

**STUDIES ON FORMULATION OF
SOYSHRIKHAND**

BY
RAJESH MANIKRAO CHEDE
B. Sc. (Agri.)

T 2311

Dissertation

*Submitted To The Marathwada Agricultural University
In Partial Fulfilment Of The Requirement
For The Degree of*

MASTER OF SCIENCE
(Agriculture)

IN

DAIRY SCIENCE



DEPARTMENT OF ANIMAL HUSBANDRY AND DAIRYING
MARATHWADA AGRICULTURAL UNIVERSITY
PARBHANI, [Maharashtra] INDIA
1993

DEDICATED TO

MY


BELOVED PARENTS

CANDIDATE'S DECLARATION

*I hereby declare that the dissertation
or part thereof has not been
previously submitted by
me for a degree of
any University*

PARBHANI

DATED : 30 JUNE 1993 .


(R. M. CHEDE)

Prof. N.V. Joglekar
Associate Professor
Dept. of Animal Husbandry
and Dairying
College of Agriculture ,
M.A.U. , Parbhani.

CERTIFICATE I

Shri. Rajesh Manikrao Chede has satisfactorily Prosecuted his course credits and research for a period of not less than four semesters and that the dissertation entitled " **STUDIES ON FORMULATION OF SOYSHRIKHAND** submitted by him 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 dissertation or part thereof has not been previously submitted by him for a degree of any University.

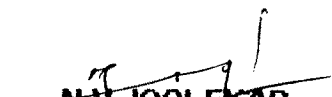
PARBHANI
DATE:30th JUNE.1993.

(~~Prof. N. V. JOGLEKAR~~)
Guide

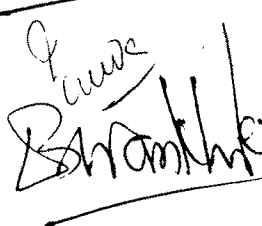
CERTIFICATE - II

This is to certify that the dissertation entitled
" STUDIES ON FORMULATION OF SOYSHRIKHAND"
Submitted by Shri. Rajesh Manikrao Chede
to the Marathwada Agricultural
University in partial fulfilment of the
requirements for the degree of MASTER OF
SCIENCE (Agriculture) in the subject of
DAIRY SCIENCE has been approved by
the student's advisory comittee after oral
examination in collaboration with examiner.

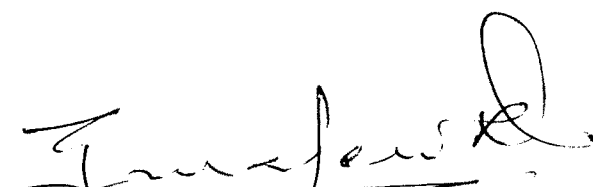

1877153
Examiner


N.V. JOGLEKAR
Guide,
Major Advisor & Chairman
ADVISORS

Dr. S. G. Rotte 

Dr. R. B. Sarode 

Dr. D . B. Wankhede 


Associate Dean and Principal
College of Agriculture
PARBHANI .

ACKNOWLEDGEMENT

I avail this opportunity to record my deep sense of gratitude to Prof. N.V. Joglekar Associate professor, Department of Animal Husbandry and Dairying, Marathwada Agricultural University, Parbhani and chairman of my Advisory Committee for suggesting interesting research problem, constant encouragement and constructive criticism. I owe to him for his meticulous care and intelligent approach with which he scrutinised the manuscript and enabled me to submit this dissertation in the present form.

With profound respect, I acknowledge the indebtedness to Dr. S.G. Rotte, Head, Department of Animal Husbandry and Dairying, Dr. R.B. Sarode, Professor, Department of Animal Husbandry and Dairying and Dr. D.B. Wankhede, Associate Dean and Principal, College of Food Science and Technology Marathwada Agricultural University, Parbhani, members of my advisory committee for needful counselling, critical scrutiny of manuscript and valuable guidance in research work.

I am also thankful to Dr. P.M. Patel, Associate Professor, Department of Animal Husbandry and Dairying, Dr. U.L. Patange, Prof. K.R. Mitkari,

Prof. A.N. Kulkarni, Prof. S.B. Lad, Prof B.R. Deshmukh and Prof. R.P. Barbind, Asstt. Professors Department of Animal Husbandry and Dairying, College of Agricultural, Parbhani for their kind and unfailing co-operation and Shri. G.L. Sutar, Shri. Mitkari and Marotirao Garad for giving the facility during the course of investigation.

I shall fail in my duties if I do not place on record the heartfelt sense of gratefulness of my everloving parents, father Shri. Manikrao, mother Smt. Mainabai, my younger brother Vinod and Kaylan and my younger sister Sushma and my close relatives for their constant encouragement and co-operation for completion of my post-graduate studies.

I am highly thankful to my friends Dr. A.B.Miskin, Ram Kawade, Jayant Kawade, Tanaji Mane, Manoj Mane, D.K. Shinde, Fartade, Survase K.G., Babar Thombare, Giram and Khalikar for their co-operation and encouragement for successful completion of present research work. Also I am thankful to my friends Avinash Pathak and Kiran Pote for completion of my research work.

PLACE : PARBHANI

DATE : 30 June, 1992


(R.M. CHEDE)

C O N T E N T S

Sr. No.	C H A P T E R	Page No.
1.	INTRODUCTION	1
2.	REVIEW OF LITERATURE	6
3.	MATERIALS AND METHODS	26
4.	RESULTS AND DISCUSSION	41
5.	SUMMARY AND CONCLUSION	69
	LITERATURE CITED	I - VII
	APPENDIX	I - II

LIST OF TABLES

Sr.No.	Title	Page No.
1	Yield of soychakka	42
2	Yield of soyshrikhand	43
3	Sensory evaluation of colour of soyshrikhand	45
4	Sensory evaluation of flavour of soyshrikhand	47
5	Sensory evaluation of sweetness of soyshrikhand	48
6	Sensory evaluation of consistency of soyshrikhand	50
7	Sensory evaluation of mouthfeel of soyshrikhand	52
8	Sensory evaluation of overall acceptability	54
9	Percentage acidity of soyshrikhand	56
10	H P of soyshrikhand	58
11	Chemical composition of soyshrikhand	59
12	Standard plate count of soyshrikhand	64
13	Coliform count of soyshrikhand	65
14	Preliminary observations on the storage quality of soyshrikhand	66

LIST OF FIGURES

Sr.No.	Title	In between the Page No.
1	Yield of <u>soychakka</u>	42-43
2	Yield of <u>soyshrikhand</u>	43-44
3	Overall acceptability of <u>soyshrikhand</u>	54-55
4	Moisture content of <u>soyshrikhand</u>	60-61
5	Total solids content of <u>soyshrikhand</u>	61-62
6	Fat content of <u>soyshrikhand</u>	61-62
7	Protein content of <u>soyshrikhand</u>	62-63
8	Lactose content of <u>soyshrikhand</u>	63-64
9	Ash content of <u>soyshrikahand</u>	63-64

LIST OF PLATES

Sr.No.	Title	Between the page No.
1	Flow diagram of manufacturing process of soyshrikhand	29-30
2	Wheyings off of soydahi in to soychakka	42-43
3	Various treatment combinations of soyshrikhand	43-44



Introduction

CHAPTER I

INTRODUCTION

The evolution and world movement of cultured/fermented milk foods began many centuries ago before christ, probably in the warm climate of the mediterranean sea basin. Also the Asiatic tribes Huns, Mongols and Goths advanced and retreated through Europe over successive centuries, simultaneously left behind their own practices for making foods from fermented milk. A fermentation is defined as the process leading to anaerobic breakdown of milk carbohydrate-lactose to lactic acid.

Cultured milks are categorised in following areas:

1. Those in which lactic fermentation is employed (eg. Yoghurt and cultured cream).
2. Those in which alcoholic fermentation is employed in addition to lactic fermentation (eg. Kefir and Koumiss).

These are reported to be popular in Scandinavia, Eastern Europe, Middle East, Near East, Africa and Asia including Afghanistan, India, Nepal, Mongolic China etc. (Orihara et al., 1992).

In India, fermented milk products such as dahi, lassi, and shrikhand are prepared and consumed since vedic

times and today they form an essential item in daily diet. Shrikhand an Indian delicacy is prepared from dahi in various parts of the country particularly in Maharashtra, Gujrat, Karnataka and Uttar Pradesh. It is a Sweet-sour product with pleasant flavour due to the fermentative activity of flavour producing bacteria and also addition of condiments eg. Nutmeg **and Elaichi as** aromatic material. It is mostly prepared on ceremonial occasions in feasts and festivals.

The available milk in the country is not sufficient to meet the consumption demand of the increasing population as per scientific recommendations. It is therefore, essential to utilize the available milk by application with the India's new leap with the technology boom and the straited efforts under the unique programme under the banner of NDDB viz., operation flood the picture has been the one with white revolution. The milk production in India has been 51.50 million tonnes by 1990. The per capita availability of milk to the estimated population of 780.5 million is 188 gm per capita at present. It is expected that the current level of production will reach to 64.4 million tonnes by the turn of this century i.e. by 2000 A.D. (Acharya, 1989). In spite of all these efforts the population boom is expected to cross 1000 million and that may create the deficit in estimated per capita availability of 190 gm/day.

Efforts need to be diverted to find out a suitable substitute for milk and milk products, to help to meet the shortage of milk and milk products in the country. Soybean has been of a considerable interest to nutritionists as a possible substitute for milk.

The role of soybean (Glycine max L.) the miracle crop of the 20th century, can hardly be under estimated in augmenting the protein and oil supply in the country since it contains about 40 per cent protein and 18-20 per cent oil. It can therefore, be useful for combating protein-calorie malnutrition in the poor strata of population. Soybean protein is a good source of 'lysine' an essential amino acid which is generally deficient in most cereal and millet proteins, hence inclusion of soybean in human diet would not only increase protein availability but also overcome the deficiency of 'lysine' in cereal based diets. The digestibility value of soyprotein varies from 82-94 per cent whereas biological value ranges from 58-68. (Singh, 1987).

When soybean is properly processed it is excellent source of vegetable proteins, the essential amino acids pattern of which makes it particularly superior, beside its high protein content.

A variety of acceptable foods can be developed from soybean to fit in Indian dietary pattern but most important example is soymilk. Soymilk is an inexpensive,

lactose free, highly digestible and nutritious alternative to cow's milk for almost half the world's population who are lactose intolerant, infants allergic to cow's milk and all increasingly health conscious members of society. It contains no cholesterol and has about 1.5 per cent fat which is rich in polyunsaturates, lecithin and linoleic acid.

Soybean has a very high nutritive value but ~~its use in~~ Indian diet is very low because it contains a number of the factors that inhibit the use of soybean for common dietary purpose ~~C.g.~~ Trypsin inhibitor and presence of Lipoxidase. These impart the product beany smell and some times bitter taste. Trypsin inhibitor could be inactivated by cooking and beany taste reduced greatly. In order to check the lipoxidase, one of the enzymes ~~s~~ that is present in soybean just underneath the skin once in contact with air would produce an objectionable beany smell. Discarding of cooking water seems to be a practical remedy though not a complete answer as experienced mostly.

A large varieties of compounds that may contribute to the flavour of soybean products have been identified. It is identified that the generation of flavour compounds is due to oxidation of lipids by the action of lipoxygenase (Wolf, 1975). Fermentation process could be looked upon to induce better flavour and mask disagreeable

ones. It is used to improve palatability of some oriental soybean preparations. The products obtained from milk by fermentation have a greater importance in digestion and assimilation of the diet. Keeping in mind the importance and nutritive value of soybean in the diet, the investigation was planned to better utilise soybean into a popular fermented product like shrikhand. Shrikhand is well understood to be made from chakka, obtained by wheying off of Dahi (curd). The delicacy is very much liked by the people in Western India i.e. Maharashtra, Gujrat and parts of Northern India. The garnishings are made with incorporation of sugar and saffron. Flavoured with cardamom, nutmeg and almonds may be used.

As such it was believed that this approach to utilize soybean in a popular fermented product similar to shrikhand could help to solve the long persistent beany flavour problem. It was with this objective that the present work was undertaken. The prime objective behind this endeavour was also the economisation of cost so as to extend the product to those who could not afford the one made from the whole milk. Hence the present reasearch work could be looked upon as a spade work in soy-based dairy foods- a novel approach.



***Review of
Literature***



CHAPTER II

REVIEW OF LITERATURE

2.1. The rapidly increasing production of cultured milk products has been the major breakthrough in the dairy industry (Lang and Lang, 1973). Bertelson et al. (1961) developed a concentrated cultured product Laktofil containing 5 per cent fat and 14-18 per cent total solids. The product had 1-2 weeks storage life at about 0-5°C. A milk protein paste 'zdorve' developed by Bogdanova and Novoselova (1962) in Russia and a Danish dairy delicacy 'Ymer' have been made from skim milk curd by the removal of its whey (Anon, 1969). Poulsen (1970) developed Danish protein enriched fermented milk product. This products was concentrated by removing approximately 54 per cent whey. Cream was added to adjust fat and was homogenised. Gandhi and Jain (1977) reported the development of a new high protein fermented food from Buffalo milk.

Shrikhand is a popular milk based dessert consumed largely in different parts of India. The raw materials used are sugar and chakka. Chakka a concentrated curd (dahi) produced by lactic fermentation of milk. Curd may

be made from skim milk or whole milk. During the course of present studies soydahi is utilised for the development of soyshrikhand and hence related intermediaries are reviewed subsequently.

2.2 Preparation of Soymilk:

De and Subramanyam (1945) prepared the milk from soybean by soaking it in water for 48 hours. Dehulled seeds were extracted in hot water at 70°C for 30 minutes with an addition of 0.2 per cent sodium bicarbonate. The clean kernels were ground in to a paste and boiled in hot water for 30 minutes. The milk was strained through muslin cloth. This milk was fairly good and superior to cow milk in certain regards.

Bedenhop and Hackler (1971) reported the effect of soaking soybeans in sodium hydroxide solution on the flavour, acceptability and nutritive value of the resulting soymilk.

Illinois process developed by Nelson et al. (1976) commonly used for soymilk preparation included hydration of whole soybean by soaking in 0.5 per cent sodium bicarbonate (1:3 bean :solution) for 8 to 12 hours, till the weight of beans doubled. The soak solution **was** then drained and the soaked beans **were** blanched by dropping directly in to the boiling water having 0.5 per cent sodium bicarbonate for 30 minutes for inactivation of

lipoxigenase. This **was** followed by draining tap water rinsing for cooling, disintegration with water. Heating the slurry to 90°C after filtering, the mass **was** homogenized (3500 psi), pasteurized (71°C for 15 second) and cooled (4°C). All these processes however aimed at achieving protein content similar to that of cow milk.

Escuenta and Benzon (1977) revealed the effect of immersion boiling as a preprocessing treatment in soymilk manufacture. Both the presoaked and nonsoaked beans showed large decrease in solids and protein extractability after 1 to 5 minutes of boiling before extraction. The decrease was faster in soaked than nonsoaked beans. The high initial moisture of soaked beans accelerated the insolubilization of the soluble solids and protein during boiling. The trypsin inhibitor activity of soymilk was completely inactivated by the boiling treatment before insolubilization of soluble solids and protein extraction was drastically lowered (2 minutes for soaked and 5 minutes for nonsoaked beans). Boiling time was restricted to 5 minutes in order to produce soymilk with protein content comparable to that of cow's milk with no trypsin inhibitor activity. Short time boiling had no effect on P^H and assured minimum damage to the essential amino acids.

Umakapoor et al. (1977) recorded the chemical analysis and acceptability of soymilk by suggesting method in which seeds were soaked overnight and kept in boiling water for 10 minutes. A slurry was prepared with boiling water (1:8) and passed through four folds of muslin cloth. Soymilk was heated for 30 minutes and 3.5 gm of sugar was added per litre in a subsequent trial. soybeans were soaked overnight in 0.03 per cent solution of NaHCO_3 and boiled for 60 minutes. After cooling the seeds were dehulled. The rest of the procedure was the same as described above. An organoleptic trial on soymilk and soymilk plus skimmed milk was carried out by a panel of 5 judges. Skimmed cow milk proved the best and soymilk was adjudged very good. NaHCO_3 pretreatment improved the taste and flavour marginally.

Nasim et al. (1986) indicated that soydal was soaked in water (1:3 W/v) for 14-16 hours. The soaked water was decanted and dal washed with fresh water and blanched for 40-45 minutes in boiling water and ground in a colloidal mill with hot water (85-90°C). The resulting suspension was filtered through double layer cloth and the filtrate boiled for 10 minutes with continuous stirring to prevent sticking of solids on scorching.

Chakrabarti and Gangopadhyay (1990) prepared soymilk for preparation of SoyRasogolla by soaking soybean in water containing 1 per cent NaOH overnight at room

temperature in ratio of 1:4 (W/v). After soaking the husks were removed by rubbing with hand for extraction of soymilk. The clean soybean was ground in mixer with luke warm water (1:5 bean: water) the resulting suspension was then filtered through a double layer muslin cloth.

Katra and Bhargava (1990) formulated soymilk for preparation of Rasogolla from blends of soymilk and cow milk by soaking soybean in 0.3 per cent Na_2CO_3 solution overnight and blanched in boiling water for 60 minutes followed by cooling and dehulling. Luke warm water was added in dehulled beans and mixture was then boiled for 2 minutes and filtered through double layer cheese cloth to remove solid portion.

Arora et al. (1991) prepared soymilk by soaking soydal in tap water (1:3 W/v) for 16-18 hours at room temperature. The soak water decanted and dal was washed with fresh water. It is then ground for 3-5 minutes in a cylinder with hot water ($85-90^\circ\text{C}$) using bean to water ratio of 1:9 (W/v). The resulting suspension was filtered through a double layer muslin cloth. The soymilk thus obtained containing approximate 6 per cent total solids.

