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Comparison of the nutritional quality of conventional and whole-grain breads commercialized in Brazil

Comparação da qualidade nutricional de pães de forma convencionais e integrais comercializados no Brasil

Abstract

Introduction: The lack of monitoring of the nutritional quality of whole-grain products, combined with the health-conscious marketing adopted by the food industry, highlights the importance of investigating whether whole-grain breads commercialized in Brazil demonstrate better nutritional quality. *Objective:* To compare the nutritional quality of whole-grain (WGB) and conventional (CB) sliced breads commercialized in Brazil. *Methods:* Cross-sectional study of sliced bread brands available in the e-commerce of the largest supermarket chain in Brazil in 2022. The Nutrition Facts and list of ingredients were collected from the brands' websites. Statistical analysis was performed using Stata® 11.0 (Mann-Whitney U test or Student's t-test, 5% significance). *Results:* A total of 69 breads were identified, 53 (76.5%) WGB and 16 (23.5%) CB. Whole-grain breads presented more dietary fiber (6.2g vs. 2.4g) and protein (12.8g vs. 9.0g) and less energy (252.3Kcal vs. 261.6Kcal), carbohydrates (40g vs. 50g) and sodium (338mg vs. 375mg) ($p<0.05$). Not all WGB presented whole-grain flour as the first component of the ingredient list (11.3%). WGB contain refined flour (64.1%) and sugar (39.6%) in the main ingredients, as well as total fat (4.6g vs. 3.1g) and saturated fat (0.9g vs. 0.9g) and food additives (2.0g vs. 3.5g), similarly to CB. *Conclusion:* WGBs commercialized in Brazil have a superior nutritional profile, although other attributes could be improved in the formulation. It is important to monitor and publicize the nutritional quality of whole foods, providing information to consumers seeking to make healthier food choices.

Keywords: Whole Food. Nutritional Information. Bread. Food Labeling. Food Ingredients.

Resumo

Introdução: A falta de fiscalização da qualidade nutricional de produtos integrais, somada ao *marketing* com apelo ao saudável adotado pela indústria alimentícia, evidencia a importância de investigar se pães integrais comercializados no Brasil demonstram melhor qualidade nutricional. *Objetivo*: Comparar a qualidade nutricional de pães de forma integrais (PFI) e convencionais (PFC) comercializados no Brasil. *Métodos*: Estudo transversal das marcas de pães de forma disponíveis em *e-commerce* da maior rede de

supermercados do Brasil em 2022. Dos *sites* das marcas, coletaram-se informações nutricionais e lista de ingredientes. Análise estatística realizada no Stata® 11.0 (teste U Mann-Whitney ou *t*-Student, significância de 5%). ***Resultados***: Foram identificados 69 pães, 53 (76,5%) PFI e 16 (23,5%) PFC. Pães integrais apresentaram mais fibras alimentares (6,2g vs. 2,4g) e proteínas (12,8g vs. 9,0g) e menos energia (252,3Kcal vs. 261,6Kcal), carboidratos (40g vs. 50g) e sódio (338mg vs. 375mg) ($p<0.05$). Nem todos os PFI apresentaram farinha integral como primeiro componente da lista de ingredientes (11,3%). PFI contêm farinha refinada (64,1%) e açúcar (39,6%) nos principais ingredientes, bem como gordura total (4,6g vs. 3,1g) e saturada (0,9g vs. 0,9g) e aditivos alimentares (2,0g vs. 3,5g), à semelhança dos PFC. ***Conclusão***: PFI comercializados no Brasil possuem perfil nutricional superior, embora outros atributos possam ser melhorados na formulação. Torna-se importante fiscalizar e divulgar a qualidade nutricional dos alimentos integrais, trazendo esclarecimentos aos consumidores que buscam fazer escolhas alimentares mais saudáveis

Palavras-chave: Alimento Integral. Informação Nutricional. Pão. Rotulagem de Alimentos. Ingredientes de Alimentos.

