Labeling and classification of breads, biscuits and toasts sold as wholegrain in Brazil

Rotulagem e classificação de pães, biscoitos e torradas vendidos como integrais no Brasil

Etiquetado y clasificación de panes, galletas y tostadas que se venden como granos integrales en Brasil

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Abstract

The objective of this study was to evaluate the labeling and classification of breads, biscuits and toasts declared as wholegrain and to compare them. The cross-sectional and descriptive study was carried in Uberaba, in 2016. Products sold in five supermarkets were classified as processed or ultra-processed according to the NOVA system, which considers the industrial processing employed. The Pan American Health Organization Nutritional Profile Model was

used to classify products with excessive amounts of critical nutrients. The products were evaluated for the carbohydrate:fiber ratio recommended by the American Heart Association. A total of 147 products were analyzed: 99 biscuits, 36 breads and 12 toasts. The average number of ingredients in the formulations was 17.3±5.4, so that 100% of the products were classified as ultra-processed. The majority, 64.6%, did not present wholegrain flour as the first ingredient. The declaration of supplementary nutritional information on dietary fiber was present in 49% of the products and 100% complied with the mandatory requirements. Despite that, 53.7% presented excessive levels of sodium and 22.4% and 56.5% had excessive levels of total and saturated fat, respectively. For the criterion of carbohydrate:fiber ratio, 38.7% had a ratio of ≥10:1, mainly biscuits, which is undesirable. All biscuits, breads and toasts sold as "wholegrain" were ultra-processed, with excessive sodium content (breads and toast in general) and fats (most biscuits). Wholegrain flours only accounted for 35.4% of the products and half of the toasts, and most of the biscuits (66.7%) could not be considered a source of fiber.

Keywords: Whole grains; Food labeling; Dietary fiber.

Resumo

O objetivo deste estudo foi avaliar a rotulagem e classificação de pães, biscoitos e torradas declaradas como integrais e compará-las. O estudo transversal e descritivo foi realizado em Uberaba, em 2016. Os produtos vendidos em cinco supermercados foram classificados como processados ou ultraprocessados pelo sistema NOVA, que considera o processamento industrial empregado. O Modelo de Perfil Nutricional da Organização Pan-Americana da Saúde foi utilizado para classificar produtos com quantidades excessivas de nutrientes críticos. Os produtos foram avaliados quanto à proporção de carboidratos:fibras recomendada pela American Heart Association. Foram analisados 147 produtos, incluindo 99 biscoitos, 36 pães e 12 torradas. O número médio de ingredientes nas formulações foi de 17,3±5,4, de modo que 100% dos produtos foram classificados como ultraprocessados. A maioria, 64,6%, não apresentou farinha integral como o primeiro ingrediente. A declaração de informações nutricionais complementares sobre fibras alimentares estava presente em 49% dos produtos e 100% cumpriam os requisitos obrigatórios. Apesar disso, 53,7% apresentaram níveis excessivos de sódio e 22,4% e 56,5% dos produtos apresentaram níveis excessivos de gordura total e saturada, respectivamente. Ao analisar o critério da razão carboidrato:fibra, 38,7% apresentaram relação ≥10:1, principalmente os biscoitos, o que é indesejável. Todos os biscoitos, pães e torradas vendidos como "integrais" eram, de fato, produtos ultraprocessados,

com teores excessivos de sódio (pães e torradas em geral) e gorduras (maioria dos biscoitos). As farinhas integrais constavam em maior proporção em apenas 35,4% dos produtos e metade das torradas, e a maioria dos biscoitos (66,7%) não podia ser considerada fonte de fibras.

Palavras-chave: Grãos integrais; Rotulagem de alimentos; Fibras na dieta.

Resumen

El objetivo de este estudio fue evaluar el etiquetado y la clasificación de panes, galletas y tostadas declarados integrales. El estudio transversal y descriptivo se realizó en Uberaba, en 2016. Productos vendidos en cinco supermercados se clasificaron como procesados o ultraprocesados de acuerdo con el sistema NOVA, que considera el procesamiento industrial empleado. El Modelo de Perfil Nutricional de la Organización Panamericana de la Salud clasificó productos con cantidades excesivas de nutrientes críticos. Los productos fueron evaluados para la relación carbohidrato:fibra recomendada por la American Heart Association. Se analizaron 99 galletas, 36 panes y 12 tostadas. El número promedio de ingredientes en las formulaciones fue de 17.3 ± 5.4, de modo que 100% de los productos se clasificaron como ultraprocesados. La mayoría, 64,6%, no presentó harina integral como primer ingrediente. La declaración de información nutricional complementaria sobre fibra dietética estuvo presente en 49% de los productos y 100% cumplió con los requisitos obligatorios. A pesar de eso, 53,7% presentó niveles excesivos de sodio y 22,4% y 56,5% tenían niveles excesivos de grasa total y saturada, respectivamente. Para el criterio de la relación carbohidrato:fibra, 38,7% tenía una relación ≥10:1, principalmente galletas, lo cual no es deseable. Todas las galletas, panes y tostadas vendidos como "integrales" fueron ultraprocesados, con un contenido excesivo de sodio (panes y tostadas en general) y grasas (mayoría de las galletas). Las harinas integrales solo representaban 35,4% de los productos y la mitad de las tostadas, y la mayoría de las galletas (66,7%) no podían considerarse una fuente de fibra.

