of different fruits

↓

Speed mixing (90-120 sec.)

↓

Consumption/serving to the customer

Grewal and Jain (1982) studied the feasibility of incorporation of preserved mango pulp in the preparation of mango milk shake and reported that addition of preserved mango pulp to milk (1:4) did not alter the salt balance of blend by neutralizing with $NaHCO_3$ or NAOH and sterilization at 116°C for 30 minutes.

Baudach (1984) reported that a number of milk shake bases could be prepared by rehydrating milk followed by manual or mechanical stirring. A preferred composition comprises 76.47 g fine sugar, 30.0 g whipping agent, 1.20 g thickener (Viscarin), 0.20 g flavouring, 0.1 g milk protein and 0.03 g yellow colouring. On rehydrating with milk, the mixture may be shaken by hand into a product with 400 percent increased volume with addition of desired flavouring (strawberry, cherry, in the form of jams, syrup etc). These base could also be used in the preparation of foods for infants and suitable for use in a tropical countries.

Nakaya *et al.* (1991) described a process for the manufacture of a thick milk shake in which 45 to 70 per cent water, 15.3 to 40 per cent carbohydrates, 15 to 35 per cent sugar, 0.3 to 1.3 per cent alcohol, 1 to 7 per cent of protein and 1 to 25 per cent of oil/ fat was mixed and ice-cream obtained by filtering, homogenising sterilizing, cooling, ageing, freezing at an over-run of 10-100 per cent, kneading with tiny pieces of ice filling in packing containers and hardening. The ice-cream was shaken and mixed at temperature in range of - 20°C to 8°C with or without addition of syrup such as a fruit sauce to make the milk shake.

Varpe (1992) prepared fruit flavoured milk shake with the fortification of mango, sapota, apple and orange pulp at the 5, 10 and 15 per cent levels each. Form this study, he concluded that milk shake with 10 to 15 per cent level of mango pulp and 10 per cent level of orange squash was found to be more acceptable.

Kshirsagar (1996) prepared fruit flavoured milk shake with fortification of mango, sapota, coco and mango essence. He concluded that milk shake prepared with 12 per cent level of mango fruit pulp had superior sensory quality and acceptability than the other milk shakes.

Kadav (2001) prepared fruit flavoured milk shake with the fortification of pineapple syrup and jamun juice at the 5, 10, 15 and 20 per cent level each. Milk shake was made by adding 5 per cent skim milk powder, 10 per cent sugar and 0.5 per cent gelatin in milk.

Salunkhe (2002) prepared milk shake fortified with fruit flavours like karonda and papaya pulp at the 5, 10 and 15 per cent level and 2.5, 5.0 and 7.5 respectively. Milk shake was made by adding 5 per cent skim milk power, 10 per cent sugar and 0.5 per cent gelatin in milk.

Jadhav *et al.* (2003) studied the acceptability of sapota milk shake with different concentrations (10, 20 and 30 %) of sapota pulp. Cow milk was filtered,

pasteurized (63°Cfor 30 minutes), then cooled to 5°C. Sapota pulp and sugar were added to the milk. The pulp- milk blend was mixed in a blender then cooled to 5°C.

Kashid *et al*. (2007) prepared golden milk shake from different proportions of safflower milk and cow milk *i.e.* 30:70 (T_1), 40:60 (T_2), 50:50 (T_3) and 100 per cent cow milk (T_0) and studied for its acceptability. Golden milk shake prepared from 70 parts cow milk and 30 parts safflower milk was closer to control in acceptability. Golden milk shake prepared from 50 parts of cow milk and 50 parts of safflower milk was also acceptable, scoring between like moderately to like very much, for all sensory attributes. The cost of production of golden milk shake prepared from safflower milk: cow milk (50:50) blend was Rs.11.30 per litre and was more economical than control. Good quality Golden milk shake could be prepared by blending cow milk with safflower milk (50:50) with addition of 8 per cent cane sugar and safflower petal extract having known therapeutic value.

Pakalwad *et al.* (2010) studied the standard procedure of preparation of milk shake from buffalo milk blended with papaya and studied for its acceptability. Milk shake was prepared from different proportions of buffalo milk and papaya pulp *i.e.* 100:0 (T_0), 90:10 (T_1), 85:15 (T_2) and 80:20 (T_3).

