STANDARDIZATION OF KAPOORKAND PREPARATION AND STUDY OF SHELF LIFE

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B.V.Sc. & A.H.

THESIS SUBMITTED TO THE
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CERTIFICATE

Miss **SWATI GUPTA** has satisfactorily prosecuted the course of research and the thesis entitled "**STANDARDIZATION OF KAPOORKAND PREPARATION AND STUDY OF SHELF LIFE**" submitted, is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination. I also certify that the thesis or part there of has not been previously submitted by her for a degree of any University.

Date: 26-4-2007
Place: Hyderabad

(Dr. K. KONDAL REDDY)
Major Advisor

CERTIFICATE

This is to certify that the thesis entitled "**STANDARDIZATION OF KAPOORKAND PREPARATION AND STUDY OF SHELF LIFE**" submitted in partial fulfillment of the requirement for the degree of **MASTER OF VETERINARY SCIENCE** of the Sri Venkateswara Veterinary University, Tirupati is a record of the bonafide research work carried out by Miss **SWATI GUPTA** under my guidance and supervision. The student's Advisory Committee has approved the subject of the thesis.

No part of the thesis has been submitted for any degree or diploma. The published part has been fully acknowledged by the author of the thesis.

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I, Miss **Swati Gupta,** hereby declare that the thesis entitled **"STANDARDIZATION OF KAPOORKAND PREPARATION AND STUDY OF SHELF LIFE"** submitted to Sri Venkateswara Veterinary University for the degree of **MASTER OF VETERINARY SCIENCE** is a result of the original research work done by me. I also declare that the thesis or part there of has not been published earlier elsewhere in any manner.

Date: 26-4-2007

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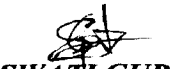

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LIST OF ABBRIVIATIONS

ANOVA	:	Analysis of variance
cfu	:	Colony forming unit
cm^2	:	Square centimetre
df	:	Degree of freedom
Fig	:	Figure
g	:	Gram
i.e.	:	That is
Kcal	:	Kilocalories
Kg	:	Kilogram
Lit	:	Litre
log	:	Logarithm
M:B	:	Milk to bottlegourd
mg	:	Milligram
ml	:	Millilitre
mm	:	Millimetre
µg	:	Microgram
PFA	:	Prevention of Food Adultration
Psi	:	Pound square inch
SNF	:	Solid not fat
SPC	:	Standard Plate Count
SSHE	:	Scraped Surface Heat Exchanger
TBA	:	Thiobarbituric Acid
TS	:	Total solid
°B	:	Degree Brix
°C	:	Degree centigrade
°F	:	Degree Fahrenheit
%	:	Per cent

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ABSTRACT

Kapoorkand or bottlegourd burfi is a traditional and popular milk product of certain parts of North India and prepared by incorporation of bottlegourd in milk. The present investigation was undertaken to standardize the preparation of kapoorkand and study the shelf life at room and refrigeration temperatures. Standardization of kapoorkand preparation was carried out by using two levels of milk to bottlegourd i.e. 60 : 40 and 70 : 30 and two levels of sugar i.e. 12 and 16 per cent.

Kapoorkand prepared with 70 : 30 milk to bottlegourd ratio resulted in significantly lower product yield and moisture content in the product. However such Kapoorkand had higher fat, protein and TBA values compared to kapoorkand prepared with 60 : 40 milk to bottlegourd ratio.

Kapoorkand prepared with 12 per cent sugar resulted in lower product yield with higher moisture, fat, protein, titratable acidity and TBA values compared to the ones prepared with 16 per cent sugar. Kapoorkand prepared by using 70 : 30 milk to bottlegourd ratio and 12 per cent sugar registered highest scores for all the sensory attributes.

Shelf life of kapoorkand was studied both at room and refrigeration temperatures in wax coated butter paper and packaged in cardboard boxes.

A gradual decrease in moisture percentage and increase in titratable acidity and TBA values were observed in all formulations of kapoorkand when stored at room and refrigeration temperature.

The study also revealed a gradual decrease in sensory scores of all eating quality attributes in all types of kapoorkand both at room and refrigeration temperatures. However, these storage changes were faster at room temperature than at refrigeration temperature.

The increase in total bacterial count and yeast and mould count was comparatively rapid at room temperature than at refrigeration temperature of storage.

At room and refrigeration temperature of storage, the shelf life of kapoorkand was 6 and 28 days for 60 : 40 milk to bottlegourd ratio with 12 per cent sugar, 12 and 56 days for 60 : 40 milk to bottlegourd ratio with 16 per cent sugar, 15 and 56 days for 70 : 30 milk to bottlegourd ratio with 12 per cent sugar and 18 and 56 days for 70:30 milk to bottlegourd ratio with 16 per cent sugar respectively.

INTRODUCTION

CHAPTER I

INTRODUCTION

The dairy industry in our country has witnessed a significant and enviable progress during the last few decades. Converting surplus milk available in our village into traditional milk products is being practiced from time immemorial. Milk being a highly perishable commodity, converting the same into different traditional products provide a profitable outlet for milk besides conserving and preserving the precious milk solids relatively for a longer period.

Traditional dairy products have played a significant role in the economic, social, religious and nutritional well being of people and are gradually becoming popular all over the world. In the context of present policy of globalization, the business leaders of multinations are trying to interact with the vast unexplored resources of Indian traditional sweet food products derived from Indian heritage and culture through the era of Vedic, Buddhism, Islamism and Christianity. Tremendous prospects are awaited to tap this potential of our own traditional wealth of knowledge in science and technology blended with the art and literature of the people of India (Bandyopadhyay *et al.*, 2006).

About half of India's total milk production is utilized for the preparation of different traditional dairy products. The production and

marketing of these products has largely been in the hands of small and petty traders and halwais (Rajorhia, 1995).

Fruits and vegetables are important contributors to meet the nutritional requirement of human beings as these foods not only fulfill the quantitative needs to some extent but also supply vitamins and minerals which improve the quality of diet and maintain health (Sudhakar *et al.*, 2003).

Vegetables contribute significantly to our economy, since India is the second largest vegetable producer in the world next to China. Bottlegourd (*Lagenaria Siceraria*) is one of the important vegetable crops, which belongs to the family *cucurbitaceae*. It has its origin in Africa and India and cultivated all over the world. The entire plant also has medicinal value and reported to cure a number of diseases (Rathi Devi *et al.*, 2003).

The cooked tender fruit is used as vegetable and also in pickles and sweets. Kapoorkand or Bottlegourd burfi is a traditional and popular milk product of North India. It's production is confined to domestic level and scattered on a limited scale by the halwais. The quality and shelf life of the product is highly variable since levels of different ingredients used and the methods of preparation is not standardized.

Sweets prepared with incorporation of other ingredients in milk might improve palatability by adding variety to the original products. Other ingredients like coconut, pista, fruits, nut, rawa, chocolatae are incorporated into the products to give to special taste.

Keeping in view the fact that Kapoorkand quality is highly variable the present study was undertaken to standardize its preparation method and also to study the shelf life of the product with the following objectives.

1. To study the effect of milk to bottlegourd ratio on quality of Kapoorkand.
2. To study the effect of added sugar levels on the quality of Kapoorkand.
3. To study the shelf life of Kapoorkand at room and refrigerated temperatures.
4. To enumerate the total viable count, yeast and mould count in Kapoorkand initially and after storage period.

REVIEW OF LITERATURE

CHAPTER II

REVIEW OF LITERATURE

2.1 GENERAL

Burfi has been favoured as one of the most popular sweets all over India. In commercial practices, burfi may be prepared directly through concentration of buffalo milk or alternatively by use of khoa. Blending with a wide range of food adjuncts has permitted development of an impressive array of burfi varieties. The food adjuncts may be artfully used singly or in an innovative combination to delight a gourmet. The artful ingenuity of sweet maker in creating special qualities in burfi fetches higher consumer prices (Aneja *et al.*, 1998). There are number of varieties of burfi, each one varying from the other in terms of composition, preparation and organoleptic qualities. Their individual palatability depends on the varied ingredients that go in preparation of each one. Thus, there are burfi preparations with cashewnut as katli (wafer thin slice), almond, pistachio, coconut, mango, orange, wood apple, bottlegourd and potato (Hemavathy *et al.*, 1994).

Kapoorkand or bottlegourd burfi is a traditional and popular milk product of North India. It is prepared by incorporation of bottlegourd in milk.

Perusal of published literature revealed that information in regard to kapoorkand or bottlegourd burfi is nearly or almost nonexist. However, related literatures on similar heat dessicated products are cited and reviewed in the chapter.

2.2 BOTTLE GOURD

2.2.1 Bottlegourd (*Lagenaria siceraria*)

Bottlegourd (*Lagenaria siceraria*) is one of the important vegetable crops which belongs to the family *cucurbitaceae*. It is commonly called as ghia, kaddu or louki. It is extensively cultivated throughout India almost all the year round and hence the fruits are always available in the market (Waskar and Yadav 1997).

The bottle like shape of fruit and its use as a container of wine and spirits in the past gave it the common name of bottlegourd. Bottlegourd contributes significantly to dietary intake of vitamins, minerals such as calcium, iron, potassium, phosphorus and carbohydrates. It is also a source of dietary fibre and added bulk to the diet. Bottlegourd fruits in green and tender stage are used as cooked vegetable and for preparation of sweets, pickle etc. (Usharani, 2003)

It is useful to cure urinary disorder, thirst during diarrhorea, diabetes problems related to eating spicy and fried products. Bottlegourd restricts the loss of minerals during sweating. It is also useful in curing insomnia (Katkar et al., 2006). Bottlegourd has a cooling effect and prevents constipation. It is easy to digest and used during convalescence. Pulp from bottle gourd is occasionally used as purgative, as an additive in cough syrup and as an antidote to some poisons (Usharani 2003).

Leaves of bottlegourd in the form of decoction with sugar are used for treatment of jaundice. The pulp is applied externally as a poultice and cooling application to shave head delirium and also rubbed on the flat of feet and hands to diminish the effect of heat (Sreevani, 2002).

2.2.2 The nutritive value of bottlegourd

Moisture (g)	96.1
Protein (g)	0.2
Fat (g)	0.1
Minerals (g)	0.5
Fibre (g)	0.6
Carbohydrate (g)	2.5
Energy (Kcal)	12
Ca (mg)	20
P (mg)	10
Mg (mg)	26
Na (mg)	2.4
Fe (mg)	0.46
K (mg)	171
S (mg)	10
Cu (mg)	0.0
Mn (mg)	0.08
Cr (g)	0.046
Cl (mg)	5
Carotene (µg)	0
Thiamine (mg)	0.03
Riboflavin (mg)	0.01
Niacin (mg)	0.2
Vitamin C	0

Source : Gopalan *et al.* , (2004)

2.2.3 Use of bottlegourd in food products

2.2.3.1 Louki kheer

Louki kheer consists of light greenish yellow, shredded and cooked bottlegourd interspersed in slightly viscous milk. Depending upon regional

preferences, the ingredients and manufacturing process of louki kheer differ. In Kashmir, rice flour and custard powder are also added to make product smoother and creamier and known as 'Gil E Firdose' and relished during Ramzan. In a typical recipe, about 50 g of rice (washed and soaked in water for 3 hours) is crushed lightly, added to one liter of boiling milk and cooked till the rice is tender. Then 250 g of sugar is added to this and cooking continued till the milk thickens. On the other hand, 250 g of seedless bottlegourd is greated and then steamed for 15 minutes to make it tender. After removing it from boiling water, excess water in it is drained off by placing the mass in a sieve. Steamed tender gourd is mixed in milk mixture and cooked for another 15 minutes. Finally, 110 g khoa, 1-2 g cardamom powder and custard powder (about 5 grams dispersed in about 15 ml of plain water) are added to the mixture and stirred for another 5 minutes before removing it from heat. At the time of serving, the top surface of louki kheer is garnished with silvered pistachio and flavoured with kewada essence (Aneja *et al.*, 1998).

2.2.3.2 Louki halwa

A vegetable based milk sweet, louki halwa is popular in North India. For preparing louki halwa, ghee is melted in a pan and grated bottle gourd (2.5 kg) is fried in it for about 20 minutes until turns into light brown. 250 g sugar and edible grade yellow colour (2 g dissolved in little water) are added and mixed thoroughly with fired grated gourd. Remaining ingredients such as khoa (500 g) and cardamom powder are added and heated with constant stirring till free fat starts separating and a uniform lump is formed. Before serving, the halwa is

evenly spread on a plate and garnished with sliced almonds and pistachio (Aneja *et al.*, 1990). Louki halwa is also known as dudhi halwa.

Upadhyay *et al.* (1993) manufactured sweets like gajar halwa, dudhi (bottlegourd) halwa, kheer and basundi on Scraped Surface Heat Exchanger (SSHE) designed for production of khoa. They used buffalo milk for manufacturing of these products in place of khoa. Peeled shredded bottlegourd weighing 40 kg was loaded in cleaned SSHE. Ghee was added @ 3.5 per cent of shredded dudhi and cooked for 30 minutes. Standardized buffalo milk @ 1.25 kg/kg of shredded dudhi and heating was continued. Sugar was added @ 35 per cent of shredded dudhi. Heating and evaporation continued till the required consistency obtained and collected in a tray for setting. Yield of the above product was 30 kg.

2.2.3.3 Pickles

Rathidevi *et al.* (2003) used bottlegourd for preparation of value added products i.e. two types of pickle viz. sweet pickle and hot pickle by using edible portion of bottlegourd in combination with other ingredients.

2.2.3.4 Tutti Fruity

Rathi Devi *et al.* (2003) prepared Tutti Fruity by slow process and one day process methods. They processed peeled bottlegourd into small cubes and subjected to steam blanching for three minutes and treated with 1 per cent calcium chloride for 3 hours. In one day process, these cubes were steeped in 70 $^{\circ}$ Bx syrup containing 1 per cent citric acid and boiled for 1-1½ hours until equilibrium was reached.

In slow process, sugar syrup containing 40 per cent sugar and 1 per cent citric acid was prepared and treated cubes were dipped in sugar syrup for 24 hrs. The sugar content in syrup was raised to 60° and 70° Bx by heating. The treated cubes were allowed to be immersed in 70° Bx syrup for 3 days. After draining sugar syrup the pieces were air dried.

2.3 STUDIES OF MILK PRODUCTS SIMILAR TO KAPOORKAND

Since the kapoorkand is closely comparable to burfi, kalakand and milk cake, studies on the above products are reviewed since there are no published reports on kapoorkand preparation and its shelf life.

2.3.1 Burfi

2.3.1.1 Method of preparation

Sachdeva and Rajorhia (1982) attempted studies on the standardization of manufacture of burfi. They added sugar @ 25, 30, 35 and 40 per cent of weight of khoa and reported that buffalo milk with 6 per cent fat after conversion into khoa added with 25-30 per cent sugar while still hot followed by whipping with ladle gave a highly acceptable product. They also reported that khoa manufactured from cow's milk containing 4-5 per cent fat and addition of 30-35 per cent sugar resulted in sticky and gummy burfi.

