



## Lebanese Consumer Perception towards *Moringa Oleifera* : Sensory Evaluation of *Moringa Oleifera* Fortified Labneh<sup>#</sup>

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### ABSTRACT

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Labneh is one of the most consumed dairy products in the Lebanese community, on breakfast, as a snack or on dinner, plain or mixed with herbs. Its various health benefits plus its acceptability among people makes it an important part of the Lebanese diet. In both its synthetic and homemade forms, several additives are usually incorporated to enhance its flavor and offer a variety of tastes. The problem with Labneh is its short shelf life, as well as its sensitive sensory profile. That is why most industries mix chemical additives with Labneh to prolong its shelf life and conserve its taste. The aim of this research is to preserve Labneh naturally by adding *Moringa Oleifera* dried leaves to extend its shelf life and inhibit rapid spoilage. Working on a natural preservation of Labneh instead of chemical preservation will be assessed by the survey's results and prepare for studying the overall acceptability of the product by making a sensory analysis. The results of the questionnaire showed that the Lebanese community which is not totally aware of *Moringa Oleifera* benefits and availability, is willing to try fortified Labneh with *Moringa* as a new product with extended shelf life and more health benefits. The results of the sensory analysis showed that the sensory attributes of the samples with *Moringa* after 21 days of storage, were not significantly different than normal plain Labneh, which indicate that adding *Moringa* did not affect the sensory attributes of Labneh giving it more acceptability to consumers.

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### Introduction

Dairy products contribute to the major part of Middle Eastern breakfast due to their nutritional benefits and unique flavor. Benefits of consuming dairy products include providing proteins, vitamins, minerals and fatty acids, muscle building, decreasing blood pressure and low-density lipoprotein cholesterol, and play an important role in prevention of diabetes, cancer, and obesity (Tunick & Van Hekken, 2015). Labneh is one of these dairy products that is obtained mainly from milk, which is fermented to obtain yogurt followed by further concentration.

Labneh, so called in the Middle East, strained yogurt in Greece and Europe or Suzme yogurt in Turkey (Abbas et al., 2015) is widely consumed as a main dish at breakfast worldwide, but more frequently in the Middle Eastern countries such as Lebanon, Iraq and Iran (Tarakci et al., 2011).

Making and consuming Labneh is mainly done in the Middle Eastern countries since ancient times but there is no specified date or history of origin about it. Labneh is made from yogurt as mentioned earlier, and the word 'yogurt' comes from Turkish word "yogurtmak," which

means to thicken, coagulate, or curdle. Despite knowing that yogurt is an extremely old dish in the kitchens of our ancestors, no one is completely sure of the exact origins of the dish. The Greek were the first to mention yogurt in a written reference 100 BC, and Indian Ayurvedic scripts mentioned benefits of consuming fermented milk back in 6000BC. (Fisberg & Machado, 2015).

Labneh is a semisolid food produced by removing water and its soluble compounds from yogurt (Nsabimana et al., 2005). It has properties of good spreadability, cream/white color and a slightly acidic and clean flavor (M. El-Saye et al., 2017; Nsabimana et al., 2005). From a nutritional point of view, Labneh is considered to have 2.5 times higher protein content, 50% more minerals, and a larger number of viable microorganisms when compared to normal yogurt (Ismail et al., 2016). Labneh is composed of 230-250g/kg total solids, 80-100g/kg fat and acidity of 1.8-2.0g/100 g lactic acid (Tarakci et al., 2011). In many villages of the Lebanese countryside, Labneh can be further concentrated to reach 40% solids and made as balls then placed in jars filled with olive oil. In this shape, people

call it Labneh Anbaris or Labneh cheese. This step is usually done to prolong the shelf life of Labneh more due to covering the surface with olive oil and thus inhibition of mold and yeast growth (Ahmad et al., 2013).

