

**PREPARATION OF *SHRIKHAND* BY USING
GUAVA PULP**

BY

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(Reg. No. 011/145)

DEPARTMENT OF ANIMAL SCIENCE AND DAIRY SCIENCE

POST GRADUATE INSTITUTE,

MAHATMA PHULE KRISHI VIDYAPEETH,

RAHURI - 413 722, DIST. AHMEDNAGAR,

MAHARASHTRA, INDIA

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A Thesis submitted to the

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In partial fulfillment of the requirements for the degree

of

MASTER OF SCIENCE (AGRICULTURE)

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APPROVED BY

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MAHARASHTRA, INDIA**

2013

Candidate's Declaration

*I hereby declare that this thesis or part there of has not been
submitted
by me or any other person
to any other University
or Institute for Degree
or Diploma*

Place : MPKV., Rahuri

(D.H.HINWAR)

Dated : / /2013

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Maharashtra State (INDIA).

CERTIFICATE

This is to certify that the thesis entitled, “**PREPARATION OF SHRIKHAND BY USING GUAVA PULP**” submitted to the Faculty of Agriculture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE (ANIMAL SCIENCE AND DAIRY SCIENCE) in DAIRY SCIENCE**, embodies the results of piece of *bona fide* research work carried out by **Mr. DHANRAJ HILAL HINWAR** under my guidance and supervision and that no part of the thesis has been submitted for any other university for degree or diploma.

Place : MPKV, Rahuri

Dated : / /2013.

(R. J. Desale)

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Associate Dean,
Post Graduate Institute,
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Maharashtra State (India)

C E R T I F I C A T E

This is to certify that the thesis entitled, **“PREPARATION OF SHRIKHAND BY USING GUAVA PULP”**, submitted to the Faculty of Agriculture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE (ANIMAL SCIENCE AND DAIRY SCIENCE)** in **DAIRY SCIENCE**, embodies the results of piece of *bona fide* research work carried out by **Mr. DHANRAJ HILAL HINWAR**, under the guidance and supervision of **Dr. R. J. DESALE**, Assistant Professor, Animal Science and Dairy Science, M.P.K.V., Rahuri and that no part of the thesis has been submitted for any other university for degree or diploma.

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(B. R.Ulmek)

Dated : / /2013.

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The task of providing complementary guidance was performed by the members of my advisory committee Dr. P. T. Dhole Ex-Professor, Department of Animal Science & Dairy Science, MPKV., Rahuri. Prof. R.V. Patil Assistant Professor, Post Harvest Technology, Dept. of Horticulture. Dr. D. P. Kaledhonkar Associate Professor, Dept. of Statistics, MPKV., Rahuri, Dr. Y. G. Fulpagare Head, Dept. of Ani. Sci. & Dairy Sci., MPKV., Rahuri whom I express my deepest sense of gratitude for their valuable suggestions and guidance during the course of these investigations.

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Place : Rahuri

Date : / /2013

(D.H.HINWAR)

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LIST OF ABBREVIATIONS

Abst.	:	Abstract
Av.	:	Average
@	:	At the rate of
BIS	:	Bureau of Indian Standards
CD	:	Critical Difference
cfu	:	Colony Forming Units
<i>et al.</i>	:	And other (et alli)
Fig.	:	Figure
g	:	Gram (s)
h	:	Hour (s)
i.e.	:	That is
lit.	:	Liter
mg	:	Milligram
ml	:	Milliliter
N	:	Normality
NS	:	Non-significant
No.	:	Number (s)
PDA	:	Potato dextrose agar
PFA	:	Prevention of food adulteration (Act)
RCDP	:	Research on cattle development programme

S.E.	:	Standard error
Sec.	:	Second
SNF	:	Solid not fat
SPC	:	Standard plate count
TS	:	Total solids
<i>viz.</i>	:	Namely
VRBA	:	Violet Red Bile Agar
wt.	:	Weight
μ	:	Micron
$^{\circ}\text{C}$:	Degree centigrade
*	:	$P < 0.05$
%	:	Per cent

ABSTRACT

PREPARATION OF *SHRIKHAND* BY USING GUAVA PULP

BY

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A candidate for the degree of

MASTER OF SCIENCE (AGRICULTURE)

in

Dairy Science

Mahatma Phule Krishi Vidyapeeth,

Rahuri - 413 722

2013

Research Guide : *Dr.R.J.Desale*

Department : Animal Science and Dairy Science

The present investigation on “Preparation of *shrikhand* by using guava pulp” was carried out at the laboratory of Department of Animal Science and Dairy Science, M.P.K.V.,Rahuri during the year 2011-12. It was intended to asses possibility and level of guava pulp that could be effect on quality of product.

The curd was prepared using LF-40 culture at the rate

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D.H.Hinwar

of 2 per cent. *Chakka* obtained from this curd was used to prepare *shrikhand*. In preliminary trials, appropriate level of sugar and guava pulp that would suit to the product were determined. Accordingly in experimental trials; three levels guava pulp viz; 10, 20 and 30 per cent and 35 per cent sugar were added by the weight of *chakka*. In addition to this one control sample was also prepared by addition of 35 per cent sugar without guava pulp.

The product prepared by using 35 per cent sugar and 20 per cent guava pulp secured the highest organoleptic score. Addition of guava pulp in *shrikhand* had significant effect on the chemical composition of *shrikhand*.

The chemical composition of guava *shrikhand* of treatment T₀, T₁, T₂ and T₃ as under. The mean chemical composition of *shrikhand* for T₀ (control) as 46.48, 10.05, 7.82, 53.52, 32.50 and 1.20; T₁ (10 parts of guava pulp) as 47.92, 9.75, 7.69, 52.08, 34.92 and 1.31; T₂ (20 parts of guava pulp) as 48.19, 9.51, 7.63, 51.81, 36.85 and 1.42 ; and for T₃ (30 parts of guava pulp) as 49.17, 9.42, 7.17, 50.83, 38.51 and 1.56 per cent, respectively as moisture, fat, protein, total solid, total sugar and acidity.

While studying the cost of preparation of 20 per cent guava pulp sample was Rs. 104.49

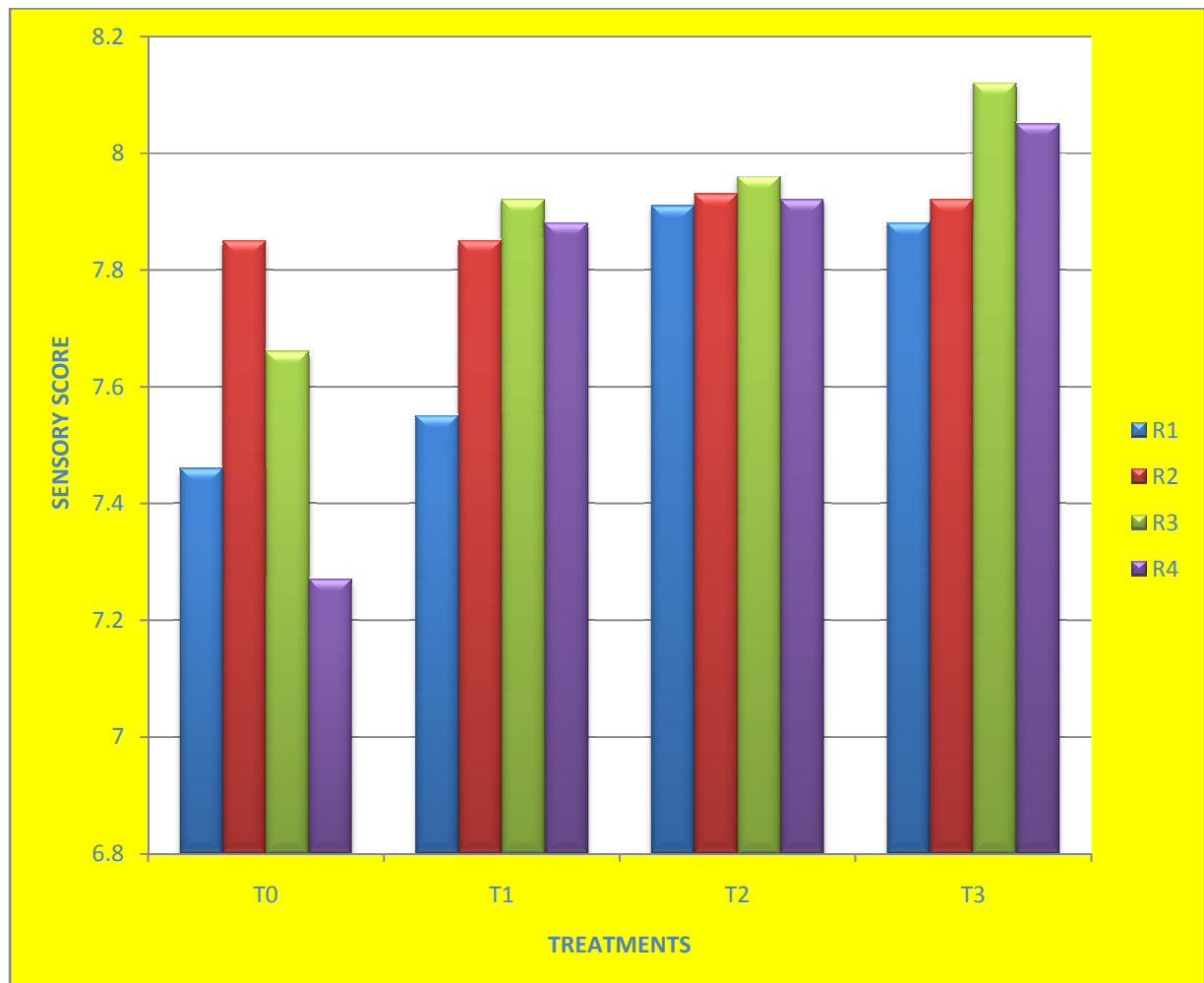


Fig.1 Score for colour and appearance of *shrikhand* by using guava pulp.

