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Conjugated Linoleic Acid (Cla) Concentration and Fatty Acid Composition of Brazilian Fermented Dairy Products

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Abstract

Fermented dairy products have been widely studied due to their nutritional importance and functional properties. Milk fat has a complex composition; even though it is a rich source of saturated fatty acids, which have been associated with increased risk of cardiovascular diseases. In this context, this study was aimed to know the fatty acid profile, evaluating the milk fat quality of whole fermented dairy products with registration in the state or federal inspection and highlight their importance to consumers' health. Samples of yogurt and fermented dairy beverages were collected to evaluate the fatty acids composition. The predominance of saturated fatty acids was observed: myristic, palmitic and stearic acids, also indicating the presence of unsaturated fatty acids: oleic, linoleic and vaccenic, besides the content (g/100 g of fatty acids) of conjugated linoleic acid ranging from 0.290 to 1.15 for yogurts and 0.546 to 0.640 for dairy beverages. Thus, the fatty acid profile of fermented dairy products has similar composition comparing the inspection registration type, besides being a source of fatty acids beneficial for health.

Keywords: Yogurt; Fermented dairy beverages; Milk fat; CLA; Food composition; Health

Introduction

Milk and dairy products have high nutritional value, being important sources of carbohydrates, lipids, proteins, calcium, phosphorus, iodine, riboflavin and vitamins A and B12 [1]. Among other nutrients, milk fat is one of the most complexes, with unique nutritional and physical properties. This fat can contain up to 400 different fatty acids, some of them recognized as indispensable components for a healthy diet. Besides, contains conjugated linoleic acid (CLA) and short- and medium-chain fatty acids that may have anti-inflammatory, anticancer, antibacterial, ulcerative, anticolite, anti-atherosclerosis, antihypertensive effects, also improving the immunological activity [2,3].

For many years, milk fat has been the subject of many researches which associated the amount of saturated fat with the risk of cardiovascular diseases, which made low-fat foods gain prominence on supermarket shelves and in the population's diet of all ages. However, several controlled and epidemiological studies on saturated fatty acids present in milk fat, although representing around 60% of total fat, have not show any evidence of increased cardiovascular disease' risks [2]. Furthermore, low-fat dairy products do not contain significant amounts of unsaturated and omega-3 fatty acids, important for mental and cardiac health [4].

The inspection registration is a Brazilian control system that certifies the quality of animal source foods of in their sanitary and technological aspect. The inspection level: federal, state or municipal concerns the level of industry marketing. Therefore, products must comply with the specific laws of each commercialization area, which usually features different quality parameters. In this context, this research aims to analyze the difference in dairy fat quality between whole fermented dairy products registered in the state and federal inspection, and emphasize the importance of the lipid composition from these products for consumers' health and well being.

Materials and Methods

Sampling

Forty-two samples of yogurt and fermented dairy beverages, both whole and strawberry flavored, were collected from April to August 2013, from different Brazilian dairy industries with federal or state inspection register.

The study included 18 yogurts (6 with federal register and 12 with state register) and 24 fermented dairy beverage samples (12 with federal register and 12 with state register). Samples were chosen considering their large consumption by the Brazilian population, according to the Annual per capita Survey of Household Food Acquisition, which found an annual national per capita consumption of 43.7 kg for dairy products, among them milk (38.4 kg), yoghurts, dairy beverages and fermented milks (3.12 kg) [5].

Fatty acid composition

The fatty acid analysis was performed by extracting total lipids according to Folch, Fess & Stanley [6] then the lipids were esterified as described by Hartman & Lago [7], all steps were performed in triplicate.

Programming parameters used to quantify CLA and fatty acid methyl esters through gas-chromatographic analysis, were as

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previously described by Kliem, Shingfiels, Livingstone & Givens [8]. Helium was used as carrier gas (flow rate of 1 mL min-1) whereas the injector temperature was maintained at 250°C and the detector at 260°C. Aliquots of 1.0 µL esterified extract were injected into a Split/Splitless type injector. The injections were performed by gas chromatography (VARIAN 430-GC, California, USA) equipped with flame ionization detector (FID); fused silica capillary column (CP WAX 52 CB, Varian) with the following parameters: 60 m × 0.25 mm and 0.25 µm of film thickness. The chromatograms were recorded on Galaxie Chromatography Data System software. Fatty acids peaks were identified by comparison with the retention times of the reference methyl esters standards (FAME Mix–18919–SUPELCO, Pennsylvania, USA). The results were expressed as g/100 g of fatty acids.