Labneh (concentrated yogurt) is prepared by draining whey and part of its soluble compounds by using traditional or modern techniques. The traditional method is still widely used in many dairy plants. It consists mainly of pouring the plain yogurt into a cloth bag or sometimes into an animal skin and allow the whey to drain until the desired semi-solid consistency is reached. After that, the content of the bag is removed and salt is being added in 1-2% and then the product is being filled in containers and refrigerated. Modern techniques include using mechanical separator (centrifugation) or ultrafiltration. Centrifugation is applied to heated yogurt at different speeds to obtain Labneh. (Nsabimana et al., 2005)

Although water, the main contributor of microbial spoilage is removed in Labneh, it still has a short shelf life even under refrigeration. This is mainly due to the growth of large amount of lactic acid bacteria combined with low access to air during storage. These conditions facilitate the growth of yeasts and molds causing deterioration of the product, and signs of yeast spoilage was observed at 7-14 days in many cases. (Nsabimana et al., 2005). Due to its short shelf life, several artificial preservatives were used during Labneh manufacturing, and those include potassium sorbate and sodium benzoate, and sometimes natamycin to produce Labneh that is yeast and mold-free with a longer shelf life. (Zamani Mazdeh et al., 2017).

According to the World Health Organization WHO, food-borne illness is responsible for 400.000 deaths and 600 million cases of food poisoning per year around the world (Yu et al., 2021). In year 2004, the World Health Organization (WHO), Food and Agricultural Organization (FAO), and the International Food Safety Authorities Network (IFOSAN) addressed this problem by creating a joint program with the purpose of reducing the increasing number of food poisoning cases caused by the wide spread of food contamination by strengthening the food safety systems worldwide (Ritota & Manzi, 2020)

On the other hand and according to WHO, 80% of the developing countries population manage to obtain their basic medical needs through medicinal herbs. These herbs have anti-septic, anti-carcinogenic, anti-viral, anti-allergic and anti-inflammatory effects, which will make their introduction to the health system via food fortification very easy (Sevindik et al., 2017).

Awareness against harmful effects of chemicals used in food, lead to attempts in replacing those chemical preservatives with natural ones. Food industry is nowadays interested in natural antioxidant sources for their antioxidant and oxidant status (Pehlivan et al., 2018). These natural preservatives can be herbs and spices as well as their oils or extracts which are rich in antioxidants and antimicrobial substances, vitamins and minerals (Sevindik et al., 2017; Pehlivan et al., 2018; Mohammed et al., 2020; Pehlivan et al., 2021). One of the many plants studied for their biological activity is the *M. globosum*, of which antioxidant, antibacterial and antifungal potential has been studied and proved to be a potential natural antioxidant agent. (Pehlivan et al., 2021). The use of this herb as a supplement to endogeneous antioxidants was proved to

delay oxidative damage since it has both TAS and TOS high values (Pehlivan et al., 2021). So the use of such herb as well as others with Labneh will increase its shelf life without any harm with the advantage of increasing the nutritional value of the product. (El-Tawab et al., 2019).

One of the essential technique to extend shelf life and reduce food poisoning cases is food processing. It is done through several methods, including physical preservation by applying heat (pasteurization) or reducing temperature (freezing), chemical preservation by adding manufactured preservatives, biological preservation by using certain microorganisms with antagonistic effects against targeted pathogens, or natural preservation that has been gaining noticeable attention lately (Yu et al., 2021).

### Moringa tree, composition and health benefits

The shift towards the nature has widely increased in the past period, and the insufficiency of synthetic drugs has earged researchers to look for natural substitutes. The increased microbial resistance and the presence of new diseases of microorganisms origin, have lead to the discovery of new antimicrobial agents from plants. (Mohammed, 2020) As such, *Mentha longifolia* ssp. *longifolia*, *Marrubium globosum*, *Scorzonera papposa*, plants that grow in Turkey and other countries have been studied and proved to have antioxidant and antimicrobial effect (Mohammed, 2020; Pehlivan et al., 2021; Sevindik et al., n.d.). Another plant of interest is, the Moringaceae family, that consists of 13 different species of *Moringa*, found originally in Kenya, Ethiopia, Somalia, Namibia, Angola, Madagascar, and the Horn of Africa. *Moringa Oleifera* which is the most widely spread species originates from the sub-Himalayan tracts of Northern India, while the derivatives of *Moringa oleifera* are now found in the Middle East, African and Asian countries (Leone et al., 2015). *M. oleifera* is also planted for ornamental purposes in several cities such as Mexico, Bolivia and Argentina. (Milla et al., 2021)

