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FERMENTED FOOD INDUSTRY IN EGYPT PARTICULARLY RELATED TO MILK PRODUCTS*

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I. BACKGROUND

Fermented dairy foods in Egypt are closely related to those produced in the Mediterranean and Middle East countries. Statistical data on production and per capita consumption of fermented milks in Egypt are given. The process of producing fermented dairy foods in Egypt varies greatly from primitive methods where fermentations occur spontaneously to the fairly advanced methods where dairy plants are established for their production under controlled conditions .

Parameters of the production process and factors affecting the quality of such products are discussed. Results of recent research work on the chemical composition, microbiological quality and organoleptic properties of fermented dairy foods in Egypt are reviewed .

The subject deal only with sour milk (Laban Rayeb or Laban Rakd) , Zabadi (a Yoghurt alike), sour buttermilk (Laban El-Salata), and Laban El-Zeer. Karish cheese, Mish paste and Mish cheese as well as Kishk are also considered.

The technical problems and recommendations which can lead to the improvement of existing processes and products are mentioned. Finally, trends and scope of the future developments of fermented milks in Egypt are discussed.

II. INTRODUCTION

The field of fermented food industry is a fairly extensive one, and it is therefore quite natural that this discussion should be limited to fermented dairy foods produced in Egypt.

It is a matter of fact that the use of fermented milk in Egypt as well as in many other countries dates back many centuries, although there is no precise record of the date when it was first made. Fermented dairy foods in Egypt are nearly the same as those in the Mediterranean and Arabic countries in the Middle East. These milk preparations are used largely because of their claimed therapeutic and health-promoting properties. Whether or not and to what extent these special claims for fermented milk is justified these products, in general, have a food value that compares fevourably with that of the milk from which they are made.

"Zabady" a yoghurt alike, is the national type of cultured milk produced in Egypt by small and large dairies. However, there is numerous fermented milk produced naturally as a result of allowing naturally contaminated milk to sour at ambient temperatures. Such milk is consumed directly or used in the production of other fermented dairy products. For instance, the sour milk which is called "Laban Rayeb" or "Laban matarid" in Egypt can be consumed directly or used in the production of a popular type of soft cheese in Egypt called "Karish cheese" after skimming the cream layer. Meanwhile, the produced sour cream may be either consumed directly or often used as a basic substrate for the production of butter which is usually converted to butter oil "Samna". Figures I, and 2 illustrate the overall process. The following discussion will cover the fermented dairy products of major importance in Egypt.

III. ZABADY

Zabady- the analogous of Yoghurt-is the main common and widely consumed fermented (cultured) milk in Egypt. It is usually produced from whole or standardised buffalo's or cow's milk in modern dairy plants as well as by small producers and even at kitchens by housewives under considerably controlled conditions. With the present shortage of milk produced in Egypt (about 2 million tons/year), it is a common practice, especially in big dairies, to make use of imported milk powder in the production of Zabady. Several investigators (Hamdy et al., 1972; El-Shibiny et al., 1977) had reported the use of powdered milk in the manufacture of Zabady. Others tried to make Zabady from milk powder reconstituted in a mixture of fresh buttermilk and water (El-Bagoury , 1980) or from milk powder reconstituted with sweet whey (El-Safty and El-Zayat,1984).

Production of Zabady in Egypt has increased significantly during the last ten years. Figure 3 illustrates the trend of Zabady production in Misr Dairies Company along the period extending from 1961 to 1981.

Besides Misr Dairies Company which belong to the public sector, Zabady is produced in many other modern producing units that belong to the private sector.

Different kinds of Zabady (Plain and flavored) are produced by these factories and are usually marketted in supermarkets, restaurants, hotels, shops and special dispensing units with other dairy products. In addition, significant quantities of Zabady are produced by small producers in small shops and sold directly to consumers along with raw milk and other dairy products. It is estimated that Misr Dairies, which produced in 1981 about

1100 tons of Zabady, supply the market with only 20% of the consumers needs while the remaining 80% are produced by the other modern and primitive producing units.

Methods of commercial production of Zabady vary considerably in certain details, but the basic process is essentially the same. Milk is firstly heated, the heat treatment varies within the range of 85°C to boiling for 10 to 30 minutes. Milk heating is intended to destroy the pathogenic bacteria and reduce the microbial load of the milk and partially concentrate its content of total solids. Heated milk is then cooled to about 40-45°C, and inoculated with the Zabady culture at a rate of 2-3%. The culture may be a small quantity of a previous Zabady of good quality or a balanced mixed culture of selected and pure strains of Streptococcus thermophilus and Lactobacillus bulgaricus.

The inoculated milk is then dispensed into suitable containers (cap. 100-200 ml.) which are usually cups of plastic, waxed paper or glass with aluminium, plastic or paper lids. Sometimes covered or uncovered porcelain glazed or unglazed earthen ware containers are used. The containers are then incubated at 40-42°C for about 3 hours until milk coagulates. The containers are then transferred to be cooled for distribution.

Figures 4 and 5 illustrate the overall process of Zabady-making in modern and primitive dairies in Egypt. Quite a number of microbiological and chemical studies have been carried out on Zabady. The original microflora of Zabady consists mainly of Str.thermophilus and L.bulgaricus, with other lactic acid bacteria and yeasts in lesser counts. Sometimes, B.subtilis, Microbacterium lacticum, Alcaligenes tolerans, Micrococcus species, and also coliform bacteria are present as contaminating microorganisms in the market samples of Zabady (Abd El-Malek and Demerdash, 1957; Fahmi et al., 1966).

Microbiological and chemical analysis were carried out by El-Sadek et al. (1972) on samples of Zabadi collected from Cairo (Egypt) markets. Their results showed that the average microbial counts were $1182x10^6$, $696x10^6$, $33x10^6$ and $688x10^3$ per ml on TYGL, Rogosa, Nutrient and Malt extract agar. The average coliform count (MPN) in formate ricinoleate broth was 152×10^3 per ml. Coliforms were detected in 58% of the samples and were identified as Escherichia coli 1 and Aerobacter cloacae.

Identification of streptococci isolated revealed that Streptococcus thermophilus was dominant.

Identification of lactobacilli isolated showed the predominance of Lactobacillus bulgaricus. L.casei,L.fermenti. L.viridescens were also isolated, but in comparatively smaller numbers.

Micrococci isolated revealed that the dairy micrococci predominated, followed by the Staphylococcus subgroup D, C then the intermediate group. Microbacteria isolated were identified as M. flavum.

The majority of the yeasts isolated belonged to genus Candida (Candmesenterica, Cand.parapsilosis varintermedia, Cand.krusi, Cand.speudotropicalis and Cand.tropicalis) and few belonged to genus Torulopsis. The average values obtained for the chemical analysis of Zabady were: 1.01% for titratable acidity, 3.7 pH, 14.32% total solids, 3.62% fat content, 4.17% total protein, 2.92% lactose and 0.65% for the ash content.

Rashed (1974) studied the bacteriological and biochemical activities in Zabadi samples collected from Alexandria markets in Egypt. He concluded that the lactic acid bacterial counts averaged $2.9x10^8$/ml. and 30% of the total samples were contaminated with coliform bacteria with an average count of $9x10^4$ organisms per ml. The counts of yeasts and aerobic sporeformers averaged $4.2x10^3$/ml. and $1.8x10^4$ respectively. The predominant species of lactic acid bacteria were Str.bovis-thermophilus and L.bulgaricus followed by Str.lactis-cremoris and Str.faecalis; L.lactis and L.casei-helveticus.

