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## Nutritional quality of biscuits available for sale in supermarkets

### *Qualidade nutricional de biscoitos disponíveis à venda em supermercados*

#### Abstract

**Introduction:** Biscuits are small bakery products made with wheat flour, fat, sugar and other ingredients, and they can be processed or ultraprocessed food. This paper aimed to evaluate the nutritional quality of biscuits sold in Brazilian supermarkets. **Materials and methods:** After authorization from the managers, two supermarkets participated in the study. The data collected from labels was the nutritional information and the list of ingredients of cookies, through photos and notes. Data were tabulated and statistically analyzed with analysis of variance (ANOVA) with a significant level of  $p < 0,05$ . **Results:** A total of 412 different products were included, which 73,5% are sweet and 26,5% are salty biscuits. About processing, 98,05% are ultraprocessed and only 1,95% processed. The average of ingredients was 14,80 and 84,7% of biscuits were produced with 11 or more ingredients; the maximum number of ingredients was 29. Vegetal fat was found in 79,6% of products. Sweet biscuits have higher values of sugar ( $p < 0,0001$ ), total fat ( $p = 0,002$ ) and saturated fat ( $p < 0,0001$ ), and salty biscuits were higher in proteins ( $p < 0,0001$ ) and sodium ( $p < 0,0001$ ). When compared with processed biscuits, the ultraprocessed ones were higher in carbohydrates ( $p = 0,001$ ), sugar ( $p < 0,0001$ ), total fat ( $p < 0,0001$ ) and saturated fat ( $p < 0,0001$ ). **Conclusion:** In this study, processed and salty biscuits had better nutritional quality than sweet and ultraprocessed ones, and are considered better choice options for consumers in supermarkets.

**Keywords:** Label facts. Nutritional information. NOVA classification.

#### Resumo

**Introdução:** Biscoitos são produtos de panificação feitos com farinha, gordura, açúcar e outros ingredientes, e podem ser alimentos processados ou ultraprocessados. **Objetiva:** O objetivo deste trabalho foi avaliar a qualidade nutricional de biscoitos comercializados em supermercados brasileiros. **Materiais e Métodos:** Após a autorização dos responsáveis, dois supermercados participaram do estudo. Foram coletados os dados de informação nutricional e a lista de ingredientes dos biscoitos a partir dos rótulos dos produtos, através de fotos e anotações. Os dados foram tabulados e analisados estatisticamente através de estatística descritiva e análise de variância (ANOVA) com nível de significância de  $p < 0,05$ . **Resultado:** No total, foram incluídos 412 biscoitos diferentes, dos quais 73,5% eram doces e 26,5%, salgados. A média de ingredientes por produto foi de 14,80, e 84,7% dos biscoitos eram produzidos com 11 ou mais ingredientes; o número máximo de ingredientes encontrado foi de 29. A gordura vegetal foi encontrada em 79,6% dos produtos. Os biscoitos doces tiveram valores mais elevados de açúcares ( $p < 0,0001$ ), gordura total ( $p = 0,002$ ) e gordura saturada ( $p < 0,0001$ ), e os biscoitos salgados tiveram valores mais

altos de proteínas ( $p < 0,0001$ ), e sódio ( $p < 0,0001$ ). Quando comparados com biscoitos processados, os biscoitos ultraprocessados tiveram níveis mais elevados de carboidratos ( $p = 0,001$ ), açúcares ( $p < 0,0001$ ), gordura total ( $p < 0,0001$ ) e gordura saturada ( $p < 0,0001$ ). **Conclusão.** No presente estudo, biscoitos processados e salgados tiveram melhor qualidade nutricional que os biscoitos doces e ultraprocessados, e são considerados melhores opções para os consumidores em supermercados.