INTRODUCTION

Society's eating patterns have changed due to industrialization of food as well as its popularization[1] and, nowadays, even if minimal, all food production goes through some processing step. Homemade preparations, which are made with natural and minimally processed foods, are being replaced by ultra-processed products which have high energy value, added sugar, fat and salt, and low in vitamins, minerals and dietary fiber,[2-4] due to the high availability and low cost of the items. This change causes negative consequences to the diet and health of Brazilians, contributing to the development of obesity and other chronic non-communicable diseases (NCDs)[4-6] and increased mortality.[5,7-9]

Due to unhealthy diet being one of the main modifiable risk factors for tackling obesity and NCDs, the adoption of official nutritional guidelines through the publication of food guides has been endorsed internationally[10-12] and nationally.[5] Among the foods that make up an adequate and healthy diet, whole grains stand out. These are associated with better nutritional quality[13,14] and are considered good sources of carbohydrates, vitamins, minerals and dietary fiber, also acting as antioxidants.[15-23] Regular consumption of whole grains is associated with a lower risk of cancer, type 2 diabetes mellitus, obesity and heart disease,[22,24-26] and some of the benefits of whole grain foods are due to their concentrations of dietary fiber.[26]

In response to the new demand for healthier foods, the food industry took action to reformulate its products, launching apparently healthier versions linked to nutritional and health claims.[27-29] Since then, the term "whole" has been adopted on food packaging as a marketing tactic to link them to health benefits.[13,30,31]

There are several reasons that determine the purchase of whole grain products, with emphasis on better nutritional quality.[31] Consumers associate whole grain foods with natural and less processed products as better options when compared to traditional products and healthier lifestyle habits.[32] The literature has identified that nutritional claims such as “high in dietary fiber” have the potential to generate effects associated with perceptions of the overall healthiness of the food, better nutritional quality and greater purchase intention by consumers.[14,33]

According to the *Pesquisa de Orçamentos Familiares* - POF (Consumer Expenditure Survey) (2017-2018), bread is one of the most consumed foods by the Brazilian population, losing only to coffee, rice and beans. When analyzing the consumption of whole-grain bread, access to these foods was higher in 2017-2018, compared to the 2002-2003 survey.[8] Similarly, in relation to products with whole grains, whole-grain bread is among the most present in the people’s daily lives[28,31-34] and is chosen more frequently when compared to traditional options.[14]

In Brazil the list of ingredients is a mandatory item on the labeling of packaged products in the absence of the consumer,[35] formulated in decreasing order of components. Therefore, it is expected that the first ingredient of whole foods is whole wheat flour. However, scientific literature has shown in recent years that not all whole-grain products have this ingredient as the main component.[36,37] This characteristic has an impact on the nutritional quality, since products made with whole wheat flour as the first ingredient tend to have a higher amount of dietary fiber[38-40] and proteins.[38]

Even though whole grain products are regulated by the Resolução da Diretoria Colegiada - RDC (Collegiate Board Resolution) No. 712/2022[41] and that consumers have a certain level of knowledge about the grains or whole foods, nutritional and health claims contained on labels as part of a marketing strategy[31] can be cause for confusion, directly interfering with their food choices.[14,42,43]

Taking into consideration the lack of inspection of the nutritional quality of whole-grain breads and the healthy appeal marketing strategies adopted by the food industry, it is important to determine whether

whole-grain breads commercialized in Brazil have better nutritional quality when compared to conventional versions. Therefore, the objective of this study is to compare the nutritional quality of whole-grain and conventional breads commercialized in Brazil.

METHODS

Characterization of the study

This is a cross-sectional study, carried out based on the investigation of labels of conventional sliced bread (CB) and whole-grain (WGB) brands commercialized in the e-commerce of the largest food retail company in Brazil, considering the highest annual gross revenue, according to the ranking of the Brazilian Association of Supermarkets.[44]

Sampling procedure

The sample selection process took place in April 2022, in a single day, in order to avoid fluctuations in brands and products available. This stage consisted of browsing the selected supermarket's e-commerce platform, surveying all brands of sliced bread available for sale, stratifying them into conventional and whole grain. The sampling process was intentional, with the aim of exploring the greatest variety of products and brands that are possibly marketed nationally. After the first stage, the research was directed to the respective websites of the identified brands, to verify the existence of nutritional facts and list of ingredients for their products and, if so, a census was carried out of all available sliced breads.

Exclusion and inclusion criteria

The breads that were part of the sample met the requirements of the Technical Regulation for Cereal, Starch, Flour and Bran Products presented in RDC No. 263/2005,[45] a resolution later replaced by RDC No. 711/2022.[46] Sliced breads from the supermarket's own bakery were not included, that is, produced, packaged and labeled by the supermarket, as there is no website for the brand itself with more information about the products. Gluten-free and lactose-free breads were not included in the sample, as they confer characteristics that would probably change the nutritional profile of these products. Crustless and flavored sliced breads (e.g., milk, butter, corn or cassava) were also not included in the sample of conventional breads, as they do not present analogous options in whole-grain versions.

