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CLA content and fatty acid composition of Greek Feta and hard cheeses

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Abstract

The CLA concentrations and fatty acid composition of Feta cheese and other Greek cheeses were determined. Greek cheese contains up to 1.9% CLA, with an average of 0.8% of their fat. Greek cheeses derive from sheep and/or goat milk and this is obviously the main reason for the relatively high content of CLA. No relationship was found between the CLA content of cheese and the linoleic acid content, or any other polyunsaturated fatty acid. Additionally, the cheese consumption in Greece is compared with the consumption in other countries of the European Union (EU) and was examined for its relation with mammary cancer figures in the EU. Greece has the lowest percent of breast cancer deaths and the highest cheese consumption among EU countries. This is a first indication that cheese consumption has beneficial effects in mammary cancer protection.

Keywords: Conjugated linoleic acid (CLA); Feta; Greek cheeses; Mammary cancer; Fatty acids composition

1. Introduction

The isomerisation of linoleic acid to conjugated dienes was initially reported by von Mikusch (1949). These results referred to dehydrated castor oil with alkalis. The product of dehydration and alkali isomerisation was a mixture of conjugated linoleic acid with double bonds in positions 9,11 and 10,12. This product is used in the manufacture of paint, varnish and other related products.

In 1986, Pariza et al. first reported that the dienes, which appear in fried ground beef, protect against chemical-induced cancer. The chemical structure of these fatty acids was later determined by Ha, Grimm, and Pariza (1987). These compounds, which are called conjugated linoleic acids (CLA), are isomers of linoleic acid with conjugated double bonds between the C-8 and C-13 positions.

Among all possible CLA isomers, only the 9*cis*, 11*trans*-isomer is normally found in nature. This isomer is formed in milk and dairy products through the microbiological metabolism of linoleic acid, by *Butyrivibrio fibrisolvens*, in the rumen (Kepler & Tove, 1969). Its presence in dairy products, such as cheese and milk, was investigated in 1989 by Ha, Grimm, and Pariza. Most cheeses are important sources of CLA. In general, cheeses from cow milk contain about 0.4–0.6% w/w CLA in their fat.

The CLA content in foods depends on many factors. One of these factors is ageing (Lin, Boylston, Chang, Luedecke, & Shultz, 1995). Changes in the concentration of CLA are also noticed in cheese during processing (Garcia-Lopez, Echeverria, Tsui, & Balch, 1994). The exact mechanism of CLA formation in processed cheese is not clearly understood. Another factor is the kind of feeding, as several animal studies have shown. For example, milk of free-bred cows contains more CLA than from cows in conventional farms (Dhiman, Anamd, Satter, & Pariza, 1999).

The most important effect of CLA is its anticarcinogenic activity, mainly against breast cancer (Ip, Chin, Scimeca, & Pariza, 1991). CLA has also a significant effect on protein to fat proportions in broilers (Simon, Maenner, Schaefer, Sagredos, & Eder, 2000), on the body fat composition in rats (Chin, Storkson, Albright, Cook, & Pariza, 1994) and in human beings

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Table 1
Cheese production in Greek cheese-dairies with five or more employees

Cheese type	Tonnes	%
Whey cheeses	3805	9.3
Hard cheeses short ageing time	8978	22
Hard cheeses long ageing time	2649	6.5
Feta	21,804	53.4
Others	3611	8.8
Total	40,847	100

Source: ESYE (1996).

(Matsakas, Petridou, Ring, Melissopoulou, Tsigilis, & Mougios, 1999). CLA appears also to be anticholesterolemic and antiatherogenic (Lee, Kritschevsky, & Pariza, 1994; Mougios et al., 2001).

The purpose of this investigation was to determine the CLA content and the fatty acid composition in Feta cheese and other Greek cheeses, which are mainly produced from sheep and goat milk. The characteristics of the investigated cheeses are showed in Table 2.

