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REVIEW ON KES CHEESE

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Abstract
Kes cheese, a traditional Turkish dairy product, is commonly made in a lot of region Anatolia. It is consumed in the various parts of Turkey, especially in the western and southeastern parts. Kes cheese is commonly produced in family businesses for their needs and also by dairy processing plants for commercial purposes. Therefore, traditional producing method is not standardized. In recent years, 20-30% White cheese curd has been added to the curd of Kes cheese in order to make the product more attractive, resulting a mosaic-like structure in the final product. Traditional Kes cheese has a range of 21.60-39.31% moisture, 4.5-23.5% fat, 31.22-50.68% protein and 2.84-13.19% salt. The aim of this review is to outline manufacture and chemical, biochemical, mineral, microbial and sensorial properties of Kes cheese.

Keywords: Kes cheese, manufacture, proteolysis, mineral, microbial, sensorial properties

KEŞ PEYNİRİ ÜZERİNE DERLEME

Özet
Keş peyniri Anadolu'nun birçok bölgesinde yaygın olarak üretilen geleneksel bir Türk ürünüdür. Türkiye'nin birçok bölgesinde özellikle batı ve güneybatı bölgesinde yaygın olarak tüketilmektedir. Keş peynir genellikle küçük aile işletmeleri tarafında kendi ihtiyaçlarını karşılamak için üretilmekte ve ihtiyaç fazlası ticari olarak değerlendirmektedir. Bundan dolayı keş peynirinin geleneksel üretim yöntemi standardize edilememiştir. Bu ürünün tüketimini daha cazip hale getirmek için son yıllarda peynir pıhtısına %20-30 oranında yağlı Beyaz peynir pıhtısı karıştırılıp kurutulmaktadır. Geleneksel Keş peyniri ortalama olarak %21.60- 39.31 nem, % 4.5-23.5 yağ, %31.22-50.68 protein ve %2.84-13.19 tuz içeriğe sahiptir. Bu derlemenin amacı, Keş peynirinin üretim yöntemini ve bu peynirin kimyasal, biyokimyasal, mineral, mikrobiyal ve duyusal özelliklerini incelemektir.

Anahtar kelimeler: Kes peyniri, üretim yöntemi, proteolysis, mineral, mikrobiyal, duyusal özellikler

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INTRODUCTION

Food products of animal origin play an important role in sufficient and balanced nutrition of human beings. Milk and milk products are among the most import food products of animal origin. Milk is often described as a complete food because it contains protein, milk, sugar, fat, vitamins and minerals (1). Kes cheese, a traditional Turkish dairy product, is commonly produced in different regions of Turkey. It is commonly produced in small family businesses for their needs and also by small dairy processing plants for commercial purposes. Generally cow's milk is used in the production and when sheep and buffalo milk are available, these milks are mixed with cow's milk. Production time is generally in summer season (2).

In Turkey, butter is either produced from cream or yoghurt; the last one is used as a raw material for butter manufacture in home production. Yayık butter is produced after the milk is processed to yoghurt. Butter granules are removed by a wooden remainder and washed by good quality cold water once or twice to remove residual Ayran among fat globules. Ayran is consumed as a drink with meals or after being converted to 'Cokelek' which is consumed at breakfast (3). The Cokelek is shaped round or oval with 30-40 g weight and dried in the sun for 10-15 days. At the end of this period, the product named 'Kurut' can be stored at ambient temperature for more than 6 months. The name 'Kurut' means 'dry' and is produced by means of salting at a level of 2-3% (w/w) and kneading of Cokelek after removing some parts of whey of the Cokelek by clot bag method. It is used as an ingredient in soup production in winter and as a beverage by mixing with warm water or as a starter culture for yoghurt manufacture (4). Kurut is made in the villages of Eastern parts of Turkey and it is a nutritious product in terms of protein and mineral contents and its protein and mineral contents are very high; however, fat content is low (i.e. 5-10% (w/w) in comparison with cheese (5).

