FATTY ACID PROFILE AND SENSORY PROPERTIES OF TRADITIONAL SHEEP KASHKAVAL

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Abstract

The purpose of this paper was to present the fatty acid profile of Galichki sheep kashkaval cheese from Bistra mountain and present its sensory characteristics. The tests were carried out in four iterations on the 180th day of the cheese production. The fatty acids were analyzed under the method AOAC 996.07. The organoleptic assessment was conducted under 20 points scale method, by examining four characteristics (flavor, aroma, texture and additional flavor in the mouth and appearance when cut). Based on the results obtained, it was concluded that the biggest percentage of the fatty acids belongs to palmitic acid (C16:0, hexadecanoic acid) with 30.57±4.17 g/100g, then the oleic (C18:1, z-octadec-11-enoic) with 24.89±1.05 g/100g and myristic acid (C14:0, tetradecanoic acid) with 11.01±0.69 g/100g. Based on the results of the sensory analysis we concluded that the Galichki kaskhaval cheese belongs to the category of very good quality cheese. The flavor was rated as distinct, characteristic for sheep cheese and moderately salty, while the aroma was characterized as pleasant, slightly sour, with no foreign odors. The cheese texture was evaluated as compact, homogeneous, and the firmness as characteristic for the product. The cheese was top-rated in terms of the appearance when cut. This property depends mostly on the skills of the master in the fast and successful shaping of the curd dough and the proper shaping of the cheese.

Keywords: quality, cheese, traditional production.

Introduction

Each traditional cheese originates from a complex system which results in unique organoleptic characteristics. The development of these unique characteristics is linked to several biodiversity factors: the environment, the climate, the natural pasture, the breed of the animals, the use of raw milk and its natural microflora, the cheesemaking technology with the unique role of human beings rather than automated technology, historical tools as well as the natural aging conditions (Licitra, 2010). Kashkaval is one of the most popular hard cheeses in many Mediterranean countries and its production is dating back to the eleventh and twelfth centuries (Kindstedt et al., 2004). One of the traditional cheeses with long history which is produced on mountain Bistra in the Republic of Macedonia is kaskaval from the region in Galichnik. The flora in this country is among the richest not only in the Balkans but also in the entire European continent (Niketić, 2014). The mountain Bistra belongs to the group of mountains which constitute the most interesting mountain-pasture area of the Balkan Peninsula, with the most beautiful hilly pastures (Srbinovska and Santa, 2014). According to Bertozzi and Panari (1993), the traditional character of the cheeses and the possession of the geographical indication are the two most important factors which influence the selection of cheese by the consumers. Cheese made using sheep milk is very popular among the consumers, primarily due to the specific sensory characteristics which have this cheese (Kalantzopoulos, 1993). Cheese flavor is one of the most important criteria determining consumer choice and acceptance. There is a lack of knowledge about the nature of the aroma compounds, but it is clear that the breakdown products of lactose and citric acid (lactic acid, diacetyl, CO2, etc.), of para casein (peptides and amino acids), and of lipids (free fatty acids) are essential for the flavor (Fatma et al., 2013). Free fatty acids are generated during cheese ripening as a result of lipolytic ensyme action. The extent of lipolysis has been used as indicator of the degree of ripening of some type of cheeses such as Italian and blue

cheeses (Martin Hernández, 1988). However, no fatty acid profile of kashkaval from Galichnik have been investigated so far. The purpose of this paper was to present the fatty acid profile of Galichki sheep kashkaval cheese from Bistra mountain and investigate its sensory characteristics.

Material and methods

Analyses for free fatty acids on 180th day of production of cheese were carried out in four itterations. FFA were detected by AOAC 996.07 method with GC 7890A with FID detector- Agilent. Nine months old kashkaval was used for the sensory analysis which was carried out by a panel of assessors and wider group of consumers. In the assessment, a scoring method was applied with a sum of 20 ponderable scores (Ritz et al., 1991; Mandic and Perl, 2006). In all samples, four characteristics (flavor, aroma, texture and additional flavor in the mouth and appearance when cut) were examined, with grades from 0 to 5, using the coefficient of significance. Regarding the amount of points scored, the category of quality where it belongs cheese was given. The table by category according to the number of ponderable points is given in Table 1.

