DOI: http://dx.doi.org/10.12957/demetra.2015.12981

Serving size and trans-fat: are the brazilian nutrition labels adequate?

Nathalie Kliemann[1]
Mariana Vieira dos Santos Kraemer[1]
Bruna Maria Silveira[1]
David Alejandro González-Chica[2]
Rossana Pacheco da Costa Proença[1]

[1] Universidade Federal de Santa Catarina, Núcleo de Pesquisa de Nutrição em Produção de Refeições, Programa de Pós-Graduação em Nutrição, Departamento de Nutrição. Florianópolis-SC, Brasil.

[2] Universidade Federal de Santa Catarina, Programa de Pós-Graduação em Nutrição, Departamento de Nutrição, Florianópolis-SC, Brasil.

Financing: Coordination for the Improvement of Higher Education Personnel (CAPES) – Master's, TDI3 and PIBIC scholarships.

Corrrespondence
Rossana Pacheco da Costa Proença
Departamento de Nutrição, Programa de Pós-Graduação em Nutrição, Universidade Federal de Santa Catarina, Campus Universitário, Trindade, 88040-900 Florianópolis-SC, Brasil.
E-mail: rossana.costa@ufsc.br

Abstract

Objective: To associate serving size and *trans* fat on the nutrition facts label of packaged foods commercialized in a Brazilian supermarket. *Methods*: The serving size was categorized according to the Brazilian law and the *trans* fat occurrence was determined by the ingredient list statement of hydrogenated fats designations. The false negative prevalence was estimated considering the products that reported nonoccurrence of hydrogenated fat on the nutrition facts, but contained this fat in the ingredient list. Chi-square and ANOVA tests were used, considering as statistically significant p-value <0.05. *Results*: Half of the products examined presented *trans* fat on the ingredient list and, comparing to the nutrition facts, almost 40% were false negative. The *trans* fat and false negative rate increased to the maximum size allowed for the serving and decreased in the products with a serving size above the allowed limit. For products classified as ready for consumption, a similar pattern of energy density and the occurrence of *trans* fat on the ingredient list was observed; however, for false negative rate, this association was reversed. *Conclusions*: The information of serving size can be related to the occurrence of *trans* fat on the nutrition facts of packaged foods.

Key words: *Trans* Fatty Acids. Food Labeling. Food Serving Size. Nutritional Facts.

Introduction

In the past decades, studies have reported changes in dietary patterns throughout the world[1] and in Brazil,[2] with grains and cereals being replaced by animal foods, sugars, fats and especially processed foods. Researchers have even proposed the definition of ultra-processed foods as those foods modified to add or introduce substances that consistently change their nature, and associated the consumption of such foods with current obesity epidemic.[3]

In this context, many industrial foods in general contain large amounts of *trans* fats.[3,4] The industry uses this type of fat, resulting from hydrogenation process, to improve the physical and sensory characteristics and preservation of industrial foods.[5] However, consumption of *trans* fat represents a risk factor for the development of various chronic diseases, e.g., cardiovascular diseases and obesity.[6-8]

So, considering that the use of *trans* fats from industrial sources have potential deleterious effects on health, the World Health Organization (WHO) launched in 2004 the Global Strategy on Diet, Physical Activity and Health, setting as goal the elimination of consumption of industrial *trans* fat.[9] Such recommendation was reinforced by WHO in 2013, including *trans* fat to the fight against chronic non-communicable diseases.[10] From the beginning of this movement, in 2008 the Pan-American Health Organization (PAHO/WHO), jointly with representative bodies of the food industry, agreed to reduce the amounts of *trans* fat in processed foods in Latin America and the Caribbean.[11] Recently, *trans* fat has been cited in publications as one of the key issues discussed in articles on the challenges to prevent obesity.[12,13]

Aiming to inform consumers on the presence of *trans* fats on processed foods, Brazilian regulations, in agreement with the Mercosur countries, since 2003 has included such statement as a mandatory item in foods labeling.[14] The regulation RDC no. 360/2003[14] defined as mandatory declaration of the percentage of *trans* fat in relation to the serving size in packaged food labels. However, this regulation[14] states that the foods with *trans* fat levels lower than or equal to 0.2 grams, which is a value described as non-significant for the serving, can be considered and informed as "zero *trans*".