The cheese consumption was also compared with the mammary cancer figures in Greece and other European Union countries.

2. Materials and methods

2.1. Sampling

The sampling of Feta and other Greek cheeses was based on the amount of their production and consumption. The distribution of the produced cheeses in dairies with five or more employees is presented in Table 1. From these data it is clear that more than half of the total cheese production in Greece is Feta.

Feta is traditionally produced from sheep milk or from a mixture of sheep and goat milk. According to Greek legislation, the cheese defined as Feta must contain at least 70% sheep milk and the minimum ageing time should be 2 months. White brine cheeses, that are produced in the same way as Feta, but do not have the above mentioned characteristics, are usually named "Feta-type-cheeses". All of the analysed cheeses that are called "Feta-type" are produced by the traditional way of Feta but the percentage of sheep milk is lower than 70%. These cheeses are mainly produced from goat milk.

According to its production, hard cheese is the second most important kind of Greek cheese. The analysed hard cheeses can be divided into those that have short ageing time, with the common names "Kasseri and Kapnisto", representing 22% of total production, and those that have long ageing time with the common names "Kefalotyri, Graviera and Ladotyri", representing 6.5%. The cheeses with short ageing time are often aged less than a day before their final treatment. After their final treatment these cheeses are stored for at least 70 days. Cheeses with long ageing time are usually aged more than 5 months.

Table 2
Characteristics of analysed cheeses

Cheese type	Characteristics
Feta	Sheep and/ or goat milk Brine 5% w/w of cheese Ageing time about 2 months at 4–5 °C
Hard cheeses	
Kasseri	Sheep milk Partially skimmed milk Ageing before the molding no more than a day at 25–30 °C Stored at least 70 days
Kapnisto (=smoked cheese)	Sheep milk Smoked variety of Kasseri
Graviera	Sheep milk Ageing min. 3 months at 14–16 °C
Ladotyri (=oil cheese)	Sheep milk Ageing 50–80 days at 4–5 °C After the ageing is kept in oil
Kefalotyri	Sheep milk Skimmed milk Long ageing times min. 5 months at 12–14 °C
Whey cheeses	
Anthotyro	Whey milk from sheep Without ageing
Manouri	Sheep milk 75% whey milk +25% fresh milk Without ageing
Myzithra	Sheep milk 90% whey milk + 10% fresh milk Without ageing

Whey cheeses represent about 10% of Greek cheese production. In general, whey cheeses are not aged. Whey cheeses can be produced only from whey milk or with adding of fresh milk. The most popular Greek whey cheeses have the common names Anthotyro, Mizithra and Manouri.

Greek consumers commonly get their cheese, not only from the market, but also direct from traditional small producers. In order to achieve more representative results we also collected samples from the market of Thessaloniki as well as from traditional small producers.

2.2. Analytical method

One gramme of cheese was exactly weighed and the fat was extracted according the method of Schmid–Bondzynski–Ratzlaff (DIN, 1981). The isolated fat was dissolved in 20 ml of heptane and 5 ml of 1 N potassium hydroxide methanolic solution containing 0.25 mg of heptadecanoic acid triglyceride were also added. The

transesterification of cheese fat to methyl esters was carried out according to the specific method for fatty acids with 4 or more carbon atoms (British Standards, 1980). The heptane upper layer, containing the methyl esters was separated and gas-chromatographed according to the literature (Zlatanos & Sagredos, 1993). The GC conditions are the following:

Apparatus:	Perkin Elmer. Auto System
Column:	SIL88
Column length:	50 m-capillary
Column film:	0.25 μm
Internal diameter:	0.25 mm
Temperature programme:	60 °C for 5 min isotherm
Rate 1:	5 °C/min to 180 °C 16 min isotherm
Rate 2:	5 °C/min to 220 °C 15 min isotherm
Column pressure:	22 psi
Detector:	FID
Detector temperature:	300 °C
Injection volume:	3 μl. split
Injection temperature:	250 °C
Inert gas:	Helium 1 ml/min

The fatty acid identification was performed by retention time comparisons with the corresponding fatty acid methyl ester standards. The standards were purchased from Sigma-Aldrich Ltd., except for the CLA standard, which was purchased from Trofocell Research and Trade Ltd. Hamburg/Germany. The gas-chromatographic results were converted to weight percentages utilising response factors.

