

Variation in processing level, energy, and critical nutrients in raw materials from different commercial brands

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Abstract

Given the increase in the consumption of meals eaten outside the home and the consequent rise in noncommunicable chronic diseases, providing the population with food of adequate nutritional quality has become essential. This study aimed to evaluate the processing level and the variation in energy, fat and sodium content of raw materials from different commercial brands. A total of 38 types of raw materials used in a commercial food service in southern Brazil were selected and classified as processed or ultra-processed. Food labels from five different brands were analyzed for each type of raw material, totaling 190 products. Of these, 63.2% were classified as ultra-processed, 36.3% were high in sodium, and 55.2% were high in saturated fat. Energy and sodium showed the greatest variation across brands in all food groups. These findings highlight the importance of establishing supplier selection criteria that incorporate assessment of the nutritional composition of raw materials used in the production of meals for communities, as products from different brands may present differences in critical nutrients concentration, with potential public health implications.

1. Introduction

A global shift in lifestyle habits has been observed across different social groups, affecting individuals' relationships with food and their eating practices [1,2], including the practice of eating outside the home. Several studies indicate that populations with a higher consumption of food prepared outside the home tend to have less favorable nutrient intake profiles, characterized by higher average intakes of sodium, energy, sugars and fats [3,4,5,6,7].

Between 2017 and 2018, the Consumer Expenditure Survey conducted by the Brazilian Institute of Geography and Statistics (IBGE) estimated that 32.8% of total food-related expenditures among Brazilian households were spent on food consumed outside the home, corresponding to an average monthly expenditure of R\$ 215.96 [8]. In April 2022, sales in restaurants, cafeterias, bars, bistros and food trucks increased by nearly 75% compared to the same month in 2021 [9].

In the United Kingdom, expenditure on food and drink consumed outside the home has increased by 5.9% from 2023 to 2024 [10]. In Canada, spending on meals and snacks purchased in restaurants reached 27.8% of the country's food budget in 2023 [11]. In the United States, expenditures on food consumed outside the home increased from US\$1.45 trillion in 2023 to US\$1.52 trillion in 2024, accounting for 58.9% of total food expenditures in 2024 [12].

The current global scenario of dietary patterns and health conditions has been characterized by increasing prevalence of obesity and diabetes mellitus. In addition, other Noncommunicable Chronic Diseases (NCDs) associated with excessive intake of calories and critical nutrients have also increased, such as hypertension, cardiovascular diseases and certain types of cancer [13].

According to the Pan American Health Organization (PAHO), sodium, sugars, saturated fats and trans fats are considered critical nutrients. Consumption of foods containing excessive amounts of one or

more of these nutrients increases the likelihood that dietary intake will exceed the nutritional targets recommended by the World Health Organization (WHO); therefore, their intake should be monitored and limited by the population [14].

Growing concern about food processing, composition and their effects on human health has generated the need to provide precise and standardized guidelines for countries and researchers. The NOVA classification is one of the systems widely applied in the scientific literature to address this issue [15]. This system categorizes food into four groups according to their level of processing: (1) fresh or minimally processed foods; (2) culinary ingredients; (3) processed foods; and (4) ultra-processed foods [13,16].

The group of culinary ingredients consists of products with high content of nutrients that may be harmful to health when consumed in excess, such as saturated fats, free sugars and sodium; therefore, their impact on the food nutritional quality depends on the quantities used in meal preparation [13]. Studies by Amerzadeh and Takian [17] and Itoh and Tanaka [18] assessed that, due to their composition, foods classified as processed and ultra-processed also increase the risks for developing NCDs.

The demand for high-quality food has been increasing steadily in recent decades, driven by growing concerns about health and environmental sustainability, as well as by consumer demands associated with greater access to information and news [19]. In this context, food service establishments that provide meals to communities become places of interest for the implementation of health promotion and healthy eating strategies, as they offer multiple opportunities for intervention, ranging from the selection and purchase of raw materials to menu planning and the final food choices made by consumers [1,20].

In commercial restaurants, the type of nutritional information most frequently provided to customers is related to the macro and micronutrient content of the dishes, with menus serving as the primary vehicle for communicating this information to consumers. In such cases, food service establishments must provide reliable, scientifically based nutritional information to avoid confusing consumers or causing harm to their health [21,22].

