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Use of Nutri-Score Algorithm to Discriminate the Quality of Processed Foods Sold in the Angolan Market: Case Study in the Province of Malanje-Angola

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ABSTRACT

The increase in the consumption of processed foods has worsened the occurrence of chronic diseases, however this situation can be controlled if the consumer knows the nutritional value of the foods they consume. This study aimed to determine the nutritional quality of processed foods sold in the Malanje market. Several tools, such as Nutri-score, were developed to determine the nutritional quality of foods. The selection of establishments for the collection of information was random, having as main criteria the frequency of consumers and their location. The selection criteria of the analyzed products were based on the presence of labels containing the nutritional information of the food, whether they were locally produced or imported. The Nutri-score algorithm was used as a tool to determine the nutritional characteristics of these foods. The results showed a certain balanced distribution between products of categories E and D in relation to products of categories A and B with 46.7% and 38.3% respectively. Despite these results, it is possible to determine the robustness of the Nutri-score tool in determining the quality of the studied foods.

Keywords: Nutritional Value; Nutri-Score Labeling System; Angolan Food Market

Introduction

Changes in eating habits in recent decades has drawn the attention of regulatory bodies and the scientific community as a whole, given that the replacement of natural foods with processed foods, the latter of which contribute significantly to the decline in the quality of the population's diet, a situation observed due to the indiscriminate use of chemical additives in processed foods (Linke, et al. [1]). Consuming nutritionally balanced foods is associated with a reduction in all-cause mortality and the risk of chronic diseases. Obesity rates have more than doubled since 1980; in 2014, the World Health Organization (WHO) estimated that more than 39% of adults are overweight and 13% are obese (Finkelstein, et al. [2,3]). In response to the emergence of these diseases, government regulations encourage the consumption of healthy foods and the practice of physical activity (Hamilton, et al. [4]).Chronic non-communicable diseases (NCDs) are associated with preventable behavioural risk factors, and several opportunities for intervention, such as unhealthy diets, lack of physical activity, smoking and excessive alcohol consumption, are listed as causes of these diseases. Unhealthy diets are among the risk factors that most contribute to the decline in health conditions, and dietary habits are important determinants of NCDs (Goiana-da-Silva, et al. [5]). Data presented by Ng, et al. [3] indicated that in Angola these diseases affected 50% of women and 40% of men. Food labeling was developed with the intention of improving the quality of the diet, in several countries labeling is mandatory and the same can be done through the introduction of voluntary labeling systems to complete the nutritional table, illustrated on the back of the packaging of many products (Finkelstein, et al. [2]).

Front of Package Labels (FoPL) were introduced in the 1980s (Edelenyi, et al. [5,6]) and adopted by different countries and companies. The most popular FoPL systems used are Endorsement (KeyHole Healthy Choice), nutrient-specific interpretive models (Traffic Light System), numerical informative models (Guideline Daily Amount System) and summary interpretive models (Nutri-score) Figure 1 [7]. The effectiveness of these systems is influenced by different criteria, as suggested by different research. The main criteria for accurately achieving this effectiveness are acceptability, objective understanding and the impact of the use of the labels on consumers purchasing decisions. Food labels are recommended by the WHO as effective measures to prevent various diseases, such as chronic diseases. FoPL should easily capture the consumer's attention, allowing them to accept and understand the quality of the food product, which can influence their purchasing choices (Egnell, et al. [8]). In 2107, a group of independent researchers developed a color-coded labeling system to

i) Help consumers choose products with better nutritional quality and

ii) Encourage producers to formulate healthy and acceptable products (Julia, et al. [9]).

