SOYA MILK AS A SUBSTITUTE FOR COW MILK

BY

E.M. JAGATH PEMASIRI

FOOD SCIENCE & TECHNOLOGY PROGRAMME
FACULTY OF APPLIED SCIENCE
UVA CAMPUS -
UNIVERSITY OF SABARAGAMUWA
SRI LANKA

SOYA MILK AS A SUBSTITUTE FOR COW MILK

by

E.M. JAGATH PEMASIRI

A report submitted in partial fulfilment of the

requirements of the advanced course

in

FOOD SCIENCE AND TECHNOLOGY

For the diploma of

FOOD SCIENCE AND TECHNOLOGY

SABARAGAMUWA UNIVERSITY OF SRI LANKA

BUTTALA
SRI LANKA
1997

Approved by

.....
Mrs.K.G.S. Ariyaratna
External Supervisor,
Head, Department of Soya food
Food Research Centre
Gunnoruwa,
Peradeniya,
Sri Lanka.
Date ..1997.-.08.-.15

.....
Mr.L.K. Gunerwardena
External Supervisor,
Managing Director,
Lucky Industries
Ruhunugama road,
Kamburupitiya.
Sri Lanka.
Date 25.-.08.-.1997.

.....
Mrs.Indira Wickramasinghe
Lecturer,
Department of Natural Resources,
Faculty of Applied Sciences,
University of Sabaragamuwa,
Buttala.
Sri Lanka.

Date 1997.08.15

.....
Dr. K.K.D.S.Ranaweera
Programme Co-ordinator/
Food Science and
Technology,
Head/Natural Resources,
Faculty of Applied
sciences,
University of
Sabaragamuwa
Buttala,
Sri Lanka.
Date .....

AFFECTIONATELY DEDICATED TO

MY EVERLOVING FATHER, MOTHER,

BROTHERS, SISTERS

AND

TEACHERS

ACKNOWLEDGEMENT

I wish to express my heartiest and sincere thanks to Mrs. Indira Wickramasinghe, my internal supervisor and lecturer, Dept. of Natural Resources of faculty of Applied science in Sabaragamuva University, for her excellent guidance, kindness, keen interest, continuous supervision and for reading the manuscript, making necessary arrangements and sparing her valuable time in bringing this project to a successful completion.

I am also deeply grateful to Dr K.K.D.S. Ranaweera, Programme Co-ordinator, food science & technology, Head/Natural Resources, faculty of Applied science in Sabaragamuva University, for his kindness, keen interest, suggestions, and who lead me during the course, encouraged extremely and helped me always.

I must thank Mrs. K.G.S. Ariyaratna, my external supervisor and Head, Dept. of soya food, and Dr. T.D.W. Siriwardana, Head, food research centre, Gunnoruwa, for assisting me to reach the goal of expected during the project.

Also I am very much thankful to Mr. L.K. Gunerwardena, my external supervisor and Managing Director of Lucky Industries, Kamburupitiya and his staff who assisted me in this project, gave necessary advice and trained well.

I need to remember Prof. Athur Bamunuarachchi an internationally recognized food scientist who made me enthusiastic to follow the course.

Also I need to remember the University tutorial staff as well as the other staff who assisted me in all the ways to full-fill my ambition.

I would like to record my appreciation of Mr. K.Kodituwakku, Training officer, Matara District Agriculture & Training Institute, Telijjawila and head, milk chilling centre, Monaragala. Also my thanks goes to tafi yoghurt producers, Pannipitiya.

Finally, I wish to remember and thank Miss. Hemamali, Who helped me to get the project report computerized. Also thanks extend to my loving brothers, sisters and Mr. Udaya and to my sincere friends and to well wishers who supported me in various ways.

ABSTRACT

Milk is considered as the nature's perfect food. Protein provides 11 of the essential amino acids which are deficient in cereals, used for food.

Also soya milk is high in protein and it contains a well balanced amino acids pattern. But with methionine supplementation it can be raised essentially to the same level as that of cows milk.

Studies all over the world have shown the eminent suitability of soya milk as an infant food. It is particularly used for children who are allergic to cow milk.

The addition of vitamins and Calcium is necessary if the milk is to be used as a substitute for cow milk in infants. Also salt, sugar, malt addition is important. It is raised taste and quality of soya milk.

During shortage of animal milk, can supply milk by using a mixture of animal milk and soya milk.

The trypsin inhibitors (in soy milk) can destroy by heat treatment. It is important for the digestion of protein consumed.

To inactivate lipoxydase enzyme in the soya milk it is necessary to drop the broken seeds directly in to boiling water for 10 min.

I used soya milk substitute for cows milk when making yoghurt. Soya milk mixed with cow milk that mixture is given successful result at the soya yoghurt making.

Also this report includes composition of milk, factors affecting composition, proper cows sanitation and microbe controlling methods.

Among dairy products ice cream, yoghurt, butter, milk powder are popular in Sri Lanka. However yoghurt production is very popular through the people. Because of yoghurt making can begin with small capital, low machinery facilities. In yoghurt making starter culture (*Streptococous thermophillus and Lactobacillus bulgaricus*) should be add freshly at 44° C temperature.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Nowadays, most people are involved in the field, that based on milk products as self-employment. Specially which are yoghurt, ice cream and sterilized milk. These products are too profitable and can begin with minor capital and as home Industry. Lack of proper knowledge about milk and their chemical, physical properties and preservation method of milk are the problems they faced nowadays. Because most of the producers do not have the proper knowledge in quality production. At least they do not have knowledge in biological process.

Milk is important in the diet because of its protein, calcium and riboflavin contents. Protein provides 11 essential amino acids which are deficient in cereals, used for food. Milk is considered as the nature's perfect food.

Also I wish to submit this report in the field of soy milk. soy milk is high in protein and it contains a well balanced amino acid pattern. It can be raised essentially to the same level as that of cow's milk. In the preparation of soy milk, the process adopted influences the end product. The manufacture of very high quality soy milk is capital intensive and required skilled operations. This report describes manufacture of soy milk at a low capital using kitchen utensils. In this task I absorbed that information from Soya Food Research Centre, Gunnoruwa and from the Industrial Development Board, Katubedda, which are most newest ones.-

I got a chance to follow the Food Science and Technology Programme at the faculty of Applied Science, Sabaragamuwa University of Sri Lanka, and observed and trained in food processing Industries under the guidance of experts in this field. In this Report I introduce some milk food processes simply and briefly and in order to improve their product quality.

1.1. OBJECTIVE :

The objective of my project was to study the preparation of soya milk with analyzing the procedure and to be sought out the ways to bring the quality up. And find out the ability of soya milk as a substitute for cows milk.

Also another objective was to process highest taste and quality milk yoghurt.

CHAPTER 11
LITERATURE REVIEW

2.1. MILK AND MILK PRODUCTS

Milk is important in the diet because of its protein, Calcium and riboflavin contents. Protein provides 11 of essential amino acids which are deficient in cereals, used for food. Milk is considered as the nature's perfect food. In the diet of man doing medium work, the intake of 500 ml milk per day contributes 75% of the recommended allowance of calcium, 50% of vitamin C, 45% of riboflavin, 20% of protein and 1% of metabolizable energy.

Milk has been defined in a number of ways by different workers. It has been defined as a " Milk is the fresh and clean lacteal secretion practically free from colostrum and obtained by the complete milking of one or more healthy cows, properly fed and maintained and excluding that obtained within 15 days before and 10 days after calving and containing not less than 8.25% solid non - fat and not less than 3.5% milk fat" [U.S.A. & United States Health Services]

Dairy farm development is more suitable where large land is available for production to grasses in Sri Lanka. There are total land only 6850059 Km2 and considering the population about 17 million approximately. So that land area available per person is very low. Therefore vital necessary is good management practices for developing the dairy programe in Sri Lanka.

To be increase the production level per cow in a dairy development programe, following considerations are to be followed.

* Increase of feed quantity and quality.
* Improvement of management, housing, husbandry methods and veterinary care,

* Genetic improvement, improving the breeds by upgrading and cross breeding.
* Prompt treatment for diseases

Milk when kept in containerize turns sour within a few hours. This cause by individual or associate action of bacteria, such as mesophilic, thermophilic, on milk and milk products. It is very important to control these microorganism to increased the quality of milk and milk products. The cows, buffaloes and goats are important milk animals in the Sri Lanka. Their milk used for consumption directly as liquid milk. However cows and buffaloes's milk used for milk products such as curd, yoghurt, milk powder, condensed milk, butter, cheese, ice-cream,etc.,

Nowadays yoghurt is the most popular fermented milk product. Yoghurt is produced almost all over the world, and some varieties are known under deferent names. since the bacterial properties can be fully controlled it is now possible to make a rational mechanization of the processing of milk into yoghurt.

Two major milk processing plants were set up during the period 1967-1975. One polannaruwa for the manufacture of condensed milk and the other at Ambewela for the production of spray dried milk powder. These units have enhanced the milk collection in the Nuwara-Eliya and Polonnaruwa districts. The National milk board was established to supply chiefly liquid milk to the consumers. However in order to achieve profits the national milk board diverted from is mainfunction of supplying liquid milk to produce other commercially attritive product such as ice cream, Yoghurt, Ghee, Butter. Curd which is also an important milk products and produced using traditional technology which has come down from generations and these units are concentrated in the dry zone, namely Hombantota district in the Eastern province in Sri Lanka. Curd is manufactured mainly from buffalo milk though cow milk is also used in this

production. There are 31 milk processing units registered with the Ministry of Industries Science and Technology out of which 17 are producing only yoghurt while 9 of making ice cream.

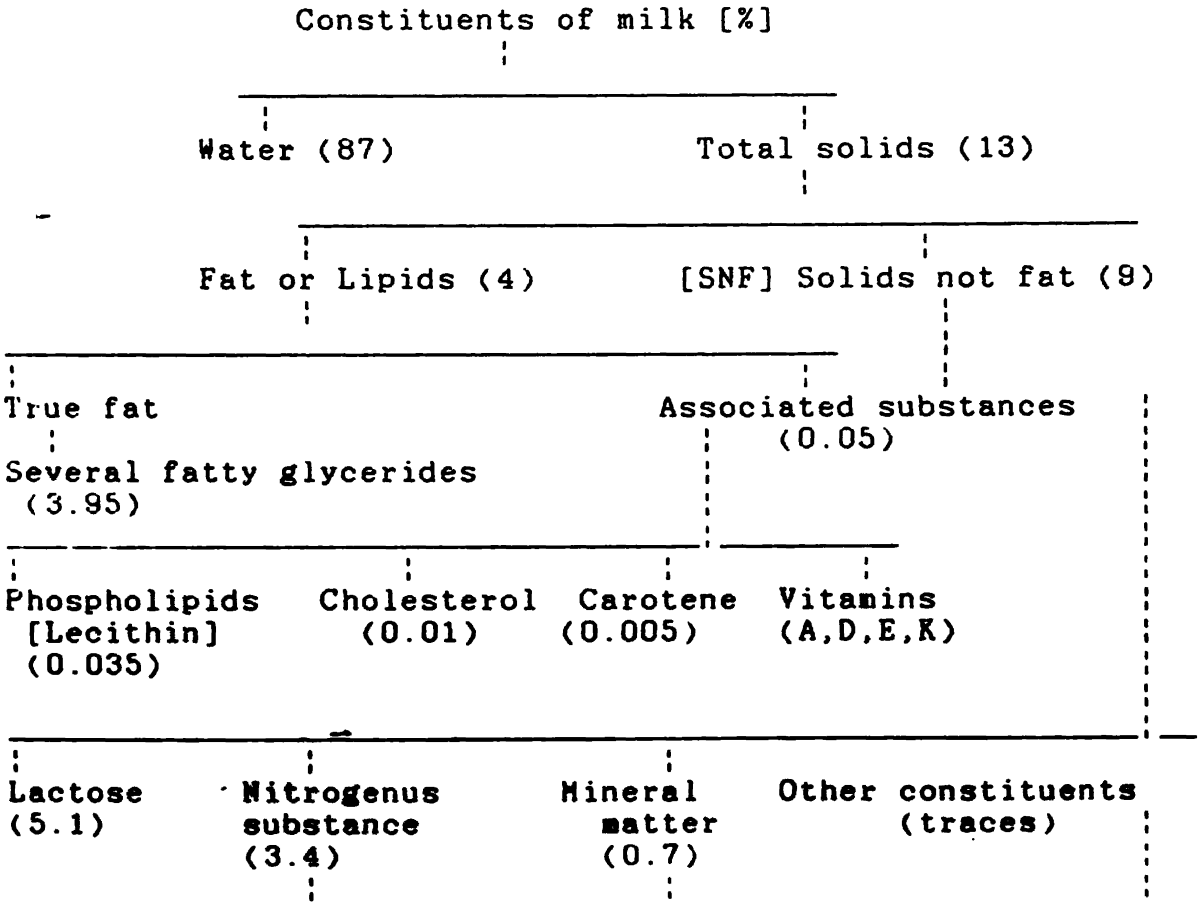
[sourse : Jasmin and Samarasinghe, (1994); Srivastava,S.M., (1993)]