3. Results and discussion

The CLA content in the investigated cheeses is depicted in Table 3. As presented, the CLA contents in the fat of Greek Feta, feta-type cheeses, whey cheeses, hard cheeses with short ageing time and hard cheeses with long ageing time were found to be 0.5–1.9% (mean 0.9%), 0.4–0.9% (mean 0.7%), 0.5–1.1% (mean 0.7%) and 0.5–1.9% (mean 0.9%), respectively. These contents correspond, respectively, to 0.06–0.34% (mean 0.18%), 0.08–0.28% (mean 0.16%), 0.12–0.25% (mean 0.15%) and 0.13–0. 56% (mean 0.26%) of the cheese mass.

The highest CLA content in all analyzed cheeses was found in hard cheeses with long ageing time. Feta cheese also contains high CLA amounts. Both cheese types have the longest ageing time. On the other hand, whey cheeses, which are produced without ageing, and hard cheeses with short ageing time, contain the lowest amounts of CLA.

The only CLA isomer that was found in all analysed cheeses was 9*cis*, 11*trans*-octadecadienoic acid, except for traces of the 10*trans*, 12*cis*-isomer that was found in some samples.

In Table 4 the CLA content of Greek cheeses is compared, to cheeses from other countries. In comparison to cheeses that are produced from cow milk, Greek cheeses, which are produced from sheep and goat milk, contain higher percentages of CLA in their fat. Swedish cheeses contain higher amounts of CLA than Greek whey cheeses and hard cheeses with short ageing time. Feta-type cheeses have similar CLA contents to the Swedish ones. Finally, hard cheeses with long ageing time contain larger amounts of CLA than all other cheeses.

Other factors, which may influence the CLA content, are the geographical origin, because of the seasonal variations and the locally varying grass-fodder of free-fed animals, as well as the initial CLA content of sheep and goat milk, the ageing time and the temperature conditions of the cheese production. The clarification of these factors might be an aim of a future investigation.

In addition to the analysis of CLA, the composition of total fatty acids in Feta cheese and other Greek cheeses was also investigated and the results are presented in Table 5. The fatty acid composition (of all types of Greek cheeses) is very similar to sheep butter. There was no apparent relationship between the CLA content and linoleic acid. This indicates that the CLA content is not influenced by the initial quantities of linoleic acid in milk. Also, no relationship was found between the CLA and other unsaturated fatty acids in cheese.

Table 6 shows the total amount of saturated fatty acids (SFA), *cis*- and *trans*-monounsaturated fatty acids (MUFA), *cis*- and *trans*-polyunsaturated fatty acids (PUFA) and CLA of cheeses and sheep butter. Butter contains the lowest amounts of SFA and the highest amounts of *cis*-MUFA and *cis*-PUFA according to the analyses. On the other hand, whey cheeses contain the highest amounts of SFA and the lowest amounts of *cis*-MUFA and *cis*-PUFA.

Cheeses that contain the highest amounts of CLA, Feta and hard cheeses with long ageing time, also contain the highest amounts of *trans*-MUFA and *trans*-PUFA. This indicates that the same factors that influence the increased CLA formation also affect the formation of *trans* fatty acids.

4. CLA and mammary cancer

Table 7 shows cheese consumption among the countries of the European Union and the statistical figures for mortality from breast cancer in these countries. These data concern a period until 1995, while more recent data is not available.

