

A Comparative Study of the Microbial, Physiochemical and Sensory Properties of Samples of Labneh Produced at Large (Industrial) Scale and Small Scale

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Abstract

Labneh is a semi-solid fermented dairy product obtained by the removal of the whey from yogurt samples. The present study is aimed to study the influence of method of labneh production on its microbial, physiochemical, and sensory properties. For this purpose (4) branded (produced at large scale) and (4) unbranded (produced at small scale) labneh samples were collected from Irbid City markets, Northern of Jordan. The data were analyzed by SPSS method. The mean values of total solids content were lower than the Jordanian Codex in branded samples while unbranded samples were conform these standards. However, the mean pH values of branded were high as compared to unbranded pH (4 vs. 3.6) and the acidity were ranged between (1.33 to 1.8%) and (1.78 to 2.2%), respectively. The range of the total count and coliform for branded and unbranded samples were (1×10^3 to 1.5×10^4 cfu/ml) and (5×10^7 to 3×10^8 cfu/ml) respectively. While the range of the coliform for branded and unbranded samples were (0.6×10 to 1×10 cfu/ml) and (3×10^2 to 8×10^2 cfu/ml) respectively. Also, unbranded samples had higher numbers of yeast and mold. Method of labneh production had a significant effect on overall acceptability and acceptability of texture, flavor and appearance.

Keywords: branded Labneh, physiochemical, microbiological, sensory characters,

1. Introduction:

The dairy product labneh, is defined as a semi- sold product obtained from yogurt which is concentrated by the removal of whey and water- soluble compounds. It is a traditional food in Arab Countries, Turkish and Greece (Tammime and Robinson 1978). Concentrated yogurt (labneh) is more accepted than normal yogurt, since it has a better taste and texture as well as a higher nutritional value (Yeganehzad et al., 2007).

Concentrated yogurt (labneh) is made from either cow, goat, or sheep milk. Production of labneh in Jordan is carried out by either the traditional or mechanical methods. In both methods, set yogurt is produced from pasteurized milk and yogurt starter, according to the standard procedure of yogurt manufacture. According to the traditional method, the desired concentrated labneh is obtained by removing the whey by straining the yogurt gel in muslin cloth bags (usually 50×70 cm), which are hung in refrigerators for 18 - 20 hr to allow drainage of the whey (Ozer et al.,1997). According to Robinson and Tamime (1994) yogurt was mixed thoroughly with 0.5% NaCl and 0.001% Tween. However, the traditional method of producing concentrated yogurt has drawbacks: lower yield, labor intensiveness, long production time, and unhygienic conditions during the drainage stage. Therefore, efforts have been made to develop better techniques (Senel et al., 2009 Abu-Jdayil et al.,2002; Robinson and Tamime 1993; Tamime et al.,1984; Dagher and Ali 1985). There are different methods have been developed to produce concentrated yogurt with a broadly similar composition as the traditional product such as: ultra- filtration of normal yogurt, fermentation of milk concentrated by reverse osmosis, reverse osmosis treatment of normal yogurt, and centrifugal separation of the whey from normal yogurt.

Mostly, in different Arab countries, the total solids (TS) content is typically 23 – 25g/100g and the product has a cream/white color, a soft and smooth body, a good spread ability with little syneresis and a delicate walnuts' flavor that is clean and slightly acidic. This perception of low acidity stems from the masking effect of the high fat content of labneh – typically around 10g/100g, for the titrable acidity may be in range of 1.8 – 2% as lactic acid. Such a level can be expected to curtail the growth of bacterial pathogens, but yeast, mold and some lactic acid bacteria can still cause the problems of spoilage. At 7°C, labneh can be kept for 2 weeks (Nsabimana et al., 2005

The Jordanian codex assigned the labneh production by 25% TS, 10% fat, acidity less than 2.5%, without any addition of preservatives or removing the milk fat and change it with vegetable oil or other addition (Jordanian Institute for Standardization and Metrology JISM, 2003). Harfouch. (2011), studied the the chemical and microbial properties of labneh in the Syrian coastal region and he found that the acidity was ranged from 1.38 to 1.73 and the pH was ranged from 3.75 to 4.14.

