



Microbiological and Chemical Characterization of Halvi, a Traditional Iranian Dairy Product Made from Sheep Milk

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| ARTICLE INFO | ABSTRACT |
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| <p><i>Article type:</i> Research Paper</p> <hr/> <p><i>Article History:</i> Received: 18 Apr 2019 Accepted: 15 May 2019 Published: 09 Jul 2019</p> <hr/> <p><i>Keywords:</i> Halvi, Sheep Milk <i>Auricularia auricular</i> Microbiological Properties Chemical Composition</p> | <p>Introduction: Halvi is a traditional dairy product made from sheep milk in Mazandaran province, especially in the mountainous areas of Noor and Kojur. The fungus used in the preparation of Halvi is <i>Auricularia auricular-judae</i>. The present study aimed to investigate the chemical composition and microbiological properties of Halvi samples produced in various regions in Noor city, Iran.</p> <p>Methods: In total, 42 Halvi samples were collected from various regions in Noor, including Chamestan (n=30), central Noor (n=8), and Baladeh (n=4), for the evaluation the chemical (protein, fat content, dry matter, ash, and pH) and microbiological analysis (aerobic plate count, coliform, molds and yeasts, <i>Staphylococcus aureus</i>, and <i>Escherichia coli</i>).</p> <p>Results: The microbiological results indicated that the samples collected from Chamestan had the highest count of aerobic mesophilic bacteria (6.4 log CFU/g). On the other hand, the samples collected from Chamestan and central Noor were more contaminated with coliform bacteria and yeast and mold compared to the samples collected from Baladeh. Moreover, <i>S. aureus</i> and <i>E. coli</i> were detected in 66.16% and 5.9% of the samples, respectively. The mean pH and protein, fat, ash, and dry matter content of the samples was 6.71, 6.84%, 8.87%, 1.42%, and 21.67%, respectively.</p> <p>Conclusion: According to the results, contamination with the mentioned pathogens indicates stricter control and proper measures during the preparation of Halvi.</p> |

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Introduction

Sheep milk contains 5.9% fat, 5.5% protein, 4.8% lactose, and 0.9% ash, and the contents of fat and protein are higher in sheep milk compared to cow milk (1). Due to the higher concentrations of fats, proteins, vitamins, and minerals in sheep milk compared to the milk of other domestic mammals, sheep dairy products have gained significant reputation in the market (2, 3). Sheep milk is mostly used for the production of various cheeses and yogurt, and its high protein, fat, and calcium content and casein make it a perfect blend for cheese production (4).

Halvi is a traditional dairy product made in the mountainous areas of Noor in Iran. This product

is made from fresh sheep milk by the addition of a specific fungus. Normally, Halvi is consumed as a meal or dessert. During the processing of Halvi, various risk factors threaten its safety and shelf life, such as biological hazards. However, since heat treatment is applied to the raw milk prior to the preparation of this product, the risk of microorganism transmission to the product decreases.

The fungus used in the preparation of Halvi is *Auricularia auricular-judae*, which is a non-toxic, edible mushroom known for its pharmaceutical properties. This fungus belongs to the *Auriculariaceae* family and contains high levels of

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protein and carbohydrates (4). Figure 1 depicts the entire process of Halvi preparation.