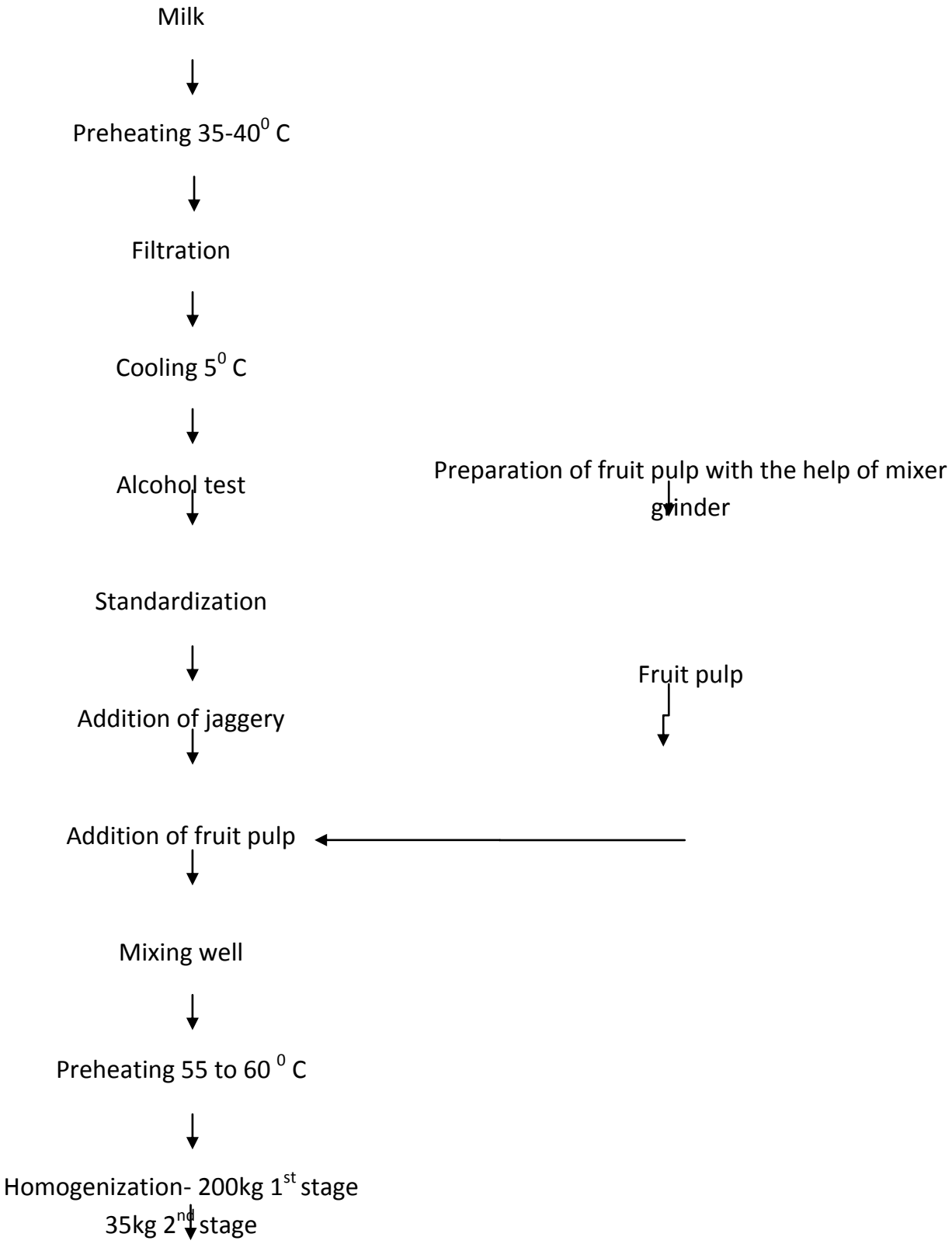
Jadhav Sonali (2012) prepared milk shake from buffalo milk with different proportions of ginger juice *i.e.* 2.5 per cent (T_1), 5 per cent (T_2), 7.5 per cent (T_3), 10 per cent (T_4) and 100 per cent buffalo milk (T_0) and studied for its acceptability. Buffalo milk was preheated, filtered, pasteurized (72°C for 30 minutes), then cooled to 10°C, ginger juice were added to milk. The juice-milk was mixed and cooled to 5°C.