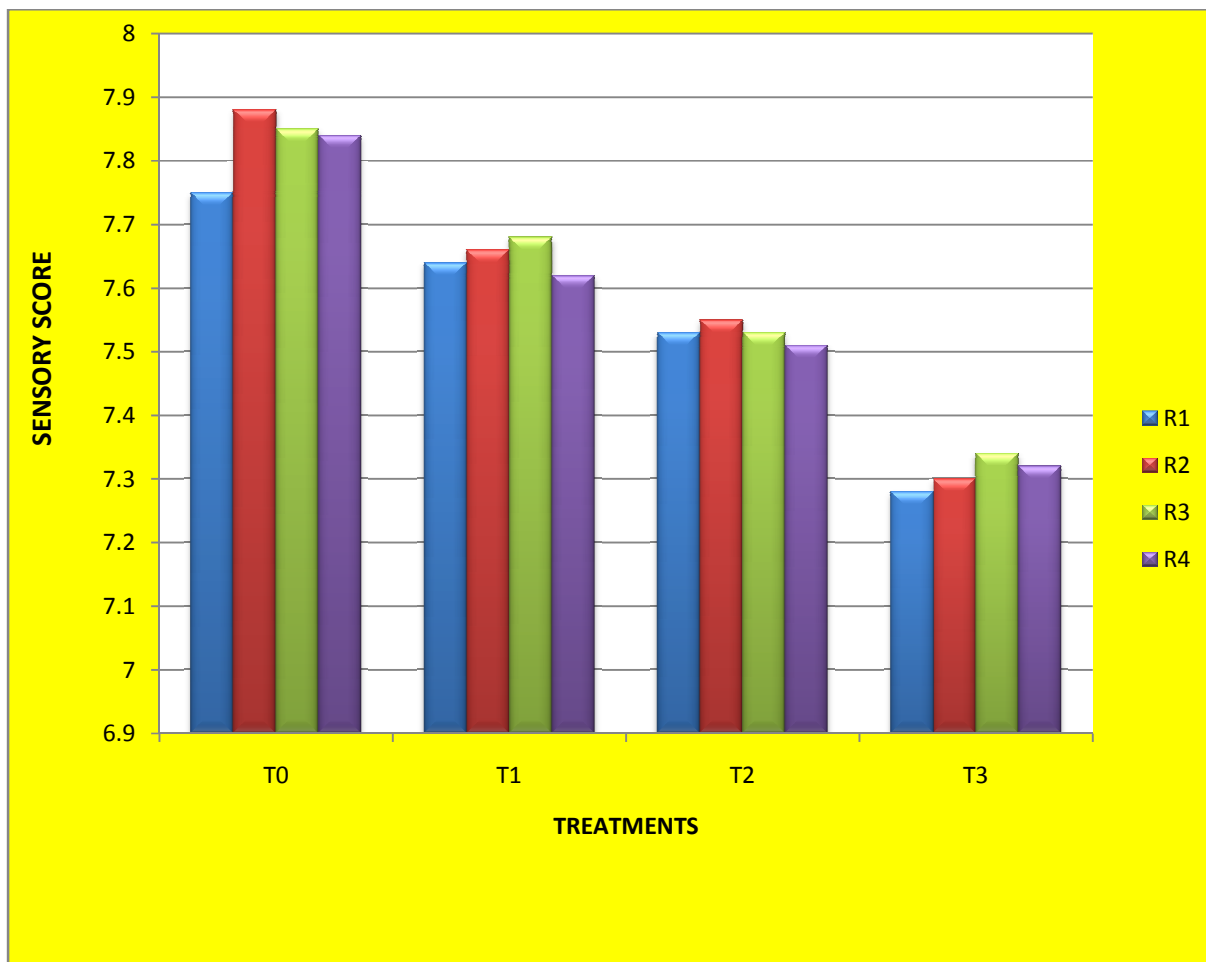


Fig. 2 Score for body and texture of *shrikhand* by using guava pulp

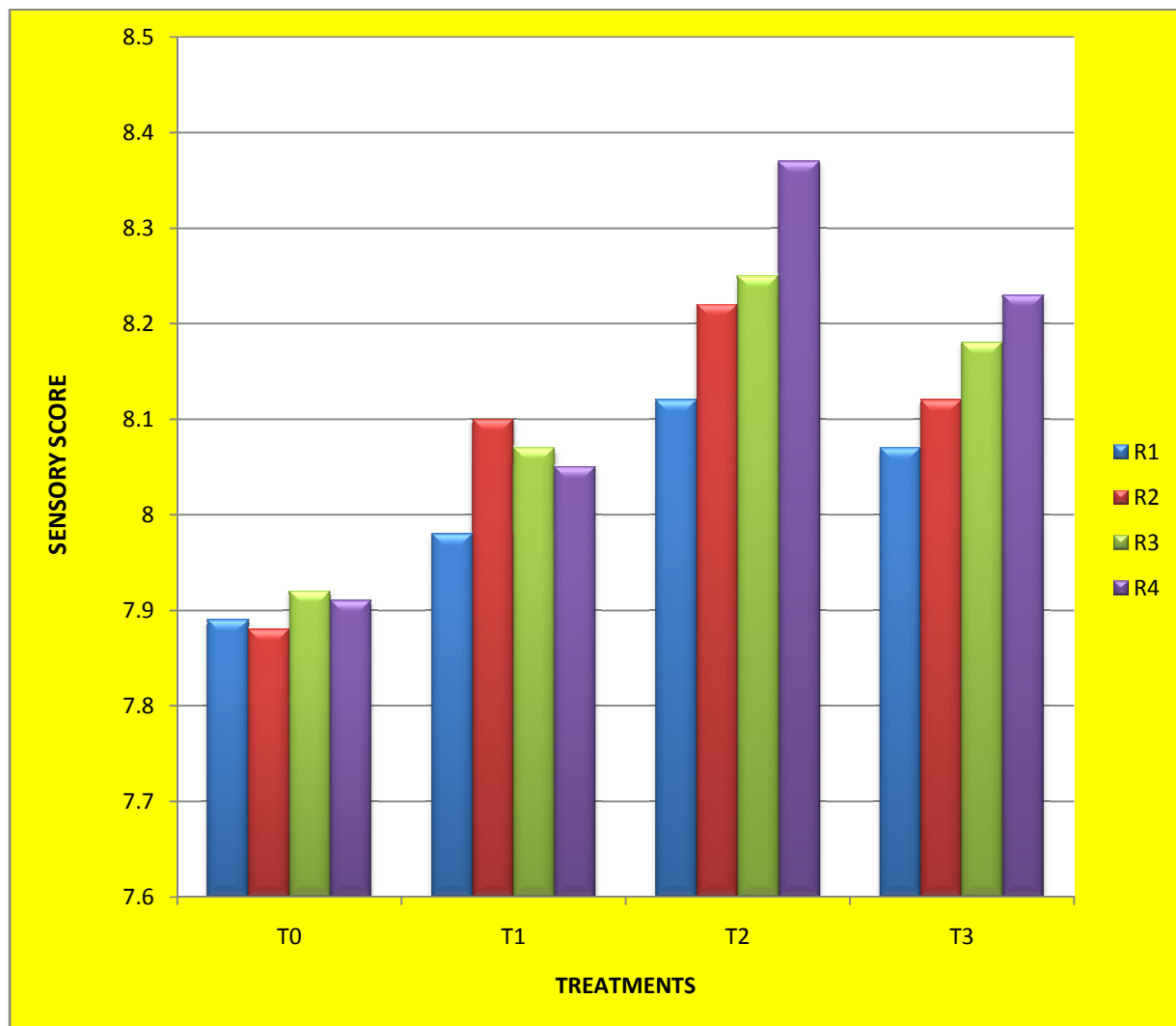


Fig.3 Score for flavour of *shrikhand* by using guava pulp

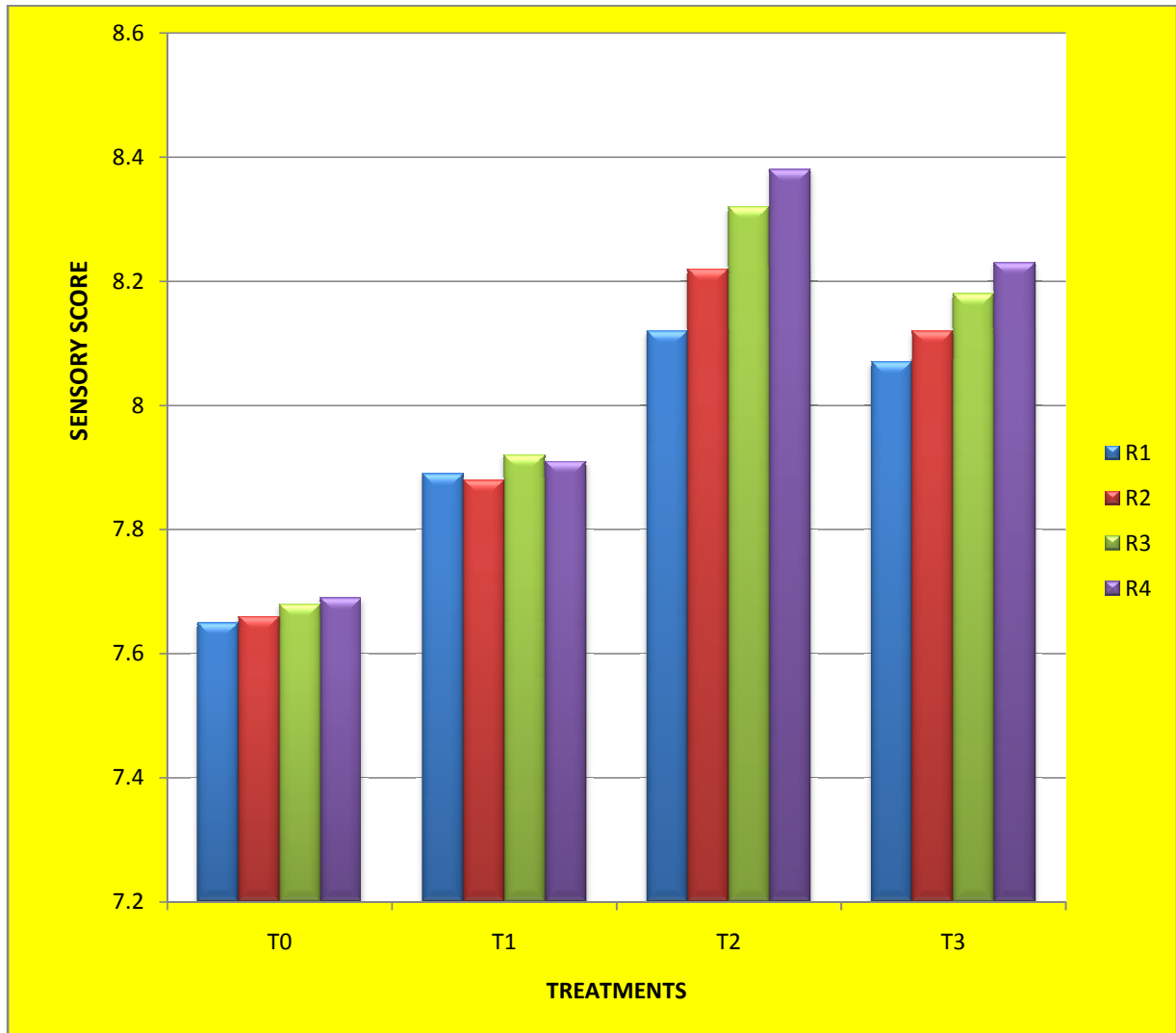


Fig.4 Score for Overall acceptability for *shrikhand* by using guava pulp

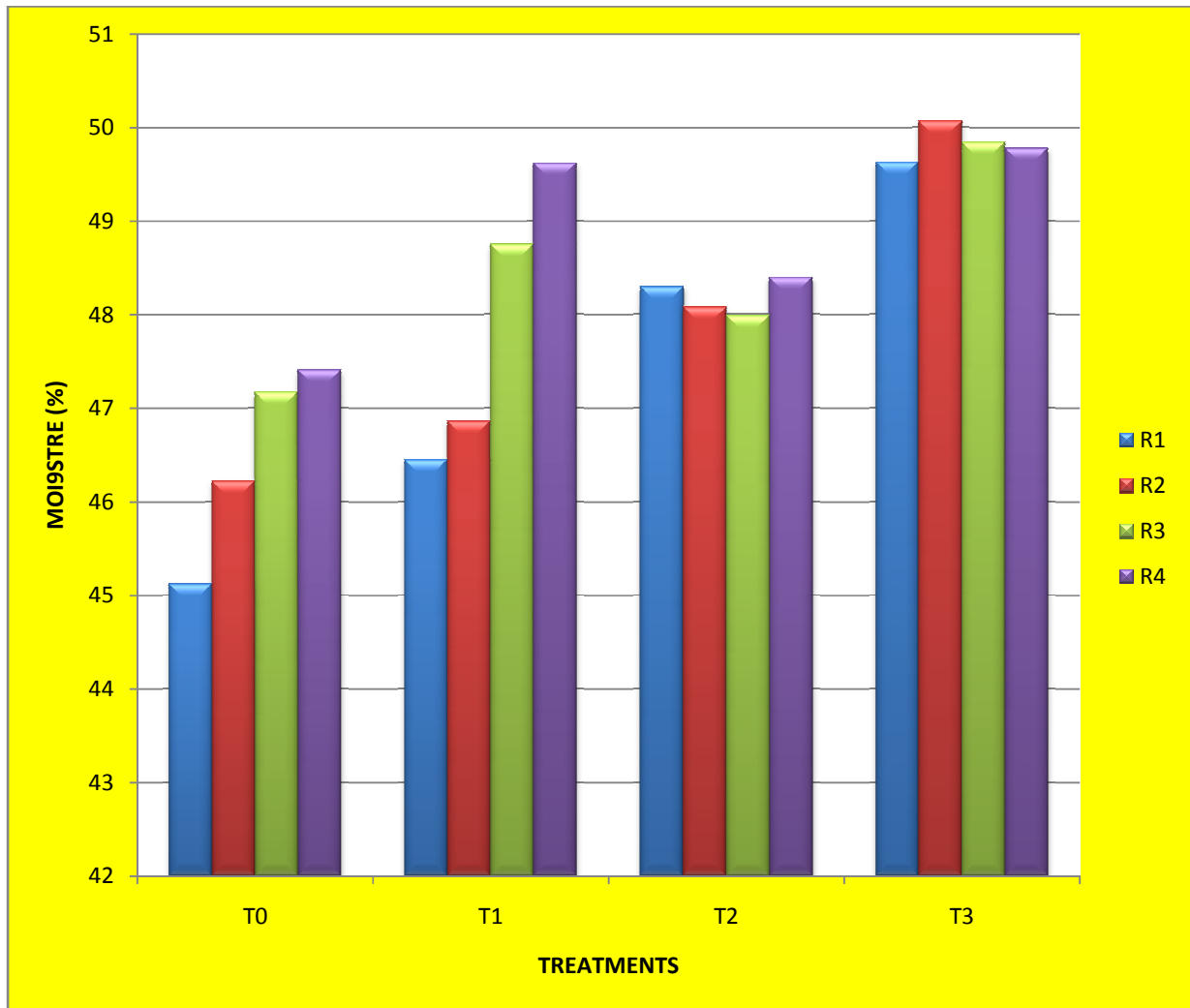


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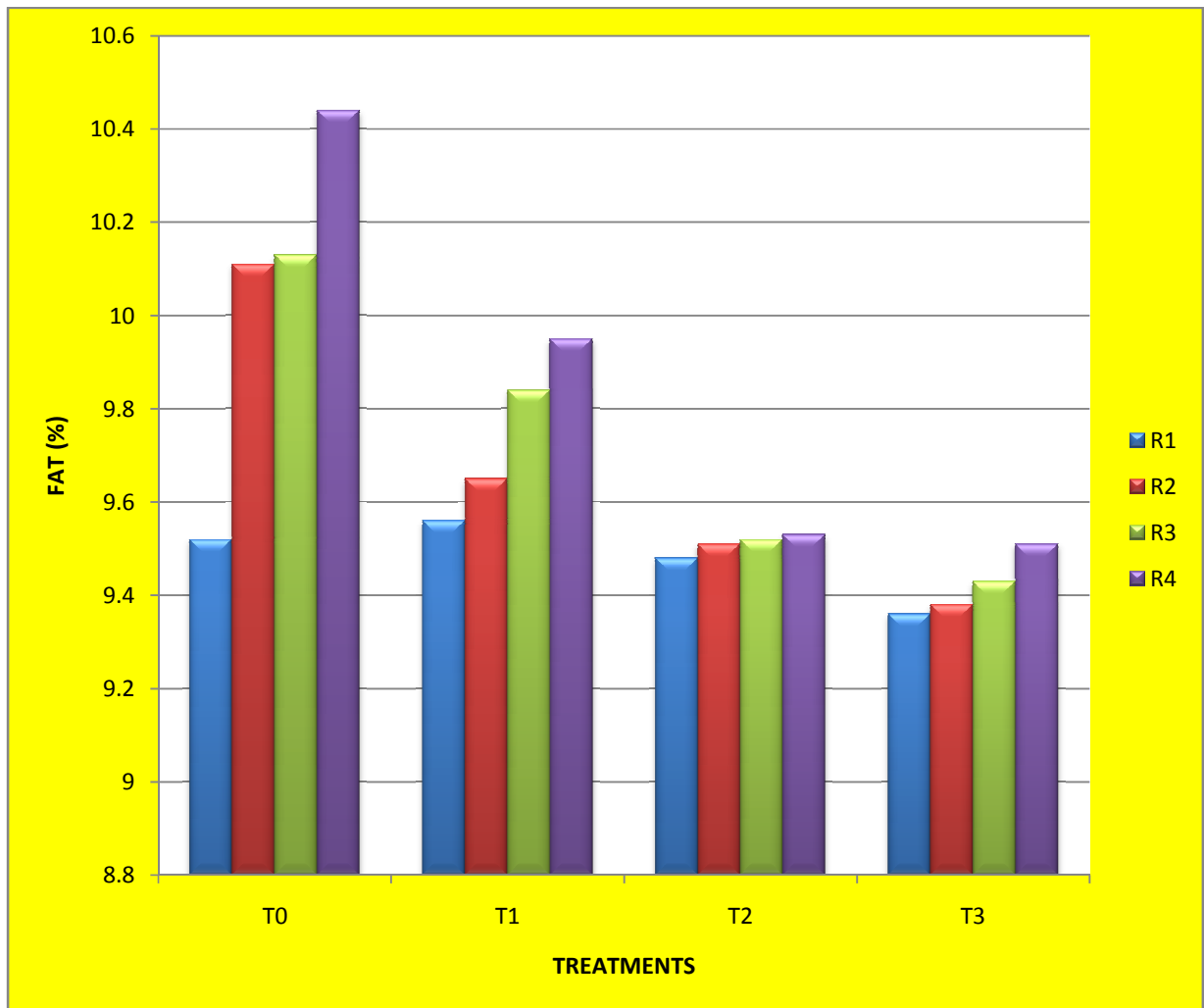


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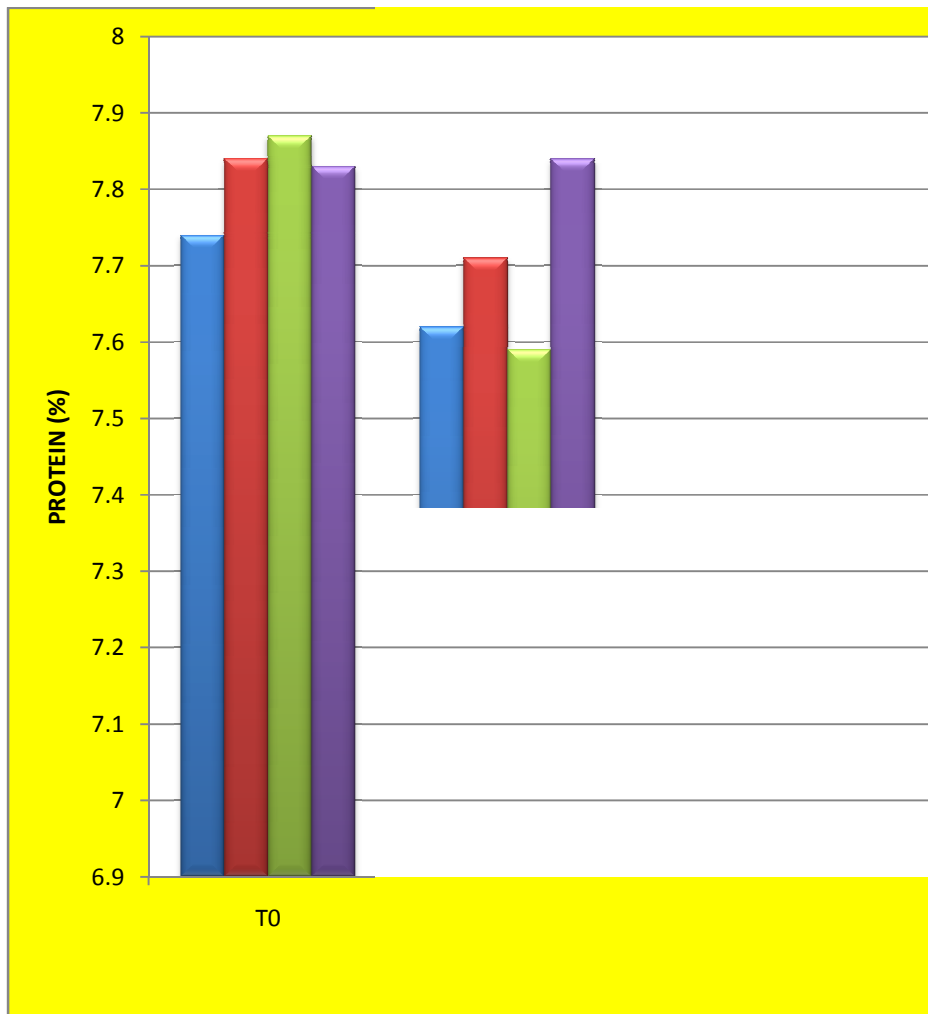


Fig.7 Protein content of *shrikhand* by using guava

1 INTRODUCTION

With the introduction of Operation flood programme the milk production of India is significantly increased and Maharashtra has been not exceptional to it. But this raised the problem of surplus milk and most choice available with milk procuring agency was conversion of surplus milk into different milk products like *khoa*, ice-cream, *ghee*, *paneer* and fermented milk product.

India is the world's largest milk producer with 127.3 MT (Indian Economy, 2011-12) of milk production. The production of fermented milk products is increasing rapidly in all the major developing countries of the world. The fermented milk products like yoghurt, cultured butter milk, *lassi*, *shrikhand* etc. are being manufactured in various countries.

Shrikhand is a delicious and delightful dessert of western India. It is made from *chakka* (strained *dahi*/curd) which is finely mixed with sugar and flavouring agents. It has the nutritive goodness of fermented milk products like *dahi*, it is very refreshing particularly during summer months. It is popular because of its characteristics flavour, taste, palatable nature and possible therapeutic value. It has higher shelf life than milk and curd. It has a high calorific value and important in nutrition due to high milk fat and protein content. Since, time immemorial the fermented milk products has enjoyed reputation due to their nutritional and therapeutic value. The process of fermentation of milk is one of the

oldest methods known for preserving milk constituent. In recent time, the fermented milks, *dahi* in India, Bulgarian milk in Bulgaria, Yogurt in Balkan countries, *Kumiss* in Central Asia, *Kefir* in South- Eastern Russia, Acidophilus milk in America, Koelder milk in Denmark, Leben in Egypt, which occupy an important place in human nutrition. *Shrikhand* is a semi solid, sweetish-sour fermented milk product prepared from *dahi*, whey is drained off from *dahi* to yield *Chakka*, Sugar, flavour, colour and spices are mix into *Chakka* to form a soft homogenous mass that resembles sweetend quarge of Germany. *Shrikhand* is popular desert and forms part of meal on festive occasion. Particularly in the state of Maharashtra, Gujarat, Karnataka and some part of South India (Aneja *et al.*, 2002).

