

SHORT COMMUNICATION

Characteristic properties of Muhlama

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The composition of muhlama, which consists of corn flour, butter, water, salt and either string, go-lot or minced curd cheese, was examined to determine its essential characteristics. Muhlama samples were collected from prominent Black Sea restaurants in Istanbul for sensory analysis and an evaluation of physicochemical properties. Sensory analysis was conducted on properties including appearance, texture, odour, flavour and aroma. Physicochemical properties such as pH, moisture, fat, fatty acid composition (saturated and unsaturated), protein, ash and energy were measured. The results of the physicochemical properties revealed pH (5.65), moisture (55.85 g/100 g), fat (13.6 g/100 g), fatty acid composition (saturated fatty acid: 1013.34 mg/kg, and unsaturated fatty acid: 286.14 mg/kg), protein (19.4 g/100 g), ash (1.34 g/100 g) and energy (239.18 kcal/100 g). The sensory analysis showed samples of light yellow colour, uniform and shiny in appearance, and a consistency in soft and smooth structure. The product had a unique flavour and aroma with the chemical structure of high energy value of the nutrient elements.

Keywords Dairy, Muhlama, Fatty acid, Sensory.

INTRODUCTION

Muhlama or kuymak is a culinary product indigenous to the culture of the Eastern Black Sea region. It is considered a traditional and regional dish served at each meal, including breakfast, and is widely consumed for its unique flavour on a daily basis by the people of this region. It has become increasingly popular in Istanbul. The population of Istanbul is 14.5 million people in 2014 (Turkish Statistical Institute), and many people of the Black Sea region live in this city. According to the Ministry of Culture and Tourism/Istanbul Provincial Directorate of Culture and Tourism official statistical data, 11,842,983 tourists came to Istanbul in 2014 and many will try the different cuisines. Muhlama is one of them.

Muhlama is prepared as follows: butter is melted in a copper pan and corn flour added and the ingredients lightly roasted. Water is added until a homogeneous mixture is achieved. This is followed by adding cheese as a final stage of preparation. In some regions, wheat flour is used instead of corn flour. It is typically served warm.

There are no reports in the literature regarding the physicochemical properties, sensory studies and/or quality characteristics of muhlama. The purpose of this study was to investigate the characteristics of muhlama using sensory analysis including sensory properties of appearance, texture, odour, flavour and aroma. The evaluation of physicochemical properties included measurements of pH, moisture, fat, fatty acid composition (saturated and unsaturated), protein, ash and energy. The results of the study can be utilised for the standardisation of muhlama production.

MATERIALS AND METHODS

A total of 24 units of muhlama were collected as materials for laboratory analysis. Muhlama samples were collected from three prominent Black Sea restaurants in Istanbul. These restaurants were selling about 200 servings a day. Each restaurant had its own standard method of production, made by chefs were from the Black Sea region. Muhlama ingredients, also from Black Sea region, included corn flour, butter, cheese and salt and were cooked in a copper pot. In this

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study, 250 g of one serving of muhlama (finishing product) included 80–100 g butter, 50–60 g corn flour, 70–80 g string cheese and 200 mL water.

The finished product is shown in Figure 1.

Experimental analysis

Physicochemical analysis

Physicochemical properties evaluated included pH, moisture, fat, fatty acid composition, total nitrogen (Kjeldahl method), salt and ash determined by reference methods. Measurements were made as follows: pH was measured by a combined electrode pH meter (AOAC 981.12, 2000); moisture content (Anonymous 2006); fat content (Anonymous 1998); fatty acid composition – Agilent FAME Method (AOAC 963.22, 2000); protein content reference methods outlined by Salo-Vaananen and Koivistoinen 1996; salt content (Anonymous 2010); ash content (AOAC 920.108, 2000); and energy and nutrients (FAO 2002).

Sensory analysis

A hedonic scale test was used for evaluation of the sensory parameters (appearance, odour, flavour, aroma, texture). The sensory test panel included 5 panellists who were trained academic staff. Each parameter was graded with points ranging from 1 to 9 (1 reflected a very low and 9 a very high score).

Statistical analysis

Data from the trials were statistically analysed using the analysis of variance SPSS (version 20.0, Armonk, NY, USA). Differences among the averages were compared using a least significant difference (LSD) test.