In Turkey, concentrated yogurt contains 70-80% moisture, 4-9% protein, 6-10% fat, 4-9% lactose, and 0.5- 0.8% minerals (Kirdar and Gun 2001).

Very careful processing is required for the production of safe and good quality of labneh. Labneh quality is affected by a number of factors. In addition to the source and quality of milk, contaminations may

deteriorate the quality of labneh and may have negative effects on consumer health. Beside the safety there is an increasing demand for sensory characteristics and keeping quality from customer side. People are becoming more and more conscious about the quality of dairy products. The objectives of this study were to compare the microbial, physiochemical and sensory properties of branded (industrial) and unbranded (locally produced) samples of labneh from Irbid City markets, as well as to evaluate the relationships among the tested parameters.

2. Materials and Methods

2.1. Sample Collection:

Four samples (A, B, C and D) of branded (Industrial) and four samples (E, F, G and H) of unbranded labneh (handmade local concentrated yogurt named Labneh) were collected from local market of Irbid under sterilized conditions. Unbranded samples were collected in 500g press-to- close sterilized plastic containers. The samples were obtained no more than one day prior to testing.

2.2. Microbiological Analysis

The total aerobic plate count (APC), coliform, yeast and mold were determined. For the purpose 11 gm of labneh were emulsified with 99 ml of sterile alkaline peptone water solution(Liofilchem s.r.i Italy). Decimal dilutions in alkaline peptone water were prepared and plated in duplicate. Aerobic Plate Count (APC) were determined on Nutrient Agar (NA) (Liofilchem s.r.i Italy) at 37C for 2 days. Coliform were enumerated on violet red blood agar (VRBA) (HiMedia Laboratories Pvt.Ltd India) after incubation at 37C for 24 hrs. Yeast and molds were grown on Potato Dextrose Agar (PDA) (HiMedia Laboratories Pvt.Ltd India) at 25 C for 5 days. All analyses were performed in duplicate.

2.3. Chemical Analysis:

Fat percentage was determined by centrifugation method as described by Pearson (1976). Acidity percentage was determined by titration and pH was measured by digital pH- meter after calibration. Total solids percentage was determined by hot air oven according to the method described by AOAC (2006). Syneresis was measured as indicated by Al-Kadamany et.al., (2003). A 20-g sample of labneh was spread in a thin layer over a Whatman # 1 filter paper, and vacuum filtered for 10 minutes. Syneresis is expressed as % free whey, was calculated as follows:

$$\% \text{ Free Whey} = \frac{\text{Weight of initial sample} - \text{Weight of sample after filtration}}{\text{Weight of initial sample}} \times 100$$

All determinations were carried out in triplicate.

2.4. Sensory Evaluation:

The sensory evaluation was conducted to determine the degree of acceptability by 20 panelists from the staff and students of the agriculture college who are familiar with the characteristics of the Jordanian labneh (14 men and 6 women). Samples were served over two consecutive days. Panelists were asked to rate samples for appearance, flavor and overall acceptability using the 9- point hedonic scale (from 1- dislike extremely to 9- like extremely). Water was given to the panel members to clean their mouths between samples

2.5. Statistical Analysis:

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS, Version 21). The data were analyzed for Analysis of Variance (ANOVA) to examine the differences among samples. A Post Hoc analysis was performed using Duncan test to compare means differences at significant rate of (P = 0.05).