Many studies were performed on the *Moringa* tree to study its composition. One of the latest studies was done on 5 samples of *Moringa* leaves gathered from 3 distinct areas of Bangladesh (Sultana, 2020). *Moringa* leaves were shade dried for 3 days, then grinded and sieved to remove debris. Resulted powder was kept in sealed sample bags at the temperature of -20 degrees (Sultana, 2020). Table 1 shows the composition of *Moringa* leaves. (Leone et al., 2016; Sultana, 2020)

Table 1. Moisture, ash, protein, fat, fiber and carbohydrates content of Moringa dried leaves and Moringa seeds. (Leone et al., 2016; Sultana, 2020)

Component	Moringa Dried Leaves	Moringa Seeds
Moisture	8.13%	7%
Ash	9.34%	6.2%
Crude Protein	25.04%	31.4%
Crude Fat	5.75%	36.7%
Crude Fiber	7.34%	7.3%
Crude Carbohydrates	52.52%	18.4%

Due to the rich nutrient profile and mineral content of *M. oleifera* leaves, it shows a wide range of anti-oxidant, anti-inflammatory, and anti-microbial effects (Anwar et al., 2007; Hodas et al., 2021; Leone et al., 2015). These effects promoted the use of *Moringa* as a hypoglycemic, hepato and kidney protective, and anti-cancer agent (Anwar et al., 2007; Leone et al., 2015). The phytochemical content of *Moringa* is responsible for the anti-microbial activity, especially benzyl-isothiocyanate, which acts directly on cell membrane synthesis of the microorganisms, leading to the disruption of its growth (Hodas et al., 2021).

The leaves extract was shown to inhibit the growth of eight pathogenic bacteria and fungi, which are *Streptococcus pyogenes*, *S. agalactiae*, *Staphylococcus epidermis*, *S. aureus*, *Salmonella senftenberg*, *Escherichia coli*, *Bacillus subtilis*, and *Candida albicans*. It also showed anti-microbial effect against gram-positive and gram-negative bacteria (Hodas et al., 2021).

### Effect of Moringa on the Shelf Life of Labneh

In the past years, many studies were done on Moringa oil and its use with Labneh. Adding Moringa oil to Labneh increased fat and total solid content, however it decreased protein content and ash as the concentration of oil increased. Acidity was an important factor to take into consideration as it affects the acceptability of the final product. It was shown that acidity increased and pH decreased as the concentration increased; thus the oil had excellent effect on the starter culture and maintained typical sour taste of the product. The Samples mixed with the highest concentration of Moringa oil had the highest antioxidant activity even after 30 days of storage over the other samples. However, it decreased in all samples as storage period increased.

Mold and yeast count are very important when determining the quality and shelf life of Labneh. When adding Moringa oil, samples remained free from mold and yeast up to 30 days while it was observed in the control after 15 days. This was explained by the presence of phenolic and flavonoid compounds that have antimicrobial activity as explained in table 4. (M. El-Saye et al., 2017)

As such, *M. oleifera* was used as natural preservative since it is highly rich in a wide variety of minerals and vitamins and can serve the intended use as preservative. The Moringa oil was not accessible in the Lebanese markets, therefore, the samples of Labneh were prepared, shaped as balls and covered with dried Moringa leaves. People in the Lebanese countryside usually shape the Labneh in balls and cover it with dried thyme or other herbs, but no one has ever covered Labneh with dried Moringa leaves. In the purpose of studying any change that might occur in the sensory attributes of Labneh. A questionnaire was conducted to study the community's basic knowledge and consumption of Labneh with natural additives, as well as their familiarity of Moringa and its health benefits. Based on the findings, Labneh fortified with dried *M. oleifera* leaves was prepared. Its sensory profile and overall acceptance by the consumers were studied and analyzed.