Ramanna *et al.* (1983) prepared khoa with preliminary concentration (30-40°Brix) in vacuum (620 mm Hg) and 0.2 – 0.3 kg/cm^2 steam pressure in forced circulation evaporation with further final concentration achieved in open kittle. Burfi was prepared by adding sugar to khoa in 1:2 proportion and 0.15 per cent sorbic acid and replacing 25 per cent of sugar by adding liquid glucose.

Palit and Pal (2005) developed a mechanized method for manufacturing of burfi, adopting thin film scraped surface heat exchanges and stephen processing kettle and by adding sugar @ 30 per cent of khoa. Despite slightly pasty texture, burfi prepared by mechanized process was highly acceptable.

2.3.1.2 Chemical composition of burfi

Sachdeva and Rajorhia (1982) collected and analysed 24 market samples of burfi from Delhi and Karnal which recorded wide variations in the contents of moisture (12.2 – 20.5 %), sugar (26 -28 %), fat (9.07 – 21.7 %), total protein (6.07– 13.58 %), lactose (9.68 – 21 %)and lactic acidity (0.33 – 0.55 %).

Sapre and Deodhar (1991) registered a progressive decrease in moisture content from 87.9 $\pm$ 0.31 per cent in milk to 35.6 $\pm$ 0.63 per cent in khoa, but increased in protein content from 4 $\pm$ 0.12 per cent to 19.8 $\pm$ 0.12 per cent, fat content from 5 $\pm$ 0.01 to 22.3 $\pm$ 0.12 per cent and lactose from 4.4 $\pm$ 0.05 per cent to 21 $\pm$ 0.24 per cent.

Table : Chemical composition of burfi

References	Source	Chemical constituents					
		Fat	Protein	Lactose	Ash	Sucrose	Moisture
Bhatele and Balachandran (1983)	Laboratory	20.48	14.92	15.82	2.75	30.36	15.67
Date and Bhatia (1955)	Market	13.00	10.50	14.20	2.60	54.30	4.3
Ghodekar *et al.* (1974)	Market	4.1-13.2 (15.20)	12.1-20.3 (8.3)	6.6-10.7 (2.3)	1.6-3.2 (52.00)	48.1-55.7 (8.90)	5.4 -18.4
Hemavathy *et al.* (1974)	Bombay	15.49-24.42 (20.65)	11.50-15.20 (14.5)	14.80-20.78 (18.34)	-	24.76-47.40 (38.37)	14.17-16.80 (15.47)
	Bangalore	19.85-27.00 (22.75)	12.90-20.50 (15.13)	6.25-21.48 (15.39)	-	32.60-48.35 (37.99)	9.33-15.66 (11.69)
	Mysore	14.45-19.25 (16.85)	12.48-16.72 (13.82)	14.58-21.06 (16.79)	-	36.00-48.20 (43.31)	7.60-13.64 (10.71)
Rastogi *et al.* (1966)	Market	14.4-24.2 (14.4)	11.8-16.6 (16.18)	10.7-20.0 (2.56)	2.19-2.93 (38.01)	24.9-47.6 (18.4)	11.0-31.4
Sharma and Gupta (1982)	Market	12.81±0.70	11.37±0.30	16.76±0.58	2.71±0.11	41.20±13.01	14.31±0.58
Sharma and Zariwala(1975)	Market	8.8-26.8	1.4-11.8	5.6-18.3	-	16.7-59.7	4.7-20.0
Sachdeva and Rajorhia (1982)	Karnal	9.07-19.75 (14.06)	6.07-13.58 (8.82)	9.86-16.58 (13.52)	1.62-3.29 (2.27)	30.17-58.62 (47.5)	12.17-18.36 (14.8)
	Delhi	14.41-21.71 (13.52)	9.14-13.0 (10.82)	16.23-21.0 (18.61)	1.52-1.63 (1.55)	26.16-38.43 (33.22)	16.23-20.47 (11.77)
Palit and Pal (2005)	Conventional	20.37	15.05	15.81	2.72	30.41	15.64
	Mechanized	19.52	15.1	15.46	2.4	29.4	18.12

Figures within the parentheses indicate average values.

2.3.1.3 Effect of sugar addition

Sachdeva and Rajorhia (1982) reported that addition of sugar in khoa after cooking while it was still warm resulted in development of desirable flavour and smooth uniform body and texture in burfi.

Bhatele (1983) stated that a good quality burfi can be prepared by the addition of 30 per cent sugar than those by 25 and 40 per cent levels.

Gothwal and Shukla (1995) studied the effect of sugar on the browning of khoa based sweets. They found that the addition of sugar at 25-35 per cent level (on weight basis) produced less browning in burfi as compared to 40 per cent sugar level. But higher levels of sugar i.e. beyond 40 per cent resulted in higher browning of khoa based sweets.

2.3.2 Kalakand

2.3.2.1 Preparation of kalakand

Kalakand is an acid coagulated and heat desiccated milk product. It is obtained by partial acid coagulation and partial dehydration of milk with addition of sugar.

To manufacture standard quality of kalakand, milk was boiled and dehydrated with addition of citric acid @ 0.5 gm/lit and sugar @ 7 per cent of milk (De, 1980).

According to Arora *et al.* (1991) kalakand is a milk sweet prepared by heating a mix of khoa and sugar with continuous stirring until characteristic texture and caramelized flavour is developed.

Mathur (1991) reported the manufacture of kalakand from danedar khoa by the addition of various ingredients such as sugar, aromatic spices etc. in a shallow pan. The entire mass was patted in a thin layer and slabs of desired size square cut for final setting once the product formed a compact mass.

Gothwal and Shukla (1995) prepared kalakand using mixed milk, standardized to 4.5 per cent fat and 8.5 per cent SNF and adding sugar at 35 per cent level. They also reported that higher sugar levels caused more browning.

Suresh and Jha (1994b) prepared kalakand using buffalo milk standardized to 6 per cent fat and 9 – 9.5 per cent SNF and with addition of 0.02 per cent citric acid and 7 per cent sugar in a double jacketed stainless steel kettle heated by steam at 20 psi resulted in a highly acceptable quality product that showed better textural properties like chewiness, gumminess and hardness.

2.3.2.2 Chemical composition of kalakand

Magadum *et al.* (1988) studied the quality of market and laboratory made kalakand and reported large variation in chemical and bacteriological qualities. An average fat content of 16-26 per cent and 16 per cent and total solid content of 80-83 per cent and 85 per cent respectively for market and laboratory made kalakand was reported by them.

Arora *et al.* (1991) studied the chemical composition of 67 samples of kalakand collected from various markets in India and reported an average of 17.32 per cent fat, 77.6 per cent total solids 13.4 per cent protein, 27.96 per cent sugar, 16.64 per cent lactose, 2.53 per cent ash and 0.39 per cent acidity.

Suresh and Jha (1994a) compared kalakand samples prepared in the laboratory with that of market samples and reported that laboratory made kalakand was significantly better than that of kalakand sold in markets. Chemical analysis of market sample showed variations in carbohydrate (34.5 – 39.9 %), fat (19.1 – 22.2 %), protein (14.1 – 15.7 %) and ash (2.1- 2.3 %) contents. Level of

titratable acidity, lactic acid, tyrosine value, peroxide value and free fatty acids were higher in market kalakand samples than those in laboratory samples.

2.3.2.3 Effect of sugar levels on kalakand

Suresh and Jha (1994b) studied three levels of added sugar i.e. 7, 9 and 11 per cent in the preparation of kalakand. They reported that kalakand made with 7 and 11 per cent sugar scored highest and lowest respectively on sensory evaluation. The kalakand with 9 per cent sugar though rated acceptable yet showed inferior colour due to browning while kalakand with 11 per cent sugar was criticized for its severe browning reaction.

2.3.3 Milk cake

2.3.3.1 Method of manufacture

Madhava Rao (1999) described the method for preparation of good quality buffalo milk cake using 6 per cent fat, 9 per cent SNF and 0.16 per cent titratable acidity followed by addition of 15 per cent sugar at 70 per cent total solids level.

Ramesh Babu (2000) prepared milk cake with milk having 6 % fat and adjusted titratable acidity to 0.18 % using citric acid. Sugar was added at 12 % level in two lots, one after partial concentration and remaining half at pat stage.

Vandavasi (2002) standardized manufacture of milk cake using cow milk containing 6 per cent fat, adding 0.02 per cent citric acid followed by addition of 12 per cent sugar on milk basis, half of which was added after partial concentration and remaining half at pat stage yielded better quality milk cake.

Karwasra *et al.* (2003) standardized a process for manufacture of milk cake and concluded that full cream milk added with 6 per cent sugar and 0.02 per cent citric acid resulted in a milk cake of good organoleptic quality.

2.3.3.2 Effect of addition of sugar on milk cake

Madahva Rao (1999) prepared buffalo milk cake using three levels of sugar i.e., 12.5, 15, 17.5 per cent and reported that milk cake prepared with 15 per cent sugar recorded a good granular size, consistency and optimum browning.

Ramesh Babu (2000) employed sensory scores for evaluation of flavour, colour, appearance and overall acceptability of milk cake prepared withbuffalo milk containing 6 per cent fat. The sensory scores increased significantly with increase in sugar level and level of 12 per cent had optimum degree of sweetness, and desirable body and texture with characteristic colour and appearance.

Vandavasi (2002) reported that for milk cake made with 12 per cent sugar has desirable grain with pleasing caramel flavour and recorded highest sensory scores for flavour, body and texture, color and appearance as compared to 10 and 15 per cent sugar levels.

Karwasra *et al.* (2003) standardized a process for the manufacture of milk cake using full cream milk added with 6 per cent sugar. The resultant milk cake had higher sensory evaluation scores than those prepared with sugar levels of 7 and 8 per cent.

2.3.3.3 Chemical composition of milk cake

Reference	Source	Moisture (%)	Fat (%)	Protein (%)	Ash (%)	Total carbohydrate (%)
Rao 1992	Hissar market	20.84	15.25	13.19	2.26	48.46
	Laboratory made	15.18	21.36	25.34	2.56	35.38
Patel *et al.*, 1994	Karnal market	13.8	14.4	11.5	2.2	58.1

Reference	Source	Moisture (%)	Fat (%)	Protein (%)	Ash (%)	Total carbohydrate (%)
Madahva Rao 1999	Hyderabad market	17.97	12.58	9.62	2.19	51.64
	Laboratory made	18.26	18.11	8.88	2.16	52.59
Ramesh Babu 2000	Karnal market	16.51	19.35	12.96	1.88	49.27
	Laboratory made	15.73	21.32	11.38	2.29	49.28
Vandavasi 2002	Laboratory made	16.42	18.5	10.5	2.12	52.46

2.3.4 Milk sweets produced by incorporation of other ingredients

2.3.4.1 Carrot halwa

Sampathu *et al.* (1981) studied standardization and preservation of carrot halwa. Fifteen kg shredded carrot were mixed with 1.75 kg of sugar and after one hour juice was expressed using basket press. Expressed juice was evaporated to nearly one fourth of original volume in steam jacketed kettle at medium heat. The carrot shreds were added and cooked. When most of water had evaporated, remaining 1.75 kg sugar was added, 1.5 kg vanaspati was melted in a steam jacketed kettle and cooked carrot shred and 4 kg khoa were added and frying at medium heat continued till vanaspati separated out. Later, cashewnut and cardamom powders were mixed. Moisture content of carrot halwa was 29.5 per cent and titratable acidity was 0.34 per cent.

Upadhyay *et al.* (1993) studied manufacture of carrot halwa on scraped surface heat exchanges (SSHE). Ghee was taken in machine @ 3.5 per cent of shredded carrot and scrapers were turned on at this stage. Peeled and shredded

carrot weighing 40 kg was cooked in SSHE for 30 minutes. Standardized buffalo milk @ 1 kg/kg of shredded carrot and sugar @ 30 per cent of shredded carrot was added. Heating and evaporation continued till required consistency was obtained. Yield of the product recorded was 32 kg.

Basantpure *et al.* (2003) studied optimization of level of ingredients and drying air temperature in development of dehydrated carrot halwa and recommended optimum conditions for making halwa i.e. milk carrot ratio of 2:1, sugar 225 g per kg of shredded carrot, 225 ppm sodium metabisulphite and drying air temperature of 71°C. They also reported the moisture content of fresh and dehydrated carrot halwa to be 43.3 – 61.3 and 3.5 – 7.6 per cent respectively.

2.3.4.2 Kalakand with substitution of coconut milk

Venkataramana (1998) studied preparation of kalakand substituted with 3 different levels of coconut milk i.e. 10 , 15 and 20 per cent and reported that Kalakand substituted with 15 per cent of coconut milk was highly acceptable because of rich flavour of coconut milk whereas 20 per cent of substitution of coconut milk scored lower due to sharp, pronounced and concentrated flavour of coconut milk.

She further reported that with increasing level of substitution of coconut milk, moisture content decreased from 20.85 to 20.35 per cent due to lower level of moisture in coconut milk as compared to buffalo milk.

Fat content and titratable acidity of coconut milk substituted kalakand was found to increase as level of coconut milk substitution increased due to higher level of fat and titratable acidity i.e. 12.5 per cent and 0.162 – 0.18 per cent respectively as compared to buffalo milk.

2.3.4.3 Sapota pulp burfi

Wakchaure *et al.* (2003) Standardized a formulation for preparation of milk sapota burfi. They blended buffalo milk with sapota pulp at 5, 7.5 and 10 per cent by weight and reported that 5 per cent sapota milk blend burfi was similar in acceptance to traditional burfi, but use of sapota pulp beyond 7.5 per cent adversely affected overall acceptance. Moreover they reported that an increase in sapota pulp content resulted in increase of moisture content and decrease in the carbohydrate content of burfi.

2.3.4.4 Kalakand blended with ashgourd pulp

Ingle *et al.* (2004) prepared kalakand from buffalo milk blended with 20, 30 and 40 per cent of ashguard (*Benincasa cerifera*) pulp. The homogenous mixed pulp with partially desiccated and citric acid coagulated buffalo milk at various levels was heated for 10 minutes followed by addition of sugar @ 6 per cent by weight of milk, followed by vigorous stirring and storing after cooling. Such milk based sweet with 30 per cent ashgourd pulp was most acceptable and economical because the colour of the finished product did not show significant difference up to 30 per cent addition of ash gourd pulp.

They observed an increase in moisture content from 38.67 to 53.22 per cent as the level of ashgourd pulp increased from 20 per cent to 40 per cent respectively.

