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LABAN- MIDDLE EASTERN FERMENTED DAIRY PRODUCT – A REVIEW

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ABSTRACT

Food fermentation is one of the oldest methods of food production, use, and storage, dates to back thousands of years in many African, Asian, Middle Eastern, and Northern and Eastern European countries. Probiotic bacteria are found in dairy products that are made using a variety of fermentation methods, especially lactic acid fermentation, and starter cultures, as well as products with a variety of textures and aromas. Fermented dairy products are those that are made by microorganisms, particularly lactic acid bacteria, fermenting lactose. Various dairy products with different names but similar content can be found all over the world, and these products are an integral part of the human diet. Traditional fermented milk products are common all over the world. These products are an important addition to the local diet, as they provide essential nutrients for growth, good health, and a pleasant taste. Al-Otaibi, (2009) and Uccello, *et al*., (2012). In most countries, fermented milks with various names and ripening by microorganisms under similar conditions are accessible. (Kosikowski, 1982). Laban is a fermented food that is commonly consumed in the Middle East. It is made from buffalo and/or cow milk that has undergone natural fermentation. Laban is a curdled dairy commodity that has been well-known and well-loved by customers for decades. It is made from cow's milk that has spontaneously fermented. It can be eaten raw or in combination with other foods. Because of differences in heat treatment, incubation temperature and pH, type of starter culture, method of manufacture, and type and composition of milk, organoleptic characteristics of laban are expected to vary significantly between samples.

I. INTRODUCTION

MANUFACTURING OF LABAN

The growth of lactic acid bacteria of the genera *lactococci* and *lactobacilli* results in the production of laban. Laban is a fermented milk beverage that is famous for its refreshing and sensory qualities. The nutritional value is also recognized, and the only difference between it and milk is the fermentation of lactose.

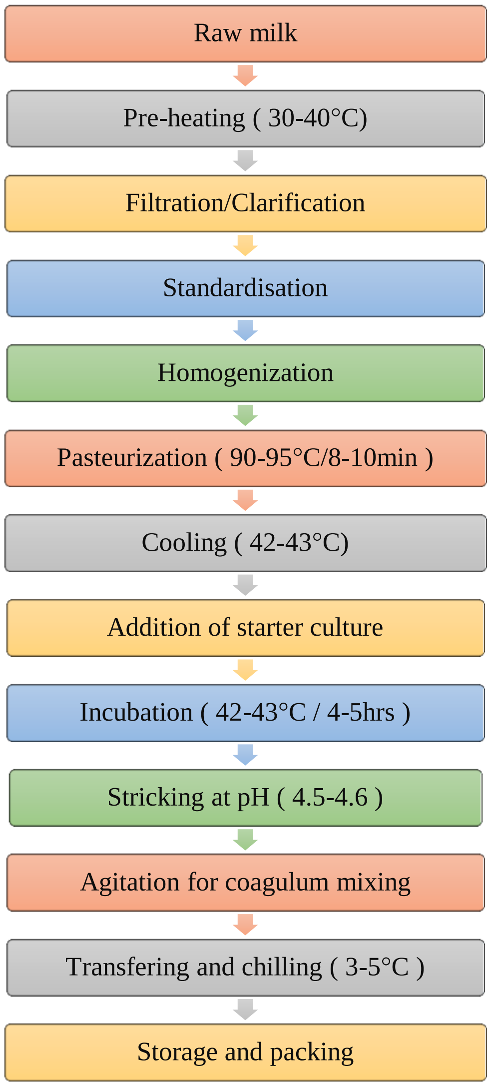
1.1 Traditional type

In most cases, cow's milk is used to make traditional laban. Following the addition of old laban, raw milk is fermented for 24-48 hours. After coagulation, the curd is churned in a goat skin bag that is vigorously shaken. Warm water and then cold water can be applied at the end of the churning process to help the butter grains coalesce. The liquid left over after the butter has been removed is known as laban.