3. Results and Discussion

3.1. Microbiological Analysis:

The means of microbial counts of the branded and unbranded samples of labneh are shown in table 1. The assessment of microbiological content of labneh is conducted to protect consumers against exposure to any health hazard as well as to ensure that the material is not suffering any deterioration during anticipated shelf life. The microbiological analysis of unbranded labneh showed a higher quantity of total count, coliform, yeast and mold and showing intensity of high mishandling. In contrast the branded labneh samples showed only higher total count, indicating some type of mishandling even at industry products. Unsanitary conditions prevailing at the time of manufacturing process, resulted the higher count of the wild strains of microbes in the unbranded samples. In addition, this number may also reflect the post- process contamination. The average total count varied between 1×10^3 to 1.5×10^4 cfu/ml in branded samples while in unbranded labneh samples it varied between 5×10^7 to 3×10^8 cfu/ml. The transfer of yogurt from filter bags used for straining to packaging materials, storage and market places may also cause microbial contamination. Somer and Gulden (2012) determined the mean value of the total plate count of thirty three samples of labneh collected from local markets in Turkey were

between 1.4×10^6 to 1.5×10^8 cfu/ml. In Egypt, Ibraim (1999) found the total count of labneh samples about 2×10^8 cfu/ml.

The average of yeast and mold count in branded and unbranded samples varied between (500 to 1000) and (1×10^6 to 12×10^6) cfu/ml respectively. Yamani and Abu-Jaber (1994) examined 19 samples of labneh from traditional producers in local market in Jordan and they found that the mean yeast and mold count after storage at 7C for 14 days were 1.1×10^7 , 1.4×10^7 and 2.3×10^6 cfu/ml for psychrophilic, mesophilic and facultative thermophilic yeast respectively. Somer and Gulden (2012) determined the mean value of the yeast and mold in traditional turkeys labneh ranged between 1.4×10^6 and 1.3×10^7 cfu/ml, which are quite a bit higher than the limits of the Turkish Food Codex, Fermented Milk Notification. Although the low pH value of yogurt limits growth of pathogenic microorganisms, yeast and molds are still able to grow in labneh.

Also the average of count coliform count in branded and unbranded samples varied between (6 to 10) and (300 to 800) cfu/ml respectively. Yammani and Abu-Jaber (1994) determined the mean value of the coliform in traditional labneh less than 10 cfu/ml. In two different studies of samples of labneh in Syria by Alshehab et al. (2015), and Harfoush, M. (2011), they found that the average counts of the coliform were 10×9.7 cfu/ml and 1.95×10^2 cfu/ml respectively; while the counts of the E-coli were 10 cfu/ml and 10×1.05 cfu/ml respectively.

Analysis of variance showed a high significant difference among the samples in means of total count, coliform and yeast and mold between branded samples and unbranded samples.

Table (1): The statistical analysis of microbial content of the samples

| Sample | | Total count ± SEM ¹ | Coliform ± SEM | Yeast and Mold ± SEM |
|--------------|-------------------|---|---|--|
| Branded | A | 1.5×10^4 a ³ ± 1.3×10^3 | 0.6×10 a ± 0.578 | 5.0×10^2 a ± 1.528×10 |
| | B | 5.2×10^3 a ± 1.1×10^2 | 0.8×10 a ± 0.000 | 6.0×10^2 a ± 2.082×10 |
| | C | 6.5×10^3 a ± 2.9×10^2 | 1.0×10 a 2.0 ± 0.577 | 1.0×10^3 a ± 1.258×10^2 |
| | D | 1.0×10^3 a 2.0 ± 2.9×10 | 1.0×10 a 2.0 ± 1.155 | 8.0×10^2 a ± 1.155×10 |
| Unbranded | E | 3.0×10^8 b $4.0 \pm 1.2 \times 10^7$ | 5.0×10^2 b 6.0 ± 11.547 | 3.0×10^6 ± 3.055×10^5 |
| | F | 6.0×10^7 a ± 5.58×10^6 | 3.0×10^2 c ± 20.817 | 1.0×10^6 a ± 1.528×10^5 |
| | G | 5.0×10^7 a ± 5.58×10^7 | 7.0×10^2 d ± 10.000 | 1.0×10^6 a ± 1.607×10^5 |
| | H | 2.1×10^8 b ± 9.1×10^7 | 8.0×10^2 e ± 15.275 | 1.2×10^7 c ± 1.607×10^6 |
| Total | 6.5×10^7 | 3.0×10^2 ± | 2.3×10^6 | |
| F value | 7.643 | 1063.993 | 50.936 | |
| Significance | HS ² | HS | HS | |

1SEM: Standard Error of the means.