One of the main challenges in calculating nutrient composition tables for culinary preparations in commercial food services (CFS) is the absence of many products from food composition tables available in the literature, as well as the divergences between the macro and micronutrient values declared in them [23,24]. Facing this challenge, it is often necessary to use the information declared on the food labels of food products purchased by the establishment itself, which varies from supplier to supplier [21,25,26].

In 2020, aiming to improve the clarity of information declared on packaged food labels, the Brazilian National Health Surveillance Agency (ANVISA) revised the requirements for the declaration of nutritional information on foods [27]. To date, more than 30 countries have introduced symbols or other front-of-

package elements as additional sources of information, including traffic light systems and warning labels for foods with high amounts of energy, sodium, sugars and fats [28].

The front-of-package labeling regulations and symbols discussed above do not directly apply to the calculation of the nutrient composition of meals prepared and served in commercial restaurants. However, in Brazil, the declaration of a nutritional information is mandatory on labels of packaged foods, including those destined for use in food services [29]. Consequently, information provided in nutritional tables can serve as an important support for nutrient calculation, as it enables the use of standardized and regulated data on ingredients purchased from external suppliers.

The dissemination of data on this topic aims to raise awareness among managers regarding the importance of evaluating the nutrient composition of raw materials, as well as to provide theoretical support for the development of supplier selection criteria. Given the need for a solid scientific basis for the formulation and disclosure of reliable nutritional information in CFS, this study aims to identify the processing level and the variation in sodium, energy and fat content of raw materials from different commercial brands.

2. Materials and Methods

This is a quantitative, cross-sectional study conducted through the analysis of food labels of raw materials from different commercial brands available in meal preparation for communities in CFS.

2.1 Sample selection

Data collection was conducted using a non-probabilistic sample (convenience sampling). The selection of raw material types was based on data obtained from the technical recipe sheets of dishes sold in a private CFS located in the state of Rio Grande do Sul, Brazil. The CFS has a production center responsible for preparing the food items sold, which are subsequently transported and distributed to the company's points of sale within hospitals in the region.

The ingredient lists of the dishes available for consumption at the points of sale of the CFS were analyzed according to the following categories:

- a) Savory dishes: served *à la carte* in individual portions, listed on the menu for customers selection during lunch and dinner meals. These dishes were further classified into three groups: meats, pasta and soups.
- b) Sweets: displayed in refrigerated display cases at points of sale and sold as desserts.

From the list of raw materials (ingredients) used in the preparation of the selected dishes, this study considered only those that were industrially packaged and classified as processed or ultra-processed groups according to the NOVA classification [16]. Raw materials classified as freshor

minimally processed were excluded, since diets predominantly based on these foods generally meet the population nutrient intake goals established by the WHO [14].

For each type of raw material included in the study, products from five different commercial brands were evaluated. Data relevant to the analysis was collected from the nutrition facts table and the ingredient lists declared on the product packaging. All label information was recorded in Microsoft 365® Excel spreadsheets.

Data from the following surveys were consulted to define additional raw material samples when less than five different commercial brands were available for a given product in the CFS during the collection period:

1) Top of Mind Foodservice: conducted in November 2021 by the Foodservice Brazil Institute (IFB) in partnership with the Sorocaba Research and Statistics Institute (IPESO). It describes the main brands purchased from a total of 30 categories, according to owners of 400 restaurants, 200 bakeries and 160 snack bars in all Brazilian capitals [30].

2) Sales Leaders: carried out by the Brazilian Supermarket Association (ABRAS), it lists the food product brands that led sales in 150 categories in 2021, being considered the favorite among Brazilian consumers [31].

2.2 Criteria for classifying the processing level

To classify foods as processed or ultra-processed, food labels were individually examined, and ingredient lists were reviewed by a researcher. Classification criteria included the presence of food additives, as well as the sodium and saturated fat content of the products.

