UTILIZATION OF POTATO (*Solanum tuberosum*) FLOUR FOR PREPARATION OF BURFI

THESIS

Submitted to
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola
in partial fulfilment of the requirements
for the Degree of

MASTER OF SCIENCE
IN
AGRICULTURE

ANIMAL HUSBANDRY AND DAIRY SCIENCE
(DAIRY SCIENCE)

By
RAMTEKE VISHAL MULCHAND

SECTION OF ANIMAL HUSBANDRY AND DAIRY SCIENCE
COLLEGE OF AGRICULTURE, NAGPUR

DR. PANJABRAO DESHMUKH KRISHI VIDYAPEETH,
KRISHINAGAR PO, AKOLA (MS) 444104

Enrolment Number – KK/82 **2018**

DECLARATION OF STUDENT

I hereby, declare that the experimental work and its interpretation of the thesis entitled **"UTILIZATION OF POTATO (*Solanum tuberosum*) FLOUR FOR PREPARATION OF BURFI"** or part thereof has neither been submitted for any other degree or diploma of any University, nor have the data been derived from any thesis or publication of any University or scientific organization. The source of materials used and all assistance received during the course of investigation have been duly acknowledged.

Place: Nagpur (Ramteke Vishal Mulchand)

Date: 01/06 /2018 Enrolment No. KK /82

CERTIFICATE

This is to certify that thesis entitled **"UTILIZATION OF POTATO (*Solanum tuberosum*) FLOUR FOR PREPARATION OF BURFI"** submitted in partial fulfillment of the requirement for the degree of **"Master of Science in Agriculture (Animal Husbandry and Dairy Science)"** of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola is a record of bonafide research work carried out by **Ramteke Vishal Mulchand** under my guidance and supervision.

The subject of the thesis has been approved by the Student's Advisory Committee.

Place: Nagpur **(Dr. V. G. Atkare)**

Date: 01 / 06 / 2018 Chairman

Advisory Committee

Countersigned

Associate Dean

College of Agriculture, Nagpur

Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola.

THESIS APPROVED BY THE STUDENT'S ADVISORY COMMITTEE INCLUDING EXTERNAL EXAMINER (AFTER VIVA-VOCE)

1. Chairman	**(Dr. V. G. Atkare)**	_____
2. Member	**(Dr. S. G. Gubbawar)**	_____
3. Member	**(Dr. R. M. Zinjarde)**	_____
4. Member	**(Dr. Maya Raut)**	_____
5. External Member	**(Dr. A. B. Motghare)**	_____

Acknowledgements

Success is not possible oneself without involvement of many mind and hands to beautify it. Emotion could not be expressed adequately in words because the emotions are transferred into mere formalities. This acknowledgement is sincere and highly emotional expression of gratitude for all those, who have made this work a most memorable milestone.

I deemed it to proud privilege to express my esteemed and profuse of gratitude to the chairman of my advisory committee Dr. V. G. Atkare, Professor of Animal Husbandry and Dairy Science, College of Agriculture, Nagpur for efforts, superb constructive criticism, innovative ideas and constant encouragement during the entire course this investigation. His guidance and encouragement sustained me all along and helped me greatly in studies and research project. His optimistic attitude and high expectations always motivated me to try for best possible.

I also owe the deemed gratitude to the member of Advisory Committee Dr. R. M. Zinjarde, Assistant Professor of Animal Husbandry and Dairy Science, College of Agriculture, Nagpur for his versatile guidance, valuable suggestion with inspiring words and constant encouragement during the course of study.

It is really a matter of profound me to express my gratitude for the member Advisory Committee Dr. S. G. Gubbawar, Associate Professor, Animal Husbandry and Dairy Science, College of Agriculture Nagpur and Dr. Maya Raut, Associate Professor, Soil Science and Agricultural Chemistry, College of Agriculture Nagpur for their valuable suggestion and needful help during the course of studies.

I really thankful to the Dr. B. R. Wankhade, Assistant Professor of Animal Husbandry and Dairy Science, College of Agriculture,

Nagpur for his valuable suggestion and keep interest taken during the investigation.

My thanks are due to Dr. N. D. Parlawar, Associate Dean, College of Agriculture, Nagpur for providing necessary facilities required to carry out present investigation.

I express my heart full thanks to Dr. Kavita Kadu Senior Research Assistant (SRA), Shri. N.H. Sable Senior Research Assistant (SRA) and Dr. Achal Shambharkar Junior Research Assistant, Animal Husbandry and Dairy Science, College of Agriculture, Nagpur for their instant help, cooperation and valuable suggestion rendered throughout the investigation.

My special thanks to Shri. P. L. Adhe, Laboratory Attendant, Shri Nilesh Choudhari, Shri. Naresh Meshram and Shri. Raju Khandare, Animal Husbandry and Dairy Science, College of Agriculture, Nagpur for helping during the present study.

Parents teach us to dream to try with our feet on the ground and sights on the sky. I think words are insufficient with me to express my sense of heart to my mother Sau. Linta and father Shri. Mulchand Potu Ramteke and sisters Pallavi, Shital, and brothers Mangesh, Rakesh, Pravin, Avinash, Gautam and all my family members who have been the source of encouragement throughout my educational career without which I would not have reached the present destination. I owe my respect to them.

I take this opportunity to keep on records the remembrance of my Seniors Shatabdi tai, Laxmi Patil, Jagdish Ingole, Swapnil Wankhade, Girish Meshram and friends Tekendra, Chetan, Santosh C., Santosh S., Achal, Vibhali and my lovely juniors Saurabh, Ajay, Rohit, Pawan, Tejaswini, Ashmita, Anjusha who helped me to keep my composure and for being there when I needed them the most.

A special thanks to my Best and lovely friends Kunal, Vishal, Ku. Ashvini, Ujjwal sir, Surendra sir, Shailesh sir, Ashish sir and All KK-Series. Whose company and cooperation help me in carrying out my study with joy and happiness.

I wish to record my sincere and humble indebtedness to all those who helped in variety of ways, to be enumerated and which are beyond the reach of my formal words. I owe everything to them.

Lastly, but not least, I bow my head before the almighty for the blessing showered upon me to complete this event successfully.

Place: Nagpur

Date : 01/06/2018 **(Ramteke Vishal Mulchand)**

TABLE OF CONTENTS

A) List of Tables

(B) List of Figures

(C) List of Plates

(D) Abbreviations

%	:	Per cent
/	:	Per
>	:	Greater than
@	:	At the rate of
^{o}C	:	Degree Celsius
^{o}F	:	Degree Fahrenheit
BIS	:	Bureau of Indian standard
C. D.	:	Critical Difference
CRD	:	Completely Randomized Design
et al.	:	et alia (and associates)
FAO	:	Food and Agriculture Organization
NDDB	:	National Dairy Development Board
Fig	:	Figure
g	:	Grams
Hrs	:	Hours
IS	:	Indian standard
Kcal	:	Kilo calorie
Kg	:	Kilogram
Lit.	:	Litre
Mg	:	Milligrams
Min.	:	Minute
Ml	:	Milliliter
Mt	:	Meter

MT	:	Million tonne
Qty.	:	Quantity
S.E. (m)	:	Standard error of (mean)
SMP	:	Skim Milk Powder
SNF	:	Solids-Not-Fat
Sig.	:	Significant
T.S.	:	Total solids
T.	:	Treatments
R.	:	Replications
viz.	:	Namely
NDF	:	Neutral Detergent Fiber
ADF	:	Acid Detergent Fiber
EMC	:	Equilibrium Moisture Content
GAB	:	Guggenhein –Ander –son –de –Boer
BET	:	Brunauer –Emmet – Teller
CMK	:	Cow Milk Khoa

(E) THESIS ABSTRACT

a) Title of the Thesis	:	**"UTILIZATION OF POTATO (*Solanum tuberosum*) FLOUR FOR PREPARATION OF BURFI"**
b) Name of student	:	**RAMTEKE VISHAL MULCHAND**
c) Name of the Advisor	:	**Dr.V. G. ATKARE** Professor, (CAS) Animal Husbandry and Dairy Science Section, College of Agriculture, Nagpur.
d) Degree to be awarded	:	M.Sc. (Agri.)
e) Major subject	:	Dairy Science
f) Year of award of degree	:	2018
g) Total No. of pages in thesis	:	101
h) Number of words in abstract	:	306
i) Signature of the student	:	
j) Signature, Name and address of forwarding authority	:	

Dr. V. G. ATKARE
Professor
Animal Husbandry and Dairy Science Section,
College of Agriculture, Nagpur

ABSTRACT

The present investigation entitled “Utilization of potato (*Solanum tuberosum*) flour for preparation of burfi” was undertaken during the year 2017-2018. Milk was standardized to 4 per cent fat and the burfi prepared in the proportion of 100:0 (T_1), 95:05 (T_2), 90:10 (T_3), 85:15 (T_4) and 80:20 (T_5) khoa to potato flour with addition of 30 % sugar.

The experiment was laid out in completely randomized design (CRD) five treatments and four replications. The data obtained after chemical analysis of fat, protein, total solids, solids not fat, moisture and ash content of burfi and evaluation of sensory characteristics like flavour, body and texture and colour and appearance were subjected to statistical analysis. The overall acceptability also analyzed by the same method. The chemical composition of burfi i.e. fat, protein, moisture and ash percentage of burfi were decreased with increased in the levels of potato flour while total solids and solids not fat percentage was increased with increased in the levels of potato flour.

The sensory evaluation carried out by the five judges, showed that potato flour burfi prepared by adding 10 per cent potato flour (T_3) had secured the highest score (96.25 out of 100) and contained 24.43 per cent fat, 17.50 per cent protein, 77.70 per cent total solids, 53.24 per cent solids not fat, 22.32 per cent moisture and 3.09 per cent ash.

The cost of production of burfi was decreased with the increase in the levels of potato flour. The highest cost of production in T_1 without addition of potato flour was Rs. 432.34 per kg while, the burfi prepared with 10 per cent of potato flour in T_3 was Rs. 389.51 per kg which was superiorly accepted by the panel of judges.

Hence, it is concluded that best quality of burfi can be prepared by using 10 per cent of potato flour.

Chapter I

INTRODUCTION

1.1 Background Information

Milk has been used as an article of food since ancient times in India. Milk is an almost ideal food. It plays an important role in the diet. It is highly nutritious food which is rich in several nutrients, calcium, potassium, vitamins, and proteins. People have been using cow milk since 6000, 8000 BC and 14th century, it has gained immerse popularity as one of the healthiest foods. Milk meets basic requirements of the body. It also helpful in the fighting against diseases. Milk is high in protein, bone forming minerals, health giving vitamins and provides energy giving lactose and milk fat. Besides, supplying essential fatty acid. All these properties make complete food for human being.

India's milk production is 18.5 per cent of world milk production and now standing in first rank. Annual output about 163.6 million tonnes during 2016-17 and per capita availability in India is 351 grams per day by 2016-2017 (Anonymous, 2017). Out of total milk production 46 per cent is utilizes as fluides milk and remaining is convert into various milk products like paneer, rabri, basundi, cheese, ghee, ice-cream, channa, butter, yoghurt, dahi, etc. (Anonymous, 2015).

Among various milk sweets burfi is the most popular and nutritious khoa based indigenous sweet, prepared either from cow or buffalo milk or a combination thereof and sugar. It contains a considerable amount of milk solids and sugar is added in different proportions in different varieties. A number of the other optional ingredients can be incorporated to improve the taste as well as composition. Based on this, different types of burfi can be prepared by adding fruits, nuts, coconut, saffron, rava , etc. and are available in the market; however the quality and recipe varies across the cities and shops (Anurag and Chawla *et al*., 2016). Burfi has a good shelf life

compared to other milk sweets owing to its lower moisture content and higher total solids (Shelke *et al*., 2008).

Potato (*Solanum tuberosum*) is one of the most important staple food crops for human consumption, together with wheat, rice and corns. India is one of the few countries in the world where different types of vegetables are being produced. India which occupies the third place in the global production. About 328.87 million tonnes of potato are produced in the world over an area about 19.13 million hectare. The processing of potatoes would contribute to reduction of post harvest losses and pressure on cold storage. Currently more quantities of potatoes are processed into value added products to fulfill the need of fast food and convenience to food industry. Potato flour is used in various value added products like soup, biscuits, breads, tikki, burfi, etc. (Kaur and Kochhar, 2014).

1.2 Importance of study

In India, khoa is widely used as a base material for the preparation of variety of popular indigenous sweets. It contains fairly large quantities of muscle building protein, bone forming minerals and energy giving fat and lactose. Khoa, an important Indian milk product, it prepared by continuous boiling of milk until desired concentration (65-72 % T.S.) and texture is attained. Cow or buffalo milk is used for making khoa. The value of khoa, produced annually in India becomes almost double on its conversion into khoa based sweets. This underlines the significance of khoa based sweets to national economy. In addition sweets have great social, cultural and religious significance in our country.

Khoa is a concentrated milk product. It is very rich in total solids and hence highly nutritious food in the diet of human beings. According to Indian Standard Institute, khoa shall not contain moisture less than 28 per cent and fat not less than 26 per cent on dry matter basis. Khoa is a major intermediate base product for a variety of sweets. Naturally,

there is a considerable demand for this product in big cities for preparation of dairy products (Kurand *et al.,* 2011).

Burfi has been favoured as one of the most popular khoa based sweet all over India. The manufacture of value added products like filled dairy products could be a better alternatives. Now-a-day local producers are using orange, mango, coconut, potato, etc. in preparation of Burfi (Kamble *et al.,* 2010).

India is one of the few countries in the world where different types of fruits and vegetables are being produced. India is second largest producer of fruit and vegetables in the world after China (Anonymous, 2017).

Vegetables are good sources of micronutrients, which promotes health and prevent diseases. Potato products found highly nutritious and these can easily supplemented to eradicate malnutrition among children. Potato has good food satisfaction value and must be consumed daily nutrition (Kaur and Kochhar, 2014).

Indigenous milk product, burfi is capable of becoming such a novelty product in the world market. There is wide scope for improve the hygienic and keeping quality of the product prepared. The blending of certain ingredients to dairy food, such as potato which aid bodily functions in addition to nutritional profile, is now in a great demand and is capturing a vast market. Therefore, the present investigation was undertaken to study “Utilization of potato flour for preparation of burfi” with following objectives.

1.3 Objectives

1. To standardize optimum level of potato flour for preparation of burfi
2. To study the chemical composition
3. To study the sensory evaluation
4. To study the cost structure

1.4 Hypothesis

The dairy products have nutrients to provide health benefits for human health and safe to human consumption. In various literature have information about milk and their importance. The market demand of value added products is increased, burfi is able to fulfill this requirements. The value added dairy products have potential to promote health benefits. The manufacturing of value added products make strong the dairy industry, they provide better alternative to preserve liquid milk. On other hands, create a suitable platform for utilization of different fruit and vegetable crops thus the technology helps to increase the dairy industry at greater extent.

Potato is the most important tuber crop of the world and most important vegetable food crop in India. Potato is a crop of highland origin and has been domesticated in the high Andes of South America and has become a major food crop in the cool highland areas of South America, Asia, and central and Eastern Africa. The energy intake from potatoes by an individual in developed and developing countries was 130 and 41 Kcal/day, respectively. Potatoes provide significant amounts of carbohydrates, potassium and ascorbic acid in the diet (Chandrasekara and Kumar, 2016).

The burfi is traditional and popular milk product in central parts of north India and central India. Its production is confined to domestic level and commercially manufactured on small scale by the halwais (Gupta *et al*., 2010). Also the literature review pertaining to the same is insufficient, therefore quality characteristics prepared by various methods varies significantly, since standard technology is not available with respect to its preparation.

Therefore, the present study is proposed to use maximum possible amount of potato flour in the preparation of cow milk burfi.

1.5 Scope and Limitations

Considering the demand of indigenous milk products in market, Burfi is one of the major indigenous milk products (Shete *et al.,* 2011). It has special importance in various social celebrations and traditional occasions. Burfi is mostly served on the ceremonial occasions as puja, wedding, inaugural functions etc.

India is second largest producer of vegetables in the world. Potato (*Solanum tuberosum)* contributes key nutrients to the diet including vitamin C, potassium and dietary fiber (Gill *et al*., 2013). A small proportion of the starch found in potatoes is resistant to enzymatic degradation in the small intestine and thus, reaches the large intestine essentially intact. Given their high potassium and low sodium content, potatoes would seem to be an ideal food to incorporate into a dietary pattern for managing hypertension. Potato contain a number of nutrients and nutritional components that may play a role in health promotion and reducing the risk of chronic disease. Therefore, information regarding nutritional content of tuber crop is well acceptable by the people.

Burfi retains its quality for a considerable long period at atmospheric storage temperature due to its low moisture content and higher concentrations of sugar. The method of preparation also ensures the destruction of almost all micro-organism present in raw material. In post manufacture contamination from undesirable micro-organism during preparation, handling, packaging and storage of final product should be avoided.

Chapter II

REVIEW OF LITERATURE

Research work carried out on “Utilization of potato (*Solanum tuberosum*) flour for preparation of Burfi’’. This chapter deals with research carried out by different workers in relation to the burfi technology. The various aspects pertaining to preparation of burfi has been reviewed and catagorized under following heads.

2.1 Type of milk and technology of khoa

2.2 Physico-chemical properties of khoa

2.3 Chemical and nutritional quality of potato

2.4 Use of fruits in manufacture of burfi

2.5 Technology of burfi preparation

2.6 Physico-chemical quality of burfi

2.7 Organoleptic / sensory evaluation of burfi

2.8 Cost of production of burfi

2.1.1 Type of milk

Khopade (2002) determined the average value for various constituents in cow milk as under.

Constituents (%)	Cow milk
Moisture	87.34
Fat	3.50
Protein	3.62
Lactose	4.86
Ash	0.68
Total solids	12.66
Solids not fat	9.16

Sangu (2002) reported that average chemical composition of cow milk was fat 4.0 per cent, protein 3.5 per cent, lactose 4.9 per cent and ash 0.7 per cent.

Banergee (2005) reported that average chemical composition of cow milk was water 87.5 per cent, fat 4.0 per cent, protein 3.3 per cent, total solids 12.5 per cent and ash 0.8 per cent.

Adani (2011) analyzed sample of cow milk obtain from herd of indigenous cow maintained at Agriculture College, Nagpur and observed chemical composition as under.

Constituents (%)	Cow milk
Fat	4.0
Protein	3.75
Total solids	14.5
Acidity	0.14

Borse (2011) analyzed sample of cow milk obtain from herd of indigenous cow maintained at Agriculture College, Nagpur and observed chemical composition as under.

