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Cholesterol Levels and Some Nutritional Parameters of Traditional Cheeses in Turkey

Türkiye'deki Geleneksel Peynirlerin Kolesterol Düzeyleri ve Bazı Beslenme Parametreleri

Alınış (Received):13.01.2016 Kabul tarihi (Accepted): 07.03.2016

Key Words:

Cholesterol, nutritional parameters, traditional cheese, Turkey

Anahtar Sözcükler:

Kolesterol, beslenme parametreleri, geleneksel peynir, Türkiye

ABSTRACT

Cheese has an important place in terms of nutrition habits in our country. In Turkey, about 200 types of local cheeses are manufactured and some of them are sold widespread especially in supermarkets and big cities. In our study, some chemical properties of 29 types of totally 50 cheeses were determined which were collected from 24 different regions. In this respect; pH, total acidity, dry matter, fat, fat in dry matter, salt, salt in dry matter, free fatty acids, total protein, water soluble nitrogen, ripening index, cholesterol and energy values of cheese samples were evaluated. The highest fat content was found in Gravyer cheese (380g/kg). Relative to the mean cholesterol values, the highest cholesterol concentration (163.46 mg/100g) was found in Dil cheese whereas Göçmen cheese had the lowest (18.95 mg/100g) cholesterol content.

ÖZET

Ülkemizde beslenme alışkanlıkları dikkate alındığında peynir önemli bir yer tutmaktadır. Türkiye'de 200'e yakın yöresel peynirler üretilmekte olup bazıları özellikle market ve büyük şehirlerde yaygın olarak satılmaktadır. Araştırmamızda 24 farklı bölgeden, 29 çeşit toplam 50 adet peynir örneğinde pH, laktik asit, kurumadde, yağ, kurumaddede yağ, tuz, kurumaddede tuz, serbest yağ asitleri, toplam protein, suda çözünen azot, olgunlaşma indeksi, kolesterol ve enerji değerleri belirlenip değerlendirilmiştir. En yüksek yağ oranı Gravyer peynirinde (380 g/kg) belirlenirken, en yüksek kolesterol miktarı Dil peynirinde (163.46 mg/ 100g), en düşük kolesterol miktarı ise Göçmen (18.95 mg/100g) peynirinde belirlenmiştir.

INTRODUCTION

Cheese is one of the widely consumed dairy products and also known as one of the main sources of animal fat, protein and cholesterol. There are over than 190 different cheese types produced and consumed in Turkey today and most of them are traditional cheese belonging to a specific geographical province. Cholesterol which is known as an essential compound for membrane structure,

hormone and steroid biosynthesis (Mahann and Escott-Stump 1996), is almost found in meat and dairy products. Cholesterol content of some traditional cheese varieties that belong to different countries had been determined by some researchers. Cholesterol content, mg/100g cheese in fresh weight (f.w.) basis, of 15 cheese varieties produced in the USA from goat milk ranged from 80.9 to 124.8, while an imported variety contained 146.8 (Park, 1999). Similar values have been

reported for several European cheese varieties, e.g., 89 mg/100g for Emmental (Ulberth and Reich, 1992), and 71.5–77.8 mg/100g for Cheddar (Hamill and Soliman, 1994). Andrikopoulos et al. (2003) determined the cholesterol levels of traditional Greece cheeses, ranged from 39.0 mg/100g to 115.2 mg/100g.

To our best knowledge, limited research determined the cholesterol content and chemical composition attribute of traditional cheeses in Turkey. The aim of this research was to evaluate the nutritional parameters and cholesterol level of traditional cheese samples widely consumed in Turkey.

MATERIAL and METHODS

Sample Preparation

50 cheese samples belonging to 29 different varieties from 24 different geographical province of Turkey were collected and taken to the laboratory of

Ege University at $4\pm 1^\circ\text{C}$. Data regarding the varieties and geographical provinces of cheese samples are given in Table 1.

Chemical Analysis

All reagents and chemicals were of analytical grade (Merck, Darmstadt, Germany). Dry matter, salt, fat, total acidity and pH values of the samples were determined according to AOAC (2000). The protein contents of the samples were detected via Kjeldahl method and calculated by using the factor 6.38. Water soluble nitrogen amount was also determined according to Kjeldahl method described in AOAC (2000). The ripening degree was calculated as $(\text{WSN}/\text{TN}) \times 100$ (Alais, 1984). Free fatty acids of cheese samples were determined according to Renner (1993). Total energy values of cheese samples were calculated by using Atwater factors of the major constituents (Watt and Merrill, 1963).