For the identification of ultra-processed foods, the presence of food substances never or rarely used in traditional cuisine was assessed, including the following classes of additives: flavorings, flavor enhancers, colorants, emulsifiers, artificial sweeteners, thickeners, foaming agents and anti-foaming agents, leavening agents, gelling agents, and glazing agents [16,32]. In addition, the presence of modified oils and fats and different types of sugars was also evaluated, such as maltodextrin, glucose syrup and invert sugar [33,34].

According to the NOVA classification, however, processed foods may also contain additives, if they are used to extend the product's shelf life, preserve its original properties, or prevent the proliferation of microorganisms. For example, the acidification of heart of palm through the addition of the acidifier citric acid prevents the germination of endospores of *Clostridium botulinum* and the consequent production of botulinum neurotoxin, which is lethal to humans [35].

2.3 Nutritional Information Analysis

Data collection from food labels of the selected raw materials was conducted between 2022 and 2023. Data from the nutritional facts tables and ingredient lists were collected in person through photographic records of the labels available in the CFS stock, to facilitate data storage and subsequent verification. For each product, values of sodium (mg), energy (kcal), total fat (g), saturated fat (g) and trans fat (g) were recorded, as well as their corresponding level of processing. However, as the deadline for adapting the products already on the market to the new labeling legislation was October 2024, it was not possible to assess added sugar content in all samples during the data collection period.

The analysis of sodium and saturated fat content was based on the critical nutrient parameters established for front-of-package nutritional labeling by Normative Instruction No. 75/2020, issued by the Brazilian Health Regulatory Agency (ANVISA). Accordingly, sodium content was classified as high when values were greater than or equal to 600 mg per 100 g of solid food or greater than or equal to 300 mg per 100 g of liquid food. Saturated fat content was considered excessive when amounts were greater than or equal to 6 g per 100 g of solid food greater than or equal to 3 g per 100 g of liquid food [27].

In accordance with the legal requirement to disclose the origin of food, determined by Resolution of the Collegiate Board RDC No. 727 of July 1, 2022, issued by ANVISA, it was possible to identify the origin of the packaged foods included in the study [36]. Data was collected in the presence of inspection stamps on foods of animal origin, which were classified as municipal, state, or federal.

2.4 Data analysis

The nutritional composition of the raw materials was evaluated by analyzing the calculated amounts of energy and critical nutrients per 100 grams of food, in order to observe the variations among the different commercial brands included in the study.

Quantitative variables of the study, as well as means and standard deviations, were recorded using Microsoft 365® Excel, and statistical analyses were performed using SPSS software, version 18.0.

2.5 Ethical aspects

This study was approved by the Research Committee of the Faculty of Medicine of the Federal University of Rio Grande do Sul (UFRGS), under protocol number 43558, in 2023. Since there was no type of intervention with human participants or animals, submission to the Research Ethics Committee was not required.

Authorization for data collection was obtained through a signed consent form from the person responsible for the site where the research was conducted. The consent form ensured that the establishment would not be identified and that all information was treated confidentially.

3. Results and discussion

3.1 Sample characteristics

A total of 38 types of raw materials used in the CFS were selected. Overall, 190 food products were analyzed, of which 109 were purchased and stored by the CFS between the years 2022 and 2023. The remaining 81 products were identified externally to the CFS and included according to data obtained in opinion surveys, which evaluated assessed commercial brands with greater prominence in the national market and among diverse consumer groups.

Figure 1 presents the origin of the raw materials according to the information declared on their labels.

[Insert Fig. 1]

Among the 190 items evaluated, products originating from the same state as the CFS were the most frequent (34.7%). Overall, most products came from the South region of Brazil (51.6%), followed by the Southeast (34.7%), Central-West (6.8%) and Northeast (3.7%) regions. Raw materials of international origin accounted for 3.1% of the sample and originated from Greece, France, Italy, Ecuador and Singapore.

In a study evaluating food purchased by restaurants in public educational institutions, Nogueira et al. [37] also reported a greater frequency of foods of national, local, regional, and state origin, with a lower proportion of products of international origin. According to Ribeiro et al. [38] and Strasburg et al. [39], an additional benefit of purchasing regional products is their lower greenhouse gas emissions (kgCO₂e), as shorter distances between production and distribution sites tend to reduce transportation-related fossil fuel consumption.