Proença & Silveira[15] advise that the scientific basis for the establishment of the legal limit values for the inclusion of *trans* fat on the nutritional facts labels is not clear and not in accordance with WHO's recommendation[9] for elimination of *trans* fat from industrial foods. In addition, the authors point out that there are no recommended values for *trans* fat intake, because this kind of fat is not a nutrient and can be harmful to health.[6,8] They also argue that determining a limit value for declaration of *trans* fat on food labels weakens the legislation, because the statement of nonexistence of *trans* fat in the nutritional facts is not safe and requires that consumers read the ingredient list so that they can identify the presence of *trans* fat in the food.[15]

Hissanaga et al.[16,17] analyzed Brazilian industrial foods whose labels stated that the foods were free from *trans* fat and found most of it on the statement of *trans*-fat component sources in the ingredient lists. Gagliardi et al.[18] analyzed in laboratory the presence of *trans* fat in packaged foods of the Brazilian kind of fast foods, which stated 0% of this ingredient, and detected the presence of trans fat in all foods examined, with values ranging from 0.01g to 1.97g of *trans* fat per serving size.

The reference serving size for labeling in metric grams (g) or milliliters (ml) is regulated by the RDC no. 359/2003,[19] which allows that the stated serving sizes can be up to 30% above or below the recommended value. However, some processed foods do not have a reference serving size in this regulation, as is the case of ready-made preparations. For these products, the regulation sets that the serving size is the amount of grams corresponding to 500 kilocalories (kcal) of the product.[19] Therefore, the food industry can choose different serving sizes for the labeling of packaged foods, which can influence the information provided on the amount of nutrients contained in the product. According to Proença & Silveira,[15] when the amount of *trans* fat does not reach the limit of 0.2 grams per serving size, as specified by the law, the company has no obligation to declare the amount of this fat on the food labels.

Thus, considering the hypothesis that the serving size can be determinant in the declaration of *trans* fat in the labels, this research aimed to examine the association of the serving size and the presence of *trans* fat, as declared in Brazilian packaged foods, considering the information contained on the food labels displayed to consumers.

Methodology

Data collection

This is a cross sectional study in which all industrial foods available for sale in a large supermarket in Florianópolis-SC, capital of a state in the south of Brazil, were examined. One supermarket branch of a chain of 21 stores in the southern region was randomly chosen for the study.

From the list of industrial foods available in the selected supermarket, the study excluded those to which the Brazilian legislation is not applicable regarding nutritional labeling[14] and/or those that did not have fat added to the composition, as detailed in the ingredient list. In addition, the products that did not inform the serving size in the nutrition information, powder products that did not provide information on yield, and the products that informed the serving size in household measures only, were excluded.

Through a form previously tested, information were collected from the labels of processed foods, including the product identification (type, commercial name, flavor and brand name), nutritional

information (serving size, in grams or milliliters, and information on *trans* fat content), and *trans* fat component declared on the ingredient list. Variations of the same food product in containers of different sizes were considered as a new product, as not all had similar serving sizes.

Trained nutritionists collected the data in May 2010, after receiving authorization by the supermarket manager.

Data analysis

The information were entered twice into two different databases and then validated to check for any typing error.

The serving size of each food product was categorized according to its compliance to the RDC no. 359/2003,[19] as shown on Table 1.

Table 1. Classification of the serving size in g or ml stated on the labels in relation to the serving size recommended by RDC no. 359/2003, the Brazilian law on nutritional labeling. Brazil, 2010.

Classification [a]	Meaning	Conformity to the Brazilian law [b]
<70%	Serving size smaller than 70% of the recommended serving size in g or ml	Inadequate
70-99%	Serving size up to 30% smaller than the recommended serving size in g or ml	Adequate
100%	Serving size identical to the recommended serving size in g or ml	Adequate
101-130%	Serving size up to 30% larger than the recommended serving size in g or ml	Adequate
>130%	Serving size larger than 30% of the recommended serving size in g or ml	Inadequate

[a] Classification of the serving size in g or ml as stated on the labels in relation to the serving size recommended by the law. [b] RDC no. 359/2003.

For the foods classified as ready for consumption, for which the law does not specify the reference serving size, the energy density was calculated by estimating kilocalories for every 100 grams of the corresponding product. This variable was subsequently classified into three categories: ≤ 100, 101-200 and > 200 kcal/100g. For each category, the median of the serving size and the interquartile interval were calculated.

To determine the presence of *trans* fat in the processed foods, the presence of the following specific designations of *trans* fat, as informed on the ingredients list, were considered: hydrogenated vegetable fat; partially hydrogenated vegetable fat; partially hydrogenated vegetable oil; hydrogenated vegetable oil[15,20] It should be noted that vegetable fat, when fully hydrogenated, is a solid fat, which does not contain *trans* fatty acids and has no practical application in foods. [21] Therefore, the designation "hydrogenated vegetable fat" was considered as an indication of the presence of *trans* fat,[21] which can be used in foods production. Moreover, as vegetable shortenings, creams and margarines may or may not contain *trans* fat, these items were included as alternative declarations of the presence of *trans* fat, in order to avoid the exclusion of foods that may contain such isomers.[22,23] Such components were defined based on scientific evidences, which have shown in physicochemical analyses that these ingredients are associated with higher contents of *trans* fat in foods. [5,24,25]

Products identified as not having *trans* fat on the nutrition facts label, but had components with *trans* fat in the ingredient list were considered, so the prevalence of false negatives for the absence of *trans* fat was estimated.