Statistical analysis

Data were submitted to analysis of variance and the medias compared by the Tukey test at 5 % in a completely randomized design with three replicates. Statistical analyses were performed using the general linear model (GLM) from the SAS statistical package [9].

Results and Discussion

The fatty acid profile of yogurts and dairy beverages, even as the register type (Table 1), showed similar lipid composition, identifying twenty-two fatty acids, consistent with results observed by Serafeimidou, Zlatanos, Laskaridis & Sagredos [10] and Kliem et al. [8] for milk fat. Several surveys concluded that processing and storage of dairy products generally does not significantly change the milk fat composition [11,12]. And this study confirms that, because even in the case of products that undergo fermentation processes distinct, yogurt and dairy beverage, the lipid composition was similar.

Saturated fatty acids (SFA) predominant in both yogurt and dairy beverage and samples with federal and state register are myristic acid, palmitic acid and stearic acid (C14: 0, C16: 0 and C18: 0, respectively), and among unsaturated fatty acids, oleic acid, vaccenic acid and linoleic acid (C18:1n9c+t, C18:1n11c and C18:2n6c, respectively) stand out with antiatherogenic effects. Vaccenic acid can be partially converted into CLA, recognized for potential health benefits [13].

The percentage of SFA ranged between 66.1 and 69.6 g/100 g of fatty acids, 26.4 and 29.9 g/100 g of fatty acids for MUFA, from 3.81 to 4.07 g/100 g of fatty acids for PUFA, consistent with Serafeimidou et al. [10]. Saturated fatty acids have higher proportion of milk fat lipids, reason why for many years it was believed that saturated fatty acids are associated with increased low density lipoprotein (LDL) and exposure to cardiovascular diseases, although recent studies have reported that there is not any evidence to support such claim [14-16]. However, saturated fat contributes to the proper functioning of the body for being an integral part of cell membranes and plays an important role in the storage of vitamins A, D, E and K in cells [3].

The content of CLA isomer (C18:2c9, t11) ranged from 0.290 to 1.15 g/100 g of fatty acids (mean 0.631 g/100 g of fatty acids) for yogurts, and from 0.546 to 0.640 g/100 g of fatty acids (mean 0.546 g/100 g of fatty acids) for dairy beverages, these results are consistent with those found for dairy products by Serafeimidou et al. [10] and Kliem et al. [8] considered excellent sources of CLA, indicating good quality of the milk fat in Brazilian fermented milk products. The variation in CLA content, especially in yogurts samples, may be explained by differences in initial CLA content of raw milk, in addition to type of starter culture, temperature and production technologies [17].

The fatty acids that showed variation in percentage of concentration ($P<0.05$) in relation to the products (yogurt and fermented dairy beverage) were: C12:0 and C14:0 (acids: lauric and myristic, respectively) and short- and medium-chain saturated fatty acids, with higher values corresponding the dairy beverages. These variations may be related to differences in fat percentage of products, geographical origin, animal feed, manufacturing process, heat treatment, among other factors [17]. The presence of short- and medium-chain saturated fatty acids is typical of bovine milk fat. In the human body, these acids are used as energy sources by muscles, heart, liver, kidneys, blood platelets and nervous system, and do not represent obesity risk [3]. Long-chain fatty acids (more than 50.0 % in this work) have antihypertensive, anti-inflammatory, antibacterial, anticarcinogenic and anti-atherosclerosis effects, and participate in the immune regulation [18].

Regarding the inspection registration of products (Table 1), no difference was found ($P<0.05$) between the fatty acid profile of products registered at state or federal level, presenting similar milk fat