Based on the types of raw materials identified in the CFS, five groups were formed according to their characteristics and composition: (1) dairy products, (2) sugary products, (3) food preserves, (4) condiments and others, and (5) processed meat products. Table 1 presents the distribution of raw materials into food groups for the total sample, which included products purchased by the CFS as well as additional commercial brands selected from national public opinion surveys.

Table 1
Description of food groups based on five commercial brands per raw material.

Food groups	n	%
Dairy products	75	39
Sugary products	35	18
Food preserves	30	16
Condiments and others	30	16
Processed meat products	20	11
Total	190	100

[Insert Table 1]

The dairy and sugary product groups together accounted for more than half of the total sample (57%), comprising 110 products. The use of these products as ingredients was identified in approximately 60% of the dishes analyzed, mainly present in pies and in sauces served with meat and pasta. The dairy group included samples of cream cheese, table cream, *dulce de leche*, condensed milk, salted butter, buffalo mozzarella, fresh cream, brie cheese, gorgonzola cheese, fresh minas cheese, mozzarella cheese, parmesan cheese, provolone cheese, grated cheese and ricotta. The sugary products group included Marie biscuits, guava paste and different types of chocolate, including milk, white, semi-sweet, 32% cocoa powder and granulated chocolate.

The food preserves group included samples of tuna, olives, corn, hearts of palm, peaches in syrup, and dried tomatoes. The condiments and others group included shoestring potatoes, concentrated chicken broth, coconut milk, tomato sauce, soy sauce, and mustard. Finally, the processed meat products group included bacon, calabrese sausage, ham, and hot dog sausages. Together, these three groups accounted for 43% of the total sample.

Among products of animal origin (n = 100), 92% bore a Federal Inspection Stamp (SIF), 6% a state inspection stamp, and 2% had a municipal inspection stamp. This distribution allows our results to more accurately portray the reality of Brazilian CFS, as products bearing a SIF are authorized for national and international commercialization [40].

3.2 Processing levels of the inputs

The samples included in this study were classified as processed or ultra-processed, as described in Table 2.

Table 2 Classification of raw materials by processing level according to the NOVA classification.			
Food groups	Processed n (%)	Ultra-processed n (%)	Total n (%)
Dairy products	39 (52)	36 (48)	75 (100)
Sugary products	2 (5.7)	33 (94.3)	35 (100)
Food preserves	25 (83.3)	5 (16.7)	30 (100)
Condiments and others	4 (13.3)	26 (86.6)	30 (100)
Processed meat products	0 (0)	20 (100)	20 (100)
Total	70 (36.8)	120 (63.2)	190 (100)

[Insert Table 2]

Overall, ultra-processed foods were the majority when compared to processed foods. The processed meat products group showed the highest proportion of ultra-processed items, followed by the sugary products, condiments and others, dairy products, and food preserves groups.

Regarding the evaluation of different types of sugars, of the 190 items analyzed, 89 (47%) contained some type of sugar in their list of ingredients; 52 of these products were classified as sweets and 37 as savory. All foods in the sugary products group had sugar in their composition, as well as 95% of the processed meat products. Among dairy products, food preserves and condiments groups, the percentage of foods from each group containing added sugars was 15%, 30%, and 50%, respectively.

Sugars may appear under different names on product packaging [41,42] and are often characterized as highly technical terms that are difficult to understand, which can create difficulties for the consumer or even go unnoticed during product selection and purchase [43]. In this study, nine different nomenclatures for sugars were identified during the analysis of product ingredient lists. The term sugar appeared on 81 food labels, followed by glucose syrup (five mentions), invert sugar (four mentions), and maltodextrin (three mentions). The terms glucose, powdered glucose, liquid sugar, dextrose, brown sugar, and liquid sugar, were also observed on the labels.

3.3 Analysis of the nutritional composition of raw materials

The results of nutrient comparisons among different commercial brands of raw materials are presented in Table 3. For each type of raw material, mean values of energy (kcal), total fat (g), saturated fat (g) and sodium (mg) were calculated, along with the corresponding standard deviations to indicate variation among brands.

Table 3

Descriptive statistics (mean $\pm$ standard deviation) for energy, total fat, saturated fat, and sodium values per 100 g of raw materials, based on five different commercial brands.