Alizadeh *et al*. (2014) reported the effect of stevia as a substitute for sugar on physico-chemical and sensory properties of fruit based milk shake. The study was conducted to formulate novel fruit based milk shake using a mixture of Kiwi, apple and banana concentrates by replacing sucrose partly with Stevia. Five different treatments of fruit milk shakes were prepared with sucrose/Stevia ratios of 100:0 (TA), 75:25 (TB), 50:50 (TC), 25:75 (TD) and 0:100 (TE). The physico-

chemical properties of the beverage were examined using conventional methods. The recommended ratio of sucrose/Stevia in beverage was 25:75. Stevia free beverage had the best sensorial acceptance.

Ubale *et al*. (2014) conducted study on “Sensory and chemical quality of sapota milk shake”. The three levels of pulp of sapota, @ 7, 8 and 9 per cent were used with three levels of jaggery 7, 8 and 9 per cent of milk. They prepared.

Flow Diagram



Fresh Fruit

↓

Washing

↓

Remove of peel with the help of knife

↓

Cool to room Temp.

↓

Filling machine

↓

Filling in 200 ml bottle

↓

Weight check

↓

Sealed with crown cork

↓

Sterilized to 120^{o}C for 20 min

↓

Sample for lab analysis Turbidity test

↓

Bottles cool to room temperature

↓

Store in room temperature

2.2 Chemical composition:

2.2.1 Skim milk:

Singh *et al*. (2006) stated an average chemical composition of skim milk as moisture 89-92 per cent, fat 0.05-0.1 per cent, protein 3.3-3.5 per cent, lactose 4.7-5.3 per cent and lactic acid 0.5-1.1 per cent.

Jangale (2009) reported the average chemical composition of skim milk as fat 0.48 per cent, protein 3.41 per cent, total solids 9.21 per cent and acidity 0.41 per cent and it is in close agreement with the values observed during the research.

Prabhudesai (2010) stated that buffalo skim milk contained an average total solids 9.15 per cent, fat 0.45 per cent, protein 3.46 per cent and acidity 0.15 per cent.

De (2015) mentioned an average chemical composition of skim milk as moisture 90.6 per cent, fat 0.1 per cent, protein 3.6 per cent, lactose 5.0 per cent and ash 0.7 per cent.

2.2.2 Flavoured milk:

Bhandari *et al*. (1976) reported composition of flavoured milk as follows:

Component	Composition (per cent)
Fat	3.5
SNF	8.5

Choi and Kosikowaski (1985) reported the composition of sweetened flavoured carbonated yoghurt beverages as fat 1.5 per cent, protein 2.8 per cent, carbohydrate 10.7 per cent, total solids 15.5 per cent and ash 0.50 per cent.

Rajeshkumar *et al.* (1989) studied on formulations of flavoured milk like beverage from cheese whey. The beverage was highly accepted and scored 7.38 on an average, on a 9 point hedonic scale in consumer's acceptability trial involving 102 consumers. The beverage contained 13-15 per cent total solids, 3.1 per cent protein, 7.5 to 11.5 per cent carbohydrates, 1.5 to 6 per cent fat and 0.42 per cent ash. The yield of beverage was found to be 28 kg/ 100 kg whey skim milk mixture.

Shelke *et al*. (2008) studied the effect of different flavours on the physico-chemical properties and acceptability of flavoured milk. They stated the treatments with chemical quality of flavoured milk as given in the following table:

Chemical composition of flavoured milk (%)

Sr. No.	Treatments	Fat	Total Solids	S.N.F	Acidity
1	T_1	2.86	19.90	17.04	0.13
2	T_2	2.85	19.97	17.12	0.13
3	T_3	2.88	19.90	17.02	0.13
4	T_4	2.87	19.95	17.02	0.13
5	T_5	2.88	20.00	17.12	0.13
6	T_6	2.88	19.90	17.02	0.13
7	T_7	2.87	20.00	17.13	0.13

Repate *et al.* (2010) prepared flavoured milk from different proportion of cow milk blended milk safflower milk 100:0 (T_0), 80:20 (T_1), 70:30 (T_2), 60:40 (T_3) and 50:50 (T_4). They observed the composition of flavoured milk as:

Treatments	Fat (%)	Protein (%)	Ash (%)	Total Solid (%)
T_0	3.00	3.20	0.72	15.21
T_1	3.00	3.08	0.68	14.59
T_2	3.00	2.91	0.66	14.03
T_3	3.00	2.78	0.62	13.58
T_4	3.00	2.65	0.59	13.10

Palthur *et al*. (2014) prepared Ginger Flavoured herbal milk by addition of ginger extract. They observed the chemical composition of Ginger flavoured milk as:

