

Free Fatty Acid Composition of Akçakatik Cheese, A Traditional Turkish Dairy Product

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Akçakatik cheese is one of the most popular varieties of cheese manufactured in some provinces in the Mediterranean of Turkey. In this study, fatty acid composition of Akçakatik cheese was analyzed by gas chromatography. The characteristics of the chromatographic profiles were studied by principal components and linear discriminant analyses were performed. The mean values for chemical properties of Akçakatik cheese were pH 5.121 ± 0.140 ; titratable acidity 0.866 ± 0.302 %; TS 73.960 ± 7.736 %; fat content 25.522 ± 5.456 %; salt content 0.409 ± 0.084 %. The saturated fatty acid, total unsaturated fatty acid, monounsaturated fatty acid, polyunsaturated fatty acid of samples were found as 61.87 ± 4.067 , 33.246 ± 2.919 , 30.728 ± 2.648 and 2.519 ± 0.516 %, respectively. Palmitic acid levels were found to be the highest of the saturated fatty acid in all samples. Oleic acid content in all cheeses was also considerable higher than those of other unsaturated fatty acids.

Key Words: Akçakatik cheese, Physico-chemical properties, Free fatty acid, Gas chromatography.

INTRODUCTION

Akçakatik is a semi-hard cheese that resembled to labne with producing method and but it is produced locally from torba or süzme yoghurt (concentrated yoghurt) added clove, salt and black cumin (*Syzygium aromaticum*). Then, this mixture is dried and pressed into the goat or cow's stomach. It undergoes a ripening period of 20-30 days. Akçakatik cheese represents a type of cheese that owes its character primarily to a strong acidity. A number of volatile compounds contribute to the aroma, which will vary according to the kind of milk, clove and black cumin.

The quality of cheese is determined by its flavour, rheological properties and visual appearance. The relative importance of each of these three quality attributes varies with the cheese variety and they are interrelated, at least to some extent. The fat fraction of cheese has a major effect on cheese texture and is important for the perception and development of cheese flavour. Poor development of flavour and texture in low-fat cheese is a direct (fatty acids) or indirect source of flavour com-

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pounds in cheese, fat serves as a solvent for sapid compounds produced from other constituents. The fat in cheese can undergo degradation *via* lipolysis, contribute directly to cheese flavour. However, extensive lipolysis is considered undesirable in most cheese varieties¹. Free fatty acids (FFA) are known to play an important role in flavours of many varieties of ripened cheese. Two major sources are generally considered for free fatty acids in ripened cheese. These are (i) the direct breakdown products of milk fat by lipolysis and (ii) the end products of carbohydrate and protein metabolism by bacteria. The breakdown of milk fat is carried out by esterase and lipases, which are either endogenous to the milk or of microbial origin (psychotropic and lactic bacteria)². The breakdown of milk fat probably occurs in all cheeses but the rate and extent of hydrolysis varies considerably between cheeses varieties³. Few references are available on free fatty acid profile of traditional cheese⁴⁻⁹.

The objective of this study was to investigate some physicochemical properties and the free fatty acid profile of Akçakatik cheese produced in the Mediterranean of Turkey.

EXPERIMENTAL

Traditionally produced Akçakatik cheese was used for the research. Akçakatik cheeses (15 samples) obtained from different markets and regional bazaars in Burdur.

Physico-chemical analyses: The pH was measured with a HANNA pH meter (HANNA Instruments, Italy) and acidity was determined by titration with N/10 in the presence of phenolphthalein. The acidity was expressed as per cent lactic acid. Percentage of NaCl was determined using the method of James¹⁰, moisture and total solid contents were determined by heating at 105 °C to a constant weight. NaCl content was expressed as salt concentration. Fat content was analyzed according to the Gerber procedure¹¹.

Analysis of free fatty acids: Free fatty acid composition was determined using a modified fatty acid methyl ester method as described by Marquard¹². The oil was extracted from 10 g sample by homogenization with hexane. The reaction mixture was prepared from 500 mL of total Na-methoxide (0.5 g), isooctane (20 mL) and methanol (80 mL) added to the oil (50 µL). After the sample was kept for 12 h, isooctane (500 µL) added to it. The methyl esters of the fatty acids were analyzed in a Hewlett-Packard 6890 series gas chromatograph (Perkin-Elmer Auto System XL, USA) equipped with a flame ionizing detector (FID), a fused silica capillary column (Cp SIL 88 (100 m × 0.25 mm i.d.); film thickness 0.2 µm). It was operated under the following conditions: oven temperature program, 60 °C for 4 min raised to 175 °C at a rate of 13 °C/min and then kept at 175 °C for 27 min; after reaching to 215 °C for 5 min raised to 240 °C at a rate of 4 °C/min and then held at 240 °C for 15 min injector and detector temperatures, were 240 and 240 °C; respectively, carrier gas, helium at flow rate of 15 cm/s; split ratio, 1/10 mL/min. The contents of palmitic (C16:0), stearic (C18:0), oleic (C18:1), linoleic (C18:2) and linolenic (C18:3) acids were determined by computing integrator.