2.3.4.5 Wood apple burfi

Sakate *et al.* (2004) optimized manufacturing technique for wood apple burfi with cow milk khoa, three different levels of wood apple pulp viz., 20, 30 and 40 per cent (by weight) and 30, 35, 40, 45 per cent sugar were used for the

purpose. They observed that 20 per cent wood apple pulp with 45 per cent sugar produced desirable product with improved quality and reduce cost of production, as because 20 per cent wood apple pulp had good blend of natural flavour of wood apple, sweetness of sugar, richness of milk solids, superior body and smooth texture with limited deleterious effect on colour and appearance. Wood apple burfi with lower levels of sugar (viz., 30, 35, 40 %) were felt sour while addition of 50 per cent sugar was too sweet in taste. So, suitable sugar level for wood apple burfi was found to be 45 per cent which was higher than for plain burfi mainly due to acidic nature of wood apple pulp added to it.

As the level of wood apple pulp increased from 20 to 40 per cent, there was an increase in moisture content (14.59 to 16.70 %), increase in titratable acidity (0.72 to 1.25 %) and decrease in contents of fat and protein i.e. 19.53 to 17.96 and 12.26 to 10.42 percent respectively.

2.3.5 Storage studies of product similar to kapoorkand

2.3.5.1 Shelf life

Rudreshappa and De (1971) found that khoa with combination of low initial moisture content of 20-25 % and high filling temperature (80-90°C) ensured a shelf life of 14 days at 37 ± 1°C in the unsterilized cans.

Deshmukh *et al.* (1977) found that keeping quality of khoa increased with increasing total solid content. The shelf life of khoa containing 70, 80 and 90 per cent total solids was 4, 6 and 9 days at 30°C, 7, 8 and 15 days at 22°C and 30, 40 and 45 days at 5°C.

Sampathu *et al.* (1981) reported that carrot halwa made after pretreatment could be preserved for one year by processing for 40 minutes at 250°F or 60 minutes in boiling water on just by filling hot (200°C).

Sachdeva and Rajorhia (1982) reported that shelf life of burfi packed in parchment paper at 30°C was 10 days and at 5°C it was 50 days. Whereas samples packed in tin containers at 30°C and 5°C had shelf life of 15 days and 105 days respectively.

Ramanna *et al.* (1983) reported that addition of sorbic acid and packaging in an inner polycel and outers polythene pouch kept burfi holds good for 90 days instead of 4-8 days as in traditional methods.

Prajapati *et al.* (1986) studied the effect of added sugar concentration (0, 30, 40 and 50 %) on shelf life of khoa which was wrapped in parchment paper stored in cardboard box and found that shelf life of khoa increases from 3-4, 9-10, 12-14 and 15-17 days respectively with increase in sugar concentration that reduced moisture and water activity.

Premavalli *et al.* (1991) studied the effect of processing and incorporation of potassium sorbate on storage stability of carrot or pumpkin halwa. They found that treated carrot and pumpkin halwa remained stable up to one and two months in polypropylene pouches and three and six months in paper – Al – foil polyethylene laminate pouches respectively.

Mathur (1991) stated that kalakand stored at 10°C developed off flavour in about 21 days whereas it develops off flavour at 37°C within 4 days.

Suresh and Jha (1994b) used potassium sorbate in kalakand samples and reported that addition of preservative at 0.2 and 0.25 per cent levels increase shelf life from 3-24 days when stored at 30-37°C.

Venkataramana (1998) reported that shelf life of kalakand blended with coconut milk at room and refrigeration temperature was 9 and 30 days respectively.

Madhava Rao (1999) found that shelf life of milk cake packaged in parchment paper and stored at 30 ± 1°C and 5 ± 1°C could be preserved well for 21 and 48 days respectively where as shelf life of milk cake packaged in polyethylene and stored at 30 ± 1°C and 5 ± 1°C was found 36 and upto 72 days respectively.

Vandavasi (2002) packaged milk cake in polythene covers and found that shelf life of milk cake at room and refrigerated temperatures was 6 and 21 days respectively.

Karwasra *et al.* (2003) studied the effect of potassium sorbate on shelf life of milk cake at 30 ± 1°C and reported that addition of potassium sorbate enhanced the shelf life of milk cake from 6 to 21 days.

Wakchaure (2003) reported that shelf life of sapota pulp burfi was 4 days at room temperature (30°C).

2.3.5.2 Moisture

Kumar *et al.* (1975) observed that moisture loss in khoa during storage was due to evaporation loss which further depends on temperature of storage and packaging material used.

Sampathu *et al.* (1981) reported that reduction in moisture content from 35-40 per cent to 25-30 per cent enhanced the shelf life of burfi at room temperature for 15days.

Sachdeva and Rajorhia (1982) reported that moisture content of burfi decreased with increasing storage period irrespective of packaging material used. However, decrease in moisture content was more rapid at 30°C than at 5 ± 1°C and in parchment paper than in tin packaged.

Prajapati *et al.* (1986) reported that addition of sugar decreased moisture content in proportion to the sugar level.

Madhava Rao (1999) reported a decrease in moisture content of milk cake alongwith the increase in storage period irrespective of the use of packaging material. However, decrease in moisture content was more rapid at 30°C than at 5°C of storage and more pronounced in parchment paper than in polyethylene bags irrespective of storage temperature since polyethylene is a good barrier for moisture evaporation.

Ramesh Babu (2000) reported a progressive decrease in moisture content of milk cake wrapped in parchment paper during storage period. The rate of decrease in moisture content being much higher at room temperature than at refrigeration temperature.

Karwasra *et al.* (2003) reported a decrease in moisture content of milk cake with the advancement of storage period irrespective of the level of potassium sorbate.

2.3.5.3 Titratable acidity

Kumar *et al.* (1975) observed that initial acidity of fresh khoa (0.43 %) did not show any significant rise upto 5 days of storage in aluminium foil laminates at 37°C while in parchment paper, the acidity reached a level of 0.58 per cent showing an increase of 0.148 per cent. A steep rise in acidity was observed in khoa packaged with aluminium foil laminate on 7th and 10th day of storage at same temperature. The increase in acidity upto 14 days at 8 $\pm$ 1°C was insignificant but later it also showed an increase by 0.1 per cent.

Sachdeva *et al.* (1982) reported that lactic acidity of burfi increased from an initial value of 0.45 to 0.72 per cent after 10 days of storage at 30°C when packaged in parchment paper.

Prajapati *et al.* (1986) observed an increased in acidity of 1.97 %, 0.645 %, 0.533 % and 0.513 % at the end of 15 days of storage for control, 30, 40 and 50 % sugar added khoa samples respectively. They stated that population of acid producing bacteria was considerably controlled by reduction in water activity.

Suresh and Jha (1994b) reported that titratable acidity of kalakand (0.5 %) remained constant upto i.e. days of storage at 30 and 32°C temperature and increased rapidly thereafter. They stated that development of titratable acidity and lactic acid was checked due to addition of 0.25 per cent potassium sorbate.

Madhava Rao (1999) reported that the titratable acidity of milk cake increased during storage irrespective of packaging material used. However refrigerated temperature was found to be effective in controlling titratable acidity indicating probable growth and activity of acid forming bacteria during storage.

Venkataramana (1998) reported that titratable acidity of kalakand incorporated with coconut milk increased faster at room temperature compared to refrigeration temperature. The value obtained on 30th day at refrigeration temperature was attained on 9th day itself at room temperature. This was speculated to be due to growth of microbes which convert lactose to lactic acid.

Vandavasi (2002) reported an increase in titratable acidity of milk cake stored both at room and refrigeration temperatures, however the rate of increase was higher at room temperature than at refrigeration temperature.

2.3.5.4 TBA

Sachdeva *et al.* (1982) reported that TBA values of burfi packaged in parchment paper increased from 0.071 to 0.186 at 30°C and 0.071 to 0.114 at 5°C storage temperatures.

Karwasra *et al.* (2003) found an increase in TBA values of all the milk cake samples along with the advancement of storage period, however, potassium sorbate treated sample showed a fairly less rapid increase in TBA values indicating effectiveness of potassium sorbate at 0.23 per cent level in preventing the development of excessive oxidative rancidity.

2.3.5.5 Microbiological quality

Sachdeva and Rajorhia (1982) reported an initial standard plate count (SPC) of 200/g in burfi which increased 2800/g by 10th day of storage at 30°C and 1120/g by 30th day of storage at 5°C.

Magadum (1988) attempted microbiological studies of kalakand samples collected from the Bangalore city and recorded SPC which varies from 1836-4160/g while the yeast and mould counts ranged from 2-154/g.

Arora *et al.* (1991) collected 67 kalakand samples from various marketing centres of India and reported a mean TVC of as 84.93 x 10^5 / g and a mean yeast and mould count as 9250 / g. However they reported considerable variations in counts from location to location.

Suresh and Jha (1994a) compared the microbiological quality of laboratory made kalakand samples with that of market samples and reported a significantly better quality of market samples. Total viable count and yeast and mould counts were 29.5 x 10^3 and 15 x 10^2 cfu/g for market sample and 1 x 10^3 and 10 cfu/g for laboratory sample. They further reported that TVC in kalakand increased from log 10 of 4 to log 10 of 6.3 after 9 days of storage at 37°C.

Venkataramana (1998) reported an increase in microbial counts of kalakand blended with coconut milk as the storage period both at room and refrigerated temperatures increased but this was of higher magnitude at room temperature which provided favourable conditions for growth and multiplication of microbes.

Madhava Rao (1999) found that TVC and yeast and mould count of milk cake showed a rapid increase when packaged in parchment paper than in polythene bags at both temperature of storage. The initial TVC (total bacterial count) of milk cake was 2.66 cfu/g which increased to 3.82 cfu/g by 21st day of storage at 30 $\pm$ 1°C and 3.04 cfu/g by 45th day of storage at 5 $\pm$ 1°C.

Karwasra *et al.* (2003) reported that along with the increase in storage period, there was a fairly rapid and continuous increase in SPC and yeast and mould counts of milk cake stored at 30 $\pm$ 1°C.

MATERIALS AND METHODS

CHAPTER III

MATERIALS AND METHODS

The experimental procedure and analytical methods followed during the present investigation are outlined under the following sections.

3.1 Location

3.2 Materials

- 3.2.1 Raw milk
- 3.2.2 Bottle gourd
- 3.2.3 Sugar
- 3.2.4 Packaging material
- 3.2.5 Equipment
- 3.2.6 Chemicals

3.3 Methods

- 3.3.1 Preparation of Kapoorkand
- 3.3.2 Packaging of Kapoorkand
- 3.3.3 Sensory evaluation
- 3.3.4 Storage studies
- 3.3.5 Analytical methods
- 3.3.6 Statistical analysis

3.1 LOCATION

The present investigation was carried out in the Department of Livestock Products Technology, College of Veterinary Science, Sri Venkateswara Veterinary University, Rajendranagar, Hyderabad-500030.

3.2 MATERIALS

3.2.1 Raw milk

Fresh raw buffalo milk was obtained from the Dairy Experiment Station, Livestock Research Institute, Rajendranagar, Hyderabad.

3.2.2 Bottlegourd (*Lagenaria Siceraria*)

Farm fresh bottlegourds were procured from a local vegetable market.

3.2.3 Sugar

Commercial grade crystalline sugar was procured from the local super market.

3.2.4 Packaging material

Wax coated butter paper and card board box of 500 g capacity, procured from local market were used for packaging of Kapoorkand.

3.2.5 Equipment

The equipment (cooking utensils) used for the present study were karahi, khunti, aluminium tray, knife etc.

3.2.6 Chemicals

All the chemicals used were of analytical grade, supplied by Qualigens Fine Chemicals, a Division of Glaxosmithkline pharmaceutical limited, St. Annie Besant Road, (Mumbai).

3.3 METHODS

3.3.1 Preparation of Kapoorkand

3.3.1.1 Method of preparation

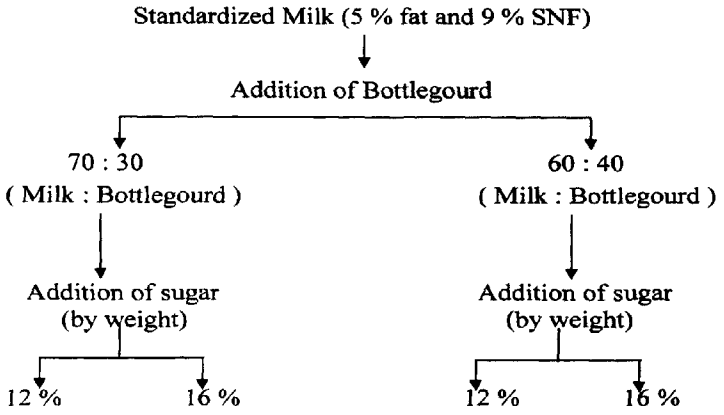
Bottlegourds of good quality were thoroughly washed in running tap water and peeled with stainless steel knife. Clean bottle gourds were grated to thin shreds by using stainless steel grater and made into fine paste in a mixer grinder.

The fresh buffalo milk was standardized to minimum PFA standards for buffalo milk i.e. 5 per cent fat and 9 per cent SNF. Standardized buffalo milk was boiled in a karahi placed over a brisk and nonsmoky fire. It was stirred vigorously and continuously with a khunti in circular motion until it was reduced to one third of its volume. At this stage, bottlegourd paste was added and stirring and scrapping procedure continued. When it reduced to half the volume, sugar was added. Heating, stirring and scraping continued till the concentrated mass attained the property of leaving the surface of karahi i.e. when a dough like stage was reached, karahi was removed from the fire and contents were set in a greasy tray. These were allowed to cool at room

temperature and cut into required size and shape followed by packaging of the same.

3.3.1.2 Standardization of Kapoorkand preparation

Levels of different raw materials used for the standardization of the product manufacture are showen below.