Constituents (%)	Cow milk
Moisture	86.2
Fat	4.0
Protein	3.3
Total solids	13.3
Acidity	0.14

Karuna Datarkar (2012) analyzed sample of cow milk obtained from herd of indigenous cow maintained at Agriculture College, Nagpur and observed chemical composition as under

Constituents (%)	Cow milk
Fat	4.0
Protein	3.70
Total solids	15
Acidity	0.14

Salunke (2012) prepared carrot kheer from cow milk with 4 per cent fat and 8.5 per cent SNF with an added 8 per cent sugar. The level of milk to shredded carrot was in ratio of 90:10, 85:15, 80:20 and 75:25.

Ahmad *et al*. (2013) reported that in buffalo milk on an average total solids, fat, lactose, crude protein, ash and conjugated linoleic acid contents were 17.2%, 7.3%, 4.65, 5.0%, 0.91% and 6.0 mg. g, respectively. The average mineral contents of calcium, phosphorous, potassium, magnesium and zinc in the milk were 1799, 1217, 844, 337 and 7 mg. kg-1, respectively.

Meshram (2014) analyzed sample of cow milk from herd of indigenous cow maintained of Agriculture college, Nagpur and observed chemical composition as under.

Constituents (%)	Cow milk
Fat	4.06
Total solids	12.88
Protein	3.68
Acidity	0.15
Ash	0.71

Tawade (2015) analyzed sample of cow milk obtained from herd of indigenous cow maintained at Agriculture college Nagpur and observed chemical composition as under.

Constituents (%)	Cow milk composition
Fat	4.06
Protein	3.68
Total solids	12.88
Acidity	0.15
Ash	0.71

Jadhav (2015) analyzed sample of buffalo milk from herd of indigenous buffalo maintained at College of Agriculture, Dapoli and observed chemical composition as under.

Constituents (%)	Buffalo milk
Fat	6.60
Total solids	15.74
Acidity	0.14
Protein	4.05

2.1.2 Technology of khoa

Khopade (2002) prepared khoa by boiling two kg of milk in karahi over a brisk non-smokey fire. The milk was stirred vigorously and constantly with circular motion by a sarata. During this operation all parts of pan with which the milk comes in contact was scrapped to prevent milk from scorching constant evaporation of milk took place and milk thickened progressively. The heating was continued with greater control and the speed of stirring come scrapping was increase. Soon the viscous mass reached a semi-sold consistency and began to dry up. The final product was ready. When it shown sign of leaving the bottom and sides of karahi and non-sticking together to form a pat.

Aneja *et al.* (2002) studied the method of preparation of khoa, fat level adjusted at 4 per cent for cow milk and 5 per cent for buffalo milk. Typically 4 to 6 lit. of milk were taken in shallow iron steel pan and simmered over direction non-smoky fire with constant and vigorous stirring and occasional scrapping of the heating surface to avoid

building of scorching. Constantly scraped and brought back into the thickened milk. After about 10 to 12 minutes of rapid evaporation when concentration of about 2.5 to 3 times has been attained, coagulated particles are brought together with stirrer and compacted as a semi-solid mass as heating continues further with constant agitation and scrapping of the heating surface, free fat oozes out. Gradually the solid mass tends to leave the heating surface cleanly and pat is formed.

Abhitosh (2005) reported the continuous khoa making system for its industrial potential. Large amount of khoa was made by the system. The samples were analyzed for chemical and sensory attributes. The sensory reports indicated that scoring was better for continuous process compared to conventional method.

Kamble *et al.* (2008) described the comparative compatibility of milk ber pulp burfi by using buffalo milk produced at Animal Husbandry and Dairy Science, College of Agriculture, Marathwada Agriculture University, Parbhani. Milk was standardized to 6.0% fat level.

De (2008) explained the method of khoa production. The milk was stirred vigorously and constantly with a circular motion by a khunti. During this operation all parts of the pan with which the milk comes into contact are lightly scrapped to prevent the milk from scorching. Constant evaporation of moisture takes place and the milk thickens progressively. The heating continued with greater control hereafter and the speed of stirring-cum-scrapping increased till the viscous mass reaches a semi-solid/pasty consistency. The final product ready when it showed signs of leaving the bottom and the sides of the karahi and sticking together.

Kumar (2010) reported that khoa is the product obtained from cow or buffalo milk, or a combination thereof by rapid drying containing milk fat content not less than 30 per cent on dry weight basis of the final product.

Dodeja and Deep (2012) laid out research on mechanized manufacture of Danedar khoa using three stages SSHE. In this trials

were conducted to optimize the process parameters such as initial acidity of milk, mass flow rate, steam pressure and scraper speed. Initial acidity of milk was varied from 0.16 to 0.19% LA. The mass flow rate was varied between 170 to 210 kg/h. Three levels of scraper speed were taken in first, four levels in second stage and three levels in third stage i.e. 200, 175 150 rpm, 200, 175, 150, 125 and 25,20,15 rpm, respectively. The quality of danedar khoa so produced was evaluated in terms of sensory evaluation and textural profile analysis. The best quality of danedar khoa was prepared by using standardized milk with 0.18% LA initial acidity and keeping scraper speed 175, 150, 15 rpm for first, second and third stage SSHE and flow rate 190 kg/h and steam pressure 4, 2 and 1.5 kg/cm^2.

Rajasekaran and Kumar (2014) reported the agitator and wiper design modification for milk khoa machine. Mixing is a very important unit operation in any dairy and food process industry. For instance, all operations involving blending homogenization, emulsion preparation, extraction, dissolution, crystallization, liquid phase reactions, etc., need mixing in one form or the other. This project is about a dynamic mixer of a food processing industry particularly about milk khoa making process. To attain uniform mixing with the optimal product preparation time for the desired quality and to remove the drudgery of human folk this newly developed automated agitator is suggested.

Sonika *et al*. (2015) studied on heat induced changes in khoa, khoa is a partially dehydrated milk product, prepared by continuous heating and manual stirring-cum-scraping until it reaches a semi solid (doughy) consistency. Various physico-chemical changes occur in milk during khoa preparation. Heating results in denaturation of milk protein forming coagulated mass. Browning reactions viz., maillard and caramelisation browning induced in milk during khoa preparation. Elevated temperature also results in formation of heat degraded products. Microstructure of khoa as revealed by scanning electron microscopy consisted of protein agglomerated protein mass and void spaces in matrices.

Bhosale (2017) prepared khoa from cow milk for bottle gourd burfi preparation. Fresh clean and standardized milk was taken and boiled in a karahi over a non-smoky fire. The milk was stirred vigorously and constantly with a circular motion by a khunti. During this operation all parts of pan with which the milk comes in to contact were lightly scraped to prevent the milk from scorching. Constant evaporation of moisture takes place and the milk thickens progressively. The heating was continued with greater control hereafter the speed of stirring-cum-scrapping increase. Then the viscous mass reaches a semi solid/ pasty consistency and begins to dried up then the final product was ready to use.

2.2.1 Physical properties of khoa

Dewani and Jayprakash (2004) reported that hardness parameters of khoa as penetration values for experimental khoa samples were 28.00, 34.66, 43.66 and 56.33 mm/5sec for 20, 30, 40 and 50 per cent MSNF replacement levels, respectively as against 19.33 mm/sec for control. Decrease in the moisture content of khoa as a result of WPC incorporation. The high moisture holding capacity of whey proteins compared to casein was the probable reasons for increase in moisture content.

Kumar (2010) studied three commercial types of khoa namely pindi, dhap, and danedar which differs in composition, texture and quality. All of these varieties are in demand and are required for making value added khoa based products like burfi, pedha, gulabjamun, pantua, kalakand, milk cake, kunda, etc.

Kakade *et al*. (2013) stated that khoa is obtained by rapidly evaporating milk in shallow pans to total solids content of about 70 per cent. The product could be preserved for several days and is also used as base for different kinds of sweet like pedha, burfi, gulabjamun, kalakand, etc. Naturally, there is a considerable demand for this product in big cities. Unfortunately, the manner in which this product is prepared, packed and transported is in very unhygienic conditions.

Rasane *et al.* (2015) reported that khoa has a uniform whitish colour with just a tinge of brown, a slightly oily or granular texture and a rich nutty flavour which is associated with a mildly cooked and sweet taste due to the high concentration of lactose.

2.2.2 Chemical properties of khoa

Khopade (2002) prepared mung flour burfi noted the chemical composition of khoa as 25.09 % moisture, 24.11% fat, 21.85% protein, 25.31% lactose and 3.64 ash when prepared from cow milk.

Aneja *et al*. (2002) analyzed the composition of khoa and studied physico-chemical characteristics and typical composition of khoa as under.

Type of milk	Per cent composition				
	Total solids	Fat	Protein	Lactose	Ash
Buffalo milk	78.40	30.50	17.70	23.90	5.90
Cow milk	80.70	25.20	15.80	33.50	4.10
Mixed milk	79.80	29.00	16.70	30.10	5.20
Market sample	71.60	24.60	19.00	25.20	3.60

Dewani and Jayprakash (2004) reported average composition of khoa as under.

Source of sample	Per cent composition					
	Total solids	Moisture	Fat	Protein	Lactose	Ash
Laboratory sample	66.34	33.66	22.20	17.53	23.05	3.55

Anonymous (2005) classified khoa on the basis of moisture, fat, protein, lactose, ash, total solids and iron content.

Constituents	Cow milk khoa composition (%)
Moisture	24.8
Fat	25.7
Protein	19.2
Lactose	25.5
Ash	3.8
Total solid	74.2
Iron	139 ppm

Sharma (2006) analyzed the chemical composition of khoa as under.

Sr. No.	**Type of sample**	**Total solids (%)**	**Fat (%)**	**Protein (%)**	**Lactose (%)**	**Ash (%)**
1	Pindi	65.0	22.5	19.5	19.4	3.5
2	Danedar	61.5	20.9	18.4	18.9	3.4
3	Dhap	56.0	19.4	17.1	16.7	2.9
4	Laboratory	66.1	22.4	19.6	20.3	3.0

Kurand *et al*. (2011) recorded the chemical composition of khoa in washim district as under.

Constituents	Composition of khoa (Percentage)
Moisture	27.20
Fat	27.70
Protein	18.89
Lactose	21.74
Ash	3.91
Total solids	72.80
Solids Not Fat	44.90

Bhosale (2017) studied the chemical composition of khoa as under.

Constituents	Per cent
Fat	27.14
Protein	18.86
Total solids	76.46
Moisture	23.54
Acidity	0.3
Ash	3.78

2.3 Chemical and nutritional quality of potato

Saxholt *et al*. (2008) studied that the constituents present in the root crops as under.

Constituent	Potato
Energy (KJ)	342
Water content (%)	80.5
Storage polymer	Starch
Carbohydrate (g/100g)	16.9
Protein (g/100g)	1.9
Fat (g/100g)	0.3
Dietary fiber (g100g)	1.4

Gill *et al.* (2013) stated that the potatoes contributes key nutrients to the diet including vitamin C, potassium, and dietary fiber.

Liu (2013) studied that chlorogenic acid, a polyphenolic compound, is a secondary plant metabolite and constitutes upto 90 % of the total phenolic content of potato tubers.

Kaur and Kochhar (2014) reported that nutrient composition of potatoes and potato flour (per 100g).

Nutrients	Potatoes	Potato flour
Moisture	74.7	13.07
Crude protein	1.6	6.22
Crude fat	0.1	1.02
Crude fiber	04	4.22
Carbohydrates	22.6	73.34
Energy Kcal	97	327.42
Calcium	10	19.38
Iron	0.48	3.82

Awgchew *et al.* (2015) observed the essential nutrients and heavy metals composition in the potato at farm 1 and farm 2 as under.

Content (mg kg-1)	Farm 1	Farm 2
Calcium	128.3	120.24
Magnesium	350.0	292.0
Potassium	20500	8071
Phosphorus	606.0	393.0
Nitrogen	7200	6700
Manganese	13.0	19.35
Iron	258.0	214.45
Copper	3.15	2.02
Zinc	19.1	34.7

2.4 Use of fruits in manufacture of Burfi

Kolhe (2003) prepared burfi by using papaya pulp. The burfi sample prepared with different levels of papaya pulp and 30 per cent sugar by weight of khoa. Burfi prepared by using cow milk khoa with addition of 40 per cent papaya pulp and 30 per cent sugar was found to be superior and hence recommended.

Gargade (2004) prepared the cow milk burfi using orange concentrate noted that, the burfi prepared with 10% orange concentrate and 30% sugar secured the maximum score (91.30) overall acceptability.

Matkar (2006) prepared burfi, the khoa was blended with 2.50, 3.75 and 5.00 per cent fig paste by weight along with 30 per cent sugar level. It was indicated that burfi prepared with addition of 3.75 % fig paste with 30 per cent sugar level was most acceptable.

Kamble *et al.* (2008) studied the comparative compatibility of ber pulp burfi to formulate a milk originated burfi product by the blending of milk and ber pulp on the total solids basis which may have better keeping quality and nutritional status.

Shelke *et al.* (2008) evaluated the mango fruit pulp burfi had longer keeping quality due to high total solids content and slightly acidic nature of the product which enhance the flavour and lower the cost of production. Therefore, it is expected that there may be greater demand and consumer's appeal to the newly formulated product.

Banker *et al.* (2013) prepared pineapple burfi. An acceptable burfi was prepared using khoa from standardized buffalo milk added with 10 parts of pineapple pulp into 90 parts khoa sugar was mixed @ 30 % by weight of khoa before heating. Pineapple burfi sample prepared with 10 parts pulp shows maximum sensory aeones. The titratable acidity got increased with higher proportions of added pineapple pulp.

Khapre *et al*. (2015) studied on processing technology and cost estimation of fig fruit powder enriched burfi. This designed with the aim to develop processing technology for preparation of fig fruits powder and subsequently utilized in value added product like burfi. Fig powder incorporated burfi was nutritionally rich in terms of fibre (3.7%), potassium (0.464%) and protein (13.12%).

2.5 Technology of burfi preparation

Prabha (2006) studied on a technology for the preparation of dietetic burfi using alternative ingredients, viz., whey protein concentrate (WPC), sorbitol, maltodextrin and sucralose and their optimal levels were found to be 1.2 per cent, 15 per cent 8.17 per cent and 0.0375 per cent, respectively. The product was found to be highly acceptable by the consumers.

Kamble *et al.* (2008) studied on comparative compatibility of ber pulp blending with milk at different proportions. The pure milk and ber

pulp blended milk at different proportions and addition of sugar at the rate of 40 per cent by weight were thoroughly mixed as per treatment and slowly heated with constant stirring till it reached to the solid mass apparently appearing like burfi then it was sprayed in a tray and allowed to cool. Finally it was cut into rectangular pieces.

Chetana *et al.* (2010) studied the effect of processing variables on quality of milk burfi prepared with and without sugar. The optimum conditions for burfi prepared with sugar were TSS of 78°B and 2–3 days of storage. Burfi prepared at optimum conditions had a breaking strength of 13.3 N with a sensory over- all acceptability score of 9.5 on a 10 point scale. Similarly, for burfi prepared with sorbitol to obtain a product close to its sugar counterpart required a TSS of 77.5°B and storage for 5–6 days to obtain a breaking strength of 12.9 N and a sensory overall acceptability score of 9.1.

Gupta *et al.* (2010) prepared the bottle gourd burfi. Two levels of milk to bottle gourd ratio i.e. 60:40 and 70:30 and two levels of sugar i.e. 12% and 16% were studied. Good quality of kapoorkand prepared by using 70:30 milk to bottle gourd ratio and 12% sugar was highly acceptance.

Kamble *et al.* (2010) studied on utilization of pine apple pulp for the preparation of burfi. Burfi was prepared by using six level of pineapple pulp by weight of khoa. 0% pineapple pulp (T_1), 5% pineapple pulp (T_2), 10% pineapple pulp (T_3), 15% pineapple pulp (T_4), 20% pineapple pulp (T_5) and 25% pineapple pulp (T_6). The overall acceptability of the pineapple pulp burfi prepared with 15 per cent pineapple pulp in treatment T_4 (93.53) was highest and superior. Treatment T_4 was more acceptable than all treatments in flavour, body texture and colour and appearance.

Bhutkar *et al*. (2015) prepared burfi by using elephant foot yam pulp. The buffalo milk was concentrated to a pasty consistency by evaporating in open pan of gentle fire. The sugar at the rate of 30 per cent was added and heated gentle till pat formation. When the product

was started to leave the sides of karahi within 5 to 8 minutes and small amount of food grazed orange colour in the sample. The elephant foot yam pulp was added and further heated on low flame till the product again started to leave the sides of karahi. The product was taken off the flame and transferred into greasy tray and was allowed to cool and cut into desirable size.

Tawade (2015) studied the preparation of burfi by utilization of stevia liquid. The cow milk was concentrated to a pasty consistency by evaporating in an open pan on gentle fire and heated gently till pat formation. When the product started to leave the sides of karahi (within 5 to 8 min), the stevia liquid was added and further heated on low flame till the product again started to leave the sides of karahi. The product taken off the flame and transferred into greasy tray and was allowed to cool and cut into a desirable size.

Girase (2016) prepared burfi by utilizing gulkand while preparing buffalo milk burfi. The buffalo milk was concentrated to a pasty consistency by evaporating in an pen pan on gentle fire and heated gently till pat formation. Then gulkand is added and further heated in low flame till product again started to leave the sides of karahi. Then product transferred into greasy tray and was allowed to cool and cut into desirable size.

2.6 Physico-chemical quality of burfi

Sabale (2005) analyzed the chemical composition of besan (Gram flour) khoa burfi as total solids 79.63 to 83.00, moisture 17.00 to 20.37, fat 16.24 to 18.37, protein 13.35 to 14.50 and ash 2.89 to 3.89 per cent.

Swati Wankhede (2005) studied the chemical composition of mango pulp burfi as moisture 16.83 to 20.23 per cent, total solids 79.76 to 83.16 per cent, fat 21.48 to 22.02 per cent, protein 12.10 to 13.43 per cent, Ash 1.90 to 3.04 per cent and acidity 0.27 to 0.98 per cent.

Borse (2011) studied the chemical composition of date burfi as follows.

Constituent	Per cent composition
Fat	20.70-22.50
Protein	12.70-14.81

Adani (2011) reported the chemical composition of date burfi as follows.