Babje et al. (1992) mentioned preparation of soymilk for paneer preparation using dal and water ratio of (1:10) was for grinding. The resulting suspension was filtered through double layer muslin cloth and boiled for 10 minutes. The soymilk maintained 10.2 per cent total solids and 2.6 per cent fat.

2.3 Physical and chemical characteristics of soymilk:

Kawai et al. (1990) reported the proximate composition and content of minerals, linolenic and tocopherols in soymilk. Soymilk was classified into 4 groups according to the Japanese Agricultural standard for soymilk. (i) soymilk (ii) prepared soymilk (iii) soymilk beverage containing fruit juices (iv) soymilk beverage containing cereal powder etc. prepared soymilk was divided into subclasses. (i-1) added NaCl as seasoning (ii-2) added vegetable oil (iii-3) added oil and tocopherols, proximate composition of soymilk was examined. Contents of K, Na, Ca, Mg, Fe, Cu, Cd and Pb were determined by **AACC**. The values were (mg/100 gm) K: 41-243, Na: 0.6-98.0, Ca: 4.5-94.8, Mg: 4.1-23.6, Fe: 0.06-0.70, Cd: BDL (Below detectable level) and Pb: BDL in wet basis. Mean levels of linolenic acid in (i), (ii-1), (ii-3), (iii) and (iv) were (gm/100 gm) 1.30 ± 0.06 , 1.15 ± 0.05 , 1.83 ± 0.20 , 2.03 ± 0.12 , 0.33 ± 0.11 and 1.30 ± 0.09 respectively.

Oguntunde and Akintoye (1991) measured and compared the density, specific heat and viscosity of cow's milk and soymilk. Density was not significantly dependent on percentage total solids of cultivars whereas specific heat and viscosity were dependent. The relationship between specific heat and per cent total solids was linear and that between viscosity and per cent total solids was

exponential for each of the 3 milk samples at the same per cent total solids. The soymilk was denser and had greater specific heat and viscosity value than did cow's milk.

Kanate (1991) noticed soymilk comprising of total solids : 5.28, fat: 1.009, protein: 3.11, Lactose: 0.00 and ash: 0.20 per cent.

Reddy and Mital (1992) reported the physical and chemical characteristics of soymilk prepared from different varieties of soybean were determined. The soymilk samples were ranging for total solid: 5.16-5.96, protein: 2.38-2.95 per cent, P^H :6.3-6.7, per cent titratable acidity:0.13-0.17, specific gravity: 1.01-1.03, viscosity:4.5-5.0 Cp, surface tension:102.10-111.79 dyne/cm, Freezing point: 0.70-0.80°C.

2.4. Dahi and soydahi:

Dahi or curd is the product obtained from pasteurized or boiled milk by souring natural or otherwise by a harmless lactic acid or other bacterial culture.

Srinivasan and Banerjee (1946) reported the various aspects of manufacturing Indian dahi by making attention on the basic requirement of lactic acid curd for the manufacturing of shrikhand. It should attain a desired level of curd firmness, acidity and aromatic traits along with an optimum rate of whey drainage. These

qualities of dahi found to be influenced by the type, composition and treatment of milk, type of starter culture and incubation conditions.

Baisya and Bose (1975) reported the effect of time of incubation upon the final dahi quality and the physico-chemical changes of milk during fermentation. Better results were obtained with respect to volatile acid and diacetyl production by using *Streptococcus thermophilus* and *Streptococcus diacetylactis* in equal proportions. The gel formed at the end of 7¹/₂ hours of fermentation with volatile acid production kept increasing up to 24 hours of fermentation and then it started falling again. The viscosity changed suddenly at the last 1/2 hours of fermentation.

Shehata et al. (1984) reported the growth ability and activity of some lactic acid bacteria in soymilk compared to cow milk for its ability to support growth of several bacteria (*Streptococcus lactis*, *Streptococcus thermophilus*, *Streptococcus cremoris*, *Lactobacillus casei*, *Lactobacillus helveticus*, *Bacillus cereus*) in an attempt to improve its flavour. Bacterial action on soyoil and proteins of soymilk, effect of heat treatment of soymilk at 60-120^oc for 5-90 minutes on acid production by lactic cultures and growth/activity of these cultures in soymilk containing 1 per cent glucose, sucrose, lactose or peptone were investigated. Soymilk could support all tested cultures except *Bacillus cereus*.

Marshall (1987) reviewed the changes in milk during the formation of organoleptically acceptable products by fermentation. These included rapid acid production from lactose and development of suitable quantities of the volatile compounds, diacetyl and acetaldehyde.

Deka and Rajor (1988) reported the manufacture of dahi like product from soybean and buttermilk. Blanched soybean cotyledons were ground with butter milk to give soysolids: Butter milk solids ratios of (i) 1:1 (ii) 1.5.:1 (iii) 2:1 and (iv) 2.5:1 in a dahi like product with 12 per cent total solids. The soymilk blends were preheated to 65°C, homogenized at 3000 to 5000 psi, pasteurized by heating to 85°C then cooled to incubation temperature and incubated with 2 per cent culture of *Streptococcus lactis* and *Streptococcus lactis* sub spp. *diacetylactis* or with *Streptococcus thermophilus* + *Lactobacillus bulgaricus*. Chemical composition of the blends did not differ significantly except for an increase in fat percentage with increasing level of soysolids.

Patel et al. (1989) noticed effect of selected lactic cultures on beany flavour in soycurd by using five combinations of starter cultures as listed below, (i) *Streptococcus thermophilus* HST + *Lactobacillus bulgaricus*

LBW (ii) Acidophilus yoghurt culture (Hansen's) (iii) *Streptococcus thermophilus*-CH₁ + *Lactobacillus bulgaricus* - CH₂ (iv) Domestic dahi culture. (v) *Streptococcus thermophilus*-B-3641 + *Lactobacillus bulgaricus*-B-548. Acidophilus yoghurt culture and HST + LBW showed good results in both acid production as well as sensory qualities. **Addition of 2.0 to 3.0 per cent** spray dried skim milk powder was necessary in development of proper setting of soycurd. Soycurd remained acceptable for 20 days at 5°C without any apparent changes in sensory quality.

Chopra and Prasad (1990) reported lactic fermentation in soymilk blended with buffalo milk. It was observed that *Streptococcus thermophilus* and *Lactobacillus bulgaricus* grow in soymilk producing 0.49 and 0.43 per cent lactic acid respectively.

Dave et al. (1992) prepared dahi from homogenized buffalo milk adjusted to 15 per cent total solids by way of adding condensed buffalo skim milk. The major cultures used included *Streptococcus thermophilus*.

2.5. Biochemical change related to soydahi:

Shallenberger et al. (1967) reported that soymilk serves as an excellent medium for the growth of lactic acid bacteria. Sufficient acid production is prerequisite for the manufacture of fermented products and depends upon the ability to utilise the available carbohydrates in the

medium. The fermentable carbohydrates in soybean are low molecular weight oligosaccharides such as sucrose, raffinose and stachyose. A marked decrease in the stachyose content during ten days fermentation was noticed.

Sugimoto and van Buren (1970) showed that small amounts of partially purified cell extracts of *Aspergillus saitoi* possessing both invertase and α -galactosidase added to soy milk resulted in complete hydrolysis of galacto oligosaccharides.

Hsu et al. (1973) reported that stachyose disappeared as a result of germination of soybean.

Mittal et al. (1973) reported that lactic acid bacteria possessing the ability to utilise sucrose, the major sugar found in soybeans can be successfully used to manufacture fermented products from soymilk.

2.6 Chakka:

The raw material used in the preparation of shrikhand is called as chakka.

Ganguly and Boman (1959) defined chakka as a product exclusively derived from buffalo milk or cow milk after removing of the whey by straining. According to them it should contain not more than 65 per cent moisture and less than 15 per cent fat. They further reported the chemical composition of chakka as, moisture: 59.58, fat: 22.4, protein: 10.3, ash: 1.03 and acidity: 2.32 per cent.

Earnest et al. (1968) reported quality of market chakka as follow: moisture: 38.3, Acidity: 2.0, Fat:15.1, Lactose: 1.4 and protein: 1.7 per cent **respectively.**

According to Aneja et al. (1977) collection of chakka on large scale involved heating milk to 85-100^oC followed by cooling to approximately 20-30^oc and inoculating it with a lactic culture to get a final acidity of 0.8-1.0 per cent in the resulted curd. Further the curd was heated to about 25-30^oc, cooled to 4^oc and then the whey was seperated from it in a centrifuge.

According to Kadam et al. (1984) the yield of chakka was increased from cow milk with an addition of 2 per cent skim milk powder and 0.3 per cent sodium alginate. It was found to produce 33.65 per cent outturn which was nearly 10 per cent more than the yield from normal cow milk and slightly more than that from buffalo milk.

Desai et al. (1985) reported the effect of homogenization of milk on the quality of Chakka. Homogenization of milk was found to improve the appearance, consistency and texture of chakka as compared to unhomogenized milk samples. This treatment also gave slightly higher yield (33.95 per cent) and higher fat recovery (93.41 per cent) as compared to 32.41 per cent and 90.89 per cent respectively from unhomogenized samples.

Choudhary and Atreja (1986) reported the growth promoting ability of chakka as assessed by measuring the protein efficiency ratio (PER) using albino rats.

Kulkarni et al. (1987) reported the chemical composition of chakka whey as follows:

Total solids: 4.98-7.03, Fat: 0.01-0.39, Protein: 0.35-1.03, Lactose: 3.97-5.26 and ash: 0.33-0.65 per cent respectively. ^HP was 3.94-5.06 with the lactic acidity of 0.55-1.33 per cent.

Jadhav et al. (1991) indicated the mineral content of chakka whey at different stages of draining as follows.

Minerals (mg/100 ml)	Cow milk	Buffalo milk
Ca	101.96 - 126.91	121.60 - 192.77
P	66.67 - 80.28	87.05 - 95.04
Mg	6.2 - 8.69	9.05 - 15.78
Na	43.24 - 45.12	26.79 - 34.78
K	132.54 - 137.24	88.36 - 97.76

2.7 Shrikhand:

Puntambekar (1968) carried out studies on standardization of shrikhand by using different

combinations of sugar viz. 30, 40 and 50 per cent by weight of chakka and fat levels of 4, 8 and 12 per cent **Y**espectively. The levels were found to be non significant.

Bhattacharya et al. (1971) studied the method of production and storage of shrikhand and recommended the addition of sodium citrate 0.1 to 0.26 per cent in the final chakka to avoid leakage of fat from the body of the chakka.

Bhattacharya et al. (1972) carried out the work on the manufacturing process of shrikhand as well as shrikhand powder as below:

Composition	Shrikhand	Shrikhand powder
Moisture	55 - 60 %	2 - 3 %
Fat	6 - 8 %	15 - 18 %
Total solids	40 - 45 %	97 - 98 %
Sugar	18 - 20 %	40 - 45 %
p ^H	4.6 - 4.8	4.6 - 4.8

Joglekar (1973) standardized the method of preparation of shrikhand by using standardized milk to 3 per cent fat. Employment of a mixed culture of *Streptococcus lactis*, *Lactobacillus bulgaricus* and *Leuconostoc citravorum* all in equal proportion at the rate of 2 per cent and incubated

at 34°C proved to be good culture to produce requisite dahi for shrikhand preparation. Chakka was sweetened with 36 per cent sugar. The quality of the shrikhand thus prepared from low fat milk was quite satisfactory.

Ingle and Joglekar (1974) reported the effect of fat and sugar variation on acceptability of shrikhand resulting from the combination of 3 per cent fat (of milk) and 36 per cent sugar (by weight of chakka) was palatable and acceptable and hence it may be recommended for adoption by trade. Kneading the contents resulted in a homogenous consistency of the shrikhand.

Aneja et al (1977) developed an industrial process for the manufacture of shrikhand. shrikhand is traditionally produced by centrifuge concentrating curd (dahi) employing basket and mixing sugar with (mechanical-kneader) planetary mixer. The curd in this process deployed centrifugal separation of whey from curd and subsequent mixing of sugar and flavourings in a planetary mixer. Satisfactory organoleptic, chemical and bacteriological quality of the product was obtained. Shrikhand prepared had on an average 5 per cent fat, 42 per cent sugar and 60 per cent total solids.

Upadhyaya and Dave (1977) described the manufacturing process of shrikhand both by traditional and

semimechanised large scale method. The need for formulation of chemical and bacteriological standards for this product was emphasized.

Chakraborty (1978) described mechanized process for indigenous dairy products. The need to bring about changes in the traditional methods for the production of indigenous milk products on large scale was stressed.

Chakraborty (1978) standardized shrikhand manufacturing process in which curd was prepared from pasteurized skim milk and then whey was drained in a basket centrifuge. The chakka thus obtained was kneaded for 40 minutes with sugar and flavouring materials.

Patel and De (1979) carried out the work during the last decade in India in developing technology for the preparation of milk based confections like kalakand, drying of dahi, lassi and shrikhand and recommended the need to standardize their methods of preparation.

2.8 Shrikhand quality :

Upadhyaya et al. (1975) collected 45 samples of plain shrikhand from 15 different manufacturers in 4 cities of Gujrat and studied the variations in the composition. The product had composition of moisture: 34.48-35.66, Fat: 1.93-5.56, protein 5.53 -16.13, lactose :1.65-2.18 and sucrose: 52.55 -53.78 per cent respectively.

Sharma and Zariwala (1978) reported that the market quality of shrikhand varied widely in moisture, fat lactose and sucrose contents as compared to shrikhand prepared under laboratory.

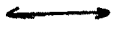
Mahajan et al. (1979) prepared shrikhand powder from cow and buffalo milk using spray drying. The product could be stored at $30 \pm 1^{\circ}\text{C}$ up to 90 days. They observed that the moisture level and volatile fatty acids of shrikhand powder remained unchanged during storage. However there was increase in free fat contents of shrikhand. Accordingly the reconstitution ability and flavour was satisfactory up to 45 days storage only.

Sharma and Zariwala (1980) reported that the shrikhand stored at $10 \pm 3^{\circ}\text{C}$ could be preserved for about 40 days. They further found that shrikhand stored at 37°C was spoiled within one week.

Reddy et al. (1984) reported various fat levels of milk and sodium citrate treatment at 0.25 per cent level had no appreciable effect on development of titrable acidity and pH of shrikhand. Sodium citrate treatment reduced fat losses in whey and produced high moisture in the finished product.

Upadhyaya et al. (1985) reported the chemical changes during storage of shrikhand, a sweetened fermented milk product at $7 \pm 20^{\circ}\text{C}$ and $-7 \pm 20^{\circ}\text{C}$ and its relation to sensory quality as follows. The product deteriorated steadily up to 50 days, as indicated by its titratable

acidity, pH, proteolytic degradation, extent of lipolysis and reducing and non reducing sugar levels. The rate of deterioration was faster at $7 \pm 2^{\circ}\text{C}$ than at $-7 \pm 2^{\circ}\text{C}$ and the product became unacceptable in both the cases within 40 and 50 days respectively.

Atreja and Deodhar (1987) determined nutrient contents at various stages during shrikhand making, using the  conventional LF-40 and a new yoghurt culture 'YH' as starters. At the stage of dahi making there was an increase in the contents of vitamin B₂ (121-131 per cent), Folic acid (165-331 per cent) and Niacin (160-201 per cent), protein and methionine contents were unaltered. During chakka making, there were substantial losses of all the three vitamins in whey. The product made with 'YH' culture was superior in nutrient contents to that made from LF-40.

Bardale et al. (1987) prepared shrikhand like product from skim milk chakka by fortifying with different fruit pulp viz. mango, apple and papaya. Skim milk shrikhand with 20 per cent apple pulp was better than the shrikhand blended with other two fruit pulps.

Prajapati et al. (1990) reported that the overall acceptability of shrikhand depends on its consistency and sensory profile. Shrikhand was subjected to post-production heat treatments by indirect heating to 55, 60, 65, 70 and 75°C for 30, 20, 10.5 and 2 minute

respectively. The product was hot packed in sanitised polystyrene cups and cooled to 10°C . These samples were compared with unheated controls for their consistency. Post-production heat treatment slightly improved the sensory quality of shrikhand and accordingly the flavour, body and texture and overall sensory score of the experimental samples ranged from 9.14 - 9.27, 4.32 - 4.49 and 16.49 - 16.70 respectively. The consistency of control shrikhand was 30.70 mm indicating a slight increase in the firmness of product. Post production heat treatment had no adverse effect on the sensory quality of shrikhand.

Prajapati et al. (1990) applied post-production heat treatment for preservation of shrikhand. An indigenous cultured product, demands greater, destruction of quality jeopardizing microbes with minimum adverse effect on organoleptic attributes. Shrikhand was prepared by mixing and kneading a calculated amount of skim milk chakka, cream, sugar and cardamom which was then heated at 55°C for 30 minutes (T_1), 60°C for 20 minutes (T_2), 65°C for 10 minutes (T_3), 70°C for 5 minutes (T_4) and 75°C for 2 minutes (T_5) Hot packed into sanitized polystyrene cups and cooled to 10°C . Total viable count, coliform counts, acid producers, proteolytic, lipolytic, yeast and mould counts for the control (unheated) as well as experimental samples were enumerated using standard methods. All samples of shrikhand studied had an absence of coliform considering counts of unheated shrikhand as 100 per cent

corresponding reduction of counts in heat treated shrikhand samples, T₁, T₂, T₃, T₄ and T₅ respectively were 61.92, 66.13, 74.13, 78.79 and 82.47 respectively for total viable count. Acid producers were absent in T₃, T₄ and T₅ however 41.58 and 21.27 per cent survived in T₁ and T₂ respectively. Post-production heat treatment of shrikhand at and above 65^oc destroyed lipolytic organisms completely. Proteolytic count was reduced by 27.21, 51.85, 67.95, 100 and 100 per cent respectively. The heat treatment at and above 65^oc destroyed yeast and moulds completely. These results indicated that post production heat treatment had a marked destructive effect on the major groups of micro-organisms.