RESULTS AND DISCUSSION

Physicochemical analysis

Physicochemical analysis results are shown in Table 1, and fatty acids are shown in Table 2.

Physicochemical analysis was conducted after muhlama samples were subjected to sensory evaluation.

The moisture of samples varied between 45.89 and 66.65 g/100 g, fat between 8.58 and 16.96 g/100 g, protein between 16.86 and 21.26 g/100 g, salt between 0.31 and 0.39 g/100 g, ash between 1.19 and 1.62 g/100 g, pH between 5.41 and 5.79 and energy between 171.26 and 286.41 kcal/100 g.

Samples from Restaurant 1 had the highest values for protein, ash and energy, and the lowest percentage of moisture, pH and salt as shown in Table 1. Although muhlama is an original material with ingredients of butter, corn flour and cheese, samples from different restaurants revealed each chef's unique recipe and formulation of these ingredients. Therefore, the lack of standardisation in formulation resulted in varied physiochemical properties.

Muhlama samples contained from 614.16 to 1420.40 mg/kg total saturated fatty acids and from 177.85 to 437.89 mg/kg unsaturated fatty acids (Table 2). The amounts of saturated and unsaturated fatty acids found in muhlama showed quantities similar to those made for cheese samples in the literature (Akalin and Gonc 1998).

Results of the study revealed that muhlama samples had a butyric acid content between 12.85 and 60.89 mg/kg and the total trans-fatty acid content between 0 and 355.57 mg/kg.

Butyric acid amounts of 12.85 mg/kg were found in the muhlama from Restaurant 1. As butyric fatty acid (C4) was <2 mg/100 g in the fatty acid analysis of the milk product, it was suggested that 99.9 g/100 g butter-flavoured fatty acid type of kitchen hydrogenated margarine may have been used in Restaurant 1 (Demirci 2012). In addition, the content of total trans-fatty acid (C18: 1 t) from Restaurant 1 was 355.57 mg/kg also indicated that hydrogenated margarine may have been used as an ingredient. Butyric acid percentages obtained from Restaurant 1 showed low levels, possibly due to the cheese used in the preparation. As trans- and total saturated fatty acids did not meet dairy product standards, it was concluded that butter-flavoured kitchen



Figure 1 Muhlama.

Table 1 Physicochemical analysis

Restaurant	Moisture ^a (g/100 g)	Fat ^a (g/100 g)	Protein ^b (g/100 g)	Salt ^a (g/100 g)	Ash ^a (g/100 g)	pH ^a	Energy value ^a (kcal/100 g)
R1	45.89 ± 6.20	15.30 ± 2.28	21.26 ± 1.93	0.31 ± 0.03	1.62 ± 0.26	5.41 ± 0.30	286.41
R2	66.65 ± 9.78	8.53 ± 0.99	16.86 ± 7.18	0.38 ± 0.05	1.19 ± 0.04	5.79 ± 0.04	171.26
R3	55.01 ± 8.87	16.96 ± 3.00	20.09 ± 3.15	0.39 ± 0.04	1.22 ± 0.03	5.74 ± 0.04	259.86

^aThe mean difference is significant at the 0.01 level.

^bThe mean difference is significant at the 0.05 level.

Table 2 The amount of fatty acids in muhlama samples (mg/kg)

Fatty acids		Restaurant 1	Restaurant 2	Restaurant 3
Saturated fatty acids	C4:0	12.85 ± 7.96	26.36 ± 6.91	60.89 ± 10.68
	C6:0	21.11 ± 6.27	16.29 ± 4.86	44.77 ± 7.63
	C8:0	16.52 ± 4.28	9.89 ± 2.64	30.02 ± 5.77
	C10:0 ^a	39.02 ± 6.27	19.79 ± 2.39	58.34 ± 7.12
	C12:0	48.04 ± 6.12	22.86 ± 2.39	66.14 ± 6.28
	C14:0 ^a	175.80 ± 20.04	165.24 ± 8.87	232.52 ± 18.32
	C15:0	nd	14.59 ± 4.18	24.93 ± 1.70
	C16:0 ^a	510.71 ± 51.56	277.99 ± 18.42	647.02 ± 44.77
	C18:0 ^a	212.98 ± 23.72	134.26 ± 9.55	255.76 ± 16.79
Total		1037.03	614.16	1420.40
Unsaturated fatty acids	C14:1	19.28 ± 2.30	11.26 ± 3.24	17.30 ± 3.56
	C16:1	20.66 ± 6.12	7.59 ± 2.81	nd
	C18:1 t	355.57 ± 106.49	16.89 ± 8.87	nd
	C18:1 (cis-9)	nd	142.11 ± 9.30	214.20 ± 8.48
	C18:2 c	42.38 ± 16.83	nd	nd
Total		437.89	177.85	231.50

nd, not detected.