Constituent	Per cent composition
Fat	15.26-21.40
Protein	12.04-13.64
Moisture	18.96-22.56
Total solids	77.43-81.03

Shete *et al.* (2012) studied on composition of market burfi samples. They found moisture 17.10 to 25.87 per cent, total solids 74.13 to 82.90 per cent, fat 10.05 to 18.02 per cent, protein 7.94 to 16.01 per cent and ash 0.21 to 0.23 per cent.

Patil (2012) analyzed the chemical composition of dried date burfi as follows.

Constituent	Per cent composition
Fat	14.76-16.96
Protein	13.15-14.08
Moisture	15.75-17.66
Total solids	82.34-84.25

Karuna Datarkar (2012) studied the chemical composition of singhara flour burfi as follows.

Constituent	Per cent composition
Fat	16.22-18.92
Protein	14.17-16.20
Moisture	13.91-14.51
Total solids	85.09-85.49

Bhutkar *et al.* (2015) reported that the chemical properties of elephant foot yam pulp burfi.

Constituents	Composition (per cent)
Moisture	16.85 – 30.47
Fat	17.61 – 21.95
Protein	12.18 – 14.91
Total solids	69.53 – 83.53
Ash	3.02 – 3.51

Charis *et al.* (2015) formulated nutri dense burfi and its physico-chemical components. Formulation of these burfi was found that nutritional improvement viz., protein, dietary fiber, beta-carotene, calcium, iron, zinc was noticed. However, beta-carotene in B_2 was absent since beet root does not contain beta-carotene. In order to improve the health of the public, distribution of these products must be initiated out of 100 per cent, 64 per cent liked B_1 and 73 per cent liked the product B_3, which is a good result. It can be suggested that, taste can be improved more by a little addition of chocolate and texture can be made soft by not over heating the sugar syrup and taking out from the fire soon on preparation.

Girase (2016) analyzed the chemical composition of Gulkand burfi prepared from buffalo milk as fat 20.01 to 22.66 per cent, protein 12.47 to 14.64per cent, total solids 82.09 to 85.39 per cent, moisture 14.61 to 17.91 per cent, ash 2.71 to 3.08 per cent.

2.7 Organoleptic / sensory evaluation of burfi

Swati Wankhede (2005) prepared mango burfi. The overall acceptability recorded as (96.11) when 40 per cent mango pulp concentrate by weight of khoa was incorporated and found significant better from the point of flavour, body and texture and colour and appearance of burfi.

Kamble *et al.* (2010) studied the preparation of pine apple burfi. The overall acceptability score noticed as (93.52) out of 100 when 15 per cent pine apple concentrate by weight of khoa was incorporated and found significant better from the point of flavour, body and texture and colour and appearance of burfi.

Kumbhar (2011) studied khoa burfi blended with ginger juice. He noticed that the most acceptable burfi scoring 7.70 was prepared by blending of 5 per cent ginger juice (T_1). This was followed by (T_2) 10 per cent ginger juice scoring 7.17, control (T_o) scoring 7.07, and (T_3) 15 per cent ginger juice scoring 6.78. The lowest score was 6.14 obtained by using 20 per cent ginger juice level in burfi (T_4).

Borse (2011) prepared the gulkand burfi. The overall acceptability score recorded as (96.4) out of 100 when 4 per cent gulkand concentrate by weight of khoa was incorporated and found significant better from the point of flavour, body and texture and colour and appearance of burfi.

Patil (2012) prepared the date burfi, dried date 15 per cent and 55 per cent khoa (out of 70 and 30% sugar added.) in (T_3) was incorporated and found significant from the point of flavour, body and texture and colour and appearance of burfi.

Karuna Datarkar (2012) studied that the sensory qualities of singhara flour burfi, as the average score obtained (out of 45) for the flavour of burfi under various treatment were in the range of 39 per cent to 41.35 per cent. The average score from (out of 35) for body and texture were 28.34 per cent to 32.23 per cent and average score from

(out of 20) for colour and appearance were 16.57 per cent to 18.75 per cent.

Banker *et al*. (2013) prepared pineapple burfi, it was observed that increase in the proportion of pineapple pulp in the blended khoa decreased the score for colour and appearance of burfi. The score in respect of body and texture in the range between 7.69 to 8.23 for treatments T_0 and T_2 combinations. The treatment T_2 was significantly superior over the rest of the treatments. In case of flavour, the score recorded was highest for T_2. The non significant differences were found amongst the treatment combination. In case of sweetness the mean score ranged from 7.69 to 8.55. It was lowest in T_0 and highest in T_2.

Satav *et al.* (2014) studied the effect of walnut powder on sensorial quality of burfi. It was observed that sensorial score of burfi was significantly influenced by the level of walnut powder. Addition of walnut powder negatively affected the colour and appearance, flavour, body and texture and overall acceptability of burfi. As the walnut level increased overall acceptability decreased. This might be due to bitter taste and dull colour.

Goyal *et al.* (2015) reported that the different quality attributes of herbal burfi. It was prepared with different level of Khoa (95, 90 and 85%), Stevia powder (15%), 2% safed musali powder and other minor ingredients based on sensory trails. The physico-chemical, microbial and sensory quality attributes of the products were evaluated just after preparation as well as during storage upto 10 days after interval of 2 days. The values of optical density, acidity, and TPC were increased significantly while ,the values of protein content, fat and sensory scores decreased significantly during 10 days of storage.

Girase (2016) studied on sensory quality of Gulkand burfi prepared from buffalo milk. It was observed that the burfi prepared by blending with 6 per cent gulkand (T_4) had highest score for flavour (42.54 out of 45), body and texture (33.06 out of 35) and colour and appearance (18.98 out of 20). The overall acceptability of burfi

prepared by blending with 6 per cent of gulkand (T_4) had the highest score (8.38 out of 9) by 9 point hedonic scale and ranked as the most acceptable treatment.

Tanuja *et al.* (2017) evaluated the sensory and nutritional properties of burfi prepared by incorporation of apple pomace at three different levels viz., 5, 10 and 15% and compared with control. The mean moisture and carbohydrate content increased in significant ($p<0.05$) manner while protein, fat, ash and total solids content decreased significantly ($p<0.05$) with increased level of apple pomace. The textural parameters i.e. hardness, adhesiveness, cohesiveness, gumminess and chewiness value decreased significantly but springiness increased in significant manner with apple pomace incorporation. The result of sensory parameters exhibited highest scores for T_3 treatment for appearance and colour, texture, flavour and sweetness. The overall acceptability was highest for apple pomace burfi prepared with incorporation of 15% apple pomace.

2.8 Cost of production of burfi

Swati Wankhede (2005) used mango pulp in preparation of burfi and reported that the cost of plain burfi (khoa) was Rs. 71.61 and that of the mango burfi which was superior amongst all was Rs.92.80. The value of orange burfi was 23.27 per cent higher than the cost plain burfi. Increased of level of added mango pulp should the increasing the trend in cost of production of mango khoa burfi.

Shelke *et al.* (2008) evaluate the cost structure for mango burfi. The lowest cost was observed for plain burfi as compared to mango burfi with different mango pulp level. As the level of the mango pulp increase the cost of mango burfi also increased. Cost of one kg mango burfi for treatment T_0 was worked out as Rs. 76.68 which is lowest in all the treatments, whereas the cost of production for 1 kg mango burfi in treatment T_1 (95 % khoa + 5 % mango pulp) was Rs. 79.85 for treatment T_2 the cost was Rs. 83.06 and for treatment T_3 was Rs.

85.40 only which is less than the market price. The prevailing market price of plain burfi was Rs. 125.00 per kg.

Patil (2012) studied the cost structure of date burfi and reported that the average cost of 1 kg burfi was Rs. 122 (T_1) to Rs. 124 (T_5) and that of the date burfi which was superior amongst all was Rs. 123 (T_3).

Bankar *et al.* (2013) prepared the pineapple burfi and reported that, the cost of finished product was Rs. 116 for control burfi, whereas for other treatments, it increased in proportion to pineapple pulp added. The cost of burfi with 10 per cent pulp was higher by Rs. 9.33 per kg over control burfi.

Navale *et al.* (2014) analyzed the cost configuration of wood apple burfi. The production cost of 10 per cent wood apple burfi, which had significantly higher acceptability score than the normal and other combination of wood apple burfi was Rs. 121.72 per kg and it was costlier than normal burfi by Rs. 1.51 per kg.

Wadhave *et al.* (2014) prepared honey burfi and reported the cost of production of 1 kg burfi ranges from Rs. 188.92 to 195.26. Burfi prepared with 6 per cent honey obtained maximum score for sensory evaluation and costing Rs. 193.08 per kg which was more than control.

Tawade (2015) reported cost structure of stevia liquid burfi. It was observed that, T_1 treatment i.e. burfi prepared with 0 part of stevia liquid had lowest cost of production (Rs. 255.07 per kg) while, the highest cost of production (Rs. 492.97 per kg) was observed in treatment T_5 i.e. burfi with 10 parts of stevia liquid. It was observed that, with increased in the level of stevia liquid resulted increased in the cost of production of burfi. The cost of most acceptable burfi (T_3) was Rs. 392.67 per kg.

Girase (2016) studied the effect of addition of gulkand on the cost structure of burfi prepared under various treatments. The cost of burfi prepared without addition of gulkand (T_1) was Rs. 270.42 per kg. The total cost of burfi prepared in the proportion of 98:2 (T_2), 96:4 (T_3) and 94:6 (T_4) khoa to gulkand were Rs. 276.83, 283.50 and 289.06 per kg, respectively. The increased in the levels of added gulkand showed that increased in cost of production. These differences were mainly due to cost of gulkand.

Bhosale (2017) studied the cost structure of bottle gourd burfi prepared from different treatments combination T_1, T_2, T_3 and T_4 were Rs.354.02, 341.20, 327.66 and 312.48, respectively. The increased in the levels of added bottle gourd pulp showed that decreased in the cost of production. These differences were mainly due to the removal of parts of khoa and less cost of bottle gourd.

Chapter III

MATERIAL AND METHODS

The present research work entitled “Utilization of potato (*Solanum tuberosum*) flour for preparation of burfi”, was undertaken in the Animal Husbandry and Dairy Science Section, College of Agriculture, Nagpur during the year 2017-2018. The materials and experimental procedure used during the present studies are given below.

3.1 Material required

3.1.1 Collection of milk

Clean, fresh and whole cow milk was taken from Animal Husbandry and Dairy Science Section, College of Agriculture, Nagpur. Cow milk was used for conducting the trials throughout the experiment.

3.1.2 Standardization of milk

Cow milk was used for conducting the trial throughout the experiment. The milk was standardized at 4 per cent fat by the addition of skim milk and cream was followed for adjustment of fat.

3.1.3 Ingredients used for experiment

1) Milk

2) Sugar

3) Potato

4) Cream

5) Skim milk

Good quality ingredients like milk, sugar and potato were purchased from local market.

3.1.4 Chemical used for experiment

1) Sulphuric acid (Conc. 98.08 %)
2) Amyl alcohol (Conc. 88.15 %)
3) Copper sulphate
4) Conc. Hydrochloric acid
5) Ethyl alcohol
6) Ammonia (Sp. gr. 0.8974)
7) Ethyl ether
8) Potassium sulphate
9) Sodium hydroxide
10) Phenolphthalein indicator
11) Distilled water
12) Petroleum ether (boiling range 40-60^{0}c)

3.1.5 Equipments and material used for experiment

1) Muslin cloth
2) Weighing balance
3) Thermometer
4) Measuring cylinder
5) Crucible
6) Pipette
7) Khunti (65 cm length and 7.5 cm flattened end)
8) Mojonnier fat extraction apparatus
9) Conical flask

10) Stainless steel container

11) Gas burner

12) Test tube

13) Rectangular aluminum trays

14) Stirrer-cum-scrapers (Laddle) with a top diameter of 30 cm and 16 cm depth

15) Iron Karahi (10 kg capacity) with a top diameter of 30 cm and 16 cm depth

16) Water bath

3.1.6 Preparation of Potato flour

The potato was purchased from local market and after that washed and cleaned. Fresh potato boiled in the hot water. Then cut into small pieces by using knife then dried into hot air oven or by natural sun drying process. After that grinded the pieces in mixture grinder and convert it into fine powder. The flour was used to incorporate in khoa as per treatments for preparing burfi.

3.1.7 Preparation of khoa

Milk was taken and boiled in a karahi over a brisk non-smoky fire. The milk was stirred vigorously and constantly with a circular motion by a khunti. During this operation all part of the pan with which the milk comes into contact was lightly scraped to prevent the milk from scorching. Constant evaporation of moisture takes place and the milk thickens progressively. The heating was continued with greater control hereafter the speed of stirring-cum-scrapping increase. Then the viscous mass reaches a semi solid/pasty consistency and begins to dry up then the final product was ready to use.

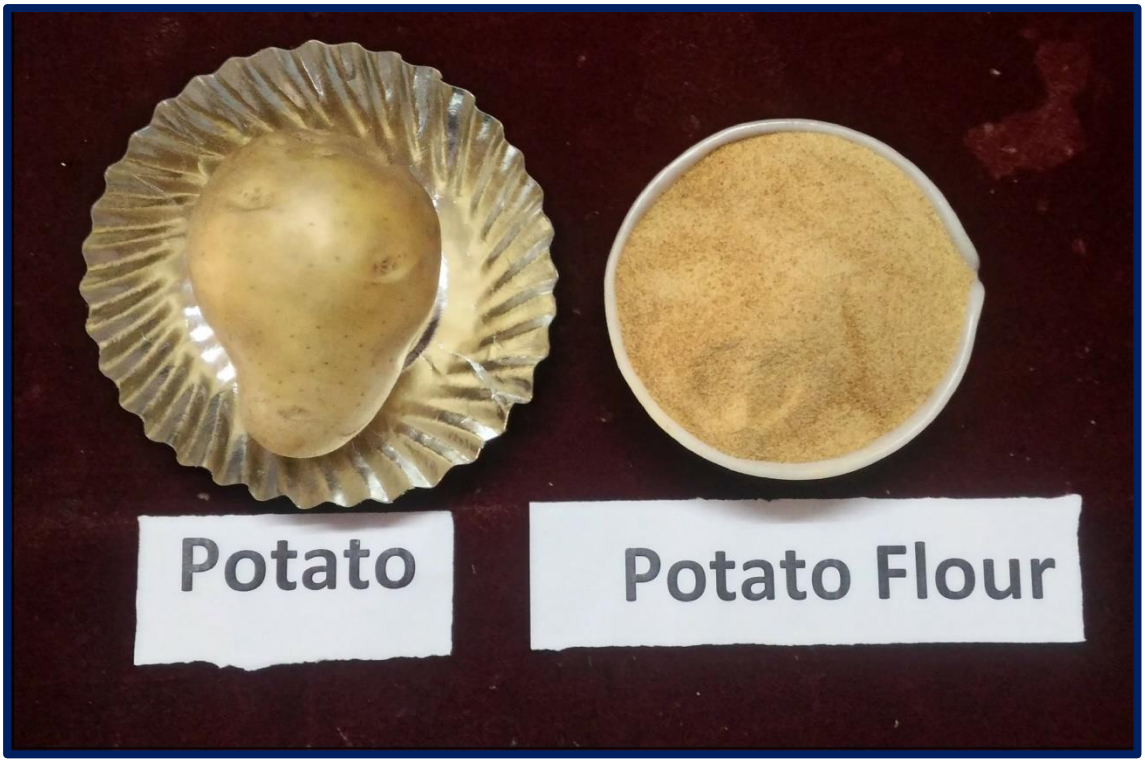


Plate 1: Potato flour used for experiments

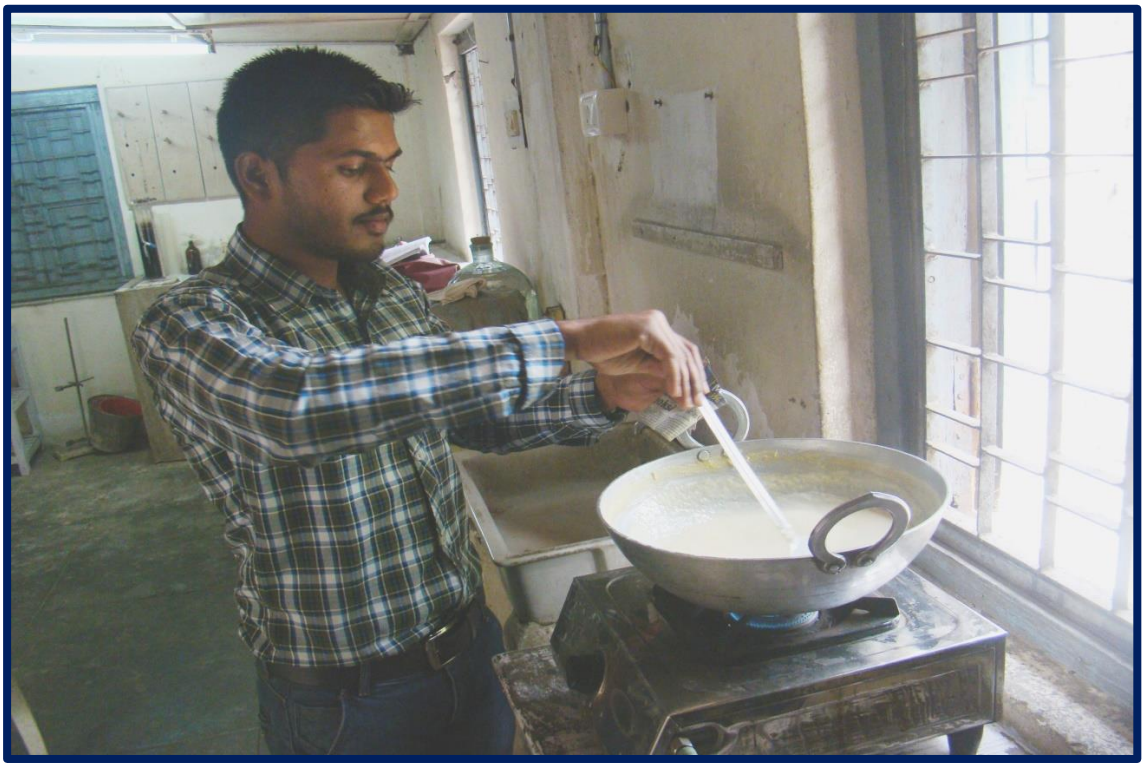


Plate 2: Preparation of khoa

3.1.8 Cleaning and sanitizing of equipments / apparatus and utensils

Cleaning and sanitizing of equipments were done by using detergent like sodium bicarbonate (washing soda) followed by drying.

3.2 Method adopted

3.2.1 Treatments details

For preparation of potato khoa burfi, following five treatments combination with four replication were studied. The ratio of khoa and potato flour are as follows.

