STUDIES ON THE DEVELOPMENT OF PROCESS FOR THE PREPARATION OF INSTANT LASSI

BY

SHRI. SANJAY RAMCHANDRA HINGMIRE

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DISSERTATION

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CANDIDATE'S DECLARATION

I hereby declare that this dissertation or
part thereof has not been submitted
by me to any other University
or Institution for a
degree or diploma.

PARBHANI

Date :25/10/1996

(HINGMIRE S.R.)

Dr. A.F. Lembhe,
Ph.D.
Professor of Dairy Science,
College of Veterinary and
Animal Sciences, M.A.U.,
Parbhani- 431 402 (M.S.)

CERTIFICATE - I

Shri. SANJAY RAMCHANDRA HINGMIRE has satisfactorily prosecuted his course of research for a period not less than two semesters and that the dissertation entitled, "STUDIES ON THE DEVELOPMENT OF PROCESS FOR THE PREPARATION OF INSTANT *LASSI*" 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.

Date :25/10/1996.

(Dr. A.F. Lembhe)
Guide

CERTIFICATE -II

This is to certify that the dissertation entitled "STUDIES ON THE DEVELOPMENT OF PROCESS FOR THE PREPARATION OF INSTANT *LASSI*" submitted by Shri. SANJAY RAMCHANDRA HINGMIRE to the Marathwada Agricultural University in partial fulfilment of the requirement for the degree of "MASTER OF VETERINARY SCIENCE" in the subject of DAIRY SCIENCE has been approved by the students advisory committee after oral examination in collaboration with the external examiner.

(External Examiner)

(Dr. A.F. Lembhe)
Guide

Head of the Department

(Dr. M.K. Sawant)

Dean (Veterinary)

(Dr. S.D. Rathi)

(Dr. P.N. Zanjad)

(Dr. R.K. Ambadkar)

ADVISORS

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CONTENTS

INTRODUCTION

Chapter 1

INTRODUCTION

Lassi is the byproduct obtained by churning the curdled whole milk with crude indigenous devices during the production of *desi* butter (De, 1993). It can be prepared by fermenting cow or buffalo milk, beating the coagulum followed by the addition of sugar and/or salt. In northern parts of India, it is also called as *chhas* or *matha* and is used as a refreshing drink for quenching thirst particularly in the summer season after the addition of ice, sugar or salt with or without flavours. It is similar to the western buttermilk which is obtained as the byproduct in the manufacture of creamary butter, and consumed in various forms viz. as plane buttermilk, salted and spiced buttermilk and also used in the preparation of *curry* or *kadhi*. It is estimated that in India about 2.07 million tonnes of buttermilk was utilized in one or the other form during 1992-93 (Goel and Choudhary, 1996).

Creamary "buttermilk" of the western countries merely represents the watery residue from the churned cream, while the Indian *lassi* is prepared by fermenting the whole milk from which only the butterfat is removed. Thus the latter is richer in protein, lactose and

milkfat which forms a valuable humman food, while the former is commonly included in the animal feed.

The fat content of *lassi* may vary with the type of milk used. In *lassi*, milk proteins are in coagulated forms and therefore are easily digestible. Lactose and fat are good source of energy. As some of the lactose is converted into lactic acid during fermentation, it gives slight sour taste which increased the palatability. Production of lactic acid also enhances its shelflife in comparision to the whole milk. *Lassi* is also considered as a good source of calcium, phosphorus and other minerals.

The method of preparation of *lassi* differs from place to place. The traditional method of *lassi* preparation is cumbersome and time consuming as it involves fermentation of milk using lactic culture till the desired level of acidity is reached. The fermentation requires atleast 12 to 16 hours. The quality of traditionally prepared *lassi* is influenced by the type and composition of milk used, type of culture, temperature and time of incubation and addition of sugar and/or salt. The propagation and maintenance of bacterial cultures are the most important prerequisites in the preparation of good quality *lassi*. The use of

direct acidification of milk in the manufacture of *lassi* would not only alleviate these problems but would reduce the processing time considerably which inturn would help in reducing the cost of production.

The dairy scientists for the past many years have been trying to develop a chemical and/or biochemical alternative to starters in the manufacture of dairy products. There are reports of manufacturing quality dairy products like *dahi*, yoghurt, sour cream *chakka* and *srikhand* and other beverage by direct acidification technique. Direct acidification of dairy products was started on a commercial scale in 1962 (Little, 1967). Sour cream was the first product produced by this method. Recently some of the acidulants viz., lactic acid, citric acid, phosphoric acid and hydrochloric acid have been tried individually or in combination for the manufacture of directly acidified milk beverage (Pagote and Balchandran, 1995).

As a result of fast changing social values and attitudes, the Instant foods are becoming more popular and their marketing is increasing widely. Direct acidification may offer an opportunity in the manufacture of milk based instant products in Dairy Industry. Therefore an attempt has been made to develop

a product called as Instant *lassi* with the following objectives :

I) To evole a process for the preparation of Instant *lassi* by direct acidification of milk using different sugar levels at different pH.

II) To study the effect of synthetic flavours as a means of improving the overall acceptability.

III) To study physicochemical properties of the product.

REVIEW OF LITERATURE

Chapter 2

REVIEW OF LITERATURE

2.1 *LASSI*

Lassi, refers to *desi* buttermilk, is the byproduct obtained by churning curdled whole milk with crude indigenous devices during the production of *desi* butter (De, 1993).

2.2 BUTTERMILK

Buttermilk is a byproduct obtained by churning the cream for butter making. Desi buttermilk is a byproduct obtained by churning whole milk curd during the production of *desi* butter/*makkhan*. Both of these are referred as natural buttermilk (De, 1993).

De (1993) also defined cultured buttermilk which is obtained by inoculation and incubation of pasteurized skim milk with lactic starter.

Creamary "buttermilk" of the western countries merely represent the watery residue from the churned cream (Rangappa and Acharya, 1975).

2.3 COMPOSITION OF *LASSI*/BUTTERMILK

Keenan *et al.* (1968) studied the quality of commercial buttermilk from regional dairies. Large variations in flavour score and concentration of

acetaldehyde, diacetyl and volatile acidity were noticed. The observations of the aforesaid survey indicated that the buttermilk with 0.84 titratable acidity had maximum flavour score.

Bodine and Martine (1979) reported the consumers acceptance of sweetened flavoured buttermilk. Buttermilk was prepared from pasteurized skim milk (9 % SNF) using one per cent inoculum of commercial lactic culture and incubated for 14,16 and 18 hours to obtain buttermilks of different acidities. The acidities of these buttermilk were 0.80, 0.87 and 0.96 per cent respectively. The flavours of raspberry, peach and blue berry were accepted at all concentrations and acidities. The lemon flavoured product (natural fruit) was more acceptable at low acidities, whereas peach flavoured and black berry flavoured product, at higher acidities.

Laxminarayana and Shankar (1980) gave the composition of *lassi*, with lactic acidity 0.5 to 1.0 per cent. Fat, protein, lactose contents were 0.1 to 1.0, 3.4 and 5 per cent respectively. The moisture content was 90.0 per cent and ash 0.7 per cent.

Chemical analysis of *lassi* samples revealed that the moisture, fat, protein, lactose and ash content were 96.2, 0.8, 1.3, 1.2 and 0.4 per cent respectively (De,

1993). He further reported that wide variations in *lassi* were observed due to composition of *Dahi*, the extent of dilution of curd at the time of churning and the efficiency of fat removal.

2.4 USES AND NUTRITITIVE VALUE OF *LASSI*

De (1993) stated that *lassi* could be used as a beverage, usually after the addition of ice (in hot weather), sugar or salt, with or without addition of flavours. It can also be used as a starter culture or coagulant. *Lassi* contains appreciable amounts of milk proteins, phospholipids and lactic acid and is an excellent beverage for quenching thirst.