The use of the right type of starter culture is an essential pre-requisite for the manufacture of *Shrikhand*. Among different starter cultures recommended by various workers, LF- 40, a culture contain in *Lactococcus lactis* subsp. *Lactis* and *Lactococcus lactis* var. *diacetylactis*, has received wide acceptance by many *Shrikhand* manufactures. The LF-40 culture @ 1-1.5 % is added to milk and the milk is incubated at 30°C for 10-12 hrs in order to get 0.9 per cent of titratable acidity in the curd. *Dahi*, so obtained is centrifuged in a basket centrifuge get *Chakka*. Measured quantities of *Chakka*, sugar, cream and additives are mixed in a planetary mixer to get *Shrikhand* (Patel and Chakraborty, 1985). In order to improve the colour, flavour and overall acceptability of milk product, it is common practice of

adding of different colouring and flavouring agent in them. *Shrikhand* is not an exception to it. In old practice charoli, nutmeg, cardamom and saffron were added for increasing taste and acceptability of *Shrikhand*. But several attempts have been made to incorporate different additives into *Shrikhand* to address the growing interest in the diversification of food products to attract a wider range of consumers. The pulp of fruits such as apple, mango, papaya, banana, guava and sapota (Bardale *et al.*, 1986; Dadarwal *et al.*, 2005), cocoa powder with and without guava pulp and incorporation of probiotic organisms (Geetha *et al.*, 2003) have been tried in *Shrikhand*. Now a day's use of pulp of different fruits in *Shrikhand* is gaining popularity. *Shrikhand* mixed with mango, strawberry, sapota, pulp are also becoming popular day by day.

The major fruits grown in India are mango, banana, citrus, guava, papaya, pineapple etc. Guava is 4th major fruit in India. So far area of Guava in India 21,590 hectare and 3,350 hectare in Maharashtra and production of Guava in India 3224.7 MT and in Maharashtra 258.0 MT (National Horticulture Board, 2009-10). Guava (*Psidium guajava* L.) a native to tropical America is exceedingly well-known fruit in India particularly in the plain region of Northern India. It is referred as 'apple of plains' due to high nutritive value with mild flavour. Guava are low in calories and fats but contain several vital vitamins, minerals, and antioxidant poly-phenolic and flavonoid compounds that play a pivotal role in prevention of cancers, anti-aging, immune-booster, etc.

The fruit is very rich source of soluble **dietary fiber** (5.4 g per 100 g of fruit, about 14% of DRA), which makes it a good bulk laxative. The fiber content helps protect the colon mucous membrane by decreasing exposure time to toxins as well as binding to cancer-causing chemicals in the colon. Guava-fruit is an excellent source of antioxidant **vitamin-C**. 100 fresh fruit provides 228 mg of this vitamin, more than three times the DRI (daily-recommended intake). Outer thick rind contains exceptionally higher levels of vitamin C than central pulp.