Parameters	Observed Values
Acidity (%)	0.15±0.004
Protein (%)	3.48±0.017
Fat (%)	2.05±0.007
Total solids (%)	17.57±0.032
Total ash (%)	0.67±0.004

Waghmode (2015) studied on "Utilization of ginger (*Zingiber officinale* L.) juice in the manufacture of flavoured milk". He prepared flavoured milk with different treatment of various level combinations of sugar viz. 5 (S_1), 7.5 (S_2), 10 (S_3) per cent and ginger juice viz. 0 (G_0), 2 (G_1), 4 (G_2), 6 (G_3) per cent. The chemical composition of flavoured milk observed as:

Treatments	Fat (%)	Protein (%)	Titratable Acidity (%)	Ash (%)	Total Solid (%)
S_1G_0	0.523	3.35	0.147	0.800	14.04
S_1G_1	0.536	3.31	0.151	0.795	14.02
S_1G_2	0.548	3.31	0.154	0.785	13.96
S_1G_3	0.56	3.23	0.161	0.777	13.37
S_2G_0	0.511	3.27	0.149	0.791	16.02
S_2G_1	0.524	3.24	0.158	0.781	15.96
S_2G_2	0.536	3.23	0.156	0.777	15.90
S_2G_3	0.548	3.17	0.165	0.765	15.02
S_3G_0	0.508	3.23	0.152	0.797	17.92
S_3G_1	0.513	3.19	0.157	0.779	17.83
S_3G_2	0.524	3.16	0.159	0.765	17.73
S_3G_3	0.541	3.01	0.168	0.755	17.05

2.2.3 Jackfruit pulp:

Jackfruit (*Artocarpus heterophyllus* L.) is one of the ancient tropical fruit of India. It is known as 'phanas' in Maharashtra. Jackfruit is commonly found in two major types *viz.,* firm flesh, known as 'kapa' and soft flesh as 'barka' in Marathi. Unripe jackfruit is used as vegetable or made into pickle, while ripe jackfruits are eaten as fresh, preserved in syrup or used in various products. Jackfruit pulp possesses high nutritive value. The nutritional quality and method of extraction of pulp reported by various research workers is cited here.

Jackfruit has been reported to contain 77.2 per cent moisture, 1.9 per cent protein, 0.1 per cent fat, 1.1 per cent fibre and 0.8 per cent mineral matter (Anonymous, 1948).

Bhatia *et al*. (1955) gave the composition of ripe jackfruit as 72.51 per cent moisture, 1.6 per cent protein, 0.22 per cent fat, 3.24 per cent fibers, 3.57 per cent ash and 7.78 mg/100 g pulp ascorbic acid .They also reported 1.24 and 1.27 total titratable acidity on per cent anhydrous citric acid in bulbs of ripe and tender jackfruit, respectively on moisture free basis.

Watt and Merill (1963) reported that ripe jackfruit contained 72.00 per cent moisture, 1.39 g / 100 g pulp protein, 0.3 per cent fat, 1.00 per cent ash, 25.40 per cent carbohydrates and 8 mg / 100 g pulp ascorbic acid.

Bhore *et al*. (1980) stated the chemical composition of jackfruit pulp as

Constituents	**Local Jackfruit Type (%)**	**Promising Jackfruit Type (%)**
Moisture	79.00	71.30
Carbohydrates	16.25	23.07
Fat	0.20	0.50
Protein	1.95	2.43
Fiber	1.20	1.50
Ash	0.90	1.20
Total Solids	21.00	28.70

Gopalan *et al.* (1982) while studying the nutritive value of Indian foods, reported that pulp of ripe jackfruit is rich in vitamin ‘A’, carbohydrates and mineral matter containing 76.2 per cent protein, 0.1 per cent fat, 19.8 per cent carbohydrates, 1.1 per cent fibre, 175 µg/100 g vitamin ‘A’ and 7 mg/100 g vitamin ‘C’.

Nadkarni (1985) studied some important jackfruit selections of 'kapa' type jackfruit. He reported the average chemical composition of bulbs as moisture- 68.99 per cent, protein- 2.39 per cent, fat- 0.492 per cent, fibre- 1.664 per cent, ash- 1.29 per cent, carbohydrates-22.92 per cent, acidity-0.1934 per cent and total sugars- 14.22 per cent.