Boghra and Mathur (1992) measured the chemical quality of major constituents and mineral composition of shrikhand collected from five shops of Anand (Gujrat) had a wide variation.

Sharma and Reuter (1992) reported that chakka would be made successfully by ultrafiltration using ceramic membrane module. There was 23 per cent extra yield of chakka when ultrafiltration was employed as against traditional methods. This was due to the recovery of whey proteins in chakka. Shrikhand of very good quality was made from this ultrafiltrate chakka. Ultrafiltration of coagulated skim milk at ^{pH} 4.6 to 4.5 was done at 50 ± 2^oc with 4 bar transmembrane pressure and 5 m/sec. velocity to a concentration of 19.2 per cent total solids. The average flux was 86.131/h.m².



Materials and Methods



CHAPTER III

MATERIALS AND METHODS

The present investigation entitled "Studies on formulation of Soyshrikhand" comprised of dahi, soycombined chakka, the shrikhand base and the formulation of soysolids combined product viz., soyshrikhand. The studies also consisted in evaluation of sensory qualities of soyshrikhand, besides the physico-chemical make up of the same. Some primary observations were also made in the microbial/storage quality of the newer product viz. soyshrikhand.

The current chapter deals with the materials involved and the methods employed for the studies which are discussed subsequently.

3.1 Milk : Cow milk which was standardized to 3.5 per cent fat and 8.5 per cent SNF was obtained from the Department of Animal Husbandary and Dairy Science, College of Agriculture, Marathwada Agricultural University, Parbhani for the experimental work.

3.2 Soybean : The soyseeds (PK-472 variety) were obtained from the farms of Sorghum Research Station, Marathwada Agricultural University, Parbhani during the course of present studies.

3.3 Starter cultures :

3.3:i Selection of cultures: The pure strains of *Streptococcus lactis*, *Streptococcus lactis* sub spp. *diacetylactis* and *Lactobacillus bulgaricus* were selected as starter organisms since these were found predominating in mild sour type dahi. These were considered as major organisms responsible for acid and flavour production (Troller 1982).

The freeze dried cultures of *Streptococcus lactis*, *Streptococcus lactis* sub spp. *diacetylactis* and *Lactobacillus bulgaricus* were procured from the Division of Dairy Microbiology, National Dairy Research Institute, Karnal (Haryana).

3.3:ii Preparation of mother culture:

The ampule of freeze dried culture was opened under aseptic conditions and 0.5 ml sterilized skim milk was added in to the ampule. The contents were mixed throughly by shaking and transferred quantitatively to the tubes containing sterilized skim milk (10 ml). These tubes containing strains of *Streptococcus lactis*, *Streptococcus lactis* sub spp. *diacetylactis* and *Lactobacillus bulgaricus* was incubated at 30, 30 and 37^oC respectively till the firm coagulum was formed.

3.3.iii Preparation of batch culture:

For preparing the batch culture, 200 ml of skim milk were sterilized in to the 250 ml capacity conical flask and cooled to 30°C. It was inoculated with respective mother culture aseptically at the rate of 2 per cent and at respective temperatures till the formation of firm coagulum. Sub culturing was done weekly. Fresh active cultures were used in equal proportion after testing for the quality of dahi.

3.4 Preparation of soymilk:

Soymilk was prepared by the modified method of Prakash et al. (1975).

A 300 gm of soybeans were soaked in 900 ml of water added with 0.5 per cent Sodium bi-carbonate. This was left over night at room temperature. The soak solution was drained. The seeds were blanched in fresh boiling tap water solution of 0.5 per cent sodium bi-carbonate (NaHCO_3) for 30 minutes. The hulls were then removed by rubbing. Approximately 100 gm of dehulled beans were taken at a time in an electrically operated mixer (Juicy type) and ground with 400 gm of boiling water for 10 minutes. The dispersion was filtered through a muslin cloth to get soymilk.

3.5 Treatment combinations of Soydahi :

For the preparation of soydahi the treatments were arranged as per the details shown below.

T₀: (Control) 100 per cent cow milk

T₁: 90 per cent cow milk + 10 per cent soymilk.

T₂: 80 per cent cow milk + 20 per cent soymilk.

T₃: 70 per cent cow milk + 30 per cent soymilk.

T₄: 60 per cent cow milk + 40 per cent soymilk.

T₅: 50 per cent cow milk + 50 per cent soymilk.

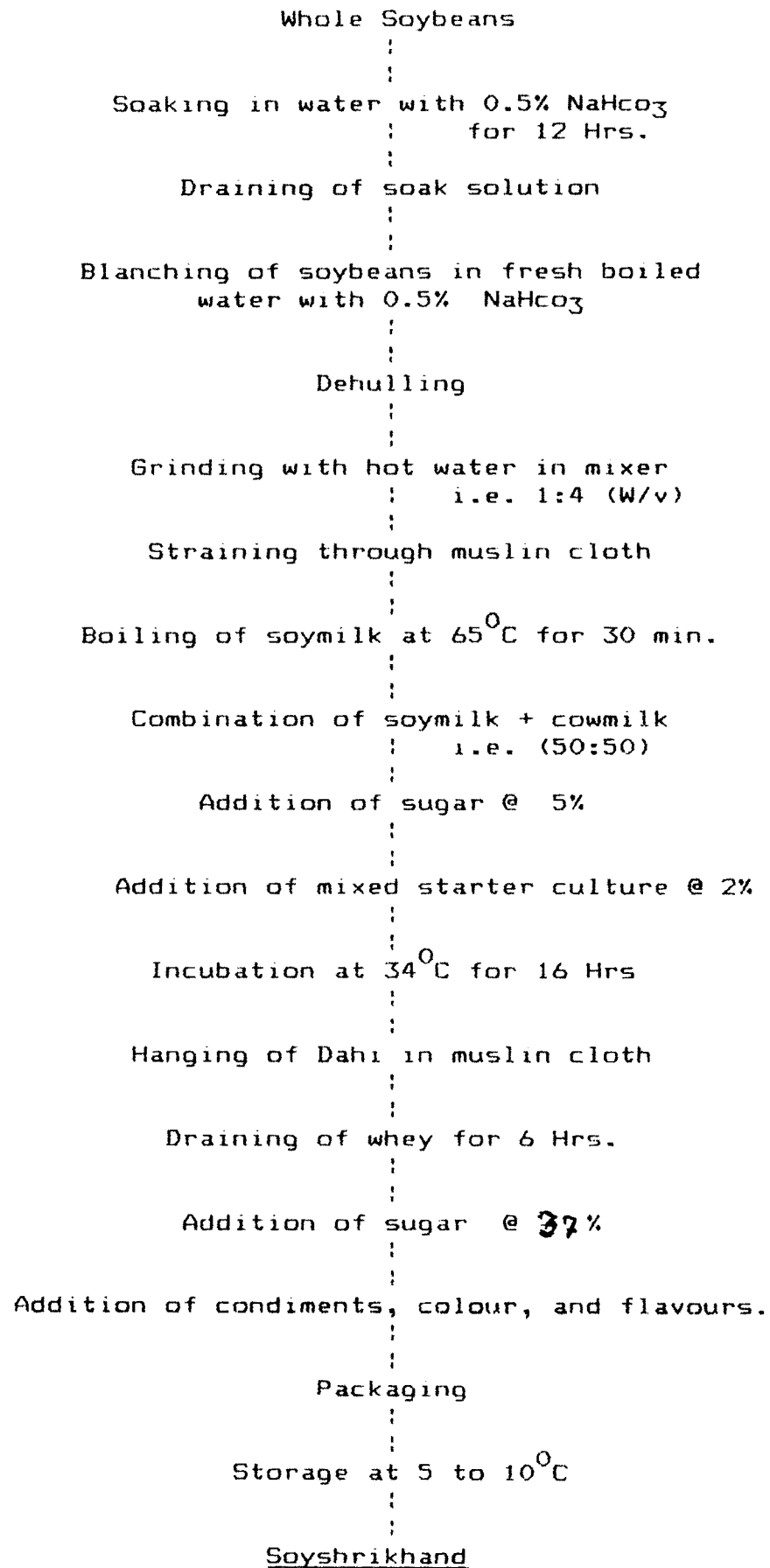
3.6 Inuoculation of starter culture:

The above combinations of each 1000 ml quantity were heated at 90^oC for 15 minutes and cooled to 30^oC (ambient conditions). The sugar was added at the rate of 5 per cent in each treatment to promote the growth of lactic fermenting organisms. These treatments were inoculated with mixed starter culture of *Streptococcus lactis*, *Streptococcus lactis* sub spp. *diacetylactis*, and *Lactobacillus bulgaricus* all in equal proportions at the rate of 2 per cent. This lot was incubated at 34^oC temperature for 16 hours for the preparation of dahi.

3.7 Preparation of soycombined chakka:

The whole quantity of dahi obtained in each treatment combination was hung in a muslin cloth for draining of whey. The draining of dahi was carried out

Flow diagram of Soyshrikhand



for 6 hours to drain out the whey. The chakka was collected and weighed and then stored in a refrigerator before it was used for the preparation of soyshrikhand.

3.8 Preparation of Soyshrikhand:

The soyshrikhand was prepared from soymilk soychakka by using traditional method. The sugar was added at the levels of 35 - 40 - 45 - 50 per cent of the weight of soychakka. After the sensory evaluation by the judges the levels of 40 per cent sugar by weight of soychakka was finalised as preferred and this was used subsequently for further studies. The addition of other condiments such as 0.5 gm Nutmeg Powder, Elaichi flavour, Saffron colour (food grade) were tried for each treatment combination lot. The product was kneaded by hand kneading machine (puranpatra). After preparing soyshrikhand it was examined for sensory qualities including flavour, consistency, colour, sweetness, Mouthfeel and overall acceptability.

3.9 Sensory evaluation of Soyshrikhand:

The extent of acceptability of the product was decided by subjecting it to sensory evaluation to a semitrained panel of judges. The evaluation of soyshrikhand combination was done for the following parameters.

- i. Colour
- ii. Flavour
- iii. Mouthfeel
- iv. Sweetness
- v. Consistency
- vi. Overall acceptability.

T 2311

The scoring was done on " 9 point Hedonic scale," developed by Quarter master, Food and container Institute, U.S.A. (Gupta 1976). The numerical values were given from 1 to 9 as shown below;

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



3.10 Statistical analysis:

The scores given by different judges were tabulated. The data were analysed statistically by Completely Randomized Design (CRD) as per Panse and Sukhatme (1967). The significance was evaluated on the basis of critical differences. Thus treatments were compared for sensory quality.

3.11 Composition of Soyshrikhand:

Soyshrikhand prepared by the different treatments was subjected to chemical analysis which comprised of the determination of moisture, total solids, ash, protein, fat, Lactose, acidity and P^H.

3.11:i Determination of moisture:

The moisture content was determined by I.S.I (1964). Method.

A 5 grams of sample was taken in a taved flat bottom evaporating dish. It was heated on water bath till dryness. Then it was transferred to hot air oven adjusted at 100^oC. Heating was continued for 30 minutes. The dish was cooled in a desicator and weighed. The process of heating, cooling and weighing was repeated till the loss in weight between two successive weighings did not exceed 1 mg. The moisture contents of samples were expressed as,

$$\% \text{ Moisture} = \frac{\text{Loss in weight of sample}}{\text{Weight of samples}} \times 100$$

3.11.ii Determination of Total solids:

The residue left after the determination of moisture was used for the calculation of total solids. The residue was weighed and total solids were calculated

by using the formula as shown below,

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

3.11.iii Determination of Ash:

For the determination of ash the method was employed as recommended in I.S.I. (1961).

The residue obtained in the determination of total solids was transferred to a "muffle furnace" at a temperature of 650°C for 5 hours and ignited. On ashing it was cooled in desiccator and weighed. The procedure was repeated till a constant weight,

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

3.11.iv. Determination of Protein content of Soyshrikhand:

The protein content of soyshrikhand was determined by the method described in A.D.A.C. (1965).

A 2.0 grams of soyshrikhand were taken in to a Kjeldahl's flask. This was added with 25 ml of pure nitrogen free concentrated sulphuric acid. It was added with 10 gm of digestion mixture (potassium sulphate and 2 per cent copper sulphate).

The flask was placed on the digestion rack. Initially the flask was heated gently in an inclined

position. When the frothing was ceased and white fumes were stopped the heating was continued strongly, taking care that the liquid boiled moderately. The flasks were rotated occasionally to wash down any carbonaceous matter remaining on the side of the flask. When the content became clear it was allowed to cool. This was diluted with water and the contents were transferred in to a distillation flask with 400 ml of ammonia free water. A 100 ml of 40 per cent NaOH were added to the flask, so as to form a distinct layer at the bottom. A 50 ml aliquot of N/10 H₂SO₄ were taken in a beaker. A few drops of methyl red indicator were added to it. This was placed below the condenser tube at the receiving end of the distillation assembly. The assembly was made air tight and the heating was started. The steam containing ammonia vapours was condensed by the condensor and was collected in N/10 H₂SO₄. When about 200 ml of distillate were collected the tube was disconnected and the end of the condensing tube was washed with distilled water in to the beaker containing the distillate. The distillate was titrated with N/10 NaOH. The methyl red indicator changed from red to yellow when neutral point was reached. A blank was run Simultaneously. The percentage of Nitrogen in the sample was calculated as (1 ml of N/10 H₂SO₄ = 0.0014 gm).

$$\% \text{ Nitrogen in sample} = \frac{\text{No. of ml. of N/10 H}_2\text{SO}_4 \times 0.0014}{\text{Weight of sample}} \times 100$$

*
% Protein = % of Nitrogen in sample x 6.25

* The amino acid values are to be expressed as g/15 g N which is equivalent to gm/100 gm crude protein i.e. (N x 6.25). As the incorporation of soyprotein is achieved this factor is of relevance.

3.11.v Determination of fat of Soyshrikhand

The fat contents of soyshrikhand were determined by the method recommended by Choudhari (1959).

A 5 gm of soyshrikhand were weighed in a cup of the butyrometer used for the determination of fat content of cream. This was added with 10 ml of sulphuric acid (sp. gravity 1.82). One ml of amyl alcohol was added to it. Then sufficient quantity of distilled water was added in order to bring the liquid in graduated stem of the butyrometer. This was stoppered and mixed thoroughly. It was placed on water bath at 70 C and occasionally shaken until the solids were dissolved. It was centrifuged at 1400 RPM in the Gerber's centrifuge for 3-4 minutes. The reading obtained in the graduated neck of the butyrometer was recorded as the fat content.

3.11.vi Determination of Lactose of Soyshrikhand:

The Lactose content of soyshrikhand was determined by Lane and Ion's method as described in IS 1479 (part-II) 1961.

A 10 gm of sample was weighed in to a 250 ml beaker. A few drops of acetic acid were added to it. This was set aside for 15 minutes. A 10 ml of boiling water were stirred well. The supernatant liquid was filtered through whatman No. 41. The filtrate was collected in a 250 ml volumetric flask. Sufficient weighings were given. Finally the volume was made up to the mark.

A 5 ml aliquot of Fehlings 'A' and 5 ml of Fehlings 'B' were mixed with 40 ml distilled water in a 250 ml conical flask. A few glass beads were added. The contents were brought to boiling. The filtrate (obtained above) was titrated against this using methylene blue indicator. Lactose percentage was found out by the following formula.

$$\% \text{ Lactose} = \frac{\text{LV} \times 250 \times 100}{\text{BR} \times 10}$$

LV - Lactose value, BR - Burette reading.

3.11:vii Determination of carbohydrate contents of Soyshrikhand:

The carbohydrate contents of Soyshrikhand were determined as per I.S.I. (1981).

The carbohydrate contents of the samples were determined by difference i.e. by subtracting the sum of per cent values of moisture, protein, fat, ash and crude fibre from 100. The resultant figure represented per cent of carbohydrate in the samples.

3.11.viii Determination of acidity of Soyshrikhand:

Acidity was determined by I.S.I. (1981) method. A 10 gm of sample were taken accurately in a porcelein dish. It was mixed with 10 ml of recently boiled and cooled distilled water. A few drops of phenolphthalein indicator were added to it and this was titrated with N/10 NaoH solution.

$$\text{Acidity percentage} = \frac{\text{No. of ml. of N/10 NaoH} \times 0.009}{10} \times 100$$

3.11.ix Determination of P^H of Soyshrikhand:

The P^H of the samples was measured by using digital P^H meter (335). Firstly the P^H meter was standardized at 25^oC by using standard buffer solution. The temperature of the P^H Meter was adjusted for standard temperature with the help of knob. The P^H of the sample was observed and recorded on the dial.

**3.11.x Determination of standard plate count (SPC) of
Soyshrikhand:**

The standard plate count being one of the important micorbial parameter was determined by adopting nutrient agar method as cited by Indian standard (1962). It was prepared as shown below;

The compositon of nutrient agar was made as:

Bactopeptone	10 gm
Common salt	5 gm
Beef extract	10 gm
Water	1000 ml
p ^H	7.2
Agar	15 gm

The media was prepared by dissolving peptone of beef extract in warm distilled water. It was added with common salt. The contents were then heated to boiling. The P^H of the medium was then adjusted using bromothymol blue indicator. The medium was again boiled for 10 minutes and filtered through the filter paper. The agar powder was added to the medium. The contents were boiled to dissolve the agar completely. The hot medium was filtered through muslin cloth lined with absorbent cotton soaked in water. The medium was distributed in quantities of 150 ml in 250 ml conical flasks and sterilized by autoclaving at 15 lbs for 15-20 min.

Appropriate dilutions of the samples in sterile saline were plated out in duplicates using the media and the plates were incubated at 37°C for 24-28 hours. The colonies were counted according to the standard procedure.