1.2 Commercial type

Pasteurized whole milk is combined with a starting culture containing an undisclosed amount of lactic acid bacteria to make commercial laban. The lactic acid starter was made with *Lactobacillus acidophilus*, *Bifidobacteria*, and *Streptococcus thermophilus* and incubated for 4-5 hours at 42-43°C. When the pH reaches 4.5 to 4.6, the coagulum is mixed with agitation before being chilled to below 4 C to prevent further fermentation.

FLOW CHART FOR PRODUCTION OF COMMERCIAL LABAN



II. MILK FERMENTATION (FUNCTIONS OF LACTIC ACID BACTERIA)

LAB (Lactic Acid Bacteria) dominates the microflora in milk products, and dairy products contain a variety of species. The growth optimal temperatures of LAB in dairy fermentation can be split into two classes: mesophilic LAB have a growth optimum temperature of 20 to 30°C, and thermophilic LAB have a growth optimum temperature of 30 to 45°C. Mesophilic bacteria can be found in Western and Northern European items, while thermophilic bacteria can be found in sub-tropical items. During glucose fermentation, the LAB is separated into two types: homofermentative and heterofermentative. Heterofermentative bacteria such as *Leuconostoc* and *Weissella* create CO2, lactate, and ethanol from glucose. (Capice and Fitzgerald 1999; Jay 2000; Kuipers *et al.*, 2000). In addition to milk products, LAB is frequently utilized in food fermentation. LAB is a proteolytic enzyme that is required for the final product to create taste components. In the laboratory, the proteolytic system is crucial for microbial development. It comprises casein utilization in LAB cells, which results in fermented milk products with organoleptic qualities.

It is critical to use LAB (Lactic Acid Bacteria) as starting strains in the production of various fermented milk products. Specifically, *Lactobacillus lactis*, *Lactobacillus helveticus*, *Streptococcus thermophiles*, and *L. delbruicki sub sp. bulgaricus* is a type of bacteria that is commonly used as a milk starting culture. *Lactococcus casei* is found in cheeses while *L. bulgaricus* and *S. thermophilus* are used to make yoghurt. To get the desired flavor and texture, the manufacturer of milk fermented goods must pick an appropriate and balanced number of LAB for starter cultures. (Derek *et al.*, 2009)

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III. MICROBIAL FERMENTATION OF LABAN

In traditional Lebanese laban, yeasts such as *Kluyveromyces fragilis* and *Saccharomyces cerevisiae* were shown to be responsible for the generation of acetaldehyde and ethanol, according to Baroudi & Collins (1975). Tantaoui Elaraki *et al*., (1983) hypothesized that yeasts could stimulate the growth of lactic acid bacteria, resulting in the formation of laban's distinctive flavors.

Finally, most strains belonged to the homofermentative acidifying (*Lactococcus lactis ssp lactis*) and homofermentative aroma generating (*Lactococcus lactis ssp lactis biovardiacetylactis*) species, both of which are significant in the acidification and aroma generation of laban. Laban has a unique microbiological composition. (Baroudi & Collins, 1975) discovered five microorganisms in artisanal products, including three bacterial species (*Streptococcus thermophilus, Lactobacillus acidophilus*, and *Leuconostoc lactis*) and two yeast species (*Klumyveromyces fragilis* and *Saccharomyces cerevisiae*).

Lactobacillus acidophilus was supposed to add acidity to Lebanese laban, whilst *Lactobacillus bulgaricus* was supposed to be responsible for increased acidity in Iraqi laban. *Lactobacillus acidophilus*, *bifidobacteria*, and *Streptococcus thermophilus* make up the starter culture used in commercial laban. No such microorganisms were detected in traditional laban, indicating that the two preparations have different sensory-characteristics