Antarkar (1991) carried out investigations on physico-chemical composition of jackfruit, storage and processing of it and reported the chemical composition of ripe soft flesh jackfruit as follow

Constituents	**Composition (%)**
Moisture	74.63
T.S.S.	25^0Brix
Reducing Sugars	7.60
Total Sugar	16.20
Titratable Acidity	0.23
pH	5.20
Ascorbic Acid	2.90 mg/100g
Protein	1.54
Fat	0.24

Further, she explained the procedure of extraction of pulp from bulbs of soft-flesh jackfruit as follows. Bulbs were removed from the ripe jackfruit. These bulbs were deseeded and then boiled for 20 minutes and passed through grinder to obtain pulp.

2.3 Organoleptic evaluation of flavoured milk

Bhandari *et al.* (1976) reported that rose and pineapple flavoured milk prepared from admixture of 50 per cent filled milk and 50 per cent standardized milk was highly acceptable.

Guleria and Jain (1980) reportd that apple, banana and orange juice were

mixed in the proportion of 37.0 to 56.8 per cent with buffalo or cow milk using 6.0 per cent sugar ,0.2 per cent stabilizer. Beverage made with buffalo milk had higher total solids and obtained higher organoleptic score than those made from cow milk.

Lederer *et al*. (1991) studied the effect of carbonation level on the sensory properties of flavoured milk beverages. Raspberry, strawberry, peach and root beer flavoured milks were carbonated at sub threshold, low and high carbonation levels with mean carbonation vol. of < 0.60, 0.74 and 1.42, respectively. The effect of carbonation on perceived aroma and flavour by mouth attributes was determined through evaluation by a trained panel. Panellists detected a significant difference in carbonation intensity between the high carbonation level, and the sub threshold and low carbonation levels. Chalkiness and bitterness were rated significantly higher at the high carbonation level than at the low or sub threshold levels.

Ibrahim ***et al.*** (1994 a) prepared that guava milk beverage by adding 6 to 11 per cent guava pulp and 3, 4 or 5 per cent sugar to buffalo skim milk in which flavour score increased with increasing guava pulp concentration up to 10 per cent at all sugar levels. When guava milk beverage made with 10 per cent guava pulp and 4 per cent sugar was sterilized at 120°C for 15 min., flavour score decreased during storage for 90 days at room temperature.

Singh ***et al.*** (1994) studied utility of paneer and cheese whey for developing acceptable whey based mango, pineapple, lemon and banana beverages. Among the beverages, mango beverage was found to be preferred most. It contained 15 per cent mango pulp, 78 per cent paneer whey, 7 per cent cane sugar and pH 4.5.

Kshirsagar (1996) studied the fruit flavoured milk shake with fortification of mango, sapota, coco and mango essence in which milk shake with 12 per cent level of mango fruit pulp had superior sensory quality and acceptability than the other milk shakes.

Muhammad *et al.* (1996) studied acceptability of cow and buffalo flavoured milk. Samples of cow and buffalo milk were flavoured with vanilla, chocolate, mango and orange in different concentrations and sweetened with 5 per cent cane sugar. A panel of 10 judges determined the most acceptable flavoured milk sample

for each flavour. Milk flavoured with vanilla, chocolate and orange containing 1 ml/litre and with mango flavour at 2 ml/litre were the most acceptable. The acceptability decreased gradually after 25 days.

Badrie *et al.* (1998) prepared pineapple flavoured fermented milk to suit canibben taste. UHT treated cow milk was inoculated with 2 to 4 per cent (v/v) Lactobacillus bulgaricus and incubated at 43°C for 3 hrs. At the end of culturing the product was cooled to 4°C and crushed pineapple was added at 5 or 8 per cent (v/ v) 4, 5 or 7 per cent sucrose syrup. Sensory characteristics of products were assessed by a panel made up of students from the university. The product containing 8 per cent fruit and 5 per cent sucrose syrup was the most acceptable.

Hassan and Ahmed (1998) studied mango milk beverage by blending 'Dashehari' variety mango pulp with different fat levels (1.5 per cent, 3 per cent, 4.5 per cent and 6 per cent). Mango milk blending produced a nutritionally rich ready to serve (RTS) beverage. The beverage contained 15 per cent milk, 30-40 per cent mango pulp and had TSS of 200 brix. The blended beverage heat **processed** and stored at room temperature for a period of six months. The products were highly acceptable.