For the analysis of the information, the industrial foods were divided into six major groups, according to the type of food, based on the classification described on the RDC no. 359/2003.[19]

- **Group A:** Bakery products, cereals, legumes, roots, tubers and tuber products (salty biscuits, snacks, shoestring fries, breakfast cereals, microwave popcorn, *farofa* (toasted cassava flour mixture), dried pasta, instant noodles, chilled pasta, pizza doughs, toasts, industrial breads, frozen fries, frozen cheese bread, frozen pasta, frozen polenta, garlic bread, frozen sandwiches, bakery goods).
- **Group B:** Milk products (yogurt, milk drinks, cheese, curd, cream cheese).
- **Group C:** Meat products (pâtés, frozen breaded foods, frozen meatball, burgers).
- **Group D:** Oils, fats and oil seeds (processed oil foods, margarine and vegetable fats, butter, *chantilly*.

- **Group E:** Sugars and products that provide energy from carbohydrates and fats (candies, chewing gums, peanut sweets, chocolate, cookies, ready-made cakes, ready-made desserts, ice cream, *brigadeiro* (sweet made of condensed milk and chocolate), granules, ice-cream powder, coverings and toppings, sweet creams.
- **Group F:** Sauces, savory spice blends, spice mixes, broth, soups and ready-made foods (savory blends, vacuum sealed meals, frozen lasagna, frozen pizza, frozen ready-made meals, frozen pies).

For the analysis of the association between the serving size (or energy density for ready-made preparations) with the presence of *trans* fat, prevalence rates were estimated with respective 95% confidence intervals. Chi-square tests and Anova trend analysis were used for heterogeneous variances to test the associations, considering $p<0.05$ as indication of statistical significance. The data was analyzed by the statistical software *Stata,* version 11.0 (StataCorp, College Station, TX, USA).

Results

A total of 2,020 industrial foods were examined, and 1,895 had serving sizes stated grams (belonging to all groups); in the other 125 food samples, servings were defined in kilocalories.

Analysis of the ingredients list revealed that hydrogenated fat (23%) was the main specific designation used to declare component with *trans* fat, while vegetable fat (58.4%) and margarine (13.4%) were considered the main alternative designations.

Regarding the serving size, it was found that 85.3% of the industrial foods (95%CI 83.6; 86.8) were in accordance with the allowed variability of more or less 30% of the recommended value. Half of all products examined had component with *trans* fat stated on the ingredient lists, and compared to the value reported on the nutrition facts label, the false negative rate was nearly 40%.

The presence of *trans* fat in the ingredients list presented a relation of reverse "J", with percentage of adequacy to the serving size in accordance with the RDC no. 359/2003[19] – i.e., it passed from only one-third in the products with lower percentage of adequacy to nearly 75% in the products found in the maximum allowed limit of variability, while more than half of the products that exceeded the allowed limit had *trans* fat in the ingredient list. The association between the adequacy of the serving size and the false negatives rate had a similar pattern of progressive increase with later reduction, which is shown on Table 2.

Table 2. Association between the percentage of adequacy to the serving size (g), as recommended by the RDC no. 359/2003, with the presence of *trans* fat in the ingredients list of industrial foods and false negatives rate[a]. Florianópolis-SC, 2010.

Percentage of conformity to RDC no. 359/2003	N	%	% with trans fat	95% CI	False negatives (%)	95% CI
				P<0.001*		P<0.001*
< 70%	203	10.7	36.0	(29.3; 42.9)	30.5	(24.3; 37.4)
70-99%	152	8.0	46.1	(37.9; 54.3)	38.2	(30.4; 46.4)
100%	1,392	73.5	52.6	(49.9; 55.2)	39.0	(36.4; 41.6)
101-130%	73	3.9	74.0	(62.3; 83.5)	50.7	(38.7; 62.6)
> 130%	75	4.0	54.7	(42.7; 66.2)	17.3	(9.6; 27.8)
Total	1,895	100.0	50.4	(48.1; 52.7)	37.6	(35.4; 39.9)

* Chi-square test with Yates' correction.

95% CI: 95% confidence interval.