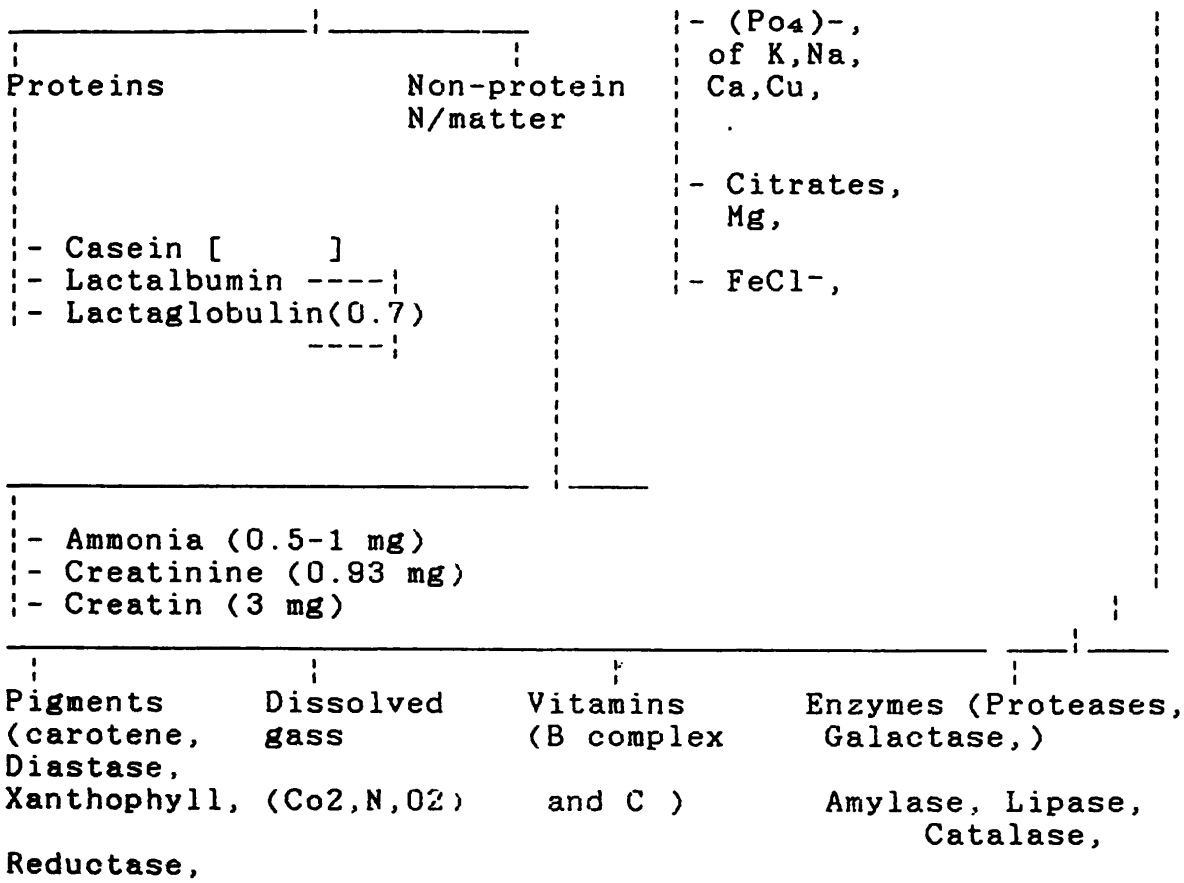
2.1.1. Composition of milk

Milk is a mixture par excellence. There is 3 constituents.

1. Water
2. Fat
3. Solids-not- fat

Further examination of these three constituents resolves them in many constituents as below.





[Cited by Jagdish and Vinitha Abraham, (1992)]

2.1.2. Factors affecting the composition of milk

There is a great deal of variation in the composition of milk, even with the same animal it is not always the same. Among the constituents the fat content of the milk is most variable. The other constituents vary in the order, Protein, Lactose and Ash. The factors responsible for such variation in the composition are as follows.

1. *Species of animal* - Milk composition of different species of animals vary from each other.

TABLE 2.1

Average composition of milk of various mammals

Mammal	Water %	Fat %	Lactose %	Protein %	Ash %	T.S. %	S.N.F. %
Cow	86.5	4.6	4.6	3.2	0.7	13.5	8.9
Buffalo	83.5	7.1	4.8	3.7	0.7	16.5	9.4
Human	87.4	4.3	6.4	1.2	0.2	12.6	8.3
Goat	86.9	4.0	4.6	3.7	0.8	13.1	9.1

[Cited by Jagdish prashd & Abraham (1992)]

2. *Influence of breed* - The milk of some breeds is comparatively high in fat and lactose contents than those of other breeds, e.g. milk of red sindhi cow contains higher fat than holstien and brown swiss.

3. *Seasonal variations* - Generally fat content of milk tends to increase in cold weather and decrease slightly in warm and rainy seasons.

3. *Length of interval between milking* - The milk drawn after longer interval contains less fat percentage than that drawn after shorter intervals. The morning milk which is drawn after longer interval, contains lesser fat as compared to that of evening milk.

4. *First and last milk* - There is a variation in fat content of fore milk, middle milk, stripping. The fore milk is poor in fat and stripping are very rich in fat. This variation is more when the milk yield is very high.

2.1.3. Principles of sanitation in milk production

Milk is known to be one of the best foods but it may also become a harmful if is not produced and handled under sanitary conditions. Milk which enters into market must be clean so that it will have good flavour and be free from harmful bacteria and other disease organisms. Milk produced under sanitary conditions will have longer keeping quality. It is more important to produce good quality milk for fluid use when milk is converted into dairy products.

Purpose :

1. To produce milk free of dirt
2. To secure milk of low bacterial count
3. To keep milk free of disease organisms
4. To prevent bad odour
5. To prevent spread of milk born diseases
6. To increase shelf-lift of milk
7. To make good quality dairy products

The source of contamination of milk and preventing methods can explain as follows.

A. Internal factors

1. *Mastitis Udder* - Test fore milk on strip cup
2. *Fore milk* - Remove two streams from each teat to reduce bacterial count.

B. External Factors

1. *Cow body* - Healthy, Clean, well groomed an hour before milking, hind quarter washed, tail tied with legs at milking time.
2. *Cows Udder* - washed, wiped with clean towel soaked in antiseptic solution, kept dry at milking time.
3. *Milker* - Healthy, nails cut , clean hands, head covered with cap, clean habits, hand washed with chlorine solution of 200 ppm.
4. *Utensils* - Clean and sterilized, stainless steel metal, seamless small open top [dome shape] washed and sterilized by chlorine solution.
5. *Barn* - White washed, free from cob, webs, bad odour, floor clean and disinfected, well lighted and ventilated.

6. *Method of milking*

- Full hand method and dry hand milking.

7. *Feed and waster*

- Free from weeds and objectionable smell. No dusty roughage at milking time.

8. *Miscellaneous*

- Milk produced must be strained through muslin cloth and then it should be stored at low [7° C] temperature.

[source : Jaddish prashd and Vinita Abraham, (1992)]

2.1.4. General chracteristic of milk

2.1.4.1. Milk acidity

PH value of milk is 6.6 (acidic side of the PH scale) Hence milk unites with alkalies. When milk is drawn from udder of the cow, it is acidic in nature. Which is called natural acidity to distinguish it from the developed acidity caused by the conversion of lactose in to lactic acid. The natural acidity is mainly due to the presence of casein , acid phosphates & citrates and lesser degree to albumin, globulin and Co2.

Fresh normal milk has acidity about 0.12 to 0.14 %

Factors affecting acidity of milk

I. Udder disease
II. Storage temperature
III. SNF % in milk
IV. Storage period

2.1.4.2. Colour

Cow milk is light yellowish due to presence of carotene. Buffalo milk is white as the fat in buffalo milk has no carotene. When casein and fat in milk is removed by adding rannet, the colour of whey is light blue due to presence of riboflavin.

2.1.4.3. Flavour

flavour is help of taste and smell, with the development of lactic acid the flavour also changes to 'sour'. This is due to lactic acid, butyric acid, diacetyl.

2.1.4.4. Specific gravity of milk

The average specific gravity of milk at 15.5 oC is 1.032, but it is most variable properties of milk.

The S.G. of milk is lowered by addition of water, cream or increased temperature and it is increased by addition of separated milk, removal of fat or reduction of temperature.

2.1.4.5. Surface tension

The surface tension of milk is low when compared to water.

2.1.4.6. Freezing point

Freezing point of milk is -0.55 oC . It can be changed between -0.525 to 0.565 oC.

factors affecting freezing point

I. Lactose and chloride content in milk.
II. Total solids in milk
III. Other soluble ingredients in milk.

[source: Rai, M.M., (1980) , Jagdish Prashd & Vinita Abraham, (1992)]

2.1.5. Lactose in the milk

Milk is the only sourse of lactose which is the principal carbohydrate in the milk. Lactose is made up of by combining two simple sugars; glucose and galactose. Cow's milk it is present about 4.8% and human milk contains about 7% . So that if cow's milk is to be fed to the infants. It should be slightly modified by adding lactose. Lactose is in true solution in milk. When it crystalizes from water, it forms hard gritty crystals which have one molecule of water appear in certain milk products under certain circumstances under

which these crystals are allowed to grow in size. These crystals appear in ice cream when the mix contains a high proportion of milk solids. Lactose is faintly sweet, about one-sixth the sweetness of sugarcane. That is way milk is only faintly sweet. (non-acid) whey appears to be more sweet due to removes of casein which masks the flavour of lactose.

Lactose is a valuble product and is used for the preparation of feed stuffs for infants and invalids. This is the only sourse of galactose for human beings and certain animals and since galactose is present in brain and nerve tissues, it becomes still more important. Lactose helps in assimilation of calcium and phosphate from intestines and has a toning effect on the alimentary canal. It is prepared from whey which is the chief source of it's manufacture.

The unique chemical and physical properties of lactose are used to advantage in the food industry. Lactose readily adsorbs flavours, aromas, and colouring materials. Hence, It is used as a carrier for such substances. Lactose is a component in biscuit and other baking mixes. In baked goods, lactose readily reacts with proteins via the Milliard reaction to form the golden brown colour found in the crusts. Lactose is not fermented by yeast so its functional properties are effective through out the baking process, i.e., Its emulsifying properties promote greater effiency from shortning, lactose is used as a preservative for flavor, colour and consistency in meat product.

2.1.6. Fermentation of milk

The fermentation of lactose producing lactic acids, is pesponsible for the souring of milk and cream. But is advantage in the production of various types of cheese, butter. The change in souring can be observed by incubating a bottle of raw milk at 37 °C and measuing the development of acid at regular intervals. In the beginning the acid

development is slow but it increases vigorously with the activity of microorganism. At 1% lactic acid , the activity of microbe decreases and hence the acid development also decreases. At an acidity 3-4% it is possible to detect a sour taste. While 6-7% acidity the milk curdless at ordinary temperature. The actual time for these changes depends upon the nature and the number of microbe percent and temp. of storing the milk. It may take few hours or even days. The main change brought by bacteria is the conversion of lactic acid.

The check in bacterial population at 1% acidity is not due to the deficiency of substrate (lactose) but is due to the acidity which becomes unfavourable to the microbe. If the acidity at this point is neutralised, the microbe are reactivated and more lactose is converted into lactic acid. 1% lactic acid is formed from 1% lactose so that 75% of lactose in milk is still available for the microorganism. Pure cultures of different bacteria have different tolerance for the accumulation of acid.

[sourse : Rai, M.M. (1980) , Aurand, (1979)]

2.1.7. Microbiology of milk

Milk is a medium most favourable for microbial growth as it contains most of the essential nutrients needed for organic lift. Therefore it is necessary that right from milking such hygienic conditions should be maintained that minimum number of microorganisms gain entrance into milk. Lesser the number of microorganisms in milk, longer will be its keeping quality. The sources of entry of microorganisms in milk are many such as:

1. Interior of udder
2. Exterior of udder
3. Atmosphere
4. Utensils.
5. Milker

The microorganisms multiply rapidly after entering into the milk. The various factors which are known to influence the growth of micro-organisms are

1. Moisture
2. Temperature
3. Food supply
4. Atmosphere
5. Physical and chemical environments

Milk is very rich in organic food and affords an ideal medium for the growth of microorganisms. As long as there is enough water in milk products the optimum conditions of growth of microorganisms is provided. The growth retards when the amount of water in milk product falls below 30 per cent. That is why condensed milk with about 25% moisture keeps longer than normal milk and dry milk which contains only about 5% water is stable. The bacteria and yeast depend more upon the moisture of the substrate than that of the atmosphere. Atmosphere is the source of oxygen required by certain bacteria. eg, milk souring bacteria and moulds grow best in atmosphere rich in oxygen. Microorganisms vary in their sensitiveness towards acidity or alkalinity. Moss bacteria slacken at an acidity of one percent, while yeasts and moulds have an affinity for an acid medium and start growing when acidity checks the growth of bacteria. Temperature also controls the growth of microorganisms. The best temperature for their growth is about 37 C . Low temperature checks their growth. Most of the microorganisms are destroyed at 60 C and so milk is pasteurized by keeping it at a temperature of 62 C for 30 minutes in order to reduce the microbial population.

The most aboundantly found bacteria in milk belong to the families lactobacilaceae and streptococaceae the organism in these families are generally reffered to as lactic acid bacteria.