3.11.xi Determination of coliform count of Soyshrikahnd:

The coliform count was measured as per the procedure given in IS (1986) by using violet red bile agar (VRBA) medium having following composition,

	Perecent
Peptone	0.70
Yeast extract	0.30
Bile salt	0.15
Lactose	1.00
Sodium chloride	0.50
Neutral red	0.003
Crystal violet	0.0002
Agar	1.50

At first the peptone yeast extract and sodium chloride were dissolved in warm distilled water followed by boiling for 10 minutes. After adjusting the P^H of the medium to 7.2, it was mixed with the bile salt solution which was seperately dissolved and adjusted to P^H 7.2. The medium was then boiled for 10 min. and filtered

through filter paper. The agar powder was then added to the medium and the mixture was boiled to dissolve the agar completely.

The hot medium was then filtered through the muslin cloth lined with absorbent cotton soaked in water. The dextrose solution and filtered solution of neutral red and crystal violet were added to the medium and the volume was made up by adding warm distilled water to it. The medium after distribution in flasks was sterilized by autoclaving at 15 lbs for 15-20 min. and the plates were incubated at 37 to 40^oC for 24 - 48 hours. The red dark coloured Colonies which appeared both on surface and subsurface were counted.



***Result
and Discussion***

CHAPTER IV

RESULTS AND DISCUSSION

The present studies comprised the formulation of soycombined dahi and chakka which further resulted in to the final product i.e. Soyshrikhand. The studies incorporated the following parameters.

1. Yield characters of Soychakka and Soyshrikhand.
2. Sensory evaluation of Soyshrikhand.
3. Chemical composition of Soyshrikhand.
4. Microbiological quality of Soyshrikhand including standard plate count and coliform count.
5. Preliminary observations on the storage of Soyshrikhand.

4.1 A novel approach was taken up to incorporate the soysolids in the popular dairy product viz., Shrikhand. The cultures employed were *Streptococcus lactis*, *Streptococcus lactis diacetylactis* and *Lactobacillus bulgaricus* all in equal proportions. The soycombined cow milk combinations as outlined in the earlier chapter were made starting from 0 to 50 per cent soymilk in T₀-T₅ combinations respectively. The heat treatment to the milk and other details are also given under the materials. The inoculation was done at the rate of 2 per cent and the incubation was carried out at 34°C for 16 hrs. which

resulted in dahi of desired characters. The Soychakka was obtained by allowing the samples to be drained to the muslin cloth by hanging for 5-6 hrs. The details of the yield obtained in case of Soychakka are presented subsequently.

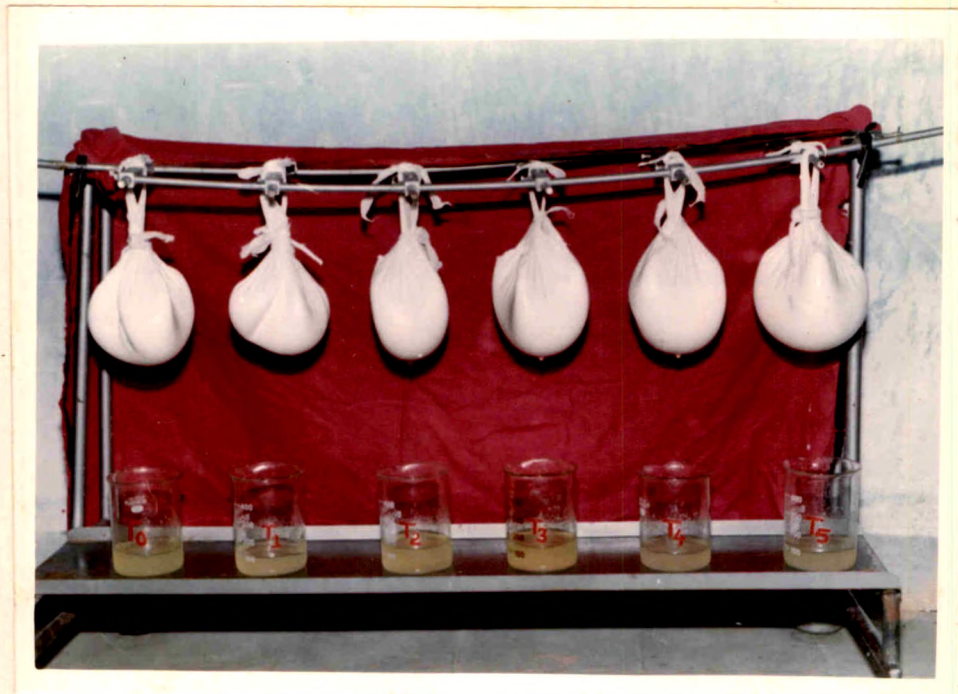
4.1.1 Yield of Soychakka .:

The yields obtained under the different treatments combination are presented under Table 1.

Table 1 Yield of Soychakka.

Replication Treatment	RI	RII	RIII	RIV	RV	Mean g/lit.
T ₀	345	348	348	350	349	348
T ₁	348	350	351	355	356	352
T ₂	354	355	356	355	355	355
T ₃	359	360	362	359	360	360
T ₄	360	363	360	365	362	362
T ₅	366	366	364	367	362	365
S.E. ±	0.92					
C.D. at 5%	2.69					

It may be apparent from this table that the mean yields of Soychakka varied between 345-350 g per litre in the control i.e. cow milk chakka. A further glance at this data revealed that the yields varied between 345-367 g. The lowest value was recorded in the treatment T₀ (100 per cent of cow milk) where as, the highest yield is in case of T₅ (50 per cent combination of soymilk) as such the



Wheyng off soydahi in to soychakka

Scale:

Y-axis: 1 cm = 10 gm.

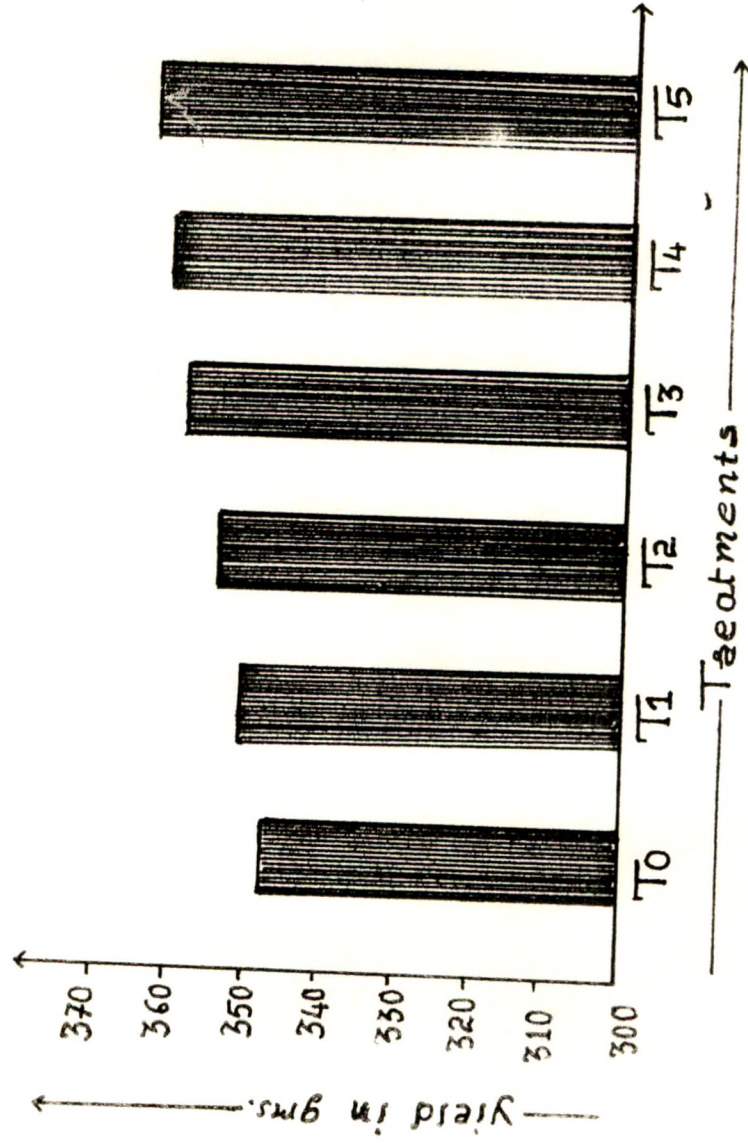


Fig-1: YIELD OF SOYCHAKKA

treatment means were significant in the combinations T₁, T₂, T₃, T₄ and T₅ over that of the control (T₀). The highest mean yield were recorded under the treatment T₅ (50 per cent soymilk combination) valued at 365 g.

A comparison of the yield data could very well suggest that there was an appreciable increase in the yield of Soychakka (base of Soyshrikhand) due to the replacement by soymilk, which is the excellent source of vegetable proteins. Desai et al. (1985) reported the yield of chakka due to homogenization of milk was slightly increased (33.95 per cent).

4.1:ii The base product of Soychakka was further transformed in to Soyshrikhand by the incorporation of 40 per cent sugar and with the addition of condiments viz., Elaichi and Saffron colour. The product resulted after kneading was weighed for the final yield. The results obtained are presented under Table 2.

Table 2 Yield of Soyshrikhand

Treatments	Details of Treatments	Quantity of Soydahi (gm)	Yield of Soychakka (gm)	Yield of Whey (ml)	Sugar added (40%) (gm)	Total yield of Soyshrikhand (gm)
T ₀	100 % cowmilk	1000	348	652	140	488
T ₁	90 % cowmilk + 10% soymilk	1000	352	648	141	493
T ₂	80 % cowmilk + 20% soymilk	1000	355	645	142	497
T ₃	70 % cowmilk + 30% soymilk	1000	360	640	144	504
T ₄	60 % cowmilk + 40% soymilk	1000	362	638	145	507
T ₅	50 % cowmilk + 50% soymilk	1000	365	635	146	511



Various treatment combinations of Soyshrikhand

Scale:
Y-axis: 1 cm = 10 gm.

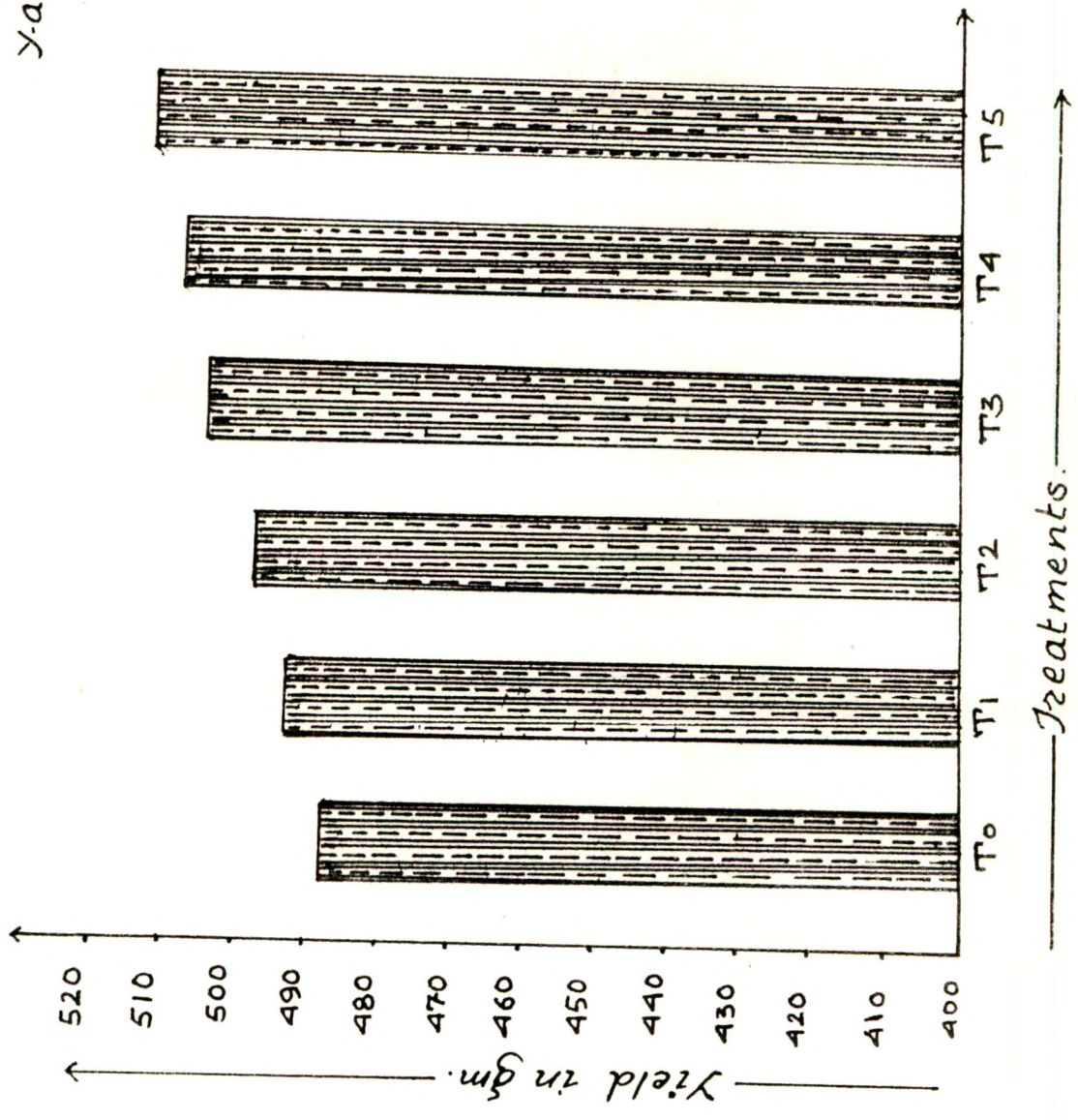


Fig-2: YIELD OF SOYSHRIKHAND.

It may be noticed from the contents of the Table I that the same quantity of Soydahi at the rate of 1 Kg was utilized for the formulation of Soychakka and Soyshrikhand. The mean yield values for Soychakka were ranging between 348 g in case of T₀ to 365 g in case of T₅ i.e. 100 per cent cow milk and 50 per cent soymilk combinations respectively. The mean yield of whey obtained **was** between 635 ml to 652 ml. The lowest being in case of T₅ i.e. 50 per cent soymilk combination. The proportion of sugar incorporated is also highlighted in the same table. The values change as per the mean yield of Chakka and **are** reported **as** 140 - 146 g in the studied combinations of T₀ - T₅ i.e. 100 per cent cow milk and 50 per cent soymilk combination **respectively.**

It is interesting to note from the contents of the same table that the final yield of Soyshrikhand varied from 488 - 511 g respectively in the combinations T₀ and T₅ i.e. 100 per cent cow milk and 50 per cent soymilk combination.

It is encouraging to note from the results obtained that there has been an appreciable gain in yield of final product i.e. Soyshrikhand as could be visualised from the description that there has been replacement of 50 per cent milk by the way of soymilk in the combination T₅. Furthermore the yields were recorded with the increasing trend with increased incorporation of soymilk. This could be taken as a positive sign to have the replacement of milk solids through the incorporation of soysolids as rightly

projected out by Acharya (1989) that the milk is becoming a commodity of dearth under Indian conditions due to the population explosion. In order to bridge the gap of per capita availability, the present way of formulation of Soyshrikhand could be taken up as a positive step in the right direction. The problem of feeding millions through milk solids could thus be tackled through the incorporation of vegetable proteins and one that has been tried is soybean.

4.2. Sensory evaluation of Soyshrikhand:

4.2.i Sensory evaluation of colour of Soyshrikhand:

The Soyshrikhand obtained was subjected to the sensory evaluation by a semitrained panel using a "9 point Hedonic scale". The results obtained are presented in Table 3.

Table 3 Sensory evaluation of colour of Soyshrikhand:

Replications Treatments	RI	RII	RIII	RIV	RV	Mean
T ₀	6.64	7.85	8.21	8.71	7.50	7.78
T ₁	6.57	7.71	8.07	7.85	8.14	7.66
T ₂	6.92	7.71	8.64	9.00	7.57	7.96
T ₃	6.42	7.57	8.92	8.57	8.57	8.01
T ₄	6.42	7.42	8.10	8.00	8.28	7.64
T ₅	5.78	7.07	8.53	8.42	8.35	7.63
S.E. ±	0.39					
CD at 5%	1.16					

A glance at this table may suggest that the product was scored for the studied character in the mean range values of 5.78 - 9.00 in case of T₅ and T₂ respectively i.e. 50 per cent soymilk combination and 20 per cent soymilk combination. The treatment means ranged between 7.63 - 8.01 respectively in T₅ and T₃ i.e. 50 per cent soymilk combination and 30 per cent soymilk combination. It may be further noticed from the data that the scores offered showed non significant differences. So far as colour character was concerned. It is interesting to note that though the control treatment of T₀ was rated at the mean value of 7.78 this was surpassed by two soycombinations viz., T₂ and T₃ recorded at 7.96 and 8.01 respectively. Though the product was artificially coloured with the food grade colour there seems to be a ready uniformity in the colour of the product. There is a ground to believe that incorporation of soymilk to the level of 50 per cent did not change the normal colour characters of the final product Soyshrikhand significantly, hence it could be inferred from these observations that soycombinations in the Soyshrikhand could go a long way without affecting the normal Shrikhand colour characters. Aneja et al. (1977) utilized the industrial process for the manufacture of Shrikhand **and** reported satisfactory characters of the final product that had 42 per cent sugar. Upadhyaya et al. (1985) recorded the changes in the sensory qualities of stored Shrikhand at 7± 2°C. Sharma and Reuter (1992)

reported a good quality Shrikhand made from ultrafiltered Chakka.

4.2:ii Sensory evaluation of flavour of Soyshrikhand:

The flavour character of the Soyshrikhand was adjudged by the same panel and the results obtained are tabulated subsequently in the Table 4.