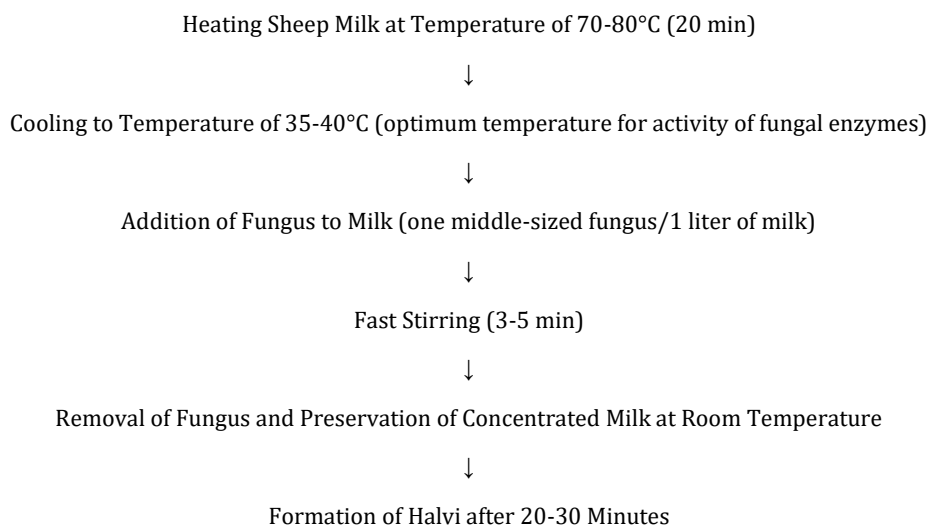


Figure 1. Process of Halvi Production

Despite the common consumption of Halvi in the northern regions of Iran, no reports have been published on the characterization of Halvi. The present study aimed to evaluate the microbiological and chemical properties of Halvi produced in various regions in Noor, Iran.

Materials and Methods

Experimental Materials

The bacterial culture media used in the present study was purchased from Merck (Germany). All the reagents and chemicals were of laboratory or analytical grade.

Experimental Methods

Sampling

This study was conducted in the summer of 2012. Halvi samples were collected from various regions in the city of Noor in Mazandaran province, Iran, including central Noor, Chamestan, and Baladeh. The Halvi samples were produced from sheep milk. In total, 42 samples were collected via convenience sampling from the mentioned regions, including 30 samples from Chamestan, eight samples from central

Noor, and four samples from Baladeh. Afterwards, the samples were transferred to the laboratory in an ice box under aseptic conditions.

Chemical Analysis

Triplicate Halvi samples were used for the evaluation of the main chemical parameters using standard methods for dairy products (5, 6). The measured parameters included protein content (Kjeldahl method), fat content (Gerber method), dry matter content (IDF method), ash content (gravimetric incineration), and pH (pH meter; model: M220 Corning, NY, USA).

Microbial Analysis

In total, 10 grams of the Halvi samples were homogenized with 90 milliliters of sterile peptone water (0.1%) using a stomacher (model: Lab Blender 400, Intersciences, France) for two minutes. Serial decimal dilutions of the homogenate were prepared with the same diluent and plated in duplicate on specific media. The microbial examinations included the aerobic plate count (APC), which was evaluated on a plate count agar for 24-48 hours at the temperature of 30°C, total coliform and *E. coli*, which were enumerated on violet red bile agar

and incubated at the temperature of 35°C for 24 hours, levels of molds and yeasts, which were determined on potato dextrose agar at the temperature of 25°C for five days, and *S. aureus*, which was detected on Baird-Parker agar at the temperature of 37°C for 48 hours (6).

Statistical Analyses

Data analysis was performed in SPSS version 16.0 (SPSS for Windows), and the numerical data were expressed as mean and standard deviation (SD).

Results

Chemical Composition

The chemical composition of the Halvi samples is presented in Table 1. According to the information in this table, the highest protein, fat, and dry matter content was 7.4%, 9.3%, and 22.3%, respectively in the samples collected from central Noor, while the highest ash content was observed in the samples collected from Chamestan. In addition, the pH of the Halvi samples collected from central Noor, Baladeh, and Chamestan was determined to be 7.2, 6.6, and 6.6, respectively.

Table 1. Chemical Composition of Halvi Samples (mean±SD)

| Proximate Composition (%) | Region | | |
|---------------------------|------------|--------------|------------|
| | Chamestan | Central Noor | Baladeh |
| Protein | 6.9±1.67 | 7.43±1.11 | 5.28±0.57 |
| Fat | 8.84±3.7 | 9.3±1.9 | 7.25±3.18 |
| Dry Matter | 21.94±6.31 | 22.32±1.73 | 18.36±2.27 |
| Ash | 1.45±0.6 | 1.36±0.4 | 1.32±1.43 |
| pH | 6.6±0.3 | 7.2±0.2 | 6.6±0.1 |

Microbiological Evaluation

The microbiological analysis of the collected Halvi samples is shown in Figure 2 and Table 2. As is depicted in Figure 2, the highest APC (6.4 log CFU/g) belonged to the samples collected from Chamestan, while the same values were recorded in the other samples (4.4 log CFU/g). With regard to the counts of coliform bacteria, yeasts, and molds, the samples collected from Chamestan and central Noor were more contaminated compared to the samples obtained from Baladeh.

