

Changes in the Physicochemical Properties of Kashkaval of Pindos Cheese Produced with Different Salting Methods during Ripening

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Abstract

Kashkaval of Pindos cheeses were produced either with sheep (100%) or mixture of sheep (90%) - goat (10%) milk. Sheep milk cheeses were manufactured either by dry salting or by immersion in 18% w/w salt (NaCl) brine. Cheeses made with the mixture of sheep- goat milk were directly immersed in brine of 15% or 18% w/w NaCl concentration. These are common practices of cheese salting used by the traditional cheese-makers. The physicochemical characteristics of all cheeses were monitored during a ripening period of 3-months. The results have shown that the physicochemical characteristics of both cheeses were not affected by the different salting methods. Therefore, Kashkaval of Pindos cheese can be salted either with dry salt or with immersion in brine, without altering their main composition and organoleptic characteristics. Furthermore, some historical data about Kashkaval of Pindos cheese are included.

Keywords: traditional, cheese, Kashkaval of Pindos, salting

1. Introduction

The endurance of rural human population in less favoured areas assures the safeguard and survival of biodiversity and leads to the manufacture of traditional products. A traditional product is a result of several factors such as raw material, transformation process and sensory characteristics (Scintu & Piredda, 2007). In this respect, it is of major importance to support the maintenance of the production of local cheeses. Greece has a wide variety of artisanal cheeses, each one with its own distinctive texture, flavour and aroma; characteristics that clearly reflect their terroir of production. Kashkaval of Pindos is a traditional paste filata cheese produced seasonally in the mountains of Pindos as a farmhouse product. Nowadays, there is an increasing demand by consumers for this local cheese. However, in order to produce a cheese with consistent physicochemical characteristics in respect to its traditional character, it is necessary to study the various technological parameters that are commonly used by different cheesemakers, on farm level. It is known that in traditional production of this type of cheese, salt can be added by either dry salting or direct immersion of cheese in brine (Pejic, 1956; Scott, 1981; Kindstedt et al., 2004).

The traditional cheese-making technology of Kashkaval cheese has been recorded since the beginning of the previous century (Dimitriadis, 1900; Liambeis, 1900; Polychroniadis, 1912) and the biochemical characteristics of the artisanal cheese have been studied before (Pappa et al., 2019; Samelis et al., 2019). The aim of the present work was a) to study the effect of the salting methods that are commonly used in its manufacture by the different cheese-makers and b) to provide some historical data regarding the Kashkaval of Pindos cheese. Therefore, in the present study, the physicochemical characteristics of Kashkaval of Pindos cheese manufactured with sheep milk and salted with two different methods: dry salting or immersion in brine (18% w/w), at different ripening dates were studied. Moreover, the physico-chemical parameters of Kashkaval of Pindos cheese manufactured with mixture of sheep (90%)-goat (10%) milk and salted by direct immersion in brine with concentration 15% or 18% w/w were assessed during ripening.

2. Materials and Methods

2.1 Cheesemaking

Kashkaval of Pindos cheeses were produced at the pilot plant of Dairy Research Department, Institute of Technology of Agricultural Products, using 100% sheep (Sh-K) or mixture of 90% sheep-10% goat (mix-K) milk following the procedure as described elsewhere (Pappa et al., 2020) and presented in Table 1.

Table 1. Protocol of Kashkaval of Pindos manufacture

Step	Description
1	Milk 100% sheep milk (Sh-K) or mixture of 90% sheep and 10% goat milk (mix-K) was filtered
2	Pasteurization Milk was heated at 63°C for 30 min and then cooled at 37°C
3	Starter culture addition Addition of freeze-dried and direct to vat set starter culture to milk (<i>Lactobacillus helveticus</i> , <i>Lactococcus lactis</i> subsp. <i>cremoris</i> , <i>Lactococcus lactis</i> subsp. <i>lactis</i> , <i>Streptococcus thermophilus</i> , RSF-736, Hansen)
4	Coagulation Addition of CaCl ₂ (20g/100 kg) and rennet (10.000 strength, NATUREN Extra NB, Hansen) to milk (milk temperature: 35°C, coagulation time: 40 min, rennet quantity: according to instructions)
5	Cutting and cooking of the curd size of curd pieces: 6-8mm; rate of temperature scalding-up: 1°C/ 3min until final temperature 42°C and keeping at 42°C, under gentle stirring, for 15 min
6	Curd forming and pressing Curd is placed at pierced stainless steel moulds containing a cheese cloth. Pressing with a weight of 4kg and after 30min curd was turned upside down in the mould and the weight was put again. This was repeated three times and then the weight was removed
7	Acidification of the curd The curd was left at 17°C to ripen until the pH reached ~5.2 (next day)
8	Texturing of the curd
9	The acidified curd was cut into long thin slices which were immersed in stainless steel containers with hot water (~80°C) and manipulated with a wooden stick until a homogenous compact texture is obtained (pasta filata)
10	Moulding of the curd The texturized curd was transferred to a cheese-table; it was kneaded by hand, moulded and transferred to 17°C. The following day (3 rd day from manufacture) the moulds were removed.
11	Salting of the cheese Half Sh-K cheeses were salted by immersing them in brine (18%) for 4 days at 17°C, while the other half cheeses were dry salted (15g/10kg cheese). Cheeses dry salting and turning lasted for ten days (four salting took place). Half mix-K cheeses were immersed in brine 18%, while the other half cheeses in brine 15% for 4 days at 17°C.
12	Ripening of the cheese The cheeses were transferred to 12°C for maturation until they were 90-days-old