Palabras clave: Granos enteros; Etiquetado de alimentos; Fibras de la dieta.

1. Introduction

The term "whole grain" is used to refer to intact, broken, milled or flaked cereal grains, whose main components –such as endosperm, germ and bran– are present in the same proportions found in the intact grain (Ghodsian & Madden, 2018; Jonnalagadda et al., 2011).

Nutritional guidelines recommend increasing the consumption of whole grains along with the reduction of refined grains consumption (Karl et al., 2017; World Health Organization, 2003). These recommendations are based on evidence linking increased intakes of whole grains to reduced risks of chronic diseases, such as cardiovascular diseases, high blood pressure, type 2 and gestational diabetes, dyslipidemia, obesity, and certain tumors, such as gastrointestinal and breast cancer (Ghodsian & Madden, 2018; Karl et al., 2017; Silva, Gallon, & Theodoro, 2014). In addition, epidemiological studies have associated higher intakes of whole grains to lower values of body mass index and adiposity (Cho, Qi, Fahey, & Klurfeld, 2013; McKeown et al., 2010; Ye, Chacko, Chou, Kugizaki, & Liu, 2012).

The beneficial effects related to increased intakes of whole grains are mainly linked to the composition of these grains, which are source of fibers, vitamins –such as E and B complex–, minerals –such as iron, magnesium, selenium, and zinc–, and antioxidant substances –such as polyphenols and flavonoids (Aune et al., 2016; Ghodsian & Madden, 2018; Karl et al., 2017; Vanegas et al., 2017). The large fiber content of whole grains, in relation to refined grains, specifically contributes to reduced appetite, improved glycemic control and insulin sensitivity, and beneficially modulates the composition and activity of intestinal microbiota (Karl et al., 2017; Kopf et al., 2018); however, a considerable portion of the beneficial constituents of whole grains is lost during the process of refining grains (Kopf et al., 2018).

Although there is a definition for whole grains, a standard definition for food products containing these grains in its formulation is still absent (Ferruzzi et al., 2014). In Europe, wholegrain food products must have a minimum of 51% wholegrain ingredients by wet weight. In the United Kingdom, these food must contain at least 8g of fiber per serving (Ghodsian & Madden, 2018). In Brazil, even though the National Agency of Sanitary Monitoring (ANVISA) provides technical regulations for cereal products, a minimum criterion to identify a product as wholegrain food is not established by this organization. The lack of specific legislation for wholegrain products may mislead the consumer, since the quantity of wholegrain ingredients may be far below the recommended to obtain the benefits of the related nutrients, such as fibers (Ferraz, Cruz, & Freitas, 2016; Silva et al., 2014).

Even if there are no specific criteria in the Brazilian health legislation for wholegrain products, there is a possibility of using complementary nutritional information, labeling and advertising materials referring to fibers. This complementary nutritional information is voluntary, but may merely be provided if it meets the requirements set forth in the legislation dealing with the "Technical Regulation on Supplementary Nutrition Information" (Brasil,

2012). For foods to declare on their labels that they are a source of this nutrient, they must have at least 2.5g of fiber per portion or 5.0g of fiber per 100g; and to be considered high-fiber content products, they must present 3.0g of fiber per portion or 6.0g of fiber per 100g (Brasil, 2012).

While guidelines recommend increasing the consumption of whole grains (Karl et al., 2017; World Health Organization, 2003), the prevalence of inadequate fiber consumption in Brazil is noticeably high (Instituto Brasileiro de Geografia e Estatística, 2010). The recommendation of the Ministry of Health regarding fiber intake is 12.5g per 1000 kcal. According to the 2008-2009 Household Budget Survey of the Brazilian Institute of Geography and Statistics (IBGE), the inadequate fiber intake for the 19-to-59 age group is 71% and 75% for males and females, respectively (Instituto Brasileiro de Geografia e Estatística, 2010). Reduced fiber intake reflects a diet based on ultra-processed foods and moderated amounts of fruits, vegetables and whole grains (Instituto Brasileiro de Geografia e Estatística, 2010). Ultra-processed food are typically unhealthy products with high calorie density, elevated levels of sugar, salt and fats, and normally present depleted content of fiber, vitamins and minerals. Consumption of this ultra-processed food contributes to an unhealthy dietary nutrient profiles and several diet-related non-communicable diseases (Machado, Claro, Martins, Costa, & Levy, 2018). Machado et al. (2018) evaluated the association between the type of food establishment and the consumption of ultra-processed foods and observed that 60% of the energy from ultra-processed foods came from supermarkets.

Bakery products are consumed in large quantities on a daily basis and have an important role in human nutrition (Martins, Pinho, & Ferreira, 2017); nevertheless, several breads, biscuits and toasts sold as wholegrain products can be ultra-processed; the absence of a definition for wholegrain foods affects the quality standards of such products as well as triggers confusion among consumers at the purchasing time. Most of the proclaimed wholegrain products are more expensive and have very low grain and fiber content (Ferruzzi et al., 2014). In addition, these products may contain significantly high levels of sugar, sodium, total fat, saturated and trans-fat, since Brazilian labels do not yet carry frontal warnings regarding these nutrients (Ghodsian & Madden, 2018; Pan American Health Organization, 2016).