He also found that the average values for the chemical analysis of the same samples to be: pH 4.08; titratable acidity 1.17%, ethyl alcohol 0.09%, total volatile acidity, 20.5 ml. NaOH N/10 per g. diacetyl and acetyl methyl carbinol, 112.18 ug/100 g. However, Rasic and Kurmann (1978) mentioned that the different organisms found in yoghurt_the analogous of Zabady_may be divided into three groups:

(a) Essential Microflora:

The following organisms should be regarded as the essential microflora of yoghurt:

- *Streptococcus thermophilus*
- *Lactobacillus bulgaricus*

(b) Non-Essential Microflora:

The following organisms should be regarded as the non-essential microflora of yohgurt:

- Homofermentative lactic acid bacteria other than *Str. thermophilus* and *Lb. bulgaricus*.
- Heterofermentative lactic acid bacteria.

The heterofermentative lactic acid bacteria can decreáse the quality of yoghurt by producing carbon dioxide and alcohol, particularly if present in a high proportion. The lactic streptococci increase the acidity of yoghurt during storage at low temperatures.

Some lactic acid bacteria may be used beneficially for supplementing the yoghurt microflora, since they are capable of influencing intestinal implantation to some extent. The most important species are the following:

- *Lactobacillus acidophilus*.
- *Lactobacillus bifidus* (now *Bifidobacterium bifidum*)

Although Lb.bifidus has not been mentioned in investigations of the original yoghurt flora, it attracted significant interest as the supplementing component of yoghurt culture.

(c) Contaminants:

The following organisms are regarded as contaminants in a strict sense:

- Yeasts and moulds.
- Coliform bacteria.
- Other undesirable organisms.

They are entirely undesirable since they substantially decrease the organoleptic and hygienic properties of yoghurt.

IV. SOUR MILK
(Laban Rayeb)

Laban Rayeb is a typical fermented dairy product obtained naturally by lactic fermentation of cow or buffalo milk. A good quality Laban Rayeb is of firm and uniform consistency with a clean acid taste and a smooth, glossy surface and free from cracks or gas bubbles.

The composition of Laban Rayeb depends upon the type of milk used and the production conditions. The methods used for producing Laban Rayeb in Egypt are different with locality. Egyptian farmers, mainly in Lower Egypt and partially in Upper Egypt set fresh raw milk in earthenware pot (cap 3-5 litres) called "Matarid" which is left undisturbed for one to two days at ambient temperature untill the cream rises and the milk coagulates.

Laban Rayeb may be consumed directly or after sweetening, usually at breakfast with other foods. Approximately 50% of the total annual milk production in Egypt (2 million tons) is converted to Laban Rayed but only about 10% of this quantity is utilized for direct consumption especially in the rural districts of Egypt. The remaining Laban Rayeb is skimmed and the cream layer is removed for butter production which in turn converted to butteroil. The lower portion of partially skimmed "Laban Rayeb" named "Laban Raad" is usually converted to an acid soft cheese known locally as "Karish cheese".

Demerdash (1960) found that Streptococcus lactis, S.kefir, S.citrovorus, micrococci and coliforms are the predominant types of bacteria present in Laban Rayeb during the cold season. However, Lactobacillus casei, L. plantarum, L.brevis and to a much less extent S.lactis, S.kefir, S.citrovorus together with some coliforms formed the flora of summer samples.

Although Laban Rayeb, is an important item in the diet for most Egyptians, it is not produced or sold on an organized basis. First, large industrial-scale production of Laban Rayeb, could make this product more easily available in large cities and thickly populated areas of the country. Second, Laban Rayeb quality deteriorates at atmospheric temperature especially during the summer. Development of a method to maintain the appealing taste of "Laban Rayeb" during atmospheric storage would be of great help. Third, lack of effective, inexpensive packing is also a hurdle in large-scale handling and distribution of "Laban Rayeb". In local markets, earthen pots are used to dispense "Laban Rayeb" and these containers are not satisfactory from a hygienic point of view. Moreover, transportation is not possible in such containers, as they are quite fragile and cannot be sealed.

V. SOUR BUTTERMILK

Buttermilk is the fluid remaining after cream is churned and removal of butter. It is a very important by-product in Egypt where about 50 percent of the total milk produced is conveted into butter. Economically, the utilization of buttermilk in making a product such as cultured buttermilk would increase its monetary value, and then would raise the income of the producer. From the nutritional point of view, processing buttermilk which is almost now a waste, into such a fermented milk would be a way to make full use of the animal protein, butterfat and other nutrients that buttermilk contains. This would contribute partly to the food required by the increasing population.

Primarily in Upper Egypt and to some extent in Lower Egypt, the wife of the farmer collects the small amounts of milk daily in goats pelts (Kerbah). The milk is churned when enough milk has been collected and the acidity is suitable, Air is blown into the kerbah before closing it tightly and shaking until the fat globules coalesce. Butter granules are removed and the remainder is called "Laban Khad" or "Laban Kerbah" in Upper Egypt and "Sour buttermilk" in Lower Egypt.

Chemical and microbialogical analysis were carried out by Abd-El-Malek and Demerdash (1970) on samples of "Laban Khad" "Sour buttermilk" taken from Lower and Upper Egypt. Their results showed that the winter samples had pH values in the range of 6.1 to 5.4 while those taken in the hot season were mostly around 3.8. The corresponding titratable acidities were 0.3 to 0.5% and around 1.4%, respectively. Acetoin, as shown by the Voges-Proskauer test, was usually absent.

Bacteriological examination using selective and non-selective media revealed that the number of coliform bacteria was high in samples examined in the cold season, while none were found in the markedly acid samples produced in the warm season. Yeasts were present in numbers ranging from 3,000 to 9,000/gram.

Streptococci dominated in cold season samples, whereas in the hot season, lactobacilli predominated. A study of lactic acid bacteria showed that the homofermentative streptococci were Streptococcus lactis, the heterofermentative ones, Leuconostoc dextranicum and Leuconostoc cremoris. The homofermentative lactobacilli were Lactobacillus casei and Lactobacillus plantarum, while the heterofermentative one was Lactobacillus brevis. The difference in the flora encountered in winter and summer samples could be attributed to the temperature prevailing in both seasons.

It may be stated that the large bulk of buttermilk in Egypt is a farmhouse type produced by the farmer, by churning his sourmilk or cream and consequently buttermilk produced in farms and villages is highly acid. In recent years there are also large quantities of sweet buttermilk produced in the big dairies where milk is partially skimmed and standardized before pasteurization, the majority of the extra cream is made into table butter. In this connection,it may be mentioned that such dairy plants can make use of some of their buttermilk in making cultured buttermilk.

However, Abd El-Gawad et al., (1984) studied the production of cultured buttermilk from recombined milk using different types and ratios of starter cultures. They recommended the use of a mixed culture of Streptococcus cremoris and Leuconostoc cremoris (70:30) as a starter for manufacturing cultured buttermilk.