Table 1. Geographical province of the cheese samples

Nr	Cheese variety	Type	Geographical province *
1	Kashar (Fresh)	Hard	İzmir – Torbalı (2), İzmir – Ödemiş (1)
2	Sepet	Semi hard	Balıkesir – Ayvalık (2)
3	Çerkez	Hard	Bursa (1), Düzce (1)
4	Dil	Hard	Düzce (1)
5	Çeçil	Semi Hard	Kars (2)
6	Antep	Hard	Gaziantep (2)
7	Erzincan Tulum	Hard	Erzincan (2)
8	Urfa	Hard	Şanlıurfa (2)
9	Ezine (from sheep milk)	Semi hard	Ezine – Çanakkale (3)
10	White Cheese	Semi hard	Lüleburgaz (1), Ödemiş – İzmir (1) Malkara – Tekirdağ (1), İzmir (1)
11	Van Otlı	Hard	Van (2)
12	Kolot	Hard	Beşikdüzü – Trabzon (1)
13	Telli	Hard	Beşikdüzü – Trabzon (1)
14	Köy	Hard	Ödemiş – İzmir (1)
15	Tire Çamur	Soft	Tire – İzmir (1)
16	Armola	Soft	Seferihisar – İzmir (2)
17	Lor (from white pickled cheese)	Soft	Menemen – İzmir (1), Susurluk – Balıkesir (1)
18	Lor (from tulum cheese)	Soft	Ödemiş – İzmir (1)
19	Örgü	Hard	Susurluk – Balıkesir (2)
20	Yumak	Hard	Malkara – Tekirdağ (1)
21	Civil	Hard	Erzurum (1)
22	Gravyer	Hard	Kars (2)
23	Mihaliç	Hard	Kemalpaşa – Bursa (1), Gönen Balıkesir (1)
24	İzmir Tulum	Hard	Tire- İzmir (1), Ödemiş – İzmir (1)
25	Ezine	Semi hard	Ezine – Çanakkale (1)
26	Hellim	Hard	Kıbrıs (2)
27	Kashar (Aged)	Hard	Kars (1)
28	Göçmen	Hard	Balıkesir (1)
29	Tulum (from sheep milk)	Hard	Bergama – İzmir (1)

Cholesterol Determination

Cholesterol contents of cheese samples were determined according to Fletouris et al., (1998) and Kınık et al. (2005). GC conditions used for analyses were as follows: ZB-1 silica capillary column (30 m \times 0.25 mm i.d., 0.1 mm film thickness; Phenomenex). Oven temperature was set at 285 °C, injection port temperature at 300 °C, and flame ionization detector temperature at 300 °C. The flow rates were 2 ml/min for nitrogen, 30 ml/min for hydrogen, and 300 ml/min for air. The injection volume was 2 ml with a split ratio of 20:1. The concentration of cholesterol (C) in analyzed samples was calculated according to the equation $C = M \times V \times 2.5$, where M is the computed mass (ng) of the analytic in the injected extract (1 ml), V the dilution factor, if any that was applied.

Statistical Analysis

All analyses were performed in triplicate and the results were expressed after simple descriptive statistical analysis. Statistical analyses were carried out using the SPSS statistical package, release 11.0.

RESULTS and DISCUSSION

Chemical Characteristics of Traditional Cheese Samples

Table 1 summarizes the features of 29 cheese samples from different 38 geographical province of Turkey. Since the selected areas of each region were chosen as representing >90% of the overall annual production, the sum of the 50 samples could be considered as representative of the annual production for all the Turkey cheese varieties. Table 2 presents the mean chemical characteristics of the traditional cheeses in Turkey.