[a]Products that reported nonexistent fat on the nutritional facts label but had this component in the ingredients list

The assessment of *trans* fat contents according to the groups of industrial foods (Table 3) showed that more than two-thirds of the products classified as sugars and carbohydrates (Group E) and more than half of the group of breads, biscuits and pasta (Group A) and ready-made preparations (Group F) had *trans* fat. Similarly, *trans* fat was found in about one-third of the meat products (Group C) and oils and fats (Group D), whereas only 5% of the milk products (Group B) had this component, and the difference between the groups was statistically significant (p<0.001). No clear pattern and no statistically significant difference were found when the association between the percentage of adequacy of the serving and the content of *trans* fat in the ingredient list was examined, according to the different groups of industrial foods.

Table 3. Association between the percentage of adequacy to the serving size (g), as recommended by the RDC no. 359/2003, and the *trans* fat content in the ingredient list, stratified by groups of industrial foods. Florianópolis-SC, 2010.

Group	Percentage of adequacy to the RDC no. 359/2003	N	%	95% CI	p-value
Group A Breads, biscuits and pasta	< 70%	50	56.0	(41.2; 70.0)	p= 0.101*
	70-99%	49	67.4	(52.4; 80.0)	
	100%	463	56.2	(51.5; 60.7)	
	101-130%	38	76.3	(59.7; 88.5)	
	> 130%	25	56.0	(34.9; 75.5)	
	Total	625	58.2	(54.3; 62.1)	
Group B Milk products	< 70%	93	6.5	(2.4; 13.5)	p= 0.204**
	70-99%	48	0.0	(--)	
	100%	207	5.3	(2.7; 9.3)	
	101-130%	1	0.0	(--)	
	> 130%	9	0.0	(--)	
	Total	358	4.8	(2.8; 7.5)	
Group C Meat products	< 70%	12	58.3	(27.6; 84.8)	p=0.147**
	70-99%	13	38.5	(13.8; 68.4)	
	100%	65	47.7	(35.1; 60.4)	
	101-130%	-	-	-	
	> 130%	7	0.0	(--)	
	Total	97	44.4	(34.2; 54.8)	
Group D Oils and fats	< 70%	1	100.0	(--)	p=0.518**
	70-99%	-	-	-	
	100%	69	37.7	(26.2;50.1)	
	101-130%	-	-	-	
	> 130%	8	25.0	(0.31; 65.0)	
	Total	78	37.2	(26.5; 48.9)	

Group	Percentage of adequacy to the RDC no. 359/2003	N	%	95% CI	p-value
Group E Sugars and carbohydrates	< 70%	45	68.9	(53.3; 81.8)	p=0.103*
	70-99%	37	73.0	(55.8; 86.2)	
	100%	546	69.6	(65.5; 73.4)	
	101-130%	34	73.5	(55.6; 87.1)	
	> 130%	23	43.5	(23.1; 65.5)	
	Total	685	69.1	(65.4; 72.5)	
Group F Ready-made preparations	< 70%	2	0.0	(--)	p=0.084**
	70-99%	5	100.0	(--)	
	100%	42	57.1	(40.9; 72.2)	
	101-130%	-	-	-	
	> 130%	3	0.0	(--)	
	Total	52	55.8	(41.3; 69.5)	

* Chi-square test with Yates' correction.

** Fisher's exact test.

95% CI: 95% confidence interval.

As can be seen on Table 4, the false negatives rate exceeded 50% in the groups of ready-made foods and sugars and carbohydrates, followed by breads, biscuits and pasta. On the other hand, the false negatives rate corresponded to one-third in the groups of meat products and oils and fats, and was only 4% in the group of milk products ($p<0.001$). In the group of breads, biscuits and pasta, more than half of the products with adequate serving size were identified as false negatives ($p<0.001$). In the group of meat products, the highest false negative rate was found in the products with serving size below 70% of the recommended value ($p=0.035$). The other groups did not present statistically significant difference between the false negative rate and the percentage of adequacy to the regulation.

Table 4. Association between the percentage of adequacy to the serving size (g), as recommended by the RDC no. 359/2003, and the false negative rate[a] in relation to the presence of trans fat, stratified by categories of industrial foods. Florianópolis-SC, 2010.