Laban El-Zeer:

Laban El-Zeer is a fermented concentrated buttermilk produced usually by farmers in the Southerm provinces of Egypt. It has an acid and salty taste, with a characteristic strong yeasty aroma, more pronounced than that of sour milk (Demerdash, 1960). For this purpose, zeers are used. The zeer is an amphora-shaped porous earthenware container of about 40 to 80 liters capacity, principally used in rural areas for holding and cooling water. New zeers are thoroughly washed with plain water, placed on metal or wooden tripods, and kept in a shaded cool place. After the addition of new batches of fresh sour milk, salt is added to taste and the contents of the zeer are mixed. The whey percolates through the prorous walls of the zeer and thus the consistency of Laban El-zeer becomes thicker. The consistency of fresh or young laban El-zeer is syrupy, but that of older samples is thick. The texture is granular in all samples, and it seems that the grains develop with aging.

The outside of the zeer is regularly washed and sprinkled with salt to assist drainage and to inhibit the formation of mucilaginous substances and objectionable odors.

In some localities skin or cloth bags are used instead of the zeer for gathering and preservation of sour milk. The gathering and preservation of sour milk as laban El-zeer usually starts in May. Accumulated laban El-zeer is used for making kishk during July, August, and September, when wheat or maize grains are plentiful. Laban El-zeer itself is consumed as a food during the hot season. It is consumed with bread, as an ingredient for salad, or as a refreshing beverage after reconstitution with water.

L.casei, L.plantarum, and L.brevis form the flora of laban El-zeer. Yeasts are encountered in moderate numbers in all the fermented milks and in markedly high numbers during the various stages of kishk making.

Abd El-Malek and Demerdash (1970) analysed 14 samples of Laban Zeer. They found that pH values varied between 3.5 and 3.8 while the corresponding titratable acidity ranged from 1.6 to 1.3%, acetoin was absent from all samples.

El-Sadek et al. (1965) analysed ten samples of Laban El-zeer, obtained from different parts of Upper Egypt after varying periods of fermentation and concluded the following results:

1. Titratable acidity varied from 1.05% to 3.30% while the pH value of the samples varied from 3.25 to 4.70.

2. Though the presumptive coliform test showed positive results in the low dilutions (10^{-1} and 10^{-2}) of 3 out of 10 samples examined, yet on violet red bile agar plates no coliforms appeared indicating the absence of coliforms. This may be due to the relatively high acid content of the samples examined.

3. The lactic acid bacteria counts as shown in lactic agar varied from 3,700 to 64,000 thousand per gram. Identification of the organisms revealed that L. casei predominated, followed by L.plantarum.

4. The sporeformer counts as shown on starch milk agar varied from 500 to one million per gram. Identification showed that they were B.megatherium and B.subtilis.

5. The yeast counts as shown on acid agar varied from 38 to 8,500 thousand per gram. All the yeasts isolated had the same characters and identified as Saccharomyces lactis.

They suggested that a special starter containing L. casei, L. plantarum and Saccharomyces lactis should be used in the making of Laban El-zeer so as to hasten up its production.

VI. KISHK

Kishk is a typical fermented dairy food produced in Egypt especially in southern provinces. It is made from a mixture of Laban El-zeer and previously boiled, dried and ground wheat grains (Triticum vulgaris).

Kishk is prepared in the form of small dried hard balls (diam. 4-6 cm.) with rough surface or irregular pieces, yellowish brown in color.

Dried Kishk is of good keeping quality and can be stored for about 2 years without deterioration. When reconstituted in water, it crumbles readily producing a highly nutritious white emulsion with an acid, salty taste and yeasty flavor. Kishk is consumed uncooked either alone or with bread as a complete meal, fried by itself or with eggs, or included as an ingredient in meat and chicken soups. Soups are served cold in jellied form or hot (fattah) with dry native bread (balady) or are combined with cooked rice and served with meat. The characteristic acid flavor of kishk survives in mixed foods and is particularly appreciated in hot weather. A common habit in the villages is to have a bowl of kishk soaking in water and to drink the water and eat the kishk after being in the hot sun.

Approximately 40 to 50 kg of kishk is consumed per person per year among the farmers. Kishk is a low-cost way of storing highly nutritious milk and wheat in a relatively stable form throughout the year.

The process of making kishk is usually carried out during July and August each year when the temperature is highest in Upper Egypt. Instead of Laban zeer, full cream, sour milk is occasionally used by wealthy people for the manufacture of this product.

Carefully cleaned wheat grains (Triticum vulgaris) are placed in large cooking pans, covered with water, heated slowly to boiling, and simmered until soft. The cooked wheat (belila) is then washed with cold water, spread on mats, air dried, rubbed by hand through a sieve to remove the bran, and coarse-ground through a stone mill. The fines are removed because they harden the final product. The coarse granules are then mixed with laban El-zeer which is prepared as previously described, in proportions of 2:1 (w/w).

The coarse granules are placed in a glazed earthenware vessel and moistened with slightly salted boiling water. After cooling, one-third of "laban El-zeer", diluted with water, milk, or buttermilk is added and thoroughly mixed to produce a homogeneous soft creamy paste called, "hamma". This is fermented for 24 hr, during which time the hamma rises; it is then kneaded by hand. The remaining two-thirds of "Laban El-zeer" is diluted and added in portions to the hamma which is again fermented for 24 hr. Following the second fermentation, the "hamma" is thoroughly mixed, formed into the typical "kishk" balls, and placed on straw mats or cloth to dry in the sun for 2-3 days. Sometimes spices such as red pepper, paprika, or cumin are added in small quantities to the final Laban El-zeer. Tomato, tomato paste, and onion may also be added (van Veen et al. 1969). Before storage, the kishk is sometimes placed in an oven for a short time to complete drying and improve its keeping quality.

Although the changes in the Kishk components during fermentation have not been clarified, the average % composition of the final product is known (Table 1).

Abd El-Malek and Demerdash (1970) showed the finished Kishk to be rich in protein, fat and carbohydrates. Titratable acidity, calculated as lactic acid, was 2.9%. Bacteriological examination revealed high counts of yeasts, lactobacilli and aerobic sporeformers.

Although most of the reducing sugars and microbial flora of the wheat were removed by boiling and during the drying of the cooked grains (belila) a very dense population of diastase-producing bacteria-mainly B. subtilis- develops and markedly enriches the reducing sugar content of the substrate. On mixing the ground wheat with the very acid Laban Zeer, the reducing sugars provide the energy source for development of the lactic acid bacteria and yeasts present in Laban Zeer, while the sporeformers (10-20 million/g) and other bacteria on the wheat are completely inhibited by the high acidity. Yeast counts increase from a few thousand to over 100 million/g, which explains the richness in B-vtamins of Kishk. Homo-and heterofermentative lactobacilli (L.plantarum and L.casei and L.brevis) were prominent in the Kishk fermentation.

El-Sadek and Mahmoud (1958) found that the total bacterial count of Kishk varied widely from 2,900 to 1,100,000 per g. of dry weight, whereas the count of sporeformers on standard milk agar ranged from 2,100 to 700,000 organisms per g of dry weight. The sporeformers varied from 57.1 to 75% of the total count and were the dominant organisms in Kishk. Among sporeformers, Bacillus subtilis and Bacillus megaterium were predominant. Other organisms including lactic acid bacteria were present in much smaller numbers, constituting from 20.2 to 42.9% of the total bacterial flora of Kishk. The counts of fungi and yeasts varied from 200 to 6,500 organisms per g of dry weight. Yeasts were present in smaller numbers.