RESULTS AND DISCUSSION

The mean values of Akçakatik cheeses for pH, titratable acidity, total solid, fat in total solid, salt content and salt content in total solid are presented in Table-1. While pH and titratable acidity as lactic acid of samples are 5.121 ± 0.140 and 0.866 ± 0.302 %, total solid and fat content are 73.960 ± 7.736 % and 25.522 ± 5.456 %, respectively. Additionally, salt content of Akçakatik cheese samples were found as 0.409 ± 0.084 %.

TABLE-1
PHYSICO-CHEMICAL PROPERTIES OF AKÇAKATIK CHEESES

	Mean \pm SD	Minimum	Maximum
pH	5.121 ± 0.140	4.920	5.470
Titration acidity (L.A. %)	0.866 ± 0.302	0.446	1.505
Total Solid (TS) (%)	73.960 ± 7.736	63.265	86.195
Fat (%)	25.522 ± 5.456	19.167	36.000
Fat/TS (%)	34.876 ± 8.465	24.363	54.821
Salt (NaCl) (%)	0.409 ± 0.084	0.289	0.526
NaCl/TS (%)	0.563 ± 0.144	0.343	0.757

SD = Standard deviation.

The compositional and processing parameters of Akçakatik cheese have been studied scarce in experimental level by now. According to another research on Akçakatik cheese by Kirdar¹³, while titratable acidity (0.9-2.16 %) and salt content (5.38-9.12 %) are higher than present findings the total solid is lower. Also, the results of fat content (10.3-30.2 %) are in agreement with present results.

Ruminant milk fats contain a wide range of fatty acids and 437 distinct acids have been identified in bovine milk fats¹⁴. This situation is reflected in the dairy products like White, Tulum and Kasar cheese⁷. Free fatty acids are released upon lipolysis and contribute directly to cheese flavour, especially short- and intermediate-chain free fatty acids¹⁵. Palmitic acid is one of the major saturated fatty acids. It raises serum cholesterol level while stearic acid does not¹⁶.

According to present results Akçakatik cheese had some fatty acids in high level as palmitic (C16) (30.831 ± 2.977), stearic (C18) (15.413 ± 2.576) and oleic (C18:1 *cis*) (26.747 ± 2.964) acids, while lauric (C12) (1.703 ± 0.507), capric (C10) (1.412 ± 0.723), caproic (C6) (1.198 ± 0.348), palmitoleic (C16:1) (1.615 ± 0.359), linoleic (C18:2) (2.215 ± 0.520), myristic (C14) (8.672 ± 1.472) and elaidic (C18:1 *trans*) (1.911 ± 0.586) were persecutor fatty acids. Additionally undecanoic (C11:1 *cis*) (0.167 ± 0.072), caprylic (C8) (0.627 ± 0.186), heptadecanoic (C17:1 *cis*) (0.289 ± 0.122) and linolenic (C18:3) (0.303 ± 0.060) acids were in low levels (Table-2). Among the fatty acids classes, the saturated fatty acids were predominating, followed by *cis*-monounsaturated fatty acids and polyunsaturated fatty acids. Present samples have also considerably less *trans*-fatty acids in total fatty acids.