2.2 Analysis of Cheese

The milk for the cheesemaking was analyzed for physicochemical parameters, i.e. fat, protein, lactose, total solid by Milko-Scan, model 6000 (Foss Electric, Hillerød, Denmark). Milk pH was measured directly with a pH meter (Micro pH 2002; Crison, Barcelona, Spain). Microbiological evaluation was carried out by assessing the total viable counts (TVC) using the Bactoscan FC (Foss Electric, Hillerød, Denmark).

Cheese samples were examined for pH electrometrically (Micro pH 2002; Crison, Barcelona, Spain) and were analyzed for their fat according to the Gerber-Van Gulik method (Schneider, 1954), salt according to the modified Volhard method (Kosikowski, 1982) and moisture content by drying to constant weight at 102±1 °C (International Dairy Federation, 1982). The fat-in-dry-matter (FDM) content was calculated by the formula: FDM% = fat% x 100/100- moisture%.

Cheeses were, also, assessed organoleptically by five trained panel members who were permanent staff of the

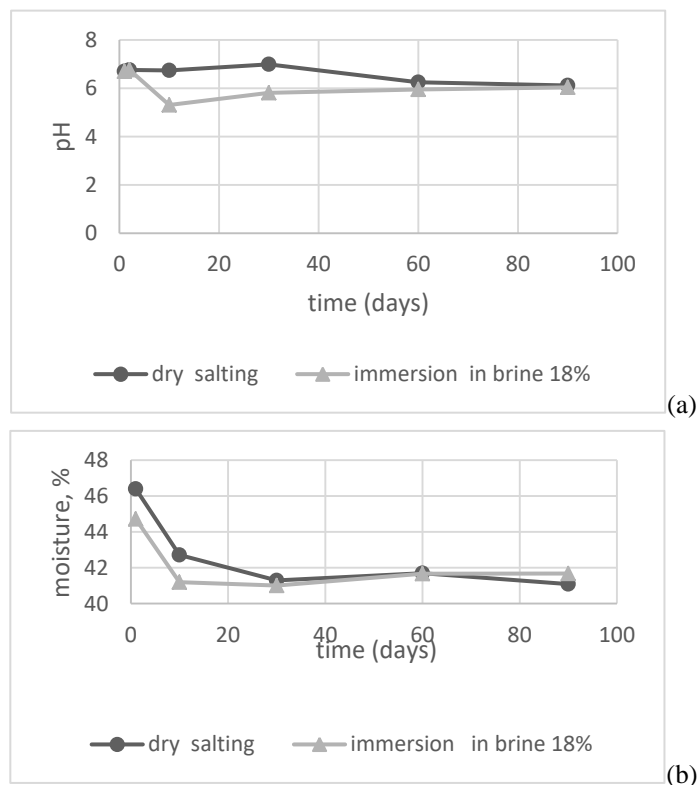
Dairy Research Department; all of them well experienced and familiar with pasta filata cheeses.

3. Results and Discussion

3.1 Effect of the Different Salting Methods on the Physicochemical Characteristics of Kashkaval of Pindos Cheese

The composition of the milk used for the manufacture of Kashkaval of Pindos cheese was fat 5.50%, protein 4.76%, lactose 4.99%, total solids 16.09% and its pH was 6.74 for the sheep milk (Sh-K) and 6.06%, 4.72%, 4.86%, 16.46% and 6.74 respectively for the mixture of 90% sheep and 10% goat milk (mix-K). The total viable counts of sheep milk were 4.79 log cfu/mL and of mixture of sheep-goat 5.88 log cfu/mL. The above results show that the milk used for the manufacture of cheeses was of good quality.