Khamrui and Rajorhia (1998) worked on utilization of cheese whey for edible purpose ready to serve beverage combining cheddar cheese whey and kinnow fruit juice. The formulation containing kinnow juice 40 per cent, whey 53 per cent, sugar 7 per cent, pectin, 0.05 per cent, carboxymethyl cellulose 0.15 per cent and pH 4.25 was fond to preferred most by sensory panel.

Singh ***et al.*** (1999) prepared a soft beverage from paneer whey and guava. Three types of guava ***viz.,*** Market grade, Lucknow-49 and Banarsi surkh and three types of edible colours were tried with different sugar level. The guava extract and whey ratios were tried at 1:5, 1:4 and 1:3. The guava whey beverage formulated by using Banarsi surkh variety of guava extract at 1:3 ratio with 8.0 per cent sugar level and lemon colour scored highest. The combinations enhanced the acceptability of whey beverage.

Vijayalakshmi and Tamilarasi Murugesan (2001) studied on profile of organoleptic and microbiological qualities of four commercial dairy products namely, flavoured milk, buttermilk, butter and sweet khoa during storage. They studied organoleptic quality of flavoured milk as below. Organoleptic quality of flavoured milk during storage at 6-8°C.

Storage period days	Colour and appearance	Flavour	Texture	Taste	Overall acceptability
1	9.0	0.9	9.0	9.0	9.0
2	4.5	7.5	8.7	5.3	8.7
3	2.0	4.5	4.7	2.3	6.8
4	1.0	1.0	2.3	2.8	4.3
5	1.0	1.0	1.3	1.4	1.5

The appearance of flavoured milk was poor due to separation *of* the product into two layers. This may be due to poor homogenization. The thick flavoured milk ultimately became thin, watery and curdled man. The results indicated that the flavoured *milk* should be consumed on the same day of preparation.

Shukla and Sharma (2002) conducted the research on manufacture of beverages. Beverage was prepared by addition of fruit juices from mango, apple and guava in 4 different concentrations *i.e.* 10, 20, 30 and 40 per cent. It was then subjected to organoleptic evaluation. The whey based beverage containing 20 per cent mango juices in buttermilk 30 per cent apple juice was rated the best. However addition of guava juice did not improve the organoleptic quality of any of the milk by-products based beverages when used in more than 10 per cent levels. It is thus concluded that a judicious combination of milk by-product and fruit juices can make a nutritious and delicious beverage.

Ramasamy *et al.* (2005) studied organoleptic study on natural coloured and flavoured sterilized milk with extracts of plant. The colour, flavour acceptability and shelf life of sterilized flavoured milk prepared with extract of beetroot (2%), carrot (5%) and stevia (2%) separately, and also in combination with cardamom (2%) and with instant coffee powder was studied. The results showed the flavoured milk prepared from carrot juice with cardamom powder retained its colour and flavour, and was more acceptable during the storage period of 6 months, followed by flavoured milk prepared from instant coffee powder.

Nicklas *et al.* (2013) reported the nutritional role of flavoured and white milk in the diets of children: Flavoured and white milk contributed, respectively,

2-6 per cent of total energy consumed, 3-12 per cent of saturated fats, 1-3 per cent of sodium, and 4-0 per cent of added sugars. The percent contribution of white milk to intakes of vitamin A (21%), vitamin D (54%), calcium (29%), potassium (17%), magnesium (12%), and phosphorus (19%) exceeded 10 per cent of total intake. Consumption of flavored milk contributed a smaller percentage to total intake. For total dairy consumed the percent contribution to intake of vitamins A and D, calcium, potassium, magnesium and phosphorus ranged from 19 per cent to 68 per cent. Milk has an important nutritional role in the diets of children.

Pelsmaeker *et al*. (2013) reported the consumption of flavored milk among a children population. The influence of beliefs and the association of brands with emotions. Although milk and dairy products are seen as an important part of a child's diet, their consumption is declining. The aim of this study is to investigate the consumption of milk and flavored milk among a sample of 513 Belgian children aged between 8 and 13 years. In addition, the association between flavored milk brands and emotions is examined. Children prefer and consume more flavored milk than plain milk. They indicate that consumption is a self-made choice and that parents mainly ensure the availability of these products. Children prefer flavored milk to plain milk, although it is perceived to be less healthy. No correlation could be found between brand awareness and the consumption of flavored milk. Brands of flavored milk evoke divergent emotions and can be classified into different groups based upon their association with a type of emotion (*i.e.* positive/negative). This study demonstrates that taste is an important factor in flavored milk consumption by children and shows a strong relationship between brands and emotions. Consequently, the taste needs to be appealing for children, but it is equally important that children associate the brand with positive emotions, as this will lead to a higher preference. Milk producers who target children can use the insights gained from this study in the development of new products.