VII. KARISH CHEESE

Karish cheese may be regarded as almost a stable item of every day diet, and plays a vital role in the health and economic life of the farmers in Egypt. The cheese, being one of the most popular types of soft cheeses contains all the skimmilk constituents including the highly nutritive milk protein, milk sugar, some of the water soluble vitamins, most of the calcium and phosphorus originally present in milk, as had been mentioned by El-Katib (1942).

It is a common practice for the farm-house wife to make Karish cheese from sour clotted skimmilk (Laban Rayeb) after the removal of cream layer. Although, details of its making differ from one area to another, and even from home to home, the principles of its preparation are approximately the same.

Fresh buffaloe's or cow's milk is usually set for creaming for 24-36 hrs. in summer or for 2-3 days in winter after which the cream layer is skimmed and the sour clotted milk is utilized in making Karish cheese. After skimming, the curd of sour clotted skimmilk is then poured into what is called cheese mat, named "Shenda" which is usually made of a type of reed, Jancus sp., for drainage. The curd is spread on the mat for few hours, then its ends are tied together to permit a portion of the whey to drain off.

This process of spreading the curd, then squeezing it in the mat is repeated once or twice, and finally the mat is hung from the joined ends with its contents suspended to complete drainage of whey. That is accomplished in a time extending from about two to three days, or until obtaining the desired texture of cheese. Finally, cheese on the mat being completely drained, is cut into suitable pieces (150-200 gm) then salted with amounts of dry salt varying greatly according to the taste of the maker. The salted cheese is left for more few hours in the mat until no more whey drains out and then becomes ready to be consumed as fresh cheese or dispatched to local markets for sale. Some farmers store Karish cheese in a pickling solution known as "Mish" for ripening and the resultant cheese is called "Mish cheese".

Skimmilk either fresh or fermented is widely used on a commercial scale for manufacture of Karish cheese in small primitive dairy plants erected in villages and surrounding areas where small hand-driven separators are usually available. The procedure used for making cheese from buttermilk is also adopted here using $S_h$enda or large wooden frames lined with cheese cloth for whey drainage.

Karish cheese made from "Laban Rayeb" is generally much better in quality and has a better flavor than that made from buttermilk, which in turn is better than that made from skim milk. This can be attributed to favorable fermentations which take place in milk during setting and to the higher fat content of "Laban Rayeb" compared to the other two products.

Although, most of Karish cheese produced in Egypt may be very much alike in most of its physical properties, yet its quality and composition may vary. a great deal owing to many factors such as the quality and composition of sour clotted skimmilk from which Karish cheese is made; the methods of making; the time required to complete drainage of whey; the quantity of salt added, and finally methods of handling the finished cheese. All these factors may be considered as the main ones affecting the quality and composition of such nutritive and valuable dairy food.

Unfortunately, figures showing the quantity of Karish cheese production in Egypt are not available, but there are many indications that about 50% of the milk produced is utilized in making this type of cheese.

Fahmi (1960) reported that the composition of Karish cheese depended on two factors, firstly, the chemical composition of the original milk used for making the cheese, and secondly, the method of making the cheese. He recorded that the fresh Karish cheese consisted of about 69% moisture and 31% solids of which 17% proteins, 6% fat, 2% other organic matters and 6% ash including 4.5% NaCl.

Moustafa (1967) studied the chemical composition and microbiological content of Karish cheese obtained from different governorates in Egypt. The results for the chemical composition are shown in Table (2).

Results of the microbial flora of the same samples of Karish cheese revealed that the predominant flora consisted mainly of Streptococci, Lactobacilli, Miscellaneous and Micrococci groups, mostly in this order. While the predominant flora isolated from plates or rogosa medium consisted of Lactobacilli followed by Streptococci then Miscellaneous groups.

Streptococci isolated numbered 571 cultures and consisted mainly of Streptococcus lactis (32.93%), Str.kefir (29.42%), Str.faecalis (27.67%), Str.cremoris (4.90%), Str. citrovorus (4.38%), Str.bovis (0.35%) and Str.thermophilus (0.35%) in this decreasing order.

Organisms belonging to the Lactobacilli group and isolated in this work were 410 in number and proved to be

Lactobacillus casei-plantarum (81.71%), L.fermenti(12.44%) L.brevis (4.16%), L.bulgaricus (0.96%) and L.casei-helveticus (0.73%) in this decreasing order.

Organisms belonging to the Micrococci group were 18 in number and proved to be Intermediate type I (66.66%), Staph. C.(11.11%), Staph.D (11.111%), Staph.B (5.56%) and Intermediate type C. (5.56%) in this decreasing order.

Organisms belonging to the miscellaneous group numbered 182 and proved to belong mainly to yeast (87.91%), Bacillus (9.89%) and Sarcina (2.20%) in this decreasing order.

VIII. MISH CHEESE

Mish cheese is an important dairy food used by Egyptian farmers and used as an appetizer by the rich. It has a yellowish-brown color, sharp flavor and a very high salt content. It's made by picking Karish cheese in a pickling medium in earthenware jars named "Zallaa or Ballas and stored for ripening for a long time (1 year or more). El-Erian and El-Gendy (1975) studied the microbial flora of Mish cheese. The results revealed that the Mish cheese samples differ in their total count, which was composed of three main groups of bacteria, namely Micrococci (60%), bacilli (20%) and Arthrobacter (18%). A fourth minor group, 2% of the total, was anaerobic sporeformers. The samples of Mish cheese showed quite a low total count compared with that of Limburger, Camembert and brick cheese.

Chemical and microbiological examination was carried out on the pickling medium by Nassib and El-Gendy (1974). The results indicated that the pH of Mish varied from 5.2 to 7.1, the fat content from 2.2 to 8%, solids content from 17.6 to 47.5%, salt content from 10.3 to 13.8% and amino nitrogen content from 5.5 to 13.6 mg N/100 ml of sample.

Total counts on T.G.E. agar varied from 100,000 to 1,300,000/ml for most samples. No relationship could be found between the numbers of bacteria and quality of Mish. Proteolytic and lipolytic bacteria were generally lower in number than the total count. Microscopic examination of colonies belonging to these groups revealed that most of them were sporeformers. Counts of spores ranged from 3,000 to 300,000/ml. None of the samples of Mish contained coliforms.

El-Gheriany (1936) reported the presence of large amounts of butyric acid bacteria in Mish, while Taha and Hamdy (1952) detected three groups of bacteria in Mish, which were aerobic sporeformers, non-sporeforming bacteria and sporeforming anaerobes. These authors believed that the members of the last group are the main organisms responsible for the ripening of Mish and development of its flavor.

The chemical analysis of Mish varied from sample to sample, depending on the components used. (Table, 3)

The moisture content varied from 55.76 to 74.14%. Salt content of Mish samples ranged from 10.3 to 18%,while fat percentages were between 3.3 and 18. About 56.9 to 84.1% of the total nitrogen of Mish was found as free amino nitrogen.

