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Evaluation of the hygienic quality and nutritional value of traditional Lebanese “Kishk”, a dried fermented goat milk product

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Abstract. “Kishk” is a traditional fermented milk, highly appreciated in Lebanon for its extended shelf life. It is a dried mixture of yogurt and bulgur, prepared essentially with goat milk, while sometimes cow milk could be used alone or mixed with goat milk. A survey has been carried out among forty Kishk producers in four Lebanese regions and samples were collected to assess their microbiological, chemical and organoleptic quality. The survey results showed that Kishk ingredients and the production techniques used differ significantly among Lebanese regions (type of milk and cereals) and according to the culinary traditions of people there. Microbiological results showed that samples fall within the Lebanese Kishk standards for Salmonella and coliforms, whereas a high contamination with *Staphylococcus aureus* and anaerobic bacteria was recorded in the samples produced with caprine milk collected from the South of Lebanon. Finally, sensory assessment showed that Kishk produced in the South received the highest score for color, which is strongly related to the use of brown bulgur there.

Keywords. Kishk – Lebanon – Fermented milk – Bulgur.

Evaluation de la qualité hygiénique et de la valeur nutritionnelle du Kishk libanais, un produit laitier caprin fermenté

Résumé. « Kishk » est un lait fermenté traditionnel, fortement apprécié au Liban pour sa longue durée de conservation. C'est un lait fermenté séché à base de yaourt et de céréales (boulgour), essentiellement préparé avec du lait de chèvre, utilisé tout seul ou mélangé à du lait de vache. Une enquête a été menée auprès de 40 producteurs de Kishk dans quatre régions libanaises, et des échantillons ont été collectés en vue d'évaluer leurs qualités microbiologiques, nutritionnelles et organoleptiques. Les résultats de l'enquête ont révélé des disparités significatives au niveau des matières premières utilisées (type de lait et céréales) et des techniques de production de Kishk entre les régions libanaises, en fonction des traditions de chaque région et des habitudes culinaires de ses habitants. Les analyses microbiologiques ont montré que les échantillons sont conformes aux normes du Kishk libanais concernant la présence des coliformes et salmonelles. Par contre, une forte contamination par *Staphylococcus aureus* et des bactéries anaérobies a été décelée dans les échantillons de Kishk à base de lait caprin produits dans la région Sud. Enfin, la couleur du Kishk du Sud a été significativement supérieure à celle des autres régions, et ceci est expliqué par l'utilisation du boulgour brun sombre dans cette région.

Mots-clés. Kishk – Liban – Lait fermenté – Boulgour.

I – Introduction

Traditional fermented milks have always been an important food supply in Mediterranean countries, especially in mountainous regions, where people developed techniques to preserve milk and prevent its spoilage. One such product, Kishk, is an old and popular fermented product, widely consumed in Lebanon for its high nutritional quality and long shelf-life properties. It is a dried mixture

of fermented milk and wheat (Tamime *et al.*, 1999) that can be consumed either raw (during the early stages of manufacturing) or in the form of a thick soup after reconstituting with water followed by simmering (Zouheiri, 2005). Kishk is typically prepared by mixing yogurt, parboiled cracked wheat “bulgur” (bulgur/yogurt ratio: ¼) and salt. The resulting dough is kneaded daily for up to 6-7 days at 35°C in order to complete the fermentation and conditioning period. Afterwards, the dough is shaped into balls, sun dried and ground into fine powder before storing it in glass jars (Tamime *et al.*, 2000; Tamime and O’connor, 1995). However, little is known about Lebanese Kishk manufacturing techniques, and the diversity of the raw materials (milk and cereals) used in its production among Lebanese regions. Consequently, the aim of this paper is to provide knowledge regarding the different raw materials and techniques, used for Kishk production in four Lebanon regions (Bekaa, Mount Lebanon, North and South), and to assess their effect on the hygienic quality, nutritional value and sensory properties of Kishk.

II – Material and methods

1. Samples collection

A survey was conducted among Kishk producers in four Lebanese regions (Bekaa, Mount Lebanon, North and South) and forty different samples were randomly collected. Essential information concerning the raw materials used and the Kishk recipe was also acquired. Samples were transported to the laboratories of the Holy Spirit University of Kaslik within 24 h and preserved at 4°C.

2. Chemical analysis

Kishk’s composition was determined according to AOAC standard methods (AOAC, 1995). Moisture content was calculated by heating 3 g of each sample to a constant weight in an oven maintained at 105°C. For determination of ash, 3 g of each sample were ashed at 550°C in a furnace until constant weight. Protein was determined by the Kjeldahl method with a conversion factor of 6.25. Fat was obtained by extracting 5 g of each sample in a Soxhlet apparatus using petroleum ether as the extractant.