**Palavras-chave:** Rotulagem de alimentos. Informação nutricional. Classificação NOVA.

## INTRODUCTION

Biscuits can be considered comfort foods, which provide well-being or some consolation when consumed.<sup>1,2</sup> They can evoke memories or feelings of a past time, like a joy with a sweet smell of homemade biscuits and bring people to a more positive emotional state.<sup>3</sup> Their recipes use flour and fat to make a flat dough in different shapes and flavors, with add of other ingredients like sugar, chocolate, salt, cheese, or natural spices and commonly are consumed like snacks between meals.<sup>4</sup>

However, due to the lack of time and the need for ready-to-eat foods, most people prefer to buy their biscuits. In Brazil, the per capita consumption of industrialized biscuits was 7,21 kg in 2019, a total of 1,5 million tones.<sup>5</sup> The rules for production define biscuits as "products obtained by mixing flour(s), starch(s) and/or starch(s) with other ingredients, submitted to kneading and cooking processes, whether fermented or not. They can have different coverage, filling, shape and texture."<sup>6</sup> Unlike homemade biscuits, industrialized biscuits used ingredients to provide specific functions in the products, such as stabilizers, preservatives, colors, and flavor enhancing.<sup>7</sup>

When biscuits are evaluated by NOVA classification system<sup>8</sup> they can be classified like processed or ultraprocessed. If they are produced with *in natura* or minimally processed foods and culinary ingredients, they are processed. However, if they contain food substances like starch, gluten, lactose, vegetable fat and/or food additives they are considered ultraprocessed products.<sup>8</sup> In supermarkets of Spain, 100% of biscuits with appealing to children are ultraprocessed.<sup>9</sup>

Diets with a higher proportion of ultraprocessed food had been evaluated with low nutritional quality. First, due the poor nutritional quality of ultraprocessed foods - commonly energy-dense, high in sugars and fats, and low in fiber, protein, and micronutrients - and also to stimulate overconsumption, since they are prepared with intense flavors, sugar, salt and fat<sup>10</sup> and are easily accessible to consumers in supermarkets.<sup>11</sup> The excessive consumption of ultraprocessed food had been associated with development of non-communicable chronic diseases, like obesity - one out of four adults are obese in Brazil<sup>12</sup> - cardiovascular diseases, diabetes, and cancer.<sup>8</sup> Furthermore, their forms of production, distribution, commercialization, and consumption adversely affect culture, social life, and the environment. For this reason, the Food Guide for the Brazilian Population advises that the consumption of ultraprocessed foods be avoided.<sup>10</sup> However, sweet and salty biscuits are in second and third place, respectively, more consumed ultraprocessed food by the Brazilian population.<sup>13</sup>

The rules of labeling had been modified in different countries to include both processing and nutrients. There are many labeling systems, with many purposes.<sup>14</sup> France uses the Food Score, a nutritional rating system that classifies the food by processing and nutritional quality of ingredients.<sup>15</sup> In Chile, a country with higher rate of overweight in Latin America, labels present nutritional warnings for high energy, sodium, total sugars, and total saturated fats, in addition to nutritional facts and ingredient list.<sup>16,17</sup> Brazil is in a transition period for a frontal labeling system with warnings of high sugar, saturated fatty acid, and sodium.<sup>18,19</sup> Another law excludes trans fatty acids by industrialized foods,<sup>20</sup> important rules for biscuits manufacturers.

To date, however, most studies have looked at cookies from other aspects, such enrichment for promote satiety,<sup>21</sup> trans fatty acids presence in biscuits,<sup>22</sup> or compliance with legislation.<sup>23</sup> However, there are few studies on the nutritional quality of biscuits available to consumers. Thereby, this work analyzed the nutritional quality of biscuits sold in supermarkets of a southern city of Brazil.

## MATERIALS AND METHODS

### Data source

An extensive data collection of biscuit labels was conducted in March and April of 2021 across two major supermarkets of a southern city of Brazil.

### Eligibility and Exclusion Criteria

All biscuits of all brands available at supermarket shelves were included and were assigned to categories indicated by the manufacturer: sweet, assorted biscuit, sweet biscuit, sweet sandwich cookie or covered cookie, wafer, salty biscuit, salty sandwich biscuit, salty whole meal biscuit, and appetizer cookie. Products excluded from the data collection process were those classified as "no sugar" or "sugar free" due to being in exclusive shelves on the supermarket, separated from common biscuits, and imported biscuits. Although several products were available in both supermarkets, each product was only recorded once.

### Ethics approval

This study was exempt from requiring ethics approval given the analysis focused solely on food products; however, it was requested an authorization by the managers of supermarkets for data collection.