Whole-grain bread was classified by identifying the term “whole grain” or similar expressions in the image on the front panel of the labels or in the product sales name. Conventional bread was identified by the absence of the term “whole grain” or similar expressions on the front panel, referring to the word “traditional” or “original”.

Data collection

Regarding data collection, sliced bread data were extracted only if its brand had a website and made the information of interest available: (a) commercial name; (b) brand; (c) net weight in grams; (d) type of sliced bread (conventional and whole-grain); (e) serving weight in grams; (f) household measure; (g) nutritional value per serving: energy value in kilocalories (kcal); carbohydrates, proteins, total fats, saturated fats and dietary fiber in grams (g) and sodium in milligrams (mg); and (h) presence of supplementary nutrition information. The trans fat content was not analyzed, as it is common to find products whose value for this nutrient is listed as “zero” or “does not contain” in the nutritional facts table, since the legislation allows this type of declaration when foods have quantities equal to or less than 0.1g per serving.[47]

The data collected were stored in a digital database using Microsoft Excel® software, designed specifically for this purpose. At the time of collection, the product description page on the brands' websites was screenshotted, in order to preserve the information and subsequently validate the database by checking for possible inconsistencies in the data tabulation.

Data processing and analysis

The resulting products from the search on the brands' websites were characterized through descriptive statistics and presented as the absolute number and percentage of sliced breads stratified by type (whole-grain and conventional).

Analytical statistics were applied to compare the nutritional composition and the list of ingredients between whole-grain and conventional versions of sliced breads. The type of sliced bread (whole-grain or conventional) was considered as the dependent variable, and the independent variables were: (a) nutritional facts per serving of the product (energy value, carbohydrates, proteins, total and saturated fats, dietary fiber and sodium); (b) number of ingredients, sugars, food additives and trans fat present in the list of ingredients; (c) quantity of classes of food additives present in the list of ingredients; (d) position of whole wheat flour, refined wheat flour, sugar and trans fat in the list of ingredients; and (e) presence of supplementary nutrition information (yes or no). The nutritional content values were converted to 100g of product.

To identify the presence of trans fat in the list of ingredients, the following terminologies were defined: hydrogenated vegetable fat, partially hydrogenated vegetable fat, partially hydrogenated vegetable oil and hydrogenated vegetable oil.[48-50] Sugars were counted by identifying all names of whole, fractionated or hydrolyzed monosaccharides and disaccharides described in the list of ingredients, namely: sugar, white sugar, refined sugar, raw sugar, crystal sugar, confectioner's sugar, invert sugar, brown sugar, sugarcane juice, sugarcane crystals, dextrose, anhydrous dextrose, fructose, glucose, corn glucose, lactose, maltodextrin, maltose, honey, molasses, treacle, nectars, sucrose, maple syrup, malt syrup, corn syrup, high fructose corn syrup, fruit juice and fruit juice concentrates.[51,52]

Considering the definition of food additives adopted by Resolution RDC No. 23/2000[53] and consulting other regulations contained in Ordinance No. 540/1997,[54] RDC No. 778/2023[55] and Normative Instruction (IN) No. 211/2023,[56] the quantity and class of additives identified in the products were obtained.

To verify whether products marketed as whole grain have a significant dietary fiber content, the reference values established by RDC No. 54/2012[57] were adopted as parameters (per 100g of product: "source" 3g | "high content" 6g).[57] The Resolution now has its content expressed in IN No. 75/2020, which maintains the same parameters.[47]

In order to verify the normality of data distribution, the Shapiro-Wilk test was used. To compare the nutritional composition, number of ingredients, sugars, trans fat and food additives, the Mann-Whitney U test or Student's t-test was used, according to the symmetry of the variables and homogeneity of the data. The results were presented as mean and standard deviation or median and interquartile range. A "p" value of $p<0.05$ was considered as a statistically significant difference. Stata® version 11.0 (Statacorp, College Station TX, USA) was used for the analyses.

RESULTS

A total of 69 sliced breads from eight different brands were identified, of which 16 (23.5%) were CB and 53 (76.5%) were WGB. The CB and WGB proportion per brand is described in Table 1. Wickbold® was the brand that presented the greatest variety of sliced breads in the study (n=20 / 29.0%) and, consequently, also presented the greatest variety of WGB (n=16 / 30.2%), with a proportion of 1 CB to 4 WGB. The brands Nutrella®, Panco®, Pullman®, Wickbold®, Seven Boys® and Kim® had more WGB varieties, while the brands Bauducco® and Visconti® had the same CB proportion and WGB variety (Table 1).