Lactic Acid Bacteria

They are gram positive bacteria and non motile. They can be rods or cocci these organism need complex nutritional requirements. The lactic acid bacteria are divided in to two group as homo fermentative and hetero fermentative. The major organism in this group found in milk are *Streptococus lactic*, *Streptococcus cremoris*, *Lactobabacillus acidophilus*, *Lactobacillus plantarum* and *Lactobacillus brevis*.

These organism do not produce disease in humans but they do ferment the carbohydrate in milk to form acids (mainly Lactic acid) lowering the PH.

When PH is lowered to about 4.5 the casein in milk becomes curdled and forms a precipitate because of the acid formed the milk tastes sour. Therefor souring of milk is a result of the activities of the bacteria normally present in milk.

E.coli is freuently found of, it is completely underniable one and its pesent is related to the sanitary conditions of the dairy. Therefore it is clear although milk is sterile with in a health cow, it gets a chractoristic flora of non pathogenic organisms as soon as it leaves the cow. The role of dairy sanitation, thus is to ensure that disease producing micro organisms do not get in to the milk and spread diseases to consumers.

[sourse : Rai, (1980) , Frazier, (1978)]

2.1.8. Common tests for milk quality

[a] Organoleptic tests

Soon after milk is received on the platform od dairy the lid of can opened and milk is stirred up with plunger to test for smell whether pleasant or unpleasant. Then it is tested for appearance [colour etc.,] taste and flavour. Stale milk will be sour.

[b] Acidity test

The production of lactic acid in milk is termed as souring. It is measured by titration of 10 ml milk against N/10 NaOH [sodium Hydroxide] using phenophthalein [0.1 ml] as an indicator. Milk showing less than 0.18% acidity is looked upon as satisfactory milk.

$$\text{Per cent acidity} = \frac{\text{ml of N/10 NaOH used} \times 0.009 \times 100}{\text{ml of milk used}}$$

Fresh milk contains 0.12 to 0.14 % acidity.

[c] Sediment test

It helps to judge the quality of milk received from villages. This test indicates the impurities and dirt in milk as a result of unhygienic conditions of production.

Test. Half to one pint of milk is collected in sediment bottle or plunger type pump and strained through a sediment disc [cotton filter pad] . The pad is removed and compared with standard sediment grades.

[d] C.O.B. test

This testis used to determine the shelf life of milk sample and its ability to with stand pasturzation. A small amount of milk is boiled in a test tube over a flame for two minutes. When acidity exceeds beyond 0.2% the milk clots and hence it is COB positive which means unsuitable to heat treatment.

[Jaddish & Vinita (1992)]

2.2. SOY MILK AS A SUBSTITUTE FOR COWS MILK

2.2.1. Introduction to soya milk

Traditionally soya milk is an aqueous extract of whole soyabeans and has been of considerable interest to Nutritionist as a possible substitute for cow or human milk, particularly in the feeding of infants who are allergic to the natural milk. Soybean milk and cow's milk have approximately the same protein content [3.5% to 4%] and accompaniment of the amino acid composition shows a correspondence. Animal experiments have shown that the nutritive value of soyamilk ranges between 60% and 90% of that of cow's milk. The main deficiency of soybean milk lack of the sulfer containing amino acids. Notably Methionine. So that with methionine supplementation it can be raised to essentially the same level as that of cow's milk. There is comparatively little superiority of cow's or human milk over suitably fortified soya milk for human consumption.

Soya beans are high in protein which contains a well balanced amino acid pattern. Soybean is an important source of protein in the diets of people in many countries. In view of its nutritional properties and other uses. Soya milk which was prepared from the traditional method had limited uses due to its undesirable flavour and odour are caused by an enzyme system called lypoxygenase.
Soybean milks are conventionally made in the orient by soaking, grinding in water, filtering to remove sediments and then heating to kill the microorganisms.

This report gives the modified Illinois process which involves blanching the soya beans in 0.5% sodium bicarbonate, grinding in hot water, addition of sugar and flavour and pasteuring soya milk is the easiest product that can be made from soya beans.

Otherwise soybean can be considered as a concentrated protein food. such as cows milk. significantly, 1 Kg of soybean produces 8 Litre of milk with a protein content equal to that of cow's milk.
The difference is that cow's milk requires special storage conditions. whereas soybean can be stored easily and cheaply. If the beans are cleaned and dried to a moisture content less than 12% . They can be stored for a year without any signicant loss in quality.

[source: Document of food Research Centre, Gannoruwa, Meegaha Kotuwa, (1996) , Gupta, (1993)]

2.2.2. Nutritional value in soya milk.

Soy milk is rich with nutrients, namely, high grade proteins, fats and vitamins. Soybean protein is similar to animal protein in that the essential amino acids. Composition is almost similar to animal protein except for sulphur containing ones.

ex. Soybean has another enzyme called as [except Lipoxydase] Trypsin inhibitor; This enzyme is very important for human nutrition for it interferes with the digestion of protein consumes.

[source: Document of food Research Centre, Gannoruwa,]

2.2.3. Market feasibility of soya milk

Research done on Soyabeans have shown that it could be used in preparation of Soya milk, Yoghurt, Ice Cream and Tofu. Use of 5-10 % of soya flour in bread, buns and various other items have shown that is an increase in nutritional value of these foods. Most popular item among these is Soya Ice cream. PLENTY CANADA which was started in 1988 was taken a

lot of interest in promoting soya food in Sri Lanka. They have two main sales outlets in Kandy and Colombo. They also run a factory at gam udawa pallekelle which produces soya bean powder and soya oil.

The sales Centre in Colombo produces about 5000 Litres of soya milk and that in Kandy produces about 2000 litres a month. There are about 35 Units which produce soya ice cream in Colombo. There are a numbers of small scale producers of soya based products in Kandy. Most of these units run with the assistance of PLENTY CANADA, [PLENTY FOODS] was trained more than 2000 personal on production of soya based products. Some of them are running small scale.

[Meegaha Kotuwa, (1996)]

2.2.4. Comparison of soy milk with cow milk

The composition of the soya milk varies with the variety of soyabeans used and with method of manufacture.

Table 2.2.1 Comparison of soy milk with cow milk

	cow milk [Average]	soya milk [probably oriented]
Water , %	87.30	92.00
Protein , %	3.42	3.70
Fat , %	3.67	2.00
Carbohydrates , %	4.78	1.80
Ash , %	0.73	0.44

[cited by Gupta, R.K]

Table 2.2.2. *Protein and Essential Amino Acids Composition of soya milk & cow milk*

Milk raw -- >	Cow milk	Soya milk
Nitrogen [g/100g]	0.55	0.56
Protein	3.5	3.2
Isoleucine	295	305
Leucine [mgm/g]	596	497
Lysine	487	348
Sulphur containing amino acids	208	195
Tryptophane	88	85
Valine	362	294
Total amino acids	6463	6010

[cited by Srivastava, S.M. 1993]

2.2.5. Technical process for soya milk

Dry beans are cleaned free of metal, grit stones, damaged beans and all extraneous matter. [separation is done by women using winowing fans] Cleaned beans are dropped into boiling water containing 0.25% of $NaHCO_3$ and boiled for 5-7 mts. The beans are then washed with hot water and, wet ground with boiling water. [Beans:water ratio is 1:10 by weight and filtered milk is then mixed with sugar 4% by weight of the extracted milk, permitted colouring and flavour [vanila, etc.,]. Then the mixture is possible is homogenized at 3500 psi in a homogenizer at 85° -90° C for 2mts. If a homogenizer is not available the mixture is blended in a high speed blender. The bottles are immediately capped and sterilized at 121° C for 20 mts after exhaustion for 20 mts in a water bath.

[source: Meegaha Kotuwa, (1996)]

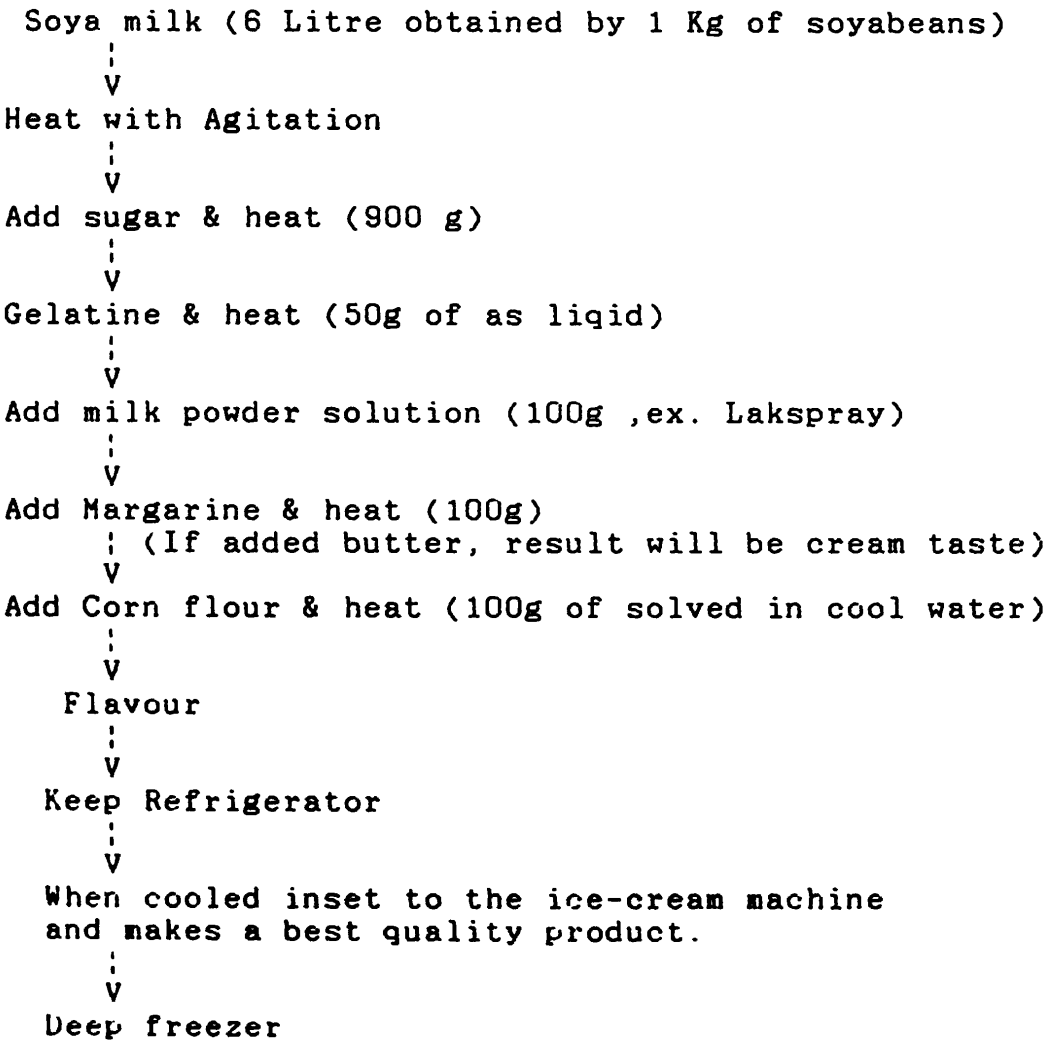
2.3. SOYA MILK BASED PRODUCTS IN SRI LANKA

2.3.1. Soya curd

Tofu is an oriental preparation. Tofu does not differ significantly from the protein found in most other soybean products. The biological evaluation of the nutritive value of soybean curd using animal or human subjects has given values which are comparable to properly heated soybean flour. Tofu has been tested as a source of protein in the solid diet of weaning infants and its performance evaluated with respect to acceptability. weight gain, Nitrogen balance. and serum level on the basis of these criteria, Tofu was judged to be nutritionally equivalent to the protein derived from a mixture of eggs, fish and liver.

2.3.2. Soya ice cream

Soya ice-cream making process as following in brief.



2.3.3. Soya yoghurt making

[Refer Page No. 50]

2.3.4. Sterilised soya milk

Sterilized soya milk making process as folowing in brief.