It is common custom for the Egyptian farmers' wife to prepare her own Mish, mainly from Karish cheese, while some wealthy farmers usually use whole milk and add some Ras or Kashkawal cheese to it.

IX. TECHNICAL PROBLEMS

It is a matter of fact that the main technical problems leading to any defect in the quality of Zabady are roughly the same as those which apply to yoghurt and similar fermented milks.

In recent years,a good deal of research and experience with yoghurt manufacture have pinpointed these problems as well as developed guidelines for their control.They may be identified as:(1) milk supply; (2) equipment; (3) bacteriophage; (4) starter cultures; (5) processing and (6) handling of the ripened product.

1. Milk supply: Of all dairy products,perhaps fermented milks should receive the most care with respect to selection of the milk supply. This is particularly true in the commercial production of these products,where the loss of product due to lack of growth of the fermenting organisms would amount to a fairly large volume. The milk supply must be of high quality, have a clean flavour and be free from inhibitory substances such as antibiotics,natural inhibitors,or residual sanitizing agents. It is generally considered advisable to check the milk supply frequently to determine the ability of the milk to support the growth of the organisms being used in the fermentation. If dried milk solids are used to fortify the milk or to prepare a reconstituted milk, the powder also should be checked to determine whether or not it will support the growth of the desired organisms.

The treatment of mastitic cows with antibiotics has caused problems for the manufacturer of fermented milks. Unless milk from treated animals is withheld by the farmer for 72 hours after treatment,sufficient amounts of residual antibiotics can be present in the milk to inhibit the growth of the culture . Some of the antibiotics (penicillin in particular) will not be completely inactivated by the heat treatments employed in processing.It has been reported that residues of penicillin have been detected in non-fat dried milk solids at levels high enough to inhibit the growth of lactic acid bacteria. Therefore fluid milk and dried milk solids should be checked frequently for the possible presence of inhibitory substances.

The development of antibiotic-resistant strains of yoghurt bacteria may be important, with special preparations intended for administration during the antibiotic therapy of humans. In other cases, e.g. large scale production of yoghurt, the use of such strains is questionable due to the recognized public health aspects of the presence of antibiotics in milk, and many countries have prohibited the use of such milk for human consumption. The effects that may arise from the presence of antibiotic residues in milk may include direct or indirect toxicity. However, numerous trials. were carried out to increase the antibiotic resistance of yoghurt cultures by training strains to grow in the presence of different amounts of antibiotics. Table 4 shows some results on the development of antibiotic resistance of Str. thermophilus, L. bulgaricus and L. acidophilus.

Many bacterial strains which have developed a resistance to antibiotics alter certain characteristics.e.g.reduce the aroma production of Str. diacetilactis or alter their ability of L. acidophilus to ferment certain substrates.

With yoghurt lactobacilli, it is found that the low level of resistance achieved after serial growth in the presence of the relevant antibiotics is lost with the exception of streptomycin (Seneca,et al.,1963).

Variable results could be expected in trials to increase the antibiotic resistance of cultures,dependent on the number of strains used for subculturing,the natural resistance of strains to different antibiotics and other factors.Under local conditions, fermented milk industry suffers a great deal from the shortage in milk supply as well as from milk adultrated with adding water or preservatives.This must be controlled through testing the milk before acceptance.

2. Equipment:Plant sanitation is of critical importance in the manufacture of fermented milks. All equipment must be thoroughly cleaned and sanitized.However,in the sanitizing operation,care must be exercised that residual sanitizing agents do not contaminate the milk. This is particularly necessary in the case of the quaternary ammonium compounds,as it has been found that as little as 5 p.p.m. of such compounds can inhibit acid production by Streptococcus lactis (Curry & Barber,1952).

Under normal conditions of milk handling and sanitizing dairy farm equipment. the possible quantities of disine-fectants to be found in milk according to Swartling (1959) are as follows:

Chlorine compounds:	0.5-1.4mg available chlorine per litre.
Iodophors:	0.1-0.2mg iodine per litre
Quaternary ammonium compounds:	0.5-1.0mg active substance per litre
Dodecyldi-(aminoethyl)-glycine-hydrochloride-(Tego 51):	2.0mg active substance per litre.

Chlorine compounds, iodophors and Tego 51 are not likely to affect yoghurt bacteria provided that normal precautions in their use on the farm are observed. Careless use of these sanitizers or their addition to milk to increase keeping quality can cause adverse effects on starter cultures.

On the other hand, critical levels of quaternary ammonium compounds are more likely to be found in milk under normal conditions of sanitary practice on the farm with conse-quent harmful effects on the culture of yoghurt. Therefore, these compounds should either be used with caution and their use followed by thorough drainage and rinsing with clean water, or preferably avoided altogether. However, hot water at about 82.2°C (180°F) is regarded as a satisfactory sanitizing agent,and chlorine solutions if properly used also sanitize equipment in a satisfactory manner.

The significance of residual disinfectants and detergents in milk for the manufacture of yoghurt and other fermented milks encouraged numerous investigators into the development of suitable methods for their detection. A proper educational programme for personnel engaged in milk production on the farm constitutes an important part of control measures.

3. Bacteriophage:Bacteriophage (commonly known as phage) can be a problem in the production of fermented milks or any product dependent upon the action of bacteria which may be susceptible to the action of phage. Phage may be carried with the culture, may develop in improperly cleaned equipment where milk residues accumulate, may be brought in by contaminated air,and is also present in whey. In areas where cheese whey is returned to the farmer in his milk cans, unless the cans are properly cleaned and sanitized with hot water or sanitizing agents before fresh milk is added, the milk itself can carry the phage and thus contaminate the plant. The rotation of cultures is recommended since phage is strain-specific(phage particles grow and attack only their own specific strain).

This rotation is claimed to prevent build-up of the phage in the plant.

Recent developments have indicated that phage can be controlled in cultures by the use of a new type of culture medium. British workers (Reiter,1956;Tybeck,1959) have developed a medium,designated "Cockade",which is low in calcium and is reported to prevent the development of phage in cultures that are carried in the medium. Workers in the USA (Hargrove,1959;United States Department of Agriculture,1959) have reported that the addition of phosphates to the milk may aid in the control of phage.

Although it is generally recognized that the primary source of phage may be the culture itself, it is known that the plant may become contaminated with phage and present a problem in phage control. Thorough cleaning and sanitizing of equipment must be practised to prevent a build-up of this type in the equipment. In some areas an air-filtration system is regarded as necessary for preventing phage contamination from the air. If a plant becomes contaminated,a thorough clean-up is always necessary and fogging of the area with a strong chlorine solution (2000 p.p.m.)has to be carried out.

In any plant where bacterial cultures are to be used for the manufacture of fermented milks,it is recommended that a special area away from the manufacturing area of the plant be set aside for the sole purpose of maintaining these cultures.Ideally,this area would be completely removed from the rest of the plant, even in a separate building.In any case, it should be recognized that special conditions and care to prevent contamination are needed in the propagation of starter cultures.

It should be noted that Str.thermophilus is much more often attacked by phages than L.bulgaricus.

The most reliable protection of yoghurt cultures against attack by phages can be achieved by rigid sanitation in the dairy and the laboratory,combined with aseptic handling of starter cultures.The introduction of a system of strains rotation may also be helpful if the lysotyping of S.thermophilus and L.bulgaricus is accomplished.