Table 1. Distribution of conventional and whole-grain sliced breads according to brands commercialized in Brazil (2022).

Brands	n (%)	Proportion	
		Conventional n (%)	Whole grain n (%)
Bauducco®	4 (5.8)	2 (50.0)	2 (50.0)
Nutrella®	12 (17.4)	1 (8.3)	11 (91.7)
Panco®	11 (15.9)	2 (18.2)	9 (81.8)
Pullman®	8 (11.6)	2 (25.0)	6 (75.0)
Seven Boys®	6 (8.7)	2 (33.3)	4 (66.7)
Visconti®	2 (2.9)	1 (50.0)	1 (50.0)
Wickbold®	20 (29.0)	4 (20.0)	16 (80.0)
Kim®	6 (8.7)	2 (33.3)	4 (66.7)

Regarding nutritional composition, WGB presented significantly higher values of dietary fiber and proteins and lower values of energy, carbohydrates and sodium ($p<0.05$), and presented similar amounts of total fat and saturated fat (Table 2).

Table 2. Content of energy, carbohydrates, proteins, total fats, saturated fats, dietary fiber and sodium per 100 grams of conventional and whole-grain sliced breads commercialized in Brazil (2022).

Variable	Conventional (n=16)		Whole grain (n=53)		p-value
	Mean / median	±SD/IQR	Mean / median	±SD/IQR	
Energy (Kcal)	261.6	16.5	252.3	16.9	0.03*
Carbohydrates (g)	50	48-50	40	36-42	<0.01+
Proteins (g)	9.0	8.1-9.6	12.8	11.6-14	<0.01+
Total fats (g)	3.1	1.3	4.6	1.5	0.99*
Saturated fats (g)	0.9	0.6	0.9	0.4	0.55*
Dietary fiber (g)	2.4	2.2-2.7	6.2	5.8-7.4	<0.01+
Sodium (mg)	375	340-394	338	300-362	<0.01+

Table caption: n=number; SD=standard deviation; IQR=Interquartile range; **t-Student test*; +Mann-Whitney test.

Furthermore, when compared to CB (n=10) ($p<0.05$), WGB had, on average, more ingredients (n=13) (Table 3). The presence of trans fat was more frequent in CB (n=0.5), and this difference was significant ($p<0.01$). WGB did not present a significant difference in the number of sugars in the formulation when compared to CB. There was no significant difference

(p>0.05) between the average number of food additives in CB and WGB (Table 3). The classes of food additives most commonly found in the formulations were acidulants, flavorings, preservatives, emulsifiers, thickeners, stabilizers and flour improvers.

Table 3. Number of ingredients, sugars, food additives and trans fat present in the formulation of conventional and whole-grain sliced breads commercialized in Brazil (2022).

Variable	Conventional (n=16)		Whole grain (n=53)		
	Mean	IQR	Median	IQR	p-value*
Ingredients	10	6.5-11.5	13	10-15	<0.01
Sugars	1	1-1	1	1-1	0.08
Food additives	3.5	1-5.5	2	2-3	0.58
Food additives categories	2.5	1-3	1	1-2	0.17
Trans fat	0.5	0-1	0	0-0	0.01

Table caption: n=number; IQR=Interquartile range; *Mann-Whitney test.

Among the WGBs, 98.1% (n=52) presented sugar in their formulations, and 13.2% (n=7) had two different sugars in the list of ingredients. Of the CBs, 93.8% (n=15) contained one type of sugar in their composition (p>0.05) (Table 4).

Table 4. Number of sugars present in the formulation of conventional and whole-grain sliced breads commercialized in Brazil (2022).

Type	None		1		2		Total
	n	%	n	%	n	%	n
Conventional	1	6.3	15	93.8	-	-	16
Whole grain	1	1.9	45	84.9	7	13.2	53
Total	2	2.9	60	87.0	7	10.1	69