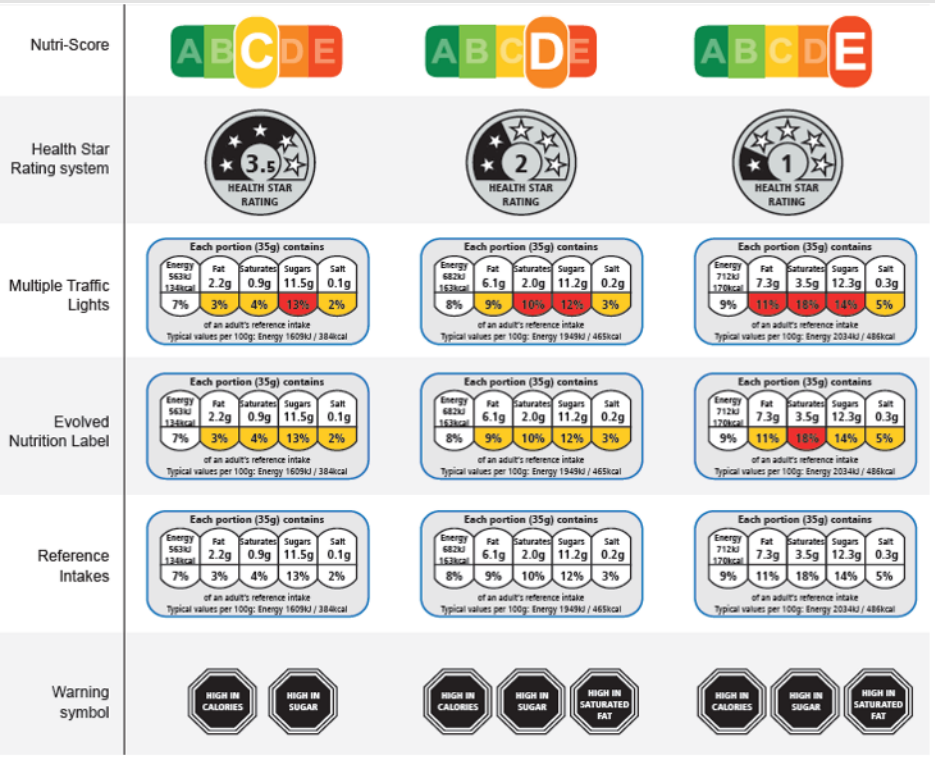

Figure 1: Different front labeling systems (Pettigrew, et al. [6]).

Nutri-Score is a summary, graded, color-coded system that provides information on the overall nutritional quality of a food product, using a 5-scale scheme. Nutri-Score considers the nutritional content of foods and non-alcoholic beverages. There is ample evidence to support its use and multiple expected public health benefits (Mialon, et al. [10]). Nutri-Score rating ranges from 'dark green', 'green', 'yellow', 'orange' and 'dark orange or dark red' Figure 2 [11]. This color-coded system would appear on the front of each food product packaging, where "green" represents the food with the highest nutritional value and "red" represents the product with the lowest nutritional value (Julia, et al. [12]). To make the label easier to understand, especially for color-blind people, the letters A to E are associated with colors and these two scales reflect the nutritional quality of the product (Edelenyi, et al. [6]). Regardless of the consumer's socioeconomic and demographic status, the Nutri-Score label is easier to recognize, understand and interpret than other labeling systems (especially the Traffic Light) (Goiana-da-Silva, et al. [5]).The aim of this study was to evaluate the applicability of Nutri-Score to discriminate the nutritional quality of processed food products marketed in Angola, particularly in the Malanje market.

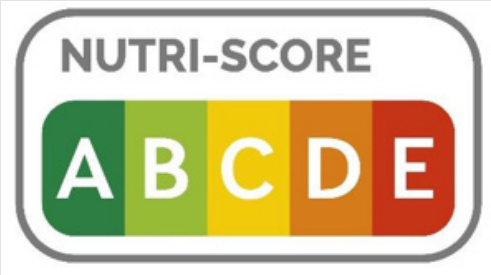

Figure 2: General Nutri-Score Label Representation Format (Ferreiro, et al. [8]).