Scientific studies shown that regular consumption of fruits rich in vitamin C helps the body to develop resistance against infectious agents and scavenge cancer causing harmful free radicals from the body. Further, the vitamin is required for collagen synthesis within the body. Collagen is the main structural protein in the human body required for maintaining the integrity of blood vessels, skin,organs and bones. The fruit is a very good source of **Vitamin-A**, and flavonoids like beta-carotene, **lycopene**, lutein and cryptoxanthin. The compounds are known to have antioxidant properties and are essential for optimum health. Further, vitamin-A is also required for maintaining healthy mucus membranes and skin. Consumption of natural fruits rich in carotene is known to protect from lung and oral cavity cancers. It contains more potassium than other fruits like banana. Potassium is an important component of cell and body fluids that helps controlling heart rate and blood pressure. Further, the fruit is also a moderate source of B-complex vitamins such as pantothenic acid, niacin, vitamin-B6

(pyridoxine), vitamin E and K, as well as minerals like magnesium, copper, and manganese. Manganese is used by the body as a co-factor for the antioxidant enzyme, *superoxide dismutase*. Copper is required for the production of red blood cells. Considering the therapeutic importance which positively affects on the health of human being.

Hence the present study has been planned with the following objectives

Objectives

1. Optimization of level of guava pulp to incorporate in *chakka* to manufacture *shrikhand* .
2. To asses the effect on physico-chemical quality of *shrikhand*.
3. To evaluate the sensory quality of *Shrikhand*.
4. To determine cost of production of guava pulp *shrikhand*.

2 REVIEW OF LITERATURE

The use of fermented milk and milk products as a food in form or other is very common in various part of the world. The work carried out by different workers in the field has shown that it has not only a desired nutritive value similar to that of milk, but also considerable therapeutic value in maintenance of desirable type of intestinal bacterial flora. *Shrikhand* is one of the most popular fermented milk products which is largely consumed in Maharashtra, Gujrat, Goa and part of Karnataka.

2 .1 Technology

Joglekar (1973) prepared *Shrikhand* from low fat milk by using mixed culture of *streptococcus lactis*, *Lactobacillus delbrueckii* sub. Sp. *Bulgaricus* and *Lactobaccillus citrovorulin* equal proportion.

Rangappa and Acharya (1973) in their book 'Indian dairy products' reported that *Shrikhand* was prepared by sweetening *dahi* with or without supernatant buffer fat layer. The curd was suspended in a muslin cloth bag until nearly all the serum had drained off. The semidry mass then was mixed up with the sugar and coloured and was scented with saffron.

Ingale and Jogalekar (1974) while studying the effect of fat and sugar variation on the acceptability of *Shrikhand* using buffalo milk with three level of fat *viz.*, 3, 5 and 7 %. The sugar was added in the proportion of 36, 42 and 48 % by weight of *Chakka*, respectively. *Dahi* was obtained from a batch of one and half litre of

standardized, boiled (10 min) and cooled (34°C) milk inoculated with @ 2 % culture and incubated 16 hrs at 34° C. *Dahi* was tied in muslin cloth and hung for 6 hrs in order to drain out whey. *Chakka* thus obtained was added with sugar passed through hand operated *Shrikhand* machine for proper mixing, for 250 g of *Chakka* condiment and spices were added in the proportion of saffron colour– 5 cc(of 0.6 % solution) nutmeg– 0.5 g, cardamom – 0.4 g and charoli–2.0 g.

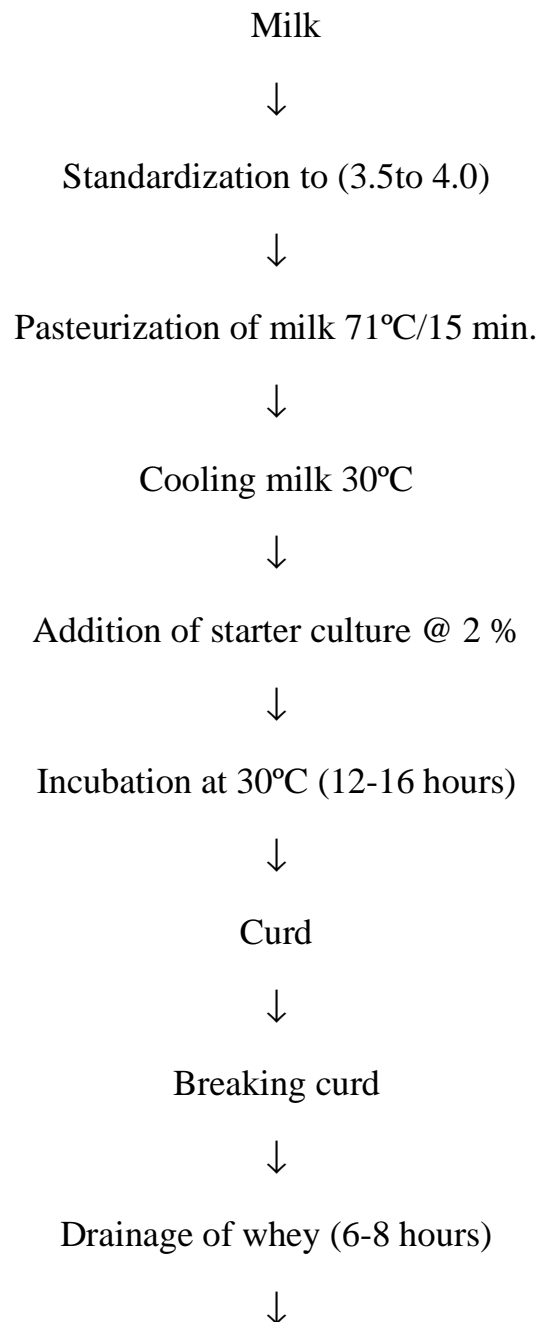
Aneja *et al.* (1977) standardized a process for the large scale manufacture of *Shrikhand*. Skim milk containing 9 per cent SNF and less than 0.05 per cent fat was heated at 85°C for 16 sec. using HTST pasteurizer. Curd was obtained by inoculating *Dahi* culture (0.25 to 0.50 %) of mixed strain after cooling the milk at 30°C. Curd having 0.8 to 1.1 per cent acidity after 8 hrs of incubation was transferred to cold storage. Whey was separated from curd after warming it to 25-30°C. Basket centrifuge having 28” diameter was used at 100 rpm for whey separation. The *Chakka* obtained was mixed with sugar at the rate of 80 per cent (amount of *Chakka*) in a 100 lit. of planetary mixer. Plastic cream containing 80 per cent fat was added at the stage of mixing sugar with *Chakka*.

Patel and Chakraborty (1978) discussed the process alterations in *Shrikhand* technology. In traditional method, 10 to 12 hrs., were required for setting of curd with starter cultures. In order to cut the time without affecting quality, they tried lactic acid acidulate for direct acidification of buffalo skim milk for *dahi* making. Results of *Shrikhand* prepared from such *dahi* and *Shrikhand* prepared by

conventional method were compared. The directly acidified samples were criticized for lack of flavour.

Flow chart for preparation of *shrikhand*

De (2008) reported the standard procedure of *Shrikhand*.



Chakka (Shrikhand base)



Addition of sugar by wt. of *Chakka*



Shrikhand



Packaging



Storage

Laxminarayana and Shankar (1980) worked on typical chemical composition of same fermented milk product. The composition for *Shrikhand* given by them was as follow.

Table 1 Chemical composition of *shrikhand*

Moisture	31 %
Fat	8 %
Protein	7 %
Lactose	1.5 %
Sucrose	40-45%

Ali *et al.* (1984) studied the modified method for preparation of *Shrikhand*. *Shrikhand* was prepared from *Chakka*

obtained by coagulating whole milk curd added with hot whole milk. The level of whole milk added was 10, 20, 30, 40 and 50 % of the total coagulum with increasing levels of hot milk. The *Shrikhand* prepared from coagulum of 30% hot milk was liked very much for taste.

Desai *et al.* (1984) studied the influence of homogenization of milk on the quality of *Chakka* and *Shrikhand*. Homogenized milk was found to improve the appearance, consistency and texture of *Chakka* and *Shrikhand* as compared to unhomogenised milk sample. This treatment also gave slightly increased yield (33.95 %) and higher fat recovery (93.41%) as compared to unhomogenized milk samples(32.41%) and 90.89 %, respectively.

Sharma and Reuter (1984) reported that *Shrikhand* prepared by mixing high fat cream, sugar and UF concentrated skim milk *Chakka* to get final composition of fat to 6 per cent, SNF 13 per cent, sucrose 41 per cent and moisture 40 per cent. The traditional method (Patel and Chakraborty, 1978) allows the whey proteins to drain along with whey. They can be retained in *Chakka*, if curd is made from skim milk concentrated by Ultrafiltration process so as to obtain the UF *Chakka*. It increased the yield of *Chakka* by about 23 per cent.

Patel and Abd. El-Salam (1986) worked on *Shrikhand* technology. They reported that LF-40 a culture comprised of *S.lactis* and *S. lactis* var. *Diacetylactis* has accepted by

many *Shrikhand* manufacturers. The LF-40 culture added of milk (1 to 1.5 %) and the milk incubated at 30°C for 10 to 12 hrs in order to get 0.9 per cent titratable acidity in the curd. *Dahi* centrifuged in a basket centrifuge (900 x 9) for about 90 min. It is desirable to keep 5 to 6 per cent fat and 41 per cent sucrose in the finished product.

Suryawanshi *et al.* (1993) reported that fresh cow milk was standardized to 4 per cent fat after giving heat treatment and cooling to room temperature it was inoculated in different lots with 2, 4 and 6 per cent level with active starter culture of *Streptococcus thermophilus* and *Lactobacillus acidophilus* and incubated at 42°C. The curd was subjected to various heat treatments and acid treatments for studying its effect on whey expulsion time. It has been observed that the higher level of inoculum and heat treatment of curd significantly reduce the time required for *Shrikhand* manufacture.

Kadu *et al.* (1994) reported the sensory changes during storage of *Shrikhand* at 24±4°C and 8±2°C prepared from homogenized and unhomogenized cow milk. Organoleptic changes were evaluated using 9 point Hedonic scale. At zero days the sensory score was 8.8 and 9 for unhomogenized and homogenized milk *Shrikhand* which decreased to 6.8 and 7.4 during 6 days storage at 24±4°C temperature, respectively. During storage at 8±2°C the sensory score decreased from 8.8 and 9 to 5 and 6.61 in *Shrikhand* prepared from unhomogenized and homogenized cow milk, respectively.

Sonawane (1998) prepared *Shrikhand* by using strawberry and observed that addition of 15 % strawberry pulp with 40 % sugar was found to be the most optimum combination for preparation of strawberry *Shrikhand*. Higher level of pulp to produce weaker body and darker colour than desired while at lower level insufficient strawberry flavour was imparted.

Giram *et al.*(2001) used whey concentrate in preparation of *Shrikhand* and studied its effect on yield, physico-chemical and sensory properties. Addition of 5% sour whey concentrate to *Chakka* increased the yield of *Shrikhand* by 5% over the traditional method; addition of whey concentrate at this level had no detrimental effect on physico-chemical and sensory properties of *Shrikhand*. However, additions of whey concentrate at levels >5% caused deterioration in quality of *Shrikhand* in terms of flavour, consistency and texture.

Ansari *et al.* (2006) used the ultra filtration (UF) technology for production of *Shrikhand* a fermented dairy product from pre concentrated skim milk. Membrane used in the plant was modified polysellphone and spirally wound configuration. Made of operation was batch type and UF plant was operated at different feed temperature and transmembrane pressure for studying flux variation. The permeation rate was more at higher feed temperature and lower transmembrane pressure. Skim milk was concentrated from 11 to 20 per cent total solids and was used in curd making and then *Shrikhand* making. The quality of *Shrikhand* made from

lower concentration UF concentrated skim milk (11 to 14 % total solids) was good in texture and viscosity and was rate close to commercial *Shrikhand* while use of higher concentration 20-22 per cent total solids resulted in sandiness and lacked viscosity.