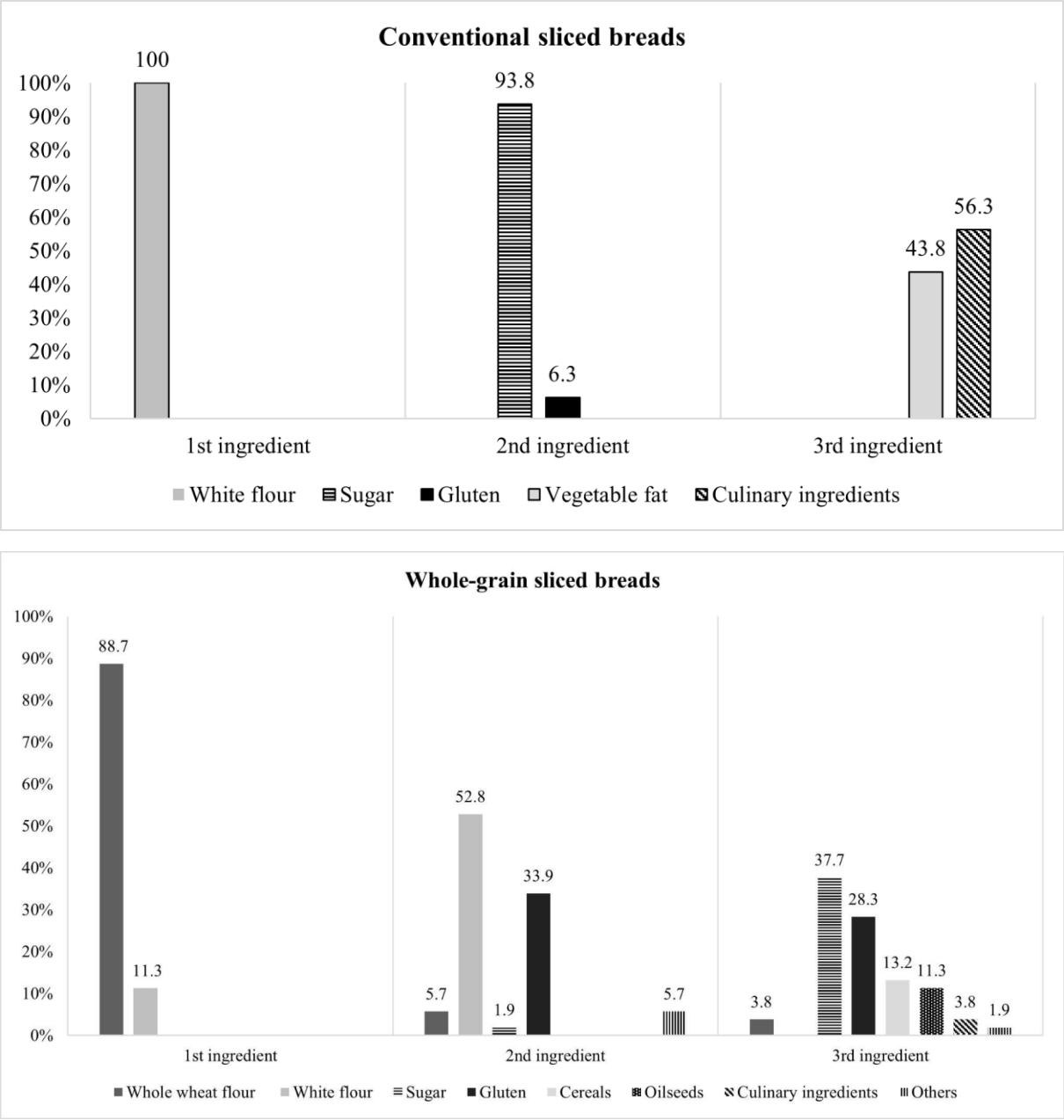
Most WGBs presented supplementary nutrition information and had almost three times higher SNI presence when compared to CBs (67.9% vs. 25.0%), as shown in Table 5. As an example, the presence of natural ingredients, dietary fiber, low fat, sodium and cholesterol content, among others, stands out.

Table 5. Presence of Supplementary Nutrition Information on the front panel of conventional and whole-grain sliced bread labels commercialized in Brazil (2022).

Type	Yes		No		Total
	n	%	n	%	n
Conventional	4	25.0	12	75.0	16
Whole grain	36	67.9	17	32.1	53
Total	40	58.0	29	42.0	69

Through the analysis of the main ingredients in the composition of sliced breads, it was observed that the first and only ingredient present in the CB was refined flour (100%). The second most present ingredient was sugar (93.8%) or gluten (6.2%). The third position contained processed culinary ingredients (salt, vegetable oils, sugar, vinegar and cornstarch) (56.2%) and vegetable fat (43.8%). Among the WGB, whole flour was the first ingredient on the list for most products (88.7%), but 11.3% presented refined flour as the first component of the ingredient list. The second most present ingredient in the WGB formulation was refined flour (52.8%), followed by gluten (33.9%) and whole flour (5.7%). When analyzing the third ingredient of the WGB, a greater presence of sugar (37.7%) and gluten (28.3%) was observed. All results showed significant difference ($p<0.01$) (Figure 1).