The highest pH value was determined in Civil cheese whereas Göçmen cheese showed the lowest value. The dry matter of the samples varied from 273.3 g/kg to 704.3 g/kg. Tire Çamur and Armola cheeses had the lowest fat content (140.0 g/kg), whereas the highest fat content belonged to Gravyer cheese (380.0 g/kg). Gravyer cheese had also the highest amount of dry matter, protein and lactic acid value which is a traditional very hard cheese variety and manufactured in the Kars province in Turkey. Kars Gravyer cheese is usually made from raw milk, which means that the microbial load and chemical characteristics of the milk used for production is obviously very important. Since controlled fermentation is not used during production and maturing, each product develops different consistency and different characteristics. Gravyer cheese takes many months to mature. The degree of maturation inevitably changes the microbiological and chemical composition of the cheeses (Topuk and Sezer

2015). The highest value of titratable acidity (6.87%) found in Gravyer cheese can be due to lactose fermentation and formation of amino acids and free fatty acids by proteolysis and lipolysis. Tire Çamur cheese is known by the name of the town of Tire in Izmir where it is produced in. It is a rare local cheese suitable for spreading on bread. Essentially, it is obtained by blending together Lor Cheese and brine from mature tinned Tulum Cheese. Tire Çamur cheese had also the lowest amount of fat, protein and lactic acid values. Amount of dry matter in Tire Çamur Cheese decreases in parallel with the amount of brine added to the Lor used for cheese production. In addition fat and protein amounts are decreased in parallel with the decrease of dry matter. On the other hand Armola cheeses had the lowest dry mater content. Armola is a local variety of Lor cheeses, produced in the vicinity of Seferihisar in Izmir. In the production of the cheese, separately kneaded Lor, White Cheese and yoghurt are mixed together, placed into a bag and hung at a height to strain. After 3–4 days, olive oil and oregano are added and the cheese is consumed (Kamber 2007). The salt content of Köy cheese was the highest (86.4 g/kg), whereas Lor cheese obtained from white cheese had the lowest value (11.7 g/kg). The highest ripening index (RI) values was detected in Dil cheese while the Hellim cheese showed the lowest ripening index value.

Fresh Kashar cheese had a pH mean value of 5.42 whereas total titration acidity value was 1.03%. These results were similar to the findings of Dinkçi et al. (2011) but lower than the findings of Dönmez et al. (2005) and Kamber (2008). Mean dry matter and fat content of fresh Kashar cheese samples were 557.2 g/kg and 280 g/kg, respectively. Mean dry matter and fat content of Kashar cheese samples were found as 554.7 g/kg and 279.2 g/kg, respectively, by Dinkçi et al. (2011) and Kamber (2008) which were similar to our results but higher than the findings Koca and Metin (2004) and Gürsoy (2009). The mean salt content of fresh Kashar cheese samples was 24.1 g/kg whereas the salt in dry matter value was 43.1 g/kg. These results were similar to the findings of Dinkçi et al. (2011) and Kamber (2008) but higher than the findings of Dönmez et al. (2005). Mean protein values of fresh Kashar cheese samples were found as 240.33 g/kg. The result is in parallel with the results obtained by the Koca and Metin (2004) who reported the mean protein content of Kashar cheese as 247.1 g/kg. On the other hand, in our study mean ripening index for the fresh Kashar samples was 19.46 and this value was similar to the finding (17.56) of Dönmez et al. (2005). Dinkçi et al. (2011) found the mean ripening index of Kashar cheese samples as 14.49 at the end of the 30th day of storage.

