

(Original Article)



Impact of Corn and Goat's Milk on Labneh Characteristics

Osama S. F. Khalil*

Dairy Science and Technology Department, Faculty of Agriculture and Natural Resources, Aswan University, Aswan, Egypt.

* Correspondence: osamakhali1968@yahoo.com

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Abstract

One of the most well-liked dairy products in the Middle East is labneh, which has become very popular since it has more nutritional benefits than regular yoghurt. In order to compare the features of labneh prepared solely from goat's milk with labneh made from a mixture of goat milk and corn milk on its chemical and organoleptic characteristics. Labneh was prepared using a conventional process, kept chilled, and periodically tested for its chemical, microbiological, and organoleptic qualities. Results indicated that the addition of corn milk by different ratios as a mixture with goat milk during the processing added value to the produced labneh until 30 % as substituting percent with goat's milk through increased nutrient content such as fat and ash content. Also, all produced labneh and control treatments were free from coliform bacteria, molds and yeasts. On the other hand, results showed that increasing the replacement ratio up to 40 % gained undesirable sensory properties. Finally, the production of an acceptable low-cost labneh from corn milk can be done by substituting raw milk until 30% with corn milk.

Keywords: Corn Milk, Goat milk, Labneh.

Introduction

Labneh is a fermented dairy product consumed all over the world, it is most common in the Middle East, particularly in Syria, Lebanon, Turkey, and the Balkans, where it is a mainstay of meals for families particularly well-liked as a food (Tamime and Robinson, 1978). Due to its substantial nutritional value and excellent storage qualities, labneh is frequently eaten as the main dish for breakfast (Abd El-Salam *et al.*, 2011). Labneh's growing economic significance can be attributed to its storage and nutritional qualities (Nsabimana *et al.*, 2005). Due to its simplicity of digestion, goat milk has recently seen an increase in popularity among consumers of all ages, including children, adults, and the elderly (Lima *et al.*, 2018).

In many parts of the world, goat milk is preferred to cow or buffalo milk (Albenzio and Santillo, 2011). Fresh goat milk can be drunk, or it can be used to make one of the popular traditional dairy goods. According to Senaka Ranadheera *et al.* (2012), goat's milk has different alkalinity, stronger buffering capacity, and fewer allergenic characteristics than cow's milk, particularly in non-sensitized

children. Goat milk characteristic is more unique compared to cow milk for having smaller lipid globules and thus easier to be digested. According to Zain and Kuntoro (2017), customers still don't like goat milk very much because of the goat aroma that is produced by the milk's lipids, which comprise capric acid, caprylate acid, and caproate acid.

It is necessary to make an attempt to lessen the goat smell in goat's milk, which is intended to boost consumer preference for drinking goat milk. Fermentation is one method used to reduce the fragrance of goat milk (Sampurno and Cahyanti 2017). Not only does milk processing through fermentation increase nutritional content, but it can also be used to get rid of some distinctive smells of fresh milk, including the sour and buck fragrance that is present in goat milk (Haskito *et al.*, 2019). According to a study by Al-Baarri *et al.* (2003), goat milk fermentation can result in the production of volatile chemicals such as acetaldehyde, diacetyl, and ethanol that can hide the goat milk's odor. The properties of goat milk and fermented goat milk can be fixed, in addition to fermentation, by the addition or fortification of specific ingredients (Haskito *et al.*, 2019).

Corn milk is regarded as a recent breakthrough, particularly when used to create cheese-based goods. The question of whether corn is healthy has generated debate given its widespread use in food products. However, corn contains bioactive substances, including lutein, folic acid, and phenolic compounds, that have nutritional advantages (Dewanto *et al.*, 2002). Due to its delicious flavor and nutritional content, corn milk solves the lactose intolerance and saturated fat issues associated with cow milk (Padghana *et al.*, 2015).

This study aimed to ascertain whether it was possible to manufacture appealing, affordable, and highly nutritious labneh using various ratios of corn milk added to goat's milk because there was insufficient information in the literature about the use of corn milk in dairy products.

Materials and Methods

Materials

Milk: Goat milk was obtained from the Mallawi farm in the Minia governorate.