Table 4 Sensory evaluation of Flavour of Soyshrikhand:

Replications Treatments	RI	RII	RIII	RIV	RV	Mean
T ₀	7.50	8.00	8.71	8.14	8.14	8.10
T ₁	6.42	7.64	8.35	8.50	8.21	7.82
T ₂	6.57	7.35	8.53	8.50	7.42	7.67
T ₃	7.00	7.35	8.67	8.67	8.50	8.02
T ₄	6.00	7.14	8.67	8.35	8.28	7.69
T ₅	6.42	6.71	8.35	8.64	8.35	7.69
S.E. ±	0.39					
CD at 5%	1.13					

It may be apparent from observations that these scores range between 6.00 - 8.71 respectively in case of T₄ and T₀ i.e. 40 per cent soymilk combination and 100 per cent cow milk. It may be further noticed that in general the mean values for flavour did not changed significantly in the opinion of judges. However rating at 8.10 which was followed by T₃ at 8.02. This means that the higher liking of Soyshrikhand made from pure cow milk was exhibited by

the panel members. However from the statistical point of view there had been no significant differences in the flavour rating for T₃ or T₅. This may be further interpreted in the terms that the combination T₅ or T₃ faired well in the opinion of judges. In other words the replacement of milk solids through soymilk solids could be succesfully tried in a product like Soyshrikhand. The problem of beany flavour which has been the persistent character in soymilk or other products has been a technological challenge in the field of food/dairy industry. The present results are note worthy interms that this problem has been totaly eliminated. Umakapoor et al. (1977) suggested that the skimmed cow milk prooved to be best which was followed by soymilk in terms of flavour. Chakrabarati and Gangopadhyay (1990). Utilised the soymilk for the preparation of SoyRasogolla that had desirable flavour. Katra and Bhargava (1990) formulated Rasogolla from blends of soymilk and cow milk.

4.2:iii Sensory evaluation of sweetness of Soyshrikhand

The sweetness character of soymilk was tested by the panel members applying the "9 point Hedonic scale". The values are presented under Table 5.

Table 5 Sensory evaluation of sweetness of Soyshrikhand

Replications Treatments	RI	RII	RIII	RIV	RV	Mean
T ₀	7.71	8.07	9.00	8.42	7.92	8.22
T ₁	7.28	7.35	8.85	8.42	8.00	7.98
T ₂	7.14	7.64	8.71	8.35	7.64	7.90
T ₃	6.71	7.85	8.57	8.85	7.92	7.98
T ₄	6.50	7.28	8.42	8.35	8.21	7.75
T ₅	6.85	6.35	8.67	8.64	8.14	7.73
S.E. ±	0.35					
CD at 5%	1.01					

It may be witnessed from the contents that values ranged from 6.35 - 9.00 respectively in case of T₅ and T₀ i.e. 50 per cent soymilk combination and 100 per cent cow milk. A further glance at the mean values for sweetness could highlight that though the values changed numerically between 7.73 to 8.22 in T₅ and T₀ were statistically non significant. The higher value for sweetness could be taken up in case of T₀ as a blending of sugar along with milk proteins and the final acid level achieved in the product. Similarly the there counterpart of soyshrikhand also exhibited an appreciable resemblance of the same character as mentioned earlier, there had been very little differences in different combinations tried and hence a level of T₅ i.e. 50 per cent soymilk incorporation could be taken up as the optimum level to get the final sweetness

character of this product. Aneja et al. (1977) reported a level of 42 per cent sugar in the final product that gave desired attribute to Shrikhand.

4.2:iv Sensory evaluation of consistency of Soyshrikhand:

The consistency attribute of Soyshrikhand are mentioned under Table 6.

It may indicate that the values range between 6.35 to 8.78 respectively incase of T₁ and T₀. Further more the mean values for the treatments occurred in the range of 7.47 - 8.03 respectively in T₅ and T₂ i.e. 50 per cent soymilk combination and 20 per cent soymilk combinations.

Table 6 Sensory evaluation of consistency of Soyshrikhand

Replications Treatments	RI	RII	RIII	RIV	RV	Mean
T ₀	6.71	7.14	8.64	8.78	7.92	7.84
T ₁	6.35	7.00	8.64	8.78	8.21	7.80
T ₂	7.14	7.35	8.50	8.50	8.64	8.03
T ₃	6.57	6.85	8.21	8.21	7.85	7.54
T ₄	6.64	6.71	8.25	7.92	8.14	7.53
T ₅	6.42	6.14	8.00	8.78	8.00	7.47
S.E. ±	0.41					
CD at 5%	1.19					

The results were non significant though the numerical differences did exist. It may be regarded there fore that the individual combinations of T₀ and T₅ were at

par with each other, so far as the consistency was concerned. This could be explained further with the interpretation that the curd formed in the original product of dahi was analogous with that of soycombined dahi. This further could suggest that the characters of Soychakka and cow milk Chakka were identical in terms of consistency. The casein i.e. milk protein seems to have been uniformly blended and amalgamated in the combination of Soychakka and subsequently the Soyshrikhand. This could be taken up again as a positive sign in the direction of the final acidity of the product. In other words the consistency of the product appears to be unique in blending of the milk proteins along with soyproteins, sugar (sucrose) as well as the residual moisture content in the final product. The resultant consistency has been the most sought for character in terms of sensory quality as well as consumer acceptability. A shrikhand can only be called as shrikhand, if it possesses a right combination of the above three. It may be possible as experienced in the milk proteins of the casein which has a binding property for water might have combined it self along with soyproteins to formulate a fine net work along with water droplets and the present fat portions. The consistency could therefore be taken up as the desired attribute which was successfully achieved in the soyshrikhand combinations discussed recently. Prajapati et al. (1990) reported the overall acceptability of shrikhand obtained from post-production

heat treatments. The consistency and sensory profile of the product was also studied. According to the reports the flavour, body and texture indicated a slight increase in firmness of the product.

4.2:v Sensory evaluation of Mouthfeel of Soyshrikhand:

The soyshrikhand was also assessed for its character of mouthfeel. The results obtained are presented under Table 7. It could be noticed from the contents that the values ranged between 5.92 to 8.71 respectively in T₅ and T₀ i.e. 50 per cent soymilk combination and 100 per cent cow milk. A further glance at the same table indicates that the treatment means were statistically non significant.

Table 7 Sensory evaluation of Mouthfeel of Soyshrikand

Replications Treatments	RI	RII	RIII	RIV	RV	Mean
T ₀	7.42	7.85	8.71	8.50	8.07	8.11
T ₁	7.07	7.28	8.50	8.50	8.50	7.97
T ₂	7.14	7.35	8.39	7.64	7.85	7.67
T ₃	6.78	6.92	8.53	8.42	7.85	7.70
T ₄	6.85	7.07	8.53	8.21	8.42	7.82
T ₅	5.92	6.42	7.85	8.64	8.14	7.39
S.E. ±	0.35					
CD at 5%	1.02					

The mouthfeel is the sensory character which may be regarded as a soy of hidden attribute in other words it

is the subjective character which has the objectivity that could measure the sensation generated after putting the product on tongue taking it under the teeth passing it to the last end of the tongue and finally gulping it, this also could live the after taste i.e. last feeling. Whole this process and the phenomena of sensation could be characterised by the word mouthfeel. The mouthfeel in case of soyshrikhand could be considered as the identification of the specific textural character i.e. consistency, secondly, the mingling effect generated due to the combination of sugar, acid and the blandness of proteins. This in sum total do effect the sensation of mouthfeel, further more it is the combination of flavours i.e. diacetile and the artificial flavours added if any. Do live there effect on there infact on the senses of the consumer or the judges. It is encouraging to note from the scores obtained for the combinations that they were liked moderately to very much and in certain cases they were like extremely. The higher value of T_0 is again suggestive that the traditional liking of the judges has been towards the dairy based product only, however, the differences being non significant. Soycombined shrikhand samples also faired well in terms that they were next only in succession. It may be inferred from this discussion that the blending of soysolids resulted in a moderately good to excellent product in terms of various sensory characters including the mouthfeel. More over it may be observed that the

product as adjudged by panel members did not hinder in any way with their sensory taking in as well as did not live also any ill-sensation after words. This is sufficient enough to indicate that by the process of fermentation and the treatment combinations utilised a well come grade product could be obtained. Bardale et al. (1987) reported the preparation of Shrikhand like product from skim milk Chakka fortified with 20 per cent apple pulp. The blends was superior over other two fruit pulps namely mango and papaya. Sharma et al. (1992) reported Shrikhand from ultrafiltration retentate process that had desired sensory qualities.

4.2:vi Sensory evaluation of Overall acceptability of Soyshrikhand:

The product of soyshrikhand was also subjected to the tasting in terms of overall acceptability. The scores analysed are presented under Table 8.

Table 8 Sensory evaluation of Overall acceptability of Soyshrikand

Replications Treatments	RI	RII	RIII	RIV	RV	Mean
T ₀	7.35	7.85	8.71	8.42	8.35	8.14
T ₁	7.00	7.35	8.35	8.14	8.07	7.78
T ₂	7.21	7.50	8.60	9.00	8.00	8.06
T ₃	6.64	7.42	8.67	8.00	8.28	7.80
T ₄	6.85	7.35	8.67	8.64	8.14	7.93
T ₅	6.35	6.78	8.35	8.42	8.42	7.66
S.E. ±	0.34					
CD at 5%	0.99					

Scale:
Y-axis: 1 cm = 1 unit of acceptability.

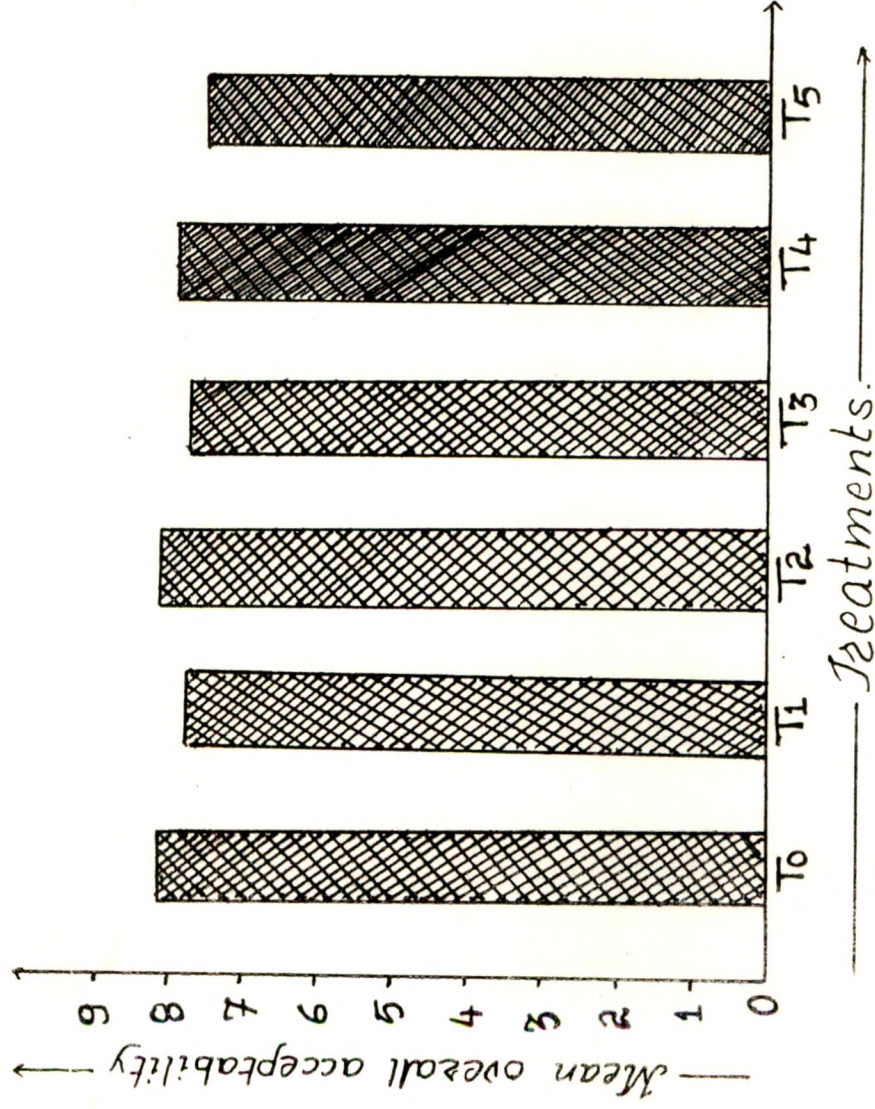


Fig-3: OVERALL ACCEPTABILITY OF
SOYSHRIKHAND

It may be apparent from the data that the treatments range between 6.35 to 9.00 that is in case of T₅ and T₂ respectively. The mean values for the treatments in terms of overall acceptability were recorded as 7.66 to 8.14 respectively in case of T₅ and T₀ i.e. 50 per cent soymilk combination and 100 per cent cow milk. It is interestingly to note that the treatment T₂ was rated at 8.06.

It may be interpreted from the data obtained under Table 8 that the overall acceptability could be taken up as the sum total of various sensory characters viz., colour, flavour, sweetness, consistency, mouthfeel and is governed by the final liking of the judges. In a nutshell this character of soyshrikhand has been the key factor in adopting this product from the market point of view. As the treatments were non significant they behaved as to be at par with each other. Though the liking of the judges was for the traditional dairy based product which was numerically higher the soycombined shrikhand also competed appreciably in terms of overall acceptability. It may be concluded therefore that from the excellence generated by this product the traditional shrikhand and soyshrikhand were at par with each other, conclusively a blend of 50 per cent soymilk and 50 per cent cow milk could result in an appreciably excellent product which would have all the desired sensory attributes of the conventional shrikhand.

considering the economics of this product this could be rationally cheaper than that of the normal shrikhand. Hence this may be regarded as a note worthy attainment of present investigation.

4.3 Chemical characters of Soyshrikhand:

4.3:i Percentage acidity of Soyshrikhand:

The acidity character of soyshrikhand was analysed and results obtained are presented in Table 9.

It may be evidenced from this table that the acidity values ranged between 1.06 to 1.27 respectively in combinations of T₂ and T₅ i.e. 20 per cent soymilk combination and 50 per cent soymilk combination. The control T₀ behave intermittently in this two ends. The mean percentage acidity values recorded non significant differences excepting the one in case of T₃ which was significance over the rest valued at 1.20 per cent. It may be interpreted from the recorded observations that the acidity of soyshrikhand was the ultimately remained after the preparation of chakka, its incorporation with sugar and other ingredients i.e. condiments. Ganguli and Boman (1959) recorded the percentage acidity of chakka at 2.32. Earnest et al. (1968) observed the acidity of market chakka at 2.0 per cent.

Table 9 Percentage acidity of Soyshrikand

Replications Treatments	RI	RII	RIII	RIV	RV	Mean
T ₀	1.17	1.22	1.08	1.19	1.26	1.17
T ₁	1.18	1.21	1.26	1.09	1.16	1.16
T ₂	1.06	1.13	1.13	1.18	1.22	1.13
T ₃	1.17	1.21	1.12	1.25	1.26	1.20
T ₄	1.21	1.18	1.26	1.26	1.09	1.20
T ₅	1.18	1.13	1.15	1.11	1.27	1.17
S.E. \pm	0.02					
CD at 5%	0.06					

As could be expected ~~that the~~ acidity level of soyshrikand has been moderately lower over that of the Chakka. This may be attributed to the use of the soysolids in different combination though the milk sugar namely lactose has been present to certain extent in all the treatment combinations. It may not be ignored that the soysolids interms of soy carbohydrates including oligosaccharide i.e. Raffinose, Stachyose and Verbascose also had been contributing towards their effect on the availability of sugar for fermentation. It is experienced generally that the oligosaccharides of the vegetable sources are difficult to break down in to simpler compound i.e. reduced sugars which could acts as substrates for fermentation and subsequent production of lactic acid. The approach adopted included the utilization of mixed strain that comprised the component of *Lactobacillus bulgaricus*. Here it is essential to note the streptococci could have

acted in the first phase of fermentation utilising the available sugars to a specific level of around 0.91. The remaining part how ever might have been taken up through the fermentation of complex sugars. These further might have generated the reducing forms of basic glucose and galactose. Finally the present levels of acidity arrived may be regarded as a sum total of the complex changes that might have occurred in total carbohydrate strata of soychakka as well as soyshrikhand. It may be concluded therefore that through the incorporation of soysolids the acidity level in the final product could be attain in the moderate ranges and not towards very very acidic side. From the consumer point it could be noted therefore that the final level of acidity in the range of 1.15 to 1.20 could be acceptable quality.

4.3:ii P^H of Soyshrikhand:

The Soyshrikhand samples also analysed for there P^H characters. The results are depicted under Table 10.

Table 10 P^H of Soyshrikhand.

Replications Treatments	RI	RII	RIII	RIV	RV	Mean
T ₀	3.50	3.50	4.00	3.50	4.00	3.70
T ₁	3.50	3.50	3.50	4.00	3.50	3.60
T ₂	4.00	3.50	3.50	3.50	3.50	3.60
T ₃	3.50	4.00	3.50	3.50	3.50	3.60
T ₄	3.50	3.50	3.50	3.50	4.00	3.60
T ₅	3.50	4.00	3.50	3.50	5.50	3.60
S.E. ±	0.10					
CD at 5%	0.30					

It could be noticed from the observations that the P^H values occurred in the range of 3.5 to 4.0 respectively in the combinations from T_0 to T_5 i.e. 100 per cent cow milk and 50 per cent soymilk combination. It may also be visualised from the mean values that non significant difference did exist in all the treatments. The numerically higher value of 3.7 was registered for T_0 where as value of 3.6 occurred in all the rest of the combinations. The higher value noticed in T_0 may be extrapolated from the discussion under the earlier parameter of percentage acidity. This could mean therefore that the production of hydrogen ion was comparatively higher in the pure mixed combinations and therefore the lower values of P^H were observed in case of all the soycombined shrikhand samples. More over the P^H value of 3.7 was observed in case of T_0 . Here it is ground to believe that the mean P^H value of the cow milk shrikhand samples remains steady where as that of the soycombination passed further to the lower P^H . This could be attributed to the fermentation changes brought about in the oligosaccharide from soysolid which could subsequently have liberated the fermentable sugars conclusively. It may be affirmed that the proportionate presence of soysolids may help to improve the P^H characteristics of shrikhand.