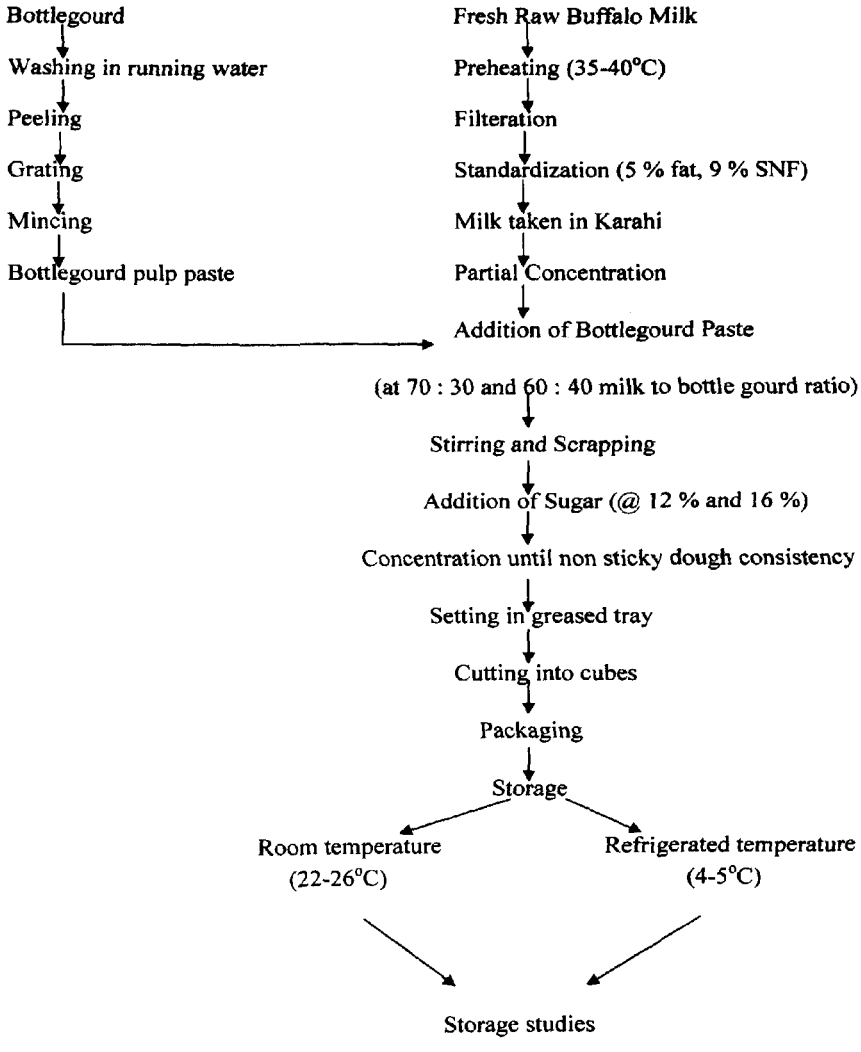


Overall, there were four lots of Kapoorkand with different proportion of raw materials. Each lot was then stored at two temperatures i.e. room (22-26°C) and refrigeration (4-6°C).

3.3.2 Packaging of Kapoorkand

Wax coated butter paper and card board boxes were used as packaging materials only after sanitizing these materials on exposure to ultraviolet rays for 30 minutes. The Kapoorkand samples were packaged in the boxes and were stored for studying the shelf life.

Flow chart for preparation of Kapoorkand



3.3.3 Sensory evaluation

The acceptability of different Kapoorkand formulations stored at room and refrigeration temperature were studied by employing a panel of five judges and by conducting sensory evaluation. The color and appearance, body and texture, flavour and overall acceptability were evaluated by using 5 point hedonic scale representing 5 as excellent and 1 as poor (Appendix I).

3.3.4 Storage studies

Kapoorkand samples stored at room temperature (22-26°C) and refrigerated temperature (4-6 °C) were analysed on alternate day and at weekly interval respectively for their moisture, titrable acidity and TBA value till the product become unacceptable. The samples were also analysed for their fat, protein, total viable count and yeast and mould count both at initial stage and also at the end of storage period i.e. when product become unacceptable.

3.3.5 Analytical methods

3.3.5.1 Chemical analysis of milk

3.3.5.1.1 Fat

The fat content in milk was determined by the Gerber method as described in IS : 1223 part I (1970).

3.3.5.1.2 SNF

The SNF content in milk was determined by the method as outlined in IS : 10083 (1982).

3.3.5.2 Analysis of Kapoorkand

3.3.5.2.1 Yield

The yield of Kapoorkand was recorded on the first day.

3.3.5.2.2 Moisture

The moisture content of Kapoorkand was estimated as per ISI method IS : 4079-1967.

3.3.5.2.3 Fat

The fat content of Kapoorkand was estimated by Rose Gottleib method as recommended by ISI in IS : 4079-1967.

3.3.5.2.4 Protein

The protein content was determined by micro kjeldahl method as recommended by ISI in SP : 18 part XI 1981.

3.3.5.2.5 Titrable acidity

The titrable acidity of Kapoorkand was estimated as per the method of AOAC (1997).

3.3.5.2.6 TBA

The TBA value of Kapoorkand was determined as per the method of Dunkley and Jennings (1951).

3.3.5.2.7 Microbiological analysis

The product was analysed for total viable bacterial count and yeast and mould count before and after storage period.

3.3.5.2.7.1 Total viable bacterial count

The total viable bacterial count was made as per the standard procedure given in IS: 1165-1975.

3.3.5.2.7.2 Yeast and mould count

The yeast and mould count were carried out as per the procedure given in APHA (1978).

3.3.6 Statistical analysis

The data obtained in the investigation was tabulated and analysed statistically according to the procedure described by Snedecor and Cochron (1994).

RESULTS

CHAPTER IV
RESULTS

4.1 EFFECT OF MILK TO BOTTLEGOURD RATIO AND SUGAR ON YIELD OF KAPOORKAND

The percentage values of yield of kapoorkand affected by different treatments are presented in Table 1 and their analysis of variance in Table 1a. The mean percent yield values of kapoorkand as affected by sugar and bottle gourd levels are presented in Table 1b.

Statistical analysis revealed a significant difference ($P<0.01$) in the yield of kapoorkand due to difference in milk to bottle gourd ratio and in the level of sugar. Maximum yield was recorded in samples with 60 : 40 milk to bottlegourd ratio and 16 per cent sugar level.

4.2 EFFECT OF MILK TO BOTTLEGOURD RATIO AND SUGAR LEVEL ON COMPOSITION AND PHYSICO-CHEMICAL PROPERTIES OF KAPOORKAND ON THE INITIAL DAY

The physico-chemical properties of kapoorkand i.e. moisture, fat, protein, titratable acidity and TBA value for different level of milk to bottlegourd ratio and sugar are presented in Table 2. The mean values of physico-chemical properties of kapoorkand affected by sugar and bottlegourd levels are presented in Table 2a.

Statistical analysis of data revealed that there was a significant difference ($P<0.01$) in moisture content of kapoorkand samples due to differences in the levels of milk to bottlegourd ratio, sugar. Significant differences were also observed in fat, protein, titratable acidity and TBA values in kapoorkand due to change in milk to bottlegourd ratio and sugar levels. Moisture content in

kapoorkand having 60 : 40 milk to bottlegourd ratio and 12 per cent sugar was significantly higher ($P<0.01$) than the ones containing 70 : 30 milk to bottle gourd ratio and 16 per cent sugar.

Fat, protein and titratable acidity of kapoorkand with 70: 30 milk to bottlegourd ratio and 12 per cent sugar level were significantly higher than 60: 40 milk to bottlegourd ratio and 16 per cent sugar.

4.3 EFFECT OF MILK TO BOTTLEGOURD RATIO AND SUGAR LEVEL ON SENSORY QUALITY OF KAPOORKAND ON THE INITIAL DAY

The mean scores of sensory evaluation of kapoorkand on the initial day are presented in Table 3a while those affected by sugar and bottlegourd levels are presented in Table 3b.

Statistical analysis revealed that samples with 70:30 milk to bottlegourd ratio scored significantly ($P < 0.01$) higher than those prepared by using 60:40 milk to bottlegourd ratio.

The body and texture, flavour and overall acceptability of kapoorkand was found to be influenced by milk to bottlegourd ratio and sugar level. Kapoorkand prepared with 70:30 milk to bottlegourd ratio and 12 per cent sugar scored highest, whereas 60:40 milk to bottlegourd ratio and 12 per cent sugar scored lowest for all the sensory attributes.

Table 1: Mean Yield (%) values of kapoorkand

Milk : Bottlegourd	60:40		70:30	
Sugar	12%	16%	12%	16%
Yield %	27.38 (0.08)	29.04(0.06)	25.99 (0.03)	28.58 (0.04)

Each value is the mean of three replications and the values in parenthesis are standard error.

Table 1a: ANOVA of mean yield (%) value of kapoorkand

Source of variation	d.f.	MSS	f value
Milk: Bottlegourd	1	2.547	122.99**
Sugar	1	13.63	658.15**
M:Bx sugar	1	0.65	31.39**
error	8	0.030.02	
total	11		

**significant at P<0.01

Table 1b: Mean yield (%) value as affected by individual factor

	Milk: bottlegourd		Sugar		M:Bx Sugar			
	60:40	70:30	12%	16%	60:40,12%	60:40,16%	70:30,12%	70:30,16%
Mean	28.71^{x}	27.28^{y}	26.26^{p}	28.82^{q}	27.38^{a}	29.04^{b}	25.99^{c}	28.58^{d}
SE	0.08	0.08	0.03	0.04	0.11	0.12	0.18	0.13

Mean with different superscripts differ significantly

Table 2: Composition and physico-chemical properties of kapoorkand on the day of preparation

Milk:Bottlegourd	60:40		70:30		F values		
Sugar(%)	12	16	12	16	M:B	sugar	MBxsugar
Moisture (%)	22.8	21.00	20.66	20.02	4323.66**	2615.57**	597.4**
Fat (%)	9.8	9.10	11.80	10.91	1271.09**	221.36**	3.15^{NS}
Protein(%)	8.19	7.25	9.72	8.79	478.54**	177.06**	0.01^{NS}
Titratable acidity(%)	0.412	0.402	0.438	0.434	45.56**	2.75^{NS}	0.65^{NS}
TBA value	0.012	0.01	0.015	0.013	25**	6.25**	0.25^{NS}

Each value is the mean of three replications.
**significant at P<0.01, NS nonsignificant

Table 2a :Composition and physico-chemical properties of kapoorkand as influenced by individual factor .

	Milk:Bottlegourd		Sugar%		CD value
	60:40	70:30	12%	16%	
Moisture (%)	21.9^{x}	20.34^{y}	21.73^{p}	20.51^{q}	0.054
Fat (%)	9.45^{x}	11.35^{y}	10.81^{p}	10^{q}	0.123
Protein (%)	7.72^{x}	9.25^{y}	8.95^{p}	8.02^{q}	0.615
Titratable acidity(%)	0.407^{x}	0.436^{y}	0.425^{p}	0.41^{q}	0.01
TBA value	0.011^{x}	0.014^{y}	0.013^{p}	0.011^{q}	0.0015

Mean with different superscripts in a row differs significantly

Table 3: Mean sensory evaluation scores of kapoorkand on the day of preparation

Milk:Bottlegourd	60:40		70:30		F value		
Sugar(%)	12	16	12	16	$F_{M:B}$	F sugar	F MBxsugar
Colour and appearance	3.85	3.66	4.68	4.33	91.75**	11.69**	1.08^{NS}
Body and texture	3.53	3.95	4.2	4.1	84.52**	12.34**	33.98**
Flavour	3.82	4	4.6	4.32	139.01**	1.07^{NS}	23.13**
Overall acceptability	3.63	4.01	4.6	4.36	83.42**	0.94^{NS}	17.62**

Each value is mean of three replications.

**significant at P<0.01 NS nonsignificant

Table 3a: Mean sensory evaluation scores of kapoorkand as affected by individual factor

	Milk:Bottlegourd		Sugar		CD value
	60:40	70:30	12%	16%	
Colour and appearance	3.75^{x}	4.5^{y}	4.26^{p}	3.99^{q}	0.181
Body and texture	3.91^{x}	4.16^{y}	4.16^{p}	4.16^{q}	0.102
Flavour	3.91^{x}	4.46^{y}	4.46	4.6	0.107
Overall acceptability	3.82^{x}	4.48^{y}	4.48	4.18	0.166

Mean with different superscripts in a row differs significantly

4.4 STORAGE STUDIES OF KAPOORKAND

4.4.1 Effect of milk to bottlegourd ratio, sugar level and storage temperature on composition, physico-chemical quality and shelf life of kapoorkand

4.4.1.1 Moisture

The changes in moisture percentage of kapoorkand during storage period at room and refrigeration temperatures are presented in Table 4 and 5 respectively.

Statistical analysis (Table 4) revealed that there was a significant change in moisture content of kapoorkand during the period of storage at room temperature as influenced by milk to bottlegourd ratio and sugar levels.

From the Table 4b, it was be observed that moisture percentage was significantly higher in kapoorkand with 60:40 milk to bottlegourd ratio than those with 70:30 milk to bottlegourd ratio and also with 12 per cent in comparison to 16 per cent sugar.

There was a gradual decrease in percent moisture content of kapoorkand during storage period, however, the decrease was not significant from the initial day to 6^{th} day of storage.

Statistical analysis (Table 5) revealed that there was significant differences in moisture content of kapoorkand during refrigerated storage due to difference in milk:bottlegourd ratio and sugar levels. From Table 5b it was observed that the moisture percentage of kapoorkand with 60:40 milk to bottlegourd ratio were significantly higher ($P<0.01$) than those with 70:30 milk to bottlegourd ratio at refrigeration temperature. Moisture percentage of kapoorkand containing 12 per cent sugar was also significantly higher ($P<0.01$)

than those containing 16 per cent sugar at refrigeration temperature. The decrease in moisture content of kapoorkand at refrigeration temperature was gradual and did not show significant difference from the initial day up to the 14th day of storage.

4.4.1.2 Titratable acidity

The changes in titratable acidity of kapoorkand during the storage period at room and refrigeration temperatures are presented in Table 6 and 7 respectively.

Statistical analysis (Table 6) revealed that significant difference in titratable acidity of kapoorkand samples during the storage period at room temperature as influenced by milk to bottlegourd ratio and the storage period.

The titratable acidity of kapoorkand containing 70:30 milk to bottlegourd ratio was significantly higher than those with 60:40 milk to bottlegourd ratio. Titratable acidity was found to increase during the storage period which was however, nonsignificant from the initial day to the forth day of storage.

Statistical analysis (Table 7) revealed that sugar levels had no significant effect on titratable acidity of kapoorkand during the storage period at refrigeration temperature. Kapoorkand prepared with 70:30 milk to bottlegourd ratio had significantly higher values of titratable acidity compared to the ones containing 60:40 milk to bottlegourd ratio.

4.4.1.3 TBA value

The changes in TBA value of kapoorkand during storage period at room and refrigeration temperatures are presented in Table 8 and 9 respectively.

Statistical analysis (Table 8) revealed that there was a significant difference ($P<0.01$) in TBA value during the storage period at room temperature as influenced by milk to bottlegourd ratio and sugar level. The increase in TBA value during the storage period was found to be statistically significant.

Analysis of data in Table 9 also revealed that there was a significant difference in TBA values during storage period at refrigeration temperature as influenced by milk to bottlegourd ratio. A significant increase in TBA values from the initial to 7^{th} day, 7^{th} to 21^{st} day, 21^{st} to 42^{nd} day of storage had been recorded in the study.

4.4.1.4 Fat and protein

Fat and protein percentage values in kapoorkand analyzed initially and at the end of storage period at room and refrigeration temperatures are presented in Table 10 and the analysis of variance in Table 11.

There was an increase in the fat and protein content of kapoorkand during the storage period which, probably might be due to a progressive decrease in moisture content. The increase in fat and protein content was found to be significant ($P<0.01$) at both room and refrigeration temperatures.

4.4.2 Sensory evaluation

4.4.2.1 Colour and appearance

The mean colour and appearance scores of kapoorkand as influenced by various treatments during storage at room and refrigeration temperatures are presented in Table 12 and 13 respectively.