The per capita cheese consumption in Greece is the greatest among the countries of the European Union. Burrel (1996) reported that, for the year 1995, the average

Table 3
CLA content of Greek cheeses

Sample	Origin	Fat (g/100 g sample)	CLA values			
			9*cis*, 11t*rans*- isomer		10*trans*, 12*cis*- isomer	
			g/100 g fat	g/100 g sample	g/100 g fat	g/100 g sample
Feta cheeses						
Feta	Grevena	18.8	0.78	0.15	n.d.[a]	–
Feta	Langadas	19.4	1.6	0.31	0.07	0.014
Feta	Langadas	19.7	0.78	0.15	n.d.	–
Feta	Libadia	17.9	1.9	0.34	0.07	0.013
Feta	Libadia	20.6	1.1	0.23	n.d.	–
Feta	Libadia	19.6	0.87	0.17	n.d.	–
Feta	Thebes	18.4	0.54	0.10	n.d.	–
Feta- type	Libadia	20.9	0.71	0.15	0.06	0.013
Feta- type	Libadia	20.5	0.45	0.09	n.d.	–
Feta- type	Meteora	12.1	0.51	0.06	n.d.	–
Hard cheeses						
Short ageing						
Kapnisto	Metsovo	19.7	0.60	0.12	n.d.	–
Kapnisto	Metsovo	18.3	0.63	0.12	n.d.	–
Kasseri	Grevena	23.2	0.51	0.12	n.d.	–
Kasseri	Lesbos	19.6	0.78	0.15	n.d.	–
Kasseri	Libadia	22.4	1.10	0.25	n.d.	–
Kasseri	Sohos	21.0	0.88	0.18	0.06	0.013
Lekorino	Amfilohia	17.6	0.71	0.12	n.d.	–
Long ageing						
Formaella	Libadia	26.3	0.89	0.23	n.d.	–
Formaella	Libadia	34.2	0.65	0.22	n.d.	–
Graviera	Arta	26.7	0.99	0.26	n.d.	–
Graviera	Arta	27.9	0.71	0.20	n.d.	–
Graviera	Dodoni	29.3	1.90	0.56	0.07	0.021
Graviera	Kreta	26.5	0.96	0.25	0.08	0.021
Kefalotyri	Libadia	28.1	0.86	0.24	n.d.	–
Kefalotyri	Grevena	27.5	0.49	0.13	n.d.	
Ladotyri	Lesbos	28.6	0.97	0.28	n.d.	–
Opsimotyri	Libadia	27.2	1.00	0.27	n.d.	–
Whey cheeses						
Anthotiro	Libadia	18.3	0.41	0.08	n.d.	–
Mizithra (unsalted)	Langadas	15.2	0.83	0.13	n.d.	–
Manouri	Langadas	32.5	0.87	0.28	0.06	0.020

[a] n.d., Not detectable (<0.03).

Table 4
Comparison of CLA composition reported in this study and others

	CLA		No. of samples	Max. value		Min. value	
	mg/g sample	mg/g fat		mg/g sample	mg/g fat	mg/g sample	mg/g fat
Feta[a]	1.8	9.2	10	3.4	19.0	0.6	4.5
Hard cheeses long ageing time[a]	2.6	9.4	10	5.6	19.0	1.3	4.9
Hard cheeses short ageing time[a]	1.5	7.4	7	2.5	11.0	1.2	5.1
Whey cheeses[a]	1.6	7.0	3	2.8	8.7	0.8	4.1
Canadian cheeses[b]	1.2	4.1	7	1.5	4.7	0.7	2.7
US cheeses[c]	1.2	4.6	17	2.3	8.0	0.2	3.6
Swedish cheese[d]	1.9	5.9	6	5.0	7.1	1.5	2.4
Cheddar cheese[e]	1.4	4.5	4	1.4	4.7	1.3	4.3

[a] This study.
[b] Ma, Wierzbicki, Field, and Clandinin (1999).
[c] Lin, Boylston, Luedecke, and Shultz (1998).
[d] Jiang, Björck, and Fondén (1997).
[e] Werner, Luedecke, and Shultz (1992), only *c*9,*t*11-isomer.