### Materials and Methods

This research was based on the need of the Lebanese communities to work on prolonging the shelf life of Labneh and help preserve it without using chemical substances as preservatives.

After looking at the different herbs available in the Lebanese Markets, we found that Moringa leaves were recently known in the society, and a few people were consuming them as hot drink. Since the profile of the Moringa is rich and suits well the Labneh, it was decided to prepare fresh Labneh and fortify it by covering Labneh balls with dried grinded Moringa leaves. The first step was to prepare a survey to investigate the people's knowledge on Moringa, its uses and benefits, as well as investigate their willingness to try this new product. The second step was to study the sensory profile of Labneh covered with Moringa and compare it to that of plane Labneh.

The questionnaire consisted of three sections. The first one was set to collect demographic information. The second section contained questions about Labneh, it aims to know how often people consume Labneh, in what form, plane or coated with herbs, handmade or industrial and whether or not they know that industrial Labneh contains chemical substances as preservatives. The third section was about Moringa, the first question was whether the respondents have ever heard of Moringa. For those who did, they were asked if they knew the benefits of Moringa and its uses in the food science, how frequent they consume it and in what forms. The final question was set in a separate section that asks respondents if they are willing to try Labneh covered with Moringa. After finishing the validity and reliability steps, the questionnaire was sent to the Institutional Review Board at the Lebanese International University for approval before going public. The IRB approval letter was received in May 2022 under the reference code Ref: LUIRB-220509-WAB-162. Only then, the questionnaire went public and the collected data from 332 respondents was analyzed via IBM SPSS Statistics Data Editor Version 25.

The next stage in this study was to prepare fresh Labneh, make it in ball shapes, and divide the set prepared into plane balls and balls covered with dried Moringa leaves. The sensory profile was prepared for the panelists to taste and evaluate.

The Sensory evaluation of Labneh fortified with Moringa dried leaves was done 21 days after preparation. The 11 panelists were chosen trained, aged between 22 to 28 years old (all females). The analysis was conducted in the lab premises of the Lebanese International University LIU. Each panelist received the following: 3 samples of the control group designated by 3 random digits presented in dishes, 3 samples of the designated product labelled each by 3 random digits, profile sheet, pen, biscuits, water, tissues, spittoons and a hedonic scale.

Labneh samples were evaluated for their compactness, firmness, cohesiveness, wetness, saltiness, sourness, metallic taste and overall acceptability. Three pieces of each Labneh sample were served on white plastic plates together with detailed information on the procedure and advice to rinse their palates with biscuits and sips of water.

The panelists used the hedonic scale for attribute intensity ranging from one (dislike extremely) to nine (like extremely). The data obtained was analyzed using IBM SPSS Statistics Data Editor Version 25.

## Results and Discussion

The results of the questionnaire were analyzed and it was found that 65.66% of the respondents consume Labneh the most among other dairy products. 33.34% of dairy products consumers find the health benefits of Labneh of great importance for their bodies, while 55.42% of participants are unaware of chemical preservatives added to industrial Labneh and their negative impact on human health.

52.3% consume home-made Labneh, while 10.8% consume industrial Labneh. On the other hand, 39.46% of participants believe that home-made Labneh has longer shelf-life than industrial Labneh. Out of the 332 participants who filled the questionnaire, 43.7% agreed that the Covid-19 pandemic made them move towards consuming more natural foods.

84.60% of the respondents were familiar with the Moringa and practically use it as hot drink, but unfortunately 73.28% of them were unaware of its use as a natural preservative. The results also showed that 44.83% of the respondents are willing to try *Moringa Oleifera* fortified Labneh.

When analyzing the data of the sensory analysis, the results obtained for the samples with or without Moringa (control) after 21 days of storage, were not significantly different, as shown in tables 2 and 3.