Material and Methods

Search Location

The survey was carried out from April to August 2023 in the city of Malanje, which occupies an area of 2,422 km^2 and is inhabited by 569,474 people (Pinto [13]). The choice of establishments for information collection was random, with the main criteria being consumer frequency and location, which also included the 4 largest food product sales outlets (Shoprite, Angomart, Nosso Super and Nossa Casa) and 15 randomly selected sales outlets, with the basic criteria being their location, easy access for consumers and having an area of over 30 m^2. Figure 3 indicates the location of supermarkets (green icons) and other points of sale (in yellow icons) where this study was carried out.

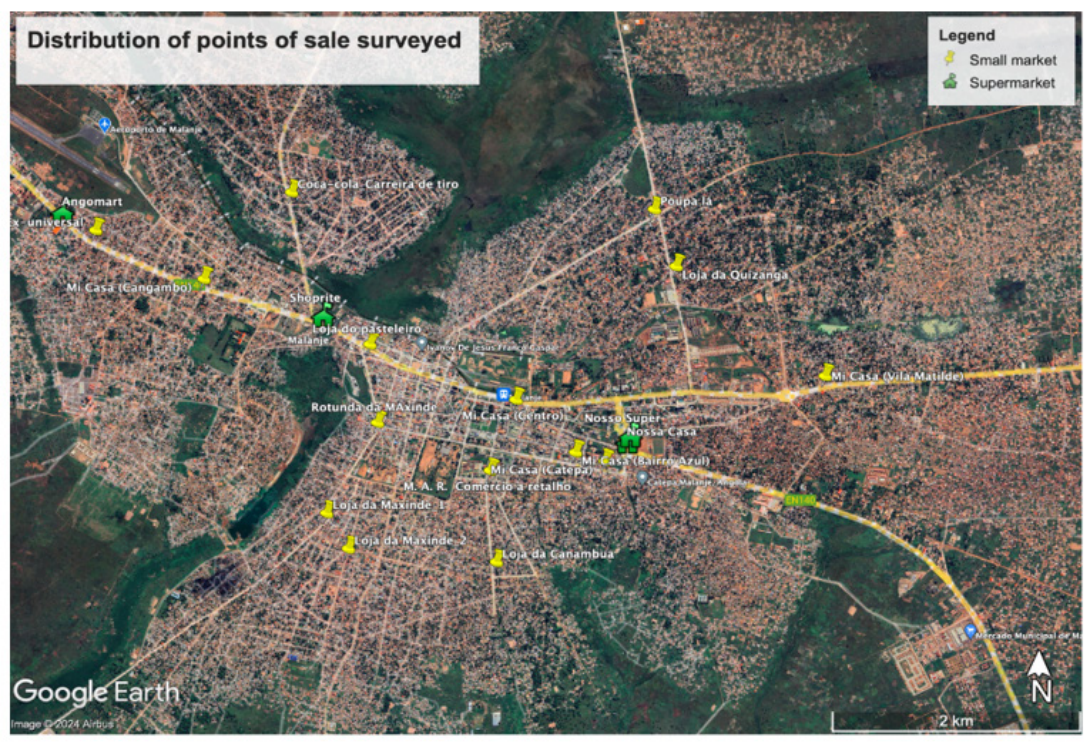

Figure 3: Distribution of surveyed points of sale in the city center of Malanje.

Data Collection

The selection criteria for the products analyzed were based on the presence of labels containing the nutritional information of the food, whether it was produced nationally or imported. In any case, for the present study, traditional foods and street foods were excluded because they did not present nutritional characterization.

Classification of Food Products

Food products were grouped according to their similarity of use and nutritional composition as follows: foods in general, cookies, oils and fats, processed meat, milk and yogurt, cheeses, processed fish, sweets, sauces and condiments, baby food, chocolate and similar products, and non-alcoholic beverages, classified into 12 groups. The Nutri-score of each food was calculated using the nutritional composition table of each product, taking into account the composition in energy, sugars, fats, saturated fatty acids (SFA), proteins, fibers, presence of fruits, legumes and vegetables and sodium, according to (Merz, et al. [14]). In total, 729 foods and beverages, obtained from different points of sale, were analyzed using the Nutri-score algorithm.