Fatty acid	Product		Register		SEM	P>F
	Yogurt	Dairy beverage	State	Federal		
C6:0	0.037	0.168	0.96	0.134	0.05	0.17
C8:0	0.163	0.347	0.23	0.314	0.05	0.07
C10:0	1.14	1.57	1.39	1.38	0.12	0.1
C12:0	2.13^{b}	2.69^{a}	2.22	2.76	0.15	0.22
C14:0	9.83^{b}	11.0^{a}	10.5	10.6	0.27	0.05
C14:1n5c	0.66	0.722	0.71	0.67	0.04	0.35
C15:0	1.35	1.34	1.38	1.29	0.03	0.78
C16:0	33.6	35.1	34	35.2	0.6	0.3
C16:1n7	1.41	1.29	1.43	1.22	0.09	0.92
C17:0	0.845	0.827	0.86	0.801	0.02	0.83
C17:1n7c	0.162	0.191	0.19	0.164	0.02	0.56
C18:0	16.6	16.1	16.3	16.3	0.37	0.41
C18:1n9c+t	24.6	21.7	23.8	21.9	0.9	0.2
C18:1n11c	2.93	2.44	2.58	2.74	0.18	0.07
C18:2n6c	2.64	2.55	2.47	2.75	0.25	0.89
C18:2c9t11 (CLA)	0.631	0.546	0.58	0.586	0.05	0.26
C18:3n3	0.443	0.448	0.48	0.397	0.05	0.75
C20:0	0.297	0.26	0.25	0.309	0.02	0.39
C20:1n9	0.079	0.045	0.07	0.046	0.03	0.83
C20:3n3c	0.251	0.295	0.26	0.298	0.04	0.64
C22:0	0.053	0.042	0.05	0.05	0.01	0.51
C23:0	0.007	0.134	0.13	0.018	0.06	0.28
SFA	66.1	69.6	67.4	69.2	1.12	0.22
MUFA	29.9	26.4	28.8	26.7	1.03	0.17
PUFA	3.97	3.88	3.81	4.07	0.28	0.93
SCSFA	1.34^{b}	2.09^{a}	1.72	1.83	0.18	0.06
MCSFA	13.3^{b}	15.1^{a}	14.1	14.6	0.4	0.06
LCSFA	51.5	52.5	51.6	52.7	0.8	0.69
ω3	0.694	0.743	0.74	0.696	0.06	0.61
ω6	2.64	2.55	2.47	2.75	0.25	0.89
ω6/ω3	3.74	3.88	3.7	3.96	0.36	0.6

SEM: standard error of the mean; CLA: conjugated linoleic acid; c: cis; t: trans; SFA: saturated fatty acid; MUFA: monounsaturated fatty acid; PUFA: polyunsaturated fatty acid; SCSFA: short-chain saturated fatty acid; MCSFA: medium-chain saturated fatty acid; LCSFA: long-chain saturated fatty acid. Means followed by different lowercase letters in the same row indicate significant differences according to Tukey's test at a 5% significance level.

Table 1: Fatty acid composition, in g/100 g of fatty acids, of products and register types.

composition regardless of the inspection level, and reflects standards of satisfactory quality for products with both federal and state inspection level, because they present significant amounts of beneficial fatty acids to health as CLA and omega-3 and omega-6 fatty acids, being offered for Brazilian consumers dairy products with uniform lipid quality.

Polyunsaturated fatty acids, especially ω3, ω6 and Conjugated Linoleic Acid (CLA) found in the products analyzed might have anti-inflammatory, anticancer, antibacterial, ulcerative anticolite, anti-atherosclerosis, antihypertensive effects, also improving the immunological activity [2,3]. Omega-6 fatty acids are necessary for many physiological functions. Several studies point to a cholesterol-lowering effect of linoleic acid, the main ω6 fatty acid, reducing the risk of cardiovascular diseases [3]. Therefore, the presence of these fatty acids in fermented dairy products indicates good quality of milk fat, because it promotes beneficial effects on consumer health.

As a result of the widespread allegations that saturated milk fat brings damages to health, whole milk has been rejected by consumers, being replaced by low-fat products. With an indication of decreased consumption of saturated fat, there has been an increase in the consumption of other nutrients such as refined carbohydrates. However, the substitution of saturated fats by simple carbohydrates might have great impact on the increased risk of cardiovascular diseases and diabetes [19].

Recent studies have shown that the inclusion of whole milk products should be recommended due to their complex and varied composition of fat milk, in addition to its greater satiety capacity, while low-fat foods do not contain significant levels of unsaturated and omega-3 fatty acids. The study by Scharf et al. [4] with children aged from 2 to 4 years-old who consumed whole and skimmed milk revealed that children who consumed skimmed milk gained more weight and were more likely to be obese than those who consumed whole milk, reinforcing the importance of this food and its derivatives in the diet.

Despite claims of benefits related to individual fatty acids, more research should be conducted to confirm these benefits in the complex mixture of fatty acids present in milk fat.

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