^aThe mean difference is significant at the 0.05 level $P < 0.05$.

type margarine was used in Restaurant 1. The contents of butyric acid and the total trans-fatty acid from restaurants 2 and 3 are in agreement with the findings of Zock and Katan (1997), and Semma (2002) when these values are taken as a percentage. The amounts of trans-fatty acid in butter and cheese was 3.8% and 4.8%, respectively, in their papers. The amounts of C4, C10, C14, C16 and C18 were found to match the fatty acid components consistent with the literature for restaurants 2 and 3 (Zlatanov *et al.* 2002) (Durmaz *et al.* 2008) (Çakmakçı and Kahyaoglu 2012) (Prandini *et al.* 2011). As muhlama is a traditional food in the Black Sea region it will reflect milk product characteristics such as the amount of butyric acid from 26.36 to 60.89 mg/kg, trans-fatty acids between undetected and 16.89 mg/kg, and saturated fatty acids 614.16 and 1420.40 mg/kg as in restaurants 2 and 3.

Sensory analysis

The sensory analyses of the samples were performed by evaluating appearance, odour, flavour, aroma and texture of muhlama samples collected from the restaurants.

The results are shown in Table 3. Scores for overall appearance of samples varied between 6.52 and 7.36; surface shine between 6.92 and 7.41; overall colour between 4.30 and 5.28; particle density between 4.28 and 5.87; shape between 6.12 and 6.68; and fat evenness between 3.73 and 4.33.

Sensory analysis scores for odour of samples varied between 6.64 and 6.78; of the cheese used between 4.74 and 6.20; of the corn flour between 3.46 and 4.68; off-odours between 3.87 and 4.70; and 'burn' between 3.69 and 4.71.

Scores for flavour of samples varied between 6.38 and 7.86; starch lay between 4.10 and 6.68; 'cheesy' between 5.90 and 7.56; butter between 6.78 and 6.96; and 'throat' between 2.45 and 3.73, while for aroma, scores varied between 6.68 and 7.04; 'cheesy' between 6.50 and 7.34; and butter between 6.38 and 6.52. Lastly, scores for the texture of samples varied between 6.05 and 6.80; for cut-ability between 5.13 and 6.23; chewiness between 5.90 and 6.60; firmness between 4.00 and 5.24; elasticity between 3.84 and 5.58; and denseness between 4.67 and 6.54 (Table 3).