Corn: Freshly harvested green corn cob grains (milky stage) were taken from a private field located in Mallawi, Minia governorate.

Preparation of Corn Milk

White cob corn was gathered when the grain was at its most milky and juicy (milky) stage of maturity. Hairs and other foreign objects were removed from the grains after they had been separated from the cob. Using a blender, corn grains were combined with tap water in a 1:2 (w/w) ratio. The resulting liquid was then filtered through cheesecloth.

Manufacture of labneh

A modified version of Tamime and Robinson's (2007) formulation was used to produce labneh. Control treatment (C) of labneh was made from goat milk only. The other three treatments were made of a mixture of goat's milk and corn milk (Table 1). The first ratio (T1) is 80 percent goat milk to 20 percent corn milk; the second (T2) is 70 percent goat milk to 30 percent corn milk; and the third (T3) is 60 percent goat milk to 40 percent corn milk. Combinations were cooked at 90 °C for 20 minutes, cooled to 45 °C, and then inoculated with 3% of the yoghurt starter culture (*Streptococcus thermophilus* and *Lactobacillus delbrueckii* subsp. *bulgaricus*). The milk was stirred, poured into glass containers, and incubated at 40 °C until it reached a pH of 4.6, at which point it had fully coagulated.

Table 1. Labneh was made from goat's milk and corn milk ratio's as following

Treatment	goat's milk %	Corn milk %
C	100	0
T1	80	20
T2	70	30
T3	60	40

In order to allow the whey to drain, the resulting coagulant was combined and placed into cheesecloth bags and mixed thoroughly with 0.5% NaCl, which was then hung in the refrigerator at 5°C for 16 hours. Each bag of fresh labneh was kept at 5°C for 21 days. The sample was collected for chemical, microbiological, and organoleptic property analysis at fresh, 7, 14, and 21-day intervals.

Chemical analysis

According to the procedures of (Ling 1963), moisture, ash, fat, and protein content were evaluated. The pH was determined using an electric pH meter (HANNA HI 2211), and the titratable acidity was determined according to AOAC, (2007).

Microbiological analysis

APHA, (1992) guidelines were used to assess total bacterial counts, coliforms, molds, and yeasts. Plate count agar was used to calculate the total number of bacteria, and it was incubated at 32°C for 48 hours. Coliforms were identified using violet-red bile agar, which was incubated for 24 hours at 37°C. On plate count agar that contained 0.01% chloramphenicol and 0.01% chlortetracycline hydrochloride, respectively, molds and yeasts were counted after incubation at 25°C for 5 days and 5°C for 10 days.

Sensory analysis

According to Ahmed and Ismail (1978), sensory evaluation includes taste (60 points), body and texture (30 points), and appearance (10 points). Ten expert panelists, staff members of the dairy science department, conducted the organoleptic examinations.

Results and Discussion

Table (2) lists the chemical composition of goat milk and corn milk. Goat milk has a pH of 6.7, 12.1% Total Solids, 3.3% Total Protein, 3.42% Fat, and 0.7% Ash. According to Ibrahim *et al.* (2019) findings, corn milk has a pH value of 6.94, 15.62% Total Solids, 0.68% Total Protein, and 0.54% Ash.

Table 2. Some chemical properties of goat milk and corn milk

Properties	Goat milk	Corn milk
Total Solids (%)	12.1	15.62
Total protein (%)	3.3	0.68
Fat (%)	3.42	-
PH	6.7	6.94
Acidity (%)	0.17	0.12
Ash (%)	0.7	0.54

Chemical composition of Labneh

Total solids

As shown in Fig. (1), the TS content of the labneh manufactured from goat's milk grew from 22.21% at the start of processing to 23.50% after 21 days of storage. At the start of processing, the TS contents of the labneh samples were between 23.60, 24.42, and 25.13% for (T1), (T2), and (T3), respectively. Following the 21 days storage period, it climbed to 25.02, 25.98, and 26.70% for (T1), (T2), and (T3), respectively.