4.3:ii Chemical composition of Soyshrikhand

The soyshrikhand samples were analysed for their chemical make up. The results obtained on composition are present under Table 11.

Table 11 Chemical composition of Soyshrikhand

Component(%) Treatments	Moisture	Total solids	Fat	Protein	Lactose	Ash	Sucrose content
T ₀	43.60	56.40	5.2	5.10	4.90	0.92	40.00
T ₁	43.18	56.82	5.1	5.86	4.50	0.88	40.00
T ₂	42.72	57.29	5.0	6.38	4.10	0.82	40.00
T ₃	42.32	57.68	4.8	7.10	3.60	0.72	40.00
T ₄	41.08	58.92	4.7	8.30	3.20	0.66	40.00
T ₅	39.96	60.04	4.5	9.50	2.60	0.56	40.00
S.E. ±	0.37	0.42	0.05	0.19	0.28	0.01	00.00
CD at 5%	1.08	1.23	0.17	0.57	0.83	0.03	00.00

Moisture :

It may be apparent from the data that the moisture contents ranged between 39.96 to 43.60 per cent respectively in case of T₅ and T₀ i.e. 50 per cent soymilk combination and 100 per cent cow milk shrikhand. Furthermore the mean moisture content varied non significantly. The observed values for the moisture content, seems to be slightly lowered than that of the traditional shrikhand.

The probable explanation for this could be given on the basis that the sucrose content was added under each

treatment at the rate of 40 per cent. What ever the free moisture content present in chakka could have been absorbed and retained in the form of a syrup of higher concentration, hence it may be likely that the moisture contents registered under this studies were in the specified ranges.

Total solids:

As regards the total solids it may be seen from the table, the values change from 56.40 to 60.04 per cent respectively in T₀ and T₅ i.e. 100 per cent cow milk and 50 per cent soymilk combination. The differences in the treatments were significant for this parameter over the control of T₀. It is interesting to note that the proportionate increases in the levels of total solids were observed with the addition of soysolids in each of the treatment combinations. Moreover the other major constituent that account for was the sugar content.

Fat:

The fat contents of soyshrikhand samples ranged between 4.5 to 5.2 per cent respectively under T₅ and T₀ i.e. 50 per cent soymilk combination and 100 per cent cow milk. The cow milk component exhibited significantly higher level of fat over that of soyproteins. This may be contrary to the expectations because certain amount of fat is present in soysolids. However it is likely that this fat might have remained least out during extraction are

Scale :

Y-axis: 1 cm = 1 %

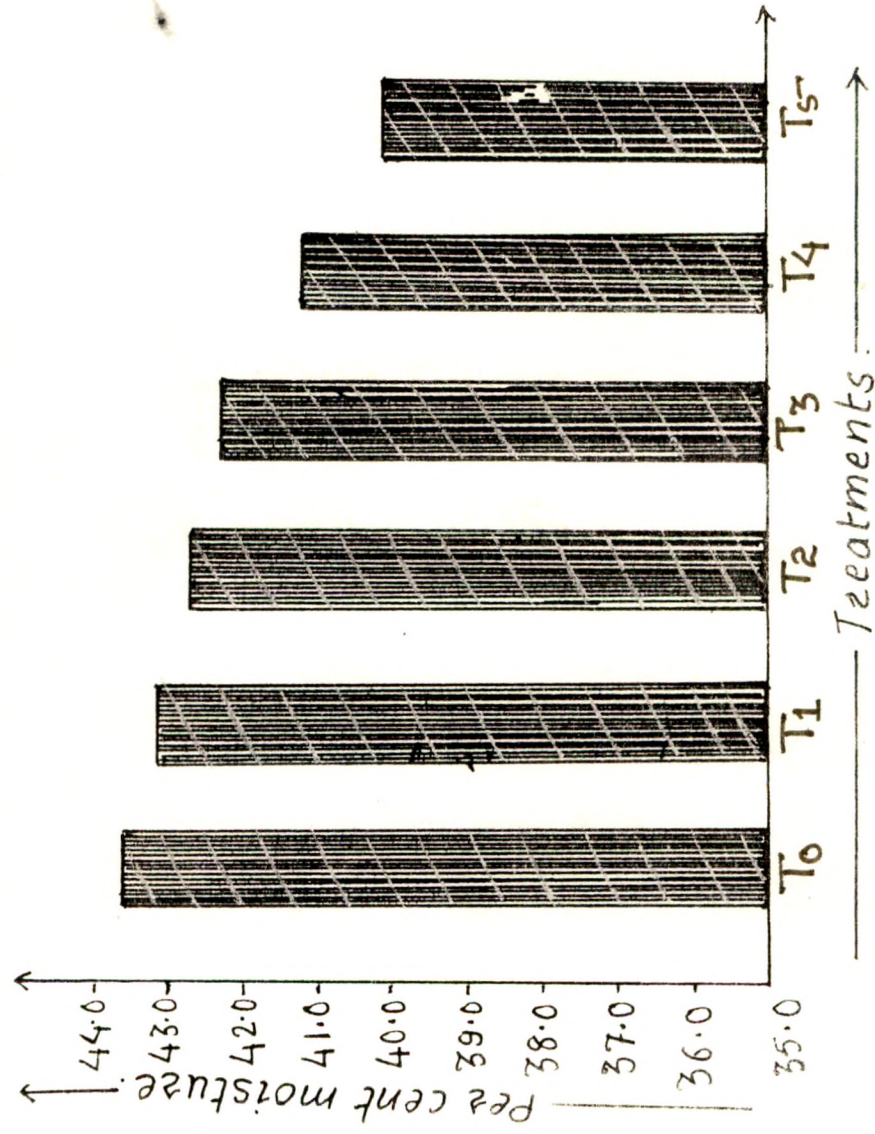


Fig-4: MOISTURE CONTENT OF

SOYSHRIKHAND

Scale :
Y-axis: 1 cm = 1 %

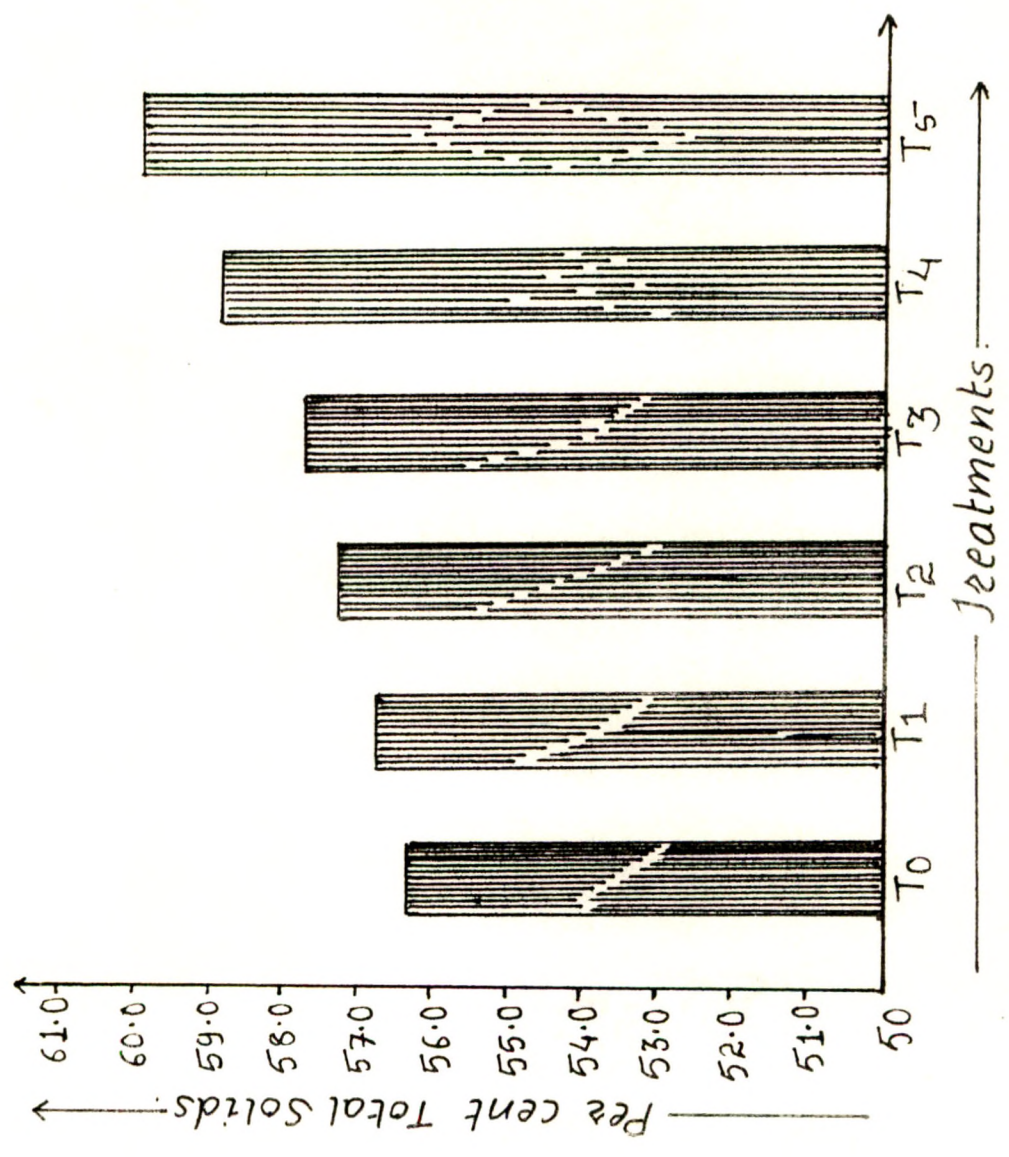


Fig-5: TOTAL SOLIDS CONTENT OF
SOYSHRIKHAND.

Scale :
Y-axis : 2cm = 1%

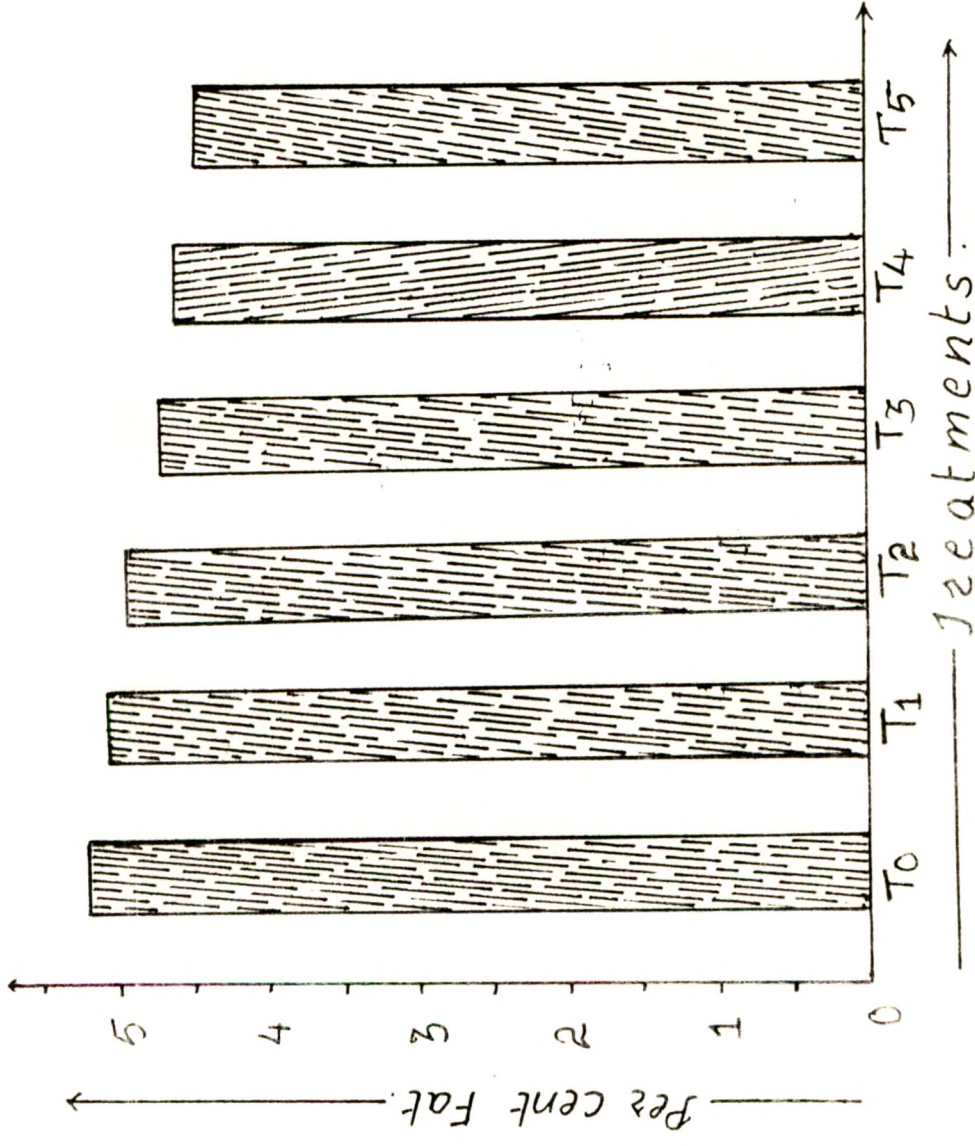


Fig-6: FAT CONTENT OF SOYSHRIKHAND.

Scale :
Y-axis: 1 cm = 1 %

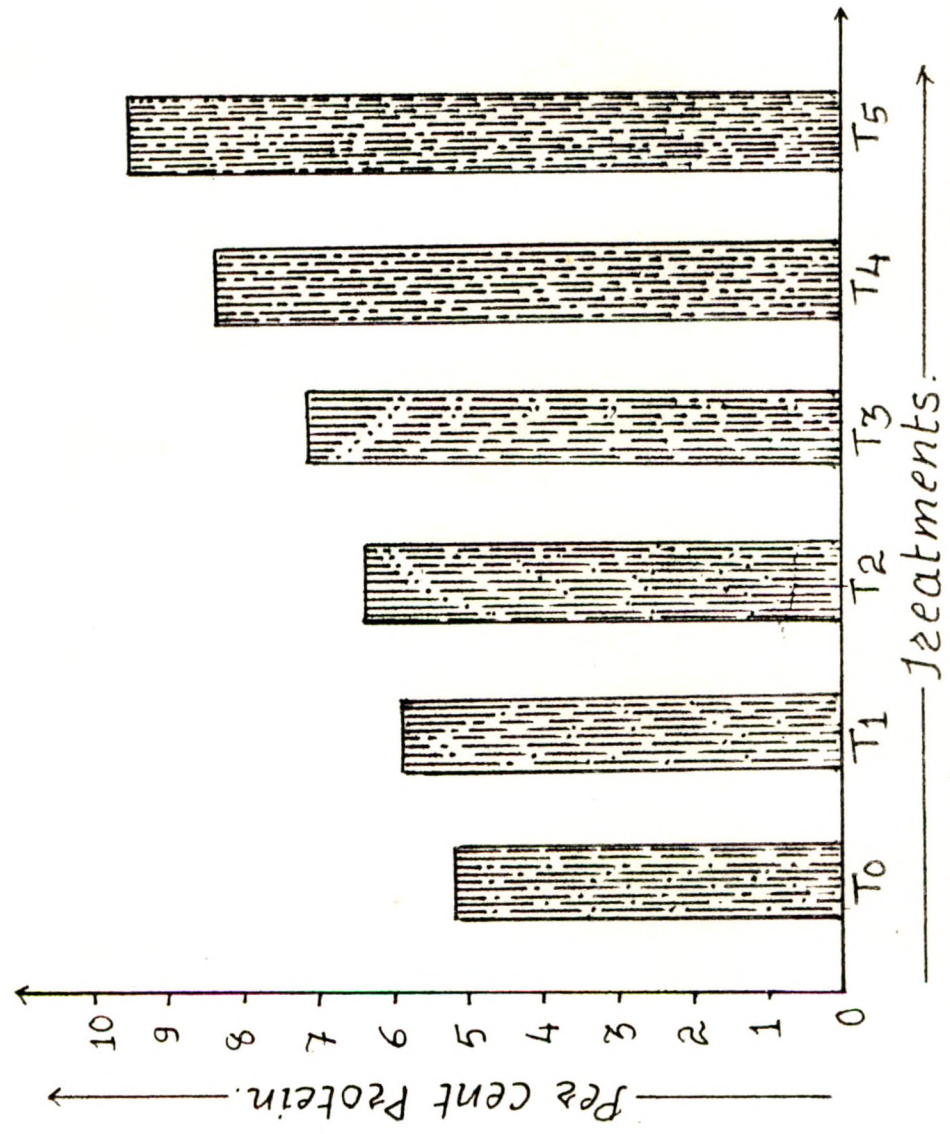


Fig-7: PROTEIN CONTENT OF SOYSHRIKHAND.

they separation. It could be taken an advantage that the levels of animal fat has been reduced at the same time the total fat content is increased as there is a presence of vegetable fat. In the last it is note worthy that there is presence of polyunsaturated fatty acids in the derived product of soyshrikhand. It is worthwhile to mention that the present trend is towards the lower dietary fat and moreover towards the consumption of higher amounts of unsaturated fat. This is rightly in the direction and attitude of people to avoid the danger of cholesterol from the saturated fatty acids as the product has been derived from cow milk. The cow milk fat is also of the softer type hence it may be advantageous for those suffering from "Atherosclerosis" and subsequent heart troubles.