Table 3 Sensory analysis of muhlama

<i>Appearance</i>	<i>Overall appearance^a</i>	<i>Surface shine</i>	<i>Overall colour^a</i>	<i>Particle density^a</i>	<i>Shape</i>	<i>Fat evenness</i>
Restaurant 1	6.52 ± 0.81	6.92 ± 0.96	4.80 ± 0.67	4.28 ± 0.70	6.12 ± 0.62	3.73 ± 1.17
Restaurant 2	7.36 ± 1.27	6.98 ± 1.27	4.30 ± 0.63	4.39 ± 1.33	6.68 ± 2.10	4.23 ± 1.90
Restaurant 3	6.62 ± 1.06	7.41 ± 0.56	5.28 ± 0.50	5.87 ± 1.62	6.22 ± 1.18	4.33 ± 1.92
<i>Odour</i>	<i>Butter</i>	<i>Cheese^a</i>	<i>Corn flour</i>	<i>Off-odour</i>	<i>Burnt</i>	
Restaurant 1	6.78 ± 0.77	5.40 ± 0.57	4.68 ± 0.63	3.87 ± 1.69	3.69 ± 1.36	
Restaurant 2	6.74 ± 1.18	4.74 ± 0.61	3.46 ± 0.79	4.43 ± 0.78	3.84 ± 1.46	
Restaurant 3	6.64 ± 0.91	6.20 ± 0.42	4.26 ± 0.52	4.70 ± 0.53	4.71 ± 0.53	
<i>Flavour</i>	<i>Intensity</i>	<i>Starch^a</i>	<i>Cheesy^a</i>	<i>Butter</i>	<i>Throat burn</i>	
Restaurant 1	7.86 ± 1.03	6.68 ± 0.92	7.46 ± 0.54	6.96 ± 0.76	2.45 ± 0.67	
Restaurant 2	6.38 ± 0.85	5.94 ± 1.57	5.90 ± 0.82	6.78 ± 1.21	3.73 ± 0.29	
Restaurant 3	7.60 ± 0.71	4.10 ± 0.89	7.56 ± 0.69	6.90 ± 1.10	2.58 ± 0.58	
<i>Aroma</i>	<i>Overall intensity</i>		<i>Cheesy</i>	<i>Butter</i>		
Restaurant 1	7.04 ± 0.99		7.34 ± 0.75	6.48 ± 0.71		
Restaurant 2	7.04 ± 1.17		6.50 ± 1.40	6.52 ± 1.28		
Restaurant 3	6.68 ± 0.50		7.14 ± 0.84	6.38 ± 1.10		
<i>Texture</i>	<i>Spreadable^a</i>	<i>Cuttability</i>	<i>Chewiness</i>	<i>Firmness</i>	<i>Elasticity^a</i>	<i>Denseness</i>
Restaurant 1	6.80 ± 0.49	6.23 ± 0.45	6.48 ± 0.50	4.00 ± 0.45	5.58 ± 0.39	4.67 ± 1.11
Restaurant 2	6.09 ± 0.75	5.13 ± 1.42	5.90 ± 1.86	5.14 ± 0.91	4.90 ± 0.88	5.19 ± 2.34
Restaurant 3	6.05 ± 0.28	6.15 ± 0.52	6.60 ± 0.59	5.24 ± 0.38	3.84 ± 0.65	6.54 ± 0.97

^aThe mean difference is significant at the 0.05 level $P < 0.05$.

It was concluded that products could vary, in terms of colour, from pale yellow to dark yellow; in texture from spreadable to quite dense while the flavour, odour and aroma could vary from buttery to 'cheesy'. From these results, it is shown that the muhlama samples collected from prominent restaurants in Istanbul had the desired sensory properties for consumers (Table 3).

It was reported by restaurant chefs that the specific sensory quality attributes of muhlama are dependent on the quality of the cheese, butter, corn flour and the ratio of ingredients.

Muhlama quality, produced in Istanbul Black Sea restaurants, varies from chef to chef. Future research is needed to determine and improve the quality and production standards.

It is recommended that specific standard products should be used in the preparation of muhlama. The standards of cheese products may be considered for re-evaluation when using high-quality butter and cheese with the final product served at a warm temperature. In addition, the application of appropriate hygiene requirements at all stages from production to consumption should be maintained. Recommendations are indicated to enhance the production of muhlama and to achieve a healthy and high-quality product.

CONCLUSION

There are a total of 20 Black Sea region traditional restaurants in Istanbul. These restaurants have been investigated for the quality of their muhlama and the top three with the best taste and highest volume usage chosen for this research, and the characteristics of the samples investigated. Properties most desired were for a moderately humid fatty and nutritious product in terms of protein and elasticity and rich in saturated and unsaturated fatty acids. One serving of 250 gms muhlama had approximately 500–700 kcal which meets the minimum one-fifth of a person's daily calorie needs. Muhlama is enjoyed especially in the Black Sea area where people have an intensely physical lifestyle throughout the day. As this foodstuff provides about 1/5 of daily energy needs and is rich in protein and fat, it gives a feeling of satiation throughout the day. The person who eats muhlama at breakfast is able to keep working all day and does not need to have any food until dinner. Therefore, the importance of the nutritional value and desirable taste of muhlama in the society can be understood.

The three restaurants selected for this study were selling about 200 servings a day. For every 200 servings, about 7 tons of butter and 5.8 tons of cheese are consumed for 250

g servings of finished product per year. Production of muhlama in the other 17 restaurants will increase the amount of consumption of butter and cheese.

The uniqueness of muhlama is dependent on its ingredients and characteristics of the butter, cheese and corn flour, and taste, odour, flavour and aroma, respectively, that make it a traditional cultural cuisine in the Eastern Black Sea region and Istanbul. These characteristics should be considered for the standardisation of the muhlama production that would result in a healthy and high-quality product.

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