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Manufacture of Fresh Labenh From Goats' Milk Using Ultrafiltration process

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Abstract: Chamical Composition and sensory evaluation of fresh labneh made from goats milk, using ultra filtration (UF) and traditional processes were investigated. Yields, recovery of fat, protien and total solids of fresh labneh were also evaluated.Labnehs prepared by using the UF process has lower contents of protien, fat, total solids and pH and higher contents of acidity compared with traditionally made labneh. An increase of 14.5% in labneh yields, 11.7% in fat recovery, 13.2% in protien recovery and 12.9% intotal solids recovery was achieved by UF process. Moreover, the UF process showed 75% reduction in the total process time and 12.5 and 62.5% reduction in the starter culture used for the labneh produced by UF before fermentation, respectively. The mean score for consistency of labneh made by UF before fermentation or by traditional process. However no diferrences were found in appearence, flavour and overall acceptability between labnehs made using UF or traditional process. Sensory characteristics of both traditional and UF process labnehs were considered to be acceptable.

Key words: Labneh, concentrated yoghurt, goats' milk, ultrafiltration

Introduction

Goats contribute about 10,144,000 metric tonnes to the world milk production (FAO, 1996). Although in the tropics and arid region, milk is secondary to meat production. Goats' milk plays an important role in certain parts of the world especially in the rural community. In Saudi Arabia, however, the goat population of 6.2 million (Anonymous, 1997) ranks even third in the indigenous total animals population and comes behind sheep and cattle. However, interest in applications for goats' milk has been increased internationally in recent years. Goats' milk has been used since long times, throughout the world, for the manufacture of different type products (Loewenstein *et al.*, 1980; Robinson and Vlahopoulou, 1988; Abrahamsen and Rysstad, 1991).

Labneh or strained/concentrated yogurt is a traditional fermented milk product, which is widely consumed, chiefly as a sandwich spread, in the Middle East, Turkey and Balkan regions. Other labneh related products are manufactured in different countries, for example, *skyr* in Iceland, *chakka* and *shirkhand* in India and labneh Anbaris in the Middle East (Tamime and Robinson, 1985,1988). Labneh is marketed, in the United Kingdom, under the name of *Greek cheese* and in North America it is often called *yoghurt cheese*. Labneh has been manufactured and studied from cow' s milk by several researchers (Tamime and Robinson, 1978, 1988; Abou-Donia *et al.*, 1992a&b; Al-Kadamany *et al.*, 2002) and produced, in commercial scale by large dairy plants, in the Mediterranean and the Middle East countries.

The recent increase in the popularity of labneh in Europe has led to more interest in the manufacture of labneh, especially in relation to milk species (Mehaia and El-Khadragy, 1999; Rao, 1987) and concentration techniques (Ozer *et al.*, 1999a&b&c; El-Samragy *et al.*, 1997; Tamine *et al.*, 1989a&b, 1991a&b&c). The traditional method for producing labneh consists of straining whole-milk yogurt in cheese cloth bags to the desired total solids level (22-26%). Modern techniques are now increasingly used to make labneh. However, ultrfiltration (UF) process was proposed as a better alternative to the traditional labneh-making process, which is uneconomical and unhygienic (Ozer *et al.*, 1999a & b; El-Samragy *et al.*, 1997; El-Samragy and Zall, 1988; Tamine *et al.*, 1989a&b, 1991a&b). Although labneh has been studied and manufactured from cow's milk using UF-process in the last two decade, published reports on preparation and quality characteristics of UF-goats' milk labneh are relatively scarce (Tamine *et al.*, 1991b). Therefore, the objectives of this work were 1) to characterize the process for making labneh from goats' milk by ultrafiltration, 2) to determine chemical composition and yield for labneh manufactured by traditional and UF processes, and 3) to evaluate sensory properties of labneh made from goats' milk by the two processes.

Materials and Metods

Materials

Fresh whole goats' milk was obtained from Qassim University Farm, Buriedah, Saudi Arabia. The milk was immediately cooled to 5 ± 1 °C, transported to the laboratory and maintained cold until use. Yoghurt (B-6) starter (a mixed strain of *Streptococcus salivarius ssp.thermophilus* and *Lactobacillus delbrueckii ssp. bulgaricus*) was obtained from Chr. Hansen's Laboratories A/S (Copenhagen, Denmark).