Table 2. The chemical characteristics of cheese varieties

Cheese variety	pH	Lactic acid (%)	Dry matter (g/kg)	Fat (g/kg)	Fat in Dry Matter (g/kg)	Salt (g/kg)	Salt in Dry Matter (g/kg)	Free Acidity (mg KOH/g fat)	Protein (g/kg)	Water Soluble Nitrogen (g/kg)	Ripening Index
Kashar (Fresh) n=3	5.42±0.33	1.03±0.35	557.2±19.40	280.0±20.00	498.8±20.70	24.1±2.40	43.1±3.50	1.79±1.21	240.33±1.22	7.3±2.80	19.46±8.00
Sepet n=2	5.34±0.09	2.19±1.85	588.7±12.20	287.5±3.50	488.5±4.20	32.6±6.80	55.6±12.70	1.84±0.90	225.2±20.80	6.3±0.90	17.90±4.26
Çerkez n=2	5.13±0.32	2.15±1.64	576.6±40.70	240.0±14.10	416.6±4.90	26.4±24.00	47.3±45.00	1.76±1.50	255.2±11.70	8.5±6.00	21.50±16.02
Dil n=1	5.40	0.95	524.1	260.0	496.1	33.7	64.2	1.62	201.6	10.4	32.91
Çeçil n=2	5.05±0.15	3.31±2.31	553.5±33.2	270.0±14.10	488.0±3.70	27.4±8.90	50.0±19.10	1.45±0.60	263.8±7.60	7.4±2.30	17.70±5.130
Antep n=2	5.31±0.27	1.98±2.02	579.0±58.20	230.0±70.70	393.0±42.70	66.1±26.60	121.1±68.70	1.46±0.59	238.7±55.90	2.1±0.40	5.80±0.41
Erzincan Tulum n=2	4.86±0.50	5.51±4.45	555.9±13.70	250.0±21.20	450.4±49.30	23.7±2.80	42.6±4.20	8.36±5.92	261.3±33.90	6.4±14.10	15.78±2.39
Urfa n=2	5.04±0.08	2.80±2.69	479.0±82.90	190.0±56.60	392.4±50.10	57.5±6.40	120.6±7.50	1.57±0.22	207.4±30.60	4.7±0.10	14.45±1.92
Ezine n=3	4.90±0.72	5.44±3.54	479.7±12.50	263.3±16.10	548.6±20.90	37.1±9.20	77.8±21.20	2.47±0.62	187.3±25.20	5.3±2.10	17.62±5.02
White cheese n=4	4.54±0.24	3.48±2.09	398.6±52.50	203.8±34.20	511.7±61.10	34.9±1.00	88.7±12.50	1.36±1.14	163.0±26.20	3.1±1.70	11.90±6.61
Van Otlu n=2	4.63±0.21	4.89±4.37	483.6±69.00	242.5±24.70	503.0±20.60	32.6±5.20	67.3±1.10	1.67±0.18	226.8±23.10	4.9±3.60	13.20±8.80
Kolot n=1	5.48	1.90	569.2	230.0	404.1	14.4	25.3	4.02	292.8	6.0	13.07
Telli n=1	5.48	1.43	564.9	235.0	416.0	24.1	42.6	1.09	299.9	5.7	12.13
Köy n=1	4.85	3.21	570.8	160.0	280.3	86.4	151.4	0.63	226.5	2.2	6.2
Tire Çamur n=1	5.30	0.48	282.1	140.0	496.3	16.8	59.6	0.68	95.1	0.6	4.03
Armola n=2	4.29±0.08	2.09±0.07	273.3±18.00	140.0±14.10	515.0±85.60	31.8±1.40	116.5±2.50	3.07±0.830	118.4±18.50	2.7±1.00	14.32±3.10
Lor* n=2	4.66±0.34	4.77±1.04	340.6±16.2	175.0±7.10	515.0±45.30	11.7±6.60	33.9±17.80	0.89±0.26	118.1±1.80	1.9±0.50	9.99±2.52
Lor** n=1	4.82	4.26	422.4	190.0	449.9	21.1	49.9	0.68	139.7	1.3	5.94
Örgü n=2	5.19±0.37	4.72±1.43	591.8±34.0	262.5±17.7	445.2±55.50	32.2±5.80	54.8±12.90	0.84±0.19	262.2±28.0	4.4±1.10	10.51±1.46
Yunak n=1	4.87	6.05	590.1	255.0	432.2	88.9	150.7	2.06	256.5	10.0	24.88
Civil n=1	6.06	3.31	554.5	250.0	450.8	39.8	71.7	1.05	289.0	7.4	16.34
Gravyer n=2	5.37±0.06	6.87±0.13	704.3±10.60	380.0±56.60	540.2±88.50	14.7±7.40	20.7±10.30	7.85±4.35	327.6±9.50	9.5±0.40	18.40±0.16
Mihalic n=2	5.07±0.06	3.31±0.96	637.5±5.70	332.5±10.60	521.7±21.30	63.8±4.20	100.1±7.40	2.05±0.08	239.3±8.10	4.2±0.70	11.24±2.26
İzmir Tulum n=2	4.87±0.05	5.54±1.08	541.7±2.50	260.0±14.10	480.0±24.00	35.7±2.50	65.9±4.90	1.33±0.41	258.1±55.50	6.9±0.80	17.70±5.90
Ezine Goat n=1	4.67	6.36	489.5	245.0	500.5	24.6	50.2	1.78	185.0	5.7	19.66
Hellim n=2	5.45±0.18	2.26±0.21	594.8±2.90	287.5±17.70	483.4±27.40	61.2±40.10	102.7±67.00	0.72±0.07	247.6±17.20	0.9±0.5	2.16±1.12
Kashar (aged) n=1	4.68	6.82	613.1	255.0	415.9	33.2	54.2	1.64	275.6	6.5	15.05
Göçmen n=1	4.20	5.14	372.3	215.0	577.5	19.2	51.5	2.09	115.5	2.2	12.16
Sheep Tulum n=1	5.30	1.40	606.1	235.0	387.7	31.3	51.6	1.66	212.5	6.8	20.42