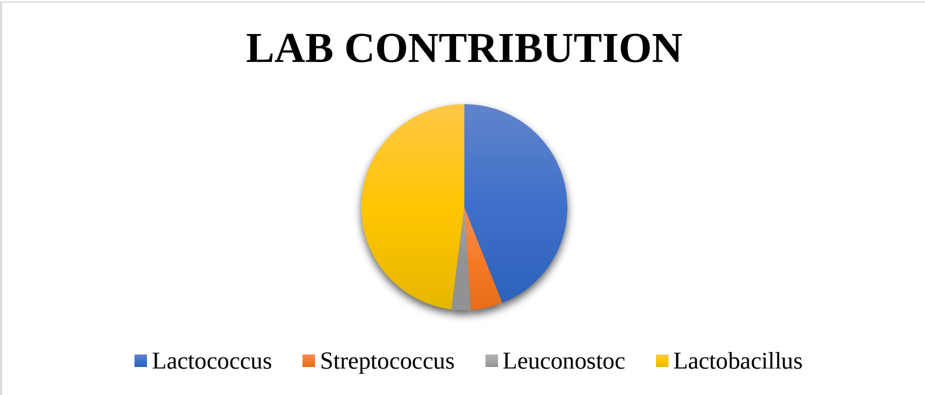

Fig 1: Lactic Acid Bacteria Distribution In Laban

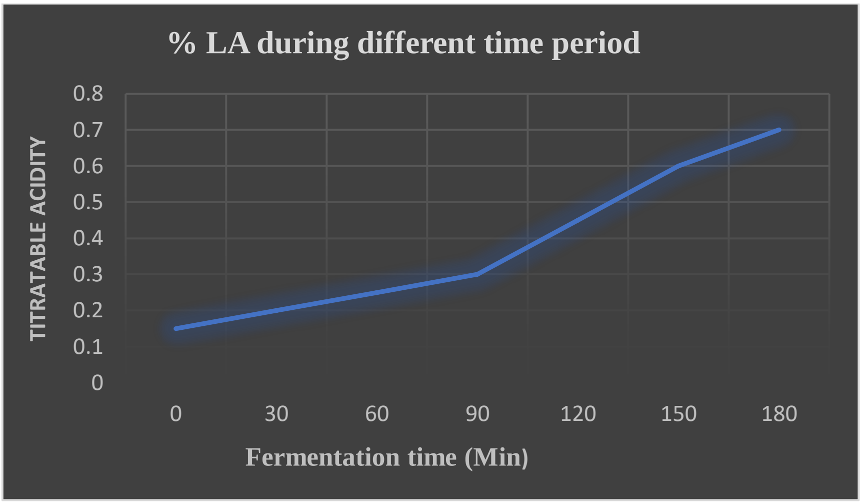

Fig 2: Effect Of Time On Titratable Acidity Development

IV. PHYSICO-CHEMICAL MECHANISMS INVOLVED IN THE FORMATION OF LABAN GELS

Due to the solubilization of CCP, acidification of milk causes the internal structural characteristics of casein micelles to be disrupted (Dalgleish and Law, 1989). The net negative charge on casein reduces as it approaches its isoelectric point (pH 4.6), reducing electrostatic repulsion between charged groups, including the phosphoserine residues that are exposed when the CCP is solubilized. Through improved hydrophobic interactions, electrostatic attraction and protein-protein attraction both increases. (Lucey, 2004). For three pH ranges, physico-chemical mechanisms for the generation of acid milk gels can be explored. (Lucey, 2004).

pH 6.7 to 6.0

The net negative charge on the casein micelles reduces as the pH of milk drops from 6.6 to 6.0, resulting in a decrease in electrostatic repulsion. The size of the casein micelles is virtually unaltered since only a minor quantity of CCP is solubilized at pH >6.0.

pH 6.0 to 5.0

The net negative charge on casein micelles diminishes as the pH of milk drops from 6.0 to 5.0, and the charged "hairs" of -casein may shrink (or curl up). This causes a decrease in electrostatic repulsion and steric stabilization, both of which are important for casein micelle stability in the original milk.