Figure 1. Proportion of the first three components in the list of ingredients of conventional and whole-grain sliced breads commercialized in Brazil (2022).



DISCUSSION

This study resonates with a sample with greater diversity of products, providing a national overview of the quality of whole-grain breads commercialized in Brazil. Compared to CB, WGB presented a better nutritional profile, with lower levels of calories, carbohydrates and sodium and higher levels of protein and dietary fiber. However, the fat profile and the number of sugars and food additives in the list of ingredients are similar to CB, and not all WGB presented wheat flour as the first component of the list of ingredients.

In the present study, eight WGB brands were identified, with a single brand accounting for the largest total variety of sliced breads analyzed (n=20/29.0%) and, consequently, of WGB (n=16/30.2%). In a study conducted in Trindade/GO, in 2020, the results were similar. Among the information on 17 whole-wheat bread labels, five different brands were identified, and a single brand accounted for almost 60% of all products analyzed.[58]

In response to health concerns arising from the consumption of ultra-processed foods, the world's largest food and beverage companies have modified and launched new products with "improved" nutritional profiles - being advertised as options that provide ideal nutrients, nutritional and health benefits,[27-29] among which whole grains are included. Recognizing that consumers have associated whole-grain foods with health and well-being,[31,32,59] and achieving promising financial results in this category in Brazil, whose profits reached R$100 billion in sales in 2020,[60] the food industry began to adopt terms referring to healthiness on food packaging, including "whole grain" and its analogues.[13] This nutritional marketing tactic aims to add value to products and relate them to healthy products, legitimizing and expanding the market.[27]

According to the Dietary Guidelines for the Brazilian Population,[5] amidst ultra-processed foods, there is sliced bread, which contains hydrogenated fat, emulsifiers and other food additives, and its consumption accounts for 2.1% of the population's daily calories.[8] Brazilians tend to consume more bread accompanied by butter, margarine, sweets, cold cuts and sausages, especially for breakfast, snacks or dinner, replacing traditional Brazilian meals such as rice and beans.[61-63] This eating pattern is associated with a higher consumption of calories and critical nutrients[64] (saturated fats, trans fats, sugars and sodium), as well as a lower consumption of dietary fiber, which can lead to health problems. The present study identified that WGB contains significantly fewer calories when compared to CB ($p<0.05$), proving to be an interesting option given the eating behavior presented.

WGB presented significantly lower carbohydrate values when compared to CB ($p<0.01$).These results add to the data from the Tables of Nutritional Composition of Food Consumed in Brazil, present in the 2008-2009 POF, regarding the amount of the nutrient in industrialized sliced breads and whole-grain breads (50.61 g vs. 41.29 g per 100 g).[65] The vast majority of products indicated the presence of at least one sugar in the list of ingredients, but only 32.1% (n=17) of whole-grain breads and 12.5% (n=2) of conventional breads stated the sugar values in the nutritional facts table. According to the 2008-2009 POF,[65] the added sugar content per 100 g of product, for CB and WGB, was 4.13 g and 6.76 g, respectively. In this study, it was not possible to analyze the added sugar content in the sliced breads since RDC No. 54/2012,[57] in force at the time, did not request the declaration of this nutrient as mandatory. However, due to the presence of this component in the list of ingredients of the products analyzed, it is suggested that these data be monitored in future research. This scenario was changed by the validity of RDC No. 429/2020,[51] which established the mandatory declaration of total and added sugar values in the Nutrition Facts Table, seeking to facilitate understanding and to provide clarity to consumers.

Sugar is used in bakery products to improve flavor, color, and softness, as well as to aid in fermentation and increase the shelf life of the product.[66] In the present study, WGB presented a greater average variety of

sugars in its formulation than CB. This fact can be explained by its use to give darker color to breads, through the process of sugar caramelization,[67,68] in addition to the existence of terms such as “brown/burnt crust color” and “beige crumb color” to characterize whole-grain bread.[69]

The protein portions in the WGB presented significant results ($p<0.01$), with average values of 12.8g per 100g of product, approximately 4g more than the CB, allowing the nutritional claim of “high protein content” according to RDC nº 54/2012.[57] In line with the results of this study, the 2008-2009 POF showed that sliced breads contained an average of 7.64g of protein per 100g, while whole-grain breads presented 12.95g.[65] The high protein content in whole-grain breads is due to the presence of whole-grain ingredients, such as whole wheat flour, associated with better protein values in the products, when first on their list of ingredients;[38] as well as the addition of whole grains and seeds, such as quinoa, oats, flaxseed, sunflower seeds and sesame, also identified in the formulation of the products analyzed in the present study.