### Data Collection and Analysis

Smartphones were used to photograph the ingredient list and nutrition information panel for each product. Data were transcribed from photographs for sheets on Microsoft® Excel. From the list of ingredients, the name of the product, the flavor were registered and each ingredient was tabulated according to NOVA classification system<sup>8</sup> as *in natura*, minimally processed, culinary ingredients, food substances, food additives and food components. The presence of vegetable fat was also recorded.

Descriptive analyses were conducted with Microsoft® Excel Version to determine the absolute (*n*) and relative (%) frequency of sweet and salty biscuits, processed and ultraprocessed biscuits, types of ingredients and products with vegetable fat. When the ingredient list presents less than 5 ingredients and only *in natura* ingredients or culinary ingredients, the biscuit was classified as processed. But if it had more than 5 ingredients and/or industrial ingredients like food substances and food additives, it was classified as ultraprocessed.<sup>8</sup>

For nutritional information, we consider the serving size indicated for the manufacturer - the Brazilian legislation defines 30 g per serving for biscuits - and we registered energy, carbohydrates, proteins, total fat, saturated fat, trans fat, fiber and sodium. The reference daily values were based on a 2,000 calorie diet: 300 g of carbohydrates, 75 g of protein, 55 g of total fat, 22 g of saturated fat, there is no limit for trans-fat, 25 g of fiber and 2000 mg of sodium.<sup>19</sup>

After tabulation we compared nutritional information (carbohydrates, proteins, total fat, saturated fat, trans fat, fiber, and sodium) between sweet and salty biscuits and processed and ultraprocessed using analysis of variance (ANOVA), with a significant level of  $p < 0,05$ .

## RESULTS

### Sample

A total of 412 products were included, 73,5% (n=303) were sweet biscuits and 26,5% (n=109) salty biscuits (Table 1).

**Table 1.** Varieties of biscuits sold in supermarkets. Brazil, 2021

Variety	<i>n</i>	%
Sweet assorted biscuit	109	26,5
Sweet sandwich cookie or covered cookie	87	21.1
Salty sandwich biscuit	59	14.3
Traditional cookie	46	11.2
Wafer	41	9.9
Sweet biscuit	22	5.3
Salty biscuit	18	4.4
Appetizer cookie	16	3.9
Salty wholemeal biscuit	14	3.4
<b>TOTAL</b>	<b>412</b>	<b>100</b>

### Processing

A substantial proportion of biscuits are ultraprocessed (98,05%, *n*=304). Only 1,95% (*n*=8) were processed. Among ultraprocessed biscuits, 74,8% (*n*=302) were sweet biscuits and 25,2% (*n*=102) salty biscuits. Among the processed biscuits, 87,5% were salty biscuits.

### Ingredients

On average, the number of ingredients per product was 14,8, and 84,7% (*n*=349) of biscuits were produced with more than 11 ingredients. Biscuits are found with a minimum of 2 and a maximum of 29 ingredients (Table 2).

**Table 2.** Number of ingredients according to the ingredient list of biscuit labels. Brazil, 2021.

Number of ingredients	<i>n</i>	%
≤ 5	8	1.9
6 to 10	56	13.6
11 to 15	180	43.7
16 to 20	117	28.4
≥21	51	12.4
<b>Total</b>	<b>412</b>	<b>100</b>

These ingredients were assigned in different categories according to NOVA classification (Table 3). Industrial ingredients like additives, food substances and food components predominated on biscuits formula.

**Table 3.** Biscuit ingredient categories according to NOVA classification. Brazil, 2021.

Ingredient	<i>n</i>	<i>sd</i> *	%
Food additives	5.66	2.11	38.2
<i>In natura</i> or minimally processed	2.87	1.99	19.4
Food substances	2.66	1.25	18
Culinary ingredients	2.39	0.88	16.2
Food components	1.22	1.22	8.2
Total	<b>14.80</b>		<b>100</b>

\*standard deviation

Most common food substances are inverted sugar, lactose, whey powder, modified starch and vegetable fat - present in 79,6% (n=328) of biscuits, especially in ultraprocessed biscuits (80,26%, n=326). More frequent additives were yeast, sweeteners, flavoring, colors and conservatives, and food components were basically chocolate drops and chocolate cover, with no description of its ingredients.