2NS: Not significant ($P > 0.05$). S: Significant ($P \leq 0.05$). HS: highly significant ($P \leq 0.01$).

3Values having different letters in the same column are significantly different ($P \leq 0.05$).

3.2. Chemical Analysis:

The chemical analysis shows the extent of adulteration in labneh production and the deterioration of its components. Table 2. Showed the physiochemical analysis (mean) of branded and unbranded labneh samples. The study showed that the mean values of the pH were 4 and 3.62 for branded and unbranded labneh respectively. Also results showed that the titrable acidity ranged between (1.33 to 1.80%) and (1.78 to 2.2%) for branded and unbranded samples respectively. Lower pH values in unbranded samples or the higher acidity are a result of uncontrolled fermentation. In addition, there is no proper system of culture dosage in unbranded labneh, which largely affects the acidity of the final labneh (Abrar et al., 2009). Yamani and Abu-jaber (1994), studied different samples of labneh and they found that the acidity was 1.4 -2.8% and the pH ranged from 3.6 to 4. Alshehabi et al., (2015), studied the characteristics of different samples of labneh in Syria, and they found that the acidity were ranged from 0.85 to 1.4 and the pH were ranged from 3.81 to 5.

On the other hand, total solids content were observed in branded samples and were ranged between 20 to 23 % except the sample (E) which was shown a creamy appearance with about 15% fat content and about 29% total solids. While the total solids in unbranded samples was ranged between 20.2 – 24.8%. The values of total

solids observed in this study are in agreement with the results of Tamime and Robinson (1978) who found that the total solids and fat contents of labneh produced by the traditional method to be 23 – 25% and 8 – 11% respectively.

The results obtained in this study showed that fat percent of branded samples was around 9% except one sample (E) had 15%. In contrast, the fat percent in unbranded samples was varied between 8% to 11%, in fact some of this results are non confirmed with the Jordanian Standards of labneh production.

Syneresis is spontaneous water release from the gel caused by gel contraction. It is undesirable and it occurs when the protein net work is unable to firmly retain water. It may result from insufficient heat treatment or rough handling of the coagulum. The higher the total solids content, the stronger the water-holding force of labneh. Also, the higher acidity and the presence of thickening agents such as gelatinized starch reduce syneresis in labneh samples. In fact, starch detection by applying the iodine test for all samples in the current study has shown negative results. Tamime et al., (1991); Somer V. and Gulden B. (2012). Higher percent of syneresis were observed in unbranded samples as compared to branded samples.

Table (2): The statistical analysis of the physiochemical properties of the analyzed samples

| Sample | | PH ± SEM ¹ | Acidity ± SEM | Total solids ± SEM | Syneresis ± SEM |
|--------------|---|------------------------------|-----------------|--------------------|------------------|
| Branded | A | 3.90 ac ³ ± 0.153 | 1.41 ab ± 0.116 | 21.00 a ± 1.155 | 4.50 a ± 0.173 |
| | B | 3.80 abc ± 0.115 | 1.76 bc ± 0.082 | 23.00 a ± 1.000 | 5.50 b ± 0.265 |
| | C | 4.00 bc ± 0.115 | 1.80 c ± 0.153 | 20.00 a ± 1.528 | 4.10 a ± 0.173 |
| | D | 4.20 bc ± 0.173 | 1.33 a ± 0.061 | 29.00 c ± 1.528 | 2.20 c ± 0.208 |
| Unbranded | E | 3.50 ab ± 0.208 | 2.00 cd ± 0.153 | 24.00 ab ± 1.732 | 6.00 bd ± 0.100 |
| | F | 3.40 a ± 0.231 | 2.20d ± 0.173 | 24.80 b ± 1.457 | 6.80 c e ± 0.173 |
| | G | 3.60 ab ± 0.208 | 1.86cd ± 0.099 | 23.20 ab ± 0.964 | 6.30 de ± 0.252 |
| | H | 4.00 bc ± 0.100 | 1.75 bc ± 0.032 | 20.20 a ± 0.473 | 3.43 f ± 0.176 |
| Total | | 3.8 | 1.76 | 23.15 | 4.85 |
| F value | | 2.68 | 5.83936 | 5.246 | 64.478 |
| Significance | | S ² | HS | HS | HS |