At pH ≤6.0

The rate of CCP solubilization rises, weakening casein micelle internal structure and increasing electrostatic repulsion between exposed phosphoserine residues. pH 5.0 totally solubilizes CCP in casein micelles in milk. However, a considerable quantity of CCP is not solubilized at this pH in rennet-coagulated cheese, most likely due to a protective function on CCP solubility from the increased solids content of curd compared to milk. The amounts and quantities of caseins dissociated from the micelles were temperature and pH dependent, according to Dalgleish and Law (1988). As the temperature drops from 30 to 4°C, more caseins break from micelles and enter the serum. Maximum dissociation occurs between pH 5.6 and 5.1 (Dalgleish and Law, 1988), which could be attributable to a partial weakening of bonds within and between caseins due to CCP loss (Lucey, 2004). Hydrophobic interactions involved in casein association are particularly weak at low temperatures.

pH ≤5.0

When the pH of milk approaches the isoelectric point of casein (pH 4.6), the net negative charge on casein decreases, resulting in a reduction in electrostatic repulsion between casein molecules. Casein-casein attraction, on the other hand, increases as hydrophobic and plus-minus (electrostatic) charge interactions rise (Horne, 1998). As a result of the acidification process, a three-dimensional network of casein clusters and chains forms (Mulvihill and Grufferty, 1995).

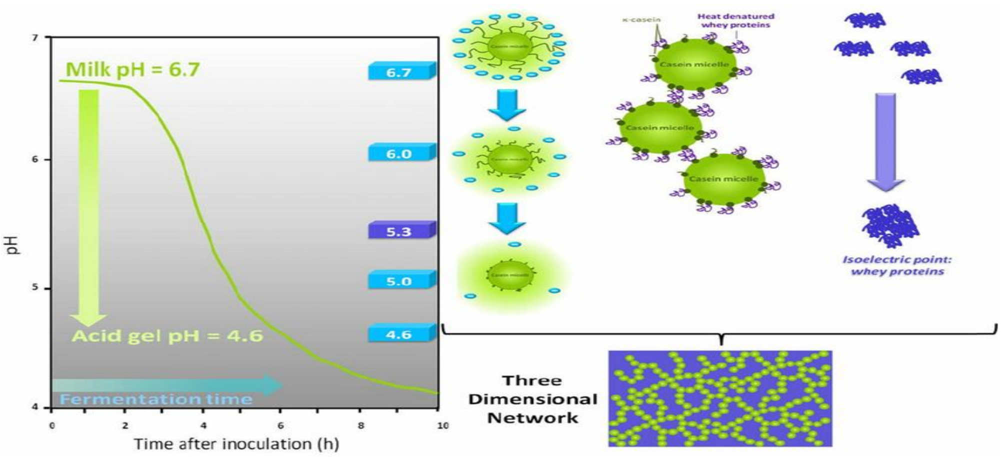

Fig 3: Typical pH profiles during the fermentation process (Marie *et al.*, 2013)

V. HEAT TREATMENT

Milk heating is a key processing variable in the preparation of laban because it has a significant impact on the physical qualities and microstructure of the product. Milk is heated before culture is added in the laban process. 85°C for 30 minutes or 90-95°C for 5 minutes are common temperature/time combinations for batch heat treatments in the dairy industry (Tamime and Robinson). However, ultra-heat temperature (UHT) (140°C for 4 to 16 s) or very high temperature short time (100°C to 130°C for 4 to 16 s) are also sometimes utilized (Sodini *et al.*, 2004). Heat treatment of milk also kills undesirable microbes, allowing the starting culture to thrive with less competition. Because Laban starting cultures are oxygen-sensitive, heat treatment aids starter growth by removing dissolved oxygen. In laban, native whey proteins from warmed milk serve as inert fillers. The main whey proteins, such as -lactoglobulin, are denatured when milk is heated over 70°C. By disulfide bridging, β -

lactoglobulin interacts with the k-casein on the casein micelle surface (and any soluble k-casein molecules, i.e. k-casein that dissociates from the micelle at high temperatures) during denaturation, resulting in increased gel hardness and viscosity of the laban gel. The increased stiffness of laban gels generated from heated milk is due to denatured whey proteins that have gotten linked to the surface of casein micelles. During the acidification process, soluble complexes of denatured whey proteins with k-casein also bind with the micelles. When milk is cooked at 80°C for 15 minutes, the denaturation of β -lactoglobulin is much higher than when milk is heated at 75°C for the same amount of time. The stiffness and viscosity of acid milk gels are affected by the degree of denaturation of whey proteins after the heat treatment of milk. (Dannenberg and Kessler, 1988).