Table 5
Fatty acid spectrum for the various Greek cheese types

	Feta		Hard cheese short ageing		Hard cheese long ageing		Whey cheese		Butter	
	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
C 4:0	5.1	4.3–6.3	5.6	4.2–7.4	5.4	4.6–6.5	5.8	4.8–7.6	4.6	4.5–4.6
C 6:0	4.0	3.4–4.8	4.4	3.1–5.7	3.9	2.8–5.1	4.7	3.7–6.4	3.3	2.9–3.7
C 7:0	0.1	0.1–0.1	0.1	0.1–0.1	0.1	0.0–0.1	0.1	0.0–0.3	0.0	0.0–0.0
C 8:0	3.5	2.9–4.3	3.5	2.1–5.0	3.3	2.2–4.4	3.7	3.4–4.2	2.7	1.6–3.1
C 9:0	0.1	0.1–0.1	0.1	0.1–0.2	0.1	0.0–0.1	0.1	0.1–0.1	0.1	0.1–0.1
C 10:0	9.8	8.1–11.8	9.0	4.9–13.4	8.7	6.0–11.7	11.3	9.2–14.0	5.8	3.3–8.3
C 12:0	4.5	3.6–5.9	4.8	4.1–6.8	4.3	3.5–5.9	5.7	4.2–7.3	4.3	3.7–4.9
C 14:0	10.2	8.7–11.9	10.7	9.7–12.0	10.4	9.2–11.6	11.7	10.1–13.6	10.6	10.1–11.0
C 14:1w 5c	0.2	0.1–0.2	0.4	0.1–0.9	0.2	0.1–0.4	0.2	0.2–0.2	1.0	0.9–1.0
C 15:0	1.0	0.8–1.3	1.0	0.8–1.1	1.1	0.9–1.4	1.1	1.0–1.1	0.6	0.0–1.2
C 16:0	21.4	20.1–23.0	22.3	18.3–28.0	21.4	18.7–25.6	21.2	20.5–21.7	24.5	22.0–27.0
C 16:1w 7c	0.9	0.8–1.2	1.1	0.7–1.6	1.0	0.8–1.5	1.1	1.0–1.1	1.5	1.1–1.8
C 16:1w 9c	0.4	0.3–0.6	0.5	0.2–0.4	0.5	0.4–0.6	0.4	0.3–0.5	0.3	0.2–0.4
C 16:1w 7t	0.5	0.3–0.7	0.4	0.4–0.5	0.5	0.4–0.7	0.5	0.3–0.6	0.4	0.3–0.5
C 17:1w 7c	0.2	0.2–0.2	0.2	0.1–0.2	0.2	0.2–0.3	0.2	0.2–0.2	0.2	0.2–0.2
C 18:0	9.8	7.6–11.4	8.8	5.9–10.2	9.5	7.0–12.5	8.0	5.2–10.5	9.2	8.8–9.5
C 18:1w 9c	14.8	13.2–17.4	14.8	11.7–18.4	15.7	13.7–17.7	12.6	8.8–15.5	17.3	15.1–19.4
C 18:1w 7c	0.3	0.2–0.4	0.3	0.3–0.4	0.3	0.3–0.4	0.3	0.2–0.3	0.6	0.4–0.7
C 18:1c	0.7	0.3–1.1	0.5	0.3–0.9	0.6	0.3–1.2	0.4	0.2–0.6	0.9	0.8–0.9
C 18:1t	3.0	1.4–5.3	2.8	1.7–4.2	3.1	1.7–5.8	2.8	2.1–.32	2.6	2.1–3.0
C 18:2w 6cc	2.0	1.4–2.8	2.1	1.6–2.6	2.0	1.8–2.7	1.8	1.4–2.1	4.5	3.9–5.0
C 18:2w 6ct	0.3	0.2–0.4	0.3	0.1–0.3	0.3	0.2–0.5	0.3	0.2–0.3	0.2	0.2–0.2
C 18:2w 6tc	0.4	0.2–0.8	0.3	0.1–0.5	0.4	0.2–1.0	0.3	0.2–0.5	0.2	0.1–0.3
