ELABORATION, NUTRITIONAL AND SENSORY ANALYSIS OF PEANUT BUTTER FLAVORED WITH MOZZARELLA CHEESE

https://doi.org/10.56238/sevened2024.031-078

Franky Soedirlan Resosemito[1], Wendel Jefferson Reis da Silva[2], Edney Harrison Ferreira Leal[3], Giselle Schmid[4], Hostilio Caio Pereira da Costa Filho[5] and Elisvanda Ramos dos Santos[6]

ABSTRACT

Peanuts are one of the foods that are linked to the northeastern culture of Brazil. The consumption of this legume varies from the seed in natura, roasted and salted, to sweet (such as the traditional northeastern paçoca), in addition to derived products that have peanuts in their formulation. However, there is still the possibility of adding value and innovation using peanuts, since food industries are always looking for innovative products that are healthier. According to this, peanut butter is an excellent alternative, as it is a peanut-based product well accepted by a large part of the population, and is consumed by all social classes and age groups, in addition to being a very rich food in nutritional terms. Peanut butter can also be supplemented with other foods, in order to increase its nutritional and sensory values. Aiming at this aspect, the use of cheese as an alternative to supplement peanut butter is a viable option, since it is a food much appreciated by the Brazilian population due to its sensory and nutritional characteristics. In this sense, the present work aims to make peanut butter with cheese using the following ingredients: peanuts, mozzarella cheese, vegetable oil and salt. The nutritional composition and sensory evaluation of peanut butter enriched with mozzarella cheese were analyzed in order to ascertain the public's acceptance and purchase intention. In the present study, five peanut butter formulations were elaborated, ranging from 0, 10, 15, 20 and 25% mozzarella cheese, respectively. It was observed that the greater the amount of mozzarella cheese added to peanut butter, the less energetic the product is made. According to the results obtained, it is possible to conclude that the peanut butters enriched with mozzarella cheese did not reach the minimum result in relation to all the parameters analyzed (appearance, color, texture, flavor and global acceptance) with the average 7 (seven) being the minimum expected result. It is noteworthy that sample E with 35% mozzarella cheese was the one that came closest to the minimum sensory requirements, while for the intention to purchase sample C with 25% mozzarella cheese. That said, it is noticeable the need for a better adaptation in the formulation or addition of extra components that increase the sensory

[1] Dr. in Food Engineering and Science
Institution: Federal Institute of Maranhão (IFMA) - Maracanã Campus
[2] Food Technologist
Institution: Federal Institute of Maranhão (IFMA) - Maracanã Campus
[3] Food Technologist
Institution: Federal Institute of Maranhão (IFMA) - Maracanã Campus
[4] Dr. in Anthropology
Institution: Federal Institute of Maranhão (IFMA) - Maracanã Campus
[5] Master in Accounting and Administration
Institution: Federal Institute of Maranhão (IFMA) - Maracanã Campus
[6] Environmental Engineering Specialist
Institution: Federal Institute of Maranhão (IFMA) - Maracanã Campus

qualities of the product, it is also notorious that the product developed is unusual to the Brazilian palate, thus causing a high deviation in relation to sensory requirements.

Keywords: Peanut. Mozzarella cheese. Peanut butter. Nutritional analysis. Sensory analysis.

INTRODUCTION

Peanuts (*Arachis hypogaea* L.) are a legume native to South America that has gained prominence on the world stage, integrating multiple productive sectors (BERTIOLI et al., 2011). It has a high social and economic value, with global production of more than 47 million tons, it is the fourth most produced oilseed in the world (USDA, 2021). In Brazil, production is abundant, with a total of 536.5 thousand tons produced in the 20/21 harvest, 94% of which came from the state of São Paulo. Other producing states are Rio Grande do Sul, Mato Grosso do Sul, and Paraná (CONAB, 2021; DEPIERI 2019).

Peanuts are used as an ingredient in the production of various foods. The main forms of consumption are roasted whole grains, mainly as a snack and products made from crushed peanuts, such as peanut butter or peanut butter. The use of peanuts as pastes and fillings has increased in recent years, especially in bakery and dessert products (WILSON, 2015). However, the growing search for health is helping to form new habits among consumers interested in finding healthier, more nutritious, and natural varieties on the market (DUARTE et. al., 2021).

Peanut butter is a product made from crushed peanuts that has been gaining popularity among athletes and exercisers due to its beneficial properties, such as fatty acid profile and protein content. In addition, it contains vitamins, minerals, and bioactive compounds, such as resveratrol, which help reduce the risk of cardiovascular disease (LUU et al., 2015; MAGUIRE et al., 2004; MACIEL, 2018). Due to its benefits, peanut butter has great growth potential in the food market.