In some regions, Kurut is known as Kes cheese. Since it has a low fat content it keeps well. Some of the best known regional varieties are the Kurut of Kars and Bitlis, the Surk (dried Cokelek) of Hatay, the Kes of Mengen, Giresun, Ordu and the dried Cokelek of Aydin (6). Cokelek cheese is called as Eksimik in Thrace, Kes in Mediterranean, and Akcakatik, Kesmik or Urda in several regions of Anatolia. These regions some wild plants are added into Cokelek in order to give a flavor; 'boyotu' (*Trigonella foenum*) is used in the west and garlic mustard in the east. Kes cheese is produced by drying of kneaded Cokelek with several aromatic plants and therefore has a special odor and aroma. It can be classified as hard cheese and its taste is little sour like a puckery taste. It is generally eaten with thin dough bread (7). The aim of this review is to examine the production methods and physico-chemical, microbiological, biochemical and sensorial properties of Kes cheese.

MANUFACTURING METHODS

For production of Kes cheese (Figure 1), milk is first filtered through a cheese-cloth prior to heat treatment to remove unwanted materials. After clarification, Milk is heated to 90-100 °C for about 15-20 minutes, and cooled to 40-45 °C and inoculated with yoghurt culture (2–3%). After the production of yogurt, it churned into the butter and Ayran. Ayran is heated to 90-100 °C for about 10 min until a white coagulum floats on the surface and transferred into a cheese cloth. It was pressed until the desire solids level is reached. The curd is salted 2-3% with dry salt and filled into cotton bags. The bags are hung from a platform in a warm room for 2-3 days. The bags are occasionally turned over for homogeneous dryness. In recent years, 20-30% White cheese curd has been added to the curd of Kes cheese in order to make the product more attractive, the resulting a mosaic-like structure in the final product (2, 8, 9).The Kes cheeses reached up to 60 to 70% total solids content can be maintained in a cool place for 4-5 months.

Raw milk ⇒ Clarification ⇒ Heat process (15-20 minutes at 90-100 °C) ⇒ Cool (to 45-50 °C) ⇒ Addition of starter culture (2-3% thermophilic culture) ⇒ Incubation (2.5-3.0 h) and Yogurt ⇒ Yogurt Churning ⇒ Ayran (the churned butter is separated from this chart) ⇒ Heating (Ayran curd) ⇒ Draining (30-40 min, pressing in cheese cloth) ⇒ Salting (curd were dry salted 20-30 g NaCl/L) at room temperature for 12-15 h) ⇒ Pressing and curd (drain water off until the desired solids level) ⇒ The bags are homogeneous dryness (hung from a platform in a warm room for 2-3 days) ⇒ Storage (at 7-8 °C)

Figure 1. The production of Kes cheese in the farm

PHYSICO-CHEMICAL PROPERTIES

Since the production method of Kes cheese is not standardized, the quality of products available in the market varies a lot. Tarakci et al. (8) determined some properties of Kes cheese. They found dry matter 60.69-78.40%, moisture 21.60-39.31%, fat 4.5-23.5%, protein 31.22-50.68%, total mineral content 4.36-14.23% salt 2.84-13.19%, titratable acidity 1,49-3.26% (LA%), and pH 3.37-4.24.

Kes cheeses (15 samples) from Ordu city, had an average of 60.98±6.22% dry matter, 7.50±2.71% fat, 38.85±6.21% protein, 4.19±1.99% ash, 3.39±1.72% salt, 1.75±0.56% (lactic acid) titratable acidity, and 4.66±0.50 pH value (2).

Dervisoglu et al. (9) reported mean values of dry matter, fat, salt, salt in dry matter, ash, and pH of 41 different Kes cheeses as 56.17±6.07%, 8.79±2.84%, 3.22±1.35%, 5.68±2.19%, 4.31±1.29%, and 4.75±0.59, respectively.

Kırdar (7, 10), reported titratable acidity 1.85%, 4.31 pH value, dry matter 72.54%, fat 36.50%, fat in dry matter 50.31%, salt 4.68% and salt in dry matter 6.45%. Akyuz and Gulumser (11), found dry matter 79.69%, fat 10.58%, protein 52.89%, ash 11.06%, salt 9.66% and acidity 59.75 SH in Kurut samples. Akyuz et al. (4) determined dry matter 85.51%, fat 8.52%, protein 54.64%, ash 14.89%, salt 12.18%, and titratable acidity 1.18% (lactic acid). Chemical composition of Kes cheese indicates that that there is no standard product in the market.