Group	Percentage of adequacy to RDC no. 359/2003	N	%	95% CI	p-value
Group A Breads, biscuits, pasta	< 70%	50	46.0	(31.8; 60.6)	p= 0.001*
	70-99%	49	59.2	(44.4; 73.0)	
	100%	463	40.2	(35.6; 44.7)	
	101-130%	38	55.2	(38.2; 71.3)	
	> 130%	25	12.0	(2.5; 31.2)	
	Total	625	41.9	(38.0; 45.9)	
Group B Milk products	< 70%	93	6.5	(2.4; 13.5)	p= 0.139**
	70-99%	48	0.0	(--)	
	100%	207	4.4	(2.0; 8.0)	
	101-130%	1	0.0	(--)	
	> 130%	9	0.0	(--)	
	Total	358	4.2	(2.4; 6.8)	
Group C Meat products	< 70%	12	58.3	(27.6; 84.8)	p=0.035**
	70-99%	13	7.7	(0.1; 36.0)	
	100%	65	36.9	(25.2; 49.8)	
	101-130%	-	-	-	
	> 130%	7	0.0	(--)	
	Total	97	33.0	(23.8; 43.3)	
Group D Oils and fats	< 70%	1	100.0	(--)	p=0.300**
	70-99%	-	-	-	
	100%	69	33.3	(22.3; 45.7)	
	101-130%	-	-	-	
	> 130%	8	12.5	(0.3; 52.6)	
	Total	78	32.1	(21.9; 43.6)	

Group	Percentage of adequacy to RDC no. 359/2003	N	%	95% CI	p-value
Group E Sugars and carbohydrates	< 70%	45	55.6	(39.9; 70.3)	p=0.442*
	70-99%	37	62.2	(44.7; 77.5)	
	100%	546	50.7	(46.4; 55.0)	
	101-130%	34	47.1	(29.7; 64.8)	
	> 130%	23	39.1	(19.7; 61.4)	
	Total	685	51.1	(47.3; 54.9)	
Group F Ready-made preparations	< 70%	2	0.0	(--)	p=0.083**
	70-99%	5	100.0	(--)	
	100%	42	57.1	(40.9; 72.2)	
	101-130%	-	-	-	
	> 130%	3	0.0	(--)	
	Total	52	55.8	(41.3; 69.5)	

* Chi-square test with Yates' correction.

** Fisher's exact test.

95% CI: 95% Confidence interval.

[a]Products that in the nutritional information were reported as not having *trans* fat, but presented component with *trans* fat in the ingredient list.

For the products classified as ready-made preparations (Table 5), the energy density was inversely related to the serving size. Contents of *trans* fat were higher in the products with energy density of 101-200kcal/100g, decreasing in the products with ≤100kcal/100g, and even lower in the products with >200kcal/100g ($p<0.001$). On the other hand, there was an inverse relation between the energy density and the false negative rate, with statistically significant trend ($p=0.049$), and inverse relation between the energy density and the median serving size in grams ($p<0.001$).

Table 5. Association between energy density (kcal/100g) and the serving size, presence of *trans* fat in the ingredients list and the false negatives rate[a]. Florianópolis-SC, 2010 (N= 125).

Kcal per 100g	N	Median serving size (g) (interquartile interval)	Presence of *trans* fat		False negatives	
			%	95% CI	%	95% CI
		P<0.001*		P<0.001**		P=0.049†
≤100 kcal	14	328 (250; 420)	28.6	(8.3; 58.1)	28.6	(8.3; 58.1)
101-200 kcal	54	313 (100; 325)	57.4	(43.2; 70.7)	16.7	(7.9; 29.2)
>200 kcal	57	100 (58; 125)	21.1	(11.3; 33.8)	8.8	(76.3; 94.9)

* ANOVA trend test for heterogeneous variances

** Heterogeneity Chi-square test with Yates' correction.

† Trend chi-square test.

95% CI: 95% confidence interval.

[a]Products that in the nutritional information were reported as not having *trans* fat, but presented component with *trans* fat in the ingredient list.

Discussion

In the study, it was found that more than half of the processed foods examined had some component with *trans* fat according to the ingredients list. Thus, this result shows that the industries are possibly failing in fulfilling the agreement made with WHO for the reduction of *trans* fat in processed foods. [11] A study conducted by Monge-Rojas et al., [26] which aimed to investigate the fulfillment of this agreement by 12 food companies received responses from only three industries (25%). According to these authors, such agreement seems that it does not ensure and provide enough information for monitoring processed *trans* fat in Latin America and the Caribbean.

Various designations were found when reporting components with *trans* fat on the ingredients list. Of these, more than half was defined as "alternative", because there was no certainty about the fat used. This fact may confuse consumers when they refer to the labels to identify whether the product contains *trans* fat or not.