Treatments	Khoa (parts)	Potato flour (parts)
T_1	100	00
T_2	95.0	5.0
T_3	90.0	10.0
T_4	85.0	15.0
T5	80.0	20.0

Sugar level at the rate of 30 per cent by weight of khoa was common in all the treatments.

3.2.2. Chemical analysis of milk.

Before preparing burfi the cow milk were analyzed for fat, protein, total solids, moisture, ash, etc.

1. Determination of fat

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

Procedure

1. 10 ml of sulphuric acid was taken into butyrometer with the help of automatic tilt measure.
2. 10.75 ml of milk sample was taken with the help of pipette and transferred slowly in to the butyrometer.
3. 1 ml of amyl alcohol was added in butyrometer by using automatic tilt measure.
4. Butyrometer was stoppered with lock stopper using guiding pin.
5. The contents in the butyrometer were shaken well till mahogany red colored observed.
6. Afterward butyrometer was kept in water bath at 65^0 C for 5 min. at 1100 rpm.
7. Reading of fat content of milk was taken directly on the butyrometer stem.

2. Determination of protein

The protein percentage of milk was determined as per the semi micro-Kjeldahl method as recommended in IS: 1479 (part II), 1961.

Procedure

1. Weighted 10 g of milk sample was taken accurately and transferred into Kjeldahl flask.
2. Added 25 ml of concentrated sulphuric acid in such way as to be down any milk particle adhering to the neck of the flask.
3. Added 0.2 g of copper sulphate and 10 g of potassium sulphate.
4. Digested the contents of solution till it become clear.
5. Cooled the contents and about 200 ml of distilled water and glass beads to avoid bumping.
6. Connected the flask to distillation assembly and condenser.

7. Placed 50 ml of 0.1 N H_2SO_4 solutions in a beaker and kept it below the condenser in such a way to dip the tip of condenser in this solutions.
8. Added 5 to 6 drop of indicator solution to sulphuric acid.
9. Heated the contents of Kjeldahl flask to collect distillate up to a volume of 250 ml the beaker.
10. Removed the beaker stopped heating and washed tip of condenser and collected washing in the beaker of distillate collected.
11. Titrate the distillate contents of beaker against 0.1 N sodium hydroxide solutions.
12. Determined the amount of excess sulphuric acid by subtracting amount of 0.1 N sodium hydroxide used.
13. A blank determination was also carried out simultaneously and nitrogen was calculated as under.

$$\text{Nitrogen (\%)} = \frac{(A-B) \times 0.0014}{W} \times 100$$

Where,

A = Volume in ml N/10 NaOH in blank determination

B = Volume in ml of N/10 NaOH in the rest

W = Weight in mg of sample taken

The protein per cent was calculated by multiplying nitrogen percentage with factor 6.38.

Protein (%) = Per cent total nitrogen × 6.38

3. Determination of total solids

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

Procedure

1. Flat bottomed 5 cm diameter porcelain crucible was taken, cleaned and dried in hot air oven for 1 ½ hrs.
2. Weight of crucible was taken and added 5 gm of milk sample in to it.
3. Crucible was put into hot air oven adjusted at 100^0C for 3 to 4 hours.
4. Removed the crucible from oven and cooled in a desiccator and weighted.
5. Again placed the crucible for ½ hrs. in oven.
6. Afterward the crucible from oven was removed and cooled in desiccator and weighted.
7. This process continues repeated till getting the constant weight or difference in last two weight should not exceed 0.001 gm. The total solids were determined by formula.

$$\text{Total solids (\%)} = \frac{\text{Weight of residue}}{\text{Weight of sample}} \times 100$$

4. Determination of moisture

Moisture content in the sample was determined by subtracting the total solids content from 100 in the sample.

$$\text{Moisture (\%)} = 100 - \text{total solids (\%)}$$

5. Determination of ash

The ash percentage was determined as per the method recommended in B.I.S Handbook of food analysis IS: 1165, (1967).

Procedure

1. Clean and dried the silica dish/crucible in an oven.

2. Cooled the crucible in the desiccators till the constant weight.

3. Weighed about 10 g of oven dried sample by difference and filled in the dish using two flame of gas burner, till no more smoke is given off by charged mass as sample.

4. With the help of tongs, transferred the dish to muffle furnace and ignite it at 550^{o}C for 5 hours and ensure no carbon particles be rest in the dish and ash was gray or white in colour.

5. Allowed the muffle to cool at 150^{o}C.

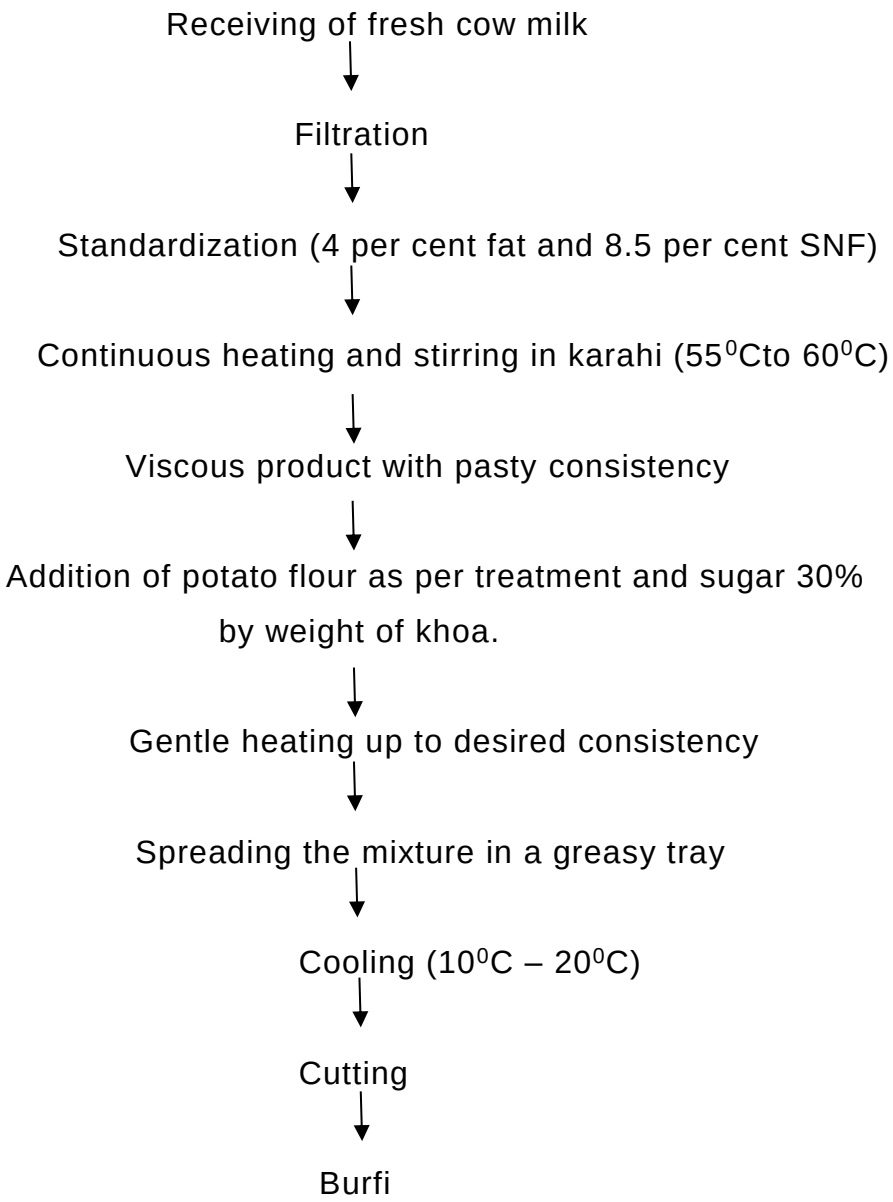
6. Removed the crucible from the furnace, cool it in desiccators and weighed. The previously recorded empty crucible weighed was subtracted and the weight of ash was determined.

$$\text{Ash (\%)} = \frac{\text{Weight of ash}}{\text{Original weight of sample}} \times 100$$

3.2.3 Preparation of burfi

Method of preparation of burfi as suggested by De (1980) was used with slight modification. The cow milk was concentrated to a pasty consistency by evaporating in open pan on gentle fire. Sugar at the rate of 30 per cent was added and heated gently till pat formation. When the product started to leave the sides of karahi (within 5 to 8 min), the potato flour was added and further heated on low flame till the product again started to leave the sides of karahi. The product taken off the flame and transferred into greasy tray and was allowed to cool and cut into a desirable size.

Fig.1: Flow chart for preparation of burfi



3.2.4 Sensory evaluation

i. The quality of burfi was judged by offering the sample to the panel of 5 judges in each trial separately. Score card method for sensory evaluation of burfi as suggested by Pal and Gupta (1985) were utilized (Appendix II).

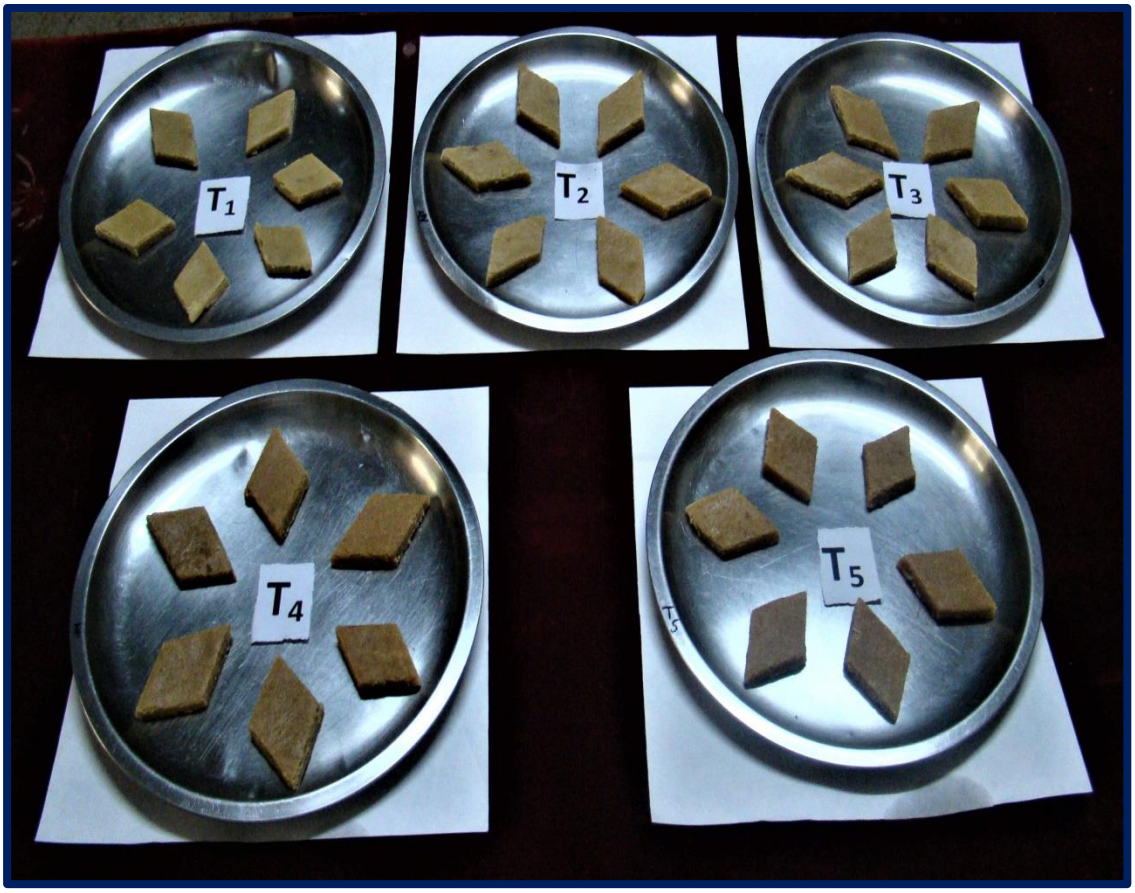


Plate 3: Potato flour burfi prepared under various treatments

Characters	Perfect score	No. of treatments				
		1	2	3	4	5
Flavour	45					
Body and texture	35					
Colour and appearance	20					
Total	100					

ii. Organoleptic evaluation for overall acceptability of the product was judged by a 9 point hedonic scale as prescribed by Nelson and Trout (1964).

Hedonic rating

Sr.No.	Remarks	Score	Sample number				
			1	2	3	4	5
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					

Note: Score of 5.5 and above indicates acceptability within the score of 1 to 9.

3.2.5 Chemical analysis of burfi

Burfi sample from all the treatments were analyzed for the following chemical constituents.

1. Determination of fat

Fat content in burfi was determined by Mojonnier fat extraction apparatus method as prescribed in B.I.S. Handbook of food analysis ISO 3889:1977.

Procedure

1. Weighted 5 gm of burfi sample and taken into a small beaker.
2. Few drops of water was added in that beaker and rubbed to a smooth paste.
3. Added 9 ml of water the first few drops being used to wash the tip of the glass rod.
4. 10 ml of conc. hydrochloric acid was added into beaker and heated on a Bunsen burner.
5. The content was transferred to the Mojonnier fat extraction flask and added 10 ml of ethyl alcohol first to the beaker and later transfer the contents to the Mojonnier fat extraction flask.
6. The content was mixed well and added 25 ml of ethyl ether to the beaker when cooled and from beaker to the Mojonnier flask.
7. Flask was stoppered with cork or a stopper of synthetic rubber unaffected by usual fat solvents and shaked vigorously for one minute.
8. Added 25 ml of petroleum ether first to the beaker and then transfer it to the Mojonnier flask and repeated vigorous shaking for one minute.
9. Decant of the clear ethereal layer into a suitable flask or dish, washed the delivery end of the extraction tube with a little ether and added the washings to the flask.
10. Repeated two extraction of the liquid remaining in the extraction tube using 15 ml of each solvent every time.

11. Added the ethereal extract to the flask and evaporate off completely the combined ether extract.
12. Dried the flask in an air-oven at 100 + 2°C, cooled and weighed, heated the flask again for 30 minutes, cooled in desiccators and weighed.
13. Repeated the process of heating for 30 minutes, cooling and weighing until the difference between two successive weights was not exceed 1 mg.
14. Removed the fat completely from the flask with the aid of small portions of the petroleum ether, dry as before and weigh.

$$\text{Fat (\%) w/w} = \frac{W_1 - W_2}{W} \times 100$$

Where, W1 = weight of dish with fat

W2 = weight of empty dish

W = weight of material taken for test

2. Determination of protein

The protein was determined by estimating the per cent nitrogen by micro- Kjeldahl method as recommend in IS: 1479 (Part II), 1961.

Procedure

1. 10 g of burfi sample was taken accurately and transferred in to Kjeldahl flask.
2. Added 25 ml of concentrated sulphuric acid in such way as to wash down any burfi particles adhering to the neck of the flask.
3. Added 0.2 g of copper sulphate and 10 g potassium sulphate.
4. Digested the contents till the solution become clear.

5. Cooled the contents and add about 200 ml of distilled water. Glass bead was added to avoid bumping.
6. Connected the flask to distillation assembly and condenser.
7. Placed 50 ml of 0.1 N H_2SO_4 solutions in a beaker and kept it bellow the condenser in such a way to dip the tip of condenser in this solution.
8. Added 5 to 6 drops of indicator solution to sulphuric acid.
9. Heated the contents of Kjeldahl flask to collect distillate up to a volume of 250 ml in the beaker.
10. Removed the beaker, stopped heating and washed tip of Condenser and collected washing in the beaker of distillate collected.
11. Titrate the distillate contents of beaker against 0.1 N sodium hydroxide solutions.
12. Determined amount of excess sulphuric acid by subtracting amount of 0.1 N sodium hydroxide used.
13. A blank determination was also carried out simultaneously and nitrogen was calculated as under.

$$\text{Nitrogen (\%)} = \frac{(A-B) \times 0.0014}{W} \times 100$$

Where,

A = Volume in ml N/10 NaOH in blank determination

B = Volume in ml of N/10 NaOH in the rest

W = Weight in mg of sample taken

The protein percent was calculated by multiplying nitrogen percentage with factor 6.38.

Protein (%) = Per cent total nitrogen x 6.38

Plate 4: Determination of fat content of potato flour burfi

Plate 5: Determination of protein content of potato flour burfi

3. Determination of total solids

The total solid percentage in burfi was determined by using gravimetric method as per the procedure of IS: 1479 (Part II) (1961).

Procedure

1. A metal dish containing 25 g of prepared sand was heated in an oven at 98-100^{0}C for about 2 hours, cool in desiccator for 30-40 min and weighed.
2. Weighed accurately about 1.5 g of sample and added about 5 ml distilled water and thoroughly mixed with the sand. Place the dish on a boiling water bath for 20 min and then transferred into the oven adjusted at 100^{O}C for one to half hours.
3. After three hours, transferred the dish into desiccator, cooled it to room temperature and weighed.
4. Repeated the process of heating, boiling and weighing until the loss of weight between two successive weighing does not exceed 0.5 mg. Noted the lowest weight. The Total solids were determined by following formula.

$$\text{Total solids (\%)} = \frac{\text{Wt. of residue obtained after drying}}{\text{Weight of burfi sample}} \times 100$$

4. Determination of Solids Not Fat

SNF was obtained by subtracting the percentage of fat from the percentage of total solids.

SNF = T.S. Percentage – Fat percentage

5. Determination of moisture

Moisture content in the sample was determined by subtracting the total solids content from 100 in the sample.

Moisture = 100 - Total solids

6. Determination of ash

Ash content of burfi was determined as per the procedure recommended in Hand book of Food Analysis Dairy Product in SP: 18 part XI (1981)

Procedure

1. Weighted 3 gm. of burfi sample was taken accurately into crucible.

2. Crucible was previously cleaned and dried in hot air oven.

3. Heated the crucible gently on a flame at first and then strongly in a muffle furnace at 550°± 20° C till gray ash obtained.

4. Cooled the crucible in desiccator and weighted.

5. Heated the crucible again at 550°± 20° C for 30 min. and cooled in desiccator and weighted.

6. Repeated this process of heating for 30 min. cooling and weighing until the difference between two successive weighing was less than one milligram.

Calculation

The ash percentage was calculated by the formula:

$$\text{Per cent of Ash} = \frac{\text{Weight of ash}}{\text{Weight of sample}} \times 100$$

3.2.6 Cost structure

The cost (Rs./kg) of the newly formulated product was worked by taking into consideration the prevailing retail rates of the ingredients used as milk, potato flour, in addition of fuel and labour charges etc. During experimental period, procedure followed for estimation of cost was on the lines of the standard economic procedure.