MICROBIOLOGICAL PROPERTIES

In general, the storage, low pH values of the samples might be expected to influence the microbial counts. The average total bacteria level found by Tarakci et al. (8) in 20 samples were in the range of 4.32 to 6.53 log cfu/g. These values were similar to these found by Akyuz and Gulumser (11) in Kurut samples and higher than Kurut products in Van by Akyuz et al. (4), and lower than Peskuten samples found by Kurt and Caglar (12). These differences may be derived from the different type of milk used in the manufactures, low pH values, high NaCl and herb levels of the samples might be expected to influence the microbial counts.

Lactic acid bacteria (LAB) counts were the dominant bacteria during the storage period and may contribute to Kes cheese production. Levels of lactic acid bacteria on MRS agar were found 4.46 log cfu/g. Kucukoner et al. (13) found similar results in Cacik samples. LAB produces lactic acid from lactose and is able to grow at high acid levels. However, during storage, lactobacilli increased while lactococci decreased, because lactobacilli are more resistant to high acid levels than lactococci. It is known that the proteolytic activity of lactobacilli is higher than that of lactococci. Thus, depending upon the increase in lactobacilli numbers, TCA (trichloroacetic acid) values increased. Proteolitic microorganism counts of Kes cheeses (8) were similar to lactic acid bacteria counts. The proteolytic enzymes of yeast and mould may contribute to a small increase in WSN and TCA values.

The yeast and mould levels (3.28 to 5.38 log cfu/g) in the samples (8) were higher a compared to these determined by Akyuz et al. (4) in Kurut samples, but lower than the results reported by Keven et al. (14) in Malatya Cokelek samples. This result may be because of the fact that yeast and moulds can grow in the low pH and moisture (13).

The coliform microorganisms were not detected by Tarakci et al. (8). The number of microorganisms of coliform indicates the microbiological quality of the samples, and was <1 log cfu/g in all samples. Coliforms are often originated in the environment of the dairy industry (equipment and plant personnel). These bacteria are salt-tolerant and are able to grow under a wide range of conditions, high NaCl levels and high acidity and temperature may allow other fecal to grow (15). Studies on Kes cheese are limited.

RIPENING OF KES CHEESE

Ripening of cheese involves a complex series of biochemical and chemical events which lead to the characteristic taste, aroma and texture of each cheese variety. Five agents are responsible in the ripening of cheese: the coagulant (rennet or rennet substitute), indigenous milk enzymes, starter bacteria and their enzymes, secondary or adjunct starter bacteria, and nonstarter bacteria (16). Ripening involves three primary biochemical events: glycolysis of residual lactose and its constituent monosaccharides, glucose and galactose, lipolysis and proteolysis (17). Proteolysis in cheese includes very complex series of events.

It is necessary to analyze the nitrogen fractions formed during ripening in order to understand the development of proteolysis in cheese (18). The WSN (water soluble nitrogen) fraction contains whey proteins, proteose-peptone (soluble proteins, peptides, amino acids, amines, urea, ammonia) and low molecular weight peptides (>15000 Dalton molecular mass) derived from casein hydrolysis (19). The soluble nitrogen compounds are mainly produced by the action of the coagulant shows nitrogen and casein fractions of Kes cheese samples. The WSN/TN (water soluble nitrogen/ total nitrogen) ratio of Kes samples by Dervisoglu et al. (9) was determined as an average of 9.36%. Differences might be due to packed or unpacked conditions, the type of the milk, manufacturing procedure, and ripening conditions etc.

Phosphotungstic acid-soluble nitrogen compounds (PTA-SN) is known as the free amino acids index of proteolysis and is obtained by extracting the water-soluble fractions of cheeses with 5% PTA, which only extracts low molecular weight peptides (<600 Da) and amino acids (20). The PTA-SN/TN value found by Dervisoglu et al. (9) was an average of 3.43%. As proteolysis continues in cheese, relatively larger molecular weight nitrogenous fractions brought about by chymosin and cell-wall proteinases are further degraded to smaller molecular weight compounds by peptidases. The formation of amino acids and peptides with molecular weight less than 600 Dalton, which are soluble in 5% phosphotungstic acid (PTA), is strongly related to the age and flavour intensity of cheese (21).