TABLE-2
FREE FATTY ACID COMPOSITION (C₄ TO C₁₈) OF AKÇAKATIK CHEESE

Free fatty acids	Cheese samples																	Mean ± SD
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A15		
SFA	61.28	52.27	59.07	56.45	64.99	60.33	61.39	64.93	63.62	60.91	59.04	66.36	64.71	66.77	65.86	61.870 ± 4.067		
C ₄₀	2.39	1.57	0.99	1.62	1.59	1.64	1.97	1.44	1.80	1.21	1.88	1.88	1.80	1.82	1.64	1.683 ± 0.327		
C ₆₀	1.94	0.94	0.55	1.46	1.03	0.97	0.96	0.99	1.18	1.79	1.16	1.16	1.13	1.33	1.38	1.198 ± 0.348		
C ₈₀	0.92	0.50	0.29	0.74	0.53	0.53	0.48	0.48	0.65	0.46	0.68	0.65	0.69	0.83	0.97	0.627 ± 0.186		
C ₁₀₀	1.69	1.11	0.75	0.42	1.10	1.16	1.03	1.03	1.41	0.98	1.41	1.60	1.50	2.87	3.12	1.412 ± 0.723		
C ₁₂₀	1.77	1.58	1.15	1.56	1.51	1.58	1.48	1.40	1.76	1.09	1.63	1.61	1.72	2.73	2.97	1.703 ± 0.507		
C ₁₄₀	7.75	8.23	6.90	7.20	8.28	8.53	7.99	9.56	9.03	8.02	7.82	7.92	9.12	11.63	12.10	8.672 ± 1.472		
C ₁₆₀	27.24	28.33	28.62	26.49	35.11	28.75	28.03	35.11	32.40	29.36	29.96	33.66	32.70	34.53	32.17	30.831 ± 2.977		
C ₁₇₀	0.48	0.57	0.51	0.57	0.56	0.54	0.61	0.73	0.81	0.70	0.50	0.87	0.82	0.69	0.96	0.661 ± 0.150		
C ₁₈₀	17.1	14.44	19.31	16.39	15.28	16.63	18.84	14.19	14.58	17.3	14.00	17.01	15.23	10.34	10.55	15.413 ± 2.576		
TUFA	34.69	36.54	37.63	37.07	30.30	33.99	33.94	29.26	33.52	34.45	34.42	31.29	33.53	30.54	27.52	33.246 ± 2.919		
MUFA	31.73	34.02	34.06	34.39	28.05	32.08	30.92	27.61	31.06	32.19	31.74	28.63	31.18	27.52	25.74	30.728 ± 2.648		
C _{11:1}	0.17	0.14	0.10	0.16	0.12	0.14	0.12	0.12	0.17	0.12	0.13	0.17	0.17	0.35	0.32	0.167 ± 0.072		
C _{16:1}	1.14	1.76	1.26	1.31	1.50	1.42	1.44	1.79	2.09	1.57	0.98	1.85	2.11	2.02	1.98	1.615 ± 0.359		
C _{17:1}	0.11	0.16	0.17	0.36	0.20	0.15	0.23	0.33	0.40	0.30	0.25	0.38	0.41	0.33	0.55	0.289 ± 0.122		
C _{18:1 trans}	2.01	1.48	1.16	2.11	1.00	2.33	2.73	2.21	1.79	2.49	1.68	2.98	1.92	1.65	1.12	1.911 ± 0.586		
C _{18:1 cis}	28.3	30.48	31.37	30.45	25.23	28.04	26.40	23.16	26.61	27.71	28.70	23.25	26.57	23.17	21.77	26.747 ± 2.964		
PUFA	2.96	2.52	3.57	2.68	2.25	1.91	3.03	1.65	2.46	2.26	2.68	2.66	2.35	3.02	1.78	2.519 ± 0.516		
C _{18:2}	2.76	2.29	3.22	2.42	1.84	1.65	2.73	1.35	2.08	2.01	2.43	2.31	2.03	2.67	1.44	2.215 ± 0.520		
C _{18:3}	0.20	0.23	0.35	0.26	0.41	0.26	0.30	0.30	0.38	0.25	0.25	0.35	0.32	0.35	0.34	0.303 ± 0.060		

SFA = Saturated fatty acids; TUFA = Total unsaturated fatty acids.

MUFA = Monounsaturated fatty acids, PUFA = Polyunsaturated fatty acids.

Concentrations of short chain fatty acids such as butyric, caproic and capric acids in cheese are different depending on the cultures used. It is known that linear free fatty acid containing four or more carbon atoms are generally produced by lipolysis of milk fat, whereas acetic acid derives from different processes, including the oxidation of lactose by lactic acid bacteria and the catabolism of alanine and serine by lactic acid bacteria¹⁷. Among thermophilic lactic acid bacteria, *S. salivarius* subsp. *thermophilus* exhibits *in vitro* noticeable intracellular lipolytic activity, whereas *Lactobacilli* have a weak lipolytic activity¹⁸. Higher amounts of butyric, caproic and caprylic acid in cheese seem to contribute to the development of piquant taste⁵. Butyric, caproic and caprylic acid contents of present cheese samples ranged from 0.99 to 2.39 %, 0.55 to 1.94 % and 0.29 to 0.97 %, respectively. Oleic acid contents of Akçakatik samples were found between 21.77 and 31.37 %. Oleic acid content (5.93-29.38 %) in all Turkish hard and soft cheese types was considerable higher than that of other *cis*-monounsaturated fatty acids⁷.

The saturated fatty acid content of Akçakatik cheese were found between 52.27-66.77 % while total unsaturated fatty acid and monounsaturated fatty acid were ranged 27.52-37.63 and 25.74-34.39 %, respectively. However, polyunsaturated fatty acid content of samples varied between 1.65-3.57 %. These values were lower than the other traditional cheese, which is called as Tulum cheese, produced in Turkey^{7,19}. The differences of amounts of these fatty acids in cheeses are possible due to the numbers of bacterial species. Traditionally, discussion of lipolysis in cheese is based upon actual measured concentrations of free fatty acids. Akçakatik cheese are manufactured using pasteurized milk, the selection of the starter culture is one of the most important steps in the manufacture of high quality. Because, for manufacturing Akçakatik cheese, the first step is to produce the strained yogurt. Blends of *Streptococcus salivarius* subsp. *thermophilus* and *Lactobacillus delbrueckii* ssp. *bulgaricus* employed to fermented milk and different concentrating techniques contribute to different behaviour of these organisms in Akçakatik cheese¹³.

Conclusion

The composition and individual amounts of free fatty acids are important for the flavour of different types of cheese as precursors for other compounds such as methyl ketones, lactones, alkanes and esters. In this study, the fatty acid profiles of Akçakatik cheese were presented and sorted out. The fatty acid profile showed that palmitic acid was predominant, whereas oleic acid was the major monounsaturated fatty acid.

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