Raw materials by food group	Energy (kcal)	Total fat	Saturated fat	Sodium
Dairy products				
Cream cheese	273.3 $\pm$ 12	26.1 $\pm$ 1.3	15.3 $\pm$ 2.3	356.7 $\pm$ 66
Table cream	191.9 $\pm$ 13.6	17.7 $\pm$ 1.3	10.6 $\pm$ 0.5	273.3 $\pm$ 12
<i>Dulce de Leche</i>	320.2 $\pm$ 25.1	6.6 $\pm$ 0.5	4.1 $\pm$ 0.4	142 $\pm$ 32.7
Condensed milk	305 $\pm$ 0	6.2 $\pm$ 0.4	3.6 $\pm$ 0.2	151 $\pm$ 56.2
Salted butter	660.7 $\pm$ 183	71 $\pm$ 24.7	44.3 $\pm$ 17.7	639.3 $\pm$ 239.1
Buffalo mozzarella	286 $\pm$ 35.4	24.7 $\pm$ 4.8	16 $\pm$ 2.9	240 $\pm$ 111
Fresh cream	438.2 $\pm$ 19.2	46.4 $\pm$ 2.8	30.2 $\pm$ 4.2	21.6 $\pm$ 14
Brie cheese	330.1 $\pm$ 19.8	28.2 $\pm$ 3.4	18.1 $\pm$ 2.8	575.7 $\pm$ 87.7
Gorgonzola cheese	334.9 $\pm$ 19.4	28.2 $\pm$ 3.4	18 $\pm$ 2.9	995.2 $\pm$ 119.3
Fresh Minas cheese	206.8 $\pm$ 45.5	12.7 $\pm$ 3.7	7.9 $\pm$ 2.3	233.5 $\pm$ 117.7
Mozzarella cheese	337.2 $\pm$ 18.8	26.3 $\pm$ 2	14.3 $\pm$ 1.7	447.2 $\pm$ 157.3
Parmesan cheese	404.3 $\pm$ 21.5	30.6 $\pm$ 1.9	20.5 $\pm$ 1.8	823.2 $\pm$ 100
Provolone cheese	352.7 $\pm$ 25.7	26.2 $\pm$ 3.5	17 $\pm$ 3.2	650 $\pm$ 144
Grated cheese	460 $\pm$ 68.9	32.6 $\pm$ 2.8	21.2 $\pm$ 4.5	1,484 $\pm$ 724.2
Ricotta	190.7 $\pm$ 71	12.6 $\pm$ 4.8	9.5 $\pm$ 3.8	262.7 $\pm$ 395.5
Sugary products				
Marie biscuit	414.4 $\pm$ 28.8	11.7 $\pm$ 1.9	4.2 $\pm$ 1.7	314.5 $\pm$ 70
Milk chocolate	539.8 $\pm$ 16.9	32.3 $\pm$ 2	19.8 $\pm$ 2.5	101.8 $\pm$ 28.8
White Chocolate	540.6 $\pm$ 13.3	30.8 $\pm$ 2.3	18.1 $\pm$ 1.8	120 $\pm$ 18.6
Semi-sweet chocolate	507 $\pm$ 32.8	29.8 $\pm$ 2.7	18 $\pm$ 1.5	17 $\pm$ 24.2
Chocolate powder	291.4 $\pm$ 117.8	4 $\pm$ 1.5	2.4 $\pm$ 0.8	12 $\pm$ 26.8
Chocolate sprinkles	433.6 $\pm$ 31.1	10.4 $\pm$ 6.1	9.4 $\pm$ 6.2	63.2 $\pm$ 42.9
Guava paste	314.5 $\pm$ 7.4	*	*	*
(*) All evaluated brands reported zero values for these nutrients on their nutrition facts tables.				