SDS-PAGE profile of Kes cheeses can be used to show the casein degradation of the samples. The α_s–CN, β–CN and, γ–casein and other peptides fractions of Kes cheeses changed between 20.65-42.7%, 22.95-41.85% and 21-56.4%, respectively (6). These results are lower than the results reported by Sengul et al. (21) Difference in a_S-casein degradation in the literature is possible due to differences of milk used, manufacturing procedure, and ripening conditions (22). Plasmin, an alkaline milk proteas, plays a major role in proteolysis (23). Plasmin dissociates from casein micelles as the pH decreased. This may have more plasmin activities and therefore more proteolysis. In White-brined cheeses, the principal proteolytic agents are the residual coagulant and enzymes from starters or the indigenous microflora. Extensive plasmin activity is not expected in this type of cheese due to its acidity and salt content, both of which are unfavorable for plasmin action (24, 25).

It has been established that β-casein is more resistant to proteolysis, especially in a cheese matrix, from either calf rennet or starter enzymes, owing to their structure and particularly, their tendency to associate (26). The β-CN hydrolysis was found between 38.51-66.24%. The γ-casein and other peptides fractions were found to be 0.66-47.87% (9). These results are also in good agreement with the finding of Irigoyen et al. (27) Difference in a_S-casein degradation in the literature are possible due to differences of milk used, manufacturing procedure, starter and nonstarter microorganisms, and ripening conditions (22).

HEAVY METAL CONTENTS

Milk and milk products are important compounds of the human diet. Cheese being one of the basic dairy products is rich in protein, fat, calcium, riboflavin and other vitamins (28).

Some mineral and trace metal levels of 41 Kes cheese samples determined on a dry weight basis as μg/g and are presented by Kilicel et al. (29). Zinc is one of the important metals for normal growth and development in human beings. Deficiency of zinc can result from inadequate dietary intake, impaired absorption, excessive excretion or inherited defects in zinc metabolism (30). The zinc content ranged from 4.30 to 37.30 μg/g, averaging 14.10 μg/g. The maximum iron content was found 22.30 μg/g, and as the minimum iron values 7.10 μg/g. The copper values of the samples varied from 5.9 to 47.8 μg/g. Manganese activates numerous essential enzymes. Mean manganese concentrations of the samples varied from 0.23 μg/g to 1.92 μg/g. The average lead concentration was found between 0.04-0.75 μg/g in Kes cheeses. Cadmium is a nonessential element in foods and natural waters, and it accumulated principally in the kidneys and livers. Cadmium in foods is mostly derived from various sources of environmental contamination (30). The cadmium levels in Kes cheeses are between 0.03-0.26 μg/g, a portion of the lead cadmium must have come from sources other than milk. The sources of high levels of Pb and Cd are likely to be the transferred from the tin can and salt used in the brine (31). The FAO/

WHO has set a limit for heavy metal intakes based on body weight. For an average adult (60 kg body weight), the provisional tolerable daily intakes for lead, iron, copper and zinc are 214 µg, 48 mg, 3mg and 60 mg, respectively (32). Cobalt and chromium contents were reported to be 0.04-0.44 and 2.31-7.25 µg/g, respectively. The manganese contents of cheese samples were between 0.23 and 1.92 µg/g. The values of cadmium in samples were found to be minimum and maximum value, 0.03 and 0.26 respectively.

SENSORIAL PROPERTIES

The body and texture scores for Kes cheese were rated lower than those of the Kurut. This may be due to the fact that are produced from ayran and skim milk making it harder, a common defect in dried samples. The low-fat milk products such as Kes have a dry, hard body and texture (33). As regards to taste and aroma full fat Kes samples were preferred compared to low-fat Kes samples. Low fat Kes cheese can be advised for the people suspicious about the full fat cheese.

CONCLUSION

Kes cheese is a traditional dairy product with high nutritional value, unique taste and aroma. Chemical composition and there for sensorial properties of Kes samples are significantly different due to ingredients used such as the ayran, skim milk and cheese added, different manufacturing, packaging, and ripening conditions etc. In order to have a standard product, all process steps should be standardized. Packaging, storage and marketing conditions should also be improved.

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