Shukla *et al.* (2007) studied the production of *Shrikhand* using ultrafiltration process. *Shrikhand* was observed to have optimum sweetness with 36.70 % sugar, lactic culture imparted better in flavour in *Shrikhand* as compared to yoghurt culture. UF process resulted in nil fat loss in whey and 20.70 % extra recovery of total solids in *Shrikhand*. The protein content in skim milk *Chakka* through UF process and in *Shrikhand* prepared from it was higher than in tradition process.

Sonawane *et al* (2007) studied the effect of addition of different levels of strawberry pulp and sugar on chemical composition of *Shrikhand* during storage. Two levels of sugar viz; 30 (S1) and 40 (S2) per cent and three levels of strawberry pulp viz; 10 (P1), 15 (P2) and 20 (P3) per cent on weight basis of *Chakka* were included in the experimental trials, along with one control sample. The moisture content in all the experimental samples was decreased during storage period. The acidity of *Shrikhand* increased with pulp level which was 1.305 per cent in control and 1.385 per cent in S2P2 sample, when samples stored at room temperature. The average soluble 'N' in fresh product was 0.081 per cent which was increased to 0.20 per cent on 11th day of storage under refrigerated temperature ($5 \pm 2^\circ\text{C}$).

A.P. Patil and K. D. Chavan (2009) studied the influence of addition of guava pulp and sugar on sensory quality of guava yoghurt, with an objectives to find out the optimum level of guava pulp that could be incorporated to obtain better quality yoghurt. It was observed that incorporation of guava pulp @ 5 to 15 per cent, after incubation in the stirred form with addition of sugar from 6 to 9 per cent was more acceptable.

Nigam *et al* (2009) prepared the *shrikhand* using papaya pulp in *Chakka* to increase the nutritional quality and overall acceptability. Papaya pulp was added at 20 per cent, 40 per cent and 60 per cent levels. The fat, protein, lactose, sucrose, ash and total solid contents significantly decreased with increase in the level of papaya pulp. The *shrikhand* prepared with 20 per cent level of papaya pulp was found most acceptable. On the basis of sensory evaluation the keeping quality of *shrikhand* was found to be 14 days, when stored at the temperature of 5°C.

Kolape (2009) prepared the *shrikhand* prepared using papaya pulp in *Chakka* to increase the nutritional quality and overall acceptability. Papaya pulp was added at 10 per cent, 20 per cent and 30 per cent levels. The fat, protein, lactose, total sugar, acidity, ash and total solid contents significantly decreased with increase in the level of papaya pulp. The *shrikhand* prepared with 20 per cent level of papaya pulp was found most acceptable on the basis of sensory evaluation.

Shambharkar *et al* (2011) standardized the optimum level of sapota pulp in the preparation of *Shrikhand* by sensory

evaluation and also study its economics. *Shrikhand* was prepared from cow milk *chakka* with constant level of sugar (40 per cent by weight of *chakka*) blended with varying levels of sapota pulp at the rate *i.e.* 5 % (T2), 10 % (T3), 15% (T4) and 20 % (T5) on the basis of *chakka*. Treatment T3 (93.72) showed highest overall acceptability than other treatments. Fat content of, treatment T1(8.05 per cent) showed highest fat content among all the treatments. Total solid content was highest in T1 (65.65 per cent) and lowest in T5 (54.31 per cent). For protein content treatment T1 (6.15 per cent) was significantly higher than rest of the treatments. Titratable acidity was highest in T1(1.86 per cent) and lowest in T5(1.69 per cent). For sugar content, treatment T1 (41.11 per cent) showed highest sugar over rest of the treatments.

Nilofar Y. Nadaf *et al* (2012) studied the effect of addition of Gulkand and rose petal powder on the chemical composition and sensory properties of *shrikhand*. Various compositions of gulkand and rose petal powder viz. 1-1.5, 1.5-1.5, 2-1.5 and 2.5-1.5 (in gm) has been added in *chakka* during *Shrikhand* preparation. The results revealed that the protein and fat percent of the *Shrikhand* decreased whereas carbohydrate, ash and moisture percent increased with increasing level of gulkand and rose petal powder. On the basis of various sensory parameters, *Shrikhand* containing 2:1.5 gm of gulkand and dried rose petal powder was most liked by panel members and hence further examined for storage efficiency. On the basis of sensory evaluation

and microbial analysis the product was acceptable for a period of 21 days under refrigerated temperature.

2.2 Composition

2.2.1 Chakka

Ganguli (1959) studied the chemical composition of *Chakka*. Analysing 52 samples he observed that the *Chakka* contained 59.59 per cent moisture, 22.4 per cent fat, 1.03 percent ash, 2.33 per cent acidity and 1.62 per cent nitrogen.

Mahajan (1971) reported the chemical composition of *Chakka* obtained from cow and buffalo milk as under.

Table 2 Chemical composition of *chakka*

	Cow milk <i>Chakka</i> (%)	Buffalo milk <i>Chakka</i> (%)
Fat	8.9	14.7
Moisture	68.8	61.2
T.S.	33.2	38.8
Acidity	0.8	0.8
pH	4.6	4.7

Jogalekar (1973) standardized processes of *shrikhand* preparation. The chemical composition of *chakka* given for three levels of fat in milk viz., 3, 5 and 7 per cent was as follows.

Table 3 Chemical composition of *chakka*

Fat (%)	Content of <i>Chakka</i> (%)				
	Moisture	Fat	Protien	T.S	Ash
3	68.0	11.5	11.0	32.0	1.00
5	64.5	19.5	10.5	35.5	1.20
7	59.0	27.5	10.5	41.5	1.35

Zariwala and Sharma (1976) studied of *Shrikhand* and *Chakka*. The composition of market samples of *Chakka* observed by them at storage temperature of $37 \pm 1^\circ\text{C}$ was as under.

Table 4 Chemical composition of market samples of *chakka*

Moisture (%)	68.85
Fat (%)	15.66
pH (%)	4.10
Acidity (% LA)	1.60
Total protein (%)	12.31
Lactose (%)	0.61
Ash (%)	0.77

IS-9532 (1980) specifications for *Chakka* are as given below.

Table 5 IS-9532 (1980) specifications for Chakka

Sr.No.	Item	Per cent
1	Total solids (min.)	30
2	Milk fat (dry basis- min.)	33
3	Milk protein (dry basis)	37
4	Titrateable acidity (max.)	2.5
5	Total ash (dry basis -max.)	3.5
6	Coliform count per gm (max.)	10
7	Yeast and mould count per g(max.) protien (dry basis - min.)	20

Kadam (1981) carried out investigation on chemical and organoleptic qualities of *Chakka* and *Shrikhand* prepared from cow and buffalo milk. The average chemical composition of *Chakka* was found as acidity 1.26 %, fat 11.88 %, TS 32.05 % moisture 67.95 % while the yield of *Chakka* 22.60 %.

Patel *et al.* (1993) studied the keeping quality of *Chakka* stored at 5, 10 and 35°C on the basis of sensory characteristics. The shelf life of *Chakka* was 4 days at 30°C, 10 days at 10°C and 16 days at 5°C. During storage the samples were criticized for being acidic, sour whey, yeasty and mouldy, The colour of *Chakka* turned to dull, yellow and surface becomes hard and coarse.

2.2.2 Chemical composition of Shrikhan

Zariwala and Sharma (1976) examined 40 samples of

Shrikhand including 6 prepared in laboratory and 34 from market for their chemical composition. They recorded following variation in the constituents.

Table 6 Chemical composition of *Shrikhand*

Components		<i>Shrikhand</i>	
		Market	Laboratory prepared
Moisture	Maximum	44.56	33.42
	Minimum	25.36	22.64
Fat	Maximum	11.56	9.75
	Minimum	6.80	7.85
Acidity	Maximum	2.23	1.64
	Minimum	0.13	0.40
Total Protien	Maximum	7.08	7.02
	Minimum	6.48	6.80
Reducing Sugar	Maximum	7.35	6.88
	Minimum	0.95	2.12
Sugar	Maximum	49.87	48.64
	Minimum	35.42	39.82
Ash	Maximum	0.564	0.497
	Minimum	0.334	0.418

Aneja *et al.* (1977) conducted experiments on the manufacture of *Shrikhand* with an industrial process. The

Shrikhand obtained with this method contained.

Table 7 Chemical composition of *Shrikhand*

Fat	5%
Sugar	42%
Total solid	60%
Acidity (% LA)	1.1-1.2%
Protein	10%

Sharma and Zariwala (1980) carried out studies on deterioration of *Shrikhand* during storage. The chemical composition of market and laboratory samples of *Shrikhand* on the first day of storage at 37°C was as under.

Table 8 Chemical composition of market and laboratory samples of *Shrikhand*

Components	<i>Shrikhand</i>	
	Market	Laboratory prepared
Moisture	33.30	24.74
Fat	7.65	8.20
pH	4.60	4.50
Acidity (LA)	1.38	2.27
Volatile acidity (%)	11.78	32.70
Reducing sugar	2.18	4.38
Sucrose	41.50	43.10
Ash	0.392	0.455

Table 9 BIS requirement for *Shrikhand*. (1980)

Sr.No	Characteristics	Per cent
1	Total solids per cent by mass (min.)	58.0
2	Milk fat per cent by mass (on dry matter basis – min.)	8.5
3	Milk protein per cent by mass (on dry matter basis - min.)	10.5
4	Sucrose per cent by mass (on dry matter basis – max.)	72.5
5	Total ash per cent by mass (on dry basis –max.)	0.9
6	Titratable acidity per cent by mass (as lactic acid – max.)	1.4
7	Coliform count, per gram (max.)	10.0
8	Yasts and moulds, per gram (max.)	50.0

Boghra and Mathur (1992) collected *Shrikhand* samples from 5 shops of Anand markrt showed wide variation in TS, fat, protein, carbohydrates, minerals and pH. Fat content varied from 1.97 to 5.08 %, protein 6.82 to 7.20 % and carbohydrates content from 47.3 to 57.4 %. However, all samples had TS > 58 % which is the minimum value for *Shrikhand* as prescribed by the BIS.

Sakore (1998) prepared *Shrikhand* by using cocoa powder and reported following composition.

Table 10 Chemical composition of *shrikhand* prepared by using cocoa powder

Component	(%)
Fat	8.14
Total sugar	33.96
Moisture	49.52
Protien	7.03
TS	50.48
Acidity	1.194
Ash	0.71

Phate (2004) prepared the *Shrikhand* by using probiotic culture and reported following composition, obtained from cow milk.

Table 11 Chemical composition of *shrikhand* prepared by using probiotic culture

Component of <i>Shrikhand</i>	(%)
Fat	9.75
Total solids	59.52
Protien	8.67
Acidity	1.192

Dadarwal *et al.* (2005) utilized banana, guava and

sapota pulp in milk as well as in *Chakka* to explore the possibility of using fruit pulp for improving the flavour of *Shrikhand* without adversely affecting overall acceptability of the product. Addition of 5 per cent fruit pulp in milk before pasturization and lactic fermentation enhanced drainage of whey. Banana and sapota pulps added in milk increased the recovery of fat and protein in *Chakka*. Preventing loss of valuable ingredients in whey. The products prepared by addition of 5 to 10 per cent in milk and 10 to 20 per cent pulp in *Chakka* were acceptable in organoleptic qualities.

Salunke *et al.* (2005) conducted comparative studies on the physico-chemical properties of *Shrikhand*. Pooled value of market sample of *Shrikhand* collected from twenty well known manufactures, five from each of the four cities from the state of Maharashtra were analysed for chemical attributes. The samples were compared with *Shrikhand* from commercial dairy plants made using either mechanized (CM) or traditional process (CT). *Shrikhand* made by CM process differed significantly ($P < 0.05$) in sugar on dry matter (SDM), pH and soluble nitrogen (SN), whereas differences in total solids (TS, protein-on-matter (PDM), sucrose, ash on dry matter (ADM) and free fatty acid (FFA) were highly significant ($P < 0.01$), compared to *Shrikhand* made by traders using traditional process. *Shrikhand* made by CT process showed appreciable ($P < 0.05$) variation in SN and showed highly significant variation ($P < 0.01$) in TS, PDM, sucrose, ash and ADM content as compared to trader's *Shrikhand*. *Shrikhand* made by commercial dairies met the

PFA/BIS requirement except CT *Shrikhand*, which did not meet SDM requirement laid down in PFA and BIS standard.