2.5 METHOD OF MANUFACTURE

Lassi is a byproduct obtained in the preparation of country butter/*makkhan* (ghee) from *dahi* by indigenous method. *Dahi* is churned with the frequent additions of water untill butter granules are formed. The product left after removal of butter granules is called *lassi*. The term *lassi* is used in some part of Northern India to designate a cold refreshing beverage obtained by blending *dahi* with water and sugar.

Chaudhary (1959) reported that *lassi* could be made by mixing equal parts of *dahi* and water. Sugar or salt could be added to make it sweet or salty drink.

Judkins and Keener (1960) described the following method of preparation of natural buttermilk. Skim milk was standardized with whole milk or cream to 0.5 to 2.0 per cent milk fat and pasteurized at 180^{o}F for 30 minutes, cooled down to 66-70^{o}F followed by incubation for about 14 hours. The curd should then be broken by slow agitation when it reached the acidity of about 0.7 to 0.8 per cent.

Howard (1961) described the method of the production of buttermilk. The process involved heating the skim milk at 195^{o}F for 75 minutes and cooling to 72^{o}F; after addition of starter it was incubated at 72^{o}F for 12-16 hours until the titratable acidity of 0.95 to 1.0 per cent was reached. He also reported that there was a practise of adding cream, to increase fat content of buttermilk to one per cent and after homogenization the product showed an uniform dispersion of butterflakes.

A highly acceptable cultured buttermilk was prepared by Kosikowski (1969) by using different fruits or their concentrates. The most acceptable product was obtained with finely minced, preserved whole strawberry. The pH of the product ranged from 4.15 to 4.70.

Hargrove (1970) recommended that the solids content of skim milk should range from 9 to 10 per cent for the preparation of buttermilk. Low contents of solids produced weak bodied buttermilk with the tendency to wheying off whereas higher levels of solids produced too viscous products.

Lampert (1970) pointed that the high quality buttermilk could not be always obtained because of the variations in churning process during the manufacture of butter and variations in the quality of cream churned during various seasons of the year. It was further reported that a large amount of cultured buttermilk was made by fermenting milk or skim milk with lactic acid bacteria. Skim milk if used, a small amount of cream should be added to improve its flavour.

Grodzova (1971) described the manufacturing process of `Molodust' a protein enriched cultured milk beverage made from skim milk. The process involved heating of skim milk to 98-100^{o}C for 3 to 4 minutes, cooling to 40-42^{o}C and inoculating with 5 per cent starter culture (*Streptococcus thermophilus* and *Lactobacillus bulgariocus* in 4:1 proportion). The product thus obtained could be sweetened with 5 per cent sugar.

Wilcox (1971) reported the following process of making buttermilk. Raw skim milk was heated to 195^{o}F in a large vessel and kept for 75 minutes. It was then cooled to 72^{o}F. At this temperature, starter culture was added and held at 72^{o}F for 12 to 16 hours. When the curd reached a titratable acidity of 0.95 to 1.0 per cent, the coagulum was broken and to which sweet cream was then added to increase the butter fat content to 1.0 per cent. The product was mixed thoroughly and cooled to 45-50^{o}F.

Rangappa and Acharya (1974) reported that refreshing *lassi* in summer could be prepared from iced *dahi* and beaten upto froth with 4 to 20 per cent sugar. They further reported that, *dahi* diluted to 3 to 5 times of its volume with water and with a pinch of salt and other spices formed *ghol*, a soothing drink.

Campbell and Marshall (1975) reported the use of *Streptococcus cremoris* and *Lactobacillus citrovorus* during the preparation of cultured buttermilk. They also recommended to add butter granules to improve the flavour and appearance.

Henson and Bret (1976) described the process of `quarge' manufacture which involved separating the milk and concentrating the skim milk by ultrafiltration to

1/3 of its original volume, incubating it with one per cent culture of *Streptococcus cremoris* for about 16 hours to a described pH of 4.60. The product after cooling was whipped with 5 per cent sugar to obtain 50 to 100 per cent overrun.

Poulsen *et al.* (1977) while investigating process technology for the manufacture of market buttermilk reported that the best results were achieved when milk was pasteurized at 73^{o}C for 1-2 minutes. It was found that the fat content of milk in the range of 0.3 to 1.0 per cent did not significantly affect its viscosity.

Martine (1978) developed a process for the manufacture of a carbonated buttermilk beverage i.e. *Frulati*. Buttermilk from ripened or sweet cream added with 10 per cent sugar and a stabilizer, was pasteurized at 90^{o}C for 5 minutes and then cooled to 5^{o}C. At this temperature, concentrated frozen fruit juice was added to form a syrup which was mixed with carbonated water (200:400 ml) and bottled. The final pH was adjusted to 4.0 by addition of citric acid.

Anonymous (1980) described a procedure of *lassi* preparation from whole milk standardized to 3.5 to 4.0 per cent fat. It was suggested to break the set curd

with agitator followed by addition of required amount of water, sugar, salt and essence.

The mixture was then passed through a single stage homogenizer. The consistency of the *lassi* was such that it could be sipped through a straw from bottles.

De (1993) reported that cultured buttermilk could be prepared by inoculation and incubation of pasteurized skim milk with lactic starter culture. The solids contents should range from 9 to 10 per cent and the desired acidity should be 0.80 to 0.85 per cent.

Gupta and Kulkarni (1983) reported the procedure of preparation of *lassi*, which involved breaking of curd with agitator, addition of required amount of water, sugar, salt and flavouring substances. The finished product could be sipped with a straw from bottles. It generally consisted of 14 to 16 per cent SNF, 3.5 to 4.0 per cent fat and acidity of about 0.75 to 0.85 per cent.

Pal and Rajorhia (1985) reported that the buttermilk/*lassi* can be prepared by churning sweet or sour cream or by churning *dahi* during the manufacture of *makkhan*.

Mathur (1991) reported that the *lassi* can be prepared by stirring *dahi* with the addition of 10 to 20

per cent water and desired level of sugar and salt. He also suggested to homogenize the product to improve its body and texture.

2.6 ORGANOLEPTIC QUALITY OF *LASSI*

Mahanta (1984) prepared *lassi* from cultured skim milk and subsequently diluting it with water. *Lassi* prepared from *dahi* during the churning of butter was superior in quality since it contained butterfat and possessed the pleasing aroma due to the production of diacetyl. When it was made from fermented skim milk, it lacked in flavour. Addition of sugar, cream and ice gave a pleasent taste to *lassi* prepared from skim milk.

Srinivasan and Anantkrishnan (1964) noticed that the palatability and wholesomeness of buttermilk not only depended on the quality of curd but also on the quantity of water added during churning.

Bulhak (1975) found that the organoleptic quality was increased as the fat content in the whipped buttermilk was increased. It was further noticed that, the skim milk product was assessed as very tasty by majority of the judges.

Campbell and Marshall (1975) recommended the addition of butter granules to increase flavour and appearance of buttermilk.

Urbene and Berghinskas (1978) found that buttermilk containing 1.0 per cent fat and 10.5 per cent SNF with an acidity above 0.9 per cent had a clean refreshing lactic flavour and uniform consistency.

Bhetele and Rajorhia (1982) reported that the *lassi* from whole milk *dahi* was highly palatable, nutritious and could be consumed as a cold beverage during summer months.

2.7 DIRECTLY ACIDIFIED MILK PRODUCTS

Little (1967) reported that direct acidification of dairy products was started on commercial scale in 1962 and sour cream was the first product produced by this method.

Kulkarni *et al.* (1980) reported that the titratable acidity was significantly higher in the cultured *dahi* than the product prepared from direct acidification. The fat content was similar in both the types of curds. Organoleptic studies indicated that both the types of *dahi* were rated almost equal by the panel of judges.