The bread varieties analyzed did not present low total fat content, defined as 3g per 100g of product according to RDC nº 54/2012,[57] with whole-grain breads presenting the highest values (4.6g vs. 3.1g), although this difference is not significant. At the same time, considering the same standard, both WGB and CB presented low saturated fat content ($p>0.05$) present in 0.9g per 100g of the foods analyzed.

Despite being mandatory,[51] no nutritional facts table has presented values for trans fat. According to Normative Instruction (IN) No. 75/2020,[47] when the trans fat amount evaluated in the food is less than or equal to 0.1g per 100g, it may be presented in the nutritional facts table as 0g. However, this study’s list of ingredients of the sliced breads was analyzed and analogous termsto trans fat[48-50] were identified only in CB. Moreover, the 2008-2009 POF indicates the presence of this component in 0.63g and 0.60g in 100g of conventional and whole-grain sliced breads, respectively.[65] These data indicate the importance of restricting the production and consumption of products with trans fat in Brazil, as well as the need for labeling inspection, an important advance present in RDC No. 632/2022.[70]

There was a significant difference ($p<0.01$) in the breads dietary fiber content analysis in this study, in which the WGB obtained more than twice the dietary fiber amount when compared to the CB (6.2g vs. 2.3g per 100g), a result similar to that found by POF between conventional sliced breads and whole-grain breads (6.71g vs. 2.4g per 100g).[65] The divergence between the dietary fiber contents is due to the ingredients included in the manufacture of these products, since the main ingredient in conventional sliced breads is refined white flour. On the other hand, the whole-grain breads formulation contains whole-grain flour and the addition of whole grains, allowing the conservation of most of its nutrients[30,71] and improving the nutritional quality of the product, with an increase in the dietary fiber concentration.[13,31]

The totality of WGB analyzed in this study (n=53) were considered a source (n=15 / 28.3%) or high content (n=38 / 71.7%) of dietary fiber, according to the reference values present in RDC nº 54/2012, being, respectively, 3.0g and 6.0g of dietary fiber per 100g of food.[57] Other studies corroborate the data presented.

In a study conducted in hypermarkets in Salvador/BA in 2016,[38] 70% of the 10 whole-grain breads analyzed were classified as "source of or rich in dietary fiber", a positive scenario and similar to the data evaluated in 2019, in Trindade/GO,[58] where the majority of the sample of 17 whole-grain breads (94.12%) was classified in the same way. The compliance of the use of nutritional claims of dietary fiber on labels of sliced breads was analyzed according to the same regulation and 91% of the 56 breads collected in supermarkets in Rio de Janeiro/RJ and Nova Iguaçu/RJ in 2018[39]were in agreement, a higher percentage than that found in supermarkets and hypermarkets in Natal/RN in 2019,[40] in which 79% of the sample used the claims correctly.

Regarding the sodium values demonstrated in the products, the amount for WGB was significantly lower ($p<0.05$) compared to CB (338mg vs. 375mg per 100g). The scientific literature has shown an inversely proportional relationship between the amount of dietary fiber and sodium present in the products, that is, the greater the amount of the former, the lower the values of the latter.[37,38] This tendency was also observed in the 2008-2009 POF, in which the values of this mineral were lower for whole-grain breads compared to conventional sliced breads (472mg vs. 681mg).[65]

Despite showing better results when compared to CBs, the sodium values identified in WGBs can still be modified in their formulation in order to reduce their content. In this study, the average Daily Value (DV) achieved for this critical nutrient was 8%, considering the recommended portion of the product (50g - 2 slices). The considerable sodium values demonstrated may be related to the presence of food additives, such as salts and sodium nitrates, added to the products to improve their preservation.[72] The high use of food additives in foods and beverages, including bakery products has been observed in Brazil, which may present harmful effects related to the combination of frequency of ingestion and the combination of certain food additives.[73]

The products labels, including breads,were analyzed in a supermarket of a large chain in Brazil, which presented the denotation "homemade".[74] Just as is with whole foods,[31,32] consumers perceive this category of products as being more natural and healthy options, which undergo less processing and contain fewer food additives.[74] The results showed that the majority of products (79%) were formulated with food additives, and there was no significant difference in the number of additives compared to products without the "homemade" indication.[74] In the totality of foods analyzed in the present study, food additives were found in the list of ingredients, with an average number of additives per product of 3.5 for CBs and 2 for WGBs, with no significant difference in either the absolute number as well as the quantity of classes of food additives found in the list of ingredients between the categories ($p>0.05$).