Mozzarella Cheese, Muzzarella Cheese or Mozzarella Cheese is the cheese obtained by stretching an acidified mass, it is an intermediate product resulting from the coagulation of milk through rennet or the action of enzymes with coagulating capabilities, and may or may not be added by the action of specific lactic acid bacteria (BRASIL, 2012). It must come from ingredients such as milk and/or reconstituted milk, standardized or not, referring to the content of fat, rennet and/or enzymes with appropriate coagulant capacities and sodium chloride. Optional ingredients such as caseinates, citric acids, lactic, acetic or tartaric acids, as well as spices, condiments and/or food substances may also be composed (BURITI et al., 2008).

That said, the growing increase in consumer demand and expectation for innovative and healthy products has stimulated the development of new food products, which drives companies in the field to invest in this sector, in order to keep up with this trend and remain stable in the market.

In view of the above, the present work aims to prepare peanut butter flavored with mozzarella cheese, in order to unite their beneficial properties in a single product. According to this, support and contribute to the food agroindustry, aiming to increase the variety of peanut-based products. In order to contribute to the growing expectation of consumers in healthy and innovative products and also aiming at good acceptance by them, the development of peanut butter flavored with mozzarella cheese is necessary, since both base products (peanuts and mozzarella cheese) are well accepted by the population and both have nutritional and sensory qualities recognized worldwide. In addition to being consumed by people from different social classes and age groups, such a product can also have a significant contribution to specific audiences such as physical exercisers and people who aim to gain weight, since the product that will be developed is rich in proteins and lipids. As a means of uniting the different nutritional qualities of both raw materials and in accordance with what was mentioned above, this project aims to make peanut butter with mozzarella cheese. The main ingredients in the formulation of peanut butter with mozzarella cheese are: roasted peanuts without shell and without salt, mozzarella cheese, soybean oil and salt. It should also be noted that the product developed is unprecedented in Brazil.

MATERIAL AND METHODS

The experiment was carried out at the Bakery Laboratory of the Federal Institute of Education, Science and Technology of Maranhão – São Luís/Maracanã Campus.

MATERIALS

The peanuts were purchased at a natural products store located in the municipality of Paço do Lumiar, while the mozzarella cheese, soybean oil and salt were purchased at a supermarket in the municipality of São Luís.

PREPARATION OF PEANUT BUTTER

The peanut base paste (PBA) was obtained according to the methodology carried out by Lima et al. (2009), using fresh peanuts. For the preparation of the PBA, the following steps are followed: selection of raw material, roasting, grinding and addition of inputs. During the selection of the raw material, it is necessary to have a good quality of the peanut so that it does not contain fungi, remains of shells and foreign materials. The peanut roasting follows the following conditions: 135°C for 1 to 2 minutes dry. After roasting, it is necessary to remove the peanut skin. Proceeding to grinding, it breaks the peanut grains and consequently their cells, causing part of the oil contained in the peanut to be released,

favoring the formation of the paste. After 4 to 5 minutes of processing, a homogeneous paste was obtained. It is worth noting that the temperature during grain processing should not exceed 60°C. In the incorporation of inputs, components were added that aim to stabilize and sensorially add the base paste (salt, vegetable oil and mozzarella cheese).

METHODS

Five formulations of peanut butter with mozzarella cheese were developed in different concentrations, one of them being standard, that is, absent of mozzarella cheese, while the others with concentrations of 20, 25, 30 and 35% of mozzarella cheese.

Initially, all the ingredients were weighed on an analytical balance and after the preparation of the PBA, the mozzarella cheese was macerated in order to facilitate its homogenization with the PBA and then, the mixture of the ingredients was done manually until a homogeneous and smooth paste was obtained.

FORMULATIONS OF PEANUT BUTTERS

The formulations of the peanut butter samples were presented in Table 1.

Table 1 – Formulations of the peanut butter samples

Ingredients	Sample A (0%)	Amostra B (20%)	Amostra C (25%)	Amostra D (30%)	Amostra E (35%)
Peanut (g)	86.24g	73.72g	70.89g	68.72g	66.24g
Cheese (g)	0.00g	14.60g	17.75g	20.40g	23.10g
Oil (g)	12.90g	10.60g	10.65g	10.20g	9,90g
Salt (g)	0,86g	0,73g	0,71g	0,68g	0,66g

Source: Prepared by the author (2023)

NUTRITIONAL ANALYSIS

To carry out the nutritional composition analysis, the determinations established by the National Health Surveillance Agency – ANVISA were followed, through the Resolution of the Collegiate Board – RDC No. 429 of October 8, 2020, which provides for the nutritional labeling of packaged foods and the Normative Instruction – IN No. 75 of October 8, 2020 (ANVISA, 2020), which establishes the technical requirements for declaring nutritional labeling on packaged foods and the Brazilian Food Composition Table – TACO 4th Edition

(BRASIL, 2020) was also used.