Raw materials by food group	Energy (kcal)	Total fat	Saturated fat	Sodium
Dairy products				
Food preserves				
Tuna	155 ± 60.5	5.3 ± 6.5	1.2 ± 0.9	415.6 ± 81.1
Olive	146 ± 55.2	14.3 ± 6.9	2.7 ± 1.9	1,351 ± 257.9
Corn	71.8 ± 9.9	1.4 ± 0.3	0.3 ± 0.2	230.8 ± 44.1
Palm heart	28 ± 9.7	1.2 ± 1.7	0.5 ± 1.2	755.8 ± 386.6
Canned peaches	78.2 ± 12.3	0.1 ± 0.2	*	1.4 ± 2.4
Dried tomatoes	166.7 ± 41.9	11.2 ± 6	0.8 ± 0.7	509 ± 221
Condiments and others				
Shoestring potatoes	460.8 ± 123.1	35.5 ± 4.2	14.1 ± 3.6	196.8 ± 106.3
Concentrated broth	224.3 ± 67.7	7.8 ± 10.7	2.9 ± 6.6	16,951 ± 1,911.2
Coconut milk	116 ± 67.2	10.9 ± 6.4	9.7 ± 6.1	36.2 ± 38.7
Tomato sauce	33 ± 6.2	*	*	388.2 ± 128.8
Soy sauce	45.7 ± 24.5	*	*	5,002 ± 853.1
Mustard	49.7 ± 27.4	*	*	855 ± 346.5
Processed meat products				
Bacon	376.5 ± 75.1	34.7 ± 11	11.6 ± 3.6	1,336 ± 476.8
Calabrese sausage	332.5 ± 44.8	28 ± 4.2	11.5 ± 3.7	1,482.2 ± 244.5
Ham	105.3 ± 29.6	3.6 ± 3.8	1.2 ± 1.6	975.1 ± 140.8
Hot dog sausage	223 ± 26	17 ± 2.6	5.1 ± 1.2	1,048.4 ± 69.7
(*) All evaluated brands reported zero values for these nutrients on their nutrition facts tables.				

[Insert Table 3]

Within the dairy group, the greatest variation relative to the mean was observed among salted butter, grated cheese, and ricotta samples when energy and sodium values were evaluated. According to the analysis of critical nutrients, 33.3% of dairy products had a high sodium content and 63% a high saturated fat content.

Among commercial brands of ricotta, a contrast was observed between a sample containing 313.2 kcal and 966.7 mg of sodium per 100 g and another containing 130 kcal and 43.3 mg of sodium for the same serving size. Similarly, the nutritional information declared for one salted butter sample indicated 333.3 kcal and 976.7 mg of sodium per 100 g, showing a great discrepancy when compared with another sample containing 740 kcal and 370 mg of sodium. The five brands of grated cheese also exhibited variation, with declared sodium values ranging from 500 mg to 2240 mg per 100 g of product.

By analyzing the labels of 1,416 processed foods sold in a supermarket chain in Florianópolis, Santa Catarina, Brazil, Martins et al. [44] found that 59% of the products had a high sodium content. The study examined ingredient lists and sodium values declared on the nutrition facts tables of processed and ultra-processed foods. Similarly, the variation in sodium content was observed among products within the same food groups, but from different brands, along with missing information in nutrition facts tables and incomplete descriptions in ingredient lists.

Within the sugary products group, the greatest variation was observed in the energy values of 32% cocoa powder chocolate and in the sodium values of Marie biscuits and granulated chocolate. The discrepancy in sodium content declared for granulated chocolate was particularly noteworthy, with declared values ranging from 6.8 mg to 108 mg per 100 g.

Four brands of 32% cocoa powder chocolate reported sodium values of zero, whereas the fifth brand declared 60 mg per 100 g. As observed for products reporting trans fat values, this brand already presented nutrient amounts per 100 g of product in the nutrition facts table at the time of data collection, in accordance with the current legislation.

Despite these differences, none of the foods in the sugary products group were classified as having a high sodium content. However, with regard to saturated fat, 63.3% of the sample exceeded the threshold established for front-of-package nutritional labeling.

For the food preserves group, 33.3% of the samples were classified as having a high sodium content. The greatest variation among brands was observed in the energy and total fat values of tuna and olive samples, as well as in the sodium values of tuna, hearts of palm, and dried tomatoes. The sodium values for heart of palm samples stand out, varying from 467 mg to 1,420 mg of sodium per 100 g of product.