Protein:

A glance on the protein content on Table 11 may reveal that the protein content ranged between 5.10 to 9.50 per cent respectively under the treatments T₀ and T₅. The treatment differences for this parameter were statistically significant. It may be mentioned that in case of T₅ (50 per cent soymilk combination) highest level of protein is present i.e. 9.5 per cent.

What ever the differences in the protein contents are observed might have been due to the increased levels of soysolids under various treatments.

Lactose :

The lactose contents occurred in the range of 2.6 to 4.9 per cent respectively under the treatment T₅ and T₀ i.e. 50 per cent soymilk combination and 100 per cent cow milk. It may be observed from the data that the significantly difference is noticed with regards to lactose content. The possible explanation for a shift of the lactose content towards the lower side with increase level of soymilk incorporation may be given to the statement that the contents were dropped with the increase in the soysolids. The lactose is the unique sugar of the animal kingdom and hence observed nature.

Ash :

The ash contents range between 0.56 to 0.92 per cent respectively in case of T₅ and T₀ i.e. 50 per cent soymilk combination and 100 per cent cow milk. It may be evidenced from the data that the treatment means differed significantly. The trend noticed was a higher proportion of ash present with the higher level of milk solids. This is indicative of the richer status of milk and milk products from the point of ash content or in other words mineral matter. It is worth while there fore to bring about a uniform blending of dairy base i.e. cow milk chakka along with the vegetable protein base i.e. soymilk chakka, so that desired effect could be obtained. Bhattacharya et al. (1972) reported the composition of shrikhand and shrikhand powder. They noted moisture 55-60 per cent and 2

Scale :
Y-axis: 1 cm = 0.5 %

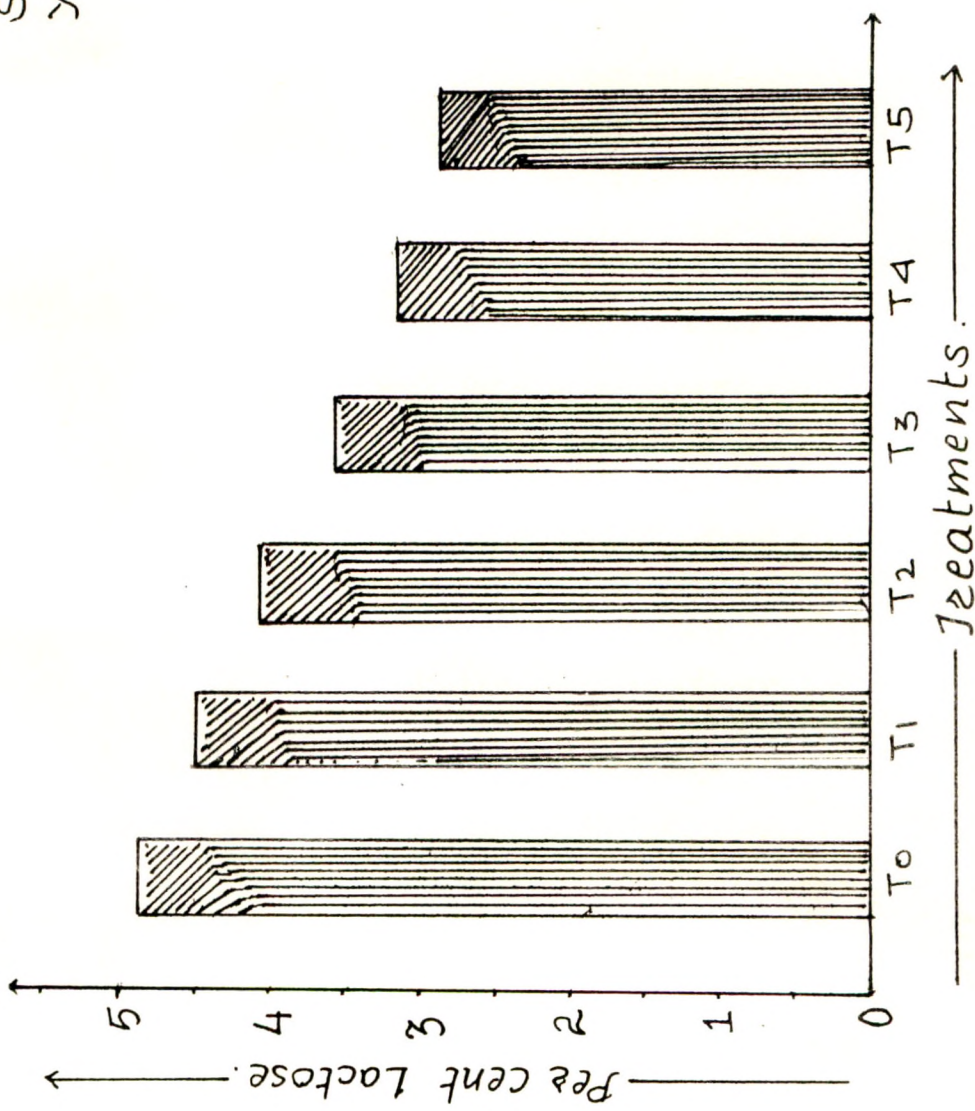


Fig-8: LACTOSE CONTENT OF SOYSHRIKHAND.

Scale:

Y-axis: 1 cm = 0.1%

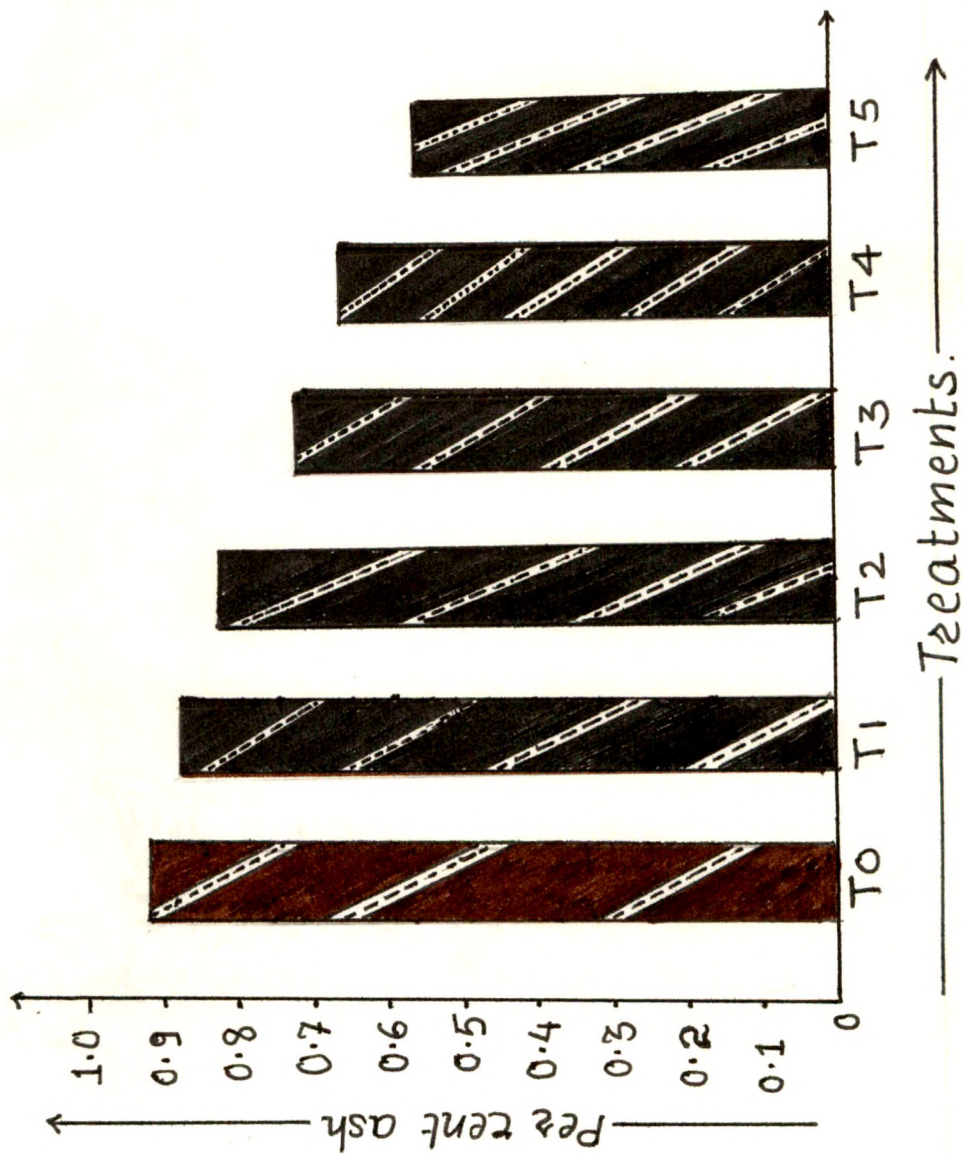


Fig-9: ASH CONTENT OF SOYSHRIKHAND

to 3 per cent respectively. It consist of total solids 40 to 45 per cent and 97 to 98 per cent respectively under the shrikhand and shrikhand powder. Aneja et al. (1977) developed industrial process for shrikhand preparation and prepared shrikhand had on an average 5 per cent fat, 42 per cent sugar and 60 per cent total solids.

4.4 Microbiological study of Soyshrikhand:

4.4:i Standard plate count (SPC) of Soyshrikhand:

The microbiological examination of the soyshrikhand samples was conducted. The first parameter in that was studied that of standard plate count employing the potato dextrose Agar media. The results obtained are presented under Table 12.

Table 12 Standard plate count of Soyshrikhand.

Treatments	SPC/gm (10^3)
T ₀	24.50
T ₁	24.35
T ₂	24.30
T ₃	24.55
T ₄	24.40
T ₅	24.65
S.E. ±	26.61
CD at 5%	77.68

It may be evidenced from the data that the maximum value of 24.65×10^3 was registered in case of T₅ where as

the minimum value of 24.30×10^3 was observed under T₂ as such though the differences were statistically significant from the microbiological point of view the values seems to be of lesser differences. The significantly lower value of T₁ or T₂ might be due to the replacement of milk solids interms of soymilk solids. At the lower level however the microbes seems to have regained their growth characteristics with increasing proportions of soymilk solids in the derived products of soyshrikhand hence the maximum value was reached or SPC under T₅. Upadhyay and Dave (1977) reported the need for formulation of chemical and bacteriological standards for the shrikhand was emphasized.

4.4:ii Coliform count of Soyshrikhand

The coliform count of soyshrikhand was also taken up as quality control test and the mean observations obtained are recorded under Table 13.

Table 13 Coliform count of Soyshrikhand

Treatments	Coliform count /gm
T ₀	9.00
T ₁	8.00
T ₂	9.00
T ₃	9.00
T ₄	7.00
T ₅	6.00
S.E. \pm	0.58
CD at 5%	1.69

It may be noticed from the contents of this table the values changed from 6 to 9 per gram further more the differences were statistically non significant within treatments. However the treatments T₄ and T₅ exhibited superior values at 7.0 and 6.0 over that of control.

The possible explanation for such a change in the growth behaviour of coliform organisms may be given in the terms that the higher levels of milk solids seem to be better suited for the growth of such organisms. However with increased levels of soymilk solids these seems to be the reverse trend of coliform count. The observed numbers might have been obtained due to the exposures of the product during draining off or other processings. However it is encouraging to note that the observed values were within the range of standard coliform count recommended for various food /dairy products.

4.5 Preliminary observations on the storage of Soyshrikhand:

The preliminary studies were conducted on the storage quality of newly developed product soyshrikhand and the mean observations obtained are recorded under Table 14.

Table 14 Preliminary observations on the storage quality of soyshrikhand

Treatments	Ambient temp. 35°C		Refrigerated temp. 5-10°C	
	Glassjar (hours)	Poly_ propylene coated cups (hours)	Glassjar (hours)	Poly_ propylene coated cups (hours)
T ₀	14	18	240	242
T ₁	17	20	251	256
T ₂	18	21	259	265
T ₃	20	22	265	273
T ₄	22	24	272	282
T ₅	22	25	288	300

For the storage of soyshrikhand two types of packages are used i.e. glass jar and polypropylene coated cups each of 200 gm capacity. These were stored under ambient conditions of (35°C) and refrigerated conditions of (5-10°C). The results entered in Table 14 indicate that the minimum storage period in control was 14-18 hrs in both packages where as the treatment T₅ could be stored well up to 22-25 hrs in either of the cases. Under refrigeration conditions the average storage period was 240 and 242 hrs for T₀ and 288 and 300 hrs for T₅ in glass jar and polypropylene coated cups respectively.

4.6 Economics of production of Soyshrikhand

The soyshrikhand was prepared employing different treatment combinations. It was during the course of investigation, the treatment T₅ proved to be of significant desired characters from the stand point of sensory qualities as well as the yield characters. It was though worthwhile there fore to work out the cost of production. The details have been given under Appendix I.

The major item of cost included the cost of soymilk for Rs.3; cost of milk at the rate of Rs. 8 and other costs were Rs. 2. So the cost of the dahi from the combination was 13 Rs./kg.

As far the cost of soyshrikhand the component cost included the cost of soychakka per kg Rs. 13, cost of sugar (40 per cent) Rs. 3, cost of condiments Rs.4 and cost of package Rs.5. This was summed up to Rs. 25 per kg. Hence it may be inferred that the cost of production was Rs. 25 per Kg. A marginal profit of 20 per cent may be added at the rate of Rs. 5 per Kg.

Hence it is concluded that the cost of the product of soyshrikhand was only Rs.30 per Kg. A comparison of market prices for similar products could revealed that any milk products of similar nature could cost around 45-50 Rs. per Kg.

Hence the developed product could be economical to suppliment the dairy food needs of the consuming population.

A decorative border consisting of a vertical strip on the left and a horizontal strip at the bottom, both featuring a repeating floral or scrollwork pattern.

***Summary
and Conclusion***

CHAPTER V

SUMMARY AND CONCLUSION

The research work carried out on the formulation of soyshrikhand can be summarised under following points.

1. The *Streptococcus lactis*, *Streptococcus lactis* sub spp. *diacetylactis* and *Lactobacillus bulgaricus* all in equal proportion proved to be a suitable starter culture for the production of soydahi at 34^oC incubation temperature and by draining of soydahi soychakka was produced. The mean yield of soychakka from the combination of milk and soymilk dahi (50:50) was 365 gms/litre.
2. On an average with the addition of 40 per cent sugar a recovery of 511 gms of soyshrikhand was obtained.
3. The T₅ combination (50:50) with the incorporation of saffron colour, elaichi flavour and lemon flavour resulted in to a very acceptable product with consumer preference for its colour, flavour, sweetness, consistency and mouthfeel characters.

4. The overall acceptability indicated better likings in case of treatment T2 i.e. 20 per cent soymilk and 80 per cent milk solids. This was at par with T₅ i.e. 50 per cent replacement so far as the overall acceptability in terms of all the sensory characters **were** considered.
5. The per cent acidity was on an average at 1.17 for the combination T₅. The lowest value was 1.13 at T₂.
6. The pH values varied slightly with a narrow range of 3.60 to 3.70.
7. The average chemical composition of the treatment T₅ was moisture : 33.96, Total solids : 60.04, Fat : 4.5, proteins : 9.50, lactose : 2.60, ash : 0.56 and sucrose content at 40 per cent **respectively.**
8. The Standard plate count of soyshrikhand was on an average 24.65×10^3 in case of T₅.
9. The coliform count recorded value of 6.0 in the treatment T₅ of soyshrikhand per gram.

10. The average storage period under the packaging of glass jars and polypropylene coated cups was 22-25 hrs. respectively under ambient condition for T₅, whereas refrigeration conditions enhanced keeping quality upto 298-300 hrs. under similar packages.
11. The cost of production of soychakka was Rs.13 per kg. The soyshrikhand cost was arrived at Rs.25 per kg. on the basis of production cost. The nominal profit if added the soyshrikhand was ready for sale at the rate of Rs. 30 per kg. It was substantially cheaper than the conventional shrikhand .

CONCLUSION

A combination of 50:50 cow milk solids + soymilk solids with the addition of 40 per cent sugar and normal colour and flavourings resulted in to a very acceptable product namely soyshrikhand. This had a lower fat of 4.5 and higher protein of 9.5 per cent which could be a plus point. The product had a fairly long keeping quality under refrigeration conditions with suitable package up to higher than 12 days. The cost of sale of soyshrikhand was Rs. 30 per kg which was cheaper than that of conventional shsrikhand.



Literature Cited



LITERATURE CITED

Acharya, P.M. (1989). Need for greater impetus. The Hindu survey of Indian Agriculture. pp:225-227.

* Aneja, R.P.; Vyas, M.N.; Nanda, K. and Thareja, V.K. (1977). Improvement in or relating to a method of Separating the solids contents known as "Maska" or "Chakka" from curd and preparing a milk based sweet known as shrikhand out of the said "Maska" or "Chakka", Indian patent opp. no. 142-162.

Aneja, R.P.; Vyas, M.N.; Nanda, K. and Thareja, V.K. (1977). Development of an industrial process for the manufacture of shrikhand. J. Fd. Sci. Technol. 14:159-163.

Anon (1969). Fd. Engr. 41:48.

A.O.A.C. (1965). Official method of analysis 11th Edn. Assoc. official analytical chemists. Washington 4 D.C.U.S.A.

Arora, S. and Mital, B.K. (1991). Preparation and evaluation of soypaneer. J. Fd. Sci. Technol., 28(1):15.

Atreja, S.K. and Deodhar, A.D. (1987). Nutrient status during Shrikhand making. J. Fd. Sci. Technol. 24(5): 166-167. ✓

Babje, J.S.; Rathi, S.D.; Ingle, U.M. and Syed, H.M. (1992). Effect of blending soymilk with buffalo milk on qualities of paneer. J. Fd. Sci. Technol. 29(2):119-120.