Table 1: Chemical Composition For Different Types Of Laban

Type of Product	Fat	Protein	Total carbohydrate	Total solids	Titratable acidity
Full Fat Laban	3.1-3.3	3.2-3.3	4.7-4.8	12.5-12.8	0.8-0.9
Low Fat Laban	1.2-1.5	3.1-3.2	4.6-4.7	10.5-11.5	0.9
Flavoured Laban	3.0-3.2	3.0-3.3	4.5-4.7	12-13	0.9

When compared to gels incubated at high temperatures (e.g. >40°C), stirred yogurts incubated at lower temperatures (e.g. <40°C) showed higher viscosity. (Beal *et al*., 1999; Martin *et al*., 1999; Sodini *et al*., 2004; Lee and Lucey, 2006). The sensory qualities of stirred yogurts, such as mouth coating and smoothness, decreased as the incubation temperature climbed. (Cho-Ah-Ying *et al*., 1990; Martin *et al*., 1999).

VI. DEVELOPMENT OF ACIDITY DURING STORAGE

The pH and acidity are inversely connected, with a rise in acidity accompanying a decrease in pH during storage. The rise in acidity could be attributed to an increase in the concentration of lactic acid and other organic acids as a result of lactose breakdown. The temperature and length of time spent in storage have a significant impact on pH.

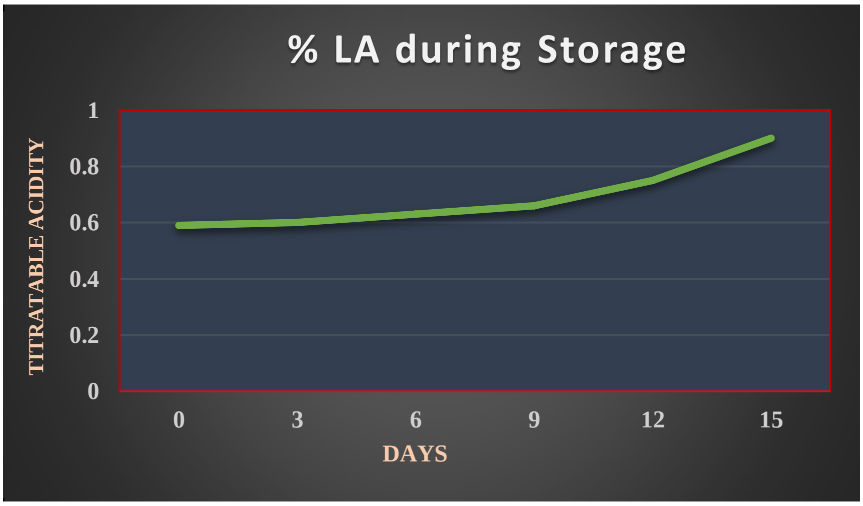

Fig 4: Development Of Acidity During Specified Time Period

VII. SHELF LIFE OF LABAN

According to (Sofu & Ekinci, 2007), 14 days after the storage of yogurt samples, there was an increase in the percentage of the entire area with tint of pale greenish-yellow, grayish-yellow, light grayish-green, and yellowish green. The presence of these tints is linked to product microbial deterioration. As a result, the shelf life of laban is determined by the level of contamination and the manufacturing process (artisanal or industrial scale). Yogurt can be sold for up to 21 days after it is made. The shelf life of laban varies between 14 and 30 days.