1SEM: Standard Error of the means.

2NS: Not significant ($P > 0.05$). S: Significant ($P \leq 0.05$). HS: highly significant ($P \leq 0.01$).

3Values having different letters in the same column are significantly different ($P \leq 0.05$).

3.3. Sensory Properties:

Means of acceptability parameters are summarized in table 3. Types of production method of labneh significantly affect overall acceptability, appearance and flavor. This study has shown that total solids contents in all samples has a principal role on the appearance as well as acidity. The unbranded sample (F) had the higher level of total solids, while the branded sample (D) had the lowest score, (overall acceptability 8.2 vs. 5.5 respectively); the adopted fat levels may have produced a high moisture content which have shown to be too liquid and thus could have affected sensory results.

Table (3): The statistical analysis of the sensory properties of the analyzed samples

| Sample | | Overall ± SEM | Appearance ± SEM | Flavor ± SEM |
|--------------|---|-----------------|------------------|----------------|
| Branded | A | 7.00 a ± 0.153 | 7.10 a ± 0.153 | 6.60 a ± 0.231 |
| | B | 6.30 b ± 0.265 | 7.00 ab ± 0.252 | 6.60 a ± 0.265 |
| | C | 7.80 c ± 0.173 | 7.00 a ± 0.306 | 7.50 b ± 0.306 |
| | D | 5.50 d ± 0.289 | 6.00 c ± 0.153 | 5.50 c ± 0.208 |
| Unbranded | E | 7.10 ac ± 0.153 | 7.20 a ± 0.231 | 7.90 b ± 0.200 |
| | F | 8.20 c ± 0.153 | 8.17 d ± 0.333 | 7.80 b ± 0.173 |
| | G | 6.20 b ± 0.173 | 6.27 bc ± 0.203 | 6.50 a ± 0.173 |
| | H | 6.30 b ± 0.265 | 6.90 ab ± 0.252 | 5.40 c ± 0.173 |
| Total | | 6.80 | 6.95 | 6.73 |
| F value | | 18.243 | 7.120 | 18.974 |
| Significance | | HS | HS | HS |

1SEM: Standard Error of the means.

2NS: Not significant ($P > 0.05$). S: Significant ($P \leq 0.05$). HS: highly significant ($P \leq 0.01$).

3Values having different letters in the same column are significantly different ($P \leq 0.05$).

4. Conclusion

Based on the results of the present study, it can be concluded that the overall picture of labneh quality assessment needs emphasis on quality control during processing as well as storage; a fact which is emphasized

by the Jordanian Food and Drug Administration (JFDA) reports, since it ordered many dairy factories to halt labneh production after sample failed safety tests, or shutting down the factories. The unbranded samples has shown positive results for coliform, which indicates insufficient process sanitation and also raises concerns of consumer health. According to the sensory evaluation, this study has shown that there were variations in the quality between branded and unbranded samples, on the other hand there were a great variation in the quality of the unbranded samples in the market of Irbid. This study has shown that unbranded samples had higher total solids and at the same time had higher amounts of lactic acids and better textural properties than branded samples. In spite of the microbial deterioration in unbranded samples, consumers still prefer unbranded one due to its favorable firmness texture and lightly acidic flavor.

Overall, this study recommends the Jordanian Food and Drug Administration (JFDA), and the Jordanian Institute for Standardization and Metrology (JISM), to ensure the application of strict food safety rules in dairy factories and plants.

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