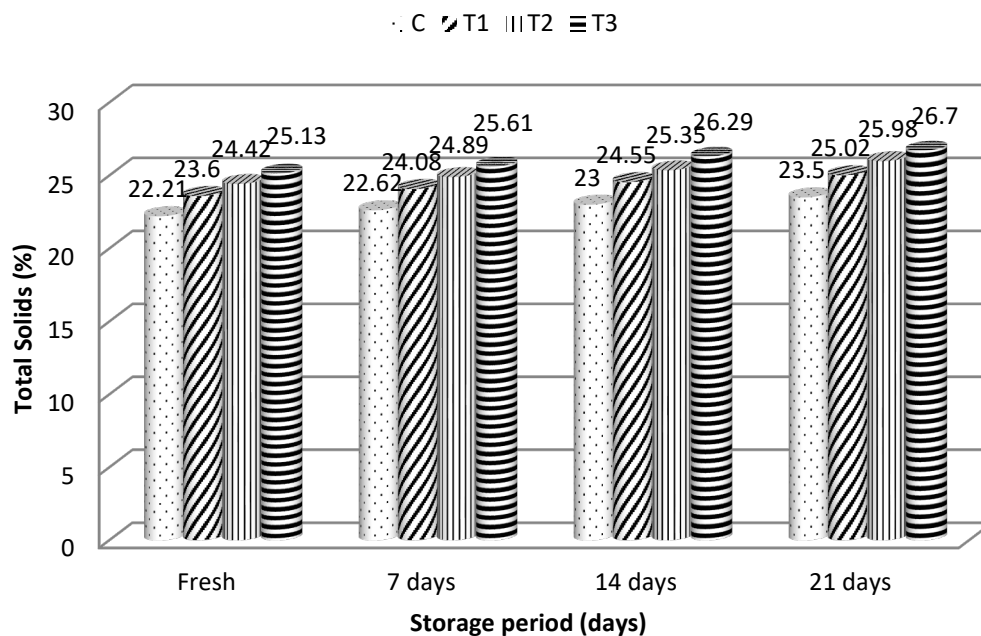


Fig. 1. Changes in total solids values of labneh samples during storage periods

C = control (100% goat milk), T1= (80 % goat milk + 20 % corn milk), T2= (70 % goat milk + 30 % corn milk), T3= (60 % goat milk + 40 % corn milk).

Additionally, the inclusion of corn milk concentrate increased the total solids content, which might have improved the sensory qualities of the labneh. According to Tamime *et al.* (1989) and Tamime (2007), total solids (T.S%) for labneh made from cow's milk using the traditional method ranged from 23 to 29 percent, while El-Samragy and Zall (1988) discovered that the TS was 23.18% for labneh made from cow's milk using the ultrafiltration technique.

According to Hefnawy *et al.* (1992), the total solids for labneh made from cow's and buffalo's milk were 22.42 and 23.24% respectively. According to Ozer *et al.* (1999), labneh made using the UF process had lower total solids than traditional (control) labneh. The degree of draining and subsequent higher concentration of the solids contents may be the cause of these variations.

Titratable acidity and pH values

Fig. (2) shows that the acidity in control was higher than that made from goat's milk with different concentrations of corn milk. Data revealed that the acidity content of Labneh made from goat's milk (control) was 1.45 at the beginning of processing and then increased to 1.60 after 21-days of storage. By the start of processing, the acidity% content of the labneh samples ranged from 1.44, 1.42, and 1.42% for (T1), (T2), and (T3), respectively, and increased to 1.59, 1.58, and 1.56% for (T1), (T2), and (T3), respectively, by the end of the storage period (21 days). Fresh and storage Labneh both became more acidic as corn milk concentrations rose. Lactic acid generation plays a major role in raising the acidity of the combined product in contrast to the control sample. The information is similarly comparable to that provided by Alshehabi *et al.* (2015), who stated that when comparing the properties of labneh created using a direct approach to labneh manufactured using a traditional method, the average amount of acidity produced after fermentation was 1.41%. Fig. (3) demonstrates that all treatments had higher pH values than the control. The pH value of labneh prepared from goat's milk (control) ranged from 4.40 at the start of processing to 4.30 after 21-days of storage, according to the data. By the start of processing, the pH content of the labneh samples ranged from 4.42, 4.45, and 4.50 for (T1), (T2), and (T3), respectively, and climbed to 4.32, 4.35, and 4.41 for (T1), (T2), and (T3), respectively, by the end of the storage period (21 days). These findings were consistent with those reported by Alshehabi *et al.* (2015), who discovered that the average pH was 4.62. On the other hand, throughout the storage period, pH readings exhibited a tendency away from acidity. The pH readings agreed with those from (Angelia *et al.*, 2014).