Among 30 examined Halvi samples collected from Chamestan, 13.3% had *S. aureus* contamination, which was lower than the recorded rate in the samples collected from central Noor and Baladeh. As for *E. coli* and *S. aureus*, the samples collected from central Noor were the most contaminated products compared to the other samples. It is also notable that no *E. coli* was detected in the samples collected from Baladeh.

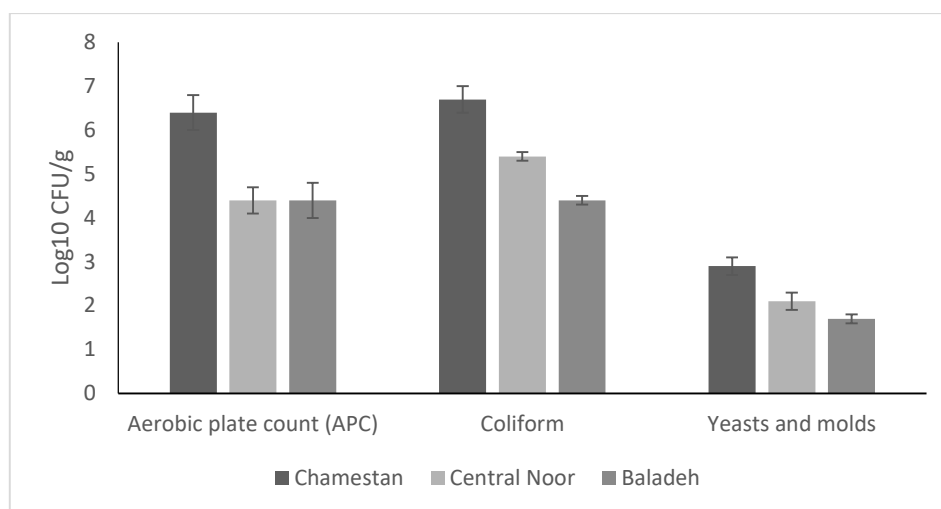


Figure 2. Counts of Aerobic Mesophilic Bacteria, Coliforms, Yeasts, and Molds (log₁₀ CFU/g) in Halvi Samples Collected from Various Regions in Mazandaran, Iran

Table 2. Levels of *S. aureus* and *E. coli* Detected in Halvi Samples in Various Regions in Mazandaran, Iran

| Region | Bacteria | |
|-----------------------|----------------------|--------------------|
| | <i>S. aureus</i> (%) | <i>E. coli</i> (%) |
| Chamestan | 13.3 | 10 |
| Central Noor | 50 | 12.5 |
| Baladeh | 25 | - |
| <i>-None detected</i> | | |

Discussion

Chemical Composition

In the present study, evaluation of the chemical composition of various Halvi samples indicated slight variations in the main components of the samples collected from various areas. Although the chemical composition of various traditional dairy products has been investigated in previous studies, no reports have been published on the characterization of Halvi. In a study in this regard, Aygun et al. (2005) assessed some of the chemical properties of Carra cheese, which is a traditional cheese variety produced in Turkey (6). According to the obtained results, the mean fat content of the Carra samples was 26.77%, and the pH value was within the range of 4.53-6.32.

Another similar research was focused on the investigation of the chemical properties of cheese Halva, which is a traditional Turkish cheese (7). In terms of chemical composition,

high variations were observed in the examined products, and the mean content of dry matter, fat, protein, sodium chloride, ash, and pH of the cheese samples was reported to be 84.32, 37.44, 13.75, 0.58, 1.49, and 5.3 kg/100 kg, respectively.

In the study by Cakmakci et al. (2011), the main chemical composition of Ispir Kaymak (a Turkish creamy dairy product) was assessed in 10 samples (8). Inconsistent with the results of the present study, the composition of the samples in the mentioned research varied widely, with the dry matter content reported to be within the range of 70.8-91.3% and fat content within the range of 43.0-63.0%. In this regard, the results of the mentioned study indicated that these variations could be due to the absence of standardized production in practice.