Patel and Chakraborty (1985) reported that the *chakka* prepared by direct acidification using lactic,

hydrochloric and citric acid was granular in texture and hence was not suitable for preparation of *srikhand*.

Biabani (1995) found that different levels of coagulation pH did not have any significant effect on sensory attributes of *chakka* obtained by direct acidification. However, the peptizing salt significantly improved the body, texture and flavour score. It was found the coagulation pH of 4.8 and peptizing salt level of 0.1 per cent gave *chakka* of most acceptable texture.

2.8 DIRECTLY ACIDIFIED MILK BEVERAGES

A method was described in British Patent (1973) for the preparation of sour milk beverage. It could be made by acidifying with citric or lactic acid, a pasteurized mixture of skim milk (100 g) and sugar (100 g) to pH of 3.52, dilution with water to 1000 g, readjustment of pH to 3.52, addition of a flavouring, carbonation, bottling and pasteurization at 60^{o}C for 30 minutes. The beverage could also be made from reconstituted dried skim milk.

Inagami *et al*. (1973) prepared drink composed of fermented or acidified milk and citrus fruit juice. Citrus fruit juice, containing 10 to 25 per cent (by volume) of pulp material, is vacuum or freeze -

concentrated to approximately 1/3 of its original weight and the resultant concentrates mixed with upto 40 per cent (by weight) of fermented milk or milk with added organic acids viz. lactic, citric and malic acids. The resultant drink, claimed to be stable to separation and coagulation, could be homogenized and ingredients such as sugar, acids, flavouring and colouring agents could be added.

Japanese Patent (1975) described a method for preparation of acidified milk beverage in which skim milk was acidified and charged with CO_2 prior to bottling.

Zscheyge *et al.* (1977) gave a method for manufacturing freshly soured milk products. The cultured buttermilk was kept fresh for long periods by adding, prior or after the acidification, mixture consisting of sugar, alcohol and pectin.

Prabhakar and Khan (1978) prepared a beverage from sweet cream buttermilk by adding 0.15 per cent salt and citric acid. It was then inoculated with starter to raise the acidity to 0.9 per cent followed by the addition of 10 per cent sugar.

Yasumatsu *et al.* (1980) prepared a stabilized acidified milk beverage by subjecting acidified skim

milk with a pH of 3.35 to 3.75 and the milk SNF content of 0.7 to 1.5 per cent to UHT treatment at 125 to 160^{o}C for not more than 10 seconds and adding sugar 8 to 13 per cent after the heat treatment.

Kim *et al.* (1984) observed that rapid addition of the citric or lactic acid even at low concentrations resulted in the precipitation of milk proteins. However, slow addition even at high concentration would not precipitate the protein.

Barnes *et al.* (1992) used 15 stabilizers and 4 buffers in a model milk beverage system that was sweetened, acidified and carbonated in order to prevent two layer separation. None of the used stabilizers prevented casein precipitation. Ammonium and Sodium phosphate in dibasic form and Sodium carbonate successfully prevented separation upto 21 days when used @ 0.3 per cent. Ammonium phosphate (dibasic), Sodium phosphate (dibasic) and Sodium bicarbonate buffers were preferred.

Groux and Hugleshofer (1993) developed a process for manufacturing of low acidity long life milk beverage. The process involved the aseptic addition of a sterile acid to a neutral milk base which was then

sterilized without stabilizers. Subsequently the mixture was packaged aseptically.

Pagote and Balchandran (1993[a] and 1993[b]) studied the storage stability of acidified milk beverage in respect of lipolytic and proteolytic changes in glass bottles and laminated pouches. Thiobarbituric acid values were subsequently increased by storage period, packaging material and storage temperature. Moreover free fatty acids and nonprotein nitrogen content were also increased. It was further reported that deterioration rate at 30^{o}C was faster than at 5^{o}C in glass bottles.

Lelli and Ferrero (1995) used various stabilizers for acidic milk drinks which had acidic pH, and was based on an aqueous mixture of a vegetable extract; juice or infusion and milk products. It also included a pectin, a polyol alginate and a fatty acid ester selected from among lauric, myristic, palmitic, caprylic or capric acid or mixture of these.

MATERIALS AND METHODS

Chapter 3

MATERIALS AND METHODS

3.1 MILK

Fresh cow milk obtained from the Dairy Unit of Veterinary College, Parbhani was used for preparation of directly acidified Instant *lassi* as well as control *lassi*.

3.2 STARTER CULTURE

Good quality *dahi* sample obtained from Parbhani market was used as a starter culture for preparation of control *lassi*. This starter culture was maintained by weekly subculturing in 12 per cent reconstituted skim milk

3.3 FLAVOUR

Synthetic flavours viz. Vanilla, Strawberry, Pineapple of Flying Bird Brand manufactured by Garden Flavouring Industries, New Bombay were purchased from local market and used during the investigation.

3.4 HEAT TREATMENT OF MILK

After standardization to 4.0 per cent fat and 8.5 per cent SNF, the milk was heated to 85^{o}C for 30

minutes and immediately cooled to room temperature (approximately 37°C).

3.5 PREPARATION OF *LASSI*

3.5.1 CONTROL *LASSI*

After the heat treatment and cooling, the milk sample was inoculated with active *dahi* culture at the rate of 2 per cent and incubated overnight i.e. for 16 hours at 37°C. The coagulum was then broken and sugar added at the rate of 8,10 and 12 per cent (as per the treatment) and mixed thoroughly using the waring blender. This cultured *lassi* was used as a control for comparision with Instant *lassi*. The pH of cultured *lassi* was adjusted at 3.80 pH.

3.5.2 INSTANT *LASSI*

For preparation of Instant *lassi* 50 per cent (v/v) Lactic acid was used as an acidifying agent. The pH of the milk, after heat treatment and cooling, was adjusted to 3.4, 3.6 or 3.8 by Systronic digital pH meter. Sugar was then added at the rate of 8,10 and 12 per cent and mixed thoroughly in a waring blender. These *lassi* samples were cooled to refrigerated temperature before their organoleptic and physico-chemical evaulation.

3.5.3 FLAVOURED INSTANT *LASSI*

The synthetic flavours viz. Vanilla, Strawberry and Pineapple were added for preparation of Flavoured Instant *lassi*. Flavours @ 0.2 per cent were added after the addition of sugar to the Instant *lassi* prepared as 3.5.2 but before blending. After cooling to refrigerated temperature, the samples were analysed for physico-chemical properties and for sensory evaluation.

3.6 SENSORY EVALUATION OF *LASSI*

The sensory evaluation of the product, in respect of colour and appearance, consistency, flavour and overall acceptability was carried out by a panel of 6 to 8 judges using nine point hedonic scale. (Amerine *et al*. 1965).

3.7 CHEMICAL COMPOSITION OF *LASSI*

3.7.1 DETERMINATION OF TOTAL SOLIDS

The total solids in the samples were determined by the method described in I S I Handbook of Food Analysis, Part XI, 1981.

3.7.2 DETERMINATION OF MOISTURE

The moisture content was determined by substraction method.

3.7.3 DETERMINATION OF FAT

The fat content in the samples was determined by the method cited in I S I Handbook of Food Analysis, Part XI, 1981.

3.7.4 DETERMINATION OF PROTEIN

The protein content was determined by the method described in I S I Handbook of Food Analysis, Part XI, 1981.

3.7.5 DETERMINATION OF ASH

The ash was determined by the method described in I S I Handbook of Food Analysis, Part XI, 1981.

3.7.6 DETERMINATION OF TOTAL CARBOHYDRATE

The total carbohydrate was calculated by difference.