*:from white cheese

**: from tulum cheese

As indicated in Table 2, mean dry matter content, pH value, titration acidity, salt and fat contents of Sepet cheese were 588.7 g/kg, 5.34, 2.19 %, 32.6 g/kg and 287.5 g/kg, respectively. According to Ercan et al. (2014), these values were 543.3 g/kg, 5.77, 1.66 %, 71.0 g/kg and 251.1 g/kg, respectively for Sepet cheese samples. Sepet cheese is produced in towns within the Aegean region that lie close to the sea, principally Ayvalık and also Dikili, Burhaniye, Foça, Çeşme, Urla, Karaburun, Ödemiş and Söke. The milk from woolly goats, which are still widely raised by shepherds and small herd owners in the area, is used in the production of the cheese. Sepet Cheese, which is a regional cheese, is similar to Tulum Cheese from the point of view of the production technique in some regions and of properties as dry matter, fat, protein, total ash and acidity (Kamber, 2007).

The mean titration acidity, fat in dry matter and salt in dry matter contents of Dil cheese were determined as 0.95%, 496.1 g/kg and 64.2 g/kg, respectively. These results were similar to the findings of Koçak et al. (1997). Tulum cheese is widely manufactured and consumed in all regions of Turkey except Trakya region. It has a typical odor and rancid taste (Dağdemir et al. 2003). Mean fat in dry matter, salt in dry matter contents and titration acidity values of Erzincan Tulum cheese samples were determined as 450.4 g/kg, 42.6 g/kg and 5.51%, respectively. These results were similar to the findings of Hayaloğlu et al. (2002) but lower than the findings of Yılmaz et al. (2005). Hayaloğlu et al. (2002) stated total protein contents of Tulum cheese samples changed between 168.4 g/kg and 213.1 g/kg during 120 days of storage which were lower than our findings. Urfa cheese samples had mean pH value, total dry matter, fat and salt contents in dry matter as 5.04, 479.0 g/kg, 392.4 g/kg and 120.6 g/kg. Total nitrogen and free fatty acid values of the samples were among 29.1-35.9 g/kg and 1.41-1.72 mg KOH/g fat. These results were similar to the findings of Atasoy and Türkoğlu (2008). Özer et al. (2002) reported the mean titration acidity, fat, dry matter and protein contents of Urfa cheese samples as 0.40%, 127.9 g/kg, 377.3 g/kg and 173.6 g/kg, respectively. These values are lower than our findings. Moreover, Yalçın et al. (2007) revealed that mean dry matter, fat and salt contents and titration acidity value of Urfa cheese samples were 485.0 g/kg, 220.2 g/kg, 92.9 g/kg and 0.29%. Titration acidity values of the samples examined in the study of Yalçın et al. (2007) were lower than our findings.

Another cheese variety which was analyzed in our project was Ezine cheese. As seen from Table 2, pH

values and total titration acidity values of Ezine cheese samples 4.90 and 5.44%, respectively. Mean fat content, dry matter amount, fat and salt contents on dry basis were determined as 263.3 g/kg, 479.7 g/kg, 548.6 g/kg and 77.8 g/kg, respectively. These results were similar to the findings of Karagül -Yüceer et al. (2007). Mean pH value, fat and salt contents in dry matter were 4.54, 511.7 g/kg and 88.7 g/kg, respectively for traditional white cheese. Mean dry matter, fat and salt contents of White cheese samples were found as 398.6 g/kg, 203.8 g/kg and 34.9 g/kg whereas protein content, water soluble nitrogen content and RI of the samples were 163.0 g/kg and 3.1 g/kg and 11.90, respectively. Chemical characteristics of our white cheese samples are in parallel with the findings of Hayaloğlu et al. (2002) and Dağdemir et al. (2003).