It was found that "breads, biscuits and pasta" and "sugars and carbohydrates" were the groups that presented the highest percentage of *trans* fat in the ingredient lists. Such findings are of concern because consumption of these products by Brazilians is very high.[2,22] Monteiro et al.[22] reported a

change in the Brazilian dietary pattern by comparing the data of the Household Budget Surveys of 2002-03 with 2008-09,[2] observing a 40% purchase increase of ready-made meals and industrial mixes and a 10% increase for biscuits. It should be noted that some studies show that foods with larger amounts of *trans* fat are often more affordable and accessible to low-income people.[4,8,27]

Regarding groups B and C, milk products and meat products, respectively, *trans* fat was found in the ingredient lists of 5% of the products of the first group and in one-third of the products of the second group. It should be noted that *trans* fat may be present in the foods of these groups by natural formation of this fat via bio-hydrogenation process carried out by the rumen microbiota.[21,28] However, if only the naturally-transformed *trans* fat were reported, there would not be *trans* fat present on the ingredients list, because it would only be stated on the nutrition facts label. Thus, the findings of this study show the addition of industrial *trans* fat in foods that already have this fat naturally. It is important to consider that during the *trans* fat natural production process, it occurs formation of conjugated linoleic acid (CLA), which has been associated with health benefits, though the studies are still not conclusive.[8,29-31]

It was found that the industrial foods that conformed to the current regulations with respect to the stated serving size represented the highest percentage, considering a margin of more or less 30%.[15] However, 15% (n= 278) of them were inadequate. These data corroborate Lobanco et al.,[32] who identified nonconformities in the nutrition facts of most of the processed foods examined, indicating violation of the provisions contained in the regulations on labeling and the rights ensured by the Consumer Protection Code.[33]

Also noteworthy is that the amount of *trans* fat, as stated on the ingredient lists, as well as the false negatives rate were high, even in the industrial foods where the serving size was in conformity to the law.

In the group analysis, although the false negative rate was higher (40-55%) in three of the six groups examined ("sugars and carbohydrates", "ready-made preparations", and "bread, biscuits and pasta"), the highest false negative rate was also found in the products with adequate serving size. Therefore, the results suggest that the serving size recommended by Resolution 359/2003[19] in most cases is sufficient to reveal the presence of *trans* fat in the nutritional facts and may affect the consumer's interpretation on the presence of this kind of fat in the food.

Similar result was found in a study conducted in the United States in which breads, snacks and cereal bars represented the largest amount of foods with the statement of "0 gram of *trans* fat" and the largest amount of foods containing *trans* fat, according to the nutrition facts.[34] Taking into account that in this country the industrial foods with *trans* fat content lower than 0.5g per serving can be declared as "zero *trans*", such researchers suggested that the food industry might

be taking advantage of the weakness of the US law to publicize their products as "zero *trans*", even when such foods contain *trans* fat[23]. This same hypothesis can be raised in the present study with respect to the Brazilian regulation.

The assessment of the nutritional labels of ready-made preparations showed that the foods with lower energy density presented an intermediate percentage of *trans* fat in the ingredient lists, but the highest rate of false negatives. Considering that consumers possibly consider as healthier the foods that have lower calorie values stated on the labels[35], it was found that such ready-made preparations – although appearing healthier because of their low energy density – are much less reliable or trustworthy regarding the information on *trans* fat. On the other hand, the group of ready-made meals prepared with higher energy density, even having a smaller amount of *trans* fat and lower false negatives rate, were the products with the smaller serving size. This shows that the failure of the legislation in not defining the serving size in grams for this group of foods allows the industries to label a serving size that may favor the product regarding the statement of ingredients considered unhealthy. Ferreira & Lanfer-Marquez[36] stress the importance of defining a recommended serving size for this group of foods because they are industrial foods that are increasingly present in the Brazilian's diet.

In the present research, it was shown the importance of the use of the nutritional facts per serving to identify the reliability of the nutritional information of *trans* fat offered to consumers. According to the literature, the serving size can compromise the statement of other nutrients that have adverse effects on the individuals' health, such as sodium and saturated fat [30]. Moreover, the variability allowed by the Brazilian legislation may affect the objective of promoting healthy eating habits to consumers. According to Garsetti et al.,[37] although the nutrition information per serving is crucial because the foods are consumed in diverse serving sizes, if the nutrition information per 100 grams were added, the consumers would be much better informed on the amount of the nutrients present in the foods, and this would make easier for them to compare products of different brands.

Limitations of the present study include the use of the information stated on the labels only; physicochemical analyses were not performed, nor were the foods weighed. However, the information to consumers displayed on the labels were examined, the only information that consumers have available to guide their food choices. Therefore, considering the consumer's right and the objective of labeling as a health public policy, such information should have their reliability ensured by the manufacturer and be subject to assessment in the light of current law. Another possible limitation of this study was the inclusion of industrial foods from only one supermarket. However, the research site is part of a large supermarket chain, and various processed foods that were investigated are marketed all over the country.