3.8 PHYSICO-CHEMICAL PROPERTIES OF *LASSI*

3.8.1 DETERMINATION OF ACIDITY

The acidity was determined according to the method described in I S I Handbook of Food Analysis, Part XI, 1981.

Ten grams of sample was accurately weighed in a beaker and titrated with 0.1 N Sodium hydroxide solution using phenolphthelin as an indicator. The titratable acidity was calculated as percentage of lactic acid in the product.

$$\text{Acidity \%} = \frac{\text{No. of ml. of 0.1 N NaOH X 0.009}}{\text{Weight of the sample}} \text{ X } 100$$

3.8.2 DETERMINATION OF SPECIFIC GRAVITY

The specific gravity was determined by using pycnometer by the following method.

Weight of clean, dry pycnometer of 50 ml capacity was recorded. The pycnometer was filled with tripple glass distilled water and weight was taken. The pycnometer was then emptied, dried and filled with the sample and weighed. The specific gravity was calculated as per the following formula.

$$\text{Specific gravity} = \frac{\text{Weight of the sample}}{\text{Weight of water}}$$

3.8.3 DETERMINATION OF VISCOSITY

Viscosity was determined by using Haake's Rotoviscometer, RV-20 model (Germany).

Calculation of viscosity

For the determination of viscosity of *lassi* samples, the observations were recorded for displayed shearing stress (% τ) at respective per cent shear rate (% D) reading over different deformation speeds ranging from 27 to 210 S^{-1} (Total 10 no. of shear rates) by using spindle MV-II. The shearing stress was calculated by using following equations and was expressed as under.

$$\tau = \%\tau \times A$$

Where τ = Sheraing stress (dyne/cm^2)

$\%\tau$ = Displayed shear stress reading

A = Shear stress factor.

The shearing rate, D (S^{-1}) also designated as deformation speed was calculated and expressed as under.

$$D = \%D \times M$$

Where D = Shearing rate (S^{-1})

% D = Per cent shear rate

M = Shear rate factor.

The spindle constant A and M for particular spindle (MV-II) were obtained from the manual of instrument supplied by manufacturing company (A = 3.76, M= 4.51).

The apparent viscosity (η) were calculated by using following formula.

$$\eta = \frac{\tau}{D} \quad \text{Pa.S}$$

Where η = Apparent Viscosity (Pa.S)

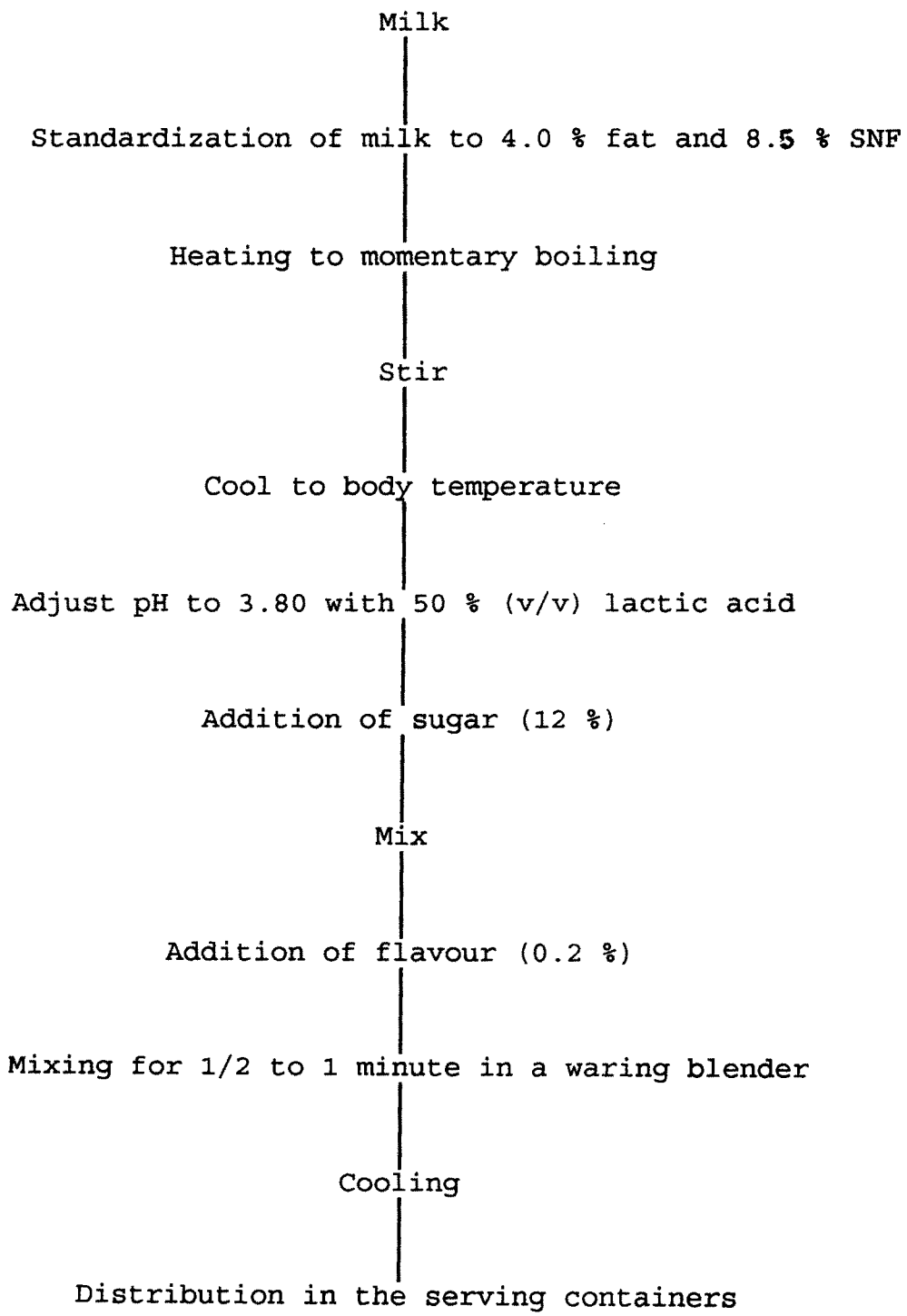
τ = Shearing stress (dyne/cm^2)

D = Shearing rate (S^{-1})

3.9 STATISTICAL ANALYSIS

The results obtained during the course of investigation were subjected to the statistical analysis. The evaluation of the experiment was done by Completely Randomised Design (Panse and Sukhatme, 1985).

FLOW DIAGRAM FOR PREPARATION OF FLAVOURED INSTANT *LASSI*



RESULTS

Chapter 4

RESULTS

The results obtained during the present investigation are presented under following headings.

I) Sensory evaluation.

II) Physico-chemical charactersitics.

4.1 SENSORY EVALUATION

The data on the sensory evaluation of Instant *lassi* with different pH and sugar levels, in respect of colour and appearance, consistency, flavour and overall acceptability in Table 4.1, 4.2, 4.3 and 4.4 respectively.

The sensory score for colour and appearance of Instant *lassi* with 12 per cent sugar were lower than the *lassi* having eight per cent sugar. However, the differences were non-significant for all the levels of sugar (Table 4.1).

Non-significant differences were observed in the consistency of Instant *lassi* prepared with 8,10 and 12 per cent sugar. However these differences were significant in respect of pH at 10 and 12 per cent sugar. The score for consistency was considerably lower at pH 3.40 than pH 3.60, 3.80 and control *lassi*. At 12 per cent sugar level the consistency socres were

significantly higher in *lassi* with pH 3.60 and 3.80, than the control and at 3.40 pH (Table 4.2).