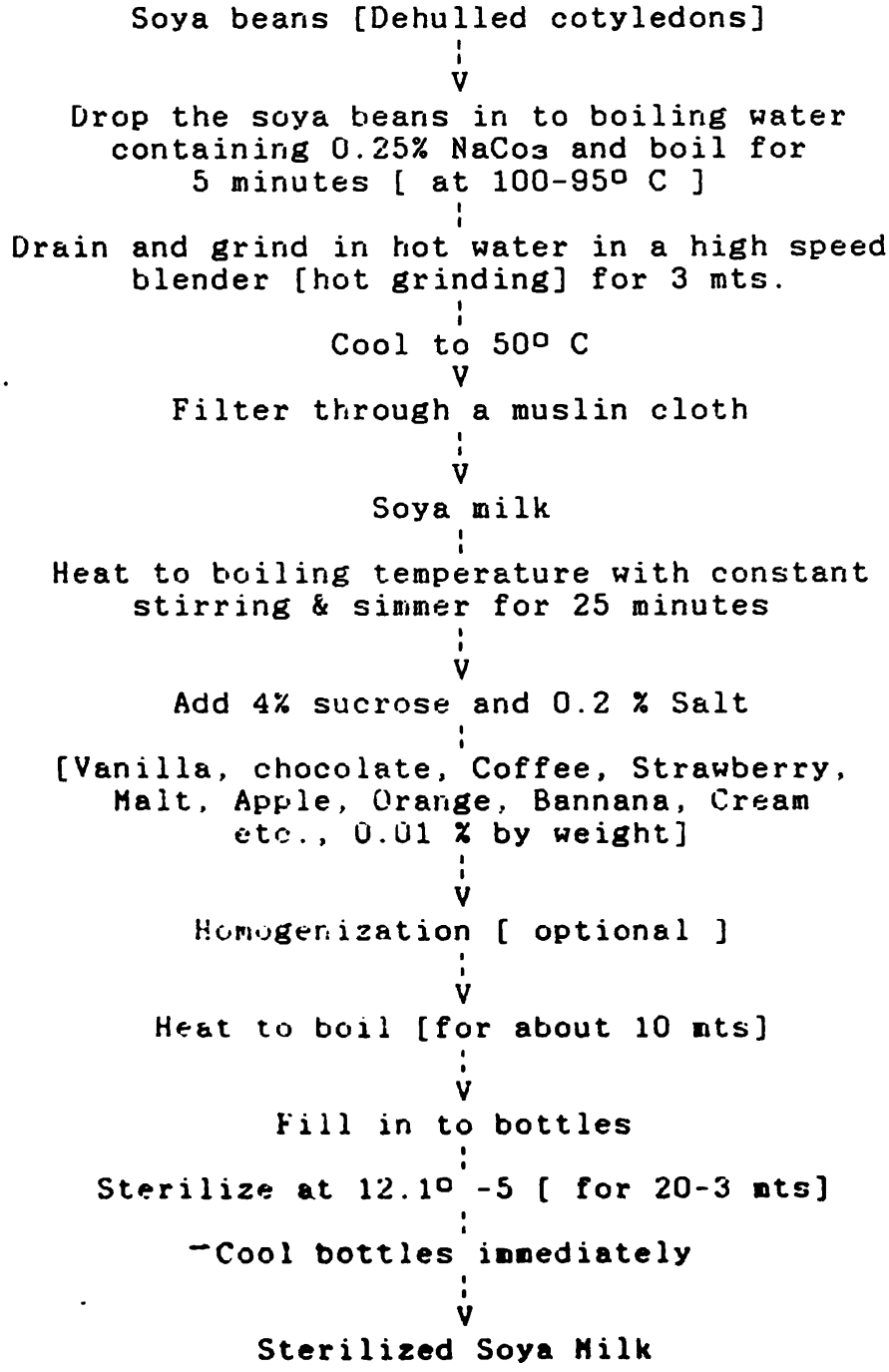


Fig.2.2 Flow diagram for soy milk process

2.3.5. Soya Tofu

Soya tofu making process as folowing in brief.

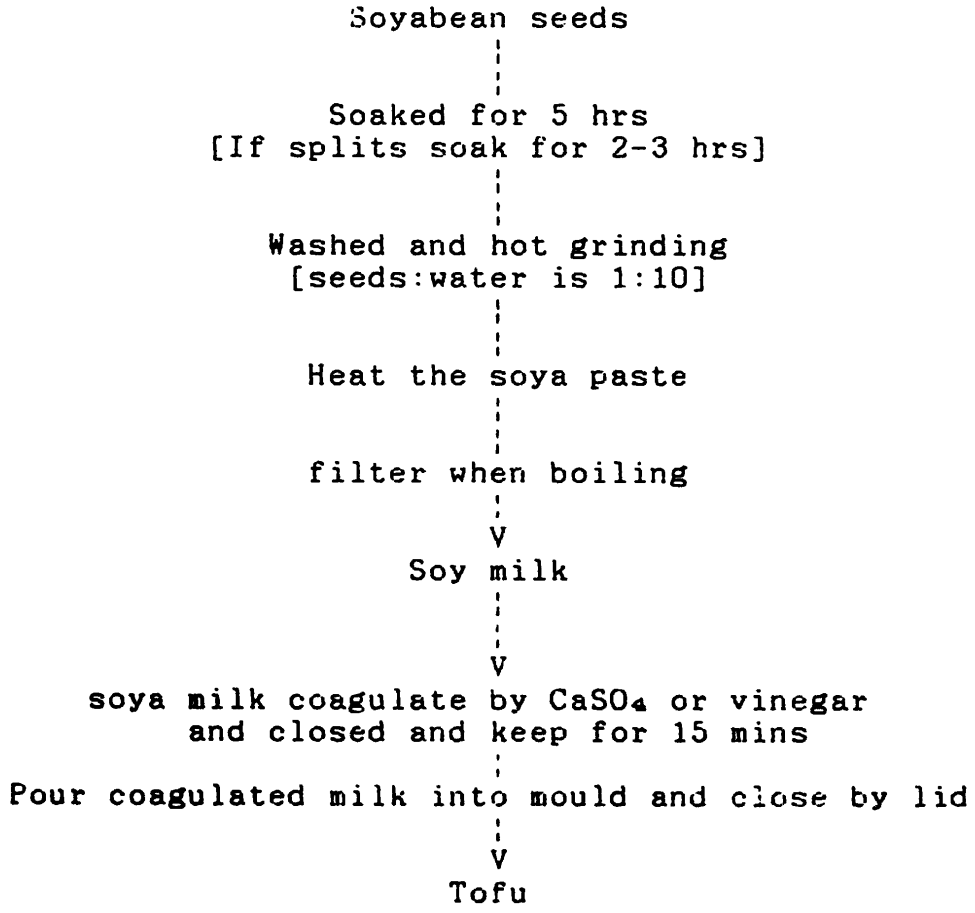


Fig.2.3 Flow diagram for soya tofu preparation

2.4. MILK PRODUCTS & THEIR TECHNOLOGY IN SRI LANKA

2.4.1. BABY MILK POWDER

The infant milk food is prepared in such a way that it is easily digested by an infant. It is more palatable than whole milk & is normally given at least upto the age of one year. The infant milk food industry is of recent origin.

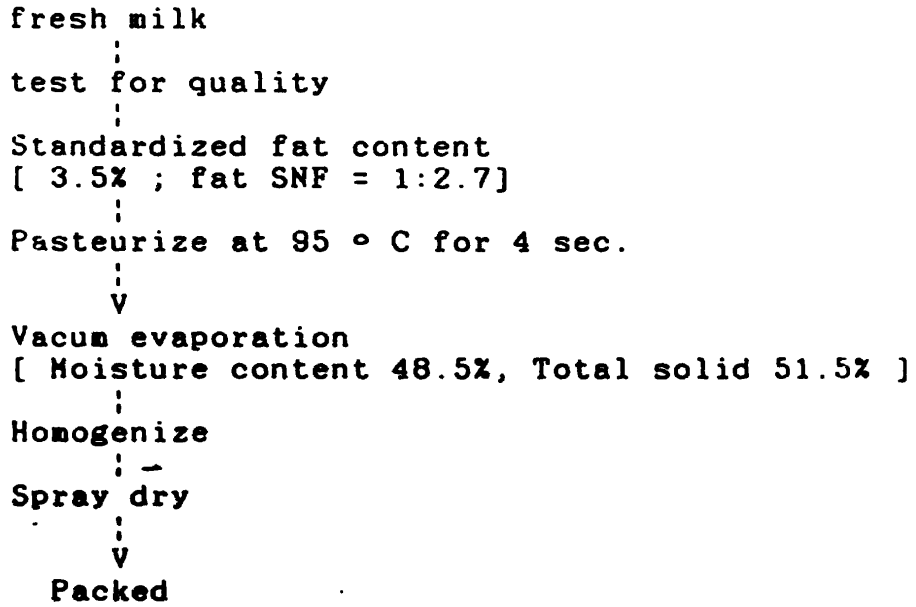
Technology & Process

The processing of infant milk food consists of standardization of fat in fluid milk, pasteurization, addition of sugar, drying of the product & packing it under inert atmosphere like N_2 gas atmosphere.

Modern spray drying process is used now a days which utilize spraying of concentrated milk in the spray drying chamber where it is dried by current of hot air. The process has the advantage of getting milk powder having better solubility, lower caramelized product & retention of original colour, flavour & nutrient contents.

2.4.2. DRY MILK POWDER

Manufacture of dry milk powder can explain as follows.



[Cited by Technology Information package , IDB]

2.4.3. STERILIZED MILK

Process of sterilized milk can explain as follows.

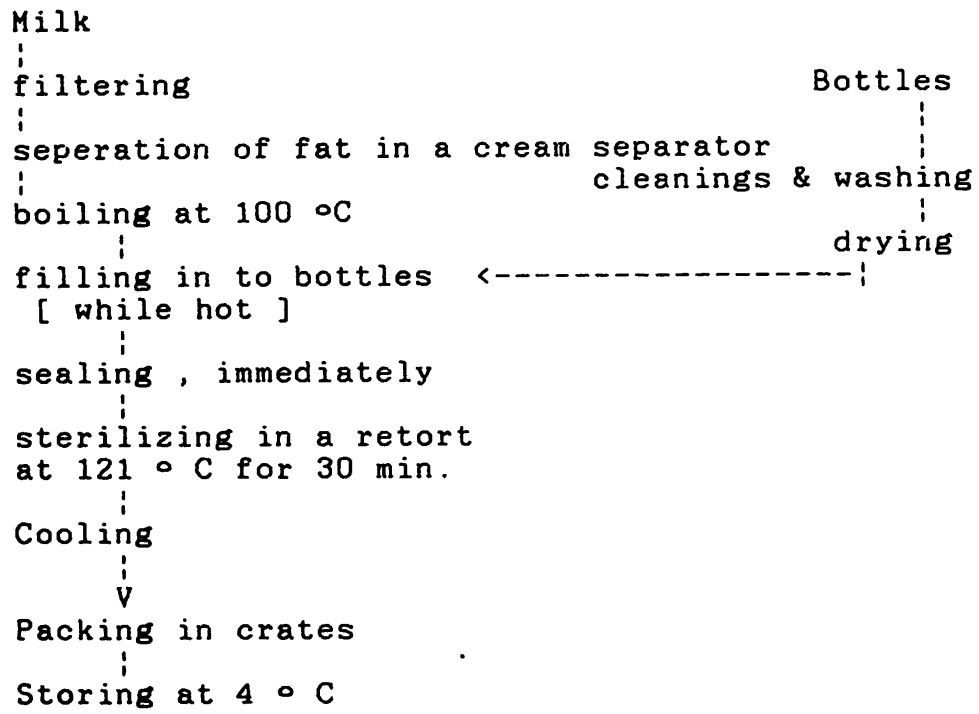


Fig 2.4 Flow diagram of sterilize milk proces

2.4.4. CHEESE

Cheese, a milk product obtained by the enzymatic coagulation of milk & subsequent drainage of whey, is rich in fat, fat soluble vitamins, protein, etc., It is taken as such as either salted & cooked with vegetables or is used for the preparation of other delicacies.

Technology & Process

Though differ type of cheese are produced commercially, the process below describe the manufacture of processed cheddar cheese,

The milk used should be preferably fresh & bacteriologically sound having an acidity of not more than 0.15% lactic acid.

The pasteurized milk is inoculated with a suitable culture of desired quantity & the milk is then held at 8-10 ^{o}C for about 12 hours. The milk is then transferred to sterilized cheese vats for further processing . Where the temperature is raised to 34-35 ^{o}C by circulating hot water in the jacket. A 40 % solution of CaCl 2 is added 15 ml per 100 l of milk. This is followed by the addition of the starter culture @ 1.5-2 % of the milk. The milk is then allowed to ripen until its acidity comes to 0.10 - 0.20 %. Hensor's powdered rennet is used @ 2.5-3.0 g for 100 l of milk. The re-netted milk is allowed to set till curd attains consistency similar to that required for cheddar cheese making. It is then cut into cubes & left undisturbed for 5 min.

The curd is then cooked gradually to raise its T' to 39 ^{o}C & is kept at this T' for 10 min. with constant stirring. The T' of the content of the vat is raised to 43-44 ^{o}C in about 10 min. & maintained for another 10 min. which is then lowered to 34-35 ^{o}C by circulation of cold water. The cooked curd particles are gathered at the end of the vat & allowed to settle down at the bottom of the vat. The vat is then covered with lid & its contents left undisturbed for 8-10 hours, until the acidity of whey increases to 0.4 to 0.45%, while the T' is maintained at 34-36 ^{o}C. The whey is drained off & the curd block is then stripped in to long pieces & passed through a milling machine to get small cubes of desired size. The sliced curd is uniformly spread in the vat & washed in the hot water for 4.5 min. taking care that the curd cubes should not float in water. The hot water is drained, the washed curd is filled in hoppers of 35x28x10 cm size & then pressed.

The block of cheese then obtained is smeared with salt mash & left in the cold storage [5-10 ^{o}C & 90% RH] for 48 hrs. The block is burned once & smeared with salt as before all the end of 24 hrs. Thereafter, the cheese is dried initially

for 48 hrs & then immersed in 18% brine solution. It is allowed to continue for 12-15 hrs in a humidity controlled at 15-16 ^{o}C & 10 degree RH. During this process, the upper surface of the floating block of cheese is sprinkled with dry salt on alternative days. The cheese block are then removed & left to dry at the same T' for 2-3 weeks subsequently, these are washed with water at 50 ^{o}C , dried, paraffined & kept in cold storage for another 4-5 weeks for further ripening. Total time for ripening is about is 8-9 weeks.