Ultrafiltration process: Twenty kilograms of raw whole goats' milk were pasteurized at 65 ° C for 30 min. The

pasteurized milk was cooled to 50 °C before ultrafiltration. Two bench-scale UF systems were used. Each system consisted of a feed tank for holding the milk, a Masterflex peristaltic pump (Cole-Parmer Instrment Co., Chicago, IL, USA) for recycling milk, two pressure gauges to monitor inlet and outlet pressures, a hollow fibre UF module with a polysulphone membrane of 30,000 molecular weight cut-off (MWCO) (Model UFP-30-C-4) obtained from A/G Technology, Needham, MA, USA, and a container to collect and measure the permeate. The UF process was started by pumping the milk at 50 °C through the membrane module while maintaining inlet and outlet pressures of 137 and 35 k Pa, respectively. Permeate volume was monitored continuously to determine reduction in milk volume. After each run, the membrane module was cleaned and disinfected according to the manufacturer's instructions and stored in a 5 °C cooler

Manufacture of labnehs: Three labneh-making trials were conducted at our dairy technology laboratory. Three different manufacturing methods were employed, and four replicates of each batch were prepared for analysis. Methods of labneh manufacture proposed by Ozer *et al.* (1999a) were applied.

Traditional labneh: To produce traditional stirred-type labneh (control), whole goats' milk was heated to 85 °C for 30 min and then cooled to 42 °C, inoculated with 2% yogurt starter and incubated at 42 °C for 2-3 hr. The coagulant was drained after overnight refrigeration following manufacture in hanging cheesecloth bags until the desired total solids concentration (~ 23%) was reached, which is typical of traditional labneh from the Middle East (Tamime and Robinson, 1985). Drainage was achieved at 4 °C and the total drainage time was 20-22 hours. Labneh was poured into plastic cups (200 gm) and held at 5 ± 1 °C.

Labneh produced by UF before fermentation (UF-BF labneh): Whole milk was concentrated by UF to about 23% total solids at 50°C. The standard yoghurt manufacturing procedure was then followed, and incubation was stopped at pH 4.0.

Labneh produced by UF after fermentation (UF-AF labneh): Ultrafiltration was applied immediately after incubation of fermented whole milk was complete (pH 4.3). The temperature was maintained at 42°C by circulating cold water around the feed vessel when necessary. After the desired concentration of total solids was reached (~ 23%), the sample was filled into plastic cups and stored in the refrigerator until analysis. Labneh samples were taken for analyses after one day.

Table 1: Manufacturing parameters for fresh labneh made from goats' milk.

Process[1]	Traditional	UF-AF	UF-BF	% Reduction
Raw milk (Kg)	20	20	20	-
Retentate (Kg)	-	7.9	7.9	60.5
Starter used (g)	400	350	150	12.5-62.5
Total process time (hr)	30-32	6-8	6-8	75

[1]UF-AF = labneh produced by UF after fermentation,UF-BF = Labneh produced by UF before fermentation.

Chemical Analysis: Proximate analyses of milk and labneh were analyzed as described by Ling (1963) and AOAC (1980). Titratable acidity was determined by titrating 10 g of sample with 0.1 N NaOH to a pink endpoint using phenolphthalein indicator and pH was measured with an Orion pH meter (Orion Research Inc., Cambridge, MA). All analyses were carried in triplicate.

Labneh yields and component recovery: Labneh yields were calculated as a weight of labneh divided by weight of milk expressed as kg 100 kg^{-1}. Component (protein, fat and milk total solids) recovery was calculated as the weight of the comp. in the labneh divided by the original weight of the component in the milk expressed as kg 100 kg^{-1}.

Sensory Evaluation: Sensory evaluation of labnehs was performed after one day of storage at 5 ± 1 °C. 12 University staff members, who were familiar with labneh, evaluated samples for flavour, consistency, appearance and overall acceptability. A nine-point hedonic scale (Stone And Sidel, 1985)) was utilized in this study (9 = like extremely, 5 = neither like nor dislike, and 1 = dislike extremely). Analysis of variance was used for statistical evaluation of the data (SAS, 1985).