Rameshwar Singh (2006) discussed the characteristic and technology of traditional Indian cultured dairy product. *Shrikhand* is prepared by blending *Chakka* with sugar, cream and other ingredient like fruit pulp, nut, flavour, spices, colour etc. to achieve the finish product of desirable composition, consistency and sensory attributes.

2.2.3 Chemical Composition of guava fruit

According to Phandis (1970) guava contain 82.50 per cent water, 2.45 per cent acid, 4.45 per cent reducing sugar, 5.23 per cent non-reducing sugar, 9.73 per cent total soluble solid, 0.48 per cent ash and 260 mg vitamin C per 100 g of fruit which differ with the cultivar, stage of maturity and season.

The flavor is the most distinguishing characteristics of guava fruits. The flavour of guava has been attributed to the presence of several volatile constituents. Among these hydrocarbons, alcohol and carbonyls are the main compounds. It is reported that 22 compounds are belived to play a predominant role in flavor and odour of guava fruit (Steven *et al.*,1970).

The fruits are found to contain citric, malic, glycolic, tatric and lactic acid, first two being predominant one. The content of organic acids has been reported to vary significantly in guava cultivars (Chang *et al.*,1971). There is a considerable variation

recorded on physico-chemical parameters of some guava varieties in respect of length, diameter, weight, TSS, total sugar and ascorbic acid contents in mature fruit were 1,8 cinde and (E)-2-hexenyl acetate (Anonymous,1993) .

Chemical composition of guava given by Adsule and Kadam (1995) is as follow.

Table 12 Chemical composition of guava pulp

Constituent	Average
TSS(Brix)	11.00
Total sugars (%)	6.15
Reducing sugar (%)	5.50
Non –reducing sugar (%)	0.65
Acidity (per cent citric acid)	0.70
pH	4.10
Ascorbic acid (mg/100g)	253
Pectin (%)	2.15

Table13 Nutritional Value of guava

Principle	Nutrient Value	Percentage of RDA
Energy	68 Kcal	3.5%
Carbohydrates	14.3 g	11.5%
Protein	2.55 g	5%
Total Fat	0.95 g	3%
Cholesterol	0 mg	0%
Dietary Fiber	5.4 g	14%
Vitamins		
Folates	49 µg	12.5%
Niacin	1.084 mg	7%
Pantothenic acid	0.451 mg	9%
Pyridoxine	0.110 mg	8.5%
Riboflavin	0.040 mg	3%
Thiamin	0.067 mg	5.5%
Vitamin A	624 IU	21%
Vitamin C	228 mg	396%
Vitamin E	0.73 mg	5%
Vitamin K	2.6 µg	2%

Electrolytes		
Sodium	2 mg	0%
Potassium	417 mg	9%
Minerals		
Calcium	18 mg	2%
Copper	0.230 mg	2.5%
Iron	0.26 mg	3%
Magnesium	22 mg	5.5%
Manganese	0.150 mg	6.5%
Phosphorus	11 mg	2%
Selenium	0.6 mcg	1%
Zinc	0.23 mg	2%
Phyto-Nutrients		
Carotene-β	374 μg	--
Crypto-xanthin-β	0 μg	--

(Anonymous 2009-www.nutrition-and-you.com)

Table 14 Nutritional Value of guava

Common Guava, per 165 g of individual fruit portion	
Calories	112
Moisture	133 g
Dietary Fiber	8.9 g (36%)
Protein	4.2 g (8%)
Fat	1.6 g (2%)
Ash	2.3 g
Carbohydrates	23.6 g (8%)
Calcium	30 mg (3%)
Phosphorus	66 mg (7%)
Iron	0.4 mg (2%)
Potassium	688 mg (20%)
Copper	0.4 mg (19%)
Beta-carotene (Vitamin A)	1030 IU (21%)
Ascorbic acid (Vitamin C)	377 mg (628%)
Thiamin (Vitamin B ₁)	0.1 mg (7%)
Riboflavin (Vitamin B ₂)	0.1 mg (4%)
Niacin (Vitamin B ₃)	1.8 mg (9%)
Folic acid	81 mcg (20%)

Jawahar (1999) observed chemical composition of guava juice as follow.

Table 15 Chemical composition of guava juice

TSS (Brix)	12.00
Titration acidity (%) (Citric acid %)	0.71
pH	3.50
Reducing sugars (%)	5.08
Non reducing sugars (%)	3.25
Total sugars (%)	8.33

Jain and Neema (2011) studied the quality of guava and papaya fruit pulp as influenced by blending ratio and storage period. Guava and papaya are the most widely grown commercial fruits of India. Both the fruits are nutritive and may be used for processing. The analysis of organoleptic characteristics (i.e., colour, flavor, texture, taste and overall acceptability) and qualitative characters (i.e., TSS, pH, acidity, ascorbic acid content) of guava and papaya fruits was conducted for fresh fruit, prepared pulp and mixed pulp.

3. MATERIAL AND METHODS

The present investigation entitled “Preparation of *Shrikhand* by using Guava pulp” was undertaken at Post Graduate Laboratory of Department of Animal Science and Dairy Science, Mahatma Phule Krishi Vidyapeeth, Rahuri during the year 2011-12. The research work was carried out from January 2011 to May 2012.

3.1 Material

3.1.1 Milk

Crossbreed cow milk was obtained from R.C.D.P. on Cattle, located at the Central Campus, M.P.K.V, Rahuri. The milk was collected immediately after morning milking.

3.1.2 Culture

Freeze dried culture of LF-40 (*Lactic fermenti*) obtained from the Division of Dairy Microbiology, N.D.R.I., Karnal was used to set *dahi*, for all trials. Culture was propagated and maintained as per the directives given by N.D.R.I., Karnal. In order to keep the culture active, it was propagated once in a week. It was stored in a refrigerator and care was taken to avoid contamination of culture.

3.1.3 Glass ware

The Corning and Borosil brand glassware were used for analytical work.

3.1.4 Chemicals

All the chemicals used in the analytical work were GR/AR grade manufactured by BDH and Glaxo India Company.

3.1.5 Guava

The fresh ripened guava fruit was purchased from the Department of Horticulture, MPKV, Rahuri.

3.1.6 Sugar

Crystalline cane sugar purchased from local market was used for preparation of *Shrikhand*.

3.1.7 Containers

Milk samples were kept in convenient size stainless steel vessels before use.

3.1.8 Cream separator

The Alfa-felix hand operated cream separator was used to obtain skim milk required for propagation of culture.

3.1.9 Weighing balance

Electronic weighing balance of 'Anamed' make, Model 300 was used.

3.1.10 Muslin cloth

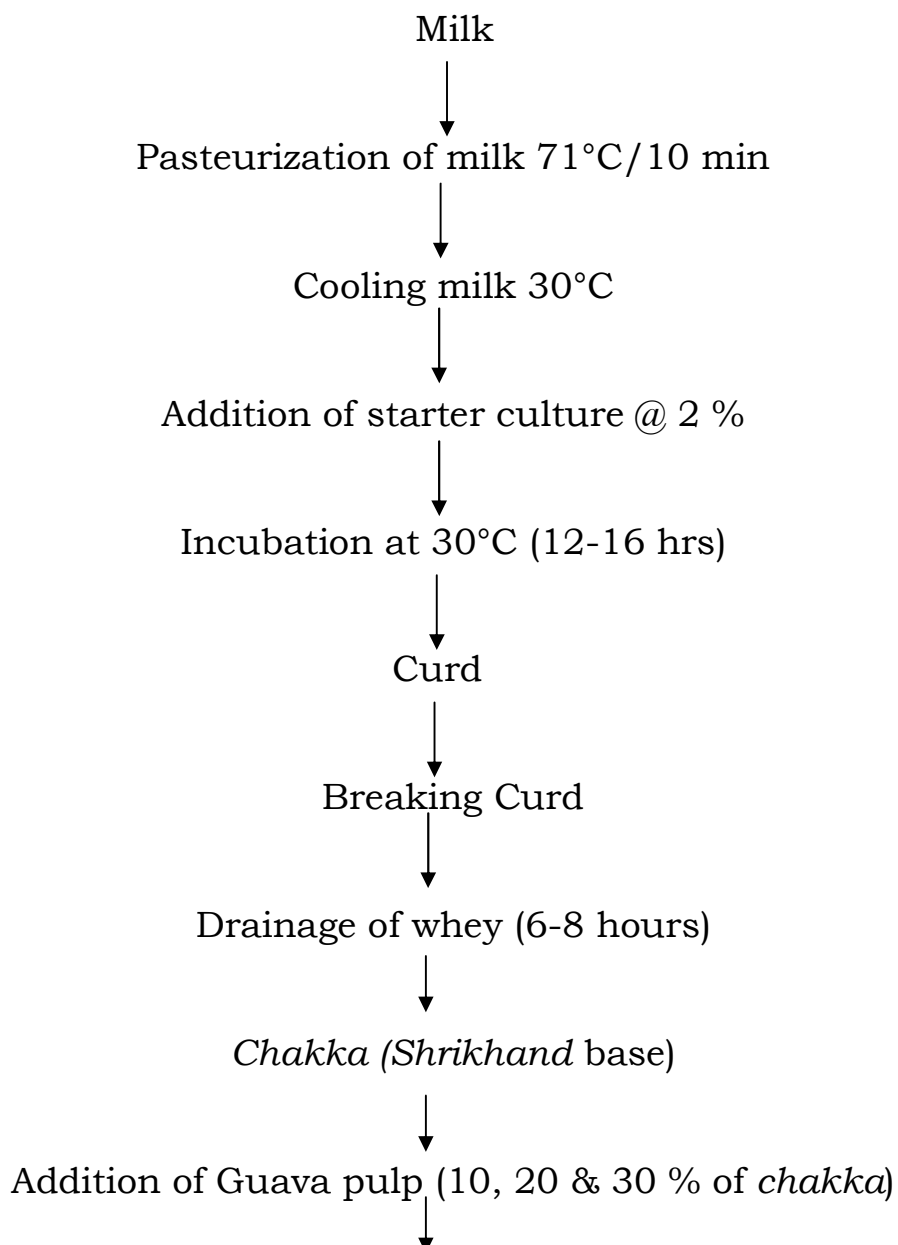
The muslin cloth pieces of suitable size were used for straining out whey from the coagulum.

3.2 Methods

3.2.1 Technology of *shrikhand* manufacture

Shrikhand was prepared adopting the standard procedure described by De (2008) with slight modification.

Flow chart for preparation of guava *shrikhand*



Addition of sugar



Shrikhand

3.2.2 Preparation of guava pulp

The normal ripe (greenish to cream coloured) guava fruits of sardar (Lucknow-49) cultivar were obtained from research farm of Department of Horticulture, MPKV, Rahuri and used for experiment.

Guava fruits were washed with clean water, skin portion was removed and were cut into small pieces. The pieces worked in mixer to obtain pulp. Then pulp was passed through muslin cloth to remove seed material.

3.2.3 Preliminary trials

Initially preliminary trials were conducted with 7 levels of guava pulp viz., 5, 10, 15, 20, 25, 30 and 35 per cent using 35 per cent sugar by weight of *Chakka*. It was observed that 5 per cent level of guava pulp did not give noticeable change in taste and flavor. The higher levels viz., 35 per cent gave much pronounced guava flavour and taste and the weak body and texture due to higher moisture content. So these levels viz., 5, 15, 25 and 35 per cent guava pulp were rejected. Sugar level was fixed as 35 per cent by weight of *Chakka* in all treatments. Culture used for *Shrikhand* preparation was LF-40 which is a mild acid producer

that is why though the sugar levels were lower than the normal (50 to 60%), the product was accepted on by all the semi trained judges without any objection.

3.2.4 Experimental trials

In experimental trials three levels of guava pulp viz., 10, 20, 30 per cent by weight of *chakka* and one level of sugar i.e 35 per cent by weight of *chakka* were used. One control sample without guava pulp and 35 per cent sugar was also prepared for comparison. There were in all 4 treatments. Since effect of guava pulp on the quality of *shrikhand* was to be judged. No other colouring or flavouring ingredients are added. Guava has strong flavour as well as imparts its colour to the product.

Table 16 Details of treatment combination

Treatment	Sugar (%)	Guava pulp (%)
T ₀ : Control	35	-
T ₁ :	35	10
T ₂ :	35	20
T ₃ :	35	30

3.3 Chemical analysis of *shrikhand*

3.3.1 Moisture

As per BIS (1981)

3.3.2 Fat

As pre modified Gerber method given by Puntambekar (1968).