2.4.5. SEPARATION OF CREAM

Milk is separated to yield a fat concentrated product called cream from which butter, Ghee, Ice cream, etc., can be made. This is done by the use of mechanical or centrifugal separators, where in the milk is revolved swiftly in the separator bowls. A centrifugal force is generated, which is about one thousand times greater than the gravitational force. Consequently the milk is thrown to the outside of the arc in which it is travelling. Due to the difference in the specific gravity between the fat & the milk serum, the greater force exerted by the serum forces it to the outside of the fat in the bowl, causing the formation of the layers, one of serum & inside of that one of fat globules, closely held & interspread with some separation of these two layers is affected by releasing them from the bowl through different outlets.

2.4.6. MANUFACTURE OF BUTTER

The pasteurized cream is warmed to 70 F to which a starter of 5-10% by its Wt. is added & left for ripening for about 12-18 hrs or till its acidity develops from 0.2 - 0.4% .The main objective of pasteurizing the milk subsequently used for cream & butter preparation, is to kill the undesirable organisms which may be present & this ensures a better

keeping quality for the butter. The churner is thoroughly cleaned by scaling & washed with cold water to avoid sticking of the cream butter to the wooden surface of the churner. The churner is normally filled half of its capacity to get to better results. About 30-36% butter fat in the cream is considered to be ideal for churning . Churning is continued till butter granules are formed and cooled to some extent. Butter milk is then drained & washed with water.

The T° of cream should be maintained at 40 °F during summer and 55 °F in winter.Butter colour is added, if it is necessary salt is added, about 4% of wt. of butter. The churner is revolved at a lower speed to incorporate the salt properly & to compact the butter granules. Butter thus produced is made into blocks as per the desired wt. It is then packed and stored at ° OF . It can also be stored in brine in a cold cellar.

2.4.7. MANUFACTURE OF GHEE

A part of creamery butter is envisaged to be utilized for ghee manufacture. to avoid certain disadvantages of the direct cream method viz. a bulkier curd layer. availability of less butter milk from cream, to use the process taking a longer time & the chances of impairing the flavour of the finished product etc.,

The butter is heated over a slow well regulated fire stirring continuously till the curd particles burn slightly brown & settle down as a light brown precipitate. The maximum T° of classification should not exceed 120 °C. The clarified butter is allowed to stand for some time & then strained. Thereafter the ghee is filled to the brime in containers & these are sealed after the contents have cooled down to the room T° . Thus aids in the granulation of ghee.

[Gupta , R.K., 1993]

2.4.8. ICE CREAM

The raw materials for ice cream may be obtained from milk, cream, butter, sweetened condensed milk, powdered milk or separated milk, sugar, gelatin, lecithin, or egg yolk preparations, sodium alginate and flavouring essence etc.

Composition of ice cream mix

constituents	General range [%]	Typical ice cream mix-composition [%]
Fat	8-18	12
Milk solids not-fat	6-12	10
Sugar	13-17	14
Gelatin	0.25-0.5	0.3
Total solids	30-40	36.3
Water	70-90	63.7
Freezing point		- 2.26 'C

Given a mixture of satisfactory composition, the quality of the product depends on its texture which must be smooth and open. Several factors effect the texture.

1. Rate of freezing
2. Temperature of freezing medium
3. Mechanical whipping of air into the mixture by means of beaters.

By whipping there is a considerable increase in volume and a consequent open texture resulting from the stabilization of air-bubbles by protein adsorption. Without this whipping process the produce remains heavy.

Generally milk solids-not-fat should be kept below 10% in order to avoid the grittiness produced by crystallization of lactose. Gelatin improves the smoothness of ice cream, increases its resistance to melting and acts as stabilizer. [So sodium alginate is a stabilizer]

Lecithin or egg yolk preparations are good emulsifiers. On a large scale the mixture is pasteurized and then homogenized. Homogenization prevents fat churning and improves the smoothness of the product. After freezing and whipping, the

ice cream is transferred to hardening chests kept at 10 °C or lower, When crystallization is carried further and the product hardens and becomes ready for consumption.

There are several formulae available for the manufacture of ice cream. Any formulae used should have the components of milk solid non fat and sucrose not fat ad sucrose not less than 8% , 8% and 10% respectively according to the Sri Lanka Standards.

Technology - Industrial scale

The ice cream mixture made using the given or any other the ice cream mixes made cooled to 4 oC and kept at they tem. for 8-24 hrs. for again if facilities are available the mix should be homogenized at 55-65 oC at 180K/cm2 pressure. After again the taken in to the ice cream plant where it is subjected to simultaneous freezing and whipping. This process takes about 3-5 mts. The ice cream formed is packed in to suitable containers and kept for hardening at -20 oC to for 12-15 hrs.

[Rai, (1980) , Jasmin,(1994)]

2.5. YOGHURT PRODUCT TECHNOLOGY IN SRI LANKA

2.5.1. Medicinal Properties in milk yoghurt

Yoghurt is a fermented milk product, with custard like consistency, flavoured or non-flavoured , whose semi-solid characteristics differentiate the product from the fermented milk. It is slightly acidic, semi-solid, cultured milk food It is a vitamin rich and digestive drink available in a variety of flavours. It is more nutritious than other fermented milk products, because of its higher milk solid contents. In addition to this, yoghurt is well known to have antibiotic properties and widely consumed for controlling intestinal disorders.

2.5.2. Munufacture of yoghurt

Yoghurt can be made from whole skim milk available either fresh or in powder form. The raw milk or the skim milk is taken in a well cleaned vessel [illegible] recipe. About 3-4 % of skim milk powder and 8-9% of sugar is dissolved in warm milk. The addition of skim milk powder improves the firmness of yoghurt. The mixture is [illegible] about 5 minutes and then cooled down to a temperature of about 45 °C. Then the yoghurt culture is added.

In case of fruit pulp [illegible] pulp also is to be added. [illegible] stage along with some extra sugar to [illegible] taste [illegible]. The [illegible] distributed in small containers of desired size. The containers are then kept at a warm place at a temperature ranging 42-50 °C . When it gets completely curdled it is removed from the warm place. This generally takes 3 to 4 hours. The temperature should not be kept below 42 °C. Otherwise firm curd will not be obtained. Once the curd is set it is then transferred to a cool place, preferably a refrigeration. It is now ready for consumption.

2.5.3. Factors effecting quality

Few of variable should be controlled accurately during the manufacturing to be get high quality product. The taste, aroma, viscosity, appearance, freedom from whey are closely related with [illegible]treatment of milk and culture.

Above qualities depending factors are

1. [illegible] treatment
2. [illegible] Preparation
3. [illegible] standardization
4. [illegible]
5. [illegible]

2.5.4. Starter culture technology

The yog[illegible] [illegible] can [illegible] from the National Culture [illegible] National [illegible] Research [illegible].

The [illegible] by [illegible] the [illegible]

[illegible]

[illegible] placed [illegible] in boiling water for 5-10 minutes. water is then [illegible] gms [illegible] are [illegible] temp[illegible] drops [illegible] liquid [illegible] *L.bulg*[illegible] may [illegible] the time [illegible] milk for the preparation of the yoghu[illegible] *thermophil*[illegible] to 1 [illegible] to give [illegible] 1:1 [illegible]

These [illegible] at 40-50 [illegible] they curdle. The are then [illegible] and [illegible] in a refrigerator. This

way, the curd culture can be propagated everyday for preparing subsequent batches of fresh yoghurt.

[source : Gupta, R.K. (1993)]

2.5.5. Packaging of yoghurt product

Yoghurt is commonly packed as single user serve and convenient plastic cups with plastic lids or aluminum foil closures. Also yoghurt can be packing in spot.

Yoghurt can be storing for 2 weeks under refrigeration condition. (4-5 °C) Yoghurt cups are delivered to outlets [illegible] or secondary packaging which may be large rigiform [illegible] wooden pallets. When labelling of yoghurt cups [illegible] be done according to the following format as given in [illegible]

- Name of the product
- List of the ingredients in decending order or proportion
- Net weight
- Name and address of the producer
- Batch [illegible]
- Expiry date

2.6 RAW MATERIALS [COW MILK AND SOYA MILK]

In Sri Lanka the milk from cows, buffaloes and goats are used as the raw material in the production of pasteuized milk, sterilized milk, cream, cheese, yoghurt,butter, ice-cream, full cream milk powder and Non fat milk powder.

In Sri Lanka the total population of cows, buffaloes, goat are 1,782,000, 964,200 and 533,600 respectively in 1986. The monthly average milk production in Sri Lanka as below.

	1985	1986
Cow's milk	20,336,400 Litres	10,558,650 Litres
Buffaloe's milk	7,494,375 Litres	4,121,100 Litres

The total milk production in Sri Lanka can divided as below.

* Dry zone accounts for - 40%
* Wet zone-upcountry - 25%
* Intermediate zone - 15%
* Wet zone - low country & coconut triangle - 10%

Here not included the large and medium scale milk processing industries which collect its own milk. But included all other milk producers engaged in manufacturing of ice - cream and yoghurt using milk powder, due to lack of fresh milk in the Urban area. Otherwise dairies are mainly confinded to the rural and state sector.

All five cheese manufacturing plants in Sri Lanka used fresh milk from its own dairy farm. They are in hill country. Higher quality raw materials is one of the most important

factor for any industry or processing plants.This is valid for the milk industry too. Therefore raw material should be kept at higher level. Following are most important to achieve it.

2.6.1. Collection of milk

Milking is done twice a day in Sri Lanka, in the morning and evening. (evening milk has higher fat content about 4.0 - 4.2%) After milking, milk should be filtered to remove dust particles, etc., In large dairy farms, their milk is piped directly from the milking unit to a cool room within a filtration unit. Small dairy holders/farmers filter the milk through a sterilized kitchen strainer with a clean cloth as filter medium.

* Then add the solution of H_2O_2 in to milk to avoid milk spoilage or contamination, until transport to the chilling certre. In this 1 Littre of H_2O_2 enough for 1000 Littie of milk and should done for every 6 hours.

After collecting the milk it will process or chilled as soon as possible.

The milk transport bowsers are divided by means of baffles. It also minimize surging. But it can act as agitations and may tend to charm the fat in milk. It is the disadvantage of baffles.

2.6.2. Method of collecting milk

Milk is collected either in cans or bulk tanks twice a day. Small industrialists collect milk using Aluminium cans. There are 10 l, 20 l and 40 l in volume .

The milk from the producers was bring to the collecting centre which is set up in the close proximity to chilling centres or processing centre. A cluster of collecting centre are generally located within 10 Km radius of the the processing centre for milk to reach the cooling or processing centre within two hours after milking to prevent spoilage and to insure quality.
Chilled milk from these centres are transported to processing industry by insulated bowsers. It has 400-600 tons capacity. (ex. Abewela.)

2.6.3 Cooling of milk

If the milk could not processed during the same day then the milk has to be chilled to 4° C to minimize the growth of microorganisms. Chilling is usually done in aluminium cans or Jacketed stainless steel tanks. In small scale chilling centres, milk is cooled in aluminium cans and that is normally done by covering the milk cans with lids and placing them in a bath of cold running water.

The large volume of milk was cooled in Jacketed bulk tanks fitted with agitators are used. Where cold water from a refrigeration unit is circulated through the Jacket. This process generally takes about 4-6 hrs. for rapid cooling.

2.6.4 Quality and quality control of milk

Maximum attension should be given to the quality of the collected milk. It will greating influence on the quality of final product. The quality and quality control are very important in milk industry. To check the quality small scale producer carry out simple spot tests such as lactometer test, organoleptic tests (flavour, colour, taste and smell)

etc., to minimise the capital outlay for testing facilities where as large milk processing companies have their own laboratories. Where do other elaborate testing such as colony counts, salt gerber test , special tests for added chlorine etc.,

To carry out organoleptic test not required the equipments. Remove the lid from milk and can observe it. milk colour is varies from bluish white to yellowish white. The taste of milk is pleasant without any after taste.

RAW MATERIALS OF SOY MILK

Soy milk and other products obtained from soyabean. There are two type which are whole soyabean and dehulled splite. Soyabean seeds can buy from Pal Vehera Goverment farm or open market in the Sri Lanka. Can get at 25/= to 35/= per Kg. When manufacturing soy milk from soyabean must be followed few important steps before begining of the process.

2.6.5 Cleaning of Soybeans

Cleaning is one of the most important step in preparing excellent tasting soymilk, Soybeans often contains foreign materials such as stones, straw, grass seeds, dirt, dust and metals such as small nuts or bolts. Thus, removing these unwanted materials is necessary in terms of eliminating foreign flavor and colour or seriously damaged euipment.(coliod mill etc.,) In addition cleaning also reduces the microorganism associated with the foreign materials.

Dehulling of soybeans

Dehulling refers to removal of the outer seed coat or hull. Soybean seeds consist of about 8% seed coat on dry basis. The seed coat is mainly composed of cellulosic type materials, but it contains about 8% protein. the soymilk prepared from whole soybeans is very viscous due to the fibrous materials in the seed coat.