At the end of storage periods, a comparatively substantial increase in acidity and a drop in pH values were discovered. This decrease was consistent with the research conducted by El-Gazzar *et al.* (2018). Additionally, these findings concurred with those of Elkot *et al.* (2021) who discovered that the control had the labneh manufactured from date fruits with the highest acidity (1.47%) and lowest pH values (4.35). Khalil *et al.* (2023) found that the 20 samples tested were all

strongly acidic (usually having a pH of 4), and the result is identical to their findings.

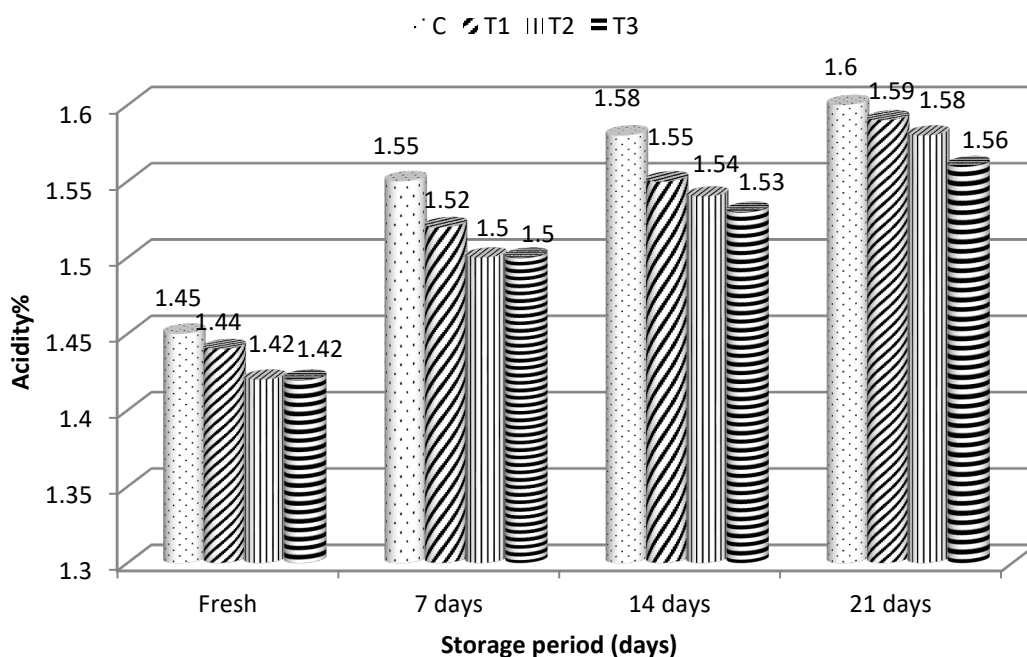


Fig. 2. Changes in titratable acidity values of labneh samples during storage periods. C = control (100% goat milk), T1= (80 % goat milk + 20 % corn milk), T2= (70 % goat milk + 30 % corn milk), T3= (60 % goat milk + 40 % corn milk).