C 18:2w 6tt	0.4	0.2–0.7	0.3	0.2–0.5	0.4	0.3–0.5	0.3	0.2–0.4	0.3	0.2–0.3
C 18:2 c9. t11	0.9	0.5–1.9	0.7	0.5–1.1	0.9	0.5–1.9	0.7	0.4–0.9	0.7	0.5–0.8
C 18:2 t10.c12	0.0	0–0.1	0.0	0–0.1	0.0	0–0.1	0.0	0–0.1	0.0	0.0
C 18:3w 3c	1.0	0.5–1.7	0.7	0.4–0.9	0.9	0.7–1.3	0.6	0.3–0.8	0.6	0.5–0.6
C 18:3w 3t	0.1	0–0.1	0.1	0.0–0.1	0.1	0.1–0.1	0.0	0.0–0.0	0.1	0–0.1
C 18:3w 6c	0.0	0–0.1	0.0	0.0–0.0	0.0	0.0–0.0	0.0	0.0–0.1	0.0	0.0–0.0
C 18:4w 3c	0.0	0.0–0.0	0.0	0.0–0.0	0.1	0.1–0.1	0.0	0.0–0.0	0.0	0.0
C 19:0	0.3	0.2–0.4	0.2	0.2–0.3	0.3	0.2–0.5	0.3	0.2–0.3	0.3	0.3–0.3
C 20:0	0.2	0.2–0.4	0.2	0.1–0.3	0.2	0.2–0.3	0.2	0.2–0.2	0.2	0.1–0.2
C 20:1w 9c	0.0	0.0–0.1	0.1	0.1–0.1	0.0	0.0–0.0	0.0	0.0–0.0	0.1	0.0–0.1
C 20:3w 6c	0.0	0.0–0.0	0.1	0.0–0.0	0.1	0.0–0.2	0.0	0.0–0.0	0.1	0.0–0.1
C 20:3w 3c	0.1	0.1–0.1	0.1	0.1–0.1	0.1	0.0–0.4	0.1	0.0–0.0	0.0	0.0–0.0
C 20:4w 6c	0.1	0.1–0.2	0.1	0.1–0.1	0.1	0.1–0.2	0.1	0.1–0.2	0.2	0.1–0.2
C 20:5w 3c	0.1	0.0–0.1	0.1	0.1–0.2	0.1	0.1–0.1	0.1	0.1–0.1	0.0	0.0–0.0
C 22:0	0.1	0.1–0.2	0.1	0.1–0.1	0.1	0.1–0.2	0.1	0.1–0.1	0.0	0.0–0.0
C 22:4w 6c	0	0	0	0.1–0.2	0	0.0–0.0	0.1	0.1–0.1	0.0	0.0–0.0
C 22:5w 3c	0.1	0.1–0.2	0.1	0.0–0.0	0.1	0.0–0.0	0.1	0.1–0.1	0.0	0.0–0.0
C 22:6w 3c	0.1	0.1–0.1	0.0	0.0–0.0	0.1	0.1–0.2	0.0	0.0–0.0	0.0	0.0–0.0
C 23:0	0.1	0.1–0.1	0.2	0.1–0.2	0.1	0.0–0.1	0.1	0.1–0.1	0.0	0.0–0.0

Table 6
Fatty acid profile for the analysed cheese and sheep's butter[a]

	Feta	Hard cheese short ageing	Hard cheese long ageing	Whey cheese	Sheep's butter
SFA	70.2	71.0	68.9	74.1	66.2
cis-MUFA	17.5	17.9	18.5	15.2	21.9
trans-MUFA	3.5	3.2	3.6	3.3	3.0
cis-PUFA	3.5	3.3	3.6	2.9	5.4
trans-PUFA	1.2	1.0	1.2	0.9	0.8
CLA	0.9	0.7	0.9	0.7	0.7

[a] SFA, total saturated fatty acids; *cis*-MUFA, total *cis*-monounsaturated fatty acids; *cis*-PUFA, total *cis*-polyunsaturated fatty acids.