Using the Nutri-Score Algorithm

Based on the nutritional composition of 100 g of food (or 100 mL of drink), the Nutri-score indicates that nutritional constituents such as energy, sugars, sodium and fats are negative and should be limited, and are therefore assigned values between 0 and 10, while positive points are assigned to nutritional elements whose consumption should be promoted, such as proteins, fiber, fruits, vegetables and nuts (0 to 5 negative points).To obtain the overall discrete score of the food, positive points are subtracted from the negative points and when maximum values of -15 are reached, the foods have high nutritional value and when maximum values of +40 points are reached, these foods have low nutritional quality. The calculation of the Nutri-score is common to most food categories, except for cheeses, oils and fats and drinks, for which specific adaptations have been made, in particular to take into account their energy density (Aguenaou, et al. [15-17]). The Nutri-score algorithm associates a letter with a color according to the final result for each food where values less than -1 are represented by the letter "A" and the color dark green, which represents the highest nutritional quality, values between 0 and 2 are represented by the letter "B" and the color light green, values between 3 and 10 are shown in yellow followed by the letter "C", thus representing an intermediate nutritional quality, values ranging from 11 to 18 are colored in orange with the letter "D" and values of 19 or more are shown in red and the letter "E", these represent the products with the lowest nutritional quality. For beverages, "A" only includes water, corresponding to the color dark green; letter "B" includes values less than or equal to 1 and the color light green; category "C" is composed of values between 2 and 5 points and the color yellow; values for "D" vary between 6 and 9 points in the color orange; and for "E" are values equal to or greater than 10, corresponding to the color dark red. (Alves, 2019; van der Bend et al., 2022). However, this algorithm has been updated regarding the classification of certain foods as well as the maximum score for products such as sugar and salt (Merz, et al. [14]).

Data Analysis

The allocation of the different food groups to the different Nutri-score categories was made according to the nutritional characteristics of each food product and the percentage of each Nutri-score category. Furthermore, within each food group, the percentage of each Nutri-score class was calculated.

Results

Among the 729 products evaluated, food in general and beverages predominated with 19.3% and 17.7%, respectively, followed, in decreasing order, by cookies, milk and yogurt, chocolate, oils and fats, sweets, breakfast cereals and baby food, sauces and condiments, cheeses, processed meats and processed fish. The least represented food category was processed fish (N = 13, corresponding to 1.8% of the total) according to Figure 4. The variability of the different Nutri-score categories of the different food groups studied is represented in Table 1, while the average centesimal composition of the different food groups obtained through the nutritional table of each of the 729 products analyzed is represented in Table 2. Food for children showed a higher concentration in Nutri-score categories A and B, totaling 47%, due to the presence of factors to be favored, such as proteins, fruits, vegetables and greens, despite a large concentration of foods in category D. The results can be understood as having been influenced by the considerable presence of sugars and sodium, with 18.31g and 338.27 mg respectively. The results obtained from the evaluation of beverages showed a balance between those classified in the categories of nutritious beverages, totaling 44% in categories A and B, in relation to products in categories D and E, which totaled 41%. For these products, it should be noted that only water free of any other constituent (such as gas) is part of Nutri-score category A, and a large part of the beverages classified in category E were soft drinks whose presence of sweeteners (natural or otherwise) is accentuated. For biscuits, 66% of the products fell into categories D and E, due to their high energy content (1947.69 kJ) and fat content (8.92 g), with the products with the highest levels of these factors being limited compared to the other products studied.