2.4 Utilization of jackfruit pulp in dairy products:

Shipurkar (1999) studied on preparation of shrikhand fortified with jackfruit pulp. He reported that incorporation of jackfruit pulp up to 10% level is a most

desirable level in manufacture of shrikhand. He reported that addition of jackfruit pulp in shrikhand results in enhancing its nutritional value without adversely affecting sensory quality and also results in reduction in cost of production.

Vesvikar (1999) conducted studies on preparation of ice-cream fortified with jackfruit pulp and reported that incorporation of jackfruit pulp up to 10% is the most desirable and acceptable level in ice-cream. Further he stated that incorporation of jackfruit pulp in ice-cream as natural flavouring agent has special significance in human diet from the viewpoint of nutrition.

Holmukhe (2002) carried out studies on utilization of jackfruit pulp in the manufacture of milk pudding. He reported that incorporation of jackfruit pulp @10% is most acceptable level in milk pudding.

Naik Poonam (2013) studied on utilization of jackfruit pulp in the manufacture of basundi. She reported that incorporation of jackfruit pulp @10% is most acceptable level in basundi.

CHAPTER V
SUMMARY AND CONCLUSION

5.1 Summary:

Now a day there has been increase in the popularity of flavoured milk consumption. Flavoured milk possesses wellme potential for its marketing. However, information on, suitability of indigenous fruits for fortification of flavoured milk is limited. Use of fruit flavours for fortification is getting a good footing especially as a novelty product. Flavoured milk fortified with fruit pulp enriches and enhances its sensory as well as nutritional quality and also gives appealing colour and pleasing flavour to the product.

The present investigation entitled “Preparation of flavoured milk with jackfruit (*Artocarpus hetrophillus* L.) pulp” was undertaken with a view to explore the feasibility of incorporation of jackfruit pulp in flavoured milk. The jackfruit pulp @ 2.5, 5, 7.5 and10 per cent was tried to prepare flavoured milk during the experiment.

Flavoured milk was prepared with different treatments by using standard method. Following levels (treatments) were selected for the study.

5) T_1:- Addition of jackfruit pulp @ 2.5 % of skim milk
6) T_2:- Addition of jackfruit pulp @ 5 % of skim milk
7) T_3:- Addition of jackfruit pulp @ 7.5 % of skim milk
8) T_4:- Addition of jackfruit pulp @ 10 % of skim milk

Thus, there were total 5 treatments with 6 replications. The raw material and the final product were subjected to the chemical analysis. The score card using Hedonic-scale was used to assess the quality and acceptability of finished product by the panel of judges. The data were subjected to statistical analysis and results obtained are summarized here under.

5.1.1 Chemical quality of Buffalo skim milk:

The buffalo skim milk used for preparation of flavoured milk was confirming to legal standard described for the state of Maharashtra. The buffalo

skim used in the present study for preparation of flavoured milk contained on an average 9.53 per cent total solids, 0.55 per cent fat, 3.62 per cent protein, 0.83 per cent Ash and 0.15 per cent acidity.

5.1.2 Chemical composition of jackfruit pulp:

Average total solids, fat, protein, ash, total sugar and acidity content of jackfruit pulp used in present investigation were 23.57 per cent, 0.28 per cent, 1.88 per cent, 0.95 per cent, 17.78 per cent and 0.24 per cent, respectively.

5.1.3 Chemical quality of flavoured milk:

Total solids:

The total solid content of flavoured milk increased significantly with increase in level of jackfruit pulp. The average values for 2.5, 5, 7.5 and 10 per cent levels of jackfruit pulp were 18.21, 18.48, 18.91 and 19.53 per cent, respectively.

Fat:

The fat content of flavoured milk varies significantly with the values of 0.54, 0.53, 0.52 and 0.52 per cent at 2.5, 5, 7.5 and 10 per cent level of jackfruit pulp, respectively. With increase in the level of jackfruit pulp, there was significant decrease in the fat content.

Protein:

The protein content of flavoured milk varied significantly with the values of 3.59, 3.40, 3.21 and 3.07 per cent at 2.5, 5, 7.5, and 10 per cent level of jackfruit pulp, respectively. With the increase in the level of jackfruit pulp, there was significant decrease in the protein content of flavoured milk.