Results and Discussion

Labneh-making processes : Manufacturing parameters and composition of milk used for goats' milk labneh are summarized in Tables 1 and 2. The UF process showed 75 reduction in the total process time, and 12.5 and 62.5% reduction in the starter culture used for the labneh produced by UF after fermentation and the labneh

produced by UF before fermentation, respectively. A similar observation was reported by Tamime *et al.* (1989, 1991a&b&c) in labneh manufacture from cow milk. Mehaia (2002) reported similar observations in fresh soft cheese made from goats' milk by UF process. However, production of labneh by UF process also eliminates the disposal problem associated with the whey of the conventional process. The benefits of using UF process in dairy products have been summarized and reported by several authors (Glover, 1985; Kosikowski, 1986; Renner and Abd El-Salam, 1991; and Cheryan, 1998).

Chemical composition of labneh : The chemical composition of fresh labnehs made from goats' milk is summarized in Table 3. The traditional (control) labneh had higher total solids, fat and protein contents than did labnehs produced by UF process. These differences may be attributed to the extent of draining and resulting increased concentration of the solids contents. A similar observations was reported by Tamime *et al.* (1989, 1991a) and Ozer

Table 2: Chemical comp. (mean ± SD) of whole goats' milk used for manufacture of fresh labneh (g 100g $^{-1}$) [1]

pH	TA[2]	Total solid	Fat	Protein[3]	Lactose[4]	Ash
6.63	0.16	12.85	3.4	4.1	4.5	0.85
± 0.05	± 0.4	± 0.16	± 0.1	± 0.13	± 0.06	± 0.02

[1]Means of triplicate analyses on each of three trials.
[2]TA = titratable acidity.
[3]Protein = total nitrogen x 6.38
[4]Lactose calculated by difference.

Table 3: Chemical composition of fresh labneh made from goats' milk (g 100g $^{-1}$)[1]

Process[2]	pH	TA	TS	Fat	Protein	Ash
Traditional	4.05[a]	1.55[c]	23.16[a]	8.82[a]	10.21[a]	0.87[b]
UF-AF	3.90[c]	1.75[a]	22.79[b]	8.62[b]	10.10[b]	0.88[b]
UF-BF	3.96[b]	1.62[b]	22.81[b]	8.61[b]	10.08[b]	0.87[b]

[a,b,c] Means with same letter in the same column are not significantly different ($P < 0.05$).
[1]Means of triplicate analyses on each of three trials.
[2]See Table 1.

Table 4: Mean [1] yields and recovery of fat, protein and milk total solids of fresh labneh made from goats' milk (kg 100 kg^{-1}).

Process [2]	Yield	Fat	Recovery Protein	Total solids
Traditional	34.5 [b]	89.5 [b]	86.0 [b]	62 [b]
UF-AF	39.5 [a]	100.0 [a]	97.3 [a]	70 [a]
UF-BF	39.5 [a]	100.0 [a]	97.1 [a]	70 [a]

[a,b] Means with same letter in the same column are not significantly different ($P < 0.05$).
[1] Means of triplicate analyses on each of three trials.
[2] See Table 1.

Table 5: Mean [1] taste panel scores for fresh labnehs made from goats' milk [2]

Process[3]	Appearance	Consistency	Flavour	Overall acceptability
Traditional	7.51 [a]	7.20 [a]	7.82 [a]	8.21 [a]
UF-AF	7.50 [a]	6.21 [b]	7.81 [a]	8.23 [a]
UF-BF	7.52 [a]	7.19 [a]	7.82 [a]	8.22 [a]

[a,b] Means with same letter in the same column are not significantly different ($P < 0.05$).
[1] Means of triplicate analyses on each of three trials.
[2] Nine-point scale (9 = like extremely, 5 = neither like nor dislike, and 1 = dislike extremely).
[3] See Table 3.

et al. (1999a&b) in labneh manufacture from cows' milk. The percentage of titratable acidity was significantly higher, and the pH was significantly lower, in labnehs made by UF after fermentation, than in other labneh samples. The pH of traditional labneh was significantly ($P > 0.5$) higher than this of labneh produced by UF process. In general the chemical composition of labneh, made by traditional or UF processes, were within the normal composition range for a similar product made from cows' milk (El-Samragy and Zall, 1988; Tamime *et al*, 1989a&b&c, 1991a&b; Ozer *et al.*, 1999).