Van Otlı (herby) cheese is one of the most known traditional Turkish cheeses, which contains different types of herbs and plants in its formulation (Coşkun 1998; Tarakçı and Temiz 2009). It is a kind of salty hard cheese with a porous structure and a yellowish-white color (Tarakçı and Temiz, 2009). Mean pH value, titration acidity, dry matter, fat and salt contents of Van Otlı cheese samples were found as 4.63, 4.89%, 483.6 g/kg, 242.5 g/kg and 32.6 g/kg. Van Otlı cheese had mean total protein and water soluble nitrogen contents and ripening index values 226.8 g/kg, 4.9 g/kg and 13.2. These results were similar to the findings of Coşkun (1998), Tarakçı et al. (2004), Tarakçı and Temiz (2009). On the other hand mean pH, titration acidity, dry matter, fat and salt contents of Köy cheese samples were 4.85, 3.21%, 570.8 g/kg, 160.0 g/kg and 86.4 g/kg, respectively. Total protein content and ripening index value of the samples were determined as 226.5 g/kg and 6.20 which were in parallel with the findings of Kesenkaş et al. (2012).

Lor is a type of traditional soft whey cheese (Kamber, 2008). As seen from Table 2, two different types of Lor cheese were analyzed during this research. One type was Lor cheese which was obtained from White cheese whereas the other was obtained from Tulum cheese. Mean dry matter, fat and fat in dry matter contents of Lor cheese samples manufactured from white cheese were determined as 340.6 g/kg, 175.0 g/kg and 515.0 g/kg, whereas mean protein and salt contents of the samples were 118.1 g/kg and 11.7 g/kg, respectively. Mean fat, protein and salt contents of Lor obtained from Tulum cheese were 190.0 g/kg, 139.7 g/kg and 21.1 g/kg, respectively. Kamber (2008) reported that mean fat and protein contents of Lor cheese samples changed between

65.0-153.3 g/kg and 96.5-135.0 g/kg. Mean pH, titration acidity, dry matter, fat and salt contents of Civil cheese samples were found as 6.06, 3.31%, 554.5 g/kg, 250.0 g/kg and 39.8 g/kg. Free fatty acid content of the samples was 1.05 mg/KOH g fat whereas protein content and ripening index value of the samples were 289.0 g/kg and 16.34. Şengül et al. (2006) also found similar results for civil cheese.

Mihaliç cheese is one of the traditional cheeses which belongs to the Marmara region in Turkey. It is made from raw sheep milk and mostly produced in Bursa-Karacabey and Balıkesir in northwestern Turkey. Mihaliç is a hard, brined, and slightly acidic cheese and its color changes from cream to light yellow. It has a sharp taste and odor and a 3–4 mm diameter rind. As seen from the table, mean titration acidity, dry matter, fat and salt contents of Mihaliç cheese samples were 3.31%, 637.5 g/kg, 332.5 g/kg and 63.8 g/kg respectively whereas protein content, RI and water soluble nitrogen content of the samples were determined as 239.3 g/kg, 11.24 g/kg and 4.2 g/kg. These results were lower than the findings of Dönmez et al. (2005) Aday and Karagül - Yüceer (2014). The difference in the salt content of the samples can be attributed to some processes different applied in the studies. Salt concentration and brining time have been said to be the most important factors affecting the salt content of cheese (Aday and Karagül – Yüceer 2014).

İzmir Tulum cheese is one of the most known and consumed traditional cheese varieties of Turkey. İzmir Tulum Cheese can be also called “Teneke Tulum” or “Salamura Tulum Cheese” according to the material in which it is packaged. Mean titration acidity, dry matter, fat and salt contents were determined as 5.54%, 541.7 g/kg, 260.0 g/kg and 35.7 g/kg. Which are similar to the findings of Dönmez et al. (2005) and Kılıç et al. (1998). Chemical composition of Tulum cheese which was manufactured from sheep milk was also given at Table 2. As seen from the table, mean titration acidity, dry matter, and fat and salt contents in dry matter were determined as 1.40%, 606.1 g/kg, 387.7 g/kg and 51.6 g/kg for Sheep Tulum cheese. These results were found lower than the findings of Yılmaz et al. (2005). Amount of dry matter in İzmir Tulum Cheese changes according to the factors such as raw material, renneting temperature, rennet amount, press weight and press period. In addition content fat content in dry matter changes according to the dry matter change. Tulum Cheese is similar to

Kashar, Çeçil, Ezine, Örgü and Yumak Cheeses in terms of fat content, yet it contains milk more fat than White Cheese.

Cholesterol Contents of Cheese Samples

Cholesterol contents of traditional Turkish cheese samples are given in Table 3. Mean cholesterol contents of cheese samples ranged from 18.95 mg/100g to 163.46 mg/100g. Highest cholesterol content was determined in Dil Cheese whereas Göçmen cheese sample had the lowest value.