Table 4: Moisture percentage of kapoorkand during storage at room temperature

Milk:Bottlegourd	Sugar	Storage period (days)										
		0	2	4	6	8	10	12	14	16	18	20
60:40	12%	22.8 (0.02)	22.4 (0.01)	21.76 (0.01)	21.33 (0.012)	21 (0.026)	-	-	-	-	-	-
	16%	21 (0.017)	20.73 (0.02)	20.38 (0.02)	19.72 (0.016)	19.41 (0.03)	18.9 (0.026)	18.46 (0.012)	18.03 (0.002)	-	-	-
70:30	12%	20.66 (0.01)	20.2 (0.01)	19.76 (0.028)	19.28 (0.026)	18.85 (0.035)	18.38 (0.03)	17.76 (0.011)	17.23 (0.008)	16.6 (0.012)	-	-
	16%	20.02 (0.03)	19.5 (0.04)	19.16 (0.026)	18.6 (0.03)	18.13 (0.028)	17.76 (0.04)	17.26 (0.02)	16.25 (0.012)	16.28 (0.006)	15.8 (0.02)	15.4 (0.02)

Each value is the mean of three replications. Values in parenthesis are standard error.

Table 4a: ANOVA of moisture content as influenced by each factor independently

Source of variation	Degree of freedom	Mean sum of square	f value
Milk:bottlegourd	1	41.18	35.30**
sugars	1	15.10	12.94**
Storage period	10	3.22	2.76**
error	20	1.16	
total	32		

**significant at P<0.01

Table 4b: Mean moisture values as affected by individual factor

	Milk: bottlegourd		Sugar		Storage period (days)										
	60:40	70:30	12%	16%	0	2	4	6	8	10	12	14	16	18	20
Mean	20.46^{x}	18.17^{y}	19.77^{p}	18.49^{q}	21.12^{a}	20.71^{a}	20.27^{ab}	19.73^{ab}	18.8^{bc}	18.35^{bcd}	17.83^{cde}	17.34^{cde}	16.44^{cde}	15.8^{cde}	15.4^{cde}
SE	0.44	0.34	0.45	0.38	0.6	0.6	0.56	0.58	0.37	0.33	0.35	0.37	0.43	0.00	0.00

Mean with different superscripts differed significantly

Table 5: Moisture percentage of kapoorkand during storage at refrigeration temperature

Milk:Bottlegourd	Sugar	Storage period (days)								
		0	7	14	21	28	35	42	49	56
60:40	12%	22.8 (0.02)	22.23 (0.01)	21.6 (0.011)	21.1 (0.03)	20.57 (0.04)	-	-	-	-
	16%	21 (0.017)	20.53 (0.016)	20.07 (0.028)	19.36 (0.024)	18.8 (0.03)	18.36 (0.03)	17.76 (0.032)	17.31 (0.027)	16.9 (0.022)
70:30	12%	20.7 (0.01)	20.3 (0.02)	19.3 (0.023)	18.9 (0.023)	18.5 (0.026)	17.9 (0.03)	17.5 (0.04)	17.1 (0.036)	16.4 (0.025)
	16%	20.02 (0.037)	19.42 (0.03)	19.03 (0.026)	18.65 (0.026)	18.12 (0.018)	17.37 (0.028)	16.92 (0.038)	16.24 (0.032)	15.7 (0.026)

Each value is the mean of three replications. Values in parenthesis are standard error

Table 5a: ANOVA of mean value of moisture influenced by each factor individually

Source of variation	Degree of freedom	Mean sum of square	f value
Milk : bottlegourd	1	21.6	21.06**
Sugars	1	11.7	11.41**
Storage period	8	5.89	5.74**
error	21	1.03	
total	31		

**significant at P<0.01

Table 5b: Mean Moisture percentage as affected by individual factor

	Milk: bottlegourd		sugar		Storage period (days)								
	60:40	70:30	12%	16%	0	7	14	21	28	35	42	49	56
Mean	19.88^{x}	18.22^{y}	19.63^{p}	18.42^{q}	21.12^{a}	20.61^{ab}	20.06^{abc}	19.51^{bcd}	18.99^{cd}	17.87^{cd}	17.38^{d}	16.87^{d}	16.34^{d}
SE	0.45	0.34	0.53	0.35	0.6	0.59	0.55	0.55	0.55	0.55	0.25	0.32	0.35

Means with different superscripts differed significantly

Table 6: Titratable acidity of kapoorkand during storage at room temperature

Milk:Bottlegourd	Sugar	Storage period (days)										
		0	2	4	6	8	10	12	14	16	18	20
60:40	12%	0.412 (0.005)	0.427 (0.003)	0.442 (0.005)	0.475 (0.004)	0.48 (0.001)	-	-	-	-	--	-
	16%	0.398 (0.004)	0.402 (0.001)	0.417 (0.002)	0.428 (0.000)	0.437 (0.002)	0.443 (0.001)	0.448 (0.001)	0.476 (0.003)	-	-	-
70:30	12%	0.437 (0.004)	0.44 (0.02)	0.443 (0.004)	0.445 (0.001)	0.448 (0.00)	0.453 (0.002)	0.467 (0.002)	0.479 (0.00)	0.488 (0.004)	-	-
	16%	0.434 (0.003)	0.437 (0.001)	0.441 (0.00)	0.442 (0.002)	0.446 (0.002)	0.451 (0.001)	0.463 (0.00)	0.475 (0.005)	0.482 (0.002)	0.495 (0.002)	0.51 (0.002)

Each value is the mean of three replications. Values in parenthesis are standard error

Table 6a: ANOVA of titratable acidity asinfluenced by each factor independently

Source of variation	Degree of freedom	Mean sum of square	f value
Milk : bottlegourd	1	.0047	22.98**
sugars	1	.00002	0.104NS
Storage period	10	.0012	6.12**
error	20	.0002	
Total	32		

**significant at P<0.01

Table 6b: Mean titratable acidity as affected by individual factor

	Milk: bottlegourd		Sugar		Storage period (days)										
	60:40	70:30	12%	16%	0	2	4	6	8	10	12	14	16	18	20
Mean	0.44^{x}	0.46^{y}	0.45	0.45	0.42^{a}	0.43^{ab}	0.44^{ab}	0.45^{b}	0.45^{b}	0.45^{b}	0.46^{bc}	0.47^{cbc}	0.48^{cd}	0.49^{Sd}	0.51^{d}
SE	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.02	0.01	0.01	0.01	0.00

Means with different superscripts differed significantly

Table 7: Titratable acidity of kapoorkand during storage at refrigeration temperature

Milk : Bottlegourd	Sugar	Storage period (days)								
		0	7	14	21	28	35	42	49	56
60:40	12%	0.412 (0.005)	0.417(0.002)	0.421 (0.001)	0.434 (0.000)	0.44 (0.003)	-	-	-	-
	16%	0.398 (0.04)	0.40 (0.001)	0.401 (0.003)	0.406 (0.002)	0.416 (0.002)	0.423 (0.002)	0.435 (0.001)	0.446 (0.003)	0.46 (0.004)
70:30	12%	0.437 (0.004)	0.438 (0.002)	0.44 (0.002)	0.442 (0.001)	0.448 (0.00)	0.45 (0.001)	0.453 (0.00)	0.456 (0.002)	0.459 (0.002)
	16%	0.434 (0.003)	0.436 (0.003)	0.438 (0.003)	0.44 (0.002)	0.443 (0.001)	0.446 (0.001)	0.448 (0.002)	0.453 (0.002)	0.458 (0.004)

Each value is the mean of three replications. Values in parenthesis are standard error

Table 7a: ANOVA of titratable acidity as influenced by each factor independently

Source of variation	Degree of freedom	Mean sum of square	f value
Milk : bottlegourd	1	.004	17.88**
sugars	1	0.0004	1.47NS
Storage period	8	0.00002	0.09NS
error	21	0.00025	
total	31		

**significant at P<0.01, NS: Non significant

Table 7b: Mean values of titratable acidity as affected by individual factor

	Milk : bottlegourd		Sugar		Storage period (days)								
	60:40	70:30	12%	16%	0	7	14	21	28	35	42	49	56
Mean	0.42^{x}	0.445^{y}	0.439	0.432	0.421	0.423	0.425	0.431	0.437	0.44	0.445	0.452	0.459
SE	0.005	0.003	0.002	0.004	0.01	0.01	0.01	0.01	0.005	0.005	0.005	0.00	0.00

Mean with different superscripts differed significantly

Table 8: TBA values of kapoorkand during storage at room temperature

Milk:Bottlegourd	Sugar	Storage period (days)										
		0	2	4	6	8	10	12	14	16	18	20
60:40	12%	0.012 (0.00)	0.014 (0.00)	0.019 (0.01)	0.021 (0.00)	0.024 (0.00)	-	-	-	-	-	-
	16%	0.01 (0.00)	0.013 (0.002)	0.016 (0.00)	0.02 (0.00)	0.023 (0.00)	0.027 (0.001)	0.034 (0.00)	0.041 (0.00)	-	-	-
70:30	12%	0.015 (0.00)	0.016 (0.00)	0.019 (0.00)	0.022 (0.001)	0.025 (0.00)	0.029 (0.00)	0.032 (0.00)	0.036 (0.00)	0.04 (0.00)	-	-
	16%	0.013 (0.00)	0.015 (0.00)	0.018 (0.00)	0.021 (0.00)	0.024 (0.00)	0.026 (0.00)	0.03 (0.00)	0.034 (0.00)	0.037 (0.00)	0.041 (0.00)	0.044 (0.00)

Each value is mean of three replications. Values in parenthesis are standard error.

Table 8a: ANOVA of TBA values as influenced by each factor independently

Source of variation	Degree of freedom	Mean sum of square	f value
Milk : bottlegourd	1	.00026	73.79**
Sugars	1	.00004	14.03**
Storage period	10	.00025	72.74**
Error	20		
Total	32		

**significant at P<0.01

Table 8b: Mean TBA values as affected by individual factor

	Milk : bottlegourd		Sugar		Storage period (days)										
	60:40	70:30	12%	16%	0	2	4	6	8	10	12	14	16	18	20
Mean	0.021^{x}	0.027^{y}	0.023	0.026	0.013^{a}	0.015^{ab}	0.018^{ab}	0.02^{b}	0.024^{b}	0.027^{b}	0.032^{bc}	0.037^{bc}	0.039^{cd}	0.039^{d}	0.04^{d}
SE	0.00	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Means with different superscripts differed significantly

Table 9: TBA values of kapoorkand during storage at refrigeration temperature

Milk : Bottlegourd	Sugar	Storage period (days)								
		0	7	14	21	28	35	42	49	56
60:40	12%	0.012 (0.00)	0.015 (0.00)	0.017 (0.00)	0.019 (0.00)	0.022 (0.00)	-	-	-	-
	16%	0.01 (0.00)	0.012 (0.00)	0.015 (0.00)	0.018 (0.00)	0.019 (0.00)	0.023 (0.00)	0.026 (0.00)	0.029 (0.00)	0.033 (0.00)
70:30	12%	0.015 (0.00)	0.016 (0.00)	0.018 (0.00)	0.02 (0.00)	0.021 (0.00)	0.022 (0.00)	0.025 (0.00)	0.028 (0.00)	0.031 (0.00)
	16%	0.013 (0.00)	0.015 (0.00)	0.017 (0.00)	0.019 (0.00)	0.02 (0.00)	0.021 (0.00)	0.024 (0.00)	0.027 (0.00)	0.03 (0.00)

Each value is mean of three replications. Values in parenthesis are standard error.

Table 9a: ANOVA of TBA values as influenced by each factor independently

Source of variation	Degree of freedom	Mean sum of square	f value
Milk:bottlegourd	1	0.000006	31.19**
Sugars	1	0.0000006	0.3NS
Storage period	8	0.0001	57.69**
Error	21	0.000006	
Total	31		

**significant at P<0.01, NS: Non significant

Table 9b: Mean TBA values as affected by individual factor

	Milk : bottlegourd		sugar		Storage period (days)								
	60:40	70:30	12%	16%	0	7	14	21	28	35	42	49	56
Mean	0.029^{x}	0.027^{y}	0.027	0.028	0.01^{a}	0.02^{b}	0.02^{b}	0.03^{c}	0.03^{c}	0.03^{c}	0.04^{d}	0.04^{d}	0.04^{d}
SE	0.004	0.004	0.002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Mean with different superscripts differed significantly

Table 10: Fat and protein percentage of kapoorkand

Milk:Bottlegourd	Sugar	On the day of preparation (Initial day)		On the last day of storage at room temperature		On the last day of storage at refrigeration temperature	
		Fat	Protein	Fat	Protein	Fat	Protein
60:40	12%	9.8 (0.06)	8.19 (0.05)	9.92 (0.05)	8.33 (0.05)	9.98 (0.04)	8.37 (0.06)
	16%	9.1 (0.06)	7.25 (0.06)	9.36 (0.04)	7.45 (0.04)	9.45 (0.07)	7.46 (0.08)
70:30	12%	11.8 (0.06)	9.97 (0.04)	12.13 (0.08)	9.97 (0.05)	12.15 (0.06)	9.99 (0.08)
	16%	10.91(0.03)	9.02 (0.06)	11.19 (0.05)	9.02 (0.05)	11.21 (0.07)	9.04 (0.06)

Each value is the mean of three replications. Values in parenthesis are standard error.

Table 11: ANOVA of fat and protein percentage of kapoorkand

Source of variation	Degree of freedom	F value	
		Fat	Protein
Treatment	3	1705.8	4930.36**
Storage days	2	38.39	92.36**
Error	6		
Total	11		

**significant at $P < 0.01$

Statistical analysis of data (Table 12) revealed that there was significant difference in colour and appearance of different formulations of kapoorkand during storage at room temperature.

Sensory evaluation studies revealed that there was a gradual decrease in color and appearance scores of kapoorkand during storage at room temperature. The decrease was however nonsignificant from the initial to 9^{th} day of storage. On the contrary, a significant decrease in scores of colour and appearance was observed from 9^{th} to 15^{th} day and 15^{th} to 18^{th} day of storage.

Kapoorkand prepared with 70:30 milk to bottlegourd ratio and 12 per cent sugar recorded highest score while that prepared with 60:40 milk to bottlegourd ratio and 16 per cent sugar registered lowest score for colour and appearance.

Statistical analysis (Table 13) revealed that there was significant difference ($P<0.01$) in colour and appearance scores of kapoorkand prepared with different formulations during storage at refrigeration temperature.

Although a gradual decrease in colour and appearance scores of kapoorkand was observed during the storage at refrigeration temperature, yet this decrease was nonsignificant from the initial to 21^{st} day of storage at refrigeration temperature.

4.4.2.2 Body and texture

The mean body and texture scores of kapoorkand as influenced by various treatments during storage at room and refrigeration temperatures are presented in Table 14 and 15 respectively.

Statistical analysis (Table 14) revealed that there was a significant difference in body and texture scores of kapoorkand among the treatment groups during storage at room temperature.

A gradual decrease in body and texture score of kapoorkand was observed during storage at room temperature, which however was nonsignificant from the initial to 9th day of storage.