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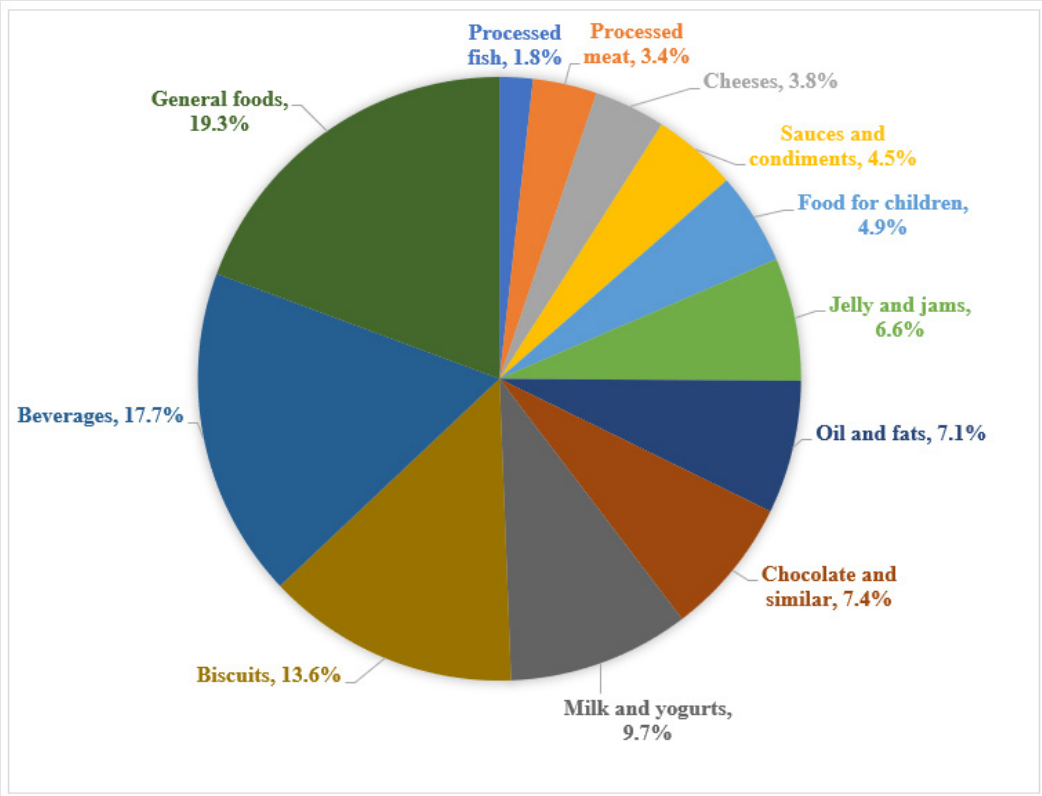

Figure 4: Distribution of the different food groups analyzed.

Table 1: Nutri-score categories of food groups.

Food products category	Nutri-score A	Nutri-score B	Nutri-score C	Nutri-score D	Nutri-score E
Food for children	13 (36%)	4 (11%)	11 (31%)	8 (22%)	-
Beverages	13 (10%)	44 (34%)	20 (16%)	6 (5%)	46 (36%)
Biscuits	11 (11%)	8 (8%)	14 (14%)	39 (39%)	27 (27%)
Processed meat	5 (20%)	1 (4%)	7 (28%)	4 (16%)	8 (32%)
Chocolate and similar	-	-	-	2 (4%)	52 (96%)
Jelly and jams	5 (10%)	6 (13%)	7 (15%)	21 (44%)	9 (19%)
General foods	102 (72%)	15 (11%)	10 (7%)	14 (10%)	-
Milk and yogurts	-	9 (13%)	5 (7%)	3 (4%)	54 (76%)
Sauces and condiments	12 (36%)	5 (15%)	4 (12%)	11 (33%)	1 (3%)
Oil and fats	-	10 (19%)	24 (46%)	13 (25%)	5 (10%)
Processed fish	8 (62%)	1 (8%)	3 (23%)	1 (8%)	-
Cheeses	4 (14%)	3 (11%)	4 (14%)	17 (61%)	-