Food labeling is considered a crucial component for empowering consumers and assisting them on deciding autonomously. In particular, food labels are considered tools to facilitate healthier food choices (Cecchini & Warin, 2016). Nonetheless, when there is no specific regulation, as in the case of whole foods in Brazil, these benefits may not be achieved

and what has been stated on the label can mask the reality. Thus, the objective of this study was to evaluate the labeling of breads, biscuits and whole toasts available in the Brazilian market and to classify them according to the NOVA food classification system, according to the Pan American Health Organization (PAHO) Nutritional Profile Model, identifying products with excessive levels of critical nutrients and according to the integral criterion, recommended by the American Heart Association (AHA).

2. Methodology

This was a cross-sectional, field, descriptive study, with a qualitative and quantitative approach (Pereira, Shitsuka, Parreira, & Shitsuka, 2018) for labeling evaluation of different brands of breads, biscuits and toasts proclaimed as wholegrain on the front panel of the label. The industrialized products –sold in five large supermarkets in the city of Uberaba, Minas Gerais State, Brazil– were analyzed in 2016. The brands of the analyzed products were not revealed in order to preserve their identity.

The information collected was related to the type of food, price (Brazilian Real All the industrialized brands were evaluated was converted to American Dollar: BRL$1.00 = USD$0.24), absolute values contained in the nutritional information and list of ingredients. The nutritional information was analyzed according to Brazilian legislations (Brasil, 2003b). This study investigated whether all the mandatory information was on the label (energy, carbohydrates, proteins, total fats, saturated fats, trans fats and sodium) (Brasil, 2003b) as well as whether the portion size of each product type was in accordance with legislation – which determines the 30g portion for salty biscuits, wholegrain and *grissini* type; 50g portion for packaged breads, sliced or not, stuffed or not; and 30g portion for toasts (Brasil, 2003a).

Products have been classified as minimally processed, processed or ultra-processed according to the NOVA food classification system (Monteiro, Cannon, Levy, Moubarac & Jaime, 2016). For this classification, the processing type, total ingredients and origin its constituents in the products were verified, since this information determines the degree of food processing and, consequently, their nutritional quality. The classification proposed by the NOVA system categorizes foods according to the extent and purpose of processing, dividing them into four distinct groups. Group 1 includes fresh and minimally processed foods, which are consumed as they are found in nature or, when processed, are intended to increase storage time and do not involve the addition of food additives. Group 2 corresponds to processed culinary ingredients, which are substances obtained directly from nature or from

group 1 foods and used in culinary preparations; examples of this group are substances such as salt, sugar and vegetable oils. Group 3 involves processed foods and includes products made with the addition of Group 2 substances, usually having two or three ingredients; examples of foods belonging to this group are canned vegetables, salted meats, cheeses, and breads. Finally, Group 4 includes ultra-processed foods, which have formulations of usually five or more ingredients, are subjected to typical industrial processing, and include additives, such as colorings, stabilizers, flavor enhancers, among others. Products in this group rarely feature Group 1 foods; soft drinks, packaged snacks, and powdered beverages are common examples (Monteiro et al., 2016).

The order of the wholegrain flour in the list of ingredients it was verified, respecting Brazilian legislation (Brasil, 2002), which states that "all ingredients must appear in descending order of their proportion". It was also observed whether the label had some claim on food fibers. In positive cases, it was verified whether this information was in accordance with Brazilian law for the source attributes (2.5g per serving or 3.0g per 100g) and high content (5.0g per serving and 6.0g per 100g) (Brasil, 2002).

The nutritional composition of the analyzed products was evaluated and compared between groups of biscuits, breads and toasts. The foods were categorized in products with excessive sodium content, total, saturated and trans fats, in relation to the criteria established by the PAHO Nutrition Profile Model (Pan American Health Organization, 2016). Foods with excessive sodium are those with sodium/kcal ratio ≥ 1. Foods with excessive total, saturated and trans fats, are those with levels of $\geq 30\%$, 10% and 1% of the total energy value, coming from these three types of fats, respectively. Finally, the products were evaluated according to the wholegrain criterion (carbohydrate:fiber ratio $\leq 10:1$) recommended by the AHA (Lloyd-jones et al., 2010). This proportion is equal to the one found in the wholegrain wheat flour and is used as a reference to represent the balance of whole grains and refined grains, indicating the general quality of the carbohydrates present in the formulations (Ghodsian & Madden, 2018).

Data on labeling, nutritional information and ingredients of the analyzed products was evaluated using the Microsoft Excel program. A descriptive statistical assessment was performed. The analysis of variance (One-Way ANOVA) was used to compare the variables of interest among the different products (biscuits, breads and toasts). For multiple comparisons, the Tukey test was carried out. For categorical variables, Pearson's chi-square test was utilized, complemented by Chi-square partition for analysis of differences. All tests

were performed in the Statistical Package for Social Sciences (SPSS 17.0) program and the significance level adopted was 5%.

3. Results

Data was collected from 147 self-claimed wholegrain products: 99 (67.5%) were biscuits, 36 (24.5%) were breads and 12 (8.2%) were toasts. The data regarding price, amount of ingredients and position of the wholegrain flour in the list of ingredients are shown in Table 1.

Table 1. Differences between biscuits, breads and toasts in relation to the price, amount of ingredients and position of the wholegrain flour in the list of ingredients. Uberaba-MG, Brazil, 2016.