3.3.3 Protein

As per the Micro-kjeldahl method describe in BIS (1981).

3.3.4. Total solids

As per the gravimetric method IS : 1966 (1973).

3.3.5 Lactose

Lactose of *shrikhand* was determined by as per Lane-Eynon's method given in IS: 1479 (Part-11)1961.

3.3.6 Total sugar

As per volumetric method IS: 1166 (1973).

3.4 Sensory evaluation

Sensory evaluation was done by panel of low many judges using 9 point hedonic scale with respect to flavor, body and texture, colour and acidity and overall acceptability given by Gupta (1976).

3.5 Cost of production

Cost of preparation of *shrihand* was worked out by taking the current market rates of fresh cow milk, sugar, guava, culture and labour etc.

3.6 Statistical analysis

Completely Randomised Design (CRD) with four treatment and four replications were used for analysis of data.

4. RESULTS AND DISCUSSION

Shrikhand is served as a dessert on ceremonial function, especially in summer. This product has very good taste and also very convenient to prepare that too at low cost. In the present investigation efforts were made to assess the possibility of using a Guava pulp in preparation of *Shrikhand*. The results obtained have been discussed under the following heads in the subsequent pages.

- 4.1) Chemical composition of cow milk.
- 4.2) Chemical composition of guava pulp.
- 4.3) Yield and chemical composition of *chakka*.
- 4.4) Chemical composition of *Shrikhand*.
- 4.5) Cost of preparation.

4.1 Chemical composition of milk:

In the present study as and when required composite whole milk samples were obtained from the crossbreed cows, maintained at RCDP on cattle, M.P.K.V, Rahuri. The average chemical composition of milk was recorded and presented in Table 1.

Table1. Chemical composition of milk

(Mean of 4 replications)

Component	Composition								pH
	Fat	Protein	Lactose	Ash	Acidity	Total solids	SNF	Moisture	
Mean	4.1	3.41	4.51	0.67	0.13	12.69	8.58	87.31	6.54
S.E ±	0.06	0.03	0.00	0.02	0.00	0.08	0.04	0.08	0.02
SD	0.10	0.05	0.01	0.03	0.00	0.14	0.06	0.014	0.04

On an average the whole milk contained 12.69 per cent total solids with 4.1 per cent fat and 8.58 per cent SNF.

The chemical composition of milk determined in present case was in close agreement as reported by earlier researchers kesarkar (2002) and Matkar (2010).

4.2 Chemical composition of guava pulp

The chemical composition of guava pulp is given in Table 18.

Table 18 Chemical composition of guava pulp

	TSS (°Brix)	Titratable acidity (% citric acidity)	Acidity (%)	Total Sugar (%)	Protien (%)	Fat (%)
Mean	11.5	1.18	0.47	7.24	0.9	0.30
Range	1-13	1.16-1.21	0.46-0.48	6.90-7.66	0.7-0.11	0.29-0.31

It was observed that the values for different constituents of guava pulp used for these experiments were within the expected range. The values confirm to the results reported by earlier research workers Phandis1970; Adsule and Kadam(1995), Jawahar (1999) and Patil 2009.

4.3 Yield and chemical composition of *chakka*

The data presented in Table 19 revealed that the moisture content in *chakka* varies from 65.45 to 66.45 with an average 65.81 per cent. It is slightly less than (68.86%) as reported by Zariwala and Sharma (1976). An average TS content was 34.19 per cent which fulfill the standard given by IS-9532 (Anonymous, 1980) (30%). The fat content in *chakka* ranges from 11.25 to13.50 per cent with an average value of 12.53 per cent as such 36.91 per cent on dry matter basis. Which is well above 33 per cent prescribed minimum by IS: 9532 (Anonymous, 1980). Jogalekar (1973) obtained similar results and observed that fat and TS content in *chakka* were increased with moisture content in *chakka* and increase in fat content of milk. The acidity of *chakka* ranged from 1.710 to 1.785 with an average 1.745 per cent which is quiet below the maximum limit of 2.5 per cent specified by IS- 9532 (Anonymous,1980) for *chakka*.

Table 19 Yield and chemical composition of *chakka*

Replication	Moisture %	TS %	Fat %	Fat(Dry) %	Acidity %	Yeild %
I.	65.55	34.45	13.50	36.64	1.710	21.33
II.	66.45	33.55	12.65	35.11	1.750	20.65
III.	65.75	34.25	11.25	38.12	1.735	19.15
IV.	65.45	34.55	12.75	37.77	1.785	23.75
Mean	65.81	34.19	12.53	36.91	1.745	21.22

The average yield of *chakka* was 21.22 per cent with the range of 19.15 to 23.75 per cent. The result coincide with those reported by Upadhyay and Dave (1977) and Aneja *et al* (1977) reported increase in yield with increase in SNF content in milk and degree of whey drained from *chakka* .

4.4 Organoleptic quality of *shrikhand*

The sample of the *shrikhand* prepared under various treatment were evaluated by panel of five semi- trained judges for sensory evaluation. A modified 9 points Hedonic scale developed by Gupta (1976) was used for judging different quality attributes of *shrikhand* (Appendix-1). The table of sensory attributes is the average of five semi-trained judges for each replication.

4.4.1 Colour and appearance of *shrikhand*

The data on colour and appearance of *shrikhand* is presented in Table 20.

Table 20. Score for colour and appearance of *shrikhand* by using guava pulp

Treatments	R1	R2	R3	R4	Mean
T0	7.46	7.85	7.66	7.27	7.56
T1	7.55	7.85	7.92	7.88	7.80
T2	7.91	7.93	7.96	7.92	7.93
T3	7.88	7.92	8.12	8.05	7.99
S.E ±					0.069
CD @ 5%					0.208

Table 20 indicate the colour and appearance character of the product. The colour and appearance score of *shrikhand* was changed due to blending of guava pulp in *shrikhand* preparation. The average score for colour and appearance of treatments T₀, T₁, T₂ and T₃ was 7.56, 7.80, 7.93 and 7.99, respectively. The highest score (7.99) was recorded with guava pulp *shrikhand* with 30 per cent of guava pulp. This observation indicated that the colour and appearance score of *shrikhand* of

treatment T₀, T₂ and T₁ minimum and was maximum for treatment T₃. This may be due to slight whitish to creamy colour of guava pulp. Treatment T₃ significantly superior over treatment T₀, T₁ and T₂.

4.4.2 Body and texture of *shrikhand*

The data regarding body and texture of *shrikhand* is presented in Table 21.

Table 21. Score for body and texture of *shrikhand* by using guava pulp

Treatment	R1	R2	R3	R4	Mean
T0	7.75	7.88	7.85	7.84	7.83
T1	7.64	7.66	7.68	7.62	7.65
T2	7.53	7.55	7.53	7.51	7.53
T3	7.28	7.30	7.34	7.32	7.31
S.E ±					0.014
CD @ 5%					0.044

Data presented in Table 21 revealed that average score for body and texture of *shrikhand* for different treatment varies from 7.31 to 7.83. Treatment T₀ is significantly superior over rest of treatments. Guava *shrikhand* with 30 per cent guava pulp

have minimum score for body and texture, this might be due to loose body and texture of guava pulp.

4.4.3 Flavour of *shrikhand*

The data on flavour of *shrikhand* is presented in Table 22.

Table 22 Score for flavour of *shrikhand* by using guava pulp

Treatment	R1	R2	R3	R4	Mean
T0	7.89	7.88	7.92	7.91	7.90
T1	7.98	8.10	8.07	8.05	8.05
T2	8.12	8.22	8.25	8.37	8.26
T3	8.07	8.12	8.18	8.23	8.15
S.E ±					0.029
CD @ 5%					0.088

The data presented in Table 22 revealed that the mean flavour score of guava *shrikhand* for treatment T₀, T₁, T₂ and T₃ was 7.90, 8.05, 8.26 and 8.15, respectively. The score for flavor decreased as level of pulp goes on increasing except for treatment T₃ (8.15). Decrease in flavour score of T₃ might be due to the pronounced flavour of guava in the product.

4.4.4. Overall acceptability for *shrikhand*

The data on overall acceptability of *shrikhand* is presented in Table 23.

Table 23 Overall acceptability for *shrikhand* by using guava pulp

Treatment	R1	R2	R3	R4	Mean
T0	7.65	7.66	7.68	7.69	7.67
T1	7.89	7.88	7.92	7.91	7.90
T2	8.12	8.22	8.32	8.38	8.26
T3	8.07	8.12	8.18	8.23	8.15
S.E ±					0.029
CD @ 5%					0.088

The data of overall acceptability for treatment T₀, T₁, T₂ and T₃ was 7.67, 7.90, 8.26 and 8.15; respectively. T₂ was significantly superior over rest of the treatments with the score of 8.26. From the sensory evaluation/ parameters it was indicated that good quality *shrikhand* can be prepared by addition of 20 per cent guava pulp and 80 per cent *chakka*.

4.5 Chemical composition of *shrikhand*

Shrikhand prepared under different treatment analyzed for moisture, fat, protein, total solid, total sugar and acidity.

4.5.1 Moisture content of *shrikhand*

The data on moisture content of *shrikhand* is presented in table 24.

Table 24. Moisture content of *shrikhand* by using guava pulp

Treatment	R1	R2	R3	R4	Mean
T ₀	45.12	46.22	47.17	47.41	46.48
T ₁	46.45	46.86	48.75	49.62	47.92
T ₂	48.30	48.08	47.99	48.40	48.19
T ₃	49.63	50.07	49.84	49.78	49.83
S.E ±					0.401
CD @ 5%					1.204

It is revealed from table 24 that the moisture content differs significantly due to inclusion of guava pulp in *shrikhand* preparation. The mean moisture content in *shrikhand* were T₀ (46.48), T₁ (47.92), T₂ (48.19) and T₃ (49.83) per cent, respectively. Significantly highest moisture content were noticed in T₃ (49.83) and lowest in T₀ (46.48). It is observed that as the level of guava pulp goes on increasing moisture content in *shrikhand* goes on increasing. This may be due to higher moisture content in guava

pulp. The results are in agreement with Lature (1996) and Upadhyay (1982).

4.5.2 Fat content of *shrikhand*

The data on fat content of *shrikhand* is presented in Table 25.

Table 25 Fat content of *shrikhand* by using guava pulp

Treatment	R1	R2	R3	R4	Mean
T ₀	9.52	10.11	10.13	10.44	10.05
T ₁	9.56	9.65	9.84	9.95	9.75
T ₂	9.48	9.51	9.52	9.53	9.51
T ₃	9.36	9.38	9.43	9.51	9.42
S.E ±					0.092
CD @ 5%					0.278

The data on fat content of *shrikhand* is presented in table 25. The fat content of *shrikhand* samples differ significantly due to addition of guava pulp. The average fat content in T₀, T₁, T₂ and T₃ were 10.05, 9.75, 9.51 and 9.42 per cent, respectively. The fat percentage was significantly highest in control *shrikhand* (T₀) (10.05%) and lowest in (T₃) (9.42%). However, treatments T₁, T₂ and T₃ were at par. Fat content was decreased proportionally with the addition of guava pulp. The fat content is in the range of 9.42 to

10.05 per cent in the samples. The results are in agreement with fat content in *shrikhand* is in the range of 5 to 15 per cent as reported by Anonyonoms, 1979 and Zariwala and Sharma (1979).

4.5.3 Protien content of *shrikhand*

The data on protein content of *shrikhand* is presented in table 26.

Table 26 Protein content of *shrikhand* by using guava pulp

Treatment	R1	R2	R3	R4	Mean
T ₀	7.74	7.84	7.87	7.83	7.82
T ₁	7.62	7.71	7.59	7.84	7.69
T ₂	7.62	7.67	7.51	7.72	7.63
T ₃	7.25	7.57	7.59	7.60	7.57
S.E ±					0.034
CD @ 5%					0.102

The data in table indicated that the mean protein content in treatment T₀, T₁, T₂ and T₃ were 7.82, 7.69, 7.63 and 7.57 per cent, respectively. The control *shrikhand* (T₀) had significantly highest protein content (7.82 %) while guava *shrikhand* prepared with 30 parts of guava pulp had lowest (7.57%) protein content. However, treatments T₁, T₂ and T₃ were at par with each other. Protein content was decreased as the proportion of added

guava pulp increased in the product. Though protein content decreased with increase in level of pulp it fulfills the ISI standard, and the results are in agreement with those reported by Aneja *et al.* (1977).