Similar to room temperature storage, there was also significant differences in body and texture of kapoorkand among treatment groups during storage at refrigeration temperature (Table15).

The gradual decrease in body and texture scores of kapoorkand observed during storage at refrigeration temperature from the initial to 28th day of storage, was however, found to be non-significant.

4.4.2.3 Flavour

The mean flavour scores of kapoorkand as influenced by various treatments during storage at room and refrigerated temperatures are presented in Table 16 and 117 respectively.

Statistical analysis (Table 16) revealed significant differences in flavour scores of kapoorkand during storage at room temperature among the treatment groups. However, mean flavour scores of kapoorkand with 60:40 milk to bottlegourd ratio and 12 per cent sugar as well as 60:40 milk to bottlegourd ratio and 16 per cent sugar level show significant difference during storage. No significant difference in flavour score was also observed in kapoorkand prepared with 60:40 milk to bottlegourd ratio and 16 per cent sugar and with 70:30 milk to bottlegourd ratio and 16 per cent sugar during storage. Although the flavour

score of kapoorkand gradually declined during the storage period, yet, this decrease was non-significant from the initial to 9th day of storage.

Statistical analysis (Table 17) revealed a significant difference in flavour of scores of kapoorkand among treatments groups when stored at refrigeration temperature. However, the differences observed in the mean flavour scores of kapoorkand prepared with 60:40 ratio of milk to bottlegourd and 12 per cent sugar and 60:40 ratio of milk to bottlegourd with 16 per cent sugar was statistically non-significant.

The flavour score of kapoorkand gradually declined during the storage at refrigeration temperature which however, was non-significant from the initial to 28th day of storage.

4.4.2.4 Overall acceptability

The mean scores of overall acceptability of kapoorkand as influenced by various treatments during the storage period at room and refrigeration temperatures are presented in Table 18 and 19 respectively.

Analysis of data (Table 18) revealed that there was significant differences in the overall acceptability scores among the treatment groups of kapoorkand during the storage period.

The decrease in scores from the initial to 6th day of storage was found to be non-significant. Although the overall acceptability scores gradually declined during storage at room temperature.

Statistical analysis of data (Table 19) revealed that overall acceptability scores of kapoorkand among treatment groups differed significantly during storage at refrigeration temperature.

A gradual but significant decrease in overall acceptability scores of kapoorkand was observed during storage at refrigeration temperature. Similarly a significant decrease in overall acceptability scores was also observed during storage at room temperature.

4.4.3 Microbial profile

4.4.3.1 Total bacterial count

The total bacterial count (cfu/g) in kapoorkand on the initial and on the end of storage period at room and refrigeration temperature are depicted in Table 20.

The results revealed that there was an increase in total bacterial count at both storage temperatures, however, it was relatively higher at room temperature when compared to refrigeration temperatures.

4.4.3.2 Yeast and mould count

The count of yeast and mould (cfu/g) on the initial and on the end of storage period both at room and refrigeration temperature are presented in Table 21.

The study revealed that there was an increase in yeast and mould count at both the temperatures of storage although it was much higher at room temperature than at refrigeration temperature.

Table 12: Colour and appearance scores of kapoorkand during storage at room temperature

Milk : Bottlegourd	Sugar	Storage period (days)						
		0	3	6	9	12	15	18
60:40	12%	3.85 (0.07)	3.7 (0.08)	3.64 (0.06)				
	16%	3.66 (0.04)	3.58 (0.05)	3.45 (0.03)	3.4 (0.02)	3.25 (0.03)		
70:30	12%	4.68 (0.09)	4.6 (0.06)	4.49 (0.05)	4.4 (0.04)	4.3 (0.02)	4.28 (0.04)	
	16%	4.27 (0.08)	4.13 (0.04)	4.07 (0.03)	3.9 (0.03)	3.72 (0.02)	3.7 (0.02)	3.5 (0.04)

Each value is the mean of three replications. Values in parenthesis are standard error.

Table 12a: ANOVA of colour and appearance scores of kapoorkand during storage at room temperature

Source of variation	Degree of freedom	Mean sum of square	f value
Treatment	3	0.96	40.02**
Storage period	6	0.07	3.096*
Error	11	0.02	
Total	20		

**significant at P<0.01, * significant at P<0.05

Table 12b: Mean scores of colour and appearance as influenced by each treatment during storage at room temperature

	Milk: bottlegourd Sugar				Storage period (days)						
	60:40 12%	60:40 16%	70:30 12%	70:30 16%	0	3	6	9	12	15	18
Mean	3.73^{p}	3.46^{q}	4.45^{r}	3.89^{s}	4.11^{a}	4.00^{a}	3.91^{ab}	3.9^{ab}	3.75^{bc}	3.9^{c}	3.5^{d}
SE	0.06	0.07	0.05	0.03	0.22	0.23	0.23	0.28	0.3	0.29	0.00

Mean with different superscripts differed significantly

Table 13: Colour and appearance scores of kapoorkand during storage at refrigeration temperature

Milk : Bottlegourd	Sugar	Storage period (days)								
		0	7	14	21	28	35	42	49	56
60:40	12%	3.85 (0.07)	3.76 (0.05)	3.66 (0.03)	3.58 (0.06)	3.5 (0.04)	-	-	-	-
	16%	3.66 (0.04)	3.6 (0.05)	3.54 (0.02)	3.51 (0.03)	3.48 (0.02)	3.42 (0.01)	3.35 (0.03)	3.3 (0.01)	3.26 (0.04)
70:30	12%	4.68 (0.09)	4.66 (0.08)	4.62 (0.05)	4.55 (0.03)	4.44 (0.01)	4.36 (0.04)	4.24 (0.02)	4.15 (0.03)	4.06 (0.00)
	16%	4.27 (0.09)	4.26 (0.06)	4.23 (0.04)	4.13 (0.01)	4.08 (0.03)	4 (0.05)	3.91 (0.04)	3.8 (0.02)	3.66 (0.03)

Each value is the mean of three replications. Values in parenthesis are standard error.

Table 13a: ANOVA of colour and appearance scores of kapoorkand during storage at refrigeration temperature

Source of variation	Degree of freedom	Mean sum of square	f value
Treatment	3	1.52	75.52**
Storage period	8	0.074	3.59**
Error	20	0.02	
Total	31		

**significant at P<0.01

Table 13b: Mean scores of colour and appearance as influenced by each treatment during storage at refrigeration temperature

	Milk: bottlegourd sugar				Storage period (days)								
	60:40 12%	60:40 16%	70:30 12%	70:30 16%	0	7	14	21	28	35	42	49	56
Mean	3.67^{p}	3.45^{q}	4.41^{r}	4.03^{s}	4.12^{a}	4.07^{ab}	4.01^{abc}	3.94^{abc}	3.87^{bc}	3.91^{c}	3.83^{cd}	3.75^{cd}	3.66^{de}
SE	0.06	0.04	0.07	0.07	0.23	0.24	0.25	0.24	0.23	0.27	0.25	0.24	0.23

Mean with different superscripts differed significantly

Table 14: Body and texture scores of kapoorkand during storage at room temperature

Milk:Bottlegourd	Sugar	Storage period (days)						
		0	3	6	9	12	15	18
60:40	12%	3.53 (0.03)	3.42 (0.04)	3.33 (0.02)				
	16%	3.95 (0.02)	3.8 (0.04)	3.77 (0.03)	3.65 (0.03)	3.33 (0.01)		
70:30	12%	4.18 (0.05)	4.02 (0.02)	3.95 90.02)	3.84 (0.03)	3.75 (0.02)	3.66 (0.03)	
	16%	4.10 (0.05)	3.9 (0.04)	3.75 (0.02)	3.63 (0.04)	3.5 (0.01)	3.33 (0.02)	3.25 (0.02)

Each value is the mean of three replications. Values in parenthesis are standard error.

Table 14a: ANOVA of Body and texture scores of kapoorkand during storage at room temperature

Source of variation	Degree of freedom	Mean sum of square	f value
Treatment	3	0.16	5.31*
Storage period	6	0.1	3.43*
error	11	0.03	
total	20		

**significant at P<0.05

Table 14b: Mean scores of body and texture as influenced by each treatment during storage at room temperature

	Milk : bottlegourd sugar				Storage period (days)						
	60:40 12%	60:40 16%	70:30 12%	70:30 16%	0	3	6	9	12	15	18
Mean	3.42^{p}	3.7^{q}	3.9^{r}	3.63^{s}	3.94^{a}	3.78^{ab}	3.7^{ab}	3.7^{abc}	3.52^{cde}	3.49^{de}	3.25^{e}
SE	0.05	0.1	0.07	0.11	0.14	0.12	0.13	0.06	0.12	0.16	0.12

Mean with different superscripts differed significantly

Table 15: Body and texture scores of kapoorkand during storage at refrigeration temperature

Milk : Bottlegourd	Sugar	Storage period (days)								
		0	7	14	21	28	35	42	49	56
60:40	12%	3.53 (0.03)	3.45 (0.01)	3.38 (0.02)	3.3 (0.01)	3.25 (0.01)	-	-	-	-
	16%	3.95 (0.02)	3.9 (0.01)	3.82 (0.01)	3.77 (0.03)	3.66 (0.02)	3.5 (0.02)	3.38 (0.04)	3.38 (0.03)	3.1 (0.01)
70:30	12%	4.2 (0.05)	4.12 (0.02)	4.03 (0.02)	4 (0.02)	3.94 (0.04)	3.72 (0.01)	3.68 (0.02)	3.52 (0.02)	3.42 (0.01)
	16%	4.1 (0.05)	4.04 (0.01)	4.00 (0.01)	3.95 (0.04)	3.9 (0.03)	3.66 (0.01)	3.5 (0.03)	3.33 (0.01)	3.0 (0.02)

Each value is the mean of three replications. Values in parenthesis are standard error.

Table 15a: ANOVA of body and texture scores of kapoorkand during storage at refrigeration temperature

Source	Degree of freedom	Mean sum of square	f value
Treatment	3	.25	6.04**
Storage period	8	.199	4.77**
Error	20	.04	
Total	31		

**Significant at P<0.01

Table 15b: Mean scores of body and texture as influenced by each treatment during storage at refrigeration temperature

	Milk: bottlegourd Sugar				Storage period (days)								
	60:40 12%	60:40 16%	70:30 12%	70:30 16%	0	7	14	21	28	35	42	49	56
Mean	3.38^{p}	3.6^{q}	3.84^{r}	3.72^{s}	3.94^{a}	3.87^{ab}	3.8^{ab}	3.75^{ab}	3.68^{ab}	3.62^{bc}	3.52^{bc}	3.41^{bcd}	3.17^{d}
SE	0.05	0.09	0.09	0.12	0.14	0.14	0.14	0.15	0.15	0.06	0.08	0.05	0.12

Mean with different superscripts differed significantly

Table 16: Flavour scores of kapoorkand during storage at room temperature

Milk:Bottlegourd	Sugar	Storage period (days)						
		0	3	6	9	12	15	18
60:40	12%	3.82 (0.01)	3.78 (0.03)	3.71 (0.01)				
	16%	4.00 (0.05)	3.86(0.02)	3.79 (0.03)	3.75 (0.03)	3.4 (0.01)		
70:30	12%	4.6 (0.05)	4.45 0.02)	4.35 (0.02)	4.24 (0.04)	4.05 (0.02)	4.00 (0.03)	
	16%	4.33 (0.04)	4.2 (0.04)	4.15 (0.02)	4.02 (0.05)	3.8 (0.02)	3.79 (0.02)	3.5(0.01)

Each value is the mean of three replications. Values in parenthesis are standard error.

Table 16a: ANOVA of flavour scores of kapoorkand during storage at room temperature

Source of variation	Degree of freedom	Mean sum of square	f value
Treatment	3	0.31	9.38**
Storage period	6	0.1	3.12*
Error	11	0.03	
Total	20		

**significant at P<0.01, *significant at P<0.05

Table 16b: Mean scores of flavour as influenced by each treatment during storage at room temperature

	Milk : bottlegourd sugar				Storage period (days)						
	60:40 12%	60:40 16%	70:30 12%	70:30 16%	0	3	6	9	12	15	18
Mean	3.77^{p}	3.76^{pq}	4.28^{r}	3.97^{q}	4.18^{a}	4.07^{ab}	4^{ab}	4^{abc}	3.75^{bc}	3.8^{c}	3.5^{c}
SE	0.03	0.09	0.09	0.09	0.17	0.15	0.15	0.14	0.18	0.1	0.00

Mean with different superscripts differed significantly

Table 17: Flavour scores of kapoorkand during storage at refrigeration temperature

Milk : Bottlegourd	Sugar	Storage period (days)								
		0	7	14	21	28	35	42	49	56
60:40	12%	3.82 (0.01)	3.76 (0.01)	3.68 (0.03)	3.61 (0.02)	3.65 (0.02)	-	-	-	-
	16%	4.00 (0.05)	3.98 (0.04)	3.90 (0.02)	3.83 (0.03)	3.75 (0.04)	3.68 (0.02)	3.52 (0.03)	3.46 (0.03)	3.4 (0.03)
70:30	12%	4.6 (0.05)	4.56 (0.03)	4.50 (0.04)	4.42 (0.01)	4.34 (0.01)	4.26 (0.03)	4.19 (0.05)	4.1 (0.02)	3.98 (0.02)
	16%	4.33 (0.04)	4.27 (0.02)	4.25 (0.04)	4.18 (0.03)	4.10 (0.02)	3.8 (0.02)	3.78 (0.04)	3.66 (0.03)	3.52 (0.02)

Each value is the mean of three replications. Values in parenthesis are standard error.

Table 17a: ANOVA of flavour scores of kapoorkand during storage at refrigeration temperature

Source of variation	Degree of freedom	Mean sum of square	f value
Treatment	3	.07	23.46**
Storage period	8	0.116	3.19*
Error	20	0.029	
Total	31		

**significant at P<0.01 *significant at P<0.05

Table 17b:Mean scores of flavour as influenced by each treatment during storage at refrigeration temperature

	Milk: bottlegourd Sugar				Storage period (days)								
	60:40 12%	60:40 16%	70:30 12%	70:30 16%	0	7	14	21	28	35	42	49	56
Mean	3.68^{p}	3.72^{p}	4.32^{q}	3.99^{r}	4.18^{a}	4.14^{ab}	4.08^{ab}	4.01^{ab}	3.93^{ab}	3.91^{bc}	3.83^{bc}	3.74^{bc}	3.6^{3c}
SE	0.04	0.07	0.07	0.09	0.17	0.17	0.18	0.18	0.17	0.17	0.19	0.18	0.17

Mean with different superscripts differed significantly

Table 18: Overall acceptability scores of kapoorkand during storage at room temperature

Milk:Bottlegourd	Sugar	Storage period (days)						
		0	3	6	9	12	15	18
60:40	12%	3.64 (0.07)	3.59 (0.03)	3.4 (0.04)				
	16%	4.01 (0.06)	3.94 (0.04)	3.8 (0.02)	3.7 (0.04)	3.58 (0.03)		
70:30	12%	4.6 (0.05)	4.55 (0.02)	4.38 (0.01)	4.19 (0.03)	4.05 (0.02)	4.00 (0.02)	
	16%	4.37 (0.08)	4.29 (0.05)	4.10 (0.02)	3.90 0.02)	3.86 (0.02)	3.63 (0.04)	3.55 (0.01)

Each value is the mean of three replications. Values in parenthesis are standard error.