Within the condiments and others group, all samples of concentrated chicken broth and soy sauce exhibited high sodium content, as did four samples of mustard, totaling 46.6% of the group. Regarding saturated fat, 36.6% of the samples in this group showed a high content of this nutrient.

In this group, the greatest variation in energy values among commercial brands was observed for shoestring potatoes and coconut milk. For coconut milk, two brands reported zero sodium, whereas the others declared 32 mg, 60 mg, and 89 mg per 100 ml. Among soy sauce brands, the declared amount of sodium ranged from 3,900 mg to 5,700 mg in 100 ml. Likewise, great variation in sodium content was

observed among mustard samples, with values ranging from 541.7 mg to 1,366.6 mg per 100 g of product.

Melo and Freitas [45] reported similar findings when quantifying, through physicochemical analyses, the sodium content of ready-made seasoning samples obtained from supermarkets in Belém do Pará, Brazil. Their results indicated excessive sodium level in those products, as well as discrepancies between the sodium content measured analytically and the values declared on product labels.

A similar pattern was observed in the results reported by Strasburg et al.[46], who evaluated the extrinsic per capita sodium content of industrialized products used in meal preparation in university restaurants, observed that sodium levels in prepared dishes varied according to the types of products used. Dishes that included ready-made seasonings in addition to iodized salt exhibited the highest sodium content.

Finally, all foods in the processed meat products group contained excessive amounts of sodium. Regarding saturated fat, 60% of the products had high levels. Bacon showed the greatest variation among brands for all nutrients analyzed. Among bacon samples, the difference in sodium content between the lowest and highest values reached 1,070 mg. Energy content ranged from 290 to 460 kcal, total fat from 21 to 47 g, and saturated fat from 7 g to 17 g per 100 g of product.

Based on the criteria established by Normative Instruction No. 75/2020 [27], the evaluation of the nutrient profile showed that 36.3% of the sample contained excessive amounts of sodium. For fats, 55.2% of the foods presented a high content of saturated fat and must display a critical nutrient warning on the front of their packaging. Trans fats were not included in the analysis, as 97.7% of the inputs had values declared as zero in the nutrition facts table.

Anastácio et al.[47] found similar results when analyzing the nutritional composition of foods consumed by children attending Basic Health Units in the city of Rio de Janeiro, Brazil. The authors reported that, out of the 351 foods studied, 66% presented an excess of at least one critical nutrient, such as total fat, saturated fat, trans fat, and sodium.

According to Polsky and Garriguet [5], the consumption of foods prepared outside the home is associated with a less favorable dietary profile in Canada, characterized by a higher average intake of sodium and total fat and lower fiber intake. In the United States, restaurant food already contributes for approximately 29% of total daily sodium intake among individuals aged 20 years and older [6]. Similarly, a systematic review by Lachat et al.[4] found that frequent consumers of foods prepared outside the home foods had higher energy intake from fat, particularly saturated fat.

In Brazil, among the population aged 10 years and older, 11.3% and 19.7% of total caloric in the 2017–2018 period came from processed and ultra-processed foods, respectively [8]. To address the need to expand the supply, availability, and consumption of healthy foods among Brazilian population, the National Pact for Healthy Eating (PNAS) has been in effect since 2015. One of the main pillars of this

initiative is the progressive reduction of added sugars, fats, and sodium in processed and ultra-processed foods [48].

4. Conclusion

Ultra-processed foods predominated among the raw materials analyzed, with more than 85% of samples originating from the South and Southeast regions of Brazil. More than one third of the products contained excessive sodium content, and over half exceeded the recommended limits for saturated fat. In this context, future studies should also investigate added sugar content, as the mandatory disclosure of this information on Brazilian food labels now allows for more comprehensive assessments of critical nutrients.

In addition, among the commercial brands analyzed, the greatest variation was observed in energy and sodium values across all food groups. These findings highlight the importance of establishing supplier selection criteria that incorporate assessment of the nutritional composition of raw materials used in the production of meals for communities, as products from different brands may present differences in critical nutrients concentration, with potential public health implications.

Declarations

5.1 Data Availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

5.2 Ethical Approval

Not applicable. This study not involved human subjects, thus waiving the need for Research Ethics Committee approval, in accordance with Resolution N°. 510/2016 of the Brazilian National Health Council. Further information regarding the approval of the study is provided in section 2.5 of this manuscript.