## Nutritional information

Energy value per serving was 134,06 Kcal in sweet biscuits and 130,14 Kcal in salty biscuits (Table 4). In most products, the main ingredients provided carbohydrates and fats.

**Table 4.** Nutritional values of sweet and salty biscuits on sale in supermarkets. Brazil, 2021.

	Sweet		Salty		p value
	g*	%	g*	%	
Carbohydrates	19.95	59.53	19.61	60.27	0.43
Sugar**	7.95	23.72	1.89	5.81	<0.001
Protein	11.96	5.85	2.87	8.82	<0.001
Total fat	5.14	34.51	4.38	30.29	0.002
Saturated fat	2	9.15	1.42	9.82	<0.001
Trans fat	1.07	7.18	0.71	4.91	0.08
Fiber	1.05	1.41	0.95	3.7	0.25
Sodium (mg)	70.89	2.94	213.36	8.9	<0.001

\*g = grams. Except for sodium (mg)

\*\*g of sugars are also included in carbohydrates

Sugar, total fat, and saturated fats were significantly higher ( $p < 0,05$ ) in sweet biscuits, and sodium and proteins were significantly higher ( $p < 0,05$ ) in salty biscuits. Carbohydrates, trans fatty acids and fiber do not reach statistical significance between sweet and salty biscuits.

Energy value per serving was 133,26 Kcal in ultraprocessed biscuit and 118,6 Kcal in processed biscuits (Table 5). Carbohydrates, sugars, total fat and saturated fat were significantly higher ( $p < 0,05$ ) in ultraprocessed biscuits. The other nutrients did not present statistical significance.

**Table 5.** Nutritional values of processed and ultraprocessed biscuits on sale in supermarkets. Brazil, 2021.

	Processed		Ultraprocessed		<i>p</i> value
	g*	%	g*	%	
Carbohydrates	25	84.32	19.8	59.43	0.001
Sugar**	-	-	6.7	20.11	<0.0001
Protein	2.66	8.97	2.18	6.54	0.18
Total Fat	0.64	4.86	5	33.77	<0.0001
Saturated fat	0.26	1.97	1.88	12.70	<0.0001
Trans fat	-	0	0.96	6.48	0.57
Fiber	0.84	2.6	1.03	4.1	0.61
Sodium (mg)	127.8	5.4	106.34	4.41	0.54

\*g = grams. Except for sodium (mg)

\*\*g of sugars are also included in carbohydrates

## DISCUSSION

In 2020, approximately 1,52 million of tons of biscuits were commercialized in Brazil, and 99,7% of families consumed biscuits that year.<sup>7</sup> Commercial importance was confirmed by this study, which found 412 different biscuits on the supermarket shelves.

For people looking for taste and convenience, biscuits can be good options, since usually they are presented in individual packets, are ready-to-eat foods, easy to carry around or store at home and have an affordable price.<sup>10</sup> However, most biscuits were ultraprocessed, which demonstrates that it is not easy for the consumers to make good choices in supermarkets.

Ultra-processed products are products made from industrial formulations, with substances often modified by chemical processes to increase their shelf life and with food additives such as flavorings and colorings that make them hyperpalatable.<sup>8</sup> Furthermore, ultraprocessed foods are more publicized - with advertisements and promotions next to check-out counters in Brazil,<sup>24</sup> stimulating excessive consumption. The orientation is to avoid ultraprocessed food whenever possible<sup>10</sup> due their association with the development of chronic diseases, but the higher consumption of biscuits by Brazilian people demonstrates that ultraprocessed biscuits are part of the population's diet more than they should be.

In culinary or gastronomy, a biscuit is a food made by mixing 2-5 ingredients, like flour, fat, and sugar and/or salt.<sup>25</sup> In this study we found up to 29 ingredients, and the majority was industrial products, like food additives, at the top of the list.

Food additives are any ingredients intentionally added to food, not for the purpose of nurturing people, but to change the physical, chemical, biological or sensorial characteristics of food during fabrication, processing, packing or storage processes.<sup>26</sup> Among the additives present in biscuits were acidulants, sweeteners, emulsifiers, flavors, colors, and preservatives. Although food additives are used in small amounts

in food, they are widely spread in industrialized foods, and there are studies that show an association of some types of additives with endocrine changes, some types of cancer and modification of the intestinal microbiota.<sup>27-29</sup> Furthermore, since additives bring sensory pleasantness - more flavor, smell, and textures to food - they encourage consumption more than ideal, leading to excess of calories and of the additives themselves.