Plate 6: Determination of total solids and moisture content of potato flour burfi

Plate 7: Determination of ash content of potato flour burfi

3.2.7 Statistical analysis

The experiment was held out in completely randomized design (CRD) with 5 treatments and four replications. The data obtained were analyzed statistically according to method described by Snedecor and Cochran (1994) for chemical analysis, data like total solids, moisture, fat, protein, Solids Not Fat, and ash for the qualitative data like flavour, body and texture, colour and appearance and overall acceptability as same method of analysis was used.

3.3 Place/ Duration/Season of Experiments

The present research work entitled “Utilization of potato flour for preparation of burfi”, was undertaken in the Animal Husbandry and Dairy Science Section, College of Agriculture, Nagpur during the year 2017-18 from December to March.

Chapter IV

RESULTS AND DISCUSSION

The result of present investigation entitled “Utilization of potato (*Solanum tuberosum*) flour for preparation of burfi” are presented and discussed in this chapter under following heads.

4.1. Chemical composition of milk

4.2. Chemical composition of khoa

4.3. Chemical composition of potato flour

4.4 Chemical composition of burfi

4.4.1. Fat

4.4.2. Protein

4.4.3. Total solids

4.4.4. Solids Not Fat

4.4.5. Moisture

4.4.6. Ash

4.5. Sensory evaluation of burfi

4.5.1. Flavour

4.5.2. Body and texture

4.5.3. Colour and appearance

4.6 Oraganoleptic evaluation of potato burfi

4.7. Cost of production of burfi

4.1. Chemical composition of cow milk

The milk procured from Section of Animal Husbandry and Dairy Science, College of Agriculture, Nagpur was analyzed for its chemical composition. The results are tabulated in Table 1. Cow milk was standardized at 4 per cent fat and analyzed for fat, total solids, protein, moisture and ash.

Table 1: Chemical composition of cow milk (%)

Constituents	Replications				
	R-I	R-II	R-III	R-IV	**Mean**
Fat	4.03	4.04	4.02	4.05	4.03
Total solids	12.82	12.76	12.98	13.02	12.89
Protein	3.66	3.52	3.56	3.59	3.58
Moisture	87.18	87.24	87.02	86.98	87.10
Ash	0.71	0.70	0.72	0.69	0.70

Table 1 shows that, the milk standardized at 4.00 per cent fat, contains 12.89 per cent total solids, 3.58 per cent protein, 87.10 per cent moisture and ash 0.70 per cent.

The figure observed in the table indicates that the composition of cow milk meets the standard prescribed for cow milk in Maharashtra state as per FSSAI, 2006 and are of good quality.

4.2. Chemical composition of khoa

The average chemical composition of khoa was tabulated in Table 2.

Table 2: Chemical composition of khoa

Constituents	Percent
Moisture	23.53
Total solids	76.56
Fat	27.16
Protein	18.87
Acidity	0.30
Ash	3.74

Table 2 shows that, prepared khoa contains 23.53 per cent moisture, 76.56 per cent total solids, 27.16 per cent fat, 18.87 per cent protein, 0.30 per cent acidity and ash 3.74 per cent.

Tawade (2015) reported the average chemical composition of khoa as moisture 23.49 per cent, fat 27.04 per cent, protein18.89 per cent, total solids 76.51 per cent, acidity 0.30 per cent, ash 3.72 per cent.

The results are also well comparable with figure reported by Sharma and Zariwala (1978), who reported the chemical composition of khoa as moisture 9.9-14.6 per cent, fat 13.5-36.0 per cent, protein 19.8-23.3 per cent, lactose 9.88- 29.0 per cent and acidity 0.28-0.38 per cent.

4.3. Chemical composition of potato flour

Potato fruit available in market was used in the present investigation for preparation of burfi.

Chemical composition of potato flour reported by Kaur and Kochhar (2014) is given in Table 3.

Table 3: Chemical composition of potato flour (Per 100 g)

Nutrients	Potato flour
Moisture (g)	13.07
Crude protein (g)	6.22
Crude fat (g)	1.02
Crude fiber (g)	4.22
Carbohydrates (g)	73.34
Energy (Kcal)	327.42
Calcium (mg)	19.38
Iron (mg)	3.82

4.4. Chemical composition of potato flour burfi:

4.4.1 Fat

The fat content of potato flour burfi affected by blending with different levels of potato flour is given in Table 4 and graphically represented in Fig. 1.

Table 4: Effect of different levels of potato flour on fat content of burfi (per cent)

Treatments	Replications				
	R-I	R-II	R-III	R-IV	Mean
T_1	27.16	27.14	26.98	27.08	27.09[a]
T_2	25.85	25.83	25.67	25.61	25.74[b]
T_3	24.54	24.52	24.36	24.30	24.43[c]
T_4	23.23	23.21	23.05	22.99	23.12[d]
T_5	21.92	21.90	21.74	21.68	21.81[e]
S.E.(m) ±					0.055
C.D.					0.165
Result					Sig.

Values with different superscripts differ significantly (P<0.05)

It is seen from Table 4 that, the average fat content in the burfi was significantly affected due to addition of potato flour. The fat content of burfi prepared in the proportion of 100:0 (T_1), 95:05 (T_2), 90:10 (T_3), 85:15 (T_4), and 80:20 (T_5) khoa to potato flour were 27.09, 25.74, 24.43, 23.12 and 21.81 per cent, respectively. The fat content in treatment (T_1) was highest (27.09%) among all the treatments. The lowest fat content (21.81%) was observed in burfi prepared with addition of 20 parts of potato flour (T_5).

The results indicated that fat content was highest in burfi prepared without addition of potato flour (T_1). Fat content in burfi was decreased as the proportion of potato flour in the burfi increased. This might be due to low fat content in potato flour.

More or less similar results were reported by Meshram (2014), they reported that with increase in air potato flour levels, there was proportionately decrease (18.92 to 16.22%) in the fat content of burfi, this might be due to low fat content in air potato.

Likewise, Tanuja *et al*. (2017), reported that with increase in Apple pomace levels, there was proportionately decrease (24.65 to 17.44%) in the fat content of burfi, this might be due to low fat content in Apple pomace. Increase in pineapple pulp level, there was proportionately decreased (22.11 to 18.37%) in the fat content of burfi Bankar *et al*. (2013).

These results are in line with the results of present study.

4.4.2 Protein

The data pertaining to the protein content of burfi affected by blending with different levels of potato flour are presented in Table 5 and graphically represented in Fig. 2.

Table 5: Effect of different levels of potato flour on protein content of burfi (per cent)

Treatments	Replications				
	R-I	R-II	R-III	R-IV	Mean
T_1	18.87	18.80	18.68	18.82	18.79[a]
T_2	18.23	18.16	17.94	18.18	18.12[b]
T_3	17.60	17.53	17.33	17.55	17.50[c]
T_4	16.96	16.89	16.69	16.91	16.86[d]
T_5	16.33	16.26	16.06	16.28	16.23[e]
S.E.(m) ±					0.057
C.D.					0.169
Result					Sig.

Values with different superscripts differ significantly (P<0.05)

It is revealed from Table 5 that the addition of potato flour had significantly affected the protein content of burfi. The average protein content of burfi prepared in the proportion of 100:0 (T_1), 95:05 (T_2),

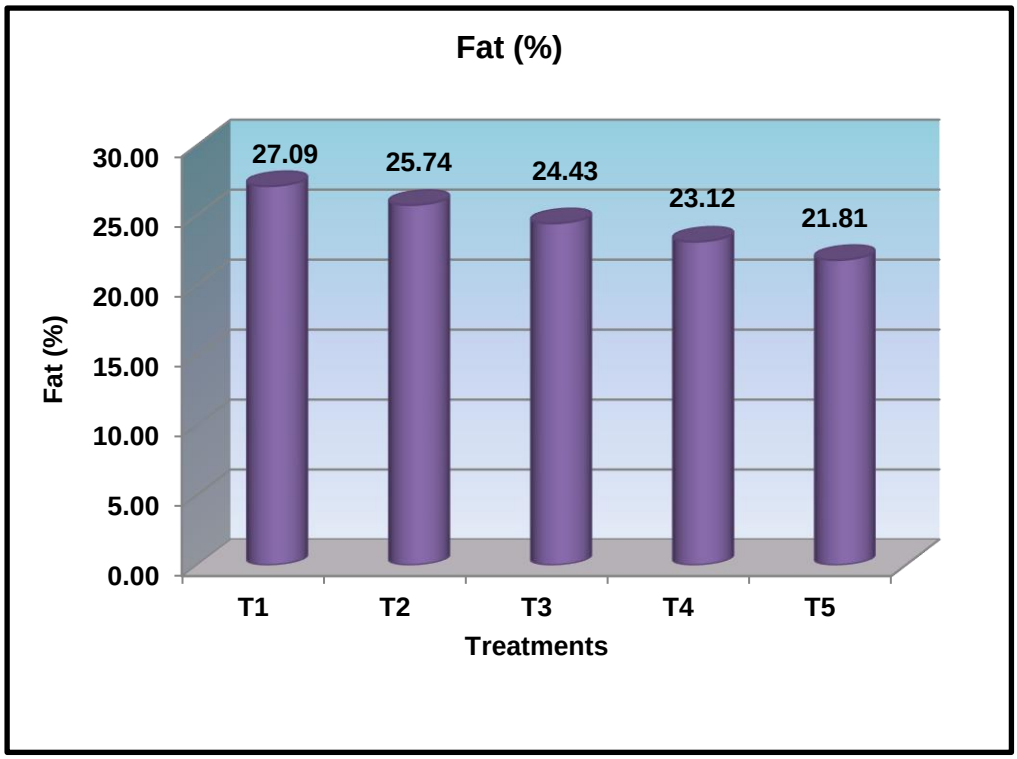


Fig.1: Effect of different levels of potato flour on Fat content of burfi (per cent)

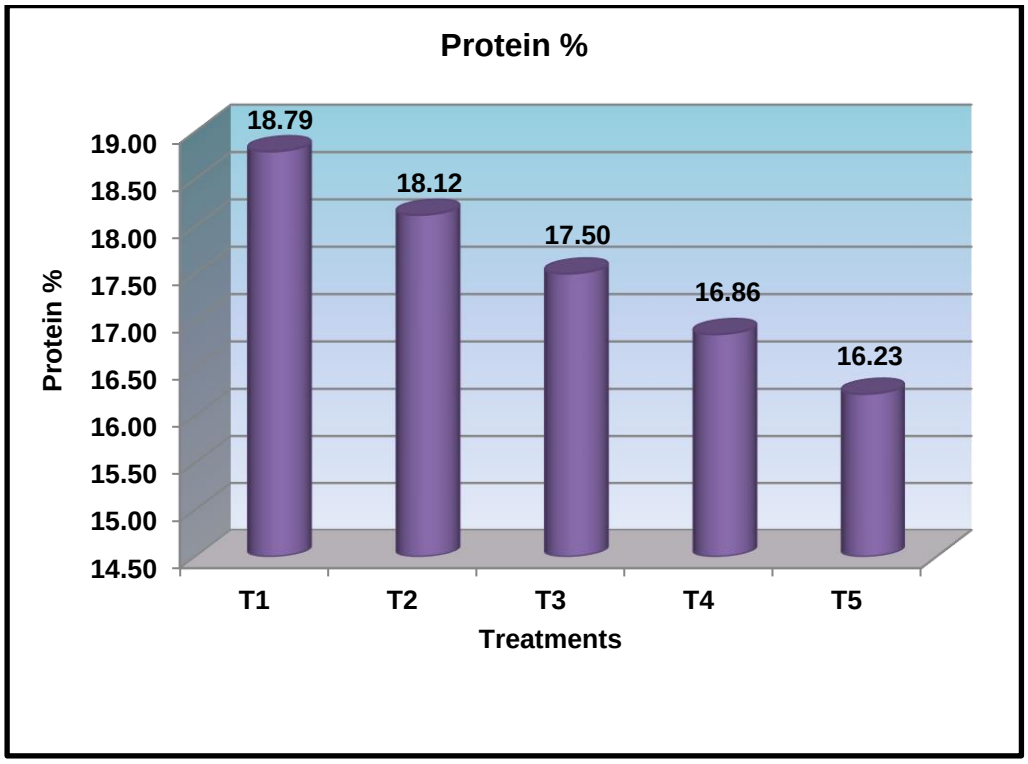


Fig.2: Effect of different levels of potato flour on protein burfi (Per cent)

90:10 (T_3), 85:15 (T_4), and 80:20 (T_5) khoa to potato flour were 18.79, 18.12, 17.50, 16.86 and 16.23 per cent, respectively. The plain burfi (T_1) prepared without addition of potato flour had highest protein content (18.79%) while, burfi prepared with 20 parts of potato flour had lowest (16.23%) protein content in (T_5) treatment.

It was observed that from the present study that as the level of potato flour increased, there was decreased in the protein content in the burfi. This might be due to low protein contents (6.22%) in the potato flour as compared to the protein content in khoa.

More or less similar results were reported by Karuna Datarkar (2012), she reported that with the increase in the levels of singhara flour, there was proportionate decreased (16.20 to 14.17%) in the level of protein. Likewise Anurag and Chawla (2016) also reported that with the increase in the levels of bottle gourd pulp, there was proportionate decrease (18.06 to 10.47%) in the level of protein content in burfi.

These results are comparable with the results of present study.

4.4.3 Total solids

The data pertaining to the total solids content of burfi affected by blending with different levels of potato flour are presented in Table 6 and graphically represented in Fig. 3.

It is inferred from Table 6 that, the addition of potato flour in preparation of burfi significantly affected the total solids content. The average value of total solids content in burfi prepared in the proportion of 100:0 (T_1), 95:05 (T_2), 90:10 (T_3), 85:15 (T_4) and 80:20 (T_5) khoa to potato flour were 76.69, 77.20, 77.70, 78.17 and 78.75 per cent, respectively. Significantly highest total solids were noticed in T_5 (78.75%). It is indicated that as the potato flour level increased, total solids content in burfi also increased. This was due to higher content of total solids (86.93%) in potato flour.

Table 6: Effect of different levels of potato flour on total solids content of burfi (per cent)

Treatments	Replications				
	R-I	R-II	R-III	R-IV	Mean
T_1	76.56	76.60	77.02	76.58	76.69[e]
T_2	77.07	77.11	77.53	77.09	77.20[d]
T_3	77.55	77.69	78.01	77.57	77.70[c]
T_4	78.05	78.09	78.50	78.07	78.17[b]
T_5	78.62	78.66	79.08	78.64	78.75[a]
S.E.(m) ±					0.109
C.D.					0.322
Result					Sig.

Values with different superscripts differ significantly (P<0.05)

Karuna Datarkar (2012), reported that with the increase in singhara flour level, there was proportionately increased (85.49 to 86.09%) in the total solids content of burfi. The result obtained in present study are also comparable with the results observed by Adani (2011), who reported that with the increase in the levels of dried date, there was proportionate increased (77.43 to 81.03%) in the level of total solids contents in burfi.

It was noticed that total solids content of besan (Gram flour) burfi was significantly increased with the addition of besan. It was seen that as the level of gram flour increases, there was an increase in content of burfi. This might be due to higher total solids content of gram flour. Increase in gram flour level, there was proportionately increased (79.63 to 83.00%) in the total solids content of burfi Sable (2005).

These findings are agreeable with the findings of present study.

4.4.4 Solids Not Fat

The data pertaining to the solids not fat content of burfi affected by blending with different levels of potato flour are presented in Table 7 and graphically represented in Fig. 4.

Table 7: Effect of different levels of potato flour on solids not fat content of burfi (per cent)

Treatments	Replications				
	R-I	R-II	R-III	R-IV	Mean
T_1	49.40	49.46	50.04	49.50	49.60[e]
T_2	51.22	51.28	51.86	51.48	51.46[d]
T_3	53.00	53.07	53.65	53.27	53.24[c]
T_4	54.82	54.88	55.45	55.08	55.05[b]
T_5	56.70	56.76	57.34	56.96	56.94[a]
S.E.(m) ±					0.145
C.D.					0.429
Result					Sig.

Values with different superscripts differ significantly (P<0.05)

The data presented in Table 7, indicates the different levels of potato flour had influenced on the Solids not fat contents in burfi significantly. The average value of Solids not fat content in burfi prepared in proportion of 100:0 (T_1), 95:05 (T_2), 90:10 (T_3), 85:15 (T_4) and 80:20 (T_5) khoa to potato flour were 49.60, 51.46, 53.24, 55.05 and 56.94 per cent, respectively. Significantly highest solids not fat were noticed in T_5 (56.94). It is indicated that the potato flour level highest level increased, solids not fat content in burfi also increased. This was due to the higher content of solids not fat in to potato flour.

The results obtained in present study were agreeable with the results reported by Meshram (2014), who observed that with the increase in the level of air potato flour, there was proportionate increased (66.08 to 73.58 %) in the level of solids not fat content in burfi.

Furthermore, Bhosale (2017), also reported that with the increase in bottle gourd pulp level, there was proportionately increased (65.95 to 67.35%) in the solids not fat content of burfi.