According to the results obtained, p values were greater than 0.05 in the control samples and those with Moringa after 21 days of storage, which indicates that there is no significant difference between samples of Labneh with and without Moringa. Thus, adding Moringa does not affect the sensory attributes of normal Labneh. Therefore, if people buy Labneh fortified with Moringa as a new innovative product, it would not be different for them in terms of sensory attributes of normal Labneh, except that they would be intensifying its health benefits. In previous similar researches, the addition of herbs to Labneh including mint, parsley, diplotaxis, dill, coriander, purslane, cress or rocket was tested for any change in appearance and color, body and texture, flavor, and overall acceptability. The different results showed that coriander and diplotaxis had the lowest flavor scores, appearance and color of mint samples were the lowest, and highest overall acceptability was for purslane, dill, parsley and rocket samples while the lowest score for acceptability was for coriander and diplotaxis. Dill, mint, parsley, coriander, diplotaxis, purslane are more recommended as Labneh preservatives.(Tarakci et al., 2011). In another study, culinary herbs such as mint, poppy seeds, cinnamon, and basil were added to Labneh, and firmness, appearance, color/brightness, surface water, taste, flavor and overall acceptability were assessed. Firmness was the highest in the control sample and lowest in cinnamon added sample but it decreased in all samples with 21 days of storage. Color and appearance of mint were the lowest while it gave the best result regarding firmness. Basil was the lowest in having water on the surface. However, in this study, control samples showed best taste and flavor and overall acceptability decreased during storage and the lowest was in mint while the highest was in the control.

Table 2. Kruskal-Wallis Test applied to compare means of different variables for control samples.

Variable	Total Number	Mean	Std. Deviation
compactness	66	7.33	±2.18
firmness	66	6.81	±1.72
cohesiveness	66	6.27	±1.91
Wetness	66	3.36	±1.81
Saltiness	66	3.12	±2.03
Sourness	66	4.94	±2.56
Metallic taste	66	3.42	±2.16
Overall acceptability	66	3.48	±2.03

Table 3. Kruskal-Wallis Test applied to compare means of different variables for samples of Labneh covered with Moringa.

Variable	Total Number	Mean	Std. Deviation
compactness	66	7.48	±2.01
firmness	66	6.51	±1.56
cohesiveness	66	6.18	±1.91
Wetness	66	3.3	±1.78
Saltiness	66	3.48	±2.14
Sourness	66	5.66	±2.52
Metallic taste	66	3.39	±2.06
Overall acceptability	66	3.97	±2.09

Olive dried leaves were also added to Labneh to make an innovative product. Adding 1%, 2%, and 3% of dried olive leaves had the best appearance, flavor, consistency over 4% and 5% , and as concentration and storage period increase , the sensory attributes of Labneh decrease. (Ismail et al., 2016). Consequently, culinary herbs were not recommended as Labneh preservatives.(Ahmad et al., 2013).

## Conclusion

The increasing demand on healthy foods especially after the Covid-19 pandemic placed the natural preservatives under spotlight, giving them more attention and appreciation. Dried *M. oleifera* leaves added to Labneh as a natural preservative to increase shelf life while maintaining acceptable quality aspects proved to be a suitable process for a new product in the Lebanese community, where *M. oleifera* is widely available, have no strong effect on sensory attributes of Labneh and the process of making the product is easily applicable. Moreover, it had a similar effect on Labneh as other additives such as thyme which is very popular in the Lebanese communities. The addition of *M. oleifera* as dried herbs to Labneh is a potential new product that can be easily introduced into the Lebanese cuisine as well as others.

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## Author Contributions

Conceptualization, S.K.; investigation, S.K. H.W and W.B; resources, S.K. H.W and W.B data curation, S.K.; writing—original draft preparation, S.K. H.W and W.B; writing—review and editing, S.K. ; supervision, S.K.; project administration, S.K.; All authors have read and agreed to the published version of the manuscript.

## Conflicts of Interest

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

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