The physicochemical characteristics of Sh-K cheeses are presented in Figure 1 (a-d) and of mix-K cheeses in Figure 2 (a-d). The pH, moisture, fat and salt content of Kashkaval of Pindos cheese made with 100% sheep milk exhibited the same trend regardless the way of salting (i.e. dry salting or immersion in brine, at all sampling days (Figure 1 a-d). Also, cheeses manufactured using a mixture of 90% sheep -10% goat milk and salted with immersion in brine 15% or 18% showed similar pH, moisture, fat and salt content, at all sampling days (Figure 2 a-d). The results have shown that in general, at 30 days of ripening the physicochemical characteristics of Kashkaval of Pindos cheeses, regardless the type of salting method used, reached equilibrium. The physicochemical characteristics found in this study were in accordance with the data found by others (Kindsted et al., 2004; Alichanidis, & Polychroniadou, 2008; Pappa et al., 2019; Pappa et al., 2020) for pasta filata and Kashkaval cheeses.



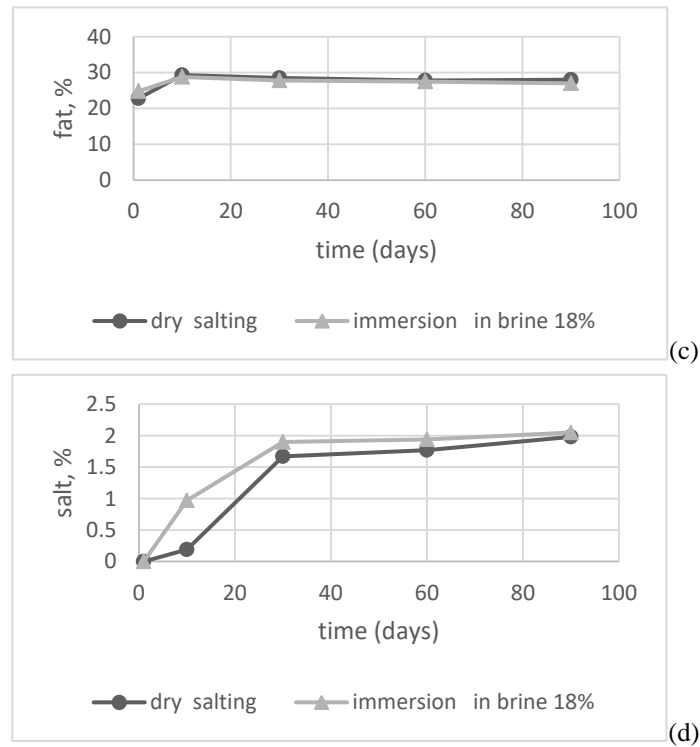
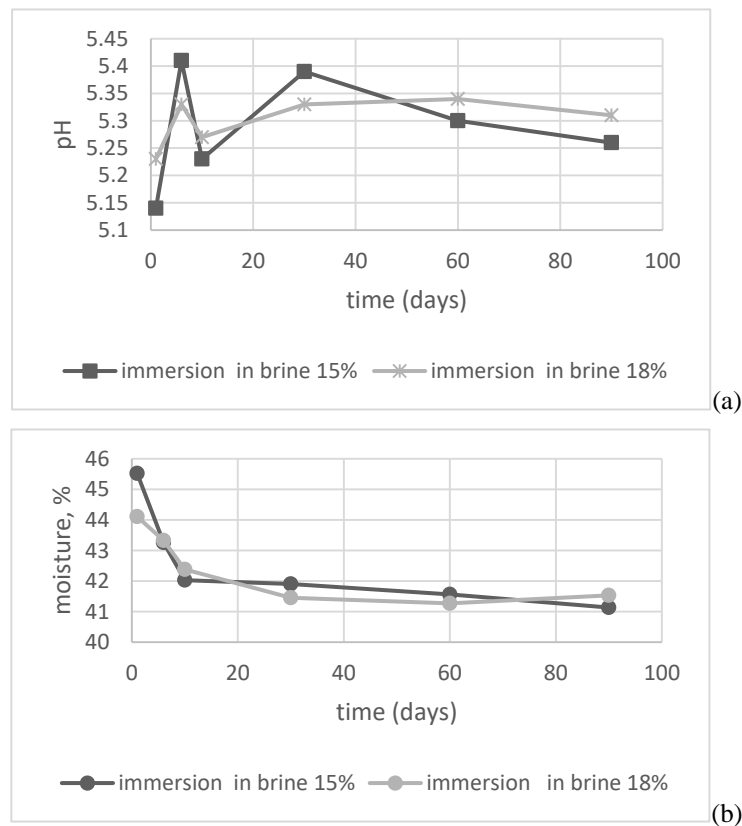