Ash:

The ash content of flavoured milk increased significantly with increase in the level of jackfruit pulp. The average values for 2.5, 5, 7.5 and 10 per cent level of jackfruit pulp were 0.847, 0.898, 0.919 and 0.960 per cent, respectively.

Total sugar:

The total sugar content of flavoured milk varied significantly with the values of 13.97, 14.52, 15.15 and 16.49 per cent at 2.5, 5, 7.5 and 10 per cent level of jackfruit pulp, respectively. With the increase in the level of jackfruit pulp, there was significant increase in the total sugar content flavoured milk.

Titratable acidity:

A difference in the titratable acidity due to jackfruit pulp was statistically significant with the values being 0.153, 0.159, 0.168 and 0.173 per cent at 2.5, 5, 7.5 and 10 per cent level of jackfruit pulp. There was increase in the acidity with increase in the level of pulp.

5.1.4 Sensory quality of flavoured milk:

Colour and General Appearance:

Amongst jackfruit pulp levels the highest score for colour and appearance was recorded for flavoured milk containing 10 per cent jackfruit pulp (8.13) followed by 7.5 per cent pulp (7.89). The differences in these values were significant. The score for colour and appearance at 2.5, 5, 7.5 and 10 per cent level of jackfruit pulp was 7.88, 7.64, 7.89 and 8.13, respectively. The highest score was observed at 10 per cent level of sugar (8.13). The lowest score was recorded in case of flavoured milk with 5 per cent jack fruit pulp *i.e.* (T_2).

Flavour:

The highest score for flavour (8.03) was recorded for flavoured milk with 7.5 per cent jackfruit pulp and lowest for flavoured milk fortified with 2.5 per cent jackfruit pulp (7.46). The variation due to different levels of pulp was significant. The score for flavour at 2.5, 5, 7.5 and 10 per cent level of jackfruit pulp was 7.46, 7.55 and 8.03 and 7.81, respectively. The highest score was recorded for 7.5 per cent level of jackfruit pulp (8.03).

Consistency:

The highest score for consistency was obtained in case of flavoured milk containing 10 per cent jackfruit pulp (7.92) and lowest was noticed at 2.5 per cent

level of jackfruit pulp (7.47). The results were statistically significant. The score for consistency at 2.5, 5, 7.5 and 10 per cent level of jackfruit pulp was 7.47, 7.69, 7.89 and 7.92 respectively. The highest score was recorded at 10 per cent level of jackfruit pulp (7.92).

Overall Acceptability:

The overall acceptability score for 7.5 per cent level of jackfruit pulp was higher (8.05) than the rest of levels. The score for overall acceptability for 2.5, 5, 7.5 and 10 per cent level of jackfruit pulp was 7.48, 7.69, 8.05 and 7.84, respectively. There was significant increase in score of overall acceptability up to 7.5 per cent after which score was declined simultaneously at 10, 5 and 2.5 per cent level of jackfruit pulp as 7.84, 7.69 and 7.84, respectively.

On the basis of overall acceptability score, the jackfruit pulp level of 7.5 per cent produced the best quality flavoured milk (8.05) followed by 10 per cent level of jackfruit pulp (7.84) which was equally good with the acceptable product.

5.1.5 Cost of production

The cost of ingredients only was taken to indicate the cost of flavoured milk production. Addition of jackfruit pulp was observed to increase production cost of flavoured milk. The cost of flavoured milk production at T_1, T_2, T_3 and T_4 was ` 40.90, 43.80, 46.60 and 49.60 per kg, respectively. The production cost of flavoured milk of most acceptable level ($T_3$) was ` 46.60 per kg.

5.2 Conclusion:

From results of the present study it was concluded that, the jackfruit pulp could successfully be utilized for preparation of flavoured milk. Addition of jackfruit pulp in flavoured milk improved sensory quality and acceptability of the product. For fortification of flavoured milk the optimum level of jackfruit pulp was found to be superior over rest of treatments. The most acceptable quality flavoured milk can be prepared by using 7.5 per cent jackfruit pulp. Such replacement did not affect appreciably the composition of flavoured milk. Jackfruit had a positive effect

on sensory attributes of flavoured milk on its acceptability and consumption. Besides peculiar flavour, it also adds nutritional importance to the product.

On the basis of sensory evaluation parameters treatment T_3 addition of 7.5 per cent jackfruit pulp was observed to be the best treatment.