Dehulled soybeans used for preparing soymilk can be selected from larger soybean varieties which are available in the market.

2.6.6. Dehulling process of soybeans

The soybean dehulling process includes 3 steps. First, the soybeans are heated in a through - flow air drier [at 200 °F for 15 min.] to a moisture content of 12-14% . The function of this treatment is to break the bonds which loosens the hulls from the cotyledons. After that heated beans are passed through a roller and stationary concave plate. The hulls which are very brittle are broken while the cotyledons which are resilience are still intact. The hulls are finally seperated from the cotyledons by air aspiration.

Dehulling efficiencies of this operation are up to 88%
[source : Publications of University of Illinois.Urbana.]

CHAPTER III

MATERIALS AND METHODS

Sterilized soya milk and soya yoghurt Production in Gunnoruwa.

Food Research Centre at Gunnoruwa, consist two units, food research division and soya food products division. Also there are proper laboratory facilities to examine food. There produce so many soya products, such as tofu, soya ice cream, soya yoghurt and sterilized soya milk, soya tempe, etc.,

I could observe and trained thoroughly about production of sterilized soya milk, soya yoghurt and tofu. Which are soya milk products. But making of soya yoghurt is produced in introductory level. But soya milk is produced in medium level. To produce all of these soya products they purchase the soybeans from Palwehera government farm and small scale farmers. BP-1 is the common, variety they had taken. Also there are enough equipments to made soya products.

3.1. Sterilized soya milk Production - Gannoruwa

INGREDIENTS

* Whole soybeans/cotyledons - 12 1.2 Kg
* Sugar - 10 Kg
* Salt - 0.2%
* Flavouring - 0.01%
* Stabilizing agents

EQUIPMENT

* **Seed cleaner**
* **Sauce pan**

* Spoons
* Heat source
* Colloid mill
* Weighing scale
* Centrifugal machine
* Heat exchanger
* steam boiler

PROCEDURE

* Whole, clean and fresh soybeans are soaked for 3-5 hrs in running water at 25 °C .

Fig. 3.1
soaked soybean seeds

* Soaked soybeans have to be blanched in boiling water for about 5 min.

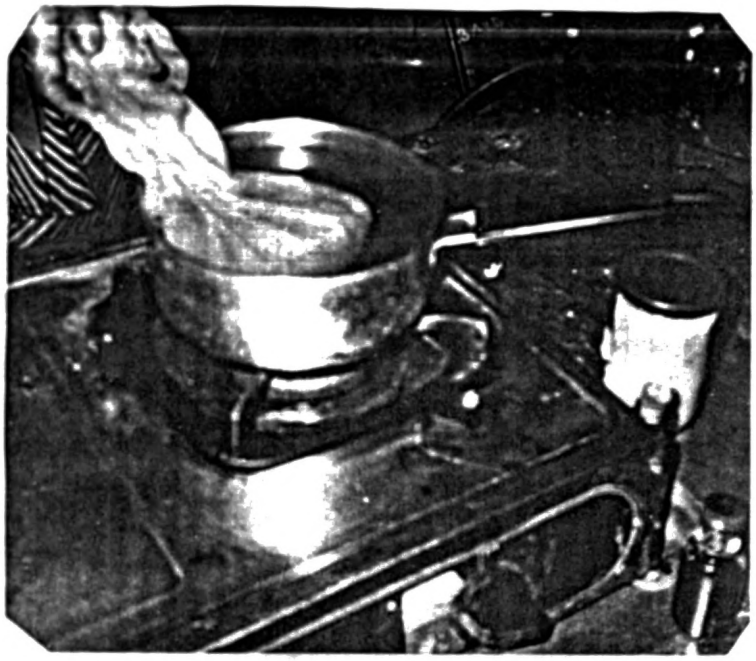


Fig. 3.2 Soybean /Blanching operation

* Then hot soybeans should be washed with cool water as well.
* Soybeans are being ground in hot water in a high speed blender for 3 min. Also can be used colloid mill.

Fig. 3.3 Soybean /grinding operation using colloid mill.

* Allowed to cool about 50 °C and can be filtered through a muslin cloth. Also can be used centrifugal machine for better filtering.

Fig.3.4 soya milk filtering / centrifugal machine

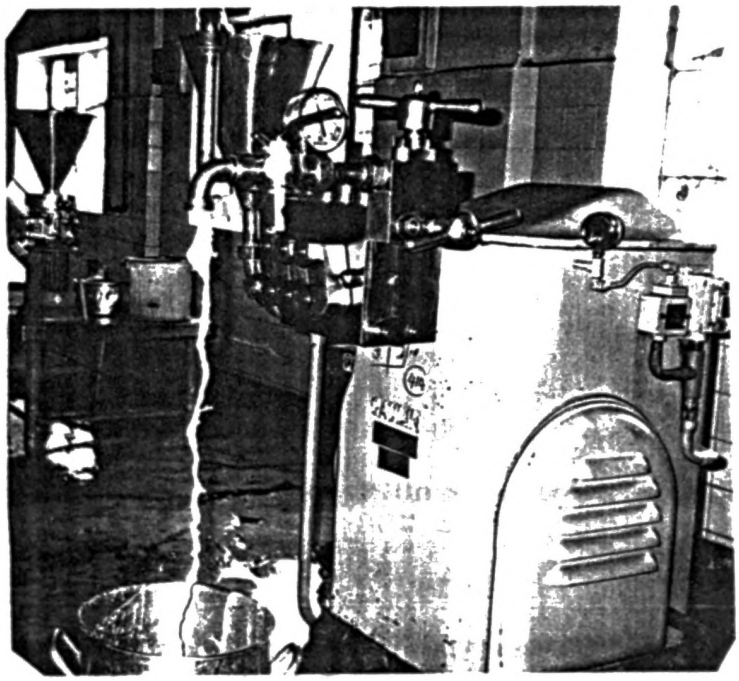
* Then separates soy milk must be heated to boiling temp. with constant stirring & simmer for 20 min.

* While soy milk are heated can be added sugar [4%] salt [0.2%], flavour and stabilizer, with stirring.

* Any volatile flavorings are added to the soy milk just before homogenizing.

* Then formulated soy milk is homogenized at 4000 psi.

Fig.3.5 formulated soya milk / Homogenizing operation at 4000 psi

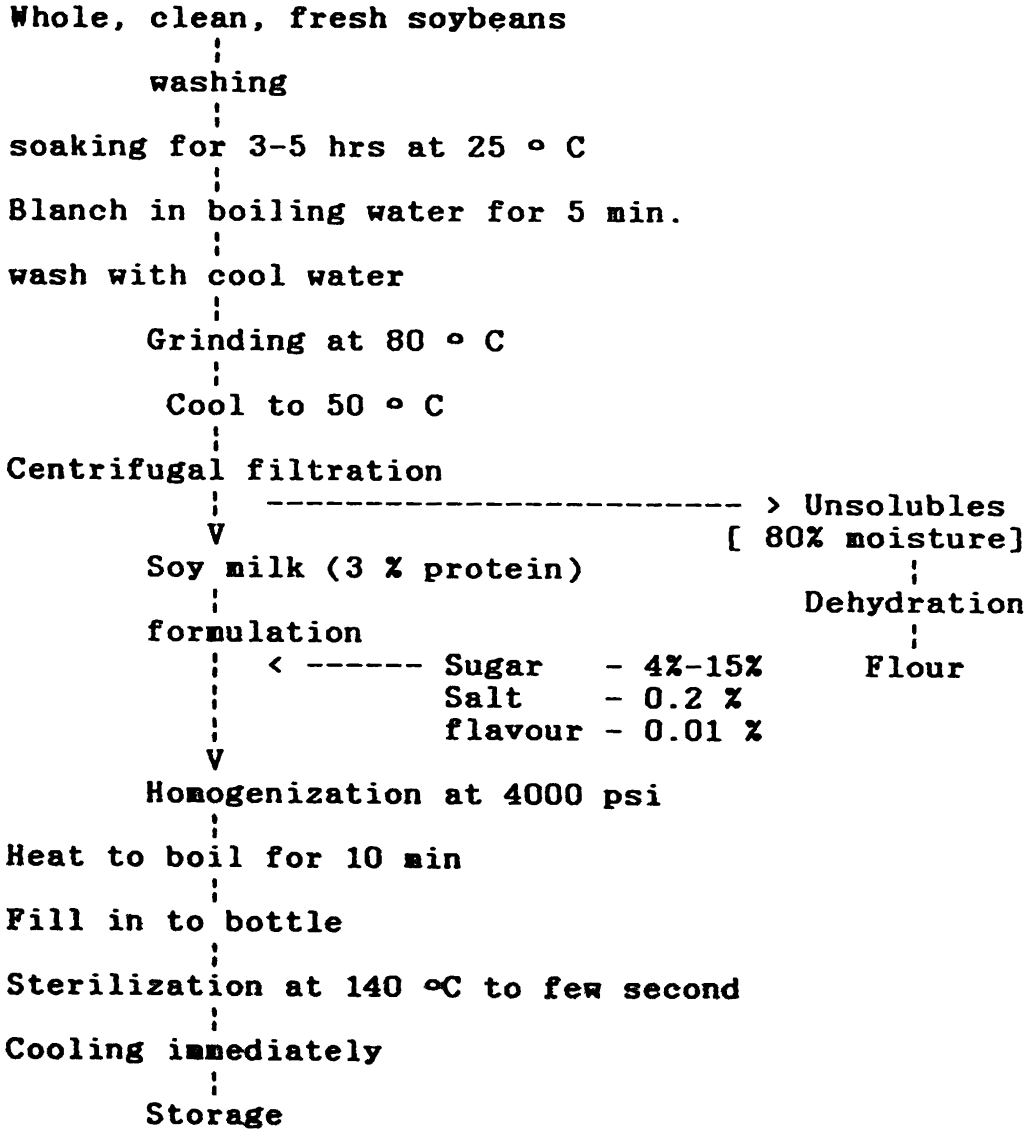


* Soy milk is heated to boil for 10 min.

* Then must be filled in to bottles.

* Homogenized soy milk is sterilized in a heat exchanger at 140 ° C for few seconds and immediately cooled.

Fig.3.6 Flow diagram for Sterilized soya milk process



3.2. Soya milk based yoghurt making

INGREDIENTS:

Soya milk	- 6 Litre
Cow milk	- 2 Litre
Sugar	- 500 grs.
Gelatine	- 80 g
Salt	- 8 g
Fresh yoghurt	- 1 cup
Colouring	- egg yellow solution

EQUIPMENTS :

Heat source [gas cooker]
Basin
cleaned plastic cups

PROCEDURE :

* If used buffalo milk or cow milk, first mixed them with soya milk. Then boiled upto 90 °C for 20 minutes. Agitation must do while boiling.
* When uses milk powder (such as Laxpray etc.) these are added then soya milk solution is concentrated.

* Then gelatine solution and sugar were added and again it was boiled.

Fig. 3.7 Soya milk /Heating Operation

* Keep to be cooled and add colouring and mixed well.

* When temperature is about 37 °C and add starter culture. Can use fresh milk yoghurt as culture, which is 5-6 of table spoons of fresh yoghurt and prepare as cream. Then add and mixed well.

* Pour the mixture into cups as slowly.

* Then covered and kept to set a yoghurt for 6 hours with worming.