Figure 1. Effect of type of salting on the pH (a), moisture (b), fat (c) and salt content (d) of Kashkaval of Pindos cheese made with 100% sheep milk



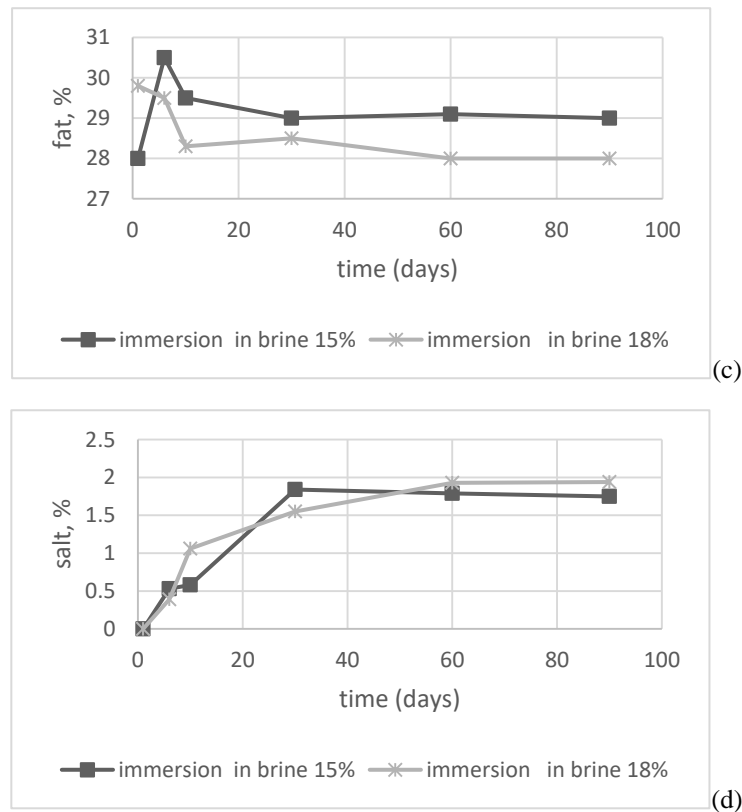


Figure 2. Effect of brine concentration on the pH (a), moisture (b), fat (c) and salt content (d) of Kashkaval of Pindos cheese made with mixture of 90% sheep -10% goat milk

Initially, there was a decrease in the pH values of the cheese due to the accumulation of lactic acid produced by the action of microorganisms to the residual lactose. Then, from day 1 to the end of salting there was an increase in the pH values and that could be attributed to the buffering effect of milk salts transferred in the cheese (Perna et al., 2014). Also, plasticization of the curd had a major influence on the composition, structure and ripening of Kashkaval cheese, as the cheese mass is washed to some extent, resulted in an increase of the pH values (Gobbetti et al., 2002). An increase in the pH values were also observed in Kashkaval cheese (Omar & El-Zayat, 1986).

The moisture content decreased until the end of salting time, probably due to the syneresis of cheeses (Pappa et al., 2006). The dry matter content (i.e. DM%= 100-moisture%) of all produced cheeses over 60 days-old ranged from 58.31-58.92% (data not shown).

Fat content of cheeses increased from day 1 until the end of salting. This trend is due to loss of moisture during the early stages of ripening. The FDM content of over 60-day cheeses regardless the type of milk or the salting method ranged from 47.14-49.79%. All Kashkaval of Pindos cheeses of this study fulfilled the requirements of regulation No 1225/90 of European Economic Community, i.e. fat-in-dry matter >45% and dry matter >58%.

The NaCl percentage of the Sh-K cheeses salted with the different methods, i.e. dry salting or immersion in 18% brine was similar (Figure 1d). Also, the salt content of mix-K cheeses salted with immersion in brine 18% or 15% did not differ (Figure 2d), especially at the end of ripening (90 days). Therefore, the different salting methods did not affect the salt content of the Sh-K and mix-K cheeses.