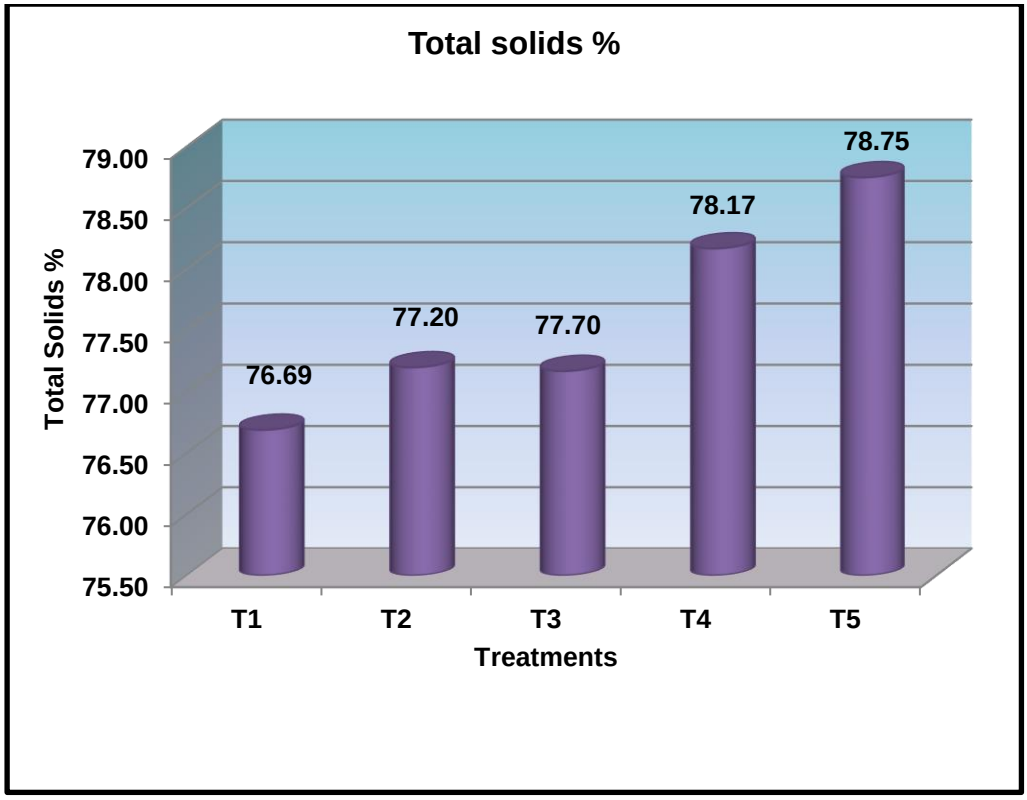


Fig.3: Effect of different levels of potato flour on total solids content of burfi (Per cent)

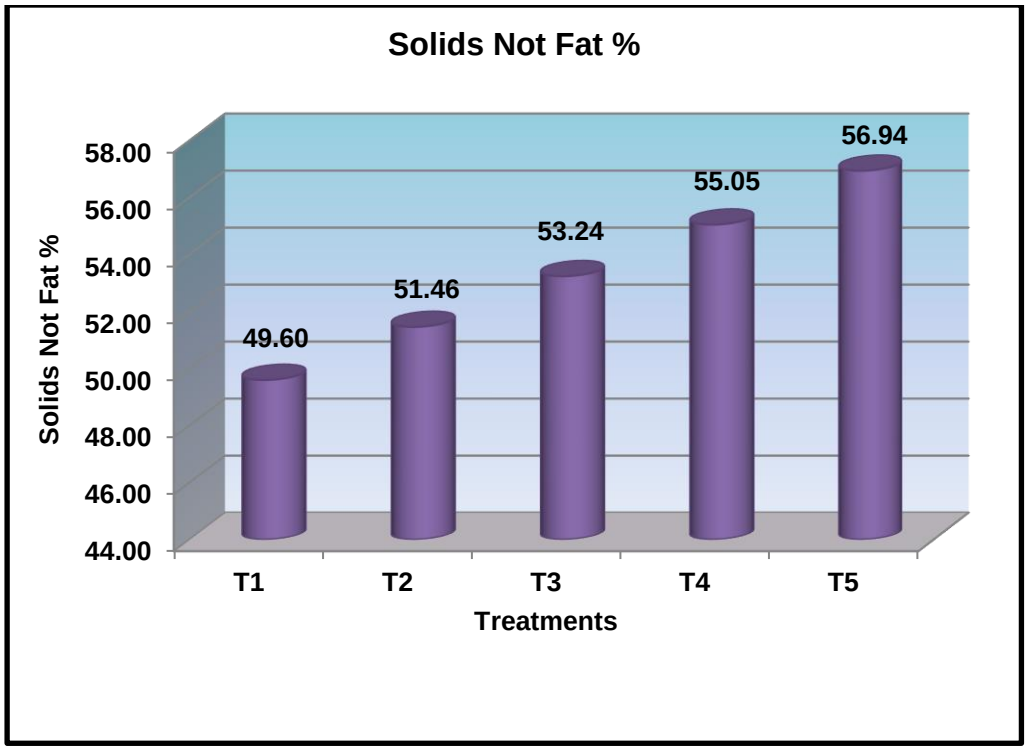


Fig.4: Effect of different levels of potato flour on solids not fat content of burfi (Per cent)

4.4.5 Moisture

The data pertaining to the moisture content of burfi affected by blending with different levels of potato flour are presented in Table 8 and graphically represented in Fig. 5.

Table 8: Effect of different levels of potato flour on moisture content of burfi (per cent)

Treatments	Replications				
	R-I	R-II	R-III	R-IV	Mean
T_1	23.44	23.40	22.98	23.42	23.31[a]
T_2	22.93	22.89	22.47	22.91	22.80[b]
T_3	22.45	22.41	21.99	22.43	22.32[c]
T_4	21.95	21.91	21.50	21.93	21.82[d]
T_5	21.38	21.34	20.92	21.36	21.25[e]
S.E.(m) ±					0.109
C.D.					0.325
Result					Sig.

Values with different superscripts differ significantly (P<0.05)

The data presented in Table 8 indicates the different levels of potato flour had influenced on the moisture content in burfi significantly. The mean moisture content of burfi prepared in the proportion of 100:0 (T_1) 95:05 (T_2), 90:10 (T_3), 85:15 (T_4), and 80:20 (T_5) khoa to potato flour were 23.31, 22.80, 22.32, 21.82, and 21.25 per cent. The moisture content (23.31%) of burfi prepared without addition of potato flour (T_1) was significantly highest than rest of the treatments. As potato flour level increased, moisture content in burfi decreased and vice vers**a.**

It was observed that moisture content of potato burfi was decreased with addition of potato flour, as the level of potato flour increases, there was an decrease in content in potato flour burfi. This might be due to lowest moisture content of potato flour.

More or less similar results were reported by Meshram (2014), they noticed that with the increase in levels of air potato flour, there

was proportionately decreased (15 to 10.20%) in the moisture content of burfi.

Likewise, Adani (2011) also observed that with the increase in the levels of date paste, there was proportionately decrease (22.56 to 18.96%) in the level of moisture content in burfi.

These results are in line with the results of present study.

4.4.6 Ash

The data pertaining to the ash content of burfi affected by blending with different levels of potato flour are presented in Table 9 and graphically represented in Fig. 6.

Table 9: Effect of different levels of potato flour on ash content of burfi (per cent)

Treatments	Replications				
	R-I	R-II	R-III	R-IV	Mean
T_1	3.10	3.14	3.13	3.15	3.13^{a}
T_2	3.08	3.12	3.11	3.13	3.11^{ab}
T_3	3.06	3.10	3.09	3.11	3.09^{bc}
T_4	3.03	3.07	3.06	3.08	3.06^{cd}
T_5	3.00	3.04	3.03	3.05	3.03^{d}
S.E.(m) ±					0.010
C.D.					0.032
Result					Sig.

Values with different superscripts differ significantly (P<0.05)

It seen from Table 9 indicates that, addition of potato flour in preparation of burfi significantly affected the ash content of burfi. The ash content in burfi prepared in the proportion of 100:0 (T_1) 95:05 (T_2), 90:10 (T_3), 85:15 (T_4), and 80:20 (T_5) khoa to potato flour were 3.13, 3.11, 3.09, 3.06, and 3.03 per cent respectively, with the range of 3.13 (T_1) to 3.03 (T_5) per cent. The maximum ash (3.13%) was noticed in burfi prepared without addition of potato flour (T_1) while minimum ash (3.03%) was noticed in burfi prepared with addition of 20 parts of

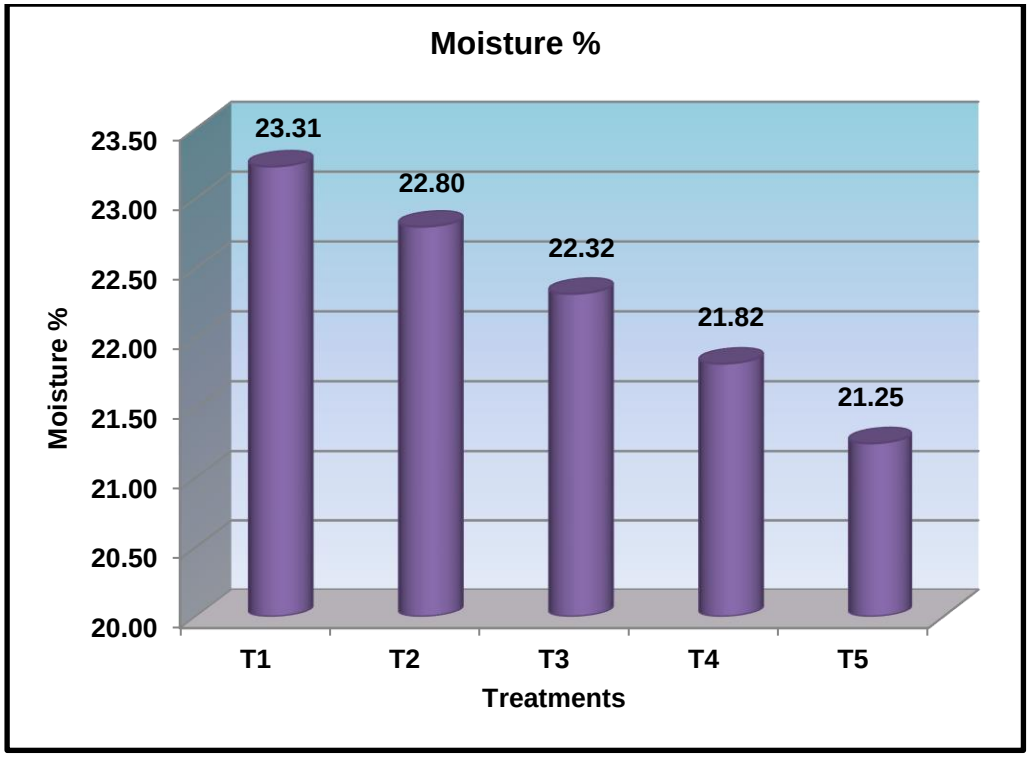


Fig.5: Effect of different levels of potato flour on moisture content of burfi (Per cent)

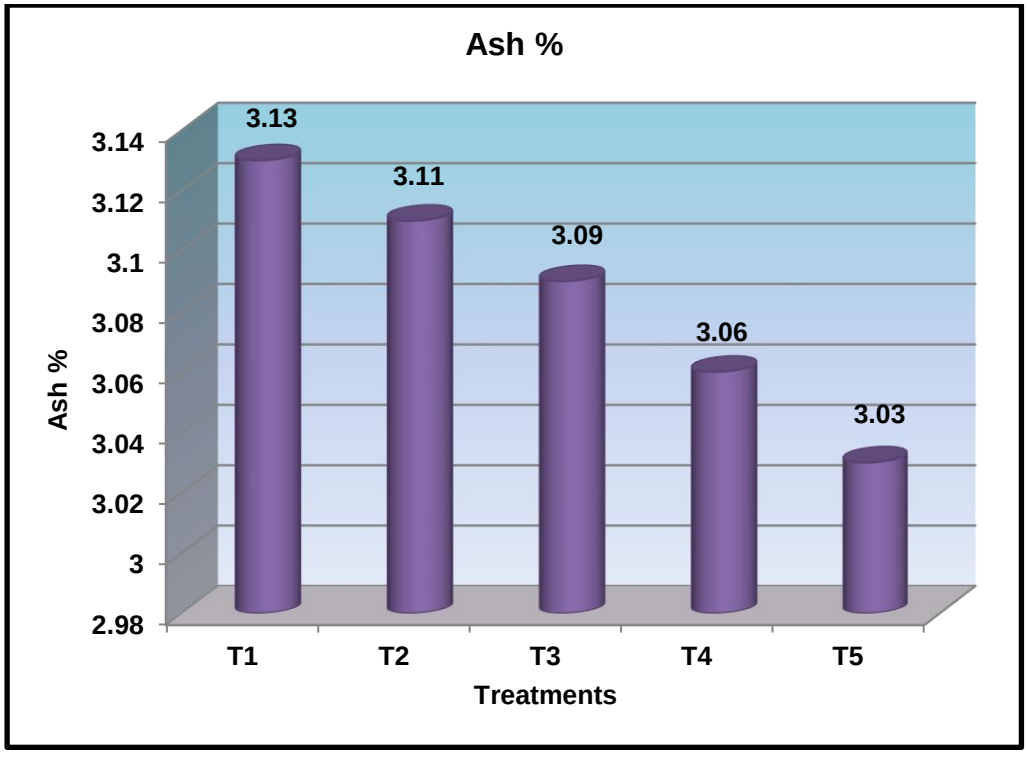


Fig.6: Effect of different levels of potato flour on ash content of burfi (Per cent)

potato flour. The data indicated that ash decreases with increased level of potato flour added in the burfi.

It was observed that increase in the level of potato flour in burfi, there was decreased in the ash content. This might be due to the low content of mineral in potato flour.

The results of present study are in agreement with Meshram (2014), who reported that the level of air potato flour increased the ash content of burfi decreased from 3.50 to 2.40 per cent. Likewise, Karuna Datarkar (2012) also reported that with the increase in the levels of singhara flour, there was decreased 3.70 to 3.36 per cent in ash content in burfi prepared with addition of singhara flour.

Kapila Kamble (2010) while studied on preparation of pine apple pulp burfi observed the chemical composition of burfi as 3.02 to 2.50 per cent ash.

Table 10: Overall average chemical composition of burfi prepared with different levels of potato flour (per cent).

Treatments	Parameters					
	Fat	Protein	Total solids	Solids Not Fat	Moisture	Ash
T_1	27.09^{a}	18.79^{a}	76.69^{e}	49.60^{e}	23.31^{a}	3.13^{a}
T_2	25.74^{b}	18.12^{b}	77.20^{d}	51.46^{d}	22.80^{b}	3.11^{ab}
T_3	24.43^{c}	17.50^{c}	77.70^{c}	53.24^{c}	22.32^{c}	3.09^{bc}
T_4	23.12^{d}	16.86^{d}	78.17^{b}	55.05^{b}	21.82^{d}	3.06^{cd}
T_5	21.81^{e}	16.23^{e}	78.74^{a}	56.94^{a}	21.25^{e}	3.03^{d}
S.E. (m) ±	0.055	0.057	0.109	0.145	0.109	0.010
C.D.	0.165	0.169	0.322	0.429	0.325	0.032

Values with different superscripts differ significantly (P<0.05)

The above mentioned results are already discussed in individual tables.

4.5 Sensory evaluation of potato flour burfi

The samples of fresh product were subjected to organoleptic evaluation by well trained panel of 5 judges. The same judges evaluated the samples of each trial throughout the experiment to avoid the possibility to variation. The evaluation was done for the flavour, body and texture and colour and appearance as per the method suggested by Pal and Gupta, (1985).

4.5.1 Flavour

The data pertaining to sensory score for flavour in respect of different levels of potato flour in burfi are presented in Table 11 and graphically represented in Fig. 7.

Table 11: Score for flavour of burfi with different levels of potato flour (Score out of 45)

Treatments	Replications				
	R-I	R-II	R-III	R-IV	Mean
T_1	40	41	40	42	40.75^b
T_2	42	42	39	41	41.00^b
T_3	44	44	45	43	44.00^a
T_4	41	40	41	40	40.50^b
T_5	43	40	40	38	40.25^b
S.E.(m) ±					0.639
C.D.					1.891
Result					Sig.

Values with different superscripts differ significantly (P<0.05)

It is observed from Table 11 that, the score for flavour was 40.75, 41.00, 44.00, 40.50 and 40.25 for burfi was samples prepared in the proportion of 100:0 (T_1), 95:05 (T_2), 90:10 (T_3), 85:15 (T_4) and 80:20 (T_5) khoa to potato flour. The flavour of burfi was significantly affected due to addition of potato flour. Significantly highest score (44 out of 45) was received by burfi prepared with 10 parts of potato flour

Plate 8: Sensory evaluation of potato flour burfi

(T_3). The mild pleasant flavour was obtained in the burfi prepared with addition of 10 parts of potato flour. Hence, result indicated that the burfi prepared with 10 parts (44.00) of potato flour was superior over 05,15, and 20 parts levels. It showed that increase in level of potato flour, increase the flavour score of burfi up to certain limit and thereafter it decrease proportionately.

Meshram (2014) observed that increase in the level of air potato flour resulted in better flavour of burfi and noticed increased the better flavour score (35.80 to 43.60), proportionately. He further inferred that cow milk burfi prepared with 7.5 per cent air potato levels gives better flavour (43.60) than other treatments. These results are in conformity with the findings of present investigation.

On contrary, Karuna Datarkar (2012) observed that as the level of singhara flour increases, resulted better flavour of burfi up to certain limit and thereafter it decreased proportionately. Likewise, Kapila Kamble *et al*. (2010) also reported that increase in level of pine-apple pulp, the flavour of burfi also increases up to certain limit and thereafter, recorded decreased score (42.16 to 39.68).

4.5.2 Body and texture

The data pertaining to sensory score for body and texture in respect of different levels of air potato flour for burfi. It are presented in Table 12 and graphically represented in Fig 8.

Table 12: Score for body and texture of burfi with different levels of potato flour (Score out of 35)

Treatments	Replications				
	R-I	R-II	R-III	R-IV	Mean
T_1	31	30	30	32	30.75^b
T_2	32	33	31	30	31.50^b
T_3	34	34	33	34	33.75^a
T_4	32	32	32	30	31.50^b
T_5	31	31	29	30	30.25^b
S.E.(m) ±					0.487
C.D.					1.442
Result					Sig.

Values with different superscripts differ significantly (P<0.05)

It is observed from Table 12 that, the score for body and texture was 30.75, 31.50, 33.75, 31.50 and 30.25 for burfi samples of burfi prepared in the proportion of 100:0 (T_1) 95:05 (T_2), 90:10 (T_3), 85:15 (T_4), and 80:20 (T_5) khoa to potato flour. The body and texture of burfi was significantly affected due to addition of potato flour. The significantly highest score (33.75 out of 35) was obtained by burfi prepared with 10 parts of potato flour. The body and texture score of burfi in treatment T_3 (33.75) was superior over rest of the treatments which had soft body and smooth grained texture burfi.

It is revealed that as the levels of potato flour increases, the score for body and texture of burfi also increased up to certain limit and thereafter it decrease gradually.

The above results are in agreement with the results obtained by Karuna Datarkar (2012), she reported that as the level of singhara flour increased, the score (32.23) for body and texture of burfi also increases up to certain limit.

On contrary, Meshram (2014) reported that increase in the level of air potato flour the score for body and texture of burfi also increased (28.60 to 33.80) up to certain limit and thereafter it decreased

gradually. Similarly, Borse (2011) observed that as the levels of gulkand increases, the score for body and texture of burfi also increased up to certain limit and thereafter, it decreased gradually.