Food group	Price per package (U\$)			Price per Kg (U\$)			Amount of ingredients (No.)			Position of wholegrain flour			
										First (No./%)	Second (No./%)	Third (No./%)	Fourth (No./%)
	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max				
Biscuits	0.40	0.81^a	1.77	2.62	7.20^a	21.02	8	18.3^a	31	29 / 29.3^a	26 / 26.3	24 / 24.2	6 / 6.0
Breads	1.13	1.68^b	2.44	2.06	4.05^b	6.24	7	15.3^{a,b}	28	22 / 51.1^b	6 / 16.7	3 / 8.3	2 / 5.6
Toasts	0.57	0.80^a	1.24	3.73	5.37^{a,b}	8.83	8	14.7^b	21	1 / 8.3^a	3 / 25.0	3 / 25.0	2 / 16.7
P value	-	<0.001	-	-	<0.001	-	-	0.004	-	<0.001	0.509	0.24	0.365

a, b equal letters indicate statistical similarity. Source: Authors.

The average price of products per kilogram was U\$5.79, U\$3.80 and U\$4.71, respectively. Biscuits were the most expensive products, and the value of both bread and toast did not differ statistically from each other. The average number of ingredients in the formulations of those products was 17.3±5.4. This number varied among the three groups, with toasts standing out as the product with the lowest number of ingredients. According to the NOVA food classification system, 100% of the products were classified as ultra-processed, due to the extension of utilized industrial processing and the presence of typical substances of this type of food products.

Wholegrain flour position in the ingredient list also varied among the three product types. From the biscuits group, 29.3% (n = 29) presented wholegrain flour as the first ingredient on the list. In the bread and toast groups, wholegrain flour was the main ingredient in 61.1% (n = 22) and 8.3% (n = 1) of the products, respectively. It is noteworthy that wholegrain flour was not the main ingredient for 64.6% (n = 95) of the analyzed samples. Wholegrain flour was classified as second, 23.8% (n = 35), and third, 21.1% (n = 31) chief

ingredients for those products. The lowest position in which wholegrain flour appeared on the ingredient list was tenth place in only one bread group product.

Table 2 shows the percentage of products that were in compliance with the current legislation.

Table 2. Percentage of compliance to the Current Brazilian Legislation of labeling of biscuits, breads and wholegrain toasts available in five large supermarkets in the city of Uberaba-MG, Brazil, 2016.

Food group	Nutritional Information[20]		Portion size description[21]		Claims on fiber content ("Source of fiber")[14]		Claims on fiber content ("High of fiber")[14]	
	No.	%	No.	%	No.	%	No.	%
Biscuits	99	100.0	69	69.7	33	100.0	-	-
Breads	36	100.0	36	100.0	30	100.0	3	100.0
Toasts	12	100.0	8	66.7	6	100.0	-	-

Source: Authors.

Regarding mandatory labeling information, 100% of the products were in accordance with the respective law (Brasil, 2003b). Considering the legislation (Brasil, 2003a) that deals with the portion size of packaged foods, 100% of the breads adapted their nutritional information to the 50g recommended portion size. For biscuits and toasts, the percentage of adequacy to the portion size was 69.7% (n = 69) and 66.7% (n = 8), respectively. With respect to biscuits group, 8.0% (n=8) of the products had a larger portion size than the recommended one.

The claims on fiber content were present in 49% (n=72) of the analyzed products. From these, 69 declared to be a "fiber source" – 33 were biscuits, 30 were breads and 6 were toasts; whilst 3 products from the bread group announced "high fiber" on their labels. All of these samples presented the mandatory requirements to claim fiber content in accordance with current legislation (Brasil, 2012). Table 3 presents the nutritional composition of the products analyzed by groups.

Table 3. Nutritional composition and classification according to labeled information of biscuits, breads and wholegrain toasts available in five large supermarkets in the city of Uberaba-MG, Brazil, 2016.

Nutritional composition	Food group			P value
	Biscuits	Breads	Toasts	
Energy value (kcal/100g)	422.6±35.1[a]	237.5±21.3[b]	366.4±15.7[c]	<0.001
Carbohydrates (g/100g)	60.7±6.2[a]	37.9±4.0[b]	63.5±7.2[a]	<0.001
Proteins (g/100g)	8.6±2.2[a]	12.9±2.6[b]	13.5±2.8[b]	<0.001
Total fat (g/100g)	15.9±2.9[a]	3.7±2.3[b]	6.2±2.6[b]	<0.001
Saturated Fat (g/100g)	4.4±2.7[a]	0.8±0.5[b]	2.3±1.5[ab]	<0.001
Trans fat (g/100g)	0.0±0.0	0.0±0.0	0.0±0.0	-
Fibers (g/100g)	6.5±3.1[a]	7.0±2.0[a]	7.8±0.7[a]	0.287
Sodium (mg/100g)	406.0±227.6[a]	370.4±75.0[a]	554.8±139.4[a]	0.019
Excess of sodium (No./%)	33 (33.3)[a]	34 (94.4)[b]	12 (100.0)[b]	<0.001
Excess of total fat (No./%)	32 (32.3)[a]	1(2.8)[b]	1 (8.3)[b]	<0.001
Excess of saturated fat N(%)	82 (82.8)[a]	1 (2.8)[b]	1 (8.3)[ab]	<0.001
Excess of trans fat (No./%)	0 (0.0)	0 (0.0)	0 (0.0)	-
Carbohydrate:fiber ratio (≤10:1) (No./%)	45 (45.5)[a]	36 (100.0)[b]	9 (75.0)[a]	<0.001

a, b, c equal letters indicate statistical similarity.
Excess of sodium, sodium:kcal≥1.
Excess of total fat, total fat ≥ 30% total kcal.
Excess of saturated fat, saturated fat ≥ 10% total kcal.
Source: Authors.