3. Microbiological analysis

One g of Kishk samples were homogenized with 9 mL of nutrient broth: the homogenous mixture was incubated at 37°C for one hour and then used for microbiological analysis (LIBNOR, 2004). All samples were evaluated for coliform counts, staphylococci, *Salmonella* spp., thermophilic anaerobic bacteria, yeasts and moulds, respecting the suitable medium and incubation temperatures.

4. Sensory evaluation

Twelve panelists evaluated Kishk samples for color, aroma, fermentation odor, goat flavor, after-taste, and mouth-feel with a scale from 1 to 10. Kishk soups were prepared by mixing 20 g of Kishk powder with 80 mL cold water and simmering for 5 min with constant stirring. The cooked samples were served to the panelists at 80°C in ceramic bowls. Water was provided to the panelists to rinse their mouths between samples.

5. Statistical analysis

Data is tested using the SPSS software (version 16.0). Statistical analysis of the results is based on one-way analysis of variance. Statistically significant differences are considered at the level of $p < 0.05$.

III – Results and discussion

1. Variation of Kishk production techniques

In Lebanon, Kishk is normally prepared by mixing cereals (bulgur or wheat) and homemade yogurt (known as Laban). Nevertheless, the results of our survey among Kishk producers showed that the production method and the ingredients used vary significantly between the four Lebanese regions (Fig. 1). Goat milk is essentially used in the South (81.8%) to prepare Laban, whereas cow milk is very common in Mount Lebanon (81.8%) and the North (75%). Besides, mixing cow and goat milk is widely used in the Bekaa (44.1%). On the other hand, brown bulgur is widely used in the South (72.7%) while white bulgur is dominant in the three other regions. Using cracked wheat or mixing white and brown bulgur is less common in the four regions. In fact, the type of milk and cereals used for Kishk production are affected by the culinary traditions of each region in Lebanon and by the prevalent livestock there. In 2009, the Bekaa region came first concerning goat livestock (47.5%) and cattle (30.7%), followed by the South with 27.3% of goat livestock. The Northern Lebanon and Mount Lebanon concentrate together around 50% of Lebanese cattle (Ministry of Agriculture, 2009).

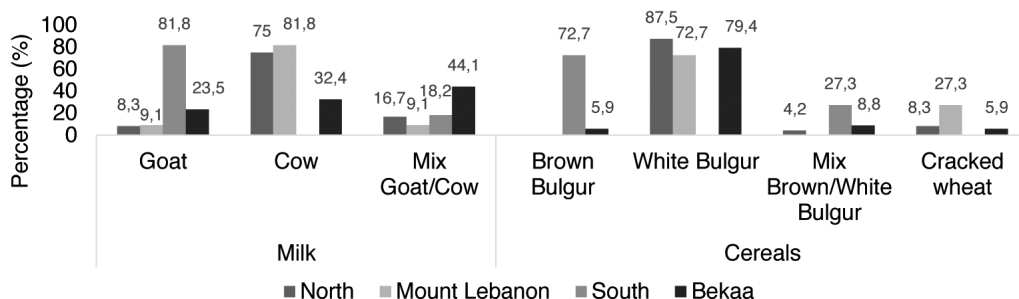


Fig. 1. Kishk ingredients among Lebanese regions.

Besides, the production technique of Kishk differs significantly between the regions. For instance, the South of Lebanon is characterized by the longest period for mixing yogurt and bulgur (2.9 days) and sun-drying (4 days), whereas the Bekaa recorded the lowest values for sun-drying (2.6 days) due to its hot climate compared to the other regions. Also, in the North, Kishk producers prefer to incorporate “Labneh” (strained yogurt) within a shorter period (2.7 days) to produce Kishk with a slight acidic flavor. Our results are not in agreement with the previous studies: Tamime *et al.* (2000) reported that yogurt must be mixed with bulgur for at least 6 days and sundried for one week before milling and conditioning. Also, Tamime and O’Connor (1995) did not mention the incorporation of strained yogurt “Labneh” as a principal ingredient.

2. Chemical analysis

Moisture, ash, protein and fat values of Kishk samples ranged between 6.42 and 9.14 %, 5.78 and 8.01%, 13.69 and 15.63%, 12.94 and 19.15% respectively. Tamime *et al.* (1999) reported similar values for moisture, ash and protein content, but lower fat content. In fact, these variations may be attributed to different factors such as the properties of ingredients (yogurt and bulgur) used in the Kishk formulation, the ratio bulgur:yogurt, the amount of salt used, the drying techniques, etc. (Temiz and Pirkul, 1990, Erkan *et al.* 2006, Tamer *et al.*, 2007).