4. Cultures:The procedures for maintenance and preparation of cultures must be followed carefully if good, active cultures are to be available for the fermentation. Commercial cultures are available in the dry,liquid or frozen state.The milk used for propagation of the cultures

must be carefully selected.It should be of high quality and free from any inhibitory substances;and may be whole milk,skimmed milk or reconstituted milk, depending upon the type of product being made. Whole milk is generally used when a high butter aroma is desired and is usually preferred for mixed cultures containing acid-formers and aroma-producers.All glassware (bottles and pipettes) must be clean and sterile.Milk is usually sterilized in an autoclave,although some plants use a heat treatment of 82.2^{o}-87.8^{o}C (180^{o}-190^{o}F)for one hour.The heated milk is cooled to the requisite incubation temperature,inoculated until the desired acidity has developed.Cultures are gardually increased in volume from the mother culture to the intermediate culture,the bulk starter culture and finally the culture in the vat.Each transfer must be made with care,using properly cleaned and sanitized equipment and selected milk. Temperatures and times of incubation must be rigidly controlled,not only in the small volumes of the mother and intermediate cultures,but also in the larger volumes of the bulk starter.Occasionally conteminants in the yoghurt starter culture impair fermentation,producing off-flavours and physical defects. Coliforms and yeasts may be troublesome,for many are unaffected by the lactic acid,in fact,yeasts can utilize the acid and grow well in association with the yoghurt culture,producing yeasty and fruity off-flavours,often with gassiness (CO_2).

5. Processing:It has been noted that the milk to be used in the manufacture of fermented milks usually receives a heat treatment somewhat more severe than normal pasteurization. This heat treatment not only completely eliminates pathogenic organisms but also reduces the number of all other organisms which might compete with the added starter cultures.

After the heat treatment,the milk is usually pumped into large vats or tanks,adjusted to the proper incubation temperature and inoculated with the desired culture or cultures.The proper incubation temperature must be maintained throughout the fermentation so that the organisms develop properly and produce the desired acidity and flavour.As soon as the proper acidity and flavour have been attained,the product is rapidly cooled to prevent further growth of the bacteria.The fermented milk should be held at refrigeration temperatures,otherwise the cultures may continue to grow and produce too much acid, making the product unpalatable.Also, unless care has been exercised to prevent contamination of the milk with other organisms,undesirable spoilage may take place.

6. Handling:Cooling,transporting and packaging the coagulated product are critical operations from the standpoint of protecting the texture. The key to successful performance at this stage of the process is gentle handling, especially when the coagulum is still near the incubation

Temperature. It was observed that too rapid cooling of yoghurt after completed incubation can bring unfavourable changes in the structure of coagulum with corresponding whey separation. This defect is probably due to the very rapid conteractions of the protein filaments and their disturbed hydration (Rasic and Kurmann, 1978). Some manufacturers tend to rely on stabilizers to achieve texture in yoghurt. Use of stabilizers, however, is little more than patchwork. Radema and Dijik (1973) maintain that the best improvement in yoghurt texture was made by using gelatin. However, alginates, carrageenan, locust bean, guar gum, and carboxy methyl cellulose (CMC) retarded acid production and caused whey separation. Agar and pectin produced satisfactory thickening but delayed acid production.

Yet, despite this progress, many questions concerning the biochemical and physiological properties of yoghurt and similar bacterial cultures still remain unanswered.

X. RECOMMENDATIONS

It is quite clear from the preceeding presentation that the quality of fermented dairy foods is affected significantly by three main factors: firstly, the quality and treatment of milk or/and other raw materials, secondly, the efficiency of technologists and technological operations, and thirdly, the purity and activity of the added starter cultures. Thus, the following recommendations may help in improving the existing processes and products.

1) Improving the quality of milk through:

   1- Solving animal feeding problems.

   2- Production of milk under hygienic conditions.

   3- Establishment of more milk collecting points and cooling centers,with the development of transportation means.

   4- Increasing the intensive modern dairy farms,either governmental or private, near the dairy plants.

- To overcome the shortage in milk supply, and to fullfil the consumers demands, it is recommended to make use of the soy bean along with milk, buttermilk or whey to produce new types of fermented dairy foods.

2) Since the starter properties affect directly the quality of the fermented dairy products, a good starter has to be maintaind in good condition. Therefore, it is recommended to establish a central unit for large-scale production and distribution of starter cultures needed for the dairy and food industry.

   This would lead to:

   1- Convenience and labour saving;

   2- Reduction of the risk of phage attacks;

   3- Better controlling the viability and activity of the starter culture; and

4- More direct application of the knowledge obtained in practice.

- In addition, this unit would supply the dairy and food industry with their needs of active and selected ready-to-set starter cultures which ought to be of great help to all countries in the region.

3) Development training programms to give new knowledge and new technological advances to those who are engaged with the dairy industry. In fact, such training programms were held in EGYPT in collaboration with F.A.O. and other sister U.N. organisations in all that develops dairy industry and promotes economic and feasibility studies in this line.

- However, many of our fermented dairy foods offer excellent opportunities for development as ingredients in the preparation of other nutritious foods, either by adding nutritive value and/or by aiding in prolonging the shelf life.

- Yoghurt-based products such as salad dressings, beverages, desserts, yoghurt confectionery and others represent new outlets.

- Recently a new product called soft-serve yoghurt, similar in consistency to soft ice-cream, has been introduced.

- Other products such as concentrated yoghurt(Labneh) which can be easily produced from "Laban Rayeb" or "Zabady" and even the sour buttermilk(Laban Khud)is considered as a potential new dairy spread (Tamime, 1978). This product can replace cottage cheese in some salad dishes or for the production of a cheesecake-like product. Such thick consistency yoghurt is being produced in Poland as "Super Yoghurt" (Zmarlicki et al.,1974) and in the Netherlands (Norling,1976).

- Production of Laban Rayeb as well as well as the sour buttermilk can be commercialized by treating the fresh milk or sweet buttermilk with a method analogous to that used in the "Zabady" or "Yoghurt" manufacture but with adding 3-5% of a mixed starter clture consisting of S.lactis subsp diacetylactis and L.thermophilus or S.lactis,S.thermophilus and L.cremoris (L.citrovorum) instead of S.thermephilus and L.bulgaricus,with incubation at 35C - 37°C instead of 40-42°C.

Such a product would be safer, as a result of the heat treatment, than "Laban Rayeb" or sour buttermilk "Laban Khud" which are produced by natural fermentation and subject to microbial contamination. In addition, development of such a technique would provide a standardised fermented dairy products of good quality having a butter-like aroma which greatly suits the taste of Egyptian consumers.

- The introduction of fruits and fruit flavors in the manufacture can promote the production of a wide range of flavored fermented milks.

- Supplimenting the yoghurt flora with L.acidophilus and/or L.bifidus for the purpose of increasing the dietetic value resulted in new cultured milks.