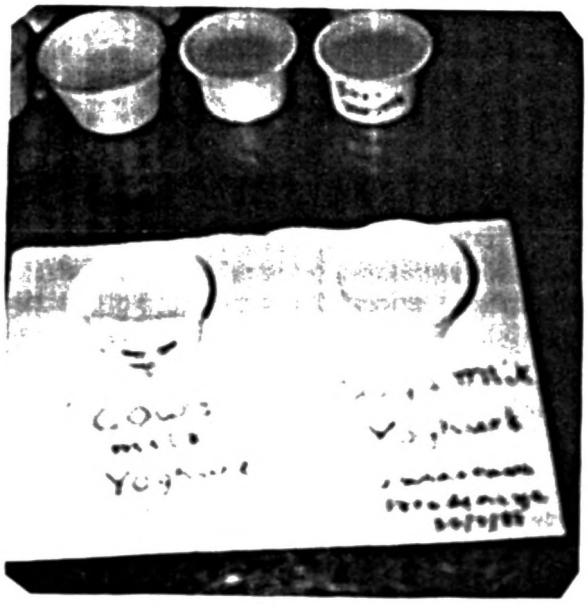
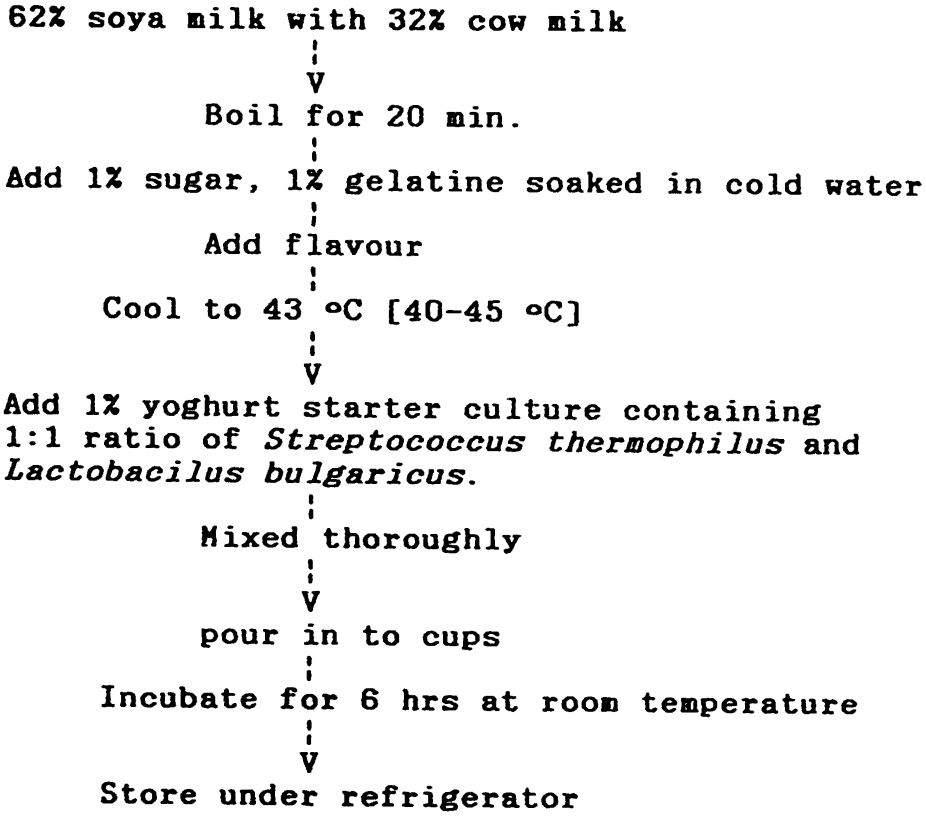


Fig. 3.8 Comparison of colour / Soya yoghurt with cow milk yoghurt

* Can prepare 65-50 cups by the above mixture

Fig. 3.8 Flow diagram for preparation of soya yoghurt



3.3. Cow milk based yoghurt

The milk product manufacturers in matara district brought milk from milk collection centres and small scale milk farmers, situated in Thihagoda in matara district and from Labuduwa, Ambalangoda and Debarawawa in southern province. All of these collecting and chilling centres are managed by MILCO.

Thihagoda chilling centre collected milk from surrounding ares. Which are Mapalana, Kamburupitiya, Kotawila, Kotapola, Bibulewela and Mulatiyana. A small scale milk farms are situated at Mapalana under faculty of Agriculture, University of Ruhuna and the Telijjawila farm at the matara district Agriculture Training & Research Centre.

Thihagoda centre had collected 1200-1300 Litre of milk per day. Statistics shows that a monthly milk collection of this centre is 40,000 Litres and the most of part will be transport to Narahenpita factory. Some used to produce yoghurt, ice cream, and other confectionery products.

Among these products, yoghurt is popular in this area. reasons may be the lower product cost, machine equipments and lower labour requirements. There are so many yoghurt producers in this district and most of these are small scale producers. Most of them are used cow's milk for their production.

I had the opportunity to observing the yoghurt making at Kamburupitiya under Matara district.

It was needed to be observed yoghurt production under milk production to submit this project report as student of the

food science and technology course, University of Sabaragamuwa. I selected at Lucky Industrity in Kamburupitiya for this task.. It is a popular name in yoghurt production in matara district. Also it has a branch in Kadawata. Kamburupitiya centre produces 2500 cups of yoghurt per day. Also I had observed different yoghurt producers, which are Chamil yoghurt at Akurugoda and Tufi yoghurt at Pannipitiya in Clombo district. That comparison helped me to proposed more suggestions to improve the quality of yoghurt.

However here I had mentioned only the kamburupitiya yoghurt production.

Milk yoghurt production - Kamburupitiya.

They are medium scale producers. They produce 2200 cups of yoghurt per day.

INGREDIENTS

Cow milk	- 13.5 Litre
Sugar	- 1.5 Kg
Milk powder	- 1.3 Kg
Gelatin (G.Blume)	- 84 g
Vanila	- 8-9 tea spoons
Colouring/egg yellow	- small quantity
fresh yoghurt culture	- 5 cups

* colouring (egg yellow) , vanila are added very small quantities by experience.

EQUIPMENTS

Heat source / Gas cooker	- 1 No
Sauce pan	- 3 No
Basin	- 1 No

filter	- 1 No
wood spoon	- 2 No
Plastic jug	- 2 No.
Cleaned cups	-

PROCEDURE

* The cow milk were filtered twice.
* The milk were boiled upto 100 °C for 1 min.

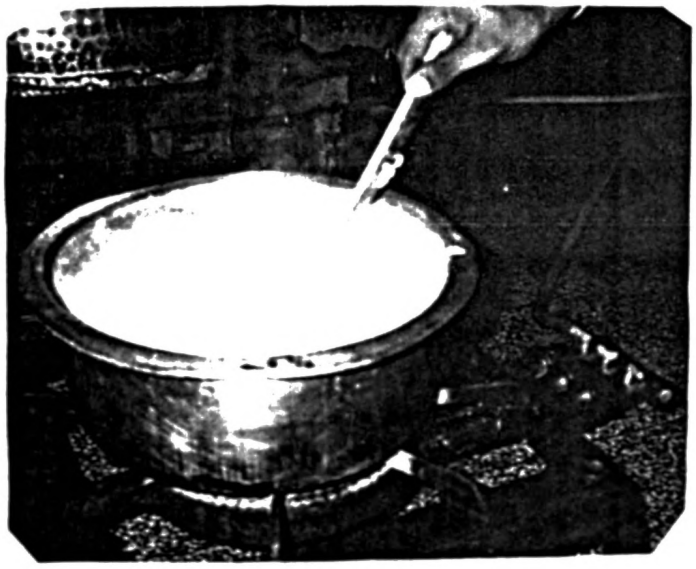


Fig. 3.9 Heating operation

* Then sugar is added as it spreading and mixture is heated again until mixed.
* Milk powder was dissolved in enough water and added to the mixture and stirred.
* It was allowed to cool to about 40-45 ° C and previously dissolved gelatin and colouring , vanila are added into the mixture.

* Then starter culture should be stirred well and added them into the mixture through filtering when temperature is about 40- 44 ° C.

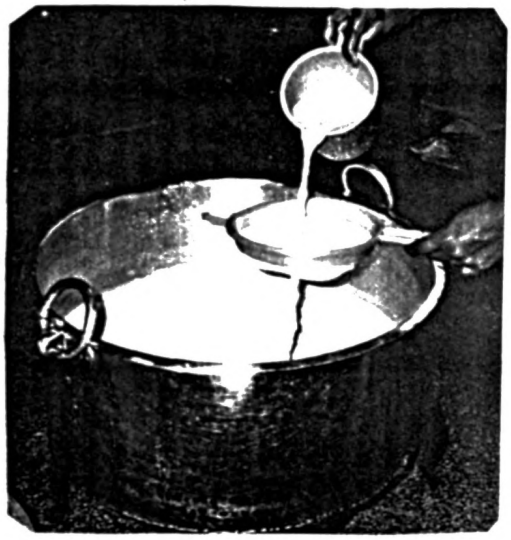


Fig. 3.10 Adding starter culture

* It was stirred well by a spoon.

* Cleaned plastic cups are filled with milk upto about 3/4 level and about 1/2 level for fruit yoghurt.

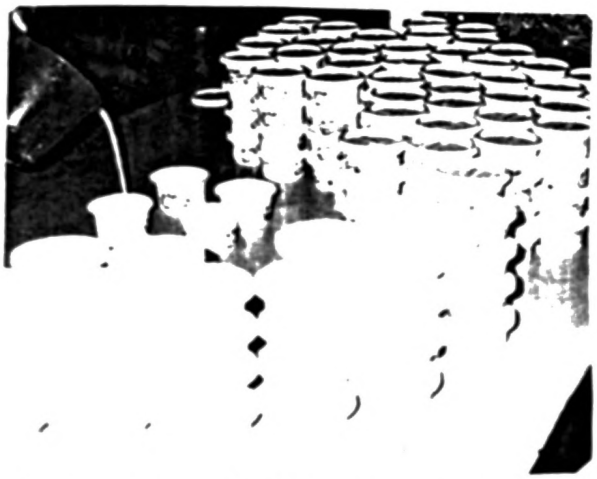
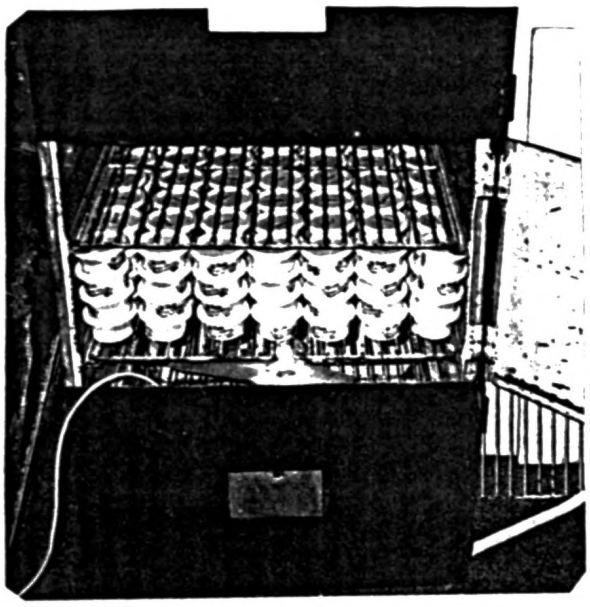


Fig. 3.11 filling a mixture into cups

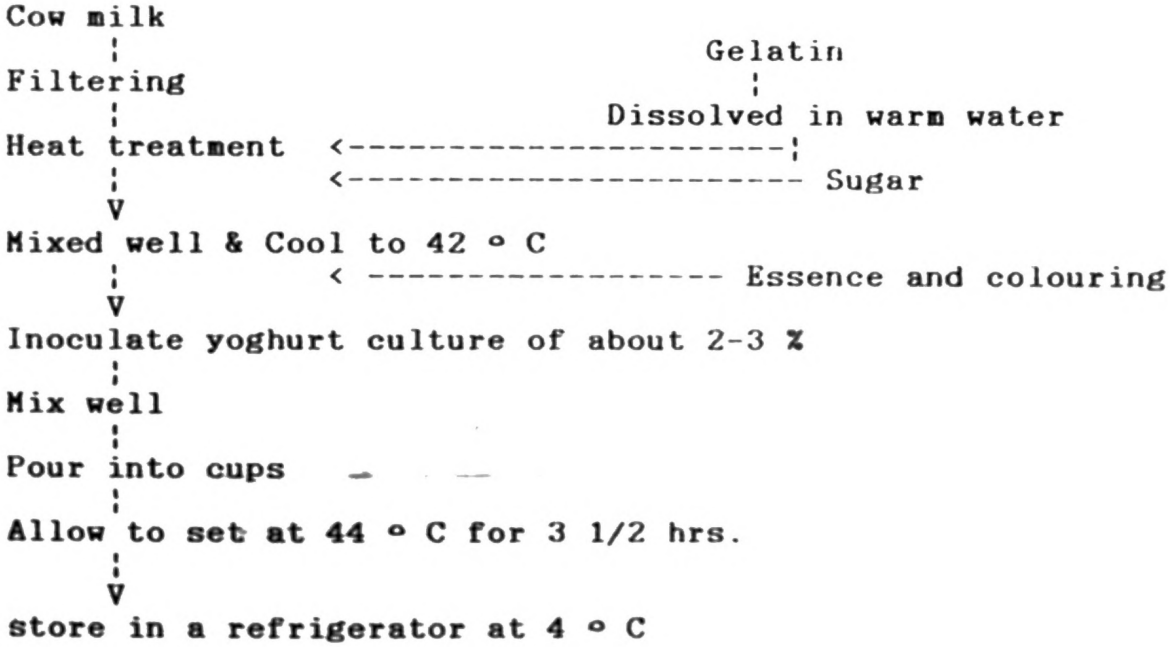
* Then cups were incubated at 44 °C for 3 1/2 hrs. until milk becomes harden.

Fig. 3.11 Incubating operation at 44 °c



* When setting was over that cups were stored in refrigerator at 4 ° C.

Fig. 3.12 Flow diagram for milk yoghurt making



CHAPTER IV

OBSERVATION AND DISCUSSION

** OBSERVATION AND DISCUSSION - SOYA MILK PROCESS*

The composition of the soya milk varies with the variety of soyabean and with the method of manufacture. Straw yellow or yellowish green varieties of soyabean can be used and it is needed to remove the unwanted materials. It helps to eliminate foreign flovour and colour or seriously damaging of the equipment. (Blender, Colloid mill etc.,) Cleaning is also help in preparing excellent tasting soya milk.

Gunnoruwa soya food centre buy soyabean seed from Palwehera farm and from small scale farmers in the area. Then dehulled the seeds. It helps to remove off-flavour of soya milk. Dehulled soybeans used for preparing soya milk. Can select larger soybean varieties which are available in market. Also it improves soya milk quality by improving flavour, colour and shelf-life of the product. Dehulling shortens the blanching time, reduces the denaturation of the protein, Which improves soya milk quality.