Table 7
Deaths from breast cancer per 100,000 women and cheese consumption in the EU

Breast cancer deaths/100,000 women[a]			Cheese consumption[b]	
Countries	Years	Average	Year	(kg/capita)
EUR 15	1986–1993	31.1	1994	15.2[c]
Belgium	1986–1992	37.4	1995	14.2[d]
Denmark	1986–1993	39.4	1995	15.9
Germany	1986–1994	32.2	1995	18.3
Greece	1986–1995	22	1995	23.5
Spain	1986–1993	23.8	1994	7.6
France	1986–1994	28	1995	23.3
Ireland	1986–1993	38.8	1995	5.3
Italy	1986–1993	29.5	1995	19
Luxembourg	1986–1995	34.8	1995	14.2[b]
Holland	1986–1994	38.6	1995	14.1
Austria	1986–1995	31.6	1994	13.2
Portugal	1986–1995	24.9	1995	7.2
Finland	1986–1995	24.2	1995	13.5
Sweden	1986–1993	25.4	1995	15.6
United Kingdom	1986–1994	40.1	1995	7.7

[a] Source: Eurostat (1997) [5].
[b] Source: Burrell (1996) [1].
[c] Data for EUR 12, EUR 15 figures not available.
[d] Data for both Belgium and Luxembourg.

cheese consumption was 23.5 kg per capita in Greece, while the average consumption in all European Union countries was 15.2 kg per capita.

The lowest mortality, 22 deaths per hundred thousand women, is registered in Greece, which enjoys a high consumption of cheese. Other countries of south Europe (France, Italy, Spain, and Portugal) show also less cancer mortality than the central European countries although, in Spain and Portugal, cheese consumption is very low. This may be a result of the Mediterranean diet, which consists of dairy products, olive oil, vegetables, legumes and fish.

It is interesting to make a comparison between the consumption of cheese and the mortality from breast cancer in countries with similar dietary habits. Among the Mediterranean countries (Greece, Spain and Italy) the mortality from breast cancer is lowest in Greece, where the consumption of cheese is the highest.

On the other hand, countries that have a high percentage of mammary cancer mortality, usually have low cheese consumption. Thus, in the United Kingdom where the cheese consumption is about the half the average in the European Union (EU), the mammary cancer mortality is the highest. Relatively high breast cancer mortality is also registered in Ireland, Belgium, Holland and Germany.

The data for the Scandinavian countries (Denmark, Sweden and Finland) seem to be peculiar. The cheese consumption in these countries is similar to the average of the EU, and although Denmark shows one of the highest percentages in mammary cancer mortality among the countries of the EU, Sweden and Finland are among the lowest. This difference might be a result of the traditional dietary habits of Sweden and Finland, where large amounts of sea products are consumed.

The Feta and hard cheese consumption in Greece and its importance against breast cancer is underlined by the fact that the blood of Greek people has four times higher concentrations (about 0.5% weight ratio of total lipids) in CLA (Matsakas et al., 1999) than Central European people (~0.12%, Zlatanos, Sagredos, Feist, & Laskaridis, in preparation).

These results provide primary evidence that dietary CLA reduces breast cancer risk to a great extent. Because of the beneficial effect in the protection against cancer, we recommend epidemiological studies, first in dairy products with regard to CLA and then in other components included in the Mediterranean diet.

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