Biscuits, breads and toasts statistically differed merely in relation to the energetic value and contents of carbohydrates and total fats. Breads were the products that presented the lowest energetic value and carbohydrate content. Moreover, biscuits denoted the highest total fat content.

Concerning the PAHO Nutritional Profile Model, more than half (n = 79) of the analyzed products portrayed excessive levels of sodium: 33 were biscuits, 34 were breads and 12 were toasts. It is worth mentioning that 94% of the products in the breads' group and 100% of the products in the toast's group displayed excess sodium content. The biscuits group was the one that presented the most excessive fat content. From this group, 32 and 82 products had total and saturated excess fat, correspondingly. All the products analyzed indicated zero trans-fat on label; however, several contained source ingredients of this nutrient, such as vegetable fats. As the legislation (Brasil, 2003b) allows the value to be omitted whether it is equal to or less than 0.2g per portion, the consumer cannot control the daily intake and may exceed the total recommended consumption rates. Regarding the carbohydrate:fiber ratio established by

the AHA, all bread products were in compliance with the recommendation. For toasts and biscuits, the percentage of adequacy was 75% and 45.5%, respectively.

4. Discussion

The present study analyzed the labeling and nutritional composition of biscuits, breads and toasts self-claimed as wholegrain. Since there is no specific legislation guaranteeing the quality of wholegrain foods in Brazil, the study aimed to evaluate the quality of these products. Compliance with current legislation dealing with labeling regulations has been evaluated in order to identify how products adhere to national standards. PAHO Nutrition Profile Model and the wholegrain criterion of carbohydrate:fiber ratio $\leq 10:1$ were another criteria utilized to evaluate the nutritional quality of these products, complementing other classifications, such as the one acquired through the NOVA system.

Though labels are considered instruments for choosing healthier foods, labeling information is often untrue and misused to deceive and mislead consumers; therefore, appropriate labeling analyses are extremely important to identify quality products.

All the products analyzed were considered ultra-processed. The large number of ingredients, as well as their nature, characterizes the products analyzed as ultra-processed. The NOVA system food classification, which is also addressed in the Dietary Guidelines for the Brazilian Population (Brasil, 2014), categorizes food based on the nature, extent and purpose of food processing (Monteiro et al., 2016). Processing is defined as all methods and techniques used by the industry to transform fresh foods into food products (Moubarac et al., 2013). Although extremely relevant to nutrition and public health (Monteiro, Levy, Claro, De Castro, & Cannon, 2010), the impacts of industrial food processing, particularly the methods and ingredients used in food products, on the quality of diet and ,therefore, on human health have not been sufficiently considered (Monteiro, Cannon, Lawrence, Costa Louzada, 2019; Monteiro et al., 2016).

Ultra-processed products represent 75% of global food sales (Juul & Hemmingsson, 2015) and are related to the current pandemic of obesity and chronic diseases, such as diabetes mellitus type 2 (Louzada et al., 2015; Monteiro et al., 2010). This is mainly due to the typical composition of these products, which are energy dense, rich in refined carbohydrates, sugars, fats and sodium, besides having a high glycemic load (Sumanac, Mendelson, & Tarasuk, 2013). As a result, consumers have become interested in more

natural, healthy and nutritionally balanced foods that support healthier lifestyles in advanced ages (Asioli et al., 2017).

This current demand has led the food industry to develop healthier products presenting more functional and natural ingredients that meet consumer demands. In this context, along with the recommendations guiding fiber and whole grains consumption increase, wholegrain foods have gained popularity. Nonetheless, foods marketed based on health properties through nutrition labeling are not always the most nutritious or healthy options and may even be more expensive than products without such labeling. Insofar as important nutritional attributes follow mandatory labeling rules, consumers can rely on and optimize food selection; however, when labels convey words and/or properties that do not follow strict quality control standards, consumers have no choice but to rely on claims made by manufacturers (Sumanac et al., 2013).

Very few products had wholegrain flour as first ingredient, especially toasts and biscuits. The variation observed in the position of wholegrain flour in the list of ingredients of the biscuits, breads and toasts analyzed is due to the lack of specific regulation for wholegrain foods in Brazil. This deficiency enables the use of the term wholegrain for food products of different nutritional qualities. It is necessary to define not only the whole grain used as an ingredient for standardization and quality control, but also to define wholegrain foods as a basis for labeling, for example, the minimum permissible percentage of the wholegrain ingredient (Van Der Kamp, Poutanen, Seal, & Richardson, 2014). Accurate and understandable nutritional labeling is a public health goal that should be considered as an important strategy to enable better food choices. Provision of clear and conspicuous nutritional information is an important way to educate consumers on nutritional content of foods, motivate healthier choices, and adhere to the advised nutritional recommendations (Roberto & Khandpur, 2014).