4.5.4 Total solids content of *shrikhand*

The data on total solids content of *shrikhand* is presented in Table 27.

Table 27. Total solids content of *shrikhand* by using guava pulp

Treatment	R1	R2	R3	R4	Mean
T ₀	53.50	53.25	53.75	53.85	53.50
T ₁	51.55	51.75	52.42	52.60	52.08
T ₂	51.48	51.77	51.85	52.22	51.83
T ₃	50.12	50.22	50.15	50.11	50.15
S.E ±					0.149
CD @ 5%					0.448

The data in table 27 indicated that the total solids content differ significantly due to inclusion of guava pulp in *shrikhand* preparation. The mean total solids content in *shrikhand* under treatment T₀, T₁, T₂ and T₃ were 53.50, 52.08, 51.83 and

50.15 per cent respectively. Significantly, highest total solids were noticed in T₀ and lowest in T₃. It is indicated that as the guava pulp level increased total solid content in *shrikhand* decreased. Similar range of total solids content was also reported by Lature (1995) (54.86%) and Bhattacharya *et.al.* (1972).

4.5.5 Total sugar content of *shrikhand*

The data on total sugar content of *shrikhand* is presented in table 28.

Table 28. Total sugar content of *shrikhand* by using guava pulp

Treatment	R1	R2	R3	R4	Mean
T ₀	30.48	30.48	30.90	30.10	30.49
T ₁	24.15	24.05	24.05	24.00	24.06
T ₂	23.50	23.55	23.45	23.50	23.50
T ₃	23.03	23.06	23.00	23.03	23.03
S.E ±					0.072
CD @5%					0.218

The data in table 28 indicated that the total sugar content was significantly changed due to inclusion of different levels of guava pulp in *shrikhand* preparation. The mean total sugar content in *shrikhand* T₀, T₁, T₂ and T₃ were 30.49, 24.06, 23.50 and 23.03 per

cent, respectively. Significantly highest total sugar was noticed in T₀ (30.49%). Similar range of total sugar also recorded by kolape (2009) and Nigam *et al* (2009).

4.5.6 Acidity of *shrikhand*

The data on acidity of *shrikhand* content is presented in Table 29.

Table 29. Acidity content of *shrikhand* by using guava pulp

Treatment	R1	R2	R3	R4	Mean
T ₀	0.78	0.79	0.80	0.83	0.80
T ₁	0.72	0.74	0.78	0.80	0.76
T ₂	0.70	0.71	0.73	0.74	0.72
T ₃	0.65	0.67	0.69	0.71	0.68
S.E ±					0.011
CD @ 5%					0.034

The data in table 29 noticed that the acidity of *shrikhand* was significantly differed due to addition of guava pulp. The acidity of *shrikhand* of treatment T₀, T₁, T₂ and T₃ were 0.80, 0.76, 0.72 and 0.68 per cent, respectively. Minimum acidity (0.68%) was noticed in treatment T₃. While maximum acidity 0.80 per cent was noticed in treatment T₀. The data indicated that acidity

decreased with increase in level of guava pulp in *shrikhand*. Similar range of acidity was recorded by Sukare (1998) and Phate (2004).

4.5.7 Mean chemical composition of *shrikhand*

The data on mean chemical composition of *shrikhand* is presented in Table 30.

It may be apparent from the Table 30 that guava *shrikhand* recorded mean chemical composition for T₀ (control) as 46, 48, 10.05, 7.82, 53.52, 30.49 and 0.80; T₁ (10 parts of guava pulp) as 47.92, 9.75, 7.69, 52.08, 24.06 and 0.76; T₂ (20 parts of guava pulp)as 48.19, 9.51,7.63, 51.81, 23.50 and 0.72 ; and for T₃ (30 parts of guava pulp) as 49.17, 9.42, 7.17, 50.83, 23.03 and 0.68 per cent, respectively as moisture, fat, protein, total solid, total sugar and acidity.

Table 30 Mean chemical composition of *shrikhand*

Constituents (%)	Treatment				S.E. ±	C D @ 5%
	T ₀	T ₁	T ₂	T ₃		
Moisture	46.48	47.92	48.49	49.17	0.401	1.204
Fat	10.05	9.75	9.51	9.42	0.092	0.278
Protien	7.82	7.69	7.63	7.57	0.034	0.102
Total Solid	53.52	52.08	51.81	50.83	0.149	0.448
Total Sugar	30.49	24.06	23.50	23.03	0.072	0.218
Acidity	080	0.76	0.72	0.68	0.011	0.034

It is sufficient to add finally that the combination T₂ (20 parts of guava pulp) could go well to give a better and nutritionally enriched product of guava *shrikhand*.

4.5.8 Cost of production

The cost of production is worked out by taking local market rates of various inputs. The cost of processing includes the cost of fuel, cooling and incubation while miscellaneous cost includes depreciation of equipments.

Table31 Cost of production of guava *shrikhand*

Ingredients required	Cost per kg.
Milk	22
Guava	30
Sugar	35
Plastic cups with lead (per cup)	05

All the ingredients required for preparation of *shrikhand* were rated as per prevailing market prices (2012-13).The cost structure of *shrikhand* preparation is presented in table 31.

Table 32 Cost of preparation of guava *shrikhand*

Ingredients used	Quantity required per Kg of <i>shrikhand</i>	Cost in Rs.
Milk	2.045 lts	44.99
Guava pulp	200 gm	10.50
Sugar	350 gm	12.25
Plastic cups with lead	5 units	25.00
Miscellaneous: Depreciation of utensils, incubation, refrigeration, etc.	-	10.00
Labour	-	1.75
Total		104.49

5. SUMMARY AND CONCLUSION

Shrikhand is semisoft, sweet sour, protein and fat rich indigenous fermented milk product. It has a refreshing taste, pleasing aroma, smooth, homogenous texture and firm consistency. It is served as special delicacy on ceremonial occasion and festival. The advantages which are aimed by consumption of *shrikhand* are that it has high calorific value. It is palatable and people who dislike milk or milk intolerant can consume it readily. It seems to exert possible therapeutic value during intestinal disorders.

Guava is good for balanced nutrition; it has no cholesterol, saturated fat and contains carbohydrate. Guava is also used as rich source of vit-A and vit-C, helpful enzyme in digestion of protein, removing skin blemishes, useful in treatment of stomach ulcer and cancer.

So looking to the diversified benefits of the guava pulp an attempt has been made to prepare low cost *shrikhand* from guava pulp and cow milk *chakka* by using various treatment combinations *viz.*, T₀ =100 %, cow milk *chakka*, T₁ =90 per cent cow milk *chakka* + 10 per cent guava pulp, T₂ =80 per cent cow milk *chakka* + 20 per cent guava pulp, T₃ = 70 per cent cow milk +30 per cent guava pulp and 35% sugar was constantly blended.

Guava *shrikhand* was prepared following standard procedure described by De (2008) with slight modification. Freeze dried *Dahi* culture LF – 40, was used which was obtained from

NDRI Karnal. The product was served to a panel of semi trained judges to know its acceptability. The data so obtained was pooled and overall acceptability was worked out. In all four treatments and four replication were conducted and data was analyzed using Completely Randomized Design (CRD). The proximate composition of *shrikhand* was also worked out. The results obtained in present investigation are summarized as under.

Acceptability of *shrikhand*

The acceptability of *shrikhand* was measured in terms of colour and appearance, body and texture, flavour and overall acceptability by a panel of semi trained judges using 9 point hedonic scale.

Colour and appearance

The colour and appearance score for *shrikhand* of treatment T₀, T₁, T₂ and T₃ was 7.56, 7.80, 7.93 and 7.99, respectively. The treatments T₃ was significantly superior over rest of the treatments. While the score for T₃, T₂ and T₁ were at par. These observations indicate that as the proportion of guava pulp in the blend increased there was increase in the colour and appearance score. This may be due to slight whitish to creamy colour of guava pulp.

Body and texture

The mean body and texture score of *shrikhand* for treatment T₀, T₁, T₂ and T₃ was 7.83, 7.65, 7.53 and 7.31,

respectively. Highest body and texture score was observed for T₀ followed by T₁, T₂ and T₃ which was significantly changed due to addition of guava pulp. Increase in the proportion of guava pulp in the blend there was decrease in the body and texture score of guava *shrikhand*. However, the body and texture of guava *shrikhand* of T₂ was also acceptable to the consumers.

Flavour

The mean flavour score of guava *shrikhand* for T₀, T₁, T₂ and T₃ was 7.90, 8.05, 8.26 and 8.15 per cent, respectively. The T₂ was significantly superior over rest of the treatments. While the score for T₀ and T₁ which was significantly changed and T₂ and T₃ were at par. This increased there was increase in the flavour score. The score for flavour is increased due to natural flavour of guava pulp.

Overall acceptability

The score of various treatments in respect of colour and appearance, body and texture, flavour of *shrikhand* was pooled and mean score for overall acceptability was worked out. It was observed that the mean score for overall acceptability for treatment T₀, T₁, T₂ and T₃ was 7.67, 7.90, 8.26 and 8.15 per cent, respectively. Maximum overall acceptability score 8.26 per cent was observed for treatment T₂. These observations indicated that as the proportion of guava pulp in blend increased the overall acceptability, score of the guava *shrikhand* increased. These

observations indicated that good quality guava *shrikhand* can be prepared by blending 20 per cent guava pulp + 80 per cent cow milk *chakka*. Guava is good for balanced nutrition; it has no cholesterol, saturated fat and contains carbohydrate. Guava is also used as a rich source of vit-A and vit-C helpful enzyme in digestion of protein, removing skin blemishes, useful in treatment of stomach ulcer and cancer. The guava *shrikhand* of treatment T₂ was acceptable to the consumers.

Chemical composition of *shrikhand*

The data on mean chemical composition of *shrikhand* is presented in Table 30.

It may be apparent that guava *shrikhand* recorded mean chemical composition for T₀ (control) as 46, 48, 10.05, 7.82, 53.52, 30.49 and 0.80; T₁ (10 parts of guava pulp) as 47.92, 9.75, 7.69, 52.08, 24.06 and 0.76; T₂ (20 parts of guava pulp)as 48.19, 9.51,7.63, 51.81, 23.50 and 0.72 ; and for T₃ (30 parts of guava pulp) as 49.17, 9.42, 7.17, 50.83, 23.03 and 0.68 per cent, respectively as moisture, fat, protein, total solid, total sugar and acidity .

Cost of production

All the ingredients required for preparation of *shrikhand* were rated as per prevailing market prices (2012 – 2013). The cost of production of guava *shrikhand* was Rs 104.49 per kg. The cost for the sensorial superior combination

T₂ (35 per cent sugar and 20 per cent guava pulp) which may be sufficiently nutritionally enriched combination of guava pulp added *shrikhand*.

Conclusion:

- The product prepared by using 35 per cent sugar and 20 per cent guava pulp secured the highest organoleptic score (8.26).
- Addition of guava pulp in *shrikhand* had significant effect on the chemical composition viz., moisture, fat, protein, total solid, total sugar and acidity of *shrikhand*.
- The cost of production 1 Kg *shrikhand* by using guava pulp was Rs.104.49

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7. APPENDIX

APPENDIX - 1

Evaluation card for sensory score of experimental samples

A specimen of evaluation card “9 Point Hedonic Scale”

Name of product : *Shrikhand* using guava pulp

Date :

Time :

Name of judge

Code No. of sample	Flavour	Body and texture	Colour and appearance	Overall acceptability (Average score)
T ₀				
T ₁				
T ₂				
T ₃				

Scoring guides according to 9 point Hedonic scale
Maximum score 9 for each parameter

Sr. no	Acceptability	Score
1	Liked extremely	9
2	Liked very much	8
3	Liked moderately	7
4	Liked slightly	6
5	Neither liked nor disliked	5
6	Disliked slightly	4
7	Disliked Moderately	3
8	Disliked very much	2
9	Disliked extremely	1

Remarks:

Signature of the judge

8. VITA

Mr. Hinwar Dhanraj Hilal

A candidate for the degree

of

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in

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