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Availability of Food Sources of Conjugated Linoleic Acid in Brazil

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Abstract: The aim of this study was to assess the availability of food sources of Conjugated Linoleic Acid (CLA) in the homes of Brazilian families. Information obtained from the Brazilian Institute of Geography and Statistics by a Household Budget Survey (2008-2009) were used for this analysis. The fat content of the selected foods was taken from tables of food composition and that of CLA from papers published in international journals. By crossing these data it was possible to found that the availability of CLA in Brazilian households is of 108 mg g^{-1} of fat, using as food sources cow's milk and its derivatives, in addition to beef. This value is below the estimated one for CLA to perform its health beneficial function which would be around 3.5 mg/day, however, it is similar to that found for the consumption of CLA in other countries.

Key words: Conjugated linoleic acid, consumption, food intake

INTRODUCTION

Data of food availability are considered important to obtain information about the feeding pattern of a population and its evolution throughout time which allows to estimate the quality of nutrients (Becker, 2001). Food availability of Brazilian households can be assessed from surveys of population data (Household Budget Survey-HBS) carried out by the Institute of Geography and Statistics (IBGE). Even though, the information about food intake of the Brazilian population can be considered scarce (Morato and Silva, 2008).

Aiming the achievement of the HBS 2008-2009, IBGE collected data in urban and rural areas across the country, from May 19th 2008 to May 18th 2009, covering a sample of 68,373 households. Information concerning the food acquisition by households was obtained through a daily record during seven consecutive days, containing a detailed description of each product purchased, for consumption, such as the quantity, the unit of measurement (weight or volume), the actual amount paid (in Reals = Brazilian currency) and the way of product acquisition (IBGE, 2010b).

The Conjugated Linoleic Acid (CLA) is a polyunsaturated fatty acid which comprises a group of positional and geometric isomers derived from linoleic acid (C18: 2n-6) (Risérius *et al*., 2001). This acid is produced by bacterial fermentation in the digestive tract of ruminant animals, therefore, its main sources are milk and its derivatives as well as meat from ruminant animals (Evans *et al*., 2002). Thus, despite being found in vegetable oils, CLA concentration is particularly high in meat and milk from ruminants, where it can reach a value of 0.65% of total lipids (Fritsch and Steinhart, 1998).

No report was found in the literature about the consumption of CLA in Brazil and even in other countries the data are scarce. It is estimated that the daily intake of CLA is approximately of 200 mg/day and that the predominant isomer in the diet is the c9t11-CLA, reaching 90% of total CLA in dairy products (Ritzenthaler *et al*., 2001).

In this way, the objective of this study was to identify the availability of foods considered sources of CLA in the Brazilian market and to estimate their consumption by the Brazilian households.

MATERIALS AND METHODS

Aiming the evaluation of the per capita daily intake of CLA, first a survey of data acquisition of foods considered as sources of CLA by the Brazilian population (CLA-Food sources) was carried out which were obtained from the HBS 2008-2009 (IBGE, 2010b). In this study, the selected CLA-Food sources were cow's milk and its derivatives (cheese, yogurt, cream, condensed milk and butter) as well as beef (Ritzenthaler *et al*., 2001; Evans *et al*., 2002; Rainer and Heiss, 2004; Whigham *et al*., 2004).

The fat content of these foods was estimated using tables of food composition (Franco, 1996; NEPA-UNICAMP, 2006). The amount of CLA in CLA-Food sources was estimated from the values found in the scientific literature (Akalin *et al*., 2007; Baublits *et al*., 2007; Ismail *et al*., 2007; Luna *et al*., 2007; Nieuwenhove *et al*., 2007; Prandini *et al*., 2007).

The amount of CLA of each food was calculated by simple rules of three, considering the fat and the CLA contents of foods. Finally, the per capita daily intake of

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CLA in Brazil was estimated by the total content of CLA of foods divided by 365 (number of days in a year). The found value was converted to mg in order to facilitate comparison of data.

RESULTS AND DISCUSSION

The selection of CLA-Food sources was based in the fact that this ingredient is produced in the rumen of cattle (and other ruminants) by the incomplete biohydrogenation of dietary polyunsaturated fatty acids via bacterial fermentation (*Butyrovibrio fibrisolvens*) that isomerizes linoleic acid to CLA (Evans *et al*., 2002). Thus, these foods originated from cattle have a high content of this molecule, as shown in Table 1.

Some studies showed that the process of skimming (partial or total) of milk is responsible for the loss of most of the CLA and only trace amounts remain in this food. Currently, dairy products contain only a third of the amount of CLA they used to have before 1960 (Dhiman *et al*., 1999). In addition, changes in cattle feed, such as the oil source, may lead to a decrease (Dhiman *et al*., 1999) or an increase (Santos *et al*., 2001) of the CLA content in meat and milk from cattle.

The CLA content of cow's milk shows a large variation depending on the type of management, breeds and seasons of the year. Thus, the CLA content in dairy products such as yogurt is a reflection of the raw materials that gave rise to them (Dhiman *et al*., 1999).

The process of pasteurization of milk seems to increase the CLA content, as reported by Shantha *et al*. (1994) who observed that yogurt made with pasteurized milk showed higher CLA content (5.25 mg CLA.g^{-1} fat) compared to that where unpasteurized milk was used (4.40 mg CLA.g^{-1} fat).

Numerous physiological properties attributed to CLA have been proven, including anticarcinogenic (Ip *et al*., 2002; Ma *et al*., 2002) and antiatherogenic (Sher *et al*., 2003) functions, changes in body composition (Park *et al*., 1997; Blankson *et al*., 2000; Risérius *et al*., 2001;Gaullier *et al*., 2004) and modulation of immune function (Cook *et al*., 1993).