Table 1. Clasification of kashkaval in quality category

Quality category	Ponderable scores
Excelent	17,6-20
Very good	15,2-17,5
Mediocre	13,2-15,1
Still acceptable	11,2-13,1
Not acceptable	<11,2

Results and discussion

Free Fatty Acid in kashkaval

Lipids in foods may undergo hydrolytic or oxidative degradation. Although some lipolysis occurs in most or all cheeses, it is most extensive in some hard Italian varieties and in blue cheese (Mc Sweeney, 2004). While short-chain fatty acids contribute directly to cheese flavor, free fatty acids (FFAs) also contribute indirectly to cheese flavor by acting as precursors for the production of volatile flavor compounds through a series of reactions known collectively as metabolism of fatty acids. Lipolysis in kashkaval cheese is not very intense. According Кожев (2006) kashkaval made from cow's milk has low fat hydrolysis, and thus not very intensive taste and aroma. More evident and intensive hydrolysis cheese is noticed in the kashkaval from sheep milk. The profile of free fatty acid of kashkaval is given in Table 2 and two representative chromatograms are presented in Figure 1. Based on our results on FFA shown in Table 2, we can conclude that the major acids present in the cheese are palmitic (C16:0), oleic (C18:1) and myristic acid (C14:0). Among them, palmitic acid was predominant, followed by oleic , myristic. This finding is in agreement with the results of Kindstedt et al.(2004) and Omar and El-Zayat (1986) on kashkaval cheese. The content of butiric acid (C4:0) corresponds to the results obtained by Gobbetti et al. (2002) in cheese Caciocavallo Pugliese. The results of our research are similar with the results of the research by Woo et al. (1984) on concentration of butiric acid (C4:0) in Parmesan and Provolone. A similar fatty acid profile was reported by Ergönül et al. (2011) on haloumi cheese. Dairy products have been identified as a good source of conugated lonoleic acid (CLA), consequently leading to greater research development in this area (Ha et.al, 1989, Chin et al., 1992). The authors found great variability in the concentration of CLA in dairy products and noted that ripening, heat treatment and protein contents were among the main factors affecting the concentration of this acid. When examining the different types of cheeses, the authors found that the highest concentration of conjugated linoleic acid is found in the blue cheese (7.96 mg/g), then in the Swiss cheese (5.45 mg/g) and edam cheese (5.38 mg/g). In our research, the conjugated linoleic acid ranged from 3.28 to 4.16 %.

Table 2. Free fatty acid profile of kashkaval (n=4), g·100g^{-1} of cheese

FFA g·100g^{-1}	X	FFA g·100g^{-1}	X
C4:0	2.09±1.98	C17:0	0.51±0.04
C6:0	/	C17:1	0.22±0.01
C8:0	0.83±0.18	C18:0	7.68±2.43
C10:0	6.46±0.60	C18:1 c	24.89±1.05
C11:0	/	C18:1 t	/
C12:0	5.20±1.28	C18:2 t	0.47±0.05
C13:0	/	C18:2 c	2.12±0.99
C14:0	11.01±0.69	C20:0	0.44±0.10
C14:1	0.26±0.10	C18:3 n-6	0.92±0.29
C15:0	1.35±0.13	CLA	4.13±0.74
C15:1	0.28	C18:3 n-3	0.85±0.22
C16:0	30.57±4.17	C21:0	1.66±0.08
C16:1	/	C20:4 n-6	0.38±0.01