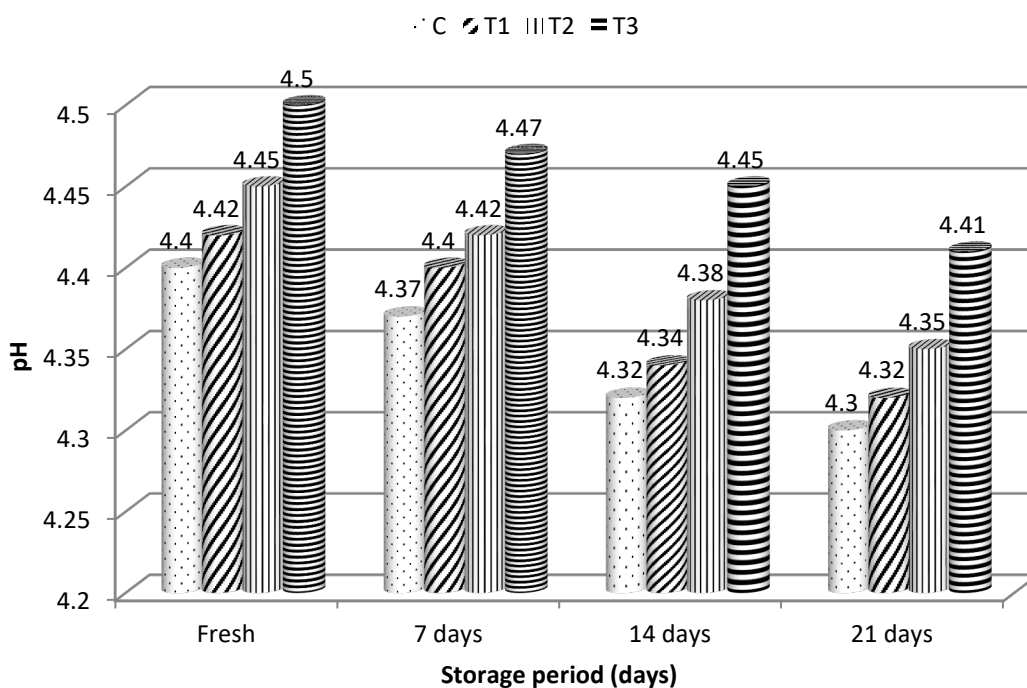


Fig. 3. Changes in pH values of labneh samples during storage periods. C = control (100% goat milk), T1= (80 % goat milk + 20 % corn milk), T2= (70 % goat milk + 30 % corn milk), T3= (60 % goat milk + 40 % corn milk).

Protein Content

Fig. (4) shows that the protein content (%) of Labneh made from goat's milk (control) was 11.00% at the beginning of the process and then increased to 12.68 % after 21-days of storage.

The protein content of the labneh samples when fresh ranged between 9.12, 8.32, and 7.10% for (T1), (T2), and (T3), respectively. After 21-days of storage period, it climbed to 11.50, 10.90, and 9.75% for (T1), (T2), and (T3), respectively. The control had more protein content than labneh manufactured using the UF method, according to Ozer *et al.* (1999), who also found this to be the case. Labneh made from goat's milk with various quantities of corn milk came in second. These findings concur with those of Abdel-Wahed *et al.* (2019).

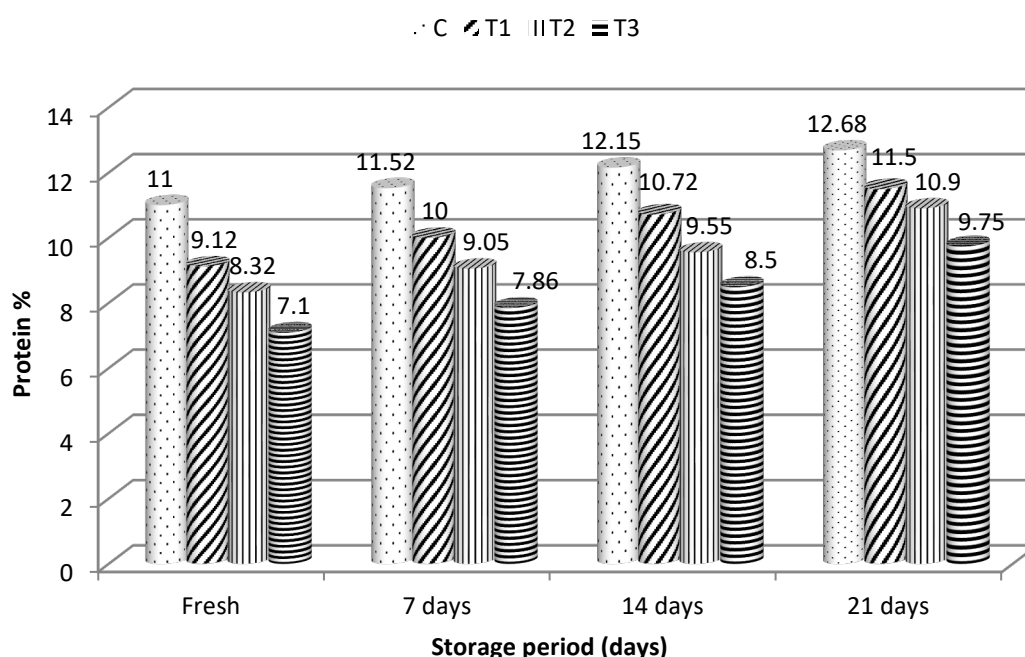


Fig. 4. Changes in protein values of labneh samples during storage periods.