The evaluation of the nutritional composition of the products analyzed showed that even if they are marketed as wholegrain products, they are in fact ultra-processed foods with excessive sodium content (especially breads and toasts) and total and saturated fats (especially biscuits), which compromises their nutritional quality. The purpose of the PAHO Nutrition Profile Model is to serve as an instrument for planning and implementing strategies related to the prevention and control of obesity and overweight. One of these strategies is the use of front-of-package warning labels of products containing excessive amounts of free sugars, salt, total saturated and trans fats (Pan American Health Organization, 2016); however, this model is not yet implemented in Brazil. Even though nutrition labeling is considered an important

tool for food selection and promotion of healthier dietary patterns (Roberto & Khandpur, 2014), a lack of knowledge about nutrition compromises the ability of consumers to interpret the information provided (Pelletier, Chang, Delzell, & McCall, 2004). Thus, the clearer and more real the nutritional information present in the packaging of food products, the easier it will be for consumers to choose healthier foods.

Concerning fiber content, it is noteworthy that the legislation (Brasil, 2012) allows that the products are analyzed both per portion and per 100g to use of fiber content claims. In some cases, the amount of fiber for this attribute could only be achieved with the consumption of 100g, which can be detrimental considering, for instance, high calorie and total and saturated fat food products. Furthermore, when analyzing the criteria recommended by the AHA, of the adequate carbohydrate:fiber ratio, 38.7% (n = 57) presented a ≥10:1 ratio, mainly in biscuits, which is an undesirable status. Ghodsian and Madden (2018) evaluated the nutritional quality of breads and morning cereals and observed that breads identified with ≤10:1 ratio also presented low levels of saturated fat and sugar, indicating the importance of this criterion for nutritional quality evaluation. This result once again points out the importance of elaborating a regulation that defines identity and quality attributes of "wholegrain" food.

5. Final Considerations

This study demonstrates that although nutritional labeling is considered an important tool for healthy food selection and eating habits, this hardly happens to be the case in practice. While all the products analyzed presented mandatory labeling information, 23.1% presented a portion size different to the one recommended by the legislation. In addition, all biscuits, breads and toasts sold as wholegrain foods were in fact ultra-processed products, with excessive sodium content (breads and toasts in general) and fats (biscuits for the most part). Wholegrain flours only accounted for 35.4% of the products and half of the toasts, and most of the biscuits (66.7%) could not be considered a fiber source.

Unfortunately, consumers do not have clear access to the real food compositions, and the lack of knowledge about nutrition makes it difficult to interpret the nutritional information contained in labels.

The study has some limitations, for example, the data analyzed is based on information on the label and not on analyzes. Ingredient lists have also been little explored. However, all products consisted of industrial formulations that contained substances and

additives typical of ultra-processed foods, mainly flavorings, emulsifiers and preservatives. Furthermore, as only Brazilian products were evaluated, extrapolating the results to the reality of other countries becomes a difficult task, since the laws in force in each country are different, as well as the products sold.

In conclusion, the lack of specific labeling regulations compromises the quality control of food products and facilitates the use of voluntary nutritional information by manufacturers. In addition, supervision by competent regulatory bodies must be continuous to ensure compliance with established standards.

Future studies should be carried out in order to better inform consumers about the real nutritional qualities of wholegrain products in Brazil. In addition, if the current proposal under evaluation on the requirements for identification as integral and for highlighting the integral ingredients in the labeling of foods containing cereals comes into force, it would be very important to evaluate and compare the changes that occurred in such products after the validity of the law.

References

Asioli, D., Aschemann-Witzel, J., Caputo, V., Vecchio, R., Annunziata, A., Næs, T., & Varela, P. (2017). Making sense of the "clean label" trends: A review of consumer food choice behavior and discussion of industry implications. *Food Research International*, *99*, 58–71. https://doi.org/10.1016/j.foodres.2017.07.022

Aune, D., Keum, N. N., Giovannucci, E., Fadnes, L. T., Boffetta, P., Greenwood, D. C., … Norat, T. (2016). Nut consumption and risk of cardiovascular disease, total cancer, all-cause and cause-specific mortality: A systematic review and dose-response meta-analysis of prospective studies. *BMC Medicine*, *14*(1), 207. https://doi.org/10.1186/s12916-016-0730-3

Brasil. Agência Nacional de Vigilância Sanitária - Anvisa. (2002). Resolução RDC nº 259, de 20 de setembro de 2002. Dispõe sobre o Regulamento Técnico sobre Rotulagem de Alimentos Embalados. Retrieved from http://portal.anvisa.gov.br/documents/10181/2718376/%281%29 RDC_259_2002_COMP.pdf/556a749c-50ea-45e1-9416-eff2676c4b22

Brasil. Agência Nacional de Vigilância Sanitária - Anvisa. (2003a). Resolução RDC nº 359, de 23 de dezembro de 2003. Dispõe sobre o Regulamento Técnico de Porções de Alimentos

Embalados para Fins de Rotulagem Nutricional. Retrieved from http://portal.anvisa.gov.br/documents/10181/2718376/RDC_359_2003_COMP.pdf/1e860ef6-10e6-404b-81e2-87aae8cfd53a

Brasil. Agência Nacional de Vigilância Sanitária - Anvisa. (2003b). Resolução RDC nº 360, de 23 de dezembro de 2003. Dispõe sobre o Regulamento Técnico sobre Rotulagem Nutricional de Alimentos Embalados, tornando obrigatória a rotulagem nutricional. Retrieved from http://portal.anvisa.gov.br/documents/10181/2718376/RDC_360_2003_COMP.pdf/caab87a1-e912-459f-8bc0-831a48b95da9