Non-significant differences in flavour of Instant *lassi* were found with different levels of sugar. However, the flavour was affected by different pH. Significantly higher scores were observed in control *lassi* at 8 and 10 per cent sugar in comparision with Instant *lassi* at different pH. Instant *lassi* with 12 per cent sugar and 3.80 pH was rich in flavour (Table 4.3).

The overall acceptability of Instant *lassi* was the highest at pH 3.80 with 12 per cent sugar. It was observed that the varying levels of sugar have not affected the overall acceptability of the Instant *lassi*. However, the scores for overall acceptability of control *lassi* were significantly higher than the Instant *lassi* with 8 and 10 per cent sugar. The scores for overall acceptability indicated that the Instant *lassi* with pH 3.80 and 12 per cent sugar was preferred by all the judges than the control at similar sugar levels (Table 4.4).

4.2 SENSORY EVALUATION OF FLAVOURED INSTANT *LASSI*

The data on sensory evaluation of flavoured Instant *lassi*, having pH 3.80 and 12 per cent sugar with

different synthetic flavours viz. Vanilla, Pineapple and Strawberry in respect of colour and appearance, consistency, flavour and overall acceptability are presented in Table 4.5, 4.6, 4.7 and 4.8 respectively.

The scores for colour and apperance of flavoured Instant *lassi* at pH 3.80 with 12 per cent sugar did not differ significantly irrespective the flavours (Table 4.5).

The scores for consistency of the flavoured Instant *lassi* and control were not affected by the types of flavours. However, highly significant differences in the scores of consistency were observed between the types of *lassi* i.e. control and flavoured Instant. The scores for consistency of the control *lassi* were higher than the flavoured Instant *lassi* (Table 4.6).

Addition of the synthetic flavours significantly affected the flavour scores of the flavoured Instant *lassi*. Addition of Pineapple and Vanilla in both the *lassi* were liked by the judges than the Strawberry as indicated by the significantly higher flavour scores. In the control, the flavour score for Pineapple was higher than the others (Table 4.7).

Comparision of scores for overall acceptability of flavoured Instant *lassi* and control indicated

insignificant differences, i.e. the Instant *lassi* with synthetic flavours was accepted at par with the control (Table 4.8).

PHYSICO-CHEMICAL CHARACTERSTICS

Following physico-chemical characteristics of control and Instant *lassi* were studied.

I) Chemical composition

II) Acidity

III) Specific gravity

IV) Viscosity

4.3 CHEMICAL COMPOSITION

The chemical composition of Instant *lassi* at pH 3.80 with 12 per cent sugar is presented in Table 4.9.

4.4 ACIDITY

The data on the titratable acidities of Instant *lassi* with different pH and sugar levels are presented in Table 4.10.

It is seen from the Table that the acidity of Instant *lassi* was not significantly affected by varying sugar levels. However, significant differences in the acidity of Instant *lassi* were observed at pH 3.40, 3.60 and 3.80. The increase in titratable acidity was proportionate to the decrease in pH of Instant *lassi*.

When the sugar levels increased from 8 to 12 per cent, there was slight decrease in the acidity and the differences were non-significant.

Comparision of titratable acidity of the flavoured Instant *lassi* with the control (Table 4.11) indicated that the addition of synthetic flavour did not influence the acidity.

4.5 SPECIFIC GRAVITY

Data on the specific gravity of Instant *lassi* with different pH and sugar levels are presented in Table 4.12.

The results indicated that the specific gravity of Instant *lassi* as well as the controls were affected not only by varying levels of sugar but also by different pH. The highest specific gravity was observed in Instant *lassi* with pH 3.40 and 12 per cent sugar. The specific gravities of all the types of Instant *lassi* were significantly different with that of the respective controls.

It can be seen from the Table 4.13, that the addition of flavour has not affected the specific gravity. However the specific gravity of the flavoured Instant *lassi* was significantly higher than the control.

4.6 VISCOSITY

The viscosity values of Instant *lassi* with different pH and sugar levels at various shear rates are presented in Table 4.14 to 4.17.

It is observed from the Tables that due to increase in shear rate, there was decrease in the viscosity of both Instant and control *lassi*. It is further observed that the viscosity of control and the Instant *lassi* varied without showing any definite trend in respect of sugar levels. However, there was considerable decrease in viscosity of both the types of *lassi* with increase in pH. The control showed higher viscosities than the Instant *lassi* at all the levels of sugar, pH and shear rate.

Table 4.1 : Sensory score for colour and appearance of Instant *lassi* with different pH and sugar level

Sugar (%)	Sensory score at different pH			
	Control	3.40	3.60	3.80
8	7.87	7.96	7.86	7.93
10	7.91	7.79	7.89	7.85
12	7.84	7.84	7.82	7.86

Analysis of Variance for Table 4.1

Source	DF	MSS	`F' value
Sugar	2	0.01891	2.531^{NS}
pH	3	0.00087	0.117^{NS}
Interaction	6	0.00826	1.105^{NS}
Error	24	0.00747	
Total	35	0.00018	

NS = Non significant

Table 4.2 : Sensory score for consistency of Instant *lassi* with different pH and sugar level

Sugar (%)	Sensory score at different pH			
	Control	3.40	3.60	3.80
8	7.65^{a}	7.39^{a}	7.52^{a}	7.51^{a}
10	7.43^{a}	6.65^{b}	7.36^{a}	7.20^{a}
12	6.83^{b}	6.93^{b}	7.45^{a}	7.80^{a}

Different superscripts indicate treatments are significantly different with each other at 5 % level.

Analysis of Variance for Table 4.2

Source	DF	MSS	`F' value	CD
Sugar	2	0.41492	2.7699^{NS}	--
pH	3	0.47109	3.1448^{*}	0.371
Interaction	6	0.27801	1.8559^{NS}	--
Error	24	0.14980		
Total	35	0.35556		

NS Non-significant

* significant (P<0.05)

Table 4.3 : Sensory score for flavour of Instant *lassi* with different pH and sugar level

Sugar (%)	Sensory score at different pH			
	Control	3.40	3.60	3.80
8	7.93^{a}	6.96^{c}	7.29^{b}	7.39^{b}
10	7.75^{a}	6.25^{c}	7.17^{b}	7.90^{a}
12	7.13^{b}	6.36^{c}	7.10^{b}	8.16^{a}

Different superscripts indicate treatments are significantly different with each other at 5 % level.

Analysis of Variance for Table 4.3

Source	DF	MSS	`F' value	CD
Sugar	2	0.12764	0.6293^{NS}	--
pH	3	2.91550	14.3750^{**}	0.432
Interaction	6	0.44657	2.2018^{NS}	--
Error	24	0.20282		
Total	35	1.06190		

NS Non-significant

** Highly significant (P<0.01)

Table 4.4 : Sensory score for overall acceptability of Instant *lassi* with different pH and sugar level

Sugar (%)	Sensory score at different pH			
	Control	3.40	3.60	3.80
8	7.81^{a}	7.10^{b}	7.30^{b}	7.27^{b}
10	7.94^{a}	6.35^{c}	7.27^{b}	7.86^{a}
12	7.03^{b}	6.33^{c}	7.30^{b}	8.38^{a}

Different superscripts indicate treatments are significantly different with each other at 5 % level.