C = control (100% goat milk), T1= (80 % goat milk + 20 % corn milk), T2= (70 % goat milk + 30 % corn milk), T3= (60 % goat milk + 40 % corn milk).

Fat in dry matter (FDM) content

Figure (5) shows that the fat in dry matter percentage (%) of Labneh made from goat's milk (control) was 32.30% at the beginning of processing and then increased to 32.63% after 21-days of storage. Fat in dry matter % of labneh samples were in range of 33.25, 34.20 and 35.03 % for (T1),(T2) and (T3) respectively at the beginning of the process then increased to 33.50, 34.52 and 35.39 % for (T1), (T2) and (T3) respectively after 21-days of storage. These findings match those noted by El-Ghandour *et al.*, (2017). It was noted that FDM gradually increased, which might be explained by the matching rise in TS.

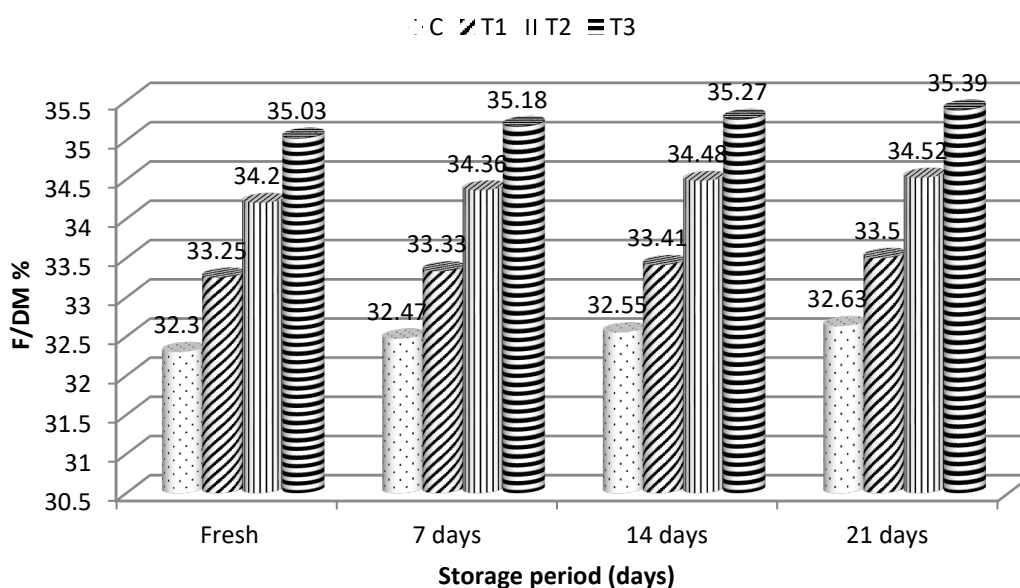


Fig. 5. Changes in fat on dry matter values of labneh samples during storage periods. C = control (100% goat milk), T1= (80 % goat milk + 20 % corn milk), T2= (70 % goat milk + 30 % corn milk), T3= (60 % goat milk + 40 % corn milk).

Ash content

According to Fig. (6), the ash content of labneh prepared from goat's milk increased from 0.96 when fresh to 1.24 after 21 days of storage. Ashes content of the labneh samples ranged from 0.96, 0.95, and 0.94% for (T1), (T2), and (T3), respectively, at the start of processing, but increased to 1.25, 1.22, and 1.20% for (T1), (T2), and (T3), respectively, at the end of storage period.