Among the ingredients found in biscuits were food substances - substances directly extracted from foods and then added singly in another food products.<sup>8</sup> Sugars were more frequent and are used to provide flavor, texture, and moisture to the biscuits<sup>8</sup> and they are used even in salty biscuits to highlight the sweet flavor.

When compared to 350 biscuits analyzed in Spain, Brazilian biscuits had, on average, similar amounts of energy, carbohydrates, sugars, fiber and protein.<sup>30</sup>

The fact that most biscuits were sweet attests the consumer's and the industry's interest for these products.<sup>31</sup> When compared with salty biscuits, they had significantly more sugar, total fat and saturated fat,<sup>9</sup> which make them have high caloric density. The excessive consumption of sugar has been associated with many healthy problems like obesity, diabetes, hepatic steatosis, and other chronic diseases.<sup>32</sup> There is not a recommendation about sugar consumption, since it is not an essential nutrient, but there are guidelines for limits of consumption for healthy eating, which is 25 g, that is, 5% of total daily calories.<sup>32</sup> In this study, the average of sugars - among the products that reported it - was about 8 g for portion of sweet biscuit (equivalent to 32% of daily limit) and 1,9 g for portion of salty biscuit (equivalent to 7,6% of daily limit).

Due to lack of biscuit growth, fat is an essential element to make the biscuit soft, crunchy with its typical texture.<sup>8</sup> In this study, vegetable fat was present in most biscuits. The nutritional composition of this fat is variable, depending on its origin - lately, soy oil has been substituted by palm oil by the industries<sup>33,34</sup> - but commonly are found saturated and *trans* fatty acids in vegetable fats.<sup>35,36</sup>

Trans fat had been excluded from food manufacturing in Brazil, with complete exclusion forecast in December 2022.<sup>20</sup> However, it still found in high levels, especially in non-industrial bakery products, made by independent bakeries.<sup>22</sup> These types of firms are excluded from the Brazilian legislation.<sup>20</sup> In other countries, trans fatty acids have already been excluded from food manufacturing due to their association with cardiovascular diseases.<sup>35</sup> It was observed that saturated fatty acids are also frequent, probably due the use of palm oil in formulation of biscuits. In other countries, changes in law led to an increase of saturated fatty acids.<sup>37</sup> According to the Brazilian legislation, the consumption limit for adults is 20 g.<sup>19</sup>

Considering both macronutrients evaluation and ingredients list, we concluded that the salty biscuits had better nutritional quality than sweet biscuits, except by the sodium. They salty biscuits had more proteins and less sugar, total fat and saturated fat. However, the average of sodium in salty biscuits (213,36 mg/30 g or 710,48 mg/100 g) is considered high by the new legislation.<sup>18,19</sup> The adequate intake of sodium is 2,300 mg daily for adults in a daily intake of 2,000 Kcal, and higher consumption is associated with increased risk of hypertension.<sup>38</sup>

## CONCLUSION

Results of this study allowed us to analyze the nutritional quality of biscuits available on supermarket shelves. We find that they are mostly ultraprocessed and sweets. The Food Guide for the Brazilian Population indicates that ultraprocessed food should be avoided, and priority of food should be *in natura* and minimally processed foods.

Most of the biscuits did not have good nutritional quality and their consumption should be reduced. However, it was found that salty and processed biscuits had better nutritional quality, both in relation to the number of ingredients and to the macronutrients, except by the sodium content.

Nowadays, it is important to apply different methods to help to reduce the intake of ultraprocessed foods, like nutritional education. With reduction the consumption of ultraprocessed food, there may be a reduction in the intake of energy, saturated and trans fat, sugar and/or sodium.

A limitation of this work is that it does not analyze with more details the quality of each ingredient - types of vegetable fat, of food substances and chemical food additives, for example - and it is suggested that further work be carried to deepen knowledge about the subject

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Silveira JT e Gasperin PD participated in the conception and design of the work, analysis and interpretation of data, revision and approval of the final version; Moura FA participated in the conception and design of the work, data interpretation, review and approval of the final version.

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