According to the Greek Codex Alimentarius (2014) Kashkaval of Pindos cheese can be sold in the market after 90 days of ripening. At that age, the organoleptic evaluation has shown that all cheeses in this study were very much appreciated by the five trained panel members. Their appearance was fairly yellow, with a smooth and thin rind and with occasionally technological slits. The texture was firm and elastic and the flavour was mild, with piquant, fruity and buttery notes. Panellists did not observe any difference regarding the salty taste of the cheeses produced with the different salting methods. No quality defects were found such as red or dirty white rind, gas holes etc as described by Caric (1993) for Kashkaval cheese and no goaty flavor was reported in the mix-K

cheeses.

3.2 Historical Data of Kashkaval of Pindos Cheese

Greece is a mountainous country and Pindos is its biggest mountain range with many picturesque villages such as Metsovo, Samarina, Syrako etc around it, with a long history in sheep and goat breeding and cheese making. The main agricultural activity of the nomadic and non-nomadic populations that lived for many years in the mountains of Pindos was sheep and goat breeding so as to provide milk, meat and wool for their families. In order to preserve milk for a longer time, they used to manufacture cheeses. Kashkaval of Pindos has been one of the most traditional and popular cheese during the centuries of the prevail of the Ottoman Empire in Greece. As this cheese belongs to pasta-filata group, its manufacture consists of two stages, the acidification of the curd after its production and the texturizing of the acidified curd with heating, kneading and stretching by soaking in hot water or in brine. Its manufacture was very popular especially during the hot summer. The coagulation and drainage of the curd was made in the mountains of Pindos to prolong the shelf-life of milk and then the drained cheese curds were gathered together and transported to the lowlands for further processing. Moreover, raw milk or milk with an increased acidity could be used for its production as during the texturizing of the acidified curd in hot water or brine ($\approx 80^{\circ}\text{C}$) a partial elimination or control of the pathogenic microflora could be achieved.

At that time, living conditions in Greece were very difficult, including unbearable taxes, robberies, killings etc. Residents of Pindos's villages were extremely familiar with the mountain trails and since the borders among the countries were not clearly demarcated, they managed to develop trade all over the Balkan Peninsula by travelling a lot with their horses, carrying various products such as wheat, oil, wool and cheese and selling them in markets. Furthermore, during the 18th century, population from the regions of Epirus and West Macedonia emigrated due to persecution or economic reasons to places such as Serbia, Austria-Hungary, Eastern Rumelia and others, exchanging with the locals, habits, culture, recipes, products etc. Based on written historical documents during the 19th century, merchants from villages in the mountains of Pindos (such as Metsovo) were commercialized in Venice, Istanbul, Alexandria, Odessa, Vienna, Boudapest, selling products such as barrels, wool textiles and Kashkaval cheese (Pouqueville, 1820; Leake, 1835; Berard, 1911; Wace & Thomson, 1914).

Mijacenic and Bulajic (2004) stated that Kashkaval cheese in the beginning was produced exclusively from sheep's milk during the grazing period, and nomads from Greece implemented the tradition of Kashkaval cheese on Stara Planina 100 years ago. Historical data showed that in the year 1903, 160 wagons of Kashkaval cheese were exported to Vienna and Budapest.

While in ancient times Kashkaval production was limited to the Greek and Roman empires as well as their colonies, nowadays it is produced in many parts of the world i.e. Crimea, South Ukraine, the Caucasus and Turkey, Greece, Italy, Bulgaria, Romania, Yugoslavia etc (Kindsted et al., 2004). In the Mediterranean region it is called simply Kashkaval with small differences in spelling. However, variations of that name can be found (Alichanidis & Polychroniadou, 2008). Kashkaval has also been given different commercial names according to the production district such as Pirdop in Bulgaria, Epir in Greece, Sarplaninski and Pirotski Kaskaval in Yugoslavia (Pejic, 1956). The Italian version is Caciocavallo and in Egypt the name Romy is commonly used.

4. Conclusions

As there is an increasing demand of Kashkaval of Pindos cheese, it is important to study the effect of the different salting methods (dry salt or immersion in brine 18% or 15%, w/w) which are commonly used by traditional cheese-makers. The results have shown that physicochemical characteristics of both cheeses were not affected by the different salting methods. Therefore, Kashkaval of Pindos cheese can be salted either with dry salt or with immersion in brine (15% or 18% concentration). However more work must be done in order to find if there is an effect of these two different methods on its level of proteolysis, lipolysis and its microbiological data.

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