3. Microbiological analysis

None of the samples contained coliforms or *Salmonella* spp. (Table 1). However, *Staphylococcus aureus* and anaerobic bacteria (*Clostridium* spp.) were detected respectively in 82.50% and 47.50% of kishk samples. Our results do not comply with the national standards (LIBNOR, 2004), since all kishk samples contain an unacceptable amount of *S. aureus* and anaerobic bacteria, which can pose a potential hazard to consumers. Zouheiri (2005) reported similar results with a high level of Kishk contamination with *S. aureus* (63.86%). Contamination levels differ significantly between the regions with the highest percentage of *S. aureus* contamination in the South (2.51×10^2 cfu/g kishk).

Table 1. Microbiological characteristics of Kishk samples (cfu.g⁻¹)

Region	<i>Staphylococcus aureus</i>	Coliforms	<i>Salmonella</i> spp.	Yeasts and moulds	<i>Clostridium</i> spp.
North	$9.61 \times 10^1 \pm 0.57^{ab}$	negative	negative	$2.00 \times 10^2 \pm 0.25^a$	$1.70 \times 10^1 \pm 0.61^a$
Mount Lebanon	$< 10^a$	negative	negative	$3.15 \times 10^2 \pm 0.20^a$	$< 10^a$
South	$2.51 \times 10^2 \pm 0.01^b$	negative	negative	$3.16 \times 10^2 \pm 0.18^a$	$1.56 \times 10^1 \pm 0.72^a$
Bekaa	$3.78 \times 10^1 \pm 0.330^{ab}$	negative	negative	$2.25 \times 10^2 \pm 0.24^a$	$1.88 \times 10^1 \pm 0.43^a$

Different letters within the column across the table show significant differences at $p < 0.05$.

In fact, one of the crucial steps in the production of Kishk is sun drying: Kishk is left to dry in the open air and a high risk of microbial contamination exists during this phase (Sengun and Karapinar, 2012). In addition, the “wet Kishk” is rubbed by hands to accelerate water evaporation and drying, leading to a higher risk of contamination especially with *S. aureus*, which is an indicator of poor personal hygiene. Consequently, the high contamination level with *S. aureus* in the kishk made in the South of Lebanon is strongly related to the long sundrying period (4 days in the South) in comparison with other regions. Therefore, Kishk contamination is mainly associated with raw materials contamination (milk and cereals) in addition to poor production conditions in rural areas during sun-drying and storage (Uçar and Çakıroğlu, 2011).

4. Sensory profiling

Regarding the sensory evaluation of Kishk samples (Fig. 2) the sampling region did not affect significantly all sensory attributes, except for color. The Kishk made in the South of Lebanon received the highest score for color (5.95) because in this region brown bulgur is mainly used instead of white bulgur (as abovementioned in Fig. 1) which leads to a darker color. As for the effect of milk type (goat, cow or mix) on the sensory properties of Kishk, most of the soups were comparable in terms of scores for all the parameters.

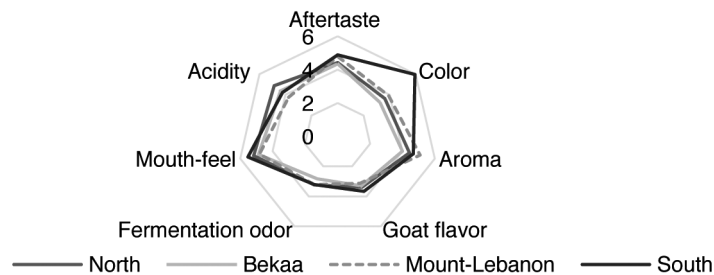


Fig. 2. Sensory assessment of Kishk samples.

IV – Conclusions

This study was conducted in order to characterize Lebanese Kishk and contribute to the preservation of Lebanese dairy heritage. The results of the present work provide an overview of the microbiological, physico-chemical and sensorial parameters of Lebanese Kishk.

It was important to point out that Kishk ingredients (milk and cereals) and the production techniques used differ significantly among Lebanese regions and according to the culinary traditions of people there. While lifestyles are changing and local culinary knowledge is lost, Kishk and other Lebanese traditional foods are threatened. Therefore, they should receive much more attention; further studies are necessary to allow a better understanding of their peculiarities, ensure their sustainability and optimize their competitiveness. Finally, the microbiological quality of these traditional products should be improved with a food safety management system in order to ensure the protection of the consumer health.

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