Likewise, 48% of processed meats fell into categories D and E, mainly due to their sodium concentration (1445.33 mg), as well as the amount of saturated fats found in these products (6.13 g). All the chocolates analyzed during the study were classified only in categories D and E. These results may be influenced by the energy content they presented, as well as the concentration of sugars (17.18g). On the other hand, these products presented a considerable presence of fruits and fibers with 31.32g and 2.51g respectively. 63% of the sweets analyzed belong to categories D and E, which is due to the high concentration of sugar (17.26g), despite being products rich in fruits (22.59g). The foods in general were classified in categories A and B, corresponding to 83%, which can be justified by the presence of fruits, vegetables and greens (25.34g) and a considerable protein content (6.41g). However, these products showed a high energy content (1327.47kJ) and sugar (18.99g). Dairy products (milk and yogurt) were mostly classified in category E (76%). According to the results presented in Table 2, it was possible to observe that these products had high amounts of sugar and sodium in their composition, with 15.82g and 34.57mg respectively. Sauces and condiments had a higher concentration in categories A and B, representing 51% of this food group, showing themselves as foods rich in vegetables and greens (26.48g) and a considerable concentration of fiber (2.60g). Oils and fats were grouped mainly in category C with a percentage value of 46.

Table 2: Nutritional value per 100 g of the food group.

	Nutritional Values per 100 g or mL							
	Energy (kJ)	**Sugar (g)**	**Saturated fats (g)**	**Sodium (mg)**	**Fruits, vegetables and legumes (g)**	**Fibers (g)**	**Proteins (g)**	**Score**
Food for children	1255,22	18,31	3,84	338,27	31,72	1,71	6,65	5,17
Beverages	1090,15	16,25	3,88	220,27	22,00	1,58	5,60	7,37
Biscuits	1947,69	14,18	8,92	153,84	11,47	3,12	7,78	11,99
Processed meat	938,03	0,92	6,13	1445,33	0,00	0,04	16,03	10,58
Chocolate and similar	1232,21	17,18	5,28	217,72	31,32	2,51	6,54	6,44
Jelly and jams	1101,30	17,26	3,82	211,47	22,59	1,55	5,60	7,44
General foods	1327,47	18,99	4,47	258,46	25,34	1,95	6,41	6,75
Milk and yogurts	517,60	15,82	2,40	34,57	9,66	0,31	4,62	11,76
Sauces and condiments	1152,14	11,58	4,07	271,83	24,53	2,60	6,32	5,42
Oil and fats	1348,36	16,62	4,82	279,31	26,49	2,05	6,83	6,60
Processed fish	685,87	0,18	1,48	919,38	0,00	0,00	19,78	0,08
Cheeses	1016,14	8,25	6,01	549,50	0,00	0,01	14,53	2,61

Despite their high energy content (1348.36 kJ), these products had a low saturated fat content and considerable fiber and protein contents of 2.05 g and 6.83 g respectively, which were shown to be high levels when compared to most foods analyzed. 70% of the processed fish analyzed in this study was grouped in categories A and B, thus being foods of good nutritional quality. Despite having a high concentration of sodium (919.38 g), these foods are products that presented low energy density (685.87 kJ), little saturated fat and the highest concentration of proteins compared to the other foods analyzed in this study. The last group of products studied were cheeses, which were grouped mainly in category D (61%). This classification was because they are products rich in sodium and saturated fats with 549.50g and 6.01g respectively, and the only favorable factor present in this food group was proteins (14.53g). The distribution of food products into the five different Nutri-Score categories was determined as shown in Figure 5. Of these products, 27.7% are in category E, 23.7% in category A, 19.1% in category D and the least represented categories are C and B with 15.0% and 14.5% respectively.