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VIII. SENSORY EVALUATION

The impression of fermented milk products by consumers is mostly based on health, nutrition, sensory features, and pleasure. As a result, manufacturers must ensure that their product meets consumer expectations in terms of natural laban. Laban is distinguished by its acidity, texture, and aroma from a sensory standpoint. Laban is more acidic than other fermented milks due to its lower breaking pH. These rheological and textural qualities are important indicators of laban quality. They can be regulated by changing the strains utilized, as well as the milk's total solids content, heat treatment, and homogenization.

These sensory qualities are important aspects of laban flavor. To generate fermented products with diverse flavor qualities, they can be managed by adjusting the type and number of strains utilized, as well as the balance between strains.

After milk fermentation, there are significant changes between pure and mixed cultures, although changes across mixed cultures are more subtle. The aroma composition of all labans formed from mixed cultures is complex, containing all the flavor components produced by the two species *S. thermophilus* and *L. delbrueckii subsp. bulgaricus*.

Laban is made up of a hard gel that forms as lactic acid levels rise. (Saint-Eve *et al.*, 2008). The gel hardness is highly influenced by the starter's composition. (Chammas *et al.*, 2006)

Aromatic chemicals such as acetaldehyde, organic acids, 2,3-butanedione, and acetoin are present in Laban, and intensity reflects their presence. (Chammas et al., 2006; Ott *et al.*, 2000).

The use of sensory analysis to judge product quality is a common practice.

a) FLAVOUR

Must have a clean acid flavor that is free of harsh, rancid, oxidized, stale, yeasty, and dirty flavors. Flavoring elements must be evenly dispersed, have a pleasant flavor, and be representative of the flavoring employed. The flavor should not be overpowering or artificial.

b) BODY/TEXTURE

A smooth, homogeneous texture is required. A spoonful must keep its shape without sharp edges, and flavoring elements must be evenly dispersed throughout the product.

c) COLOR/APPEARANCE

Shall have a smooth velvety look and a clean, natural color. The color of unflavored laban can range from dazzling white to off-white. Excess whey separation, surface development, or discoloration should not be visible on the surface. The size, distribution, and color of the flavoring ingredients must all be consistent.

Table 2. contains the sensory qualities as well as their definitions.

Perception category	Attributes	Definition
Appearance	Gel firmness	Absence of syneresis
	Color	Scale yields from white to yellow
Texture assessed with the spoon	Gel-like	Product's ability to wiggle like a gelatin dessert
	Smooth	Presence of grain-size particles in the gel quantified by visual inspection of the spoon's back
	Thick	Product's ability to flow from the spoon
	Slimy	Product's ability to flow in a continuous way from the spoon
Texture assessed in the mouth	Thick	Product's flowing resistance assessed by pressing one spoonful of the product between the tongue and palate
	Mouth coating	Product's ability to form a film lining the mouth

IX. CONCLUSION

Humans require fermented dairy products in their diet. Consumption of new and enriched foods has increased at a faster rate as a result of the growing need for safe and functional foods. With the introduction of new probiotic and fermented dairy beverages to the market, it is certain that demand for these products will increase. As a result, new items must be introduced to the market, as well as additional research into their functional characteristics.

X. FUTURE-OUTLOOK

In Arab countries, dairy exports are still quite low, especially when compared to Saudi Arabia, where dairy exports are rapidly expanding. Even though Syria is the largest producer among these countries, only minor amounts are processed by dairy factories with limited infrastructure and technology, as opposed to on-farm and artisanal production. Saudi Arabia, on the other hand, has more developed processing units and employs advanced technology, with a higher percentage of milk sent to dairy plants. (Alqaisi, Ndambi, Uddin, & Hemme, 2010). Aside from laban production, labneh and other Middle eastern fermented milks have a different manufacturing procedure since these fermented goods are concentrated by eliminating a portion of the serum (whey). This is generally done by swirling the laban and then straining it through cloth or animal skin bags. More contemporary technologies, such as membrane methods (ultrafiltration and reverse osmosis) or centrifugation, are now accessible. (Nsabimana, Jiang, & Kossah, 2005). The key distinctions between labneh and laban are its rheological qualities, which are a result of its higher total solids content (230-250 g/kg). (Ozer & Robinson, 1999)

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