MICROBIOLOGICAL ANALYSIS

Due to the susceptibility of peanuts to contamination by microorganisms, microbiological analysis is necessary (SPINELLI et. al., 2018). The multi-tube technique for the determination of thermotolerant coliforms was carried out in the microbiology laboratory of the Federal Institute of Education, Science and Technology of Maranhão, Maracanã Campus (SPINELLI et. al., 2018; ARAÚJO et al., 2019).

SENSORY ANALYSIS

The sensory analysis was carried out based on the methodology recommended by Lopes (2012), using a nine-point Hedonic Scale, being 9 = very much liked, 8 = very much liked, 7 = moderately liked, 6 = slightly liked, 5 = indifferent, 4 = slightly disliked, 3 = moderately disliked, 2 = very disliked and 1 = extremely disliked. The following characteristics were evaluated: appearance, color, texture, flavor and global acceptance.

To evaluate the purchase intention, a Purchase Intention Form was used by a 5-point attitude scale, as follows: 1 = I would certainly buy this sample, 2 = I would probably buy this sample, 3 = I have doubts about whether I would buy this sample, 4 = I probably would not buy this sample and 5 = I certainly would not buy this sample.

The sensory evaluation was carried out at the Federal Institute of Maranhão IFMA – São Luís/Maracanã Campus, on October 16, 2023, with the cooperation of 56 untrained evaluators, male and female servers and students, where all signed the Informed Consent Form (ICF). Everyone made the evaluation individually and was properly instructed to observe the characteristics of the product and mark the answer sheets.

STATISTICAL ANALYSIS

The data were evaluated using the *Excel* version 2019 program (*Microsoft Corporation*).

RESULTS AND DISCUSSION

NUTRITIONAL COMPOSITION OF PEANUT PASTES

Using the nutritional values that make up each ingredient, and having as reference the Brazilian Table of Food Composition – TACO, table 2 was elaborated. Table 2 shows the nutritional composition of peanut butters flavored with mozzarella cheese in the respective proportions of 0, 20, 25, 30 and 35% mozzarella cheese.

Table 2 – Nutritional composition of peanut butters

Nutritional components	Sample A (0%)	Amostra B (20%)	Amostra C (25%)	Amostra D (30%)	Amostra E (35%)
Energy value (kcal)	667,9	615,4	607,66	598,48	588,81
Protein (g)	19,40	20,53	20,74	20,96	21,14
Carbohydrate (g)	16,13	14,38	13,86	13,55	13,18
Fibers (g)	6,73	5,75	5,53	5,36	5,17
Total Fats (g)	58,42	52,86	52,14	51,16	50,17
Saturated fats (g)	10,32	10,41	10,8	10,86	10,93
Gorduras trans (g)	0	0	0	0	0
Sodium (mg)	860	779,50	792,89	775,27	767,89

Source: Prepared by the author (2023)

Analyzing the nutritional values of the five samples of peanut butters, it can be observed that the nutrient content changed according to the formulation used, however all formulations were presented as a source of protein, in addition to having reduced carbohydrate, total fat and sodium content. It was also observed that the greater the amount of mozzarella cheese added, the less energetic the peanut butter is. This is due to the fact that standard peanut butter contains more lipids than peanut butter plus mozzarella cheese.

MICROBIOLOGICAL ANALYSIS

Table 3 shows the values of the microbiological analyses.

Peanut butter	Coliforms totais	Thermotolerant coliforms	*Salmonella spp.*
Sample A	< 3,0	< 3,0	absent
Sample B	< 3,0	< 3,0	absent
Sample C	< 3,0	< 3,0	absent
Sample D	< 3,0	< 3,0	absent
Sample E	< 3,0	< 3,0	absent

Source: Prepared by the author (2023)

According to table 3, the absence of *Salmonella spp* and the low value in relation to the concentration of total and thermotolerant coliforms were found in all samples, thus ensuring the microbiological quality of the peanut pastes flavored with mozzarella cheese by having the results in accordance with normative instruction No. 60 of December 23, 2019 (ANVISA, 2019).

ANALISE SENSORIAL

Table 4 shows the statistical values of the sensory analysis.

Table 4 - Results of the sensory analysis