4.5.3 Colour and appearance

The data pertaining to sensory score for colour and appearance in respect of different levels of potato flour for burfi is presented in Table 13 and graphically represented in Fig. 9.

Table 13: Score for colour and appearance of burfi with different levels of potato flour (Score out of 20)

Treatments	Replications				
	R-I	R-II	R-III	R-IV	Mean
T_1	15	16	15	17	15.75^{b}
T_2	16	16	17	15	16.00^{b}
T_3	19	19	18	18	18.50^{a}
T_4	18	18	17	16	17.25^{ab}
T_5	17	17	16	13	15.75^{b}
S.E.(m) ±					0.566
C.D.					1.676
Result					Sig.

Values with different superscripts differ significantly (P<0.05)

It is observed from Table 13 that, the score for colour and appearance was 15.75, 16.00, 18.50, 17.50 and 15.75 for burfi samples prepared in the proportion of 100:0 (T_1), 95:05 (T_2), 90:10 (T_3), 85:15 (T_4), and 80:20 (T_5) khoa to potato flour. The colour and appearance of the burfi was significantly affected due to addition of potato flour. The significantly highest score (18.50 out of 20) was obtained by burfi prepared with 10 parts of potato flour (T_3) as compared to other treatments. Hence, it is indicated that increase in the level of potato flour resulted in better colour and appearance of burfi up to certain limit and thereafter it decreased proportionately.

The results obtained in present study are in accordance with the results reported by Meshram (2014), he found that cow milk burfi prepared with 7.5 (T_4) per cent air potato was superior in colour and appearance (18.40 out of 20) than plain burfi.

Table14: Overall average sensory score of burfi as affected by different treatments (out of 100)

Treatments	Parameters		
	Flavour (45)	Body &Texture (35)	Colour & Appearance (20)
T_1	40.75^b	30.75^b	15.75^b
T_2	41.00^b	31.50^b	16.00^b
T_3	44.00^a	33.75^a	18.50^a
T_4	40.50^b	31.50^b	17.25^{ab}
T_5	40.25^b	30.25^b	15.75^b
S.E. (m) ±	0.639	0.487	0.566
C.D.	1.891	1.442	1.676

Values with different superscripts differ significantly (P<0.05)

The combined Table 14 for overall average sensory parameters score of burfi showed that the burfi prepared with 10 parts of potato flour (T_3) was superior over rest of the treatments in the proportion of 100:0 (T_1), 95:05 (T_2), 85:15 (T_4), and 80:20 (T_5) khoa to potato flour. The results were already discussed in individual tables.

4.6 Oraganoleptic evaluation of potato burfi

Oraganoleptic evaluation of overall acceptability of product was judged by a 9 point Hedonic scale as prescribed by (Nelson and Trout, 1964). The data pertaining to organoleptic evaluation for overall acceptability of burfi blended with different potato flour levels of burfi is presented in Table 15 and graphically represented in Fig. 8.

Table 15: Score for organoleptic evaluation of burfi prepared with different levels of potato flour on the basis of 9 point Hedonic scale.

Treatments	Replications				
	R-I	R-II	R-III	R-IV	Mean
T_1	6	7	8	6	6.75^{b}
T_2	7	8	6	7	7.00^{b}
T_3	9	9	9	8	8.75^{a}
T_4	8	8	7	6	7.25^{ab}
T_5	8	6	4	5	5.75^{b}
S.E.(m) ±					0.532
C.D.					1.575
Result					Sig.

Values with different superscripts differ significantly (P<0.05)

It is revealed from table 15. that, the mean scores for overall acceptability of burfi prepared in the proportion of 100:0 (T_1), 95:05 (T_2), 90:10 (T_3), 85:15 (T_4) and 80:20 (T_5) khoa to potato flour were 6.75, 7.00, 8.75, 7.25 and 5.75 respectively. The score of (9 point Hedonic scale) burfi prepared with 10 parts of potato flour (T_3) was highest amongst all the treatments followed by T_4 (15 parts), T_2 (5 parts), T_1 (0 parts), T_5 (20 parts), respectively.

From the results, it can be concluded that burfi prepared with addition of 10 parts potato flour (T_3) level had highest overall acceptability (8.75 out of 9) as compared to 05 (T_2), 15 (T_4) and 20 (T_5) parts of potato flour.

The present results study are in line with Karuna Datarkar (2012) and Adani (2011), they reported significant effect of addition of singhara flour (T_2) 5% and date paste (T_4) 4% respectively on the overall acceptability of burfi.

Meshram (2014) prepared air potato flour burfi. He also reported highest score for overall acceptability in T_4 (7.5) was 8.20 and lowest score in T_1 (0%) was 5.20 respectively, out of 9 point hedonic scale.

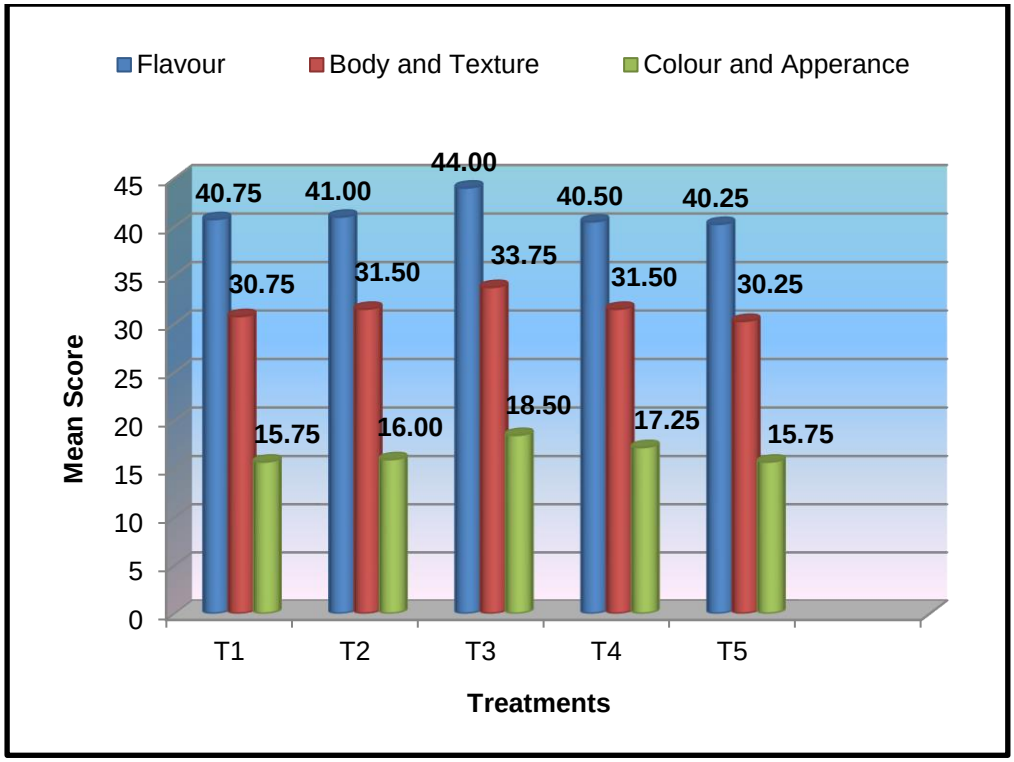


Fig.7: Effect of different levels of potato flour on score of sensory evaluation of burfi (score out of 100)

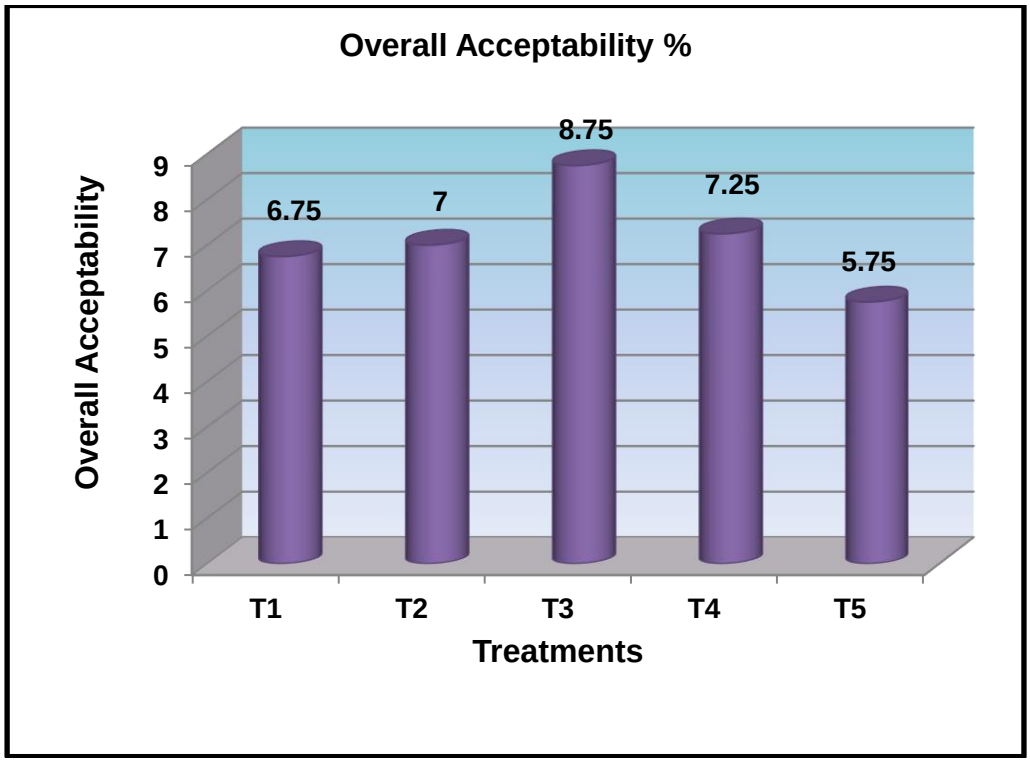


Fig.8: Effect of different levels of potato flour on (9 point Hedonic scale) overall acceptability of burf

4.7 Cost structure of burfi

The effect of addition of potato flour on the cost structure of burfi prepared under various treatments was studied and presented in table 16.

The cost of production of 1 kg burfi under various treatments was calculated by considering the prevailing retail market price for various items i.e. milk, potato flour, sugar, fuel, labour charges and electricity charge.

The cost of burfi prepared without addition of potato flour (T1) in (control) was Rs.432.34 per kg. The average total cost of burfi prepared in the proportion of 95:05 (T_2), 90:10 (T_3), 85:15 (T_4), and 80:20 (T_5) khoa to potato flour were Rs. 421.06, 409.53, 402.44 and 389.51 per kg, respectively.

The data showed that the cost of production 1 kg burfi was found to be decreased as the levels of potato flour increased. The labour charges was required 115 Rs. per 1 Kg. burfi may be reduced when large scale or industrial scale production of burfi will be carried out.

The highest cost of production of plain burfi was Rs. 223.06 per kg while lowest cost i.e. Rs. 216.82 per kg was observed in value added burfi blended with 10 per cent air potato flour was also observed by Meshram (2014). The cost of production of burfi was decreased with increase in the level of bottle gourd. The cost of production was higher of treatment T_1 with 0 parts of bottle gourd level (Rs.354.02 per kg) while the burfi prepared by blending with 15 parts of bottle gourd level (T_4 treatment) costing (Rs.312.48 per kg) which was superiorly accepted by panel of judges (Bhosale, 2017).

These findings are supportive to the findings of present study.

Hence, it was noticed that addition of 10 per cent potato flour (T_3) can produce superior quality burfi and would receive more price in market.

Table 16: Cost of production for 1 Kg potato flour burfi prepared under various treatments

Items	Treatments									
	T1		T2		T3		T4		T5	
	Qty	Value (Rs)	Qty	Value (Rs)	Qty	Value (Rs)	Qty	Value (Rs)	Qty	Value (Rs)
Milk (lit.) @ Rs 40/lit. (Khoa g)	3.00 (462)	120	3.00 (463)	120	3.00 (364)	120	3.00 (460)	120	3.00 (466)	120
Potato flour (gm) @ Rs.100/kg	0	0	23.15	2.31	46.4	4.64	69	6.9	93.2	9.32
Sugar @ 30% (by weight of khoa) (gm) @ 40/kg	138	5.52	138	5.52	138	5.52	138	5.52	138	5.52
Fuel Charges LPG (gm) Rs. 750/14.2 kg	500	27.00	500	27.00	500	27.00	500	27.00	500	27.00
Electricity charges @Rs. 5/Unit	0.40	2.00	0.40	2.00	0.40	2.00	0.40	2.00	0.40	2.00
Labour charges @ Rs 230/8hrs	4	115	4	115	4	115	4	115	4.00	115
Total		269.52		272.83		273.98		276.42		278.84
Cost of burfi / kg (Rs.)		432.34		421.06		409.53		402.44		389.51

Chapter V

SUMMARY AND CONCLUSIONS

The present investigation entitled “Utilization of potato (*Solanum tuberosum*) flour for preparation of burfi” was undertaken during the year 2017-18. The purpose of present investigation was to standardize the optimum level of potato on the basis of physico-chemical properties and sensory and organoleptic evaluation of burfi. An attempt has also been made to estimate the cost structure of finished product.

The cow milk was standardize to 4% fat and the burfi was prepared by addition of potato flour in the proportion of 100:0 (T_1), 95:05 (T_2), 90:10 (T_3), 85:15 (T_4) and 80:20 (T_5) with 30 per cent sugar by weight of khoa was added. The cow milk was concentrated to a pasty consistency by evaporating in open pan on gentle fire. Sugar at the rate of 30 per cent was added and heated gently till pat formation. When the product started to leave the sides of karahi (within 5 to 8 min), the potato flour was added and further heated on low flame till the product again started to leave the sides of karahi.

The burfi prepared were analyzed for chemical constituents like fat, protein, total solids, solids not fat, moisture, ash and sensory evaluation like flavour, body and texture and colour and appearance with five treatments and four replications. The data were statistically analyzed by CRD.

The results obtained in present investigation are summarized and concluded in this chapter.

5.1 Chemical composition of potato flour burfi

5.1.1 Fat

The highest fat content i.e. 27.09 per cent was observed in burfi prepared in the proportion of 100:0 khoa to potato flour. While the fat percentage was decreased to 25.74, 24.43, 23.12 and 21.81 in the proportion of burfi prepared with 95:05 (T_2), 90:10 (T_3), 85:15 (T_4) and

80:20 (T_5) khoa to potato flour, respectively. The fat percentage of burfi was decreases continuously with increase in the levels of potato flour.

5.1.2 Protein

Protein content of burfi was significantly affected due to the addition of different levels potato flour. Protein content of burfi prepared in the proportion of 100:0 (T_1) 95:05 (T_2), 90:10 (T_3), 85:15 (T_4) and 80:20 (T_5) khoa to potato flour were 18.79, 18.12, 17.50, 16.86 and 16.23 per cent, respectively. The protein content of burfi was decreased with increase in the level of potato flour. The highest protein content i.e. 18.79 per cent was observed in burfi prepared in the proportion of 100:0 khoa to potato flour.

5.1.3 Total solids

Total solids content of burfi increases with the increase in the level of potato flour. The total solids content of burfi prepared in the proportion of 100:0 (T_1), 95:05, (T_2), 90:10 (T_3), 85:15 (T_4) and 80:20 (T_5) khoa to potato flour were 76.69, 77.20, 77.70, 78.17 and 78.75 per cent, respectively. The maximum total solids content (78.75%) was noticed in burfi with 20 parts of potato flour in T_5 treatment; whereas lowest percentage 76.69 was noticed in burfi with 0 part potato flour. (T_1). Addition of potato flour increases the total solids content of burfi also increases.

5.1.4. Solids Not Fat

Solids not fat content of burfi increase with increase in the levels of potato flour. The solids not fat content of burfi prepared with addition of potato flour at 0% (T_1), 05% (T_2), 10% (T_3), 15% (T_4) and 20% (T_5) were 49.60, 51.46, 53.24, 55.05 and 56.94 per cent, respectively. The maximum solids not fat content (56.94 per cent) was noticed in burfi with addition of potato flour (T_5) whereas, lowest percentage (49.60 per cent) was noticed in burfi prepared without addition of potato flour (T_1).

5.1.5 Moisture

Moisture content of burfi was significantly affected due to the addition of different levels of potato flour. Moisture content of burfi prepared in the proportion of 100:0 (T_1), 95:05, (T_2), 90:10 (T_3), 85:15 (T_4) and 80:20 (T_5) khoa to potato flour were 23.31, 22.80, 22.32, 21.82 and 21.25 per cent, respectively. The highest moisture content i.e. 23.31 per cent was observed in burfi prepared in the proportion of 100:0 khoa to potato flour. The moisture content of burfi was decreased with increase in the level of potato flour.

5.1.6 Ash

The highest ash percentage was observed in burfi prepared in the proportion of 100:0 (T_1), 95:05 (T_2), 90:10 (T_3), 85:15 (T_4) and 80:20 (T_5) khoa to potato flour were 3.13, 3.11, 3.09, 3.06 and 3.03 per cent ash, respectively. The ash content of burfi was decrease with increase in the levels of potato flour.

5.2 Sensory qualities of potato burfi.

5.2.1 Flavour score

While studying the effect of different levels of potato flour on the flavour of burfi, it was found that, as the levels of potato flour increased, there was a simultaneous increase in the flavour score of burfi up to certain limit and thereafter, it decreased. Burfi prepared by using 10 parts potato flour (T_3) scored the highest marks (44 out of 45) while the lowest score (40.25 out of 45) secured by the burfi prepared by 20 parts of potato flour. Statistically, treatment T_3 i.e. 10 parts potato flour was superior among all the treatments, which had mild pleasant flavour.

5.2.2 Body and texture score

The body and texture score of burfi seems to be mainly depending on levels of potato flour added. It was observed that as the levels of potato flour increased, there was a simultaneous increase in

the body and texture score of burfi up to certain limit, after that, it decreased. Burfi prepared with 10 parts of potato flour (T_3) scored the highest marks (33.75 out of 35), while the lowest score (30.25 out of 35) secured by the burfi prepared with 20 parts of potato flour. Statistically, treatment T_3 with 10 parts of potato flour was superior among all the treatments.

5.2.3 Colour and appearance score

The colour and appearance score of burfi seems to be mainly depends on levels of potato flour. As the level of potato flour increased, colour intensity and appearance was also improved. The highest score for colour and appearance was obtained (18.50 out of 20) by the burfi prepared with 10 parts of potato flour (T_3), while the lowest score was secured (15.75 out of 20) by the burfi prepared with 20 parts of potato flour. Statistically, treatment T_3 with 10 parts of potato flour was superior among all the treatments.