Conclusion

In the present study it was possible to identify a high percentage of industrial foods in which the nutrition facts labels did not state the presence of *trans* fat, but had fat source in the ingredient list. This finding was true even for the products that are in conformity with the serving size recommended by law. Breads, biscuits and pasta, sugars and carbohydrates, as well as ready-made meals were the major groups of foods in this regard.

Therefore, the serving size proved insufficient to inform the presence of *trans* fat in processed foods, so it is necessary to refer to the ingredients list.

Given the above, it is recommended that these findings be considered for a revision of the Brazilian legislation on the declaration of *trans* fat in foods labeling, and that education programs be promoted to inform consumers properly about the presence of *trans* fat declared in the processed foods labels.

Acknowledgements

The authors wish to thank the Coordination for the Improvement of Higher Education Personnel (CAPES) for the grant of the Master' scholarship to Nathalie Kliemann; the National Council for Scientific and Technological Development (CNPq) – Scholarship grant for Industrial Technological Development (DTI 3) awarded to Bruna Maria Silveira; and Scientific Trainee Grant (PIBIC) to Mariana Vieira dos Santos Kraemer.

References

1. Popkin BM. Global nutrition dynamics: the world is shifting rapidly toward a diet linked with noncommunicable diseases. Am. J. Clin. Nutr. 2006; 84(2):289-298.
2. Instituto Brasileiro de Geografia e Estatística. Pesquisa de orçamentos familiares 2008-2009: aquisição alimentar domiciliar per capita. Rio de Janeiro: IBGE; 2010. 272 p.
3. Monteiro CA, Cannon G, Levy RB, Claro R, Moubarac JC, Martins AP, et al. The food system. Ultra-processing. The big issue for nutrition, disease, health, well-being. J. World Public Health Nutr. Assoc. [Internet] 2012; 3(12).
4. Castro MA, Barros RR, Bueno MB, César CLG, Fisberg RM. Trans fatty acids intake among the population of the city of São Paulo, Southeastern Brazil. Rev. Saúde Pública 2009; 43(6):991-997.

5. Chiara VL, Sichieri R, Carvalho TSF. Teores de ácidos graxos trans de alguns alimentos consumidos no Rio de Janeiro. Rev. Nutr. 2003; 16(2):227-233.

6. Chavarro JE, Rich-Edwards JW, Rosner BA, Willett WC. Dietary fatty acid intakes and the risk of ovulatory infertility. Am. J. Clin. Nutr. 2007; 85(1):231-237.

7. Costa AGV, Bressan J, Sabarense CM. Ácidos graxos trans: alimentos e efeitos na saúde. Arch. Latinoam. Nutr. 2006; 56(1):12-21.

8. Remig V, Franklin BSM, Kostas G, Nece T, Street JC. Trans fats in America: a review of their use, consumption, health implications, and regulation. J. Am. Diet Assoc. 2010; 110(4):585-592.

9. World Health Organization. United Nations. Global strategy on diet, physical activity and health: list of all documents and publications. Fifty-seventh World Health Assembly, A57/9. Geneva: WHO; 2004.

10. World Health Organization. Follow-up to the political declaration of the high-level meeting of the General Assembly on the Prevention and Control of Non-communicable Diseases. Sixty-sixth World Health Assembly. Geneva: WHO; 2013.

11. Organização Pan-Americana da Saúde. Américas livres de gorduras trans. Rio de Janeiro: OPAS; 2008. Acesso em: 31 jan. 2013. Disponível em: http://189.28.128.100/dab/docs/portaldab/documentos/nota_imprensa_gorduras_trans.pdf

12. Malik VS, Willett WC, Hu FB. Global obesity: trends, risk factors and policy implication. Nat. Rev. Endocrinol. 2013; 9(1):13-27.

13. Brownell KD, Pomeranz JL. The trans-fat ban: food regulation and long-term health. N. Engl. J. Med. 2014; 370(19):1773-1775.

14. Brasil. Resolução RDC nº 360, de 23 de dezembro de 2003. A Diretoria Colegiada da ANVISA/MS aprova o regulamento técnico sobre rotulagem nutricional de alimentos embalados. Diário Oficial da União 26 dez. 2003.

15. Proença RPC, Silveira BM. Recomendações de ingestão e rotulagem nutricional de gordura trans em alimentos industrializados brasileiros: análise de documentos oficiais. Rev. Saúde Pública 2012; 46(5):923-928.

16. Hissanaga VM, Pastore JA, Proença RPC. Gordura trans: experiências de controle em unidades produtoras de refeições. Nutrição em Pauta 2010; 104(18):4-9.