Table 18a: ANOVA of overall acceptability scores of kapoorkand during storage at room temperature

Source of variation	Degree of freedom	Mean sum of square	f value
Treatment	3	0.45	22.5**
Storage period	6	0.07	3.5*
Error	11	0.02	
Total	20		

**significant at P<0.01, *significant at P<0.05

Table 18b: Mean scores of overall acceptability as influenced by each treatment during storage at room temperature

	Milk: bottle gourd Sugar				Storage period (days)						
	60:40 12%	60:40 16%	70:30 12%	70:30 16%	0	3	6	9	12	15	18
Mean	3.54^{p}	3.8^{q}	4.3^{r}	3.99^{s}	4.15^{a}	4.09^{a}	3.93^{a}	3.93^{b}	3.83^{bc}	3.81^{c}	3.55^{c}
SE	0.07	0.07	0.09	0.1	0.21	0.2	0.21	0.14	0.14	0.13	0.00

Mean with different superscripts differed significantly

Table 19: Overall acceptability scores of kapoorkand during storage at refrigeration temperature

Milk:Bottlegourd	Sugar	Storage period (days)								
		0	7	14	21	28	35	42	49	56
60:40	12%	3.64 (0.07)	3.58 (0.05)	3.52 (0.06)	3.36 (0.02)	3.25 (0.03)	-	-	-	-
	16%	4.01 (0.06)	3.94 90.03)	3.82 (0.02)	3.75 (0.01)	3.70 (0.03)	3.62 (0.04)	3.57 90.02)	3.48 (0.01)	3.36 (0.02)
70:30	12%	4.6 (0.05)	4.56 (0.04)	4.48 (0.04)	4.43 (0.01)	4.37 (0.01)	4.29 (0.01)	4.22 (0.05)	4.03 (0.03)	3.88 (0.02)
	16%	4.37 (0.08)	4.33 (0.04)	4.27 (0.02)	4.19 (0.02)	4.10 (0.03)	4.00 (0.06)	3.93 (0.04)	3.83 (0.02)	3.65 (0.03)

Each value is the mean of three replications. Values in parenthesis are standard error.

Table 19a: ANOVA of overall acceptability scores of kapoorkand during storage at refrigeration temperature

Source of variation	Degree of freedom	Mean sum of square	f value
Treatment	3	1.03	30.35**
Storage period	8	0.08	2.64*
error	20	0.03	
total	31		

**significant at P<0.01 *significant at P<0.05

Table 19b: Mean scores of overall acceptability as influenced by each treatment during storage at refrigeration temperature

	Milk: bottlegourd sugar				Storage period (days)								
	60:40 12%	60:40 16%	70:30 12%	70:30 16%	0	7	14	21	28	35	42	49	56
Mean	3.47^{p}	3.69^{q}	4.31^{r}	4.07^{s}	4.15^{a}	4.1^{ab}	4.02^{ab}	3.93^{ab}	3.85^{b}	3.97^{b}	3.9^{bc}	3.78^{c}	3.63^{c}
SE	0.07	0.08	0.08	0.08	0.21	0.21	0.21	0.23	0.24	0.2	0.18	0.16	0.15

Mean with different superscripts differed significantly

Table 20: Total bacterial count (cfu/g) of kapoorkand

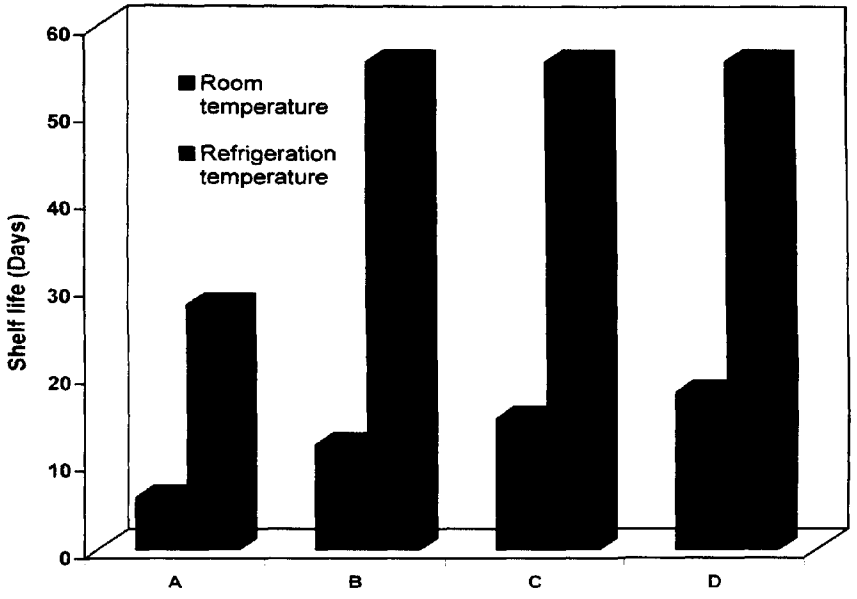
Milk:Bottlegourd	Sugar	On the day of preparation (Initial day)	On the last day of storage at room temperature	On the last day of storage at refrigeration temperature
60:40	12%	$3.9x10^2$ (2.9)	$4.1x10^3$ (3.2)	$3.2x10^3$ (3.1)
	16%	$3.5x10^2$ (3.4)	$4.4x10^3$ (3.9)	$2.6x10^3$ (3.2)
70:30	12%	$3.2x10^2$ (3.6)	$4.3x10^3$ (3.6)	$2.4x10^3$ (3.1)
	16%	$3.0x10^2$ (2.4)	$4.3x10^3$ (3.8)	$3.2x10^3$ (2.9)

Each value is the mean of three replications. Values in parenthesis are standard error.

Table 21: Yeast and mould count (cfu/g) of kapoorkand

Milk:Bottlegourd	Sugar	On the day of preparation (Initial day)	On the last day of storage at room temperature	On the last day of storage at refrigeration temperature
60:40	12%	8	$2.8x10^2$ (2.2)	$2.1x10^2$ (2.6)
	16%	6	$2.6x10^2$ (3.8)	$2x10^2$ (2.4)
70:30	12%	5	$2.5x10^2$ (3.4)	$1.6x10^2$ (2.1)
	16%	4	$2.3x10^2$ (3.2)	$1.5x10^2$ (2.3)

Each value is the mean of three replications. Values in parenthesis are standard error.



A - 60 : 40 milk to bottlegourd ratio with 12 % sugar
B - 60 : 40 milk to bottlegourd ratio with 16 % sugar
C - 70 : 30 milk to bottlegourd ratio with 12 % sugar
D - 70 : 30 milk to bottlegourd ratio with 16 % sugar

Fig. 1 : Shelf life of Kapoorkand at room and refrigeration temperature

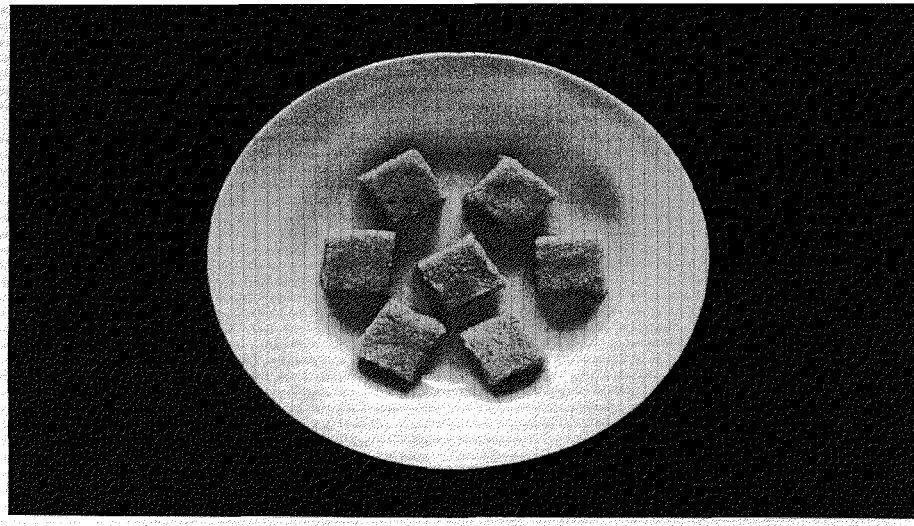


Plate1: Kapoorkand prepared by using milk and bottlegourd (60:40) with 12% sugar

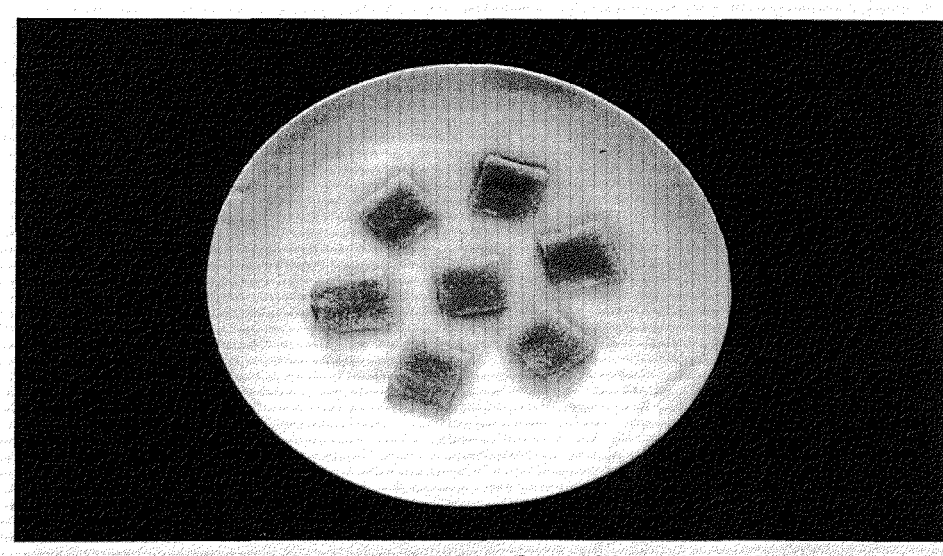


Plate2: Kapoorkand prepared by using milk and bottlegourd (60:40 with 16% sugar

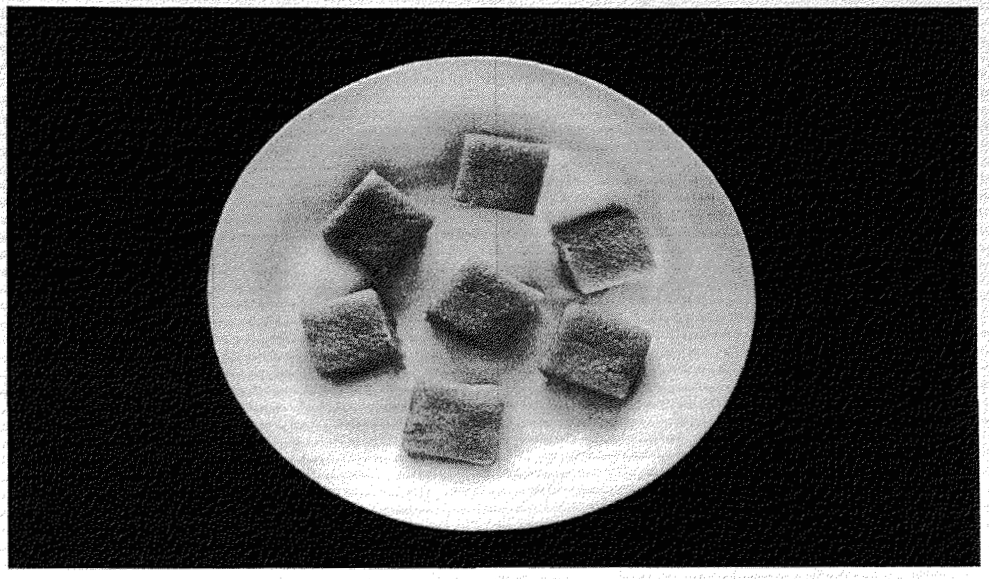


Plate3: Kapoorkand prepared by using milk and bottlegourd (70:30) with 12% sugar

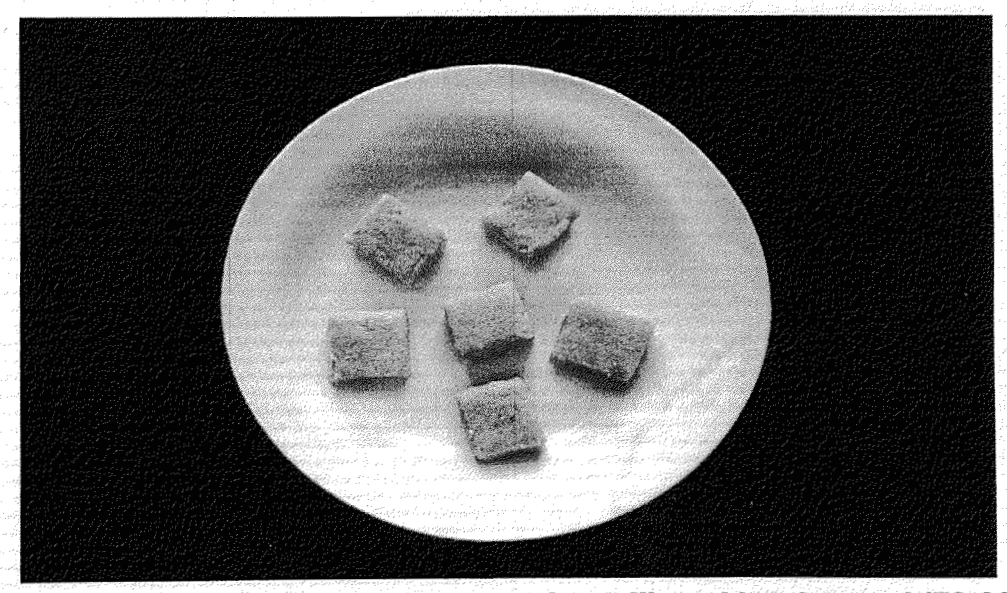


Plate4: Kapoorkand prepared by using milk and bottlegourd (70:30) with 16% sugar

DISCUSSION

CHAPTER V

DISCUSSION

The effect of two levels of milk to bottlegourd ratio i.e. 60 : 40 and 70 : 30 and two sugar levels i.e. 12 % and 16 % on shelf life of kapoorkand was studied at room and refrigeration temperatures.