Whole wheat flour is one of the most used components in the production of whole-grain breads.[40] According to resolution RDC No. 727/2022,[35] which provides for the labeling of packaged foods, all components in the list of ingredients must be ordered in descending order, according to their proportion. Therefore, knowing that wheat flour is the essential ingredient for making bread, it is understood that if the bread called whole-grain does not have whole wheat flour as the first component of the list of ingredients, it will probably not be the best choice for consumption.[40] The data from this study demonstrated that the majority (88.7%) of WGBs declared whole wheat flour as the first ingredient. At the same time, white flour was one of the main components of the ingredient list in 64% of the WGBs analyzed, present in 11.3% of the sample as the first ingredient, and in 52.8% as the second.

Scientific literature has focused on investigating the nutritional composition of whole-grain breads in light of the presence of whole-grain flour as the first component in the formulation of products commercialized in several Brazilian states. The analysis of 30 whole-grain bread labels in Caxias do Sul/RS, in 2014,[37] found that 60% (n=18) of the sample did not list whole-grain flour as the first ingredient, while in Salvador/BA,[38] in 2016, 40% (n=4) of the 10 labels analyzed also did not list this ingredient as the first ingredient. In 2017, out of the 21 labels of whole-grain bread collected in supermarkets in Belém/PA, whole wheat flour was not the most prevalent element in 28.6% (n=6) of the labels,[36] a result that adds to the data collected in 2019[58] in supermarkets in Trindade/GO, which revealed the same condition among 35.29% (n=6) of the 17 labels analyzed.

Based on the studies cited, it is possible to observe a progressive improvement in the nutritional composition of whole-grain breads from 2014 onwards,[36-38,58] with regard to whole wheat flour as the first

component of the list of ingredients, in line with the present study, in which only 11.3% (2022) of the sample did not have this item as the first on the list.

The Resolution RDC No. 712/2022, which sets out the rules for the composition and labeling of whole grain products, represents a step forward in this scenario, as it establishes the criteria for designating a product as "whole grain". In this case, the food must contain cereals or pseudocereals that, when exposed to any processing, maintain their anatomical components intact as well as the presence of whole wheat flour in at least 30% of the composition of the products is mandatory and this must be higher than the amount of refined ingredients. Furthermore, the total percentage of whole grain components must be informed and declared on the label when the product does not meet the specifications but contains whole grain ingredients and the term "whole grain" must not be used in the sales name.[30,41,75]

The need for continuous regulation and monitoring of commercialized whole foods, especially sliced breads, given the national scenario, has become evident. In the last few years, it has been possible to monitor progress in the regulatory agenda, through the update of several resolutions in the food sector, providing greater clarity to consumers when purchasing. Therefore, it is suggested the study of the impact of the RDC No. 712/2022 implementation, in order to compare and monitor the nutritional quality of whole foods before and after its implementation. It is also suggested that the RDC No. 429/2020, which provides for the new format of nutritional labeling and establishes parameters for critical nutrients such as sugar, sodium, and saturated fat, to have its impact on the formulation of new versions of whole foods to be investigated.

The digital format of data collection is highlighted as a possible limitation of the study. Although this was an intentional choice to include a larger number of products, the information contained on the websites of sliced bread brands may differ from that found on the labels of products available on supermarket shelves. Another possible limitation is the fact that the regulations for denomination of whole grain products in Brazil were published while this research was being conducted. However, the regulations had not yet come into effect due to the adaptation period of the labels by manufacturers,[41] making it impossible to conduct an analysis in accordance with the parameters currently in force.

CONCLUSION

This study provides a national overview of the nutritional quality of sliced breads commercialized in Brazil. Whole-grain sliced breads have a better nutritional profile when compared to conventional ones, although there are similarities in their composition regarding fat, sugar and food additive values. The importance of inspection by the competent governmental agencies is highlighted, in order to ensure that the standards for denominating whole-grain foods are actually met. It is worth noting that nutritional labeling is considered an important tool for adopting healthier food choices, being the first contact the consumer has with the packaged food.

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Contributors

Moreira CC and Cortez-Vega WR were responsible for the study design; Abatti LS collected, tabulated and processed the data; Moreira CC, Cortez-Vega WR and Abatti LS conducted the analysis and interpretation of the data. All authors participated in the writing of the paper and in preparing tables and figures, and all also critically reviewed the manuscript and approved the final version, assuming public responsibility for the content of the article.

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