In another study, Farimani et al. (2017) assessed the traditional yogurt produced by nomads in terms of chemical properties (Hajimohamadi farimani, Habibi Najafi, and Fazli Bazaz, 2017).

According to the obtained results, the pH of the samples was within the range of 3.8-4.3, and the composition of yogurts have revealed that the chemical composition of the tested Halvi samples is generally closer to yogurt compared to other dairy products, such as various types of cheese (10).

Based on the national dairy standards, the maximum accepted level of most dairy products is 4 log CFU/g (11). Our findings demonstrated that the APC value of 69.04% in the tested Halvi samples was below the acceptable limit.

In a research in this regard, Aygun et al. (2005) investigated the microbiological quality of Carra (a traditional Turkish cheese), reporting the mean APC value to be 8-9 log CFU/g in the cheese samples, which is relatively higher than the recorded value in the present study (6). Similar studies have also been focused on the count of aerobic mesophilic bacteria in two types of traditional Turkish cheese (Ispir Kaymak and Helva). Accordingly, the APC values have been estimated at 7.6 and 4.02 log CFU/g in Helva and Ispir Kaymak, respectively, which indicates that the latter has higher quality. The difference in the APC values between traditional dairy products could be due to their primary microbial load and hygienic conditions during production. With respect to APC, the quality of Halvi is speculated to be higher compared to similar products, which Manipulation of the product. On the other hand, the percentage of the Halvi samples that were contaminated with *E. coli* was 9.5% in the present study, which is significantly higher compared to the reported results by Shadan and Khoushabi (2002) in samples of traditional cheese in Zahedan (Iran) (14). In fact, this finding demonstrates fecal contamination and unsanitary conditions in the production process. According to national standards, dairy products must be free of *E. coli* (11).

In the current research, the mean count of yeasts and molds in the samples was close to the values reported by Cakmakci et al. (2011) in Ispir Kaymak samples, while Mirzaei et al. (2008), Aygun et al. (2005), and Sengul et al. (2006) reported higher counts in samples of Lighvan cheese (4.96 log CFU/g), Carra cheese (7.6 log CFU/g), and Halva (4.8 log CFU/g), respectively. Contamination with molds and yeasts may occur

fat content was within the range of 0.5-45%. Other investigations regarding the chemical

may indicate the lower primary microbial load and/or production of Halvi in hygienic conditions.

According to the findings of the current research, the mean coliform count of the Halvi samples was higher compared to the reported values of similar traditional products, including Ispir Kaymak, Helva, and Carra (6-8). Coliforms are heat-sensitive, and the presence of these bacteria in heated food products could be due to post-heat treatment contamination. Considering that heated milk is used in the preparation of Halvi, the high coliform count in Halvi could be due to the poor hygienic conditions in the production process, non-compliance with sanitation regulations on behalf of the producers, and use of contaminated containers or washing water (12).

According to the national standards regarding microbial criteria in cheese and whey powder, the upper acceptable limit of *S. aureus* is 2 log CFU/g (11). As mentioned earlier, *S. aureus* was detected in 16.66% of the samples in the present study. In a study by Mirzaei et al. (2008), the count of *S. aureus* in 10.1% of Lighvan cheese samples was higher than the acceptable limit (13). The presence of this bacterium indicates the insanitary

during production, threatening the health of the consumers.

Halvi is a traditional dairy product, and since its preparation and production are not in accordance with hygienic standards, its microbial quality is suppose to be lower than industrial dairy products. Failure to monitor sanitary conditions during milking or use of improper containers and equipment for the collection and storage of milk could lead to the contamination of the product. However, post-process contamination should also be considered. It is also noteworthy that due to the use of heat-treated milk in the production of Halvi, its microbial load is lower compared to other similar traditional products.

Conclusion

According to the results of chemical analysis, the variations in the chemical composition of the

samples were not significant compared to other traditional dairy products. According to the microbiological analysis, the Halvi samples collected from Chamestan region were more contaminated compared to the samples obtained from central Noor and Baladeh regions. Moreover, the detection of foodborne pathogens in some of the Halvi samples urged stricter hygienic measures during the production process, while highlighting the need for the standard compilation of this product.

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