5.2.4 Overall acceptability of potato burfi

The overall acceptability score of burfi on a 9 point Hedonic scale revealed that the highest score (8.75 out of 9) was rated by panel of judges to burfi prepared with 10 parts of potato flour (T_3) level, while the lowest score (5.75 out of 9) was rated to burfi prepared with 20 parts of potato flour (T_5) level. Thus, it was observed that, overall acceptability was increased with increased level of potato flour in burfi up to certain limit.

5.3 Cost structure of potato burfi

The effect of addition of potato flour on the cost structure of burfi prepared under various treatments was studied and presented in Table 16.

The cost of production of 1 kg burfi under various treatments was calculated by considering the prevailing retail market price for various items i.e. milk, potato flour, fuel, labour charges and electricity charges.

Considering the cost structure of burfi prepared from different treatment combination, it was observed that T_1 treatment i.e. burfi with (T_1) 0 parts of potato flour had highest cost of production i.e. Rs. 432.24 per kg. While, the lowest cost of production (Rs.389.51 per kg.) was observed under treatment T_5 i.e. burfi with 20 parts of potato flour. It is observed that with increase in level of potato flour resulted decrease in the cost of production of burfi. The cost of most acceptable burfi in treatment T_3 was Rs. 409.53.

From the results obtained during the present study, it can be concluded that good quality burfi could be prepared with addition of 10 parts of potato flour with cost of production of Rs.409.53.

Conclusions

It may be concluded from the present study that,

1. The physico-chemical composition of burfi i.e. fat, protein, moisture and ash was significantly decreased while total solids and solids not fat percentage significantly increased with increased levels of potato flour.

2. Burfi prepared with addition of 10 parts of potato flour (T_3) was scored highest marks (96.25) over the rest of the treatments. Good quality burfi can prepared by using 10 parts of potato flour which had mild pleasant flavour, smooth body and texture and light brownish colour.

3. The cost of burfi decreased with the increased in the levels of potato flour. The cost of most acceptable treatment prepared with 10 parts of potato flour (T_3) was Rs. 409.53 per kg.

Hence, it is concluded that superior quality burfi can be produced by addition of 10 parts of potato flour with 90 parts of khoa. The potato flour could be successfully utilized economically for preparation of burfi.

Implications:

Adding value by processing of dairy food products increases nutritional, health enhancement as well as disease prevention.

As income rised and economic condition improved, demand for more varied foodstuff increased. In this regards, milk and milk products lend themselves extremely well to being presented in diverse forms, Via processing, value is added to the raw material: milk. Even milk itself, can be presented in a wide number of ways, many of which are associated with adding value.

Increasing urbanization, general health awareness and growing purchasing power of middle class has led to the rapid changes in consumption pattern for dairy products all over the country. There is growing demand for safe, nutritious, health promoting convenience milk products calling for value addition, product diversification and complete quality assurance. Value addition to dairy foods would provide health benefit to the consumers and improve the scale of economy in the dairy industry. Value addition with incorporation of vegetable for the preparation of dairy products is thought to be a convenient and economical alternative for utilization of these vegetables. Value addition to the traditional milk products through application of new processes, biotechnological intervention, packaging and mechanized manufacturing system will modernize the technology of preparation of potato flour burfi.

This value added product may be taken up for large scale manufacture and provide a new variety of burfi.

Chapter VI

LITERATURE CITED

Abhitosh, 2005. Performance evaluation of continuous khoa making machine. M.Sc. (Agri.) thesis, submitted to Bundelkhand University, Jhanshi.

Adani, R. (2011). Utilization of date in the preparation of cow milk burfi. M.Sc. thesis (unpub.) Dr. P.D.K.V., Akola.

Ahmad Sarfraz, Tiehua Zhang, Frank Lee, Yanyan Liu, Xiaodong Li and Mingruo Guo, 2013.Seasonal Variations in Chemical Composition of Buffalo Milk. Buffalo Bulletin, 32(2): 1324-132.

Aneja, R. M., B. N. Mathur, R. C. Chandan and A. K. Banerjee, 2002. Desiccated milk based products In Technology of Indian Milk Products. A Dairy India publ., pp. 122-125.

Anonymous, 2005. Chemical composition of khoa. http://shodhganga.inflibnet.ac.in/bitstream/10603/15614/8/08_chapter%202.pdf

Anonymous, 2015. Milk production of India. (Annual report of NDDB 2014-2015).

Anonymous, 2017. Potato production in world. https://www.statista.com/statistics/188222/top-potato-chip-brands-in-the-united-states.

Anonymous, 2017. Milk production of India. (Annual report of NDDB 2016- 2017).

Anurag and R. Chawla, 2016. Studies on preparation of composite dairy food Bottle gourd burfi. Asian J. of Dairy and fd. Res., 35(3): 196-200.

Awgchew, H., H. Gebrekidan and A. Molla, 2015. Nutrient status of potato (*S. tuberosum L.*) tubers and lettuce (*Lactuca sativa L.*) leaves produced along the bank of river Beressa. Journal of horticulture and forestry., Vol. 7 (8) pp. 179-185.

Banergee, G.C., 2005. A text book of Animal Husbandry. 8th Edn. Oxford and IBH publishing Co. Pvt. Ltd. New Delhi. pp 355.

Bankar ,S. N., R. P. Barbind, R. L. Korake , S. V. Gaikwad and S. S. Bhutkar, 2013. Studies on Preparation of Pineapple Burfi. Asian J. Dairy & Food Res., 32 (1): 40 – 45.

Bhutkar, S. S., D.H. Jadhav and Tungar, 2015. N. M effect of elephant foot yam pulp on sensory and chemical properties of burfi. IOSR Journal of Agriculture and Veterinary Sci., (4): PP 22-24.

Bhutkar, S.S., S. D Toraskar and P.B .Shinde, 2015. Standardization And production of traditional Indian Milk Product Basundi from Cow milk with Bottle gourd pulp. IOSR J. of Agriculture and Veterinary Sci., (4):PP19-21.

Bhosale Suchita. 2017. Studies on Utilization of bottle gourd (*Lagenaria siceraria*) pulp in preparation of cow milk burfi. M.Sc. Thesis (unpub.) Dr. P.D.K.V., Akola.

Borse, N. 2011. Effect of different level of gulkand on the quality of burfi prepared from cow milk M.Sc. Thesis (unpub.) Dr. P.D.K.V., Akola.

Chandrasekara, A. and T. J. Kumar, 2016. Roots and tubers crops as functional foods: A review on phytochemical constituents and their potential health benefits. International Journal of Food science, Vol. 2016, Article ID 3631647.

Charis Kharkongor Ripnar, Umadevi S. Hiremath, S. Anitha, 2015. Formulated nutri-dense burfi and its physico-chemical components. J. of Fd. and Nutrition Sci.; 3(3):108-113.

Chetana R., R. Ravi, S. Yella Reddy, 2010. Effect of processing variables on quality of milk burfi prepared with and without sugar. Journal of Food Science Technology, 47(1):114–118.

Datarkar, K. 2012. Utilization of singhara flour in preparation of cow milk burfi. M. Sc. Thesis (unpub.) Dr. P.D.K.V., Akola.

De, S. (1980). Outlines of Dairy technology, Oxford Uni. Press. New Delhi, India. PP 389.

De, S. 2008. Outlines of Dairy Technology. Oxford University press. New Delhi. India. PP 35.

Dewani, P. P. and H. M. Jayprakash, 2004. Process optimization for production of peda from pre-concentrated milk by reverse

osmosis and vaccum evaporation. J Food Sci. Technol. 41(4): 386-390.

Dodeja, A. K and A. Deep, 2012. Mechanized manufacture of Danedar khoa using three stage SSHE. Indian J. of Dairy Sci., 65(4).

FSSAI (2006) The Food Safety and Standard Act, 2006 Universal publication, New Delhi, PP 361-364.

Gargade, D. A. 2004. Use of orange concentrate in the preparation of burfi. M. Sc. Thesis (unpub.) Dr. P. D. K. V., Akola.

Girase, S. 2016. Studies on preparation of Gulkand burfi from Buffalo milk. M.Sc. (Agri.) Thesis (Unpub.) Dr. P.D.K.V., Akola.

Goyal, S.K. and Samsher, 2015. Studies on quality attributes of herbalburfi. K.V.K, Institute of Agric. Sciences, BHU, RGHC, Barkachha, Mirzapur (U.P).

Gupta, S., K.K. Reddy, K. S. Reddy and K. Dhanalakshmi, 2010. Standardization of Kapoorkand preparation and study of its shelf life. , Indian J. of Dairy Sci., 63(1):16-21.

IS: 1479 Part-II 1961. Method of test for dairy industry: Chemical analysis of milk. Indian Standard Institution, Manak Bhavan, New Delhi.

IS: 1165 – (1967). Indian standard specifications for milk powder (whole and skim). Indian Standards Institute, Manak Bhavan, New Delhi.

IS: 1224 Part –I (1977). Determination of fat by Garber's method (Revised Indian Standard Institution), Manak Bhavan, New Delhi, India.

ISO 3889 (1977).Milk and milk products- Determination of fat content by Mojonnier-type fat extraction tasks, Indian standard Institute, Manak Bhavan, New Delhi.

Jadhav, R.S. 2015. Incorporation of Gram flour in preparation of khoa burfi. M.Sc. thesis (unpub.) Dr. B.S.K.K.V., Dapoli.

Kakade N.B., V.G. Atkare, S.R. Kute, N.N. Humane and P.N. Ingle, 2013. Physico chemical study of khoa sold in Nagpur city. J. Soils and Crops., 23 (1) 111-115.

Kamble , N. S., S. T. Hajare, R. N. Dhawale, S. D. Karnewar, V. P. Suryawanshi and O. P. Digraskar, 2008. To study the comparative compatibility of ber pulp blending with milk at different proportions. J. soils and crops., 18 (2) 385 – 389.

Kamble, K., P. A. Kahate, S. D Chavan and V. M. Thakare, 2010.Effect of pine-apple pulp on Sensory and Chemical Properties of Burfi. Veterinary World. 3 (7):329-331.

Kaur, A. and Anita Kochhar, 2014. Sensory and nutritional evaluation of value added products using potato flour for nutritional and health benefits. International journal of medical sciences, Volume 7; 1-6.

Khopade, Y. S. 2002. Evaluation of mung (*Vigna radiata*) flour khoa burfi. M.Sc. thesis (unpub.) Dr. P.D.K.V., Akola.

Khapre, A.P., P. N. Satwadhar and H. M. syed, 2015. Studies on processing technology and cost estimation of fig fruit powder enriched Burfi. College of food technology, V.N.M.K.V., Parbhani - 431 402 (M.S) India. J. of Applied and Natural Sci. 7(2):621-624.

Kolhe, P. V. 2003. Utilization of papaya pulp in preparation of burfi. M. Sc. Thesis (unpub.). Dr. P.D.K.V., Akola.

Kumar, B. K. and A. K. Dodeja, 2003. Development of continuous burfi making machine. Indian J. Dairy Sci. 56(5): 84-87.

Kumar, M. 2010.Up-gradation of Khoa Production and Preservation Technologies. S-JPSET: ISSN : 2229-7111, (4).

Kumbhar, R. R. 2011. Studies on preparation of khoa burfi blended with ginger (*Zingiber officinale)* juice. M.Sc. Thesis submitted to Dr. B.S.K.K.V., Dapoli.

Kurand, M.S., R.R. Shelke, S.G. Gubbawar and S.P. Nage, 2011. Quality of khoa sold in Washim district. Food science research journal. Volume 2 Issue 2, pp 200-204.

Liu, R.H. 1Health promoting components of fruits and vegetables in the diet. Adv Nutr. 2013 ; 4 (3) : 384S-92S

Matkar, S.P. 2006. Preparation of fig burfi. M.Sc. (Agri.) thesis, submitted to M.K.V., Parbhani.

McGill C.R., Kurilich A.C., Davignon J. The role of potatoes and potato components in cardiometabolic health: a review. Ann Med. 2013; 45 (7):467-73.

Meshram, P. M. 2014. Utilization of air potato (*Dioscorea bulbifera*) flour for preparation of burfi. M.Sc. Thesis (unpub.). Dr. P. D. K. V., Akola.

Navale , A. S., B. R. Deshmukh, R. I. Korake, S. G. Narwade and P. R. Mule, 2014. Production profile, proximate composition, sensory evaluation and cost configuration of wood apple burfi. Animal Science Reporter, 8: 114-120.

Nelson, J.A. and G.M. Trout, 1964. Judging dairy products. 4th edition. The Olesen Publishing Co. Milwankee Official Methods of Analysis Chemists, Washington.

Pal, D. and S.K. Gupta, 1985. Sensory evaluation of Indian milk products. Indian Dairyman, 37(10): 465-467.

Patil, R. 2012. Utilization of dried date in preparation of burfi. M. Sc. Thesis (unpub.). Dr. P. D. K. V., Akola.

Prabha, S. 2006.Development of a technology for the manufacture of dietetic burfi. Ph.D. thesis. National Dairy Research Institute (Deemed University), Karnal.

Rajasekaran, E and Kumar, B. 2014. Agitator and wiper design modification for milk khoa machine. International Journal of Innovative Research in Science, Engineering and Technology.3 (1): 1262-1267.

Rasane, P., B. Tanwar and A. Dey, 2015. Khoa : A heat desiccated indigenous Indian dairy product. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 6(5): 39-48.

Sable T.A. (2005) Preparation of besan (Gram flour) khoa burfi. M.Sc. Thesis (unpub.) Dr. P.D.K.V., Akola.

Salunke, M.R., 2012. Studies on Utilization of carrot (*Daucus carota*) for kheer preparation. M.Sc. Thesis (unpub.) Dr. P.D.K.V., Nagpur.

Sangu, K.P.S., 2002. Dairy processing technology. 1st Edn. Technical publishers of India. Allahabad. pp 87.

Sharma, R. 2006. Production, processing and quality of milk products, published by “International Book Distribution Company” Luckhnow, (UP), India.

Sharma, U. D. and I. T. Zariwala, (1978). Survey of quality of milk products in Bombay. J. Fd. Sci. Tech.15: 118-121.

Satav, Y. L., S. G. Narwade, R. P. Kadam and Hashmi Syed Imran, 2014. Effect of walnut powder incorporation on sensorial, nutritional and textural quality profile of burfi. Asian J. Animal Sci., 9(2):129-133.

Saxholt, E., A. T. Christensen, A. Moller, H. B. Hartkopp, K. H. Ygil and O.H. Hells, 2008. Danish food composition databank , revision 7. Retrieved 2012. Department of nutrition, National food institute, Technical university of Denmark.

Shelake, R. R., V. M Thakare and S.G. Gubbawar, 2011. Study on sensory evaluation of bottle gourd kheer. Research J. of animal Husbandry and dairy sci., 2(1&2):37-39.

Shelke, C. Y., S. V. Baswade, B. C. Andhare, R. S. Mule, and S. B. Adangale, 2008. Economics of preparation of mango burfi. J. Dairying, Fd. Health Sci. 27(3/4):196-198.

Shete, S. M., B. K. Pawar, D. M. Choudhari and D. K. Kamble, 2012. Quality of different types of burfi sold in Ahmednagar market. J. Dairying, Foods & H.S., 31(1).

Shete, S. M., B. K. Pawar, D. M. Choudhari and B. D. Patil, 2011. Sensory quality of different types of burfi sold in Ahmednagar market. Food Sci. Research J., Vol. 2: 80-82.

Snedecor, G. W. and W. G Cochran, (1994) Statistical methods, 8th edition, Oxford and IBA publishing company, Calcutta.

SP: 18.Part XI.1981. ISI Handbook of food analysis Dairy products Bureau of Indian standard, manak Bhavan, New Delhi.

Sonika Choudhary., Anuradha Kumari and Sumit Arora. 2015. Heat induced changes in khoa : A Review. Indian J. Dairy Sci. 68 (5): 415-424.

Swati Wankhede. (2005). Studies on preparation of mango pulp burfi. M.Sc. Thesis (unpub.) Dr. P.D.K.V., Akola.

Tanuja, V. Pathak and M. Goswami, 2017. Development and quality evaluation of apple pomace incorporated burfi . Indian J. Dairy Sci. 70 (2).

Tawade, S. S. 2015. Utilization of stevia liquid (*Stevia rebaudiana*) for preparation of burfi. M.Sc. (Agri.) Thesis (Unpub.) Dr. P.D.K.V., Akola.

Wadhave, S. N., R. R. Shelke, S. U. Suryawanshi, P. G. Kokate, 2014. Sensory evaluation of burfi prepared buffalo milk khoa blended with honey. Asian J. Animal Sci., 9(1): 23-25.

VITA

1. Name of student : RAMTEKE VISHAL MULCHAND

2. Date of Birth : 3rd May 1994.

3. Name of the College : College of Agriculture, Nagpur.

4. Residential address : At.- Sitepar, Post - Virsi,

Tah.- Sakoli Dist. – Bhandara.

Pin code - 441802

Mo.No. - +91 7387304367

Email id – ramtekevishal72@gmail.com

5. Academic qualifications:

Sr. No.	Name of Degrees awarded	Year in which obtained	Division/ Class	Name of Board/awarding University	Subjects
1	B.Sc. (Agri.)	2016	First	Dr.P.D.K.V. Akola	Agriculture
2	H.S.C.	2012	First	Nagpur	Science
3	S.S.C.	2010	First	Nagpur	Semi-English

6. Field of interest **:** Agriculture research

Place: Nagpur

Date: 01 /06 / 2018 **Signature of student**

Appendix- I

Score card for sensory evaluation of Potato Flour burfi.

NAME OF PRODUCT: **Date:**

NAME OF JUDGE: **Time:**

Please evaluate these samples for quality attributes according to guideline provided for scoring.

Sr. No.	Attributes	Score	Sample No.				
			T_1	T_2	T_3	T_4	T_5
1.	Flavour	45					
2.	Body and texture	35					
3.	Colour and appearance	20					
4.	Total	100					

Remark:

Signature of Judge

Appendix – II

Score card for evaluation of the overall acceptability of burfi.

i. Name of Judge:

ii. Date:

iii. Time:

Please rate the samples for acceptability attributes according to 9 point Hedonic scale given below.

Sr.No.	Remarks	Score
1	Like extremely	9
2	Like very much	8
3	Like moderately	7
4	Like slightly	6
5	Neither like or dislike	5
6	Dislike slightly	4
7	Dislike moderately	3
8	Dislike very much	2
9	Dislike extremely	1

Note: Score of 5.5 and above indicates acceptability within the score of 1 to 9

Remark :

Signature of Judge