5.3 Consent to Participate

Not applicable, as the study did not involve human participants.

5.4 Consent for Publication

Not applicable. The manuscript does not contain any individual person's data in any form (including individual details, images, or videos).

5.5 Clinical trial number

Not applicable.

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Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

During the preparation of this work, the authors used the Gemini artificial intelligence by Google© for the development of the Graphical Abstract. After using this tool/service, the authors reviewed the material produced and assume full responsibility for the content of the published article.

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Figures

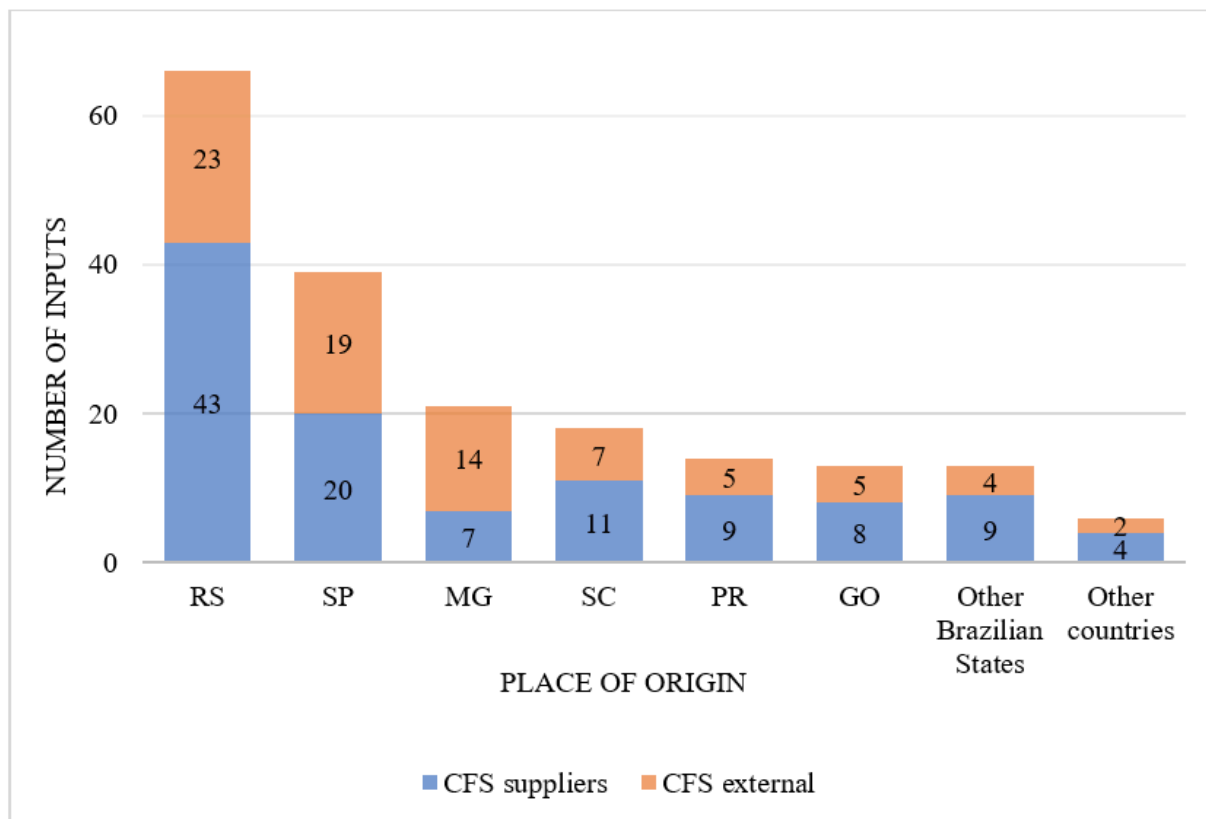


Figure 1

Distribution of raw materials by place of origin. Rio Grande do Sul (RS). São Paulo (SP). Minas Gerais (MG). Santa Catarina (SC). Paraná (PR). Goiás (GO). Commercial Food Service (CFS).

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