TABLE 1. Composition of Egyptian Kishk

Constituent	Range	Mean
Moisture (%)	6.35-8.96	7.95
Fat (%)	3.01-12.57	6.86
Protein (%) (nitrogen x 6.38)	8.29-17.86	13.43
Soluble nitrogen (%)	0.280-0.546	0.434
Soluble nitrogen: Total nitrogen(%)	11.33-38.76	22.53
Ash (%)	3.56-9.98	6.40
Carbohydrate (% by difference)		59.0
Fiber (%)		2.5
Calcium (mg/100 g)		55.0
Phosphorous (mg/100 g)		410.0
Iron (mg/100 g)		3.8
Niacin (mg/100 g)	2.20-5.68	3.35-3.69[a]
Riboflavin (mg/100 g)	0.147-0.545	0.262-0.284[a]

[a]Means varied depending upon the method.

Source: Adapted from El-Sadek et al. (1958) and Morcos et al.(1973).

Table 2. Chemical Composition of Karish Cheese.

Constituent	Range Minimum Maximum	mean
Acidity (as lactic)(%)	0.71- 2.47	1. 5 ± 0.05
Moisture (%)	62.91-79.12	71.68 ± 0.51
Total solids (%)	20.9 -37.1	28.31 ± 0.55
Fat (%)	0.15- 9.67	2.71 ± 0.27
Fat/dry matter(%)	0.64-32.65	9.39 ± 0.89
Protein (%)	10.3 -26.1	16.02 ± 0.29
T. N. (%)	1.62- 4.09	2.52 ± 0.41
S. N. (%)	0.09- 0.36	0.17 ± 0.006
S. N./T. N. (%)	3.53-22.34	7.09 ± 0.31
Salt (%)	0.87-11.23	5.52 ± 0.29
Salt/water (%)	1.12-16.8	7.90 ± 0.43

Source: Adapted from Moustafa (1967).

TABLE 3 . Chemical composition of Mish cheese.

Component	Minimum	Maximum
pH	5.00	7.50
Acidity, %	1.00	2.05
Moisture, %	55.76	74.14
Total solids, %	25.86	44.24
Salt, %	10.30	18.00
Fat, %	3.30	18.00
Amino N, %	0.98	1.90
Total N, %	1.58	2.85

Source: El-Erian et al. (1975).

Table 4 . Development of Antibiotic Resistance.

Organisms Tested	Antibiotics	Minimum Inhibitory Concentration per ml Milk	Reference
S.thermophilus	Penicillin	>3I.U	Hargrove et al. 1950
S.thermophilus	Streptomycin	>500meg	
L. bulgaricus	Penicillin	>3I.U	
L. bulgaricus	Streptomycin	>500meg	
S.thermophilus	Chlortetracycline	70-120meg	Solomon et al. 1964/65
L. bulgaricus	Chlortetracycline	70-120meg	
L. acidophilus	Chlortetracycline	70-120meg	
S.thermophilus	Streptomycin	500meg	
L. bulgaricus	Streptomycin	500meg	
L. acidophilus	Streptomycin	500meg	
S.thermophilus	Chloramphenicol	40-50meg	
L. bulgaricus	Chloramphenicol	40-50meg	
L. acidophilus	Chloramphenicol	40-50meg	

Source:Rasic and Kurmann (1978).

Figure 1.

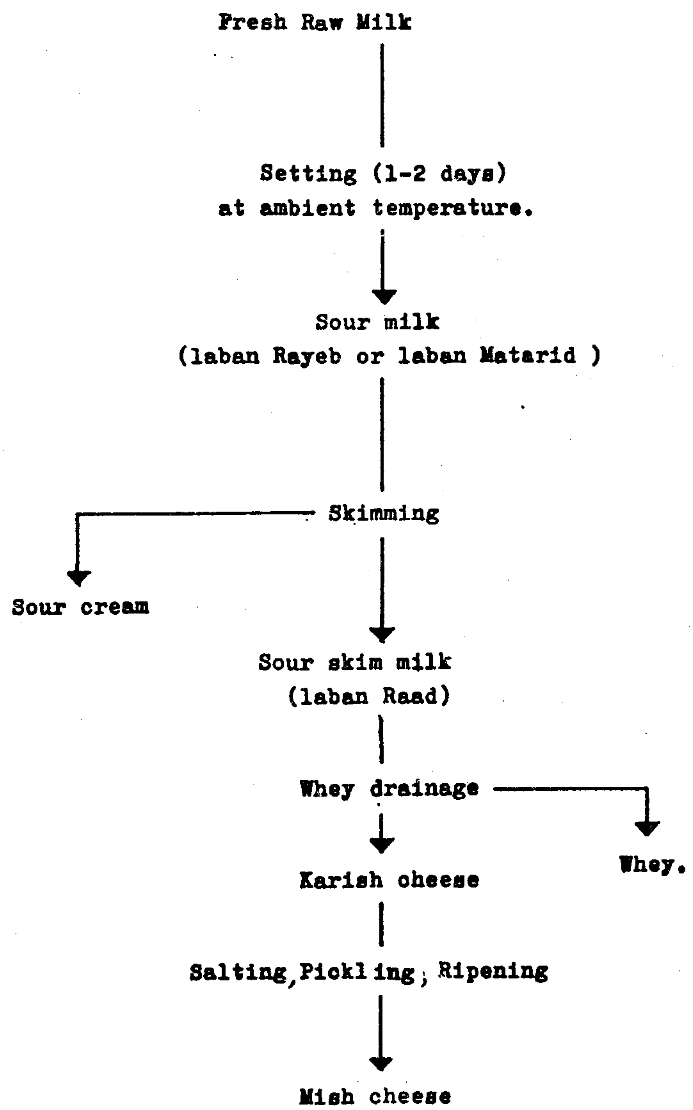
Fresh Raw Milk
Setting (1-2 days)
at ambient temperature.
Sour milk
(laban Rayeb or laban Matarid)
Skimming
Sour cream
Sour skim milk
(laban Raad)
Whey drainage
Whey.
Karish cheese
Salting, Pickling, Ripening
Mish cheese

Figure 2.