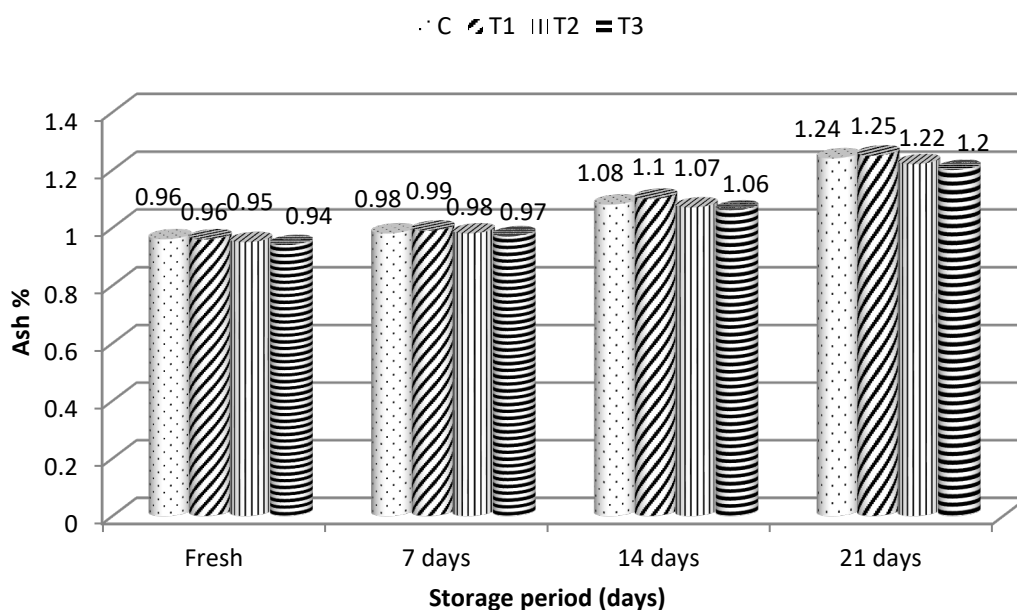


Fig. 6. Changes in ash contents of labneh samples during storage periods. C = control (100% goat milk), T1= (80 % goat milk + 20 % corn milk), T2= (70 % goat milk + 30 % corn milk), T3= (60 % goat milk + 40 % corn milk).

These support the findings of El- Rhmany *et al.* (2022) who examined functional low-fat labneh enhanced with resistant potato starch (RPS) as prebiotic and discovered that the ash content of labneh from all treatments gradually increased over the course of storage. The fresh control (C) contained 0.994% ash, while adding resistant potato starch at 0.5, 1.0 and 1.5% increased ash to reach 0.992, 0.987 and 0.979 % in order. While after 29 days, labneh samples were 0.979, 1.01, 0.999 and 0.997 % in the treatments (C, RPS1, RPS2 and RPS3) respectively.

Microbiological analysis

Table (2) displays the total bacterial count (log cfu/g) of the labneh treatments. TBC of labneh samples gradually increased throughout the first week of storage with the increase of corn milk content before declining by the progress of storage period. As the acidity increased throughout the course of the storage period, the TBC numbers gradually fell. These results coincide with that obtained by Sharaf *et al.* (1996), Salem *et al.* (2007), El-Ghandour *et al.* (2008), Elkot and Khalil (2022) and El- Rhmany *et.al.* (2022). The results demonstrate that there were no coliform bacteria, yeasts, or mold in any of the labneh samples. According to Habib *et al.* (2017), Yeasts, molds, and coliform bacteria shouldn't be present in fermented dairy products. The products' microbiological quality satisfies the 2016 version of the Egyptian Standard for Fermented Dairy Products (ES 8042). This may be because milk was efficiently heated (90°C for 20 min.) and there were strict hygienic standards followed during production and cold storage. These findings concur with those reported by Ammara (2000) and El-Gazzar *et al.* (2018).

Table 2. Total bacterial count (log cfu/g) of labneh samples during storage periods.

Storage period (days)	Treatments			
	C	T1	T2	T3
Fresh	6.3	7.0	7.2	7.3
7	6.7	7.2	7.3	7.5
14	5.4	6.5	6.8	6.9
21	4.8	5.9	6.0	6.1

C = control (100% goat milk), T1= (80 % goat milk + 20 % corn milk), T2= (70 % goat milk + 30 % corn milk), T3= (60 % goat milk + 40 % corn milk).