Brasil. Agência Nacional de Vigilância Sanitária - Anvisa. (2012). Resolução RDC nº 54, de 12 de novembro de 2012. Dispõe sobre o Regulamento Técnico sobre Informação Nutricional Complementar. Retrieved from http://portal.anvisa.gov.br/documents/10181/4825974/%281%29RDC_54_2012_.pdf/921d3c25-cef9-40d8-9b3f-7861eb7b8235

Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Básica. (2014). Guia alimentar para a população brasileira. 2. ed., 1. reimpr. Brasília: Ministério da Saúde. Retrieved from https://bvsms.saude.gov.br/bvs/publicacoes/guia_alimentar_populacao_brasileira_2ed.pdf

Cecchini, M., & Warin, L. (2016). Impact of food labelling systems on food choices and eating behaviours: a systematic review and meta-analysis of randomized studies. *Obesity Reviews*, *17*(3), 201–210. https://doi.org/10.1111/obr.12364

Cho, S. S., Qi, L., Fahey, G. C., & Klurfeld, D. M. (2013). Consumption of cereal fiber, mixtures of whole grains and bran, and whole grains and risk reduction in type 2 diabetes, obesity, and cardiovascular disease. *The American Journal of Clinical Nutrition*, *98*(2), 594–619. https://doi.org/10.3945/ajcn.113.067629

Ferraz, E. C., Cruz, M. M., & Freitas, E. do C. (2016). Avaliação dos rótulos de diferentes marcas de pães integrais versus pães sem glúten comercializados no município de Vitória da Conquista – BA. *C&D-Revista Eletrônica Da Fainor*, *9*(1), 46–55.

Ferruzzi, M. G., Jonnalagadda, S. S., Liu, S., Marquart, L., McKeown, N., Reicks, M., …

Webb, D. (2014). Developing a Standard Definition of Whole-Grain Foods for Dietary Recommendations: Summary Report of a Multidisciplinary Expert Roundtable Discussion. *Advances in Nutrition: An International Review Journal*, *5*(2), 164–176. https://doi.org/10.3945/an.113.005223

Ghodsian, B., & Madden, A. M. (2018). Evaluating the ≤10:1 wholegrain criterion in identifying nutrient quality and health implications of UK breads and breakfast cereals. *Public Health Nutrition*, *21*(6), 1186–1193. https://doi.org/10.1017/S1368980017003718

Instituto Brasileiro de Geografia e Estatística - IBGE. (2010). Pesquisa de Orçamentos Familiares 2008-2009 – Análise do Consumo Alimentar Pessoal no Brasil. Retrieved from https://biblioteca.ibge.gov.br/visualizacao/livros/liv50063.pdf

Jonnalagadda, S. S., Harnack, L., Hai Liu, R., McKeown, N., Seal, C., Liu, S., & Fahey, G. C. (2011). Putting the Whole Grain Puzzle Together: Health Benefits Associated with Whole Grains—Summary of American Society for Nutrition 2010 Satellite Symposium. *The Journal of Nutrition*, *141*(5), 1011S-1022S. https://doi.org/10.3945/jn.110.132944

Juul, F., & Hemmingsson, E. (2015). Trends in consumption of ultra-processed foods and obesity in Sweden between 1960 and 2010. *Public Health Nutrition*, *18*(17), 3096–3107. https://doi.org/10.1017/S1368980015000506

Karl, J. P., Meydani, M., Barnett, J. B., Vanegas, S. M., Goldin, B., Kane, A., … Roberts, S. B. (2017). Substituting whole grains for refined grains in a 6-wk randomized trial favorably affects energy-balance metrics in healthy men and postmenopausal women. *The American Journal of Clinical Nutrition*, *105*, 589–599. https://doi.org/10.3945/ajcn.116.139683.1

Kopf, J. C., Suhr, M. J., Clarke, J., Eyun, S. Il, Riethoven, J. J. M., Ramer-Tait, A. E., & Rose, D. J. (2018). Role of whole grains versus fruits and vegetables in reducing subclinical inflammation and promoting gastrointestinal health in individuals affected by overweight and obesity: A randomized controlled trial. *Nutrition Journal*, *17*(1), 72. https://doi.org/10.1186/s12937-018-0381-7

Lloyd-jones, D. M., Hong, Y., Labarthe, D., Mozaffarian, D., Appel, L. J., Horn, L. Van, …

Yancy, C. W. (2010). Defining and Setting National Goals for Cardiovascular Health Promotion and Disease Reduction The American Heart Association ' s Strategic Impact Goal Through 2020, *121*(4), 586–613. https://doi.org/10.1161/CIRCULATIONAHA.109.192703

Louzada, M. L. da C., Baraldi, L. G., Steele, E. M., Martins, A. P. B., Canella, D. S., Moubarac, J. C., … Monteiro, C. A. (2015). Consumption of ultra-processed foods and obesity in Brazilian adolescents and adults. *Preventive Medicine*, *81*, 9–15. https://doi.org/10.1016/j.ypmed.2015.07.018