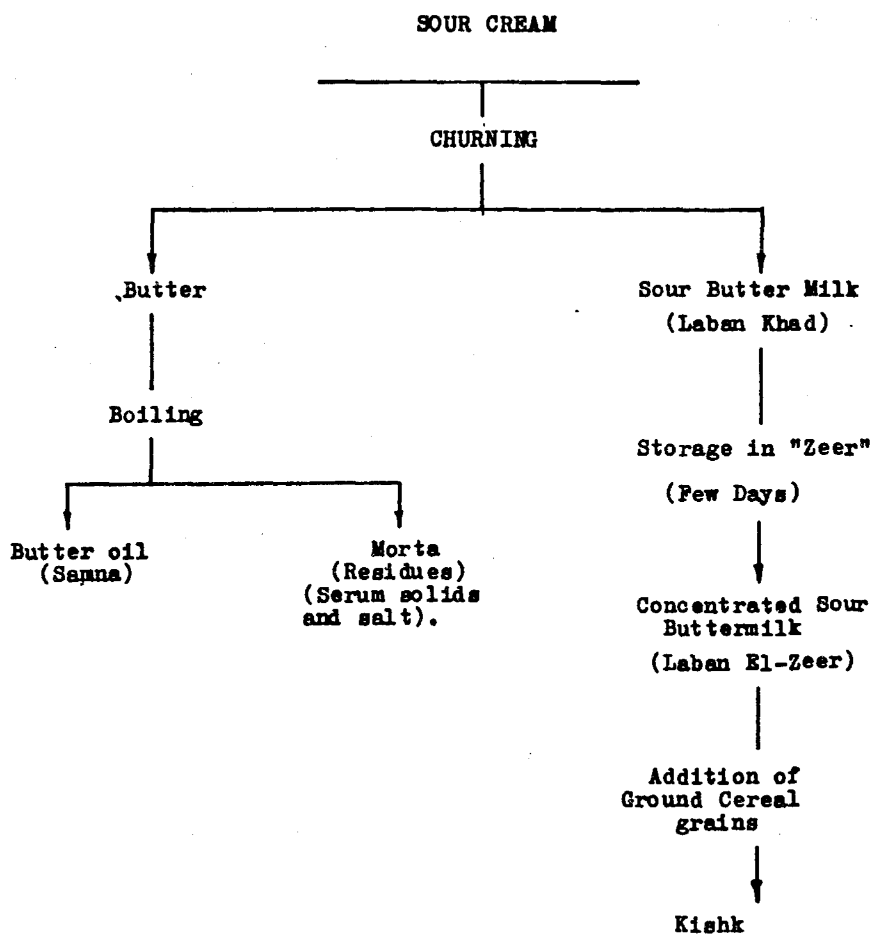
SOUR CREAM
CHURNING
Butter
Sour Butter Milk
(Laban Khad)
Boiling
Storage in "Zeer"
(Few Days)
Butter oil
(Samna)
Morta
(Residues)
(Serum solids
and salt).
Concentrated Sour
Buttermilk
(Laban El-Zeer)
Addition of
Ground Cereal
grains
Kishk

Figure 3.

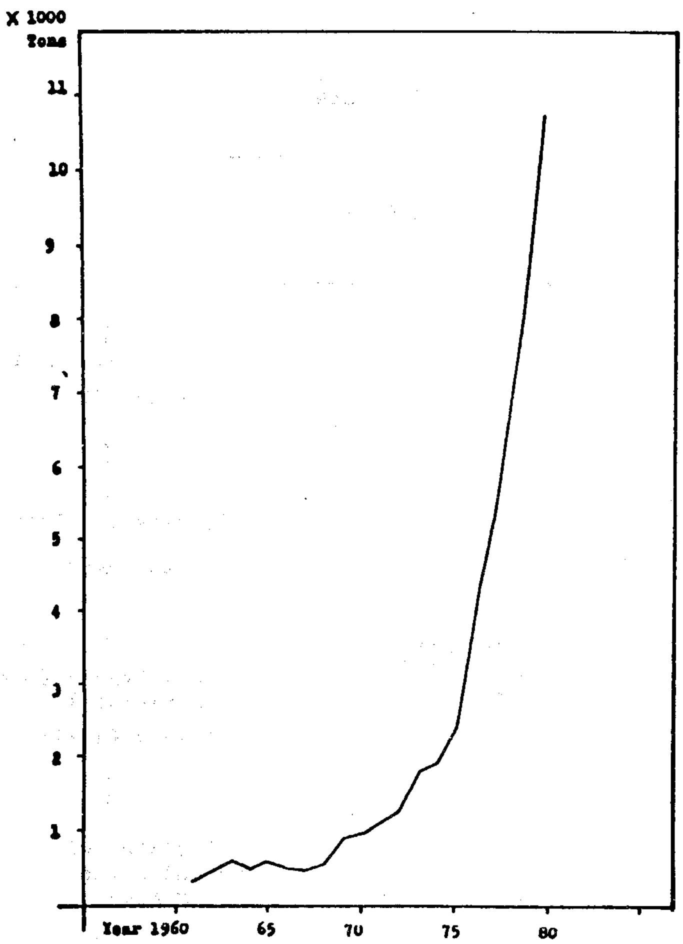

Figure 4

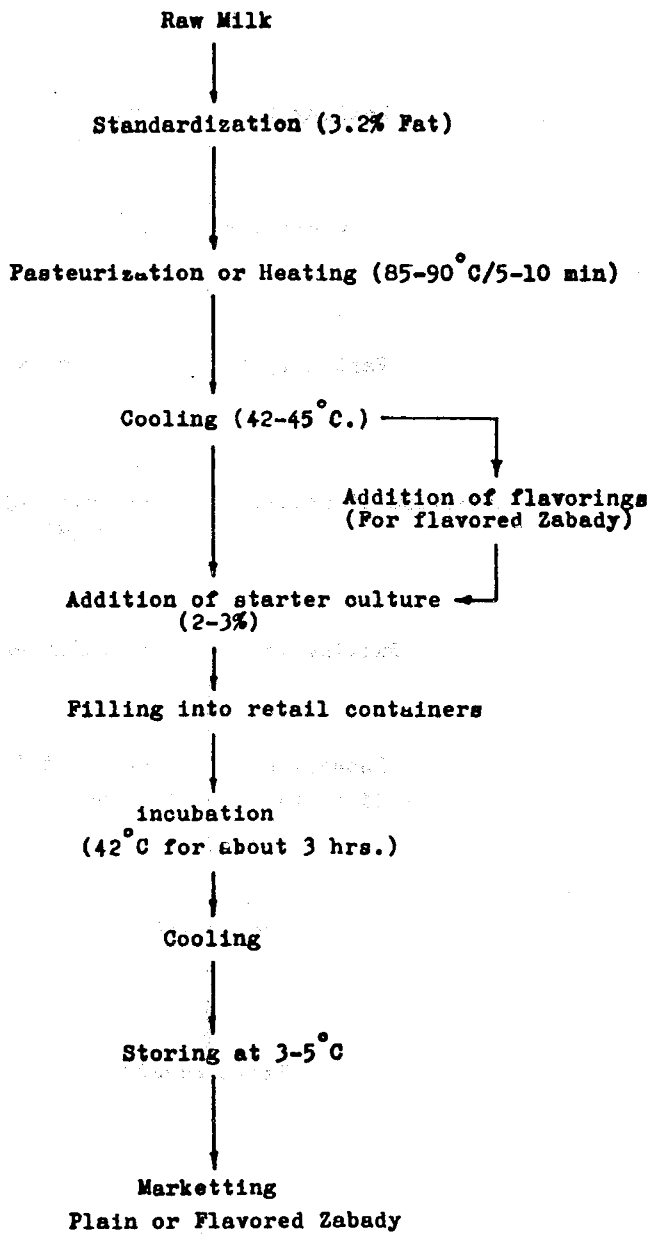
Raw Milk
Standardization (3.2% Fat)
Pasteurization or Heating (85-90°C/5-10 min)
Cooling (42-45°C.)
Addition of flavorings (For flavored Zabady)
Addition of starter culture (2-3%)
Filling into retail containers
incubation (42°C for about 3 hrs.)
Cooling
Storing at 3-5°C
Marketting
Plain or Flavored Zabady

Figure 5.

Raw Milk

↓

Boiling (about 30 min)

↓

Cooling at 40-42°C.

↓

Partially skimming the milk

↓

Addition of starter (a previous day zabady) (3-5%)

↓

Filling into retail containers.

↓

Incubation at 40-42°C until firm coagulum is produced

↓

Marketting

↓

Plain Zabady

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