Sensory properties

Food product sensory evaluation is a crucial predictor of possible consumer preferences. The average grade of the sensory qualities of labneh produced with various ratios of goat and corn milk are described in Table 3. For fresh labneh samples, sensory evaluation findings revealed that the 80% goat milk: 20% corn milk combination had the greatest overall score when compared to other treatments. According to Table 3's findings, the products' acceptability decreased when the mixture's corn milk content was increased to 40%. However, labneh can be produced using maize milk up to a 20% increase, and consumers have embraced this method. This result supports the findings of Ibrahim *et al.* (2019), who claimed that maize milk may be combined with cow or buffalo milk to create some dairy

products. Most panelists did not like and rejected the flavor of the control samples, which had the lowest score of 51 from 60 when fresh and reduced to reach 47 after 21 days of storage. This is unquestionably related to free fatty acids, particularly caproic, caprylic, and capric (which together account for 15% of goat milk fat). The discrepancies between the other attributes (Body and texture and Appearance), however, were minor. These findings agreed with Hamad *et al.* (2014) Basiony *et al.* (2015). Ayyad *et al.* (2015) and El-Ghandour *et al.* (2017).

Table 3. Sensory evaluation of labneh samples during storage periods.

Treatments	Storage period (day)	Flavor (60)	Body and texture (30)	Appearance (10)	Overall acceptability (100)
C	Fresh	51	27	9	87
	7	51	26	9	86
	14	49	25	8	82
	21	47	24	7	78
T1	Fresh	57	27	9	93
	7	56	27	9	92
	14	55	26	8	89
	21	52	25	7	84
T2	Fresh	54	26	8	88
	7	52	26	8	86
	14	51	25	8	85
	21	51	24	7	82
T3	Fresh	53	25	8	86
	7	51	25	7	83
	14	49	25	6	79
	21	48	24	6	78

C = control (100% goat milk), T1= (80 % goat milk + 20 % corn milk), T2= (70 % goat milk + 30 % corn milk), T3= (60 % goat milk + 40 % corn milk).

Conclusion

The current study concluded that adding corn milk in various ratios during the production labneh process by substituting ratios of goat milk gave value to the labneh and increased the nutritious content of the generated labneh. Additionally, it came to the conclusion that adding corn milk up to 30% to goat's milk might produce a labneh with acceptable and affordable properties.

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تأثير لبن الذرة ولبن الماعز على خصائص اللبننة

اسامة صفوت فوزي خليل*

قسم علوم وتكنولوجيا الألبان، كلية الزراعة والموارد الطبيعية، جامعة اسوان، مصر

الملخص

تعتبر اللبننة واحدة من أكثر منتجات الألبان شهرة في الشرق الأوسط، والتي أصبحت شائعة جدًا نظرًا لأنها تحتوي على فوائد غذائية أكثر من الزبادي العادي. من أجل مقارنة خصائص اللبننة المحضرة فقط من لبن الماعز مع اللبننة المصنوعة من خليط من لبن الماعز ولبن الذرة على خصائصها الكيميائية والحسية. تصنع اللبننة بطريقة تقليدية، وحفظها مبردة، واختبارها بشكل دوري لصفاتها الكيميائية والميكروبيولوجية والحسية. أشارت النتائج إلى أن إضافة لبن الذرة بنسب مختلفة كخليط مع لبن الماعز أثناء التحضير أضاف قيمة للبننة المنتجة حتى 30% كنسبة استبدال بلبن الماعز من خلال زيادة المحتوى الغذائي من الدهن والرماد. بالإضافة إلى أن جميع معاملات اللبننة المضاف إليها لبن الذرة والمعاملة الكنترول كانت خالية من بكتيريا القولون والفطريات والخمائر. من ناحية أخرى أظهرت النتائج أن زيادة نسبة الاستبدال إلى 40% اعطى خصائص حسية غير مرغوب فيها. أخيرًا، يمكن إنتاج لبننة منخفضة التكلفة من لبن الذرة باستبدال اللبن الخام حتى 30% بلبن الذرة.