Analysis of Variance for Table 4.4

Source	DF	MSS	`F' value	CD
Sugar	2	0.04371	0.16538^{NS}	--
pH	3	2.61790	9.9029^{**}	0.494
Interaction	6	0.72619	2.7470^{*}	0.855
Error	24	0.26436		
Total	35	1.11800		

NS Non-significant

** Highly significant (P<0.01)

* Significant (P<0.05)

Table 4.5 : Sensory score for colour and appearance of flavoured Instant *lassi* with pH 3.80 and 12 per cent sugar

Synthetic flavour	Sensory score	
	Control	Instant *lassi*
Vanilla	7.29	7.22
Strawberry	7.41	7.30
Pineapple	7.37	7.42

Analysis of Variance for Table 4.5

Source	DF	MSS	`F' value
Flavour	2	0.03023	0.15504^{NS}
Type	1	0.00760	0.03899^{NS}
Interaction	2	0.01073	0.05505^{NS}
Error	12	0.19504	
Total	17	0.01791	

NS Non-significant

Table 4.6 : Sensory score for consistency of flavoured Instant *lassi* with pH 3.80 and 12 per cent sugar

Synthetic flavour	Sensory score	
	Control	Instant *lassi*
Vanilla	7.33^{a}	6.68^{a}
Strawberry	7.51^{b}	6.66^{a}
Pineapple	7.32^{b}	6.50^{a}

Different superscripts indicate treatments are significantly different with each other at 5 % level.

Analysis of Variance for Table 4.6

Source	DF	MSS	`F' value	CD
Flvaour	2	0.04686	0.0942^{NS}	--
Type	1	2.69890	5.4265^{**}	0.712
Interaction	2	0.01768	0.0355^{NS}	--
Error	12	0.49737		
Total	17	0.56561		

NS Non-significant

** Highly significant (P<0.01)

Table 4.7 : Sensory score for flavour of flavoured Instant *lassi* with pH 3.80 and 12 per cent sugar

Synthetic flavour	Sensory score	
	Control	Instant *lassi*
Vanilla	7.02^{b}	7.29^{a}
Strawberry	6.74^{b}	6.61^{b}
Pineapple	7.50^{a}	7.37^{a}

Different superscripts indicate treatments are significantly different with each other at 5 % level.

Analysis of Variance for Table 4.7

Source	DF	MSS	`F' value	CD
Flavour	2	0.89402	7.99020^{**}	0.413
Type	1	0.00001	0.00004^{NS}	--
Interaction	2	0.07737	0.69151^{NS}	--
Error	12	0.11189		
Total	17	0.38856		

NS Non-significant

** Highly significant (P<0.01)

Table 4.8 : Sensory score for overall acceptability of flavoured Instant *lassi* with pH 3.80 and 12 per cent sugar

Synthetic flavour	Sensory score	
	Control	Instant *lassi*
Vanilla	7.27	7.13
Strawberry	6.86	6.54
Pineapple	7.46	7.31

Analysis of Variance for Table 4.8

Source	DF	MSS	`F' value
Flavour	2	0.76244	3.582^{NS}
Type	1	0.19220	0.902^{NS}
Interaction	2	0.01451	0.068^{NS}
Error	12	0.21285	
Total	17	0.34922	

NS Non-significant

Table 4.9 : Chemical composition of Instant *lassi* with pH 3.80 and 12 per cent sugar

Constituent	Composition (%)	
	Control	Instant *lassi*
Water	74.89	75.20
Fat	4.05	4.00
Protein	3.59	3.47
Ash	0.74	0.76
Total Carbohydrate	16.73	16.57

Table 4.10 : Titratable acidity of Instant *lassi* with different pH and sugar level.

Sugar (%)	Acidity at different pH			
	Control	3.40	3.60	3.80
8	0.981^{c}	1.566^{a}	1.188^{b}	0.918^{d}
10	0.963^{c}	1.530^{a}	1.166^{b}	0.909^{d}
12	0.945^{c}	1.500^{a}	1.125^{b}	0.900^{c}

Different superscripts indicate treatments are significantly different with each other at 5 % level.

Analysis of Variance for Table 4.10

Source	DF	MSS	`F' value	CD
pH	3	0.71602	272.64^{**}	0.0495
Sugar	2	0.00627	2.3910^{NS}	--
Interaction	6	0.00040	0.1530^{NS}	--
Error	24	0.00262		
Total	35	0.19664		

** Highly significant (P<0.01)

NS Non-significant

Table 4.11 : Titratable acidity of flavoured Instant *lassi* with pH 3.80 and 12 per cent sugar.

Synthetic flavour	Acidity	
	Control	Instant *lassi*
Vanilla	0.944^{a}	0.894^{b}
Strawberry	0.946^{a}	0.901^{b}
Pineapple	0.946^{a}	0.902^{b}

Different superscripts indicate treatements are significantly different with each other at 5 % level.

Analysis of Variance for Table 4.11

Source	DF	MSS	`F' value	CD
Flavour	2	0.00004	0.0408^{NS}	--
Type	1	0.00961	9.0274^{*}	0.0329
Interaction	2	0.00001	0.0108^{NS}	--
Error	12	0.00106		
Total	17	0.00194		

* Significant (P<0.05)

NS Non-significant

Table 4.12 : Specific gravity of Instant *lassi* with different pH and sugar level

Sugar (%)	Specific gravity at different pH			
	Control	3.40	3.60	3.80
8	1.028	1.058	1.057	1.056
10	1.039	1.065	1.064	1.062
12	1.051	1.075	1.073	1.070

Analysis of Variance for Table 4.12

Source	DF	MSS	`F' value	CD
Sugar	2	0.00115	36.764**	0.004
pH	3	0.00220	70.150**	0.005
Interaction	6	0.00009	2.928*	0.009
Error	24	0.00003		
Total	35	0.00086		

* significant (P<0.05)

** Highly significant (P<0.01)

Table 4.13 : Specific gravity of flavoured Instant *lassi* with pH 3.80 and 12 per cent sugar.

Synthetic flavour	Specific gravity	
	Control	Instant *lassi*
Vanilla	1.068^{b}	1.074^{a}
Strawberry	1.067^{b}	1.074^{a}
Pineapple	1.066^{b}	1.073^{a}

Different superscripts indicate treatments are significantly different with each other at 5 % level.

Analysis of Variance for Table 4.13

Source	DF	MSS	`F' value	CD
Flavour	2	0.00001	2.375^{NS}	--
Type	1	0.0002	450.02^{**}	0.0006
Interaction	2	0.00001	1.1249^{NS}	--
Error	12	0.00001		
Total	17	0.00004		

NS Non-significant

** Highly significant (P<0.01)

Table 4.14 : Viscosity of control *lassi* with different sugar levels at different shear rate

Sugar %	Viscosity (Pa.S.) at different shear rate (S^{-1})		
	583	968	1621
8	0.0413	0.0321	0.0253
10	0.0414	0.0324	0.0257
12	0.0408	0.0316	0.0254

	Sugar	Shear rate	Interaction
S.E.	0.0011	0.0011	0.0019
C.D.	0.0034	0.0034	0.0058

Table 4.15 : Viscosity of Instant *lassi* with pH 3.40 at different sugar level and shear rate

Sugar %	Viscosity (Pa.S.) at different shear rate (S^{-1})		
	583	968	1621
8	0.0133	0.0110	0.0094
10	0.0120	0.0104	0.0093
12	0.0130	0.0111	0.0123

	Sugar	Shear rate	Interaction
S.E.	0.0008	0.0008	0.0014
C.D.	0.0024	0.0024	0.0041

Table 4.16 : Viscosity of Instant *lassi* with pH 3.60 at different sugar levels and sheare rate

Sugar %	Viscosity (Pa.S.) at different shear rate (S^{-1})		
	583	968	1621
8	0.0115	0.0095	0.0082
10	0.0119	0.0100	0.0087
12	0.0108	0.0094	0.0084

	Sugar	Shear rate	Interaction
S.E.	0.0003	0.0003	0.0005
C.D.	0.0009	0.0009	0.0015

Table 4.17 : Viscosity of Instant *lassi* with pH 3.80 at different sugar levels and shear rate

Sugar %	Viscosity (Pa.S.) at different shear rate (S^{-1})		
	583	968	1621
8	0.0088	0.0075	0.0064
10	0.0095	0.0078	0.0067
12	0.0082	0.0072	0.0062