Labneh yields and components recovery : Yield is one of the most economically important aspects of labneh and cheese manufacturing. Abou-Donia (1986) reported that factors such as milk composition, addition of salt, pasteurization of milk, milk concentration, and addition of starter, affect the yield of Domiati cheese. A major advantage of UF process is the inclusion of whey proteins and the all fat in the cheese/labneh as whey drainage is reduced or eliminated, thereby increasing cheese yield (Renner and Abd El-Salam, 1991; Cheryan, 1998; Mehaia, 2002).

Yield and recovery of protein, fat, and milk total solids of labnehs made from goats' milk are shown in Table 4, which clearly indicates that UF labneh yields are higher than those produced by traditional process. An increase of 14.5% in labneh yields was achieved by UF process, because increased recovery of proteins, fat and milk total solids. The percent yield of traditional goats' labneh (34.5%) was lower than that reported by Abou-Donia *et al.* (1992) for cows' labneh (39.5%). On the other hand, Mehaia (2002) reported that the cheese yield of fresh soft cheese produced from ultrafiltered goats' milk could be increased by about 21% compared with the traditional product.. However, higher cheese yields, using the UF process, have been reported for several types of cheese (Renner and Abd El-Salam, 1991; Eriksed, 1986; Cheryan, 1998: Rodriguez *et al.*, 1998; Hydamaka *et al.*, 2000). Labneh recovery values for fat, protein, and milk total solids are shown also in Table 4. In all labnehs, fat recovery (89.5 to 100%) was higher than protein recovery (86.0 to 97.3%), whereas total solids recovery (62 to 70%) was low. Total milkfat and 97.3% of milk proteins were retained by UF membrane. An increase of 11.7% in fat recovery, 13.2% in protein recovery, and 12.9% in total solids recovery was achieved by UF-process. However, the recovery of fat, protein, total solids was significantly ($P < 0.05$) higher for UF cheeses. This was consistent with the reported findings on milk concentrated with UF membrane (Glover, 1971, 1985; Green *et al.*, 1984; Bastian *et al.* 1991; Mehaia, 1996; Mehaia and El-Khadragy, 1998; Mehaia, 2002). Similar observations were reported by Hydamaka *et al.* (2000) for acid coagulated cheese made from ultrafiltered milk retentates.

Sensory evaluation : Mean scores of the sensory panels for labnehs made from goats' milk, using traditional and UF processes, are listed in Table 5. These data show that consistency of labneh was affected by manufacturing process. Labneh made by UF after fermentation process scored lower for consistency than those made by UF before fermentation or by traditional process. No differences ($P < 0.05$) were found in consistency between labnehs made using UF before fermentation or traditional process. Ozer *et al.* (1996) reported that the labneh made from cows' milk concentrated by UF prior to fermentation gave a viscosity measurement close to the traditional labneh. However, a difference in appearance, flavour and overall acceptability between UF labnehs and traditional process labnehs was not verified. On the other hand, Abrahamsen and Holmen (1981) reported that yoghurts made from goats' milk by UF process gave the best flavour and viscosity compared to yoghurts made by different concentration methods. Mehaia (2002) reported that the texture of UF soft white (Domiati-type) cheese made from goats' milk was significantly higher than that of cheese made by traditional process. Mahmoud (1980), Omar and Buchheim (1986), Hagrass *et al.* (1986) and Hydamaka *et al.* (2001) also reported that UF soft white cheeses made from cows' milk had a uniform and closed texture, good appearance and better organoleptic properties than the cheeses made by traditional process.

Conclusions

It is evident from this study that ultrafiltration can be employed for the production of labneh by concentrating goats' milk before or after fermentation. Chemical composition of labnehs obtained from this study compared favorably with labneh characteristics reported from cows' milk. The labnehs made by UF process was higher in pH and moisture content, whereas protein and fat contents were lower compared to those labnehs made by traditional process. An increase of 14.5% in labneh yields, 11.7% in fat recovery, 13.2% in protein recovery and 12.9% in total solids recovery was achieved by UF-process. Moreover, The UF process showed 75% reduction in the total process time, and 12.5 and 62.5% reduction in the starter culture used for the labneh produced by UF after fermentation and the labneh produced by UF before fermentation, respectively.

The mean score for consistency of labnehs made by UF after fermentation process was significantly ($P < 0.05$) lower than that of labnehs made by UF before fermentation or by traditional process. No differences ($P < 0.05$) were found in consistency between labnehs made using UF before fermentation or traditional process However, no difference ($P < 0.05$) were found in appearance, flavour and overall acceptability between labnehs made using UF or traditional process.

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