Baisya, R.K. and Bose, A.N. (1975). Role of inoculating organisms on the physico-chemical changes of milk and on final curd (dahi) quality. J. Fd. Sci. Technol. 28(3): 179-183. ✓

Bardale; P.S. Waghmare; P.S. Zanjad, P.N. and Khedkar, D.M. (1987). The preparation of shrikhand like product from skim milk chakka by fortifying with fruit pulp. Ind. J. Dairy Sci. 49:711. ✓

- Bedenhop, A.A. and Hackler, L.R. (1971). Effect of soaking soybeans in sodium hydroxide solution such as pretreatment for soymilk production. Cereal science 18:84-86.
- * Bertelson, E.; Ljunggren, B. and Mattson, N. (1961). Dairy Sci. abstr. 24:977.
- * Bhattacharya, D.C.; Tiwari, B.D.; Balchandaran, R. and Ghodekar, D.R. (1971). N.D.R.I., Amul report. pp 145.
- * Bhattacharya, D.C.; Mathur, D.N.; Tiwari, B.D.; Balchandran, R. and Srinivason, M.R. (1972). Studies on methods of production of shrikhand and shrikand powder. N.D.R.I., Amul report. pp : 167-168.
- Boghra, V.R. and Mathur, O.N. (1992). Chemical quality of some marketed indigenous milk products, major constituents and mineral composition of shrikhand. J. fd. Sci. Technol. 29 (2) : 121-122.
- * Bogdanova, G. and Novoselova, L. (1962) Md. prom. 23 (11): 16-17.
- Chakraborty, B.K. (1978). Process of innovations in selected Indian dairy products. Indian Dairyman. 30 : 619-628.
- * Chakraborty, B.K. (1986). Process of innovation in selected Indian dairy products. XX International dairy congress conference. pp : 10.
- Chakrabarti, S.R. and Gangopadhyay (1990). Innovation of Rasogolla analogue from soymilk. J.Fd.Sci. Technol. 27 (4) :224.
- Choudhari, A.G. (1959). Practical Dairy science and Laboratory Scientific Book Agency, culcutta publication methods pp : 65.
- Choudhary, A. and Atreja, S.K. (1986). Growth promoting ability of chakka. Ind. J.Dairy Sci., 39(3) : 247-250.
- * Chopra, R. and Prasad, D.N. (1990). Lactic fermentation in soymilk blended with buffalo milk. Brief communication of the XXIII Internation Dairy congress.
- Dave, R.I., Dave, J.M. and Sannabhadti, S.S. (1992). Antibacterial activity of Buffalo milk Dahi

prepared using Streptococcus thermophilus strains as starter culture. Ind. J. Dairy Sci., 45 (11) : 607-610.

- De, S.S. and Subrahmanyam (1945). Processing of soybean for production of milk. Current Sci., 14 : 204-205.
- Deka, D.D. and Rajor, R.B. (1988). Manufacture of Dahi like product from soybean and butter milk. Ind. J. Dairy Sci. 41 (4) : 474-477.
- Desai, H.K.; Vyas, S.H. and Upadhyay, K.G. (1985). Influence of homogenisation of milk on the quality of chakka and shrikhand. Ind. J. Dairy Sci. 38 (2) : 102.
- * Earnest, P.C.; Sharma, U.P.; Laxminarayana, H. and Paul, T.H. (1968). Studies on the manufacture of shrikhand. 5th Dairy Industry Conference. Hyd. 2.9, 24.
- * Escuenta, E.E. and Benzon, J. (1977). Preextraction boiling of soybeans as a pretreatment in soymilk preparation. Philippines Agriculturist, 61 : 104-114.
- Gandhi, N.K. and Jain, S.C. (1977). A new high protein fermented food using buffalo milk. J. fd. sci. Technol. 14 : 156-158.
- Ganguly, S. and Boman, T.J. (1959). Chemical composition of chakka. Ind. J. Dairy Sci. 12 : 121-124.
- Gupta, S.K. (1976). Sensory evaluation in food industry. Ind. Dairyman 28 (7) : 293-295.
- Hsu, S.H.; Hadley, H.H. and Hymonitz, T. (1973). Changes in carbohydrate content of germinating soybean seeds. crop Sci. 13 : 407.
- Ingle, U.M. and Jogtekar, N.V. (1974). Effect of fat and sugar variation on acceptability of shrikhand preparation. J. fd. Sci. Technol. 11 : 189-190.
- I.S.I. (1961). IS :1479 (part I), 29-31.
- I.S.I. (1962). Indian standards Institution, New Delhi.
- I.S.I. (1964). Indian standards Institution, New Delhi IS :2765 : 8.
- I.S.I. (1981). Hand book of food Analysis of Dairy

products (part-XI). Indian standards institution,
Manak Bhavan, New Delhi.

- I.S.I. (1986). Indian standards Institution, New Delhi.
- Jadhav. P.E., Kulkarni, M.B. and Narawade, V.S. (1991). Factors influencing mineral content of chakka whey. Indian J. Dairy Sci., 44 (8) :510-513.
- ✓Joglekar, N.V. (1973). Studies on standardization of shrikhand preparation. M.Sc. (Agri) Thesis, M.A.U. PBN.
- Kadam. S.J.; Bhosale, D.N. and Chavan, I.G. (1984). Studies on preparation of chakka from cow milk. J. fd. Sci. Technol. 21 (3): 180-182.
- Katra. R.V. and Bhargava, V.N. (1990). Production of Rasogolla from cow milk containing different levels of soymilk. Animal J. Dairy Res. 9 (4) :175.
- Kawai. H.; Tokato, S. and Kaneshi, T. (1990). Proximate composition and content of minerals, linolenic and Tocopherols in soymilk J. Japanese Society fd. Sci. Technol. 37 (4) :293-297.
- ✓Kahate, P.A. (1991). Studies on paneer from blends of soymilk and Buffalo milk. M.Sc. (Agri) Thesis, P.K.V. Akola.
- Kulkarni, M.B.; Chavan, I.G. and Belhe, N.D. (1987). Chemical composition of chakka whey., Ind. J. Dairy Sci. 40 (1) : 65-69.
- Lang, F. and Lang, A. (1973). Fd. Manuf. 48 :23.
- Mahajan. B.M.; Mathur, O.N.; Bhattacharya, D.C. and Shrinivasan, M.R. (1979). Production and shelf life of spray dried shrikhand powder. J. fd. Sci. Technol. 16 : 9-11.
- Marshall, V.M. (1987). Lactic acid bacteria: starters for flavour. FEMS microbiology Reviews, 46 (3) : 327-336.
- Mittal, B.K.; Shallenberger, R.S. and Steinkraus, K.H. (1973). L. galactosidase activity of lactobacilli. Appl. Microbiol. 26 : 783.
- Nasim, M.; Mittal B.K. and Tyagi, S.M. (1986). Development of a process of preparation of soypaneer. J. fd. Sci. Technol. 23 : 69.
- Nelson. A.I.; Steinberg, M.P. and Wei. L.S. (1976).

Illinois process for preparation of soymilk J. fd. Sci. 41 : 57.

- Oguntunde, A.O. and Akintoye, D.A. (1991). Measurement and comparison of density, specific heat and viscosity of cow's milk and soy milk. J.f.d. Enggr. 13 (3) : 221-230.
- * Orihara, O.; Sakauchi, I. and Nakazawa, Y. (1992). Types and standards for fermented milk and lactic drinks. In functions of fermented milk challenges by health services edited by Nakazawa, Y. and Hosono, A. London (U.K.) Elsevier applied publication. As cited in Dairy Sci. abstr. 1992 54 (12).
- Panse, V.G. and Sukhatme, P.V. (1967). Statistical methods for Agricultural workers. 2nd Ed. ICAR, New Delhi.
- Patel, A.A. and De, S. (1979). Dried Indigenous milk and milk products; prospective for the future. Ind. Dairyman, 31 : 79-82.
- Patel, J.R., Dave, R.I., Sannabhatti, S.S. and Dave, J.M. (1989). Effect of selected lactic cultures on beany flavour in soy curd. Indian J. Dairy Sci. XLII (2) : 230-234.
- * Poulsen, P.R. (1970). XXIII Int. Dairy cong. Sydney. IE40g.
- * Prajapati, J.P.; Upadhyay, K.G. and Desai, H.K. (1990). Effect of post production heat treatment on storageability of "Shrikhand". In brief communication of the XXIII Int. Dairy cong.
- * Prajapati, J.P.; Upadhyay, K.G. and Desai, H.K. (1990). Effect of post production heat treatment on microbiological quality of "Shrikhand". in Brief communication of the XXIII Int. Dairy cong.
- Prakash, C.; Sharma, S.P. and Mulay, C.A. (1975). Utilization of soymilk in flavoured milk preparation, J.Fd. Sci. Technol., 12 (4) : 163-165.
- * Puntambekar, P.M. (1968). Studies on the level of fat and sugar on the quality of Shrikhand and estimation of fat by modifying the Gerber's test for milk. M.Sc. (Agri) Thesis, Institute of Agril. Anand.
- Reddy, K.K.; Pasha, M.; Rao, B.V. and Rao, T.J. (1984). studies on production and quality of shrikhand from buffalo milk. Ind. J. Dairy Sci. 37 (4)

:293-296.

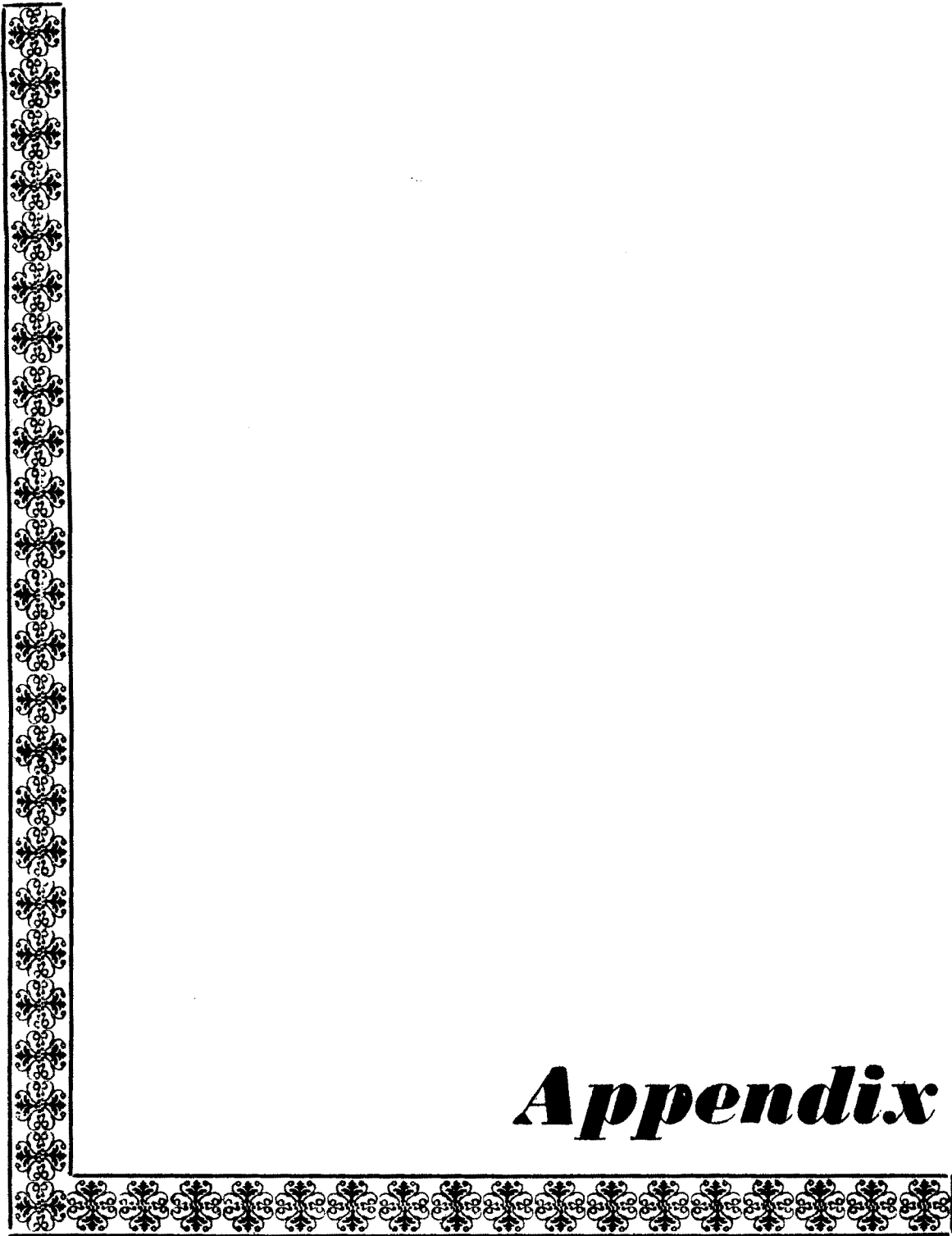
- Reddy, R.V. and Mital, B.K. (1992). Physical and chemical characteristics of soy milk. *J.Fd. Sci. Technol.* 29 (3): 193-194.
- * Shallenberger, R.S.; Hand, D.B. and Steinkraus, K.H. (1967). Changes in sucrose, raffinose and stachyose during the tenpel fermentation. Report of 8th Bean Res. Conf. Bellair. ARS. 74-41 USDAP-68.
- Sharma, U.P. and Zariwala, I.T. (1978). Survey of quality of milk products in Bombay. *J.Fd. Sci. Technol.* 15 : 118-121.
- Sharma, U.P. and Zariwala I.T. (1980). Deterioration of shrikhand during storage. *Ind. J. Dairy Sci.* 33 :223-231.
- Sharma, D.K. and Reuter, H. (1992). Employment of ultrafiltration using ceramic membrane model for the preparation of shrikhand. *Ind. Dairyman.* XLV (4) :132-134.
- * Shehata, A.E.; Magdoub, M.N.I.; Elsamaragy, Y.A.; Mohammad, N.H., and Nageib, M. (1984). Growth ability and activity of some lactic acid bacteria in soy milk. *Annals of Agril. Sci. Ainshams Univ. Cairo (Egypt).* 29 (2) : 779-792.
- Srinivasan, M.R. and Banerjee, B.N. (1946). Various aspects of manufacturing Indian dahi. *Ind. J. Vet.Sci.* 16 :72.
- Singh, G. (1987). Nutritious soybean. *Ind. farmers digest.* XX (12) : 37-39.
- Sugimoto, H. and VanBurell, J.P. (1970). Removal of oligosaccharids from soy milk by an enzyme from soy milk by an enzyme from *Aspergillus saitoi*. *J. Fd. Sci.* 35 :655.
- Troller, S.A. (1982). *Dairy Sci. Abstr.* 44 : 789.
- Umakapoor, Datta, I.C. and Qudri, M.H. (1977). Note on chemical analysis and acceptability of soymilk. *Ind. J. Agric. Sci.* 47 :475-476.
- Upadhyaya, K.G.; Vyas, S.H.; Dave, J.M. and Thakar, P.N. (1975). Studies on the chemical composition of market samples of shrikhand. *J.Fd. Sci. Technol.* 12 : 199.
- Upadhyaya, K.G. and Dave, J.M. (1977). Shrikhand and its

technology. Ind. Dairyman, 29 :487-490.

Upadhyay, **K.G.**; Dave, J.M. and Sannabhadti, S.S. (1985). Chemical changes in stored shrikhand, their measurement and relationship with organoleptic quality. J.Fd. Sci. Technol. 22 (3) :185-190.

* Wolf, W.J. (1975). J. Agric. Fd. Chem. 23:136 as cited by Patel, J.R.; Dave, R.I. (1989). Effect of selected lactic cultures on beany flavour in soy curd. Ind. J. Dairy Sci. 42(2): 230-234.

* Originals not seen.



Appendix

APPENDIX I

Economics of production of soyshrikhand

A. Cost of milk :

1. Cost of cow milk : Rs.8.00/ litre
2. Cost of production of soymilk
 - Cost of soybean : Rs.8.00/ kg.
 - Quantity of soymilk : 4.00 lit/kg of soybean obtained
 - Cost of soymilk : Rs.2.00/ litre
 - Other charges : Rs.1.00/ litre
(Electric, labour)
 - Total cost of production of soymilk : Rs.3.00/ litre

B. Combination of soymilk and cow milk :

1 litre of cow milk + 1 litre of soymilk : 2 litre milk
i.e.(50:50)

Sugar added at the rate of 5 per cent i.e. 100 gm.

Cost of the sugar : Rs.1.00

C. Cost of dahi produced from combination

- 1 litre cow milk : Rs. 8.00
- 1 litre soymilk : Rs. 3.00
- Others
 - i) Sugar : Rs. 1.00
 - ii) Cultures : Rs. 1.00
- Total cost of Dahi : Rs. 13 per 2 kg of Dahi

. **Yield of soychakka :**

The soychakka produced from 1 litre of milk combination : 365 gm

So from 2 litre milk combination : 730 gm

: \approx 700gm

E. Cost of Soyshrikhand :

a. i) The sugar added at the rate of 40 per cent i.e. 300 gm sugar is added for the 700 gm of soychakka.

The cost of the sugar : Rs 3.00

ii) Soyshrikhand contents condiments, colour, essence and the cost of these was Rs.4.00/kg of soyshrikhand.

iii) Packaging of soyshrikhand in polypropylene coated boxes, the cost of packaging : Rs. 5/kg

b. Yield of soyshrikhand :

Soychakka	+	sugar	=	Total
700 gm		300 gm	=	1000 gm i.e. one kg.

c. Total cost of production of soyshrikhand :

Soychakka	+	sugar	+	condiments	+	package	=	Total
13.00		3.00		4.00		5.00		Rs.25/kg of soyshrikhand

Total cost of production + Marginal profit @ 20 % = sale cost

25	+	5	=	Rs.30/kg
----	---	---	---	----------