Table 3: The cholesterol contents and energy values of cheese varieties

Cheese variety	Cholesterol (mg/100g)	Energy (kcal/100 g)
Kashar (Fresh) n=3	70.11±43.16	362.88
Sepet n=2	112.24±23.91	379.23
Çerkez n=2	106.80±80.13	350.64
Dil n=1	163.46	339.64
Çeçil n=2	78.36±62.84	356.4
Antep n=2	140.25±91.87	346.60
Erzincan Tulum n=2	78.15±42.59	347.36
Urfa n=2	124.80±90.40	286.60
Ezine Sheep White Pickled n=3	87.12±79.50	323.53
White Cheese n=4	87.01±78.79	261.34
Van Otlu n=2	95.03±11.72	314.69
Kolot n=1	110.25	341.88
Telli n=1	139.74	343.46
Köy n=1	42.75	308.62
Tire Çamur n=1	85.92	182.84
Armola n=2	33.61±8.24	179.32
Lor (from White cheese) n=2	132.60±71.07	223.74
Lor (from tulum cheese) n=1	61.33	263.84
Örgü n=2	70.37±47.39	367.94
Yumak n=1	20.68	356.97
Civil n=1	74.85	342.80
Gravyer n=2	54.23±27.30	471.72
Mihalic n=2	30.17±21.74	421.25
İzmir Tulum n=2	115.33±25.67	346.68
Ezine Goat n=1	35.83	318.30
Hellim n=2	72.72±3.82	440.72
Aged Kashar n=1	30.58	372.74
Göçmen n=1	18.95	279.50
Sheep Tulum n=1	137.51	359.94

Telli cheese had a cholesterol content of 139.74 mg/100g which was followed by Sheep Tulum cheese which had a cholesterol level of 137.51 mg/100g. Dönmez et al. (2005) investigated the cholesterol contents of traditional Turkish cheese samples and reported that the value changed between 44.6 mg/100g and 147.69 mg/100g. On the other hand, Andrikopoulos et al. (2003) reported that cholesterol contents of traditional Greek soft cheese samples ranged from 51.3 mg/100g to 85.3 mg/100g whereas the values for semi-hard and hard cheese samples changed between 81.0-102.6 mg/100g and 76.2-110.5 mg/100g, respectively. In our research, the cholesterol content of İzmir Tulum cheese which is a kind of traditional hard cheeses was determined as 115.33

mg/100g whereas this value was 61.33 mg/100g for Lor cheese which is known as a soft cheese. Mean calorie values of the cheese samples can be also seen in Table 3. As it is expected, the lowest calorie content (179.32 kcal/100g) was determined in the Armola cheese whereas the highest (471.72 kcal/100g) value was obtained from the variety Gravyer. The lowest fat content was also detected in Armola cheese and the highest value was determined for Gravyer cheese. It has been well-known that fat content is an important fact for calculating the energy value of foods. The differences observed for the fat and cholesterol content between the examined varieties could not be attributed only to the physiological fluctuations of cholesterol content of milk, but could be rather related to processes and treatments applied during the production of different types of cheese and, in particular, to the amounts of whey removed. It is known that cholesterol in milk is found—together with phospholipids—in the hydrophilic surface layer of fat globules (Andrikopoulos et al., 2003).

CONCLUSION

The cheese making is a developing industrial sector in Turkey and moreover, Turkey possesses the capacity and the variety in order to increase its cheese production much more than today. Anatolian cheeses

can constitute a valuable resource in expanding the variety of cheeses available in Turkey and abroad. Recent studies have provided strong and consistent evidence that dietary lipids play an important role in the etiology of degenerative diseases such as coronary heart disease. The importance of reducing fat and cholesterol intake is increasingly emphasized as a step in the prevention of coronary heart disease. Therefore, the determination of cholesterol content of dairy products has great importance.

The present study represents knowledge about some nutrient parameters, cholesterol levels and microbiological characteristics of 29 traditional cheese variety produced in Turkey. It had been observed that the examined parameters varied depending on the cheese variety. There are limited international literatures evaluating the characteristics of traditional Turkish cheeses, so that more researches are needed to point out detailed characteristics of traditional cheeses and their importance in the diet.

ACKNOWLEDGEMENTS

This study was financially supported by Ege University Scientific Research Fund (Pr Nr: 2009- ZRF-017).

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