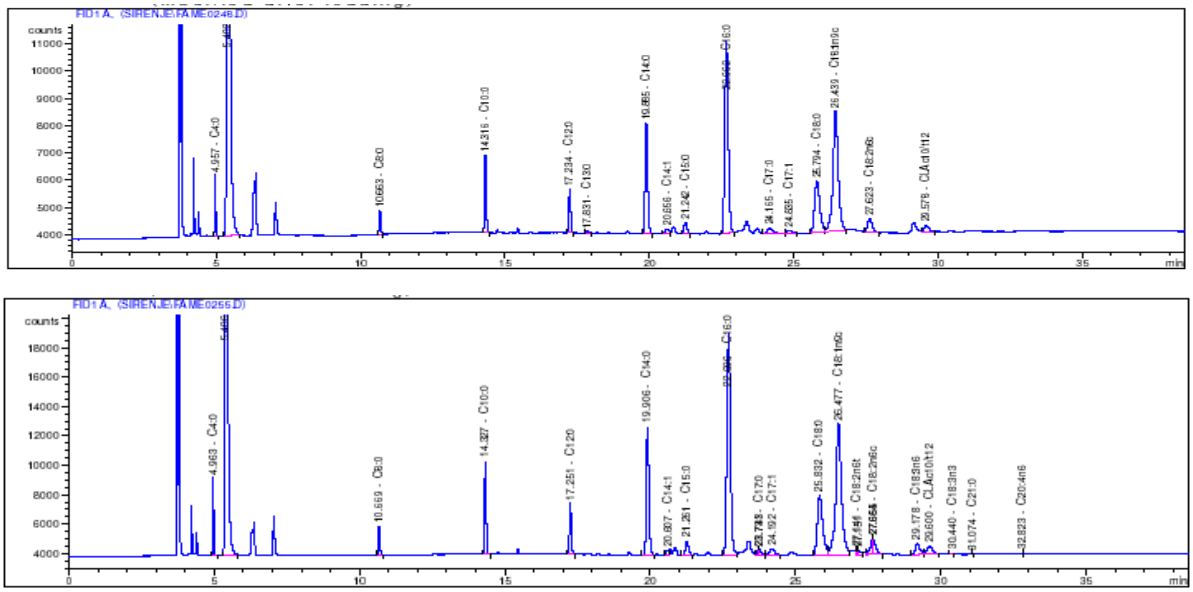

Figure 1. Representative chromatograms of the samples of cheese

Sensory properties

The assessors evaluated the taste as clearly expressed, characteristic for sheep kashkaval cheese and moderately salty, while the aroma was characterized as a pleasant, discreetly sourish, without external odors. These positive features of the sheep kashkaval are associated with its specific geographic area, considering that Bistra Mountain abounds with aromatic plants, whose alkaloids affect the sensory properties of milk, and hence the dairy products as well. Additional influence on the more intensive taste of this cheese has the very use of raw sheep milk as a raw material for the production of the traditional kashkaval. This is also confirmed by other authors (Mendia, 2000; Ballesteros, 2006) in the sensory evaluation of the sheep milk cheeses: Idiazabal and Manchego, who have shown that cheeses made from raw sheep milk receive higher scores than the ones made from pasteurized sheep milk. Namely, Ballesteros (2006) noted that higher scores are given to raw milk cheeses with regard to their intensity and duration of the aroma, the intensive aroma of the sheep milk and bitter taste. The authors associate the obtained higher sensory ratings with the presence of heterogeneous microflora, the complex enzyme system and the high concentration of nitrogen fractions in the cheeses made from raw milk.

Table 3. Results of the sensory properties of Galichki kashkaval (n=4)

Parameter	n	Score	□	SF	PMS	MNP
Flavour	1	4.16	4.05	1.50	6.071	7,5
	2	4.00				
	3	4.02				
	4	4.02				
Aroma	1	4.12	4.03	0.50	2.017	2,5
	2	3.67				
	3	4.36				
	4	3.99				
Texture and additional flavor in the mouth	1	4.27	4.04	1.00	4.044	5
	2	3.45				
	3	4.34				
	4	4.12				
Appearance when cut	1	4.31	4.50	1.00	4.499	5
	2	3.61				
	3	5.95				
	4	4.13				
Total:					16.631	20

n –itterations
SF – Significance factor
PMS - Ponderable mean scores
MNP – Maximum number of possible ponderable points

Thus, we come to the conclusion that the characteristic taste of the traditional sheep kashkaval results from many factors like the presence of the microflora in the raw milk, as well as from the proteolysis and lipolysis level and other factors, including the location itself and the sheep's nutrition and feeding. Generally, the texture of the kashkaval was rated as compact, homogeneous and its hardness characteristic for the product. During storage, formation of a mold was noted on the kashkaval wheel's surface. This phenomenon is frequent in the traditional kashkaval cheeses, primarily because of the manual formation of the wheels and removal of the ''navel'' where there is a possibility cracks to be formed in which the mold develops. In order to prevent further penetration of the mould inside the kashkaval cheese , the mould was regularly removed from the surface. After this, on the 100th day of the production, the kashkaval cheese wheels were protected by polymer emulsion, which, in the research period , such protection proved to be a good protective layer. Talevski (2013), in his research on cheese with different surface protection, concluded that the best sensory characteristics showed the kachkaval protected with polymer emulsion. The appearance when cut piece was evaluated as regular without unevenness, homogeneous and equal throughout the whole surface. This feature depends largely on the skills of the master who needs to quickly and successfully mold the cheese dough, appropriately remove the air and form regularly shaped wheels, to the contrary a horizontal layering will appear, which can often occur in traditional cheese. No such occurrence was noted in our cheese during ripening and storage. Based on the results of the sensory analysis we concluded that the Galichki kaskhaval cheese belongs to the category of very good quality cheese.