Blanching is the next important step in preparing soy milk. It has two functions. Which are hydration of cotyledons and inactivation of enzymes. Lipoxygenase enzymes are responsible for beany off flavour in soy milk. Beany off flavour develops when the seeds are damaged. Also trypsin inhibitor is another enzyme in soybeans, which reduce protein digestibility. These enzyme can adequately decreased by blanching and cooking of the soya milk.

Blanching steps can be achieved by few ways. Drop the soy cotyledons in to boiling water containing 0.25 % $NaCo_3$ and boil for 5 min. But I did not apply this to prepare soya

milk. Because of that flavour of soya milk can be affected. Instead of that I used the soyabean seeds soaked for 3-5 hrs at 25 o C and blanch in boiling water for 5 min. When soaked enzymes are dissolve in water and boiling then these are destroyed. This can apply to prepare soya milk at home level. Also soaking helps for highest soy milk yield. Besides inactivating enzymes, blanching aids in further cleaning the cotyledons and reducing water soluble oligosaccharide, such as raffinose and stachylose which cause flatulence. However Nacos serves several functions during blanching process. It tenderizes the cotyledons to allow shorter blanching time and aids in reduction of trypsin inhibitor activity. Soya milk obtained from this process has a P^h of 7.1 , therefore the protein in the soy milk is highly soluble and overall flavour is greatly improved. Then blanched soybean was washed with cool water to discard the enzyme solution.

Then we ground soybean in hot water in a high speed blender. Also can use colloid mill at industry level. Grinding results in releasing cellular components. Allowed to be cooled about 50 ^oC and filtered through a muslin cloth. It is used at home level. Otherwise can use centrifugal machine for better filtering at large scale.

The amount of hot water use at grinding step range from 5-10 times of dry cotyledons weight and this concentration affects the richness and total solids and protein recoveries. Reducing water addition increases the richness of the soy milk with higher solids and protein yields in the soy milk. ex. soy yoghurt making. If it remain with very fine insoluble materials which may result in poor mouth feel or chalkiness in soy milk. These fine materials are essentially removed by the 200 mesh screen separator.

After the extracting and filtering , soy milk is simmered at 185-190 ° F for 20 min. The purpose of cooking is to further inactivate trypsin inhibitors as well as some proteolytic enzymes and destroy microbe & improve flavour of soya milk.

Soy milk should be formulated during the cooking. By adding 4% of sucrose, 0.2% of salt and 0.01% of vanila, chocolate, bannana, strawberry by weight, can gets excellent tasty and flavouring soy milk.

Then formulated soy milk is homogenized. The objective is reducing size of fat globules and remaining insoluble materials into very fine and uniform particles by forcing them under high pressure (about 4000 psi) through very small opening. without homogenization the fat globules tend to form clumps and rise to the top of the storage container while the remaining insoluble particles tend to settle to the bottom. Homogenization gives to soy milk a smoother, creamier and whiter and increase the volume of milk. In addition it improves the uniformity of the product when formulating ingredients are added to soy milk.

Sterilizing of soy milk is needed, to store for a long period. otherwise soy milk can be spoilaged. because of it is ideal for medium for microbial growth.

* By adding of 25 % of cows milk with soya milk give excellent taste and flavour of soy milk.

** OBSERVATION AND DISCUSSION - SOYA YOGHURT PROCESS*

Here soy milk is used as a substitute for cow milk. I can recommend to use 35% of cow milk mix with 65% of soya milk for high quality of soya yoghurt. Also help for quality these. more concentration, total solids and protein yield of soy milk. (1 Kg of soybean --> 5-6 Litres of soy milk)

Adding of cow milk is important it gives lactose for fermentation. Also adding of sugar improves the taste of yoghurt. Then dissolve gelatine in cool water and add. [1 teaspoon per 1 Lit. of soy milk]

In soya yoghurt making; mixing is vital. while heating operation. otherwise milk can be coagulated.

Also sufficient quantity of colouring [egg yellow] & vanila should be added when cool. Then starter culture can add at 37-38 °C. And can use fresh milk yoghurt. [1 table spoon per 1 lit. of soy milk] But first it prepare as creamy. it is needed to avoid the forming of foam while mixture is pour into cups. Then keep without lid for 1/2 hrs. to eliminate vapour making.

However incubator is not needed for setting of soy yoghurt. It sets at room temp. It is the advantage than milk yoghurt. I observed that enough setting during 3-4 hrs at room temperature, but cups are needed to be closed to remain heat.

After setting it transfer to refrigeration. but soy milk can not store more than one day. It can account for high protein and fat content of soy milk. It is very favourable for microbes.

* OBSERVATION AND DISCUSSION - MILK YOGHURT

Usually the milk purchased for yoghurt making is from small scale cow milk farmers. In this case, the purchased milk contains varies water percentage. As some milk farmers add more water into milk for their market advantages.Therefore kamburupitiya yoghurt factory has been noticed that 100 ml of milk is reduced per 1 Litre for more diluent milk. The milk quality depend on water content. This factor is very important as it can be effected the milk coagulation. The less water content helps more coagulation rate and quicker the formation of yoghurt.

Next important factor regarding milk is their pureness. The common milking method is hand milking in this areas. But milk farmer less applied the sanitary instruction for milk. Milkers and their hands should be cleaned prior to milking. Also milk containers and other used utensils must be sterilized. If disagree, milk can be contaminated with microorganism. Therefore must use properly sterilized vessels.

Raw milk has to be filtered two times which is more important for quality. However items used in this operation should be cleaned properly.

The quality of yoghurt can be effected to a considerable level by the heating operation. They use gas cookers to heat the milk. It reduce the problem such as ash forming from flem and adulterating the milk. In this operation a special attention should be paid that not to allow and overflow of milk. If it is not used, better to use fire wood by covering the vessels, and open when milk is reached to over flow.
In heating optimum temperature is about 82-93 ° C for 30-60 min. However the objective of this is to be minimized microbial population in milk.

Also other vital factor is quality of the starter culture. It is depended on the age of the culture and the condition of it is kept. So that producer should be more attention in selecting a fresh starter culture. I observed that most of them used their own prepared culture. If they use yoghurt available at the market, they must consider about the freshness. So that producer should be educated and encouraged to select a fresh culture. In addition they should be given instructions to add starter culture at 40-44 ^{o}C . Because of bacteria in the culture well performed at this temperature.

In the yoghurt making process use gelatin, vanila, coloring, essence and sugar as additives. But these additives should be added in proper quantities and temperature. So that the producer should be educated on that background, and when adding gelatin, milk is very hot and as dissolved in water.

Also important to control the incubating temperature. I observed at the Kaburupitiya yoghurt producer that had a better incubator and they used a thermometer.

There are satisfactory transporting facilities. They had two vans and used regiform boxes for storing the product while transportation. It's wall consists a layer of cotton wool. It is kept at optimum temperature. If producer have not proper transport facility, they can use shock-proof, also must took steps avoid shaking of yoghurt.

Quality of yoghurt & shelf - life is depend on fat content of milk. According to several studies , more fat in milk is more susceptible the yoghurt shrinkage. This can be lead to destruction.

RECOMMENDATIONS

* SOYA MILK & SOYA YOGHURT

* Soybean seeds should be took freshly. It should be used within 6 months after harvesting. Also the damaged seeds, discoloring seeds and other unwanted particles, should be removed.

* Soybean has to be cleaned. It is the most important step in preparing excellent tasting soy milk.

* Unwanted materials should be removed , which is necessary for eliminating foreign flavor and colour or seriously damaging equipment [Coild mill etc.,].

* In addition, Cleaning also reduces the microorganism associated with the foreign materials.

* It can be recommended the dehulling of soybeans. Because of it is improved soymilk quality by improving flavor, colour and shelf-life of the product. Also dehulling shortens the blanching times, and reduces the denaturation of the protein which improves soy milk quality.

* The step of blanching of soya cotyledons. Because of trypsin inhibitors which reduce protein digestibility.

* It can be proposed soymilk is simmered at 185-190 °F for 20 min. which is further inactivate trypsin inhibitors, some proteolytic enzymes and destroy microorganism and improve flavor of soy milk.

* The addition of vitamins [such as vitamin A & D, thamine, riboflavin,] and Calcium is necessary if the milk is to be used as a substitute for breast or cow milk in infants

* When making soy yoghurt should be add at 35% of cow milk with soy milk for excellent quality. Also It is important for better fermentation.

* It can be added fresh milk yoghurt as a starter culture and it should be in creamy condition.

* It is required to add the correct amount of gelatine, dissolved in water at the temparature of 60 ^{o}C to improve the quality of soy yoghurt.

* Also important to add sufficient amount of Colouring and flavor when mixture was at 40 ^{o}C for highest taste and quality of soy yoghurt.

* Mixture should be poured in to cups without forming foams and must not be closed with lid for half an hours to eliminate vapour forming and should be kept at room temperature to set the soy yoghurt.

**** MILK & MILK YOGHURT ****

* **The milk farmers should be trained in the fields of cows sanitations, proper milking. Because the quality of milk product was directly depend on raw milk.**

* **Milking utensils and milk collecting utensils must be kept as clean and dryness. It can be achieved by washing with cool water, hot water and by sterilizing daily.**

* The starter culture should be added when the mixture is reached at about 40-44 °C. At this temperature culture bacteria will perform well. This is suggested for better hardening.

* It can be recommended the milk solid amount should be between 20% - 24% and fat content between 3.5% - 4.0% for standard yoghurt products, to increase the quality. when the fat level is below 3.0% the setting will be slow.

* Yoghurt product is incubated at 44°C for 4 hours for the high activity of culture bacteria of [*Streptococcus thermophiluss* and *Lactobacillus bulgaricus*]. Otherwise if the temperature reached 50°C culture bacteria will grow fast and change the texture of the product.

* It can be suggested to use the thermometer to check the incubating temperature and it will help to adjust the generating heat.

* It can be advised to keep the yoghurt product below 4/5 °C for it's optimum growth of culture bacteria. When the temperature reached to about 2 °C culture bacteria can be changed the structure.

* It can be proposed to use a shock proof container and it must be kept at optimum temperature while transporting of yoghurt to the market.

REFERENCES

1. Alfa Laval, A.B., Dairy Hank Book, 1st Ed. ; Dairy and food engineering publishers, P. 1-30 (1986)

2. Andrew, L., Kate Barber., Milk and Milk Products, Agro Botanical Publishers, P.29,111 (1993)

3. Aurand, L.W. and Woods, A.E., Food chemistry, 2nd Ed. ; The Avi publishers, P. 76 & 77 (1979)

4. Ecles, C.A., Combs., W.B. and Macy, Milk and Milk Products, 4th Ed., P.212 (1993)

5. Frazier, W.C. and Westhoff, D.C., Food Microbiology, 3rd Ed.; Tata McGraw - Hill publisher, New Delhi (1978)

6. Gupta, R.K., SBP Hand Book of Export Oriented Food Processing Projects, SBP consultants & Engineers (pvt) Itd. publishing; P 350-765 (1993)

7. Jasmin, A.M.Y. and Samarasinghe, Y.G., Technology Information Package, 1st Ed.; Centre for Industrial Technology Information Services, P. 1-35 (1994)

8. Jagdish Prashd and Vinita Abraham, Animal Husbandry and Dairy Science, 1st Ed., Kalyani publishers, New Delhi, (1992)

9. Lincoln M. Lampert, Modern Dairy Products, Eurasia publisher, New delhi, (1970)

10. La Grange, Condensed milk and Milk powder, 1st Ed.,(1914)

11. Meegaha kotuwa, S.B., Model Project Report in Soya milk, 1st Ed., Technical service Division of Industrial Development Board (1996)

12. Nelson, A.I., and Steinberg, M.P., Publications from international Soybean program, University of lllinois, Urbana (1976)

13. Rai, M.M., Dairy Chemistry and Animal Nutrition, 3rd Ed.; Kalyani publisher, New Delhi, P.(part I) 3-125 (1980)

14. Rajalakshmi, R., Applied Nutrition, 3rd Ed., Oxford & IBH publishers, New Delhi. (1981)

15. Srivastava, S,M., Milk and Its Properties, Kalyani publishers, New Delhi, P. 1-177 (1993)

16. Webbjohnson & Alford, Fundamentals of Dairy Chemistry, 2nd Ed.;CBS publisher, (1987)

National Digitization Project

National Science Foundation

Institute : Sabaragamuwa University of Sri Lanka

1. Place of Scanning : Sabaragamuwa University of Sri Lanka, Belihuloya
2. Date Scanned : ..2017-09-19.....
3. Name of Digitizing Company : Sanje (Private) Ltd, No 435/16, Kottawa Rd, Hokandara North, Arangala, Hokandara
4. Scanning Officer

Name : ...S.A.C. Sadaruwan.....

Signature : .....

Certification of Scanning

I hereby certify that the scanning of this document was carried out under my supervision, according to the norms and standards of digital scanning accurately, also keeping with the originality of the original document to be accepted in a court of law.

Certifying Officer

Designation : .....Librarian.....

Name : .....T. N. Neighsoorei.....

Signature : .....

MR. T.N. NEIGHSOOREI
Librarian
Sab

Date : ..2017-09-19.....