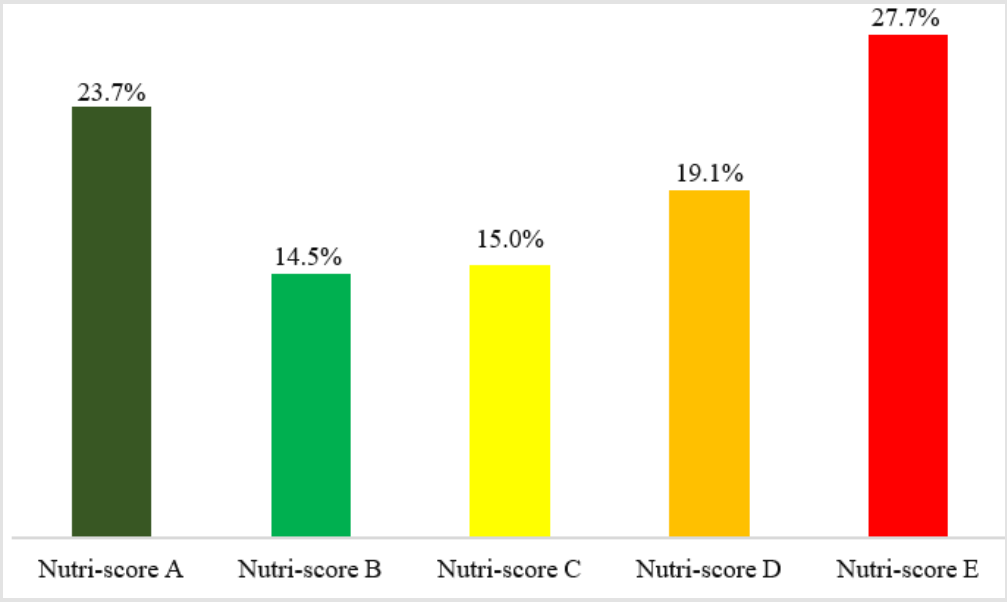

Figure 5: Nutri-score distribution of evaluated food products (N=729).

Discussion

The Nutri-score algorithm performed well in discriminating the nutritional quality of the evaluated foods distributed in the different groups as previously described by (Julia, et al. [18]) by studying the composition of processed foods sold in French markets, thus validating the ability of Nutri-Score to discriminate the nutritional quality of products in various sociocultural contexts. Dréano-Trécant, et al. [19] reported a high degree of consistency of their results with official dietary guidelines in different European countries. Deschasaux, et al. [20] showed that processed foods were mostly less healthy (distributed into classes C, D or E), unlike raw products, which were the healthiest (classified into classes A and B). Water and unsweetened beverages (tea, juices and some coffees) were classified as healthier than sweetened beverages, such as soft drinks and fruit nectars. Artificially sweetened beverages were the products with the lowest nutritional value compared to naturally sweetened products or products with no added sugar (Finkelstein et al., 2019). Nutri-score can be used as a powerful tool to guide overall dietary guidelines recommendations (Herforth, et al. [21]). Nutri-score improves the ability to understand nutritional information and make healthier food choices, leading to healthier food choices (Goiana-da-Silva, et al. [4,22]). For Drewnowski, et al. [23] The major concern is not only related to macronutrient intake, but there is also great interest in determining the effect of food composition on micronutrients such as vitamin A, iron, zinc and iodine. This demonstrates the need for studies aimed at developing labeling systems that allow the integration of the effect of micronutrients on the nutrition of populations in developing countries in Africa, Asia and South America.

Strengths and Limitations

A strength of this research is that it is the first study focused on investigating the nutritional quality of foods using the Nutri-score system in the Angolan market. The current study, however, was limited to the province of Malanje, which is not representative of the entire country. Analysis of other food categories and a greater diversity could have provided us with more information on the nutritional composition of the products [24,25].

Conclusion

The results highlight the importance of Nutri-Score and its adaptability to determine the nutritional value of processed foods. Of the processed foods evaluated in this study, a certain balance was observed between foods belonging to categories E and D, corresponding to 46.7% of the total, while foods classified in categories A and B corresponded to 38.3% and the remaining 15% were in category C. This study demonstrates that Nutri-score is a powerful alternative for the implementation of complementary nutritional labeling of foods and, ultimately, the same system allows avoiding confusion among consumers through the coexistence of several food labeling systems.

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