17. Hissanaga VM, Block JM, Proença RPC. Development of a Method for Controlling Trans Fatty Acids in Meals - MCTM. J. Culinary Sci. Technology 2012; 10:1-18.

18. Gagliardi ACM, Mancini Filho J, Santos RD. Perfil nutricional de alimentos com alegação de zero gordura trans. Rev. Assoc. Med. Bras. 2009; 55(1):50-53.

19. Brasil. Resolução RDC nº 359, de 23 de dezembro de 2003. A Diretoria Colegiada da ANVISA/MS aprova regulamento técnico de porções de alimentos embalados para fins de rotulagem nutricional. Diário Oficial União 26 dez. 2003.

20. Silveira BM, Gonzalez-Chica DA, Costa Proença RP. Reporting of trans-fat on labels of Brazilian food products. Public Health Nutr. 2013; 16(12):1-8.

21. Martin CA, Matshushita M, Souza NE. Ácidos graxos trans: implicações nutricionais e fontes na dieta. Rev. Nutr. 2004; 17(3):361-368.

22. Monteiro CA, Levy RB, Claro RM, Castro IR, Cannon G. Increasing consumption of ultra-processed foods and likely impact on human health: evidence from Brazil. Public Health Nutr. 2011; 14(1):5-13.

23. Scheeder MRL. About the trans-(hi) story: how did trans fatty acids enter the human food chain. J. Am. Oil Chem. Soc. 2007; 18(2):133-135.

24. Aued-Pimentel S, Caruso MF, Cruz JMM, Kumagai EE, Corrêa DUA. Ácidos graxos saturados versus ácidos graxos trans em biscoitos. R. Inst. Adolfo Lutz 2003; 62(2):131-137.

25. Wagner KH, Plasser E, Proell C, Kanzler S. Comprehensive studies on the trans fatty acid content od Austrian foods: convenience products, fast food and fats. Food Chemistry 2008; 108(3):1054-1060.

26. Monge-Rojas R, Colón-Ramos U, Jacoby E, Mozaffarian D. Voluntary reduction of trans-fatty acids in Latin America and the Caribbean: current situation. Rev. Panam. Salud Publica 2011; 29(2):126-129.

27. Silveira BM, Kliemann N, Silva DP, Colussi CF, Proença RP. Availability and price of food products with and without trans fatty acids in food stores around elementary schools in low- and medium-income neighborhoods. Ecol. Food Nutr. 2013; 52(1):63-75.

28. Mozaffarian D, Katan MB, Ascherio A, Stampfer MJ, Willett WC. Trans fatty acids and cardiovascular disease. N. Engl. J. Med. 2006; 354(15):1601-1613

29. Agueda M, Ángeles M, Martínez JF. Efecto del ácido linoleico conjugado (CLA) sobre el perfil lipídico en humanos. Arch. Latinoam. Nutr. 2009; 59(3):245-252.

30. Santos-Zago LF, Botelho AP, Oliveira AC. Os efeitos do ácido linoléico conjugado no metabolismo animal: avanço das pesquisas e perspectivas para o futuro. Rev. Nutr. 2008; 21(2):195-221.

31. Tanaka, K. Occurrence of conjugated linoleic acid in ruminant products and its physiological function. Anim. Sci. J. 2005; 76(4):291-303.

32. Lobanco CM, Vedovato GM, Cano CB, Bastos DHM. Fidedignidade de rótulos de alimentos comercializados no município de São Paulo, SP. Rev. Saúde Pública 2009; 43(3):499-505.

33. Brasil. Lei nº 8.078, de 11 de setembro de 1990: dispõe sobre a proteção do consumidor e dá outras providências. Diário Oficial da União 11. set. 1990.

34. Brandt M, Moss J, Ferguson M. The 2006–2007 Food Label and Package Survey (FLAPS): nutrition labeling, trans fat labeling. J. Food Compost Anal. 2009; 22(1):S74–S77.

35. Steenhuis IHM, Vermeer, WM. Portion size: review and framework for interventions. Int. J. Behav. Nut. Phys. Act. 2009; 6(58):1-10.

36. Ferreira AB, Lanfer-Marquez UM. Legislação brasileira referente à rotulagem nutricional de alimentos. Rev. Nutr. 2007; 20(1):83-93.

37. Garsetti M, De Vries J, Smith M, Amosse A, Rolf-Pedersen N. Nutrient profiling schemes: overview and comparative analysis. Eur. J. Nutr. 2007; 46(2):15–28.

Received: September 23, 2014
Reviewed: December 16, 2014
Accepted: January 14, 2015