No report was found in the literature about the consumption of CLA in Brazil. Thus, this parameter was estimated by cross-checking the data, as described in the methodology and shown in Table 2. Regarding the CLA consumption in other countries, some data were found in the literature. Thus, some studies carried out in the U.S. showed averages of 139 mg/day of CLA for young men and women (Herbel *et al*., 1998) and up to 290 mg/day of CLA for women in stage of lactation who consumed dairy products. Ritzenthaler *et al*. (2001) found different values for the population in the U.S., i.e., 176 mg/day for men and 104 mg/day for women. In Sweden, the CLA consumption was estimated at 160 mg/Day, for both women and men, in average (Jiang *et al*., 1999).

It is worth stating that in all works found in the literature concerning the CLA consumption, a high intake of dairy products was considered as the main source of this substance in the diet.

In general, the analysis of the data of CLA consumption in the literature showed a similar estimate of CLA availability between Brazilian population and that one from other countries.

However, it is important to note that the data collected by the HBS 2008-2009, concerning the type and quantity of

Table 1: CLA content in foods considered sources of this ingredient

Foods[1]	CLA Content[2] (mg g^{-1} of fat)
Milk	5.5
Cheese	4.9
Yogurt	3.28
Butter	4.7
Margarine	1.22
Cream	0.55
Condensed milk	0.32
Beef	4.3

[1]Foods derived from cattle.

[2]Average content of CLA (Akalin *et al*., 2007; Baublits *et al*., 2007; Ismail *et al*., 2007; Luna *et al*., 2007; Nieuwenhove *et al*. 2007; Prandini *et al*., 2007).

Table 2: Estimated availability of CLA and fat in Brazilian households

	Annual per capita consumption of foods[1] (Kg)	Annual per capita consumption of fat[2] (g)	Annual per capita consumption of CLA[3] (g g^{-1} fat)	Per capita availability estimates of CLA[4] (mg g^{-1} fat)
Whole milk	38.05	1141.59	6.28	
Cheese	1.91	381.15	18.68	
Yogurt	2.05	61.41	0.20	
Butter	0.27	224.17	1.05	
Margarine	1.68	1271.93	1.55	108
Cream	0.38	115.37	0.06	
Condensed milk	0.67	58.29	0.02	
Beef	17.03	2553.14	10.89	

Sources: [1]Household Budget Survey (HBS) 2008-2009 from Brazilian Institute of Geography and Statistics (IBGE).

[2]Assessment of fat in tables of food chemical composition.

[3]Measured by crossing data from the HBS 2008-2009 and CLA content of papers published in international journals.

[4]Value obtained by the sum of column 4 divided by 365 (number of days in a year) and divided by 1000, in order to convert to mg.

food purchased by Brazilian families, indicated the availability of food for consumption at home and not the consumption by individuals, since no evaluation was performed out of home.

In this same work it was shown that around 31.1% of feeding expenses are allocated to out-of-home meals, implying that most of the spending correspond to lunch and dinner which contain large amount of meat (an important CLA source).

It should be emphasized that the food consumption from bovine origin in Brazil varies considerably between the population from different regions and the North and the South are the largest consumers (IBGE, 2010b). Also, one must consider the differences among the methodologies used for estimating CLA intake. Thus, in international studies this is made by sampling (maximum of one hundred subjects) and evaluates the diets of selected volunteers, while in Brazil HBS 2008-2009 was used which represents a more reliable sampling, because this data collection considered the whole Brazilian population.

Moreover, it is important to mention about the Workers' Food Program in Brazil, since it provides food to the worker in his working environment, mainly in the south and southeast regions. Considering that these meals, containing meat and dairy products, were not considered in this study, the assessment of CLA intake in Brazil is only possible if the estimates based on food consumption surveys are carried out.

However, it is important to point out that a more complete assessment of the nutritional adequacy of the actual food consumption by the Brazilian population (food consumption outside home and at home) will be made in due course from the collected data from IBGE (IBGE, 2010a). This will allow a more accurate estimate of CLA consumption by this population and not only the availability of food sources will be considered.

It is still important to emphasize that the CLA consumption is influenced by the type and quantity of food consumed by the population. In Brazil, the consumption of dairy products increased around 88.5% between 1992 and 1996, while that of yogurt increased of 308% over the same period (Cotini, 1998) and that of fermented milk of 625% in the period from 1974 to 2003 (IBGE, 2008). Considering that these foods are important sources of CLA in the diet, it can be inferred that consumption of this acid in Brazil increased during the last years.

There is no consensus about the optimal per capita consumption of CLA. Using the extrapolation from experiments with rats, IP *et al.* (1991) estimated that consumption of this ingredient for a person weighing 70 kg should be of 3.5 g daily in order to produce a reduction of proliferative activity of cells. Blankson *et al.* (2000), in a study with humans, found that a dose of 3.4 g/day of CLA produced a significant reduction in fat mass of overweight or obese individuals.

By comparing the data obtained in the present study with the proposed doses of CLA, it can be inferred that the consumption of this ingredient by Brazilian population from cow's milk, its derivatives and beef, is much lower than those recommended for obtaining benefits mentioned above. Thus, it would not be possible to achieve the doses of CLA suggested in the studies only by the diet, since this ingredient is present in the fat of foods and the total dietary fat intake would rise to unhealthy levels.

Conclusion: The estimate of the availability of CLA in Brazil, using as food sources cow's milk and its derivatives (cheese, yogurt, cream, condensed milk and butter) as well as beef, was of 108 mg g^{-1} of fat. This value is similar to those reported in studies of CLA consumption in other countries, however it is below the estimated values for the CLA to produce beneficial health functions which would be around 3.5 g/day.

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