Conclusions

Each traditional cheese is a complex system, with defined flavors that represent the territory where it is produced. Galichki kashkaval from mountain Bistra is one of the famous traditional product in the country. The major acids present in the cheese are palmitic (C16:0), oleic (C18:1) and myristic

acid (C14:0). The concentration of conjugated linoleic acid (CLA) was 4.13±0.74%. Based on the results of the sensory analysis, Galichki kaskhaval cheese belongs to the category of very good quality cheese.

References

1. Ballesteros, C., Poveda, J.M., Gonzalez-Vinas, M.A., Cabezas, L. (2006). Microbiological, biochemical and sensory characteristics of artisanal and industrial Manchego cheeses Food Control 17, pp. 249–255
2. Bertozzi, L. and Panari, G. (1993). Cheeses with Appellation d'Origine Controlée (AOC). Factors that affect quality. International Dairy Journal 3, pp. 297–312.
3. Chin, S. F., Liu. J. Storkson M., Ha Y. L., Pariza M. W. (1992). Dietary sources of conjugated dienoic isomers of linoleic acid, a newly recognized class of anticarcinogens. J. Food Compo Anal. 5:185.
4. Fatma, A. M. H., Mona, A., Enab A. K. (2013). Flavour Compounds in Cheese (Review). Research on Precision Instrument and Machinery Vol. 2 Iss. 2.
5. Gobbetti, M., Morea, M., Baruzzi F., Corboc, A. M.R. Mataranteb T., Considined R. D. C., Guineee T.,Fox P.F. (2002). Microbiological, compositional, biochemical and textural characterisation of Caciocavallo Pugliese cheese during ripening International Dairy Journal 12, pp. 511–523.
6. Ha, Y. L., Grimm N.K., Pariza. M. W. (1989). Newly recognized anticarcinogenic fatty acids: identification and quantification in natural and processed cheeses. J. Agric. Food Chern. 37:75.
7. Kindstedt, P., Caric, M., Milanovic, S. (2004). Pasta-filata cheeses. In Cheese: Chemistry, Physics and Microbiology. Vol 2. Major Cheese Groups, 3rd edn. Fox, P.F., McSweeney, P.L.H., Cogan, T.M. and Guinee, T.P. pp. 251–277.
8. Licitra, G. (2010). Worldwide traditional cheeses: Banned for business? Dairy Sci. Technol. 90, pp. 357–374.
9. Кожев, А. (2006). Кашкавал Парени сирена, ИК Енъовче, София.
10. Mandić, M. L., Perl, A. (2006). Osnove senzorske procjene hrane. Prehrambeno - tehnološki fakultet. Osijek.
11. Martin Hernández, M.C., Alonso L., Juárez M., Fontecha J. (1988). Gas chromatographic method for determining free fatty acids in cheese Chromatographia February, Volume 25, Issue 2, pp. 87-90.
12. Mc Sweeney, P.L.H. (2004). Biochemistry of cheese ripening, International Journal of Dairy Technology, 57 (2-3), pp. 127-144.
13. Mendia, C., Ibanez, F. C., Torre, P., Barcina, Y. (2000). Influence of the season on proteolysis and sensory characteristics of Idiazabal cheese. Journal of Dairy Science, 83, 1899–1904.
14. Niketić, M., Tomović G., Melovski Lj., Stevanović V., Matevski V. (2014). New species for the vascular flora of Republic of Macedonia and their distribution in the Balkan Peninsula. Botanica Serbica, 38 (1): 57-67.
15. Omar, M.M., E1-Zaya, A.I. (1986). Ripening changes in Kashkaval cheese made from Cow's milk Food Chemistry No 22, pp. 83-94.
16. Ritz, M., Vojnović, V., Vahčić, N. (1991). Sistem bodovanja u senzorskoj procjeni kvalitete sira Mljekarstvo 41 (5), pp. 127-135.
17. Santa, D. and Srbinovska, S. (2014). Traditional production and main characteristics of Galichki kashkaval. Mljekarstvo. 64: 119-126.
18. Талевски, Г. (2013). Промени на квалитет на кашкавалот со употреба на различни заштитни средства на неговата површина. Докторска дисертација.