5.1 QUALITY OF KAPOORKAND ON INITIAL DAY

5.1.1 Effect of milk to bottlegourd ratio on the yield, physico-chemical and sensory properties

The percentage yield of kapoorkand prepared with 60 : 40 milk to bottlegourd ratio was significantly higher than yield of kapoorkand prepared with 70 : 30 milk to bottlegourd ratio. This increase in yield might be due to higher moisture retention in the bottlegourd pulp after concentration process. The moisture level in bottlegourd pulp was 96.1 per cent. Ingle *et al.* (2004) also reported significantly higher yields of ashgourd burfi with 30 or 40 per cent ashgourd pulp compared to ashgourd burfi with 20 per cent ashgourd pulp.

The moisture content of kapoorkand increased significantly with increase in the levels of bottlegourd. This might be due to higher level of moisture content (96.1 %) in bottlegourd. Wakchaure *et al.* (2003) and Ingle *et al.* (2004) also noted an increase in moisture content alongwith the increase in level of sapota pulp and ashgourd pulp in sapota burfi and ashgourd burfi respectively.

The fat and protein content was found to decrease significantly as the level of bottlegourd pulp increased. This might be due to lower level of fat (0.1 %) and protein (0.2 %) in bottlegourd pulp compared to standardized buffalo milk (5 % fat and about 3.7 % protein).

Titratable acidity of kapoorkand prepared with 60 : 40 milk to bottlegourd was found to be lower than the ones prepared with 70 : 30 milk to bottlegourd ratio. This might be primarily due to lower levels of titratable acidity of bottlegourd compared to buffalo milk.

In generally, protein content also contributes to titratable acidity in milk, the low protein content in bottlegourd pulp might have also contributed in lowering of titratable acidity in kapoorkand prepared with 60:40 milk to bottlegourd ratio.

TBA values of kapoorkand were found to decrease as the level of bottlegourd increased. This might be due to lower content of fat in bottlegourd which might undergo oxidative rancidity.

Kapoorkand prepared with 70 : 30 milk to bottlegourd scored significantly higher than those with 60 : 40 milk to bottlegourd ratio with respect to all sensory attributes. Body and texture of kapoorkand samples prepared with 60 : 40 milk to bottlegourd were softer than the ones prepared with 70 : 30 milk to bottlegourd. The soft body might be due to higher moisture retention in kapoorkand with higher level of bottlegourd.

The flavour score of kapoorkand prepared with 70 : 30 milk to bottlegourd was significantly higher than those prepared with 60 : 40 milk to bottlegourd. This improvement in flavour could be related to the richness contributed by higher levels of milk solids. The lower flavour score registered in 60 : 40 of kapoorkand might also be related to higher proportion of bottlegourd, whose flavour score was lower than the milk solids.

Overall acceptability was also significantly higher for kapoorkand prepared with 70:30 milk to bottlegourd due to overall superior sensory attributes i.e. colour and appearance, body and texture and flavour.

Based on the above observations, it may be concluded that kapoorkand with 70 : 30 milk to bottlegourd had better acceptability than those with 60 : 40 milk to bottlegourd.

5.1.2 Effect of sugar levels on the yield, physico-chemical and sensory qualities of kapoorkand

The higher percentage yield of kapoorkand made with 16 per cent sugar as compared to 12 per cent could be attributed to higher proportion of sugar level added to the product.

The moisture content of kapoorkand decreased with increase in sugar levels. This might be correlated to the higher levels of solids resulting from better evaporation during the desiccation process.

Prajapati *et al.* (1986) also observed a decrease in moisture content of khoa due to an increase in the contents of sugar i.e. 30, 40 and 50 per cent (w/w).

The significant decrease in protein and fat contents of kapoorkand due to the increased levels of sugar. This decrease might be due to a relatively higher proportion of sugar contributing towards the solid content in the product.

Sugar being a neutral compound, might not have significantly affected the titratable acidity of kapoorkand at 16 and 12 per cent levels.

TBA values of kapoorkand were found to decrease as the levels of sugar increased. This could be attributed to lower contents of fat in kapoorkand with higher levels of sugar.

The colour and appearance and body and texture scores of kapoorkand with 12 per cent sugar were significantly higher than those with 16 per cent sugar. Kapoorkand with 12 per cent sugar looked more greenish in colour while those containing high percentage of sugar appeared brownish colour and this could be related to caramellization, maillard reaction on exposure to heat (cooking). Gothwal and Shukla (1995) also reported that the higher levels of sugar caused more browning in khoa based sweets.

Kapoorkand with 12 per cent sugar scored better than those with 16 per cent sugar in respect of flavour and overall acceptability. Ramesh Babu (2000) and Vandavasi (2002) also reported optimum level of sweetness with desirable body and texture in milk cake, when sugar was added at 12 per cent level.

5.2 STORAGE STUDIES OF KAPOORKAND

5.2.1 Physico-chemical changes in kapoorkand during storage at room and refrigerated temperatures

Keeping quality of any product mainly depends upon its moisture content. During storage the product deteriorates at a faster rate at room temperature due to faster multiplication of microorganisms compared to refrigeration temperature.

In the present study, a gradual decrease in moisture percentage of all the four types of kapoorkand was observed during storage at both room and refrigeration temperature. The rate of decrease was faster when stored at room temperature than at refrigeration temperature. Moisture loss during storage was due to surface evaporation and as expected was more at higher temperature of storage. The finding of present study corroborated well with the report of

Sachdeva and Rajorhia (1982) in burfi and Madhava Rao (1999) and Ramesh Babu (2000) in milk cake.

There was a slight increase in fat and protein content of kapoorkand samples during storage which however was consistent with the decrease in moisture content.

The titratable acidity of all the four types of kapoorkand samples was found to be increased during storage period both at room and refrigeration temperature. The rate of increase in titratable acidity was higher in the products stored at room temperature compared to the ones stored at refrigeration to samples stored at refrigeration temperature in all the formulations of kapoorkand prepared. The increase in titratable acidity during the storage period might be attributed to production of lactic and other acids due to fermentation by microorganisms. Most of the microorganisms that gain entry into the milk products belong to mesophilic group, consequent to which the rate of increase in titratable acidity was higher in the product samples stored at room temperature compared to those stored at refrigeration temperature. The finding of the product study was in close agreement with the report of Sachdeva and Rajorhia (1982) in burfi and Madhava Rao (1999) and Ramesh Babu (2000) in milk cake.

TBA values were found to be increased in all the formulations of kapoorkand samples as the storage period advanced. The increase in TBA value was faster in the products stored at room temperature compared to those stored at refrigeration temperature. The increase in TBA values might be due to oxidative and hydrolytic rancidity of fat that occurred at faster rate in product samples stored at room temperature which encourage the activity of enzymes. Similar

increasing trends of TBA values were observed by Sachdeva and Rajorhia (1982) in burfi and Karvasra (2003) in milk cake during storage.

5.2.2 Sensory evaluation of kapoorkand during storage at room and refrigeration temperatures

A gradual decrease in colour and appearance scores for all types of kapoorkand was observed both at room and refrigeration temperatures of storage. However, such decrease was faster at room temperature than at refrigeration temperature. The decrease in colour and appearance scores might be due to the development of dull colour owing to partial drying and evaporation of moisture from the kapoorkand surface.

The results of the present investigation corroborated well with the reports of Madhava Rao (1999), Ramesh Babu (2000) and Vandavasi (2002) who also noted faster deterioration in colour and appearance of milk cake stored at room temperature.

A decrease in body and texture scores during storage was recorded for kapoorkand samples both at room and refrigeration temperatures. This rate of decrease was faster at room temperature when compared to refrigeration temperature. The decrease in body and texture scores of kapoorkand might be due to a slow but continuous loss of moisture from the kapoorkand surface resulting from drying of the product. The body and texture of kapoorkand prepared with 16 per cent sugar was little more harder than the ones with 12 per cent sugar, during the storage period. This hardness could probably be due to a high percentage of sugar in the former. The gradual decline in flavour score of all the four types of kapoorkand during storage at room and refrigeration

temperatures might be ascribed to both biochemical alterations reactions and microbial activity that took place during the storage period. The finding of the present study further strengthened the reports of earlier workers (Madhava Rao, 1999 and Vandavasi, 2002).

There was a gradual decrease in overall acceptability scores of all four types of kapoorkand during the storage period at room and refrigeration temperature. This was very much expected since the overall acceptability is a cumulative effect of all the sensory attributes i.e. colour and appearance, body and texture and flavour.

5.2.3 Microbial profile of kapoorkand during storage

As expected the total bacterial and yeast and mould counts of kapoorkand increased at a faster rate during room temperature storage as compared to storage at refrigeration temperature. It is an established fact that most of microbes in milk and milk products belong to the mesophilic group, which grow best at room temperature than at refrigeration temperature.

However, at the end of the storage period total bacterial count were within the acceptable limit as prescribed by SP:18:Part XI 1981, indicating the fact hygienic handling helps in minimizing bacterial population in milk products.

5.2.4 Shelf life of kapoorkand at room and refrigeration storage

At room temperature storage, shelf life of kapoorkand prepared with 60 : 40 milk to bottlegourd ratio and 12 per cent sugar, 60 : 40 milk to bottlegourd ratio and 16 per cent sugar, 70 : 30 milk to bottlegourd ratio and 12 per cent sugar, 70 : 30 milk to bottlegourd ratio and 16 per cent sugar were found

to be 6, 12, 15 and 18 days respectively. On the last day of storage, kapoorkand was not acceptable due to visible mould growth on the surface.

At refrigeration temperature storage, shelf life of kapoorkand prepared with 60 : 40 milk to bottlegourd ratio and 12 per cent sugar, 60 : 40 milk to bottlegourd ratio and 16 per cent sugar, 70 : 30 milk to bottlegourd ratio and 12 per cent sugar, 70 : 30 milk to bottlegourd ratio and 16 % sugar was found to be 28, 56, 56 and 56 days respectively. On the last day of storage period visible mould growth was observed in kapoorkand prepared with 60:40 milk to bottlegourd ratio with 12 per cent sugar only whereas kapoorkand prepared with three other formulations did not show visible mould growth.

Based on results of storage studies, it may be inferred that the kapoorkand stored at refrigeration temperature will have longer shelf life in comparison to storage at room temperature.

The shelf life of kapoorkand also decreased as the level of bottlegourd increased. This might be due to higher moisture content in the bottlegourd pulp which indirectly enhancing the moisture content. The shelf life of kapoorkand with 16 per cent sugar also registered longer shelf life than the ones with 12 per cent sugar. This fact revealed the preservative effect of sugar by way of decreasing the water activity in the product, and consequently enhancing the shelf life of the product.

SUMMARY

CHAPTER VI

SUMMARY

Kapoorkand or bottlegourd burfi is a traditional and popular milk product of certain parts of North India. Present study was carried out to find out the effect of two levels of milk to bottlegourd ratio viz., 60:40 and 70:30 with two levels of sugar viz., 12 and 16 per cent on kapoorkand and to study the shelf life of kapoorkand both at room and refrigeration temperatures.

Fresh buffalo milk was standardized to 5 per cent fat and 9 per cent SNF and boiled in a karahi by placing over a brisk and non smoky fire in four lots. Milk was stirred with a khunti in circular motion continuously until it was reduced to one third of its volume and then bottlegourd pulp paste at 60:40 and 70:30 was added for two lots separately with continuous stirring and scrapping. When it was reduced to half the volume, sugar was added at two levels i.e., 12 and 16 per cent for each lot. When dough like stage was reached, contents were set in a greasy tray and allowed to cool and cut into required size and shape.

Increase bottlegourd level resulted in a significant rise in yield and percent moisture in kapoorkand but simultaneously decreased the fat, protein, titratable acidity and TBA values in the product.

Kapoorkand prepared with 70:30 milk to bottlegourd ratio scored higher for all the sensory attributes than the ones with 60:40 milk to bottlegourd ratio.

Increase in sugar levels from 12 to 16 per cent resulted in significant increase in per cent yield of kapoorkand and decrease in moisture, fat, protein content and TBA values.

Kapoorkand prepared with 12 per cent sugar scored higher for flavour and overall acceptability than those prepared with 16 per cent sugar.

Among all the four formulations, kapoorkand prepared with 70:30 milk to bottlegourd ratio and 12 per cent sugar scored highest for all the sensory attributes. This was followed by 70:30 milk to bottlegourd ratio and 16 per cent sugar, and thereby 60:40 milk to bottlegourd ratio and 16 per cent sugar. Kapoorkand having 60:40 milk to bottlegourd ratio with 12 per cent sugar scored lowest for body and texture, flavour and overall acceptability.

Based on the results obtained in the present study, it may be concluded that good quality kapoorkand can be prepared by using 70:30 milk to bottlegourd ratio with addition of 12 per cent sugar.

Kapoorkand prepared with different levels of milk to bottlegourd ratio and sugars were wrapped in wax coated butter paper, packaged in card board boxes to study the shelf life of kapoorkand at room and refrigeration temperature.

The moisture content of kapoorkand decreased with increase in storage period in all the four formulations of kapoorkand at both room and refrigeration temperatures. However, the rate of decrease in moisture content was more rapid at room temperature than at refrigeration temperature.

There was an increase in fat and protein percentages both at room and refrigeration temperatures. This trend was due to decrease in moisture content during the storage period.

Titratable acidity and TBA values of kapoorkand increased at a faster rate during the storage period at room temperature compared to refrigeration temperatures.

A progressive decrease in sensory qualities of all types of kapoorkand was observed during the storage period at both room and refrigeration temperatures.

Among all types of kapoorkand, those prepared by using 70:30 milk to bottlegourd ratio with 12 per cent sugar scored highest for all the sensory attributes during storage both at room and refrigeration temperature.

There was a rapid increase in total bacterial count and yeast and mould count in all the four types of kapoorkand at room temperature compared to refrigeration temperature.

At room temperature, shelf life of kapoorkand prepared by using 60:40 milk to bottlegourd ratio with 12 per cent sugar, 60:40 milk to bottlegourd ratio with 16 per cent sugar, 70:30 milk to bottlegourd ratio with 12 per cent sugar and 70:30 milk to bottlegourd ratio with 16 per cent sugar was 6, 12, 15 and 18 days respectively.

At refrigeration temperature, shelf life of kapoorkand prepared by using 60:40 milk to bottlegourd ratio with 12 per cent sugar, 60:40 milk to bottlegourd ratio with 16 per cent sugar, 70:30 milk to bottlegourd ratio with 12 per cent sugar and 70:30 milk to bottlegourd ratio with 16 per cent sugar was 28, 56, 56, 56 days respectively.

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APPENDIX I

SCORE CARD FOR SENSORY EVALUATION OF KAPOORKAND

Name of the evaluator: Date:
Time:

Requested to evaluate the given samples for their colour and appearance, body and texture, flavour and overall acceptability with the help of 5-point hedonic scale.

Hedonic rating	Score
5	Excellent
4	Very good
3	Good
2	Fair
1	Poor

Attribute	Sample score			
	A	B	C	D
Color & appearance				
Body & texture				
Flavour				
Overall acceptability				

Remark, if any –

Signature