Machado, P. P., Claro, R. M., Martins, A. P. B., Costa, J. C., & Levy, R. B. (2018). Is food store type associated with the consumption of ultra-processed food and drink products in Brazil? *Public Health Nutrition*, *21*(1), 201–209. https://doi.org/10.1017/S1368980017001410

Martins, Z. E., Pinho, O., & Ferreira, I. M. P. L. V. O. (2017). Food industry by-products used as functional ingredients of bakery products. *Trends in Food Science and Technology*, *67*, 106–128. https://doi.org/10.1016/j.tifs.2017.07.003

McKeown, N. M., Troy, L. M., Jacques, P. F., Hoffmann, U., O'Donnell, C. J., & Fox, C. S. (2010). Whole- and refined-grain intakes are differentially associated with abdominal visceral and subcutaneous adiposity in healthy adults: The Framingham Heart Study. *American Journal of Clinical Nutrition*, *92*, 1165–1171. https://doi.org/10.3945/ajcn.2009.29106

Monteiro, C. A., Levy, R. B., Claro, R. M., De Castro, I. R. R., & Cannon, G. (2010). Increasing consumption of ultra-processed foods and likely impact on human health: Evidence from Brazil. *Public Health Nutrition*, *14*(1), 5–13. https://doi.org/10.1017/S1368980010003241

Monteiro, C. A., Cannon, G., Lawrence, M., Costa Louzada, M.L., Pereira Machado, P. (2019). Ultra-processed foods, diet quality, and health using the NOVA classification system. Rome, FAO. Retrieved from https://www.researchgate.net/profile/Geoffrey_Cannon/publica tion/334945695_FAO_Ultra-processed_foods_diet_quality_and_health_using_the NOVA_classification_system/links/5d45a462a6fdcc370a79b7aa/FAO-Ultra-processed-foods-diet-quality-and-health-using-the-NOVA-classification-system.pdf

Monteiro, C. A., Cannon, G., Levy, R. B., Moubarac, J. C., Jaime, P., Martins, A. P., Canella, D., Louzada, M., Parra, D. (2016). NOVA. The star shines bright. *Word Nutrition*, *7*(1–3), 28–38. Acesso em 31 de julho de 2020, em: http://www.cookie.com.br/site/wp-content/uploads/2016/12/NOVA-Classifica%C3%A7%C3%A3o-dos-Alimentos.pdf

Moubarac, J.C., Martins, A. P. B., Claro, R. M., Levy, R. B., Cannon, G., & Monteiro, C. A. (2013). Consumption of ultra-processed foods and likely impact on human health. Evidence from Canada. *Public Health Nutrition*, *16*(12), 2240–2248. https://doi.org/10.1017/S1368980012005009

Pan American Health Organization - PAHO. (2016). Nutrient Profile Model. Washington, DC: PAHO.

Pereira, A. S., Shitsuka, D. M., Parreira, F. J., & Shitsuka, R. (2018). *Metodologia da pesquisa científica.* [e-book]. Santa Maria. Ed. UAB/ NTE / UFSM. Retrieved from https://repositorio.ufsm.br/bitstream/handle/1/15824/Lic_Computacao_Metodologia-Pesquisa-Cientifica.pdf?sequence=1

Pelletier, A. L., Chang, W. W., Delzell, J. E., & McCall, J. W. (2004). Patients' understanding and use of snack food package nutrition labels. *Journal of the American Board of Family Practice*, *17*(5), 319–323. https://doi.org/10.3122/jabfm.17.5.319

Roberto, C. A., & Khandpur, N. (2014). Improving the design of nutrition labels to promote healthier food choices and reasonable portion sizes. *International Journal of Obesity*, *38*, S25–S33. https://doi.org/10.1038/ijo.2014.86

Silva, V. C. P., Gallon, C. W., & Theodoro, H. (2014). Evaluation of labeling and nutritional information of wholemeal breads: fiber, sodium and adequacy with current legislation. *Demetra: Alimentação, Nutrição & Saúde*, *9*(4), 985–1001. https://doi.org/10.12957/demetra.2014.11979

Sumanac, D., Mendelson, R., & Tarasuk, V. (2013). Marketing whole grain breads in Canada via food labels. *Appetite*, *62*, 1–6. https://doi.org/10.1016/j.appet.2012.11.010

Van Der Kamp, J. W., Poutanen, K., Seal, C. J., & Richardson, D. P. (2014). The healthgrain definition of "whole grain." *Food and Nutrition Research*, *58*(1), 22100. https://doi.org/10.3402/fnr.v58.22100

Vanegas, S. M., Meydani, M., Barnett, J. B., Goldin, B., Kane, A., Rasmussen, H., … Meydani, S. N. (2017). Substituting whole grains for refined grains in a 6-wk randomized trial has a modest effect on gut microbiota and immune and inflammatory markers of healthy adults. *The American Journal of Clinical Nutrition*, *105*(3), 635–650. https://doi.org/10.3945/ajcn.116.146928

World Health Organization - WHO. (2003). Global strategy on diet, physical activity, and health. Geneva: WHO.

Ye, E. Q., Chacko, S. A., Chou, E. L., Kugizaki, M., & Liu, S. (2012). Greater Whole-Grain Intake Is Associated with Lower Risk of Type 2 Diabetes, Cardiovascular Disease, and Weight Gain. *The Journal of Nutrition*, *142*(7), 1304–1313. https://doi.org/10.3945/jn.111.155325

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