	Sugar	Shear rate	Interaction
S.E.	0.0001	0.0001	0.0003
C.D.	0.0005	0.0005	0.0009

DISCUSSION

Chapter 5

DISCUSSION

Lassi is the byproduct obtained by churning the curdled whole milk with crude indigenous devices during the production of *desi* butter. It is a popular indigenous fermented milk beverage which is usually prepared by mixing *dahi* and water in equal parts. The product is especially more popular in central and northern parts of the country. The techniques for the manufacture of *lassi* vary widely. Traditional method of *lassi* preparation involves fermentation of milk using lactic culture, beating the curd and addition of sugar and/or salt. The quality of traditionally prepared *lassi* is influenced by the type and composition of milk used, quality of culture, temperature and time of incubation and addition of sugar. This process of *lassi* preparation is cumbersome and time consuming since 12 to 16 hours are required. The product is prepared on cottage scale and hardly any quality control approach is adopted to ensure uniformity in the physio-chemical and sensory characteristics. In order to overcome some of the inherent problems associated with conventional method of *lassi* preparation such as starter failure, prolonged manufacturing period and high cost involved in starter maintenance etc., an attempt was made in the

present investigation to explore the possibility of the manufacture of the Instant *lassi* by direct acidification of milk. During the study, citric acid and lactic acid were tried as the acidulants in the preparation of Instant *lassi*. Since the after taste was slightly bitter with citric acid, its use in the study was discontinued and only lactic acid was used as an acidulant during the entire study.

The quality of any food products is generally judged by organoleptic evaluation. Colour and appearance is one of the most important parameters. The consumers are first attracted to the product on the basis of its appearance. The scores for colour and appearance of the Instant *lassi* in the present investigation as judged by 9 point hedonic scale, suggested the appreciation of the product by the judges. The scores indicated that the colour and appearance of Instant *lassi* prepared with different pH and varying sugar levels were comparable to the traditional *lassi* prepared from fermented *dahi*.

The acceptability and demand of the dairy product is influenced by its consistency. Thus the consistency of dairy product is an important aspect. The consistency of instant *lassi* in the present investigation was significantly affected by the pH. The

lowest score for the consistency was observed in Instant *lassi* with pH 3.40. This may be due to additon of extra quantity of 50 % (v/v) lactic acid to lower the pH of product. This resulted in quicker coagulation ultimately affecting the consistency. It is well established that slow coagulation of milk gives firm curd which inturn gives *lassi* with good consistency. It is observed that Instant *lassi* with pH 3.80 and the control with 8 and 10 per cent sugar, had almost similar scores. The highest score for consistency was observed in the Instant *lassi* having 3.80 pH and 12 per cent sugar and can be attributed to the higher total solids in the product.

Flavour of any food product is a blend of taste and odour. The sense of smell plays an important role in the judging of dairy products. Results of the present study indicated that the effect of pH on flavour of the Instant *lassi* was highly significant. The lowest score for the flavour was recorded in Instant *lassi* with pH 3.40 irresepctive of the sugar contents. The highest score for flavour in the Instant *lassi* was at pH 3.80 with 12 per cent sugar.

Overall acceptability of the product depended upon the colour and appearance, consistency and flavour. The results of the present investigation clearly

indicated that all these sensory parameters were affected by the pH of the product and its sugar content. On the basis of the score of the various parameters it is observed that the Instant *lassi* with pH 3.80 and 12 per cent sugar was the most acceptable. The results of the present investigation in respect of all sensory characteristics are in agreement with the findings of Kulkarni *et al.* (1980) who worked on the acidified *dahi*.

Synthetic flavours are widely used in various food products to improve their palatability and acceptability. In order to assess the effect of some of the flavours which are commonly used as food flavours viz. Vanilla, Strawberry and Pineapple, were used for flavouring the Instant *lassi* with pH 3.80 and 12 per cent sugar. It is evident from the present study that the use of these synthetic flavours had no significant effect on colour and appearance and consistency of Instant *lassi* and the control. Among the three flavours, Pineapple flavoured Instant *lassi* and the control scored highest indicating that Pineapple flavour is more suited for sour foods.

The Instant and the control *lassi* were prepared from the standardised cow milk. However variations in the contents of water and total carbohydrates have been observed. The variation in the moisture and

corbohydrate are due to the addition of 50 per cent (v/v) of lactic acid and addition of sugar respectively. The fat, protein and ash contents of control and Instant *lassi* at 3.80 pH and 12 per cent sugar were almost similar.

The titratable acidity of the Instant *lassi* in the present investigation varied from 0.900 to 1.566 per cent depending upon pH, whereas, it was in the range of 0.945 to 0.981 per cent in controls.

The general trends of acidity values indicated that the acidity increases with decrease in pH of the product. It was observed that there was slight decrease in acidity of both the types of *lassi* due to increase in sugar level. The acidity of control *lassi* was higher than that of Instant *lassi* at pH 3.80. The results of the present investigation could be supported by the findings of Kulkarni *et al.* (1980) who also reported that the acidity of the cultured *dahi* was higher than the acidified *dahi*. The addition of synthetic flavour has not effected the titratable acidity of both Instant and control *lassi*.

The specific gravity of Instant *lassi* was significantly affected due to increase in the sugar level and pH. In control also, due to increase in sugar level, the specific gravity increased. The increase in

the specific gravity of both control and Instant *lassi* can be attributed to increase in the total solids due to addition of sugar. The specific gravity of Instant *lassi* was higher not only due to increase in the sugar content but also due to the addition of lactic acid, having higher specific gravity than milk, used for acidification.

Viscosity, one of the physical parameters reflecting on the quality of the product, is the resistance of a liquid to flow due to the internal friction and is considered as an important property of *lassi*. The viscosity was determined at different shear rate and it was observed that as the shear rate was increased, the viscosity decreased indicating that *lassi* is a shear thinning subsance. It was also observed that the viscosity of control *lassi* was higher than the Instant *lassi*. This increase in the viscosity of control *lassi* might be due to slow coagulation during prolonged incubation, while in the Instant *lassi*, the coagulation was instant due to direct acidification. With the increase in sugar level from 8 to 12, the viscosity did not vary much and did not show any definite trend.

SUMMARY

Chapter 6

SUMMARY

The present investigation was undertaken with a view to explore the possibility of the manufacture of Instant *lassi* with desirable sensory characteristics and physico-chemical properties. The results of the investigation are summarised as under.

I) Three pH levels (3.40, 3.60 and 3.80) and three sugar levels (8 %, 10 % and 12 %) were used for preparation of Instant *lassi*. It was observed that the colour and appearance of the Instant *lassi* and control were neither affected by pH nor by the sugar levels. However, the consistency and flavour of Instant *lassi* were influenced significantly by pH. Overall acceptability of the product was influenced both by pH and sugar. It was also found that the Instant *lassi* with 3.80 pH and 12 per cent sugar gave the most acceptable consistency, flavour and overall acceptability.

II) Sensory evaluation of flavoured Instant *lassi* at pH 3.80 with 12 per cent sugar indicated that different flavours and type of samples (viz. Instant and control) have no influence on colour and apperance and overall acceptability. Among the different flavours,

the scores of Pineapple flavoured Instant *lassi* were the highest for colour and apperance, flavour and overall acceptability.

III) The average water, fat, protein, ash and total carbohydrate contents of Instant *lassi* with 3.80 pH and 12 per cent sugar were were 75.20, 4.00, 3.47, 0.76, 16.57.

IV) The values of titratable acidity of the Instant *lassi* indicated that there was an inverse relationship between pH and acidity. There is slight decrease in acidity with increase in sugar level.

V) pH and sugar both have significantly affected the specific gravity of Instant *lassi*. Flavoured Instant *lassi* have higher specific gravity than the control.

VI) The viscosity of control *lassi* was higher than Instant *lassi*. The viscosity of both control and Instant *lassi* decreased with increased shear rates.

From the above study it may be concluded that a good acceptable quality *lassi* can be prepared instantly by direct acidification of milk. Acidification to the extent of 3.80 pH and addition of 12 per cent sugar was highly acceptable. Among the different synthetic flavours, Pineapple was the most suitable.

LITERATURE CITED

LITERATURE CITED

Amerine, M.A.; Pangborn, E.B. and Rossler, E.B. (1965). Principles of sensory evaluation of food. Academic Press, New York.

Anonymous (1980) Dairy Handbook (Processing). National Dairy Research Institute (NDRI), Karnal, Haryana.

*Barnes, D.L.; Mcguire, R.P.; Bodyfelt, F.W. and McDaniel (1992). Effect of selected stabilizing and buffering agents on a sweetened, acidified, carbonated milk beverage. Cult. Dairy Prod. J., 27(3):21-25.

Bhetele, I.D. and Rajorhia, G.S. (1982). Quality attributes of fermented milk. Dairy Guide, **4**(6):39.

Berzhinskas, G.G. and Urbene, S.K. (1977). New buttermilk beverage. Moloch. Prom. No. 8:34-35. Cited in Dairy Sci. Abstr., **40**(4):210.

Biabani, S.A.S.Z. (1995). Studies on manufacture of *shrikhand* by direct acidification and its preservation by thermization. M.Sc. Thesis submitted to Marathwada Agricultural University, Parbhani- 431 402 (M.S.).

*Bodine, A.B. and Martine, J.H. (1979). Consumer acceptance of flavoured, sweetened buttermilk. Cult. Dairy Prod.J., **14**(4):20.

*British Patent (1973). Method for manufacturing of milk beverage. 1 316 718.

*Bulhak, E. (1975). Test on preparation of a new "Whipped buttermilk" beverage from standardized skim milk. Prezeglad Mleczarslei, 24(7):19.

Campbell, J.R. and Marshall, R.T. (1975). "The science of providing milk for man". McGraw Hill Books Co., 605-606.

Chaudhari, A.C. (1959). Practical Dairy Science and Laboratory methods. Scientific Book Agency, Calcutta.

De, S. (1993). "Outlines of Dairy Technology" Oxford University Press, Bombay.

Goel,B.K. and Choudhary, V.K. (1996). Techno economic aspect of production of soilted spiced buttermilk: A promising profit making byproduct utilisation. Indian Dairym., 35(10):593.

*Grodzova, G.N. (1971). New Product. Moloch. Prom., 32(2): 35-36. Cited in Dairy Sci. Abstr. 33(6):2817.

*Groux, M.J.A. and Hugleshofer, W. (1993). Liquid milk products and process for its preparation. European Patent Application EPO 546 200 A1 6.

Gupta, S.K. and Kulkarni, S.S. (1983). Recent technological advances in milk based beverages. Indian Dairym., 35(10):593.

Hargrove, R.E. (1970). Byproducts from milk. 2nd Edn., The AVI Publ. Co.

*Henson, A.F. and Bret, G.M.M. (1976). Cultured milk products. British Patent 1 429 788. Cited in Dairy Sci. Abstr. 38(11):6964.

*Howard, J.W. (1961). Process for the production of buttermilk. United States Patent 2 958 1. Cited in Dairy Sci.Abstr. (1961) 23(6):1609.

*Inagami, K.; Mitsui, I. and Kando, H. (1973). Drink composed of fermented or acidified milk and citrus fruit juice. United States Patent 3 764 710.

I S I (1981). Handbook of Food Analysis, Part XI, Dairy Products, Indian Standard Institution, New Delhi.

*Japanese Patent (1975). Acidified milk beverage 5 004 750.

Judkins, H.F. and Keener, H.A. (1960). Milk Production and Processing. John Wiley and Sons, Inc.

Keenan, T.W.; Bodyfelt, F.W. and Lindsay, R.C. (1968). Quality of commercial buttermilk. J. Dairy Sci., 51(2):226-227.

*Kim, K.S.; Kim, H.J. and Kim, Y.J. (1984). Method and level of addition of acid for development of sour milk. Research reports of the Office of Rural Development, Livestock and Veterinary, Suweon, Korea, 26(2):13-18.

Kosikowski, F.V. (1969). Flavoured buttermilks. J. Dairy Sci., 52(6):799.

Kulkarni, M.B.; Bhosale, D.N. and Chavan, I.G. (1980). Cultured *Vs.* Directly acidified *dahi*. Part I. Technology and quality. Indian J. Dairy Sci., 33 (3) : 381-386.

Lampert, L.M. (1970). Modern Dairy Products. Chemical Publ. Co. Inc.

Laxminarayana, H. and Shankar, P.A. (1980). Fermented milk in human nutrition. Indian Dairym., 32(2): 120-121.

*Lelli, A. and Ferrero, P. (1995). Stabilizer for acidic milk drinks. European Patent Application EP 0 639 335 A1 : 6.

Little, L. (1967). Techniques for acidified dairy products. J. Dairy Sci., 50(3):434-440.

Mahanta, K.C. (1984). "Handbook of Dairy Science". Kitabistan, Allahabad.

*Martine, A.C.H. (1978). `*Frulati*': A new Brazilian carbonated drink made from buttermilk. XX International Dairy Congress. 942.

Mathur, B.N. (1991). Indigenous milk products of India: The related research and technological requirements. Indian Dairym., **43** (2) : 67.

Pagote, C.N. and Balchandran, R. (1993)[a]. Storage stability of acidified milk beverage. I. Lypolytic and proteolytic changes. Indian J. Dairy Sci., **46**(9): 431-434.

Pagote, C.N. and Balchandran, R. (1993)[b]. Storage stability of acidified milk beverage. II. Physical and chemical changes. Indian J. Dairy Sci., **46**(9): 435-439.

Pagote, C.N. and Balachandran, R. (1995). Optimisation of taste in directly acidified milk beverage. J.Dairying, Foods and Home Sci., **14**(3):113-116.

Pal, D. and Rajorhia, G.S. (1985). Buttermilk utilizaiton in Dairy Industry. Indian Dairym., **37**(9):397.

Panse, V.G. and Sukhatme, P.V. (1985). Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research (ICAR), New Delhi.

*Patel, R.S. and Chakraborty, B.K. (1985). Preparation of *chakka* by direct acidification. Egyptian J. Dairy Sci., 13:79.

*Poulsen, P.P.; Madsen, H. and Mogenson, G. (1977). Investigation into process technology with regard to alternative methods for manufacture of market buttermilk. Bretning fra Statens forsogsmejeri No. 216:47. Cited in Dairy Sci. Abstr., (1967). 39(7):419.

*Prabhakar, S. and Khan, A.Q. (1978). Studies on utilization of sweet cream buttermilk for the preparation of beverage. XX International Dairy congress, 945.

Rangappa, K.S. and Acharya, K.T. (1974) "Indian Dairy Products". Asia Publication House, New Delhi.

Srinivasan, M.R. and Anantkrishnan, C.P. (1964). "Milk Products of India" Indian Council of Agricultural Research (ICAR), New Delhi.

*Wilcox, G. (1971). Buttermilk and allied milk products. Food Processing Review No. 18:53.

*Yasumatsu, M.; Katayama, K. Takenchi, S. and Saito, Y. (1980). Preparation of an acidified milk beverage. United States Patent, 4 194 019.

*Zscheyge, F.T.W.; Zscheyge, C. and Molkerej, C. (1977). Method of manufacturing freshly soured milk products. German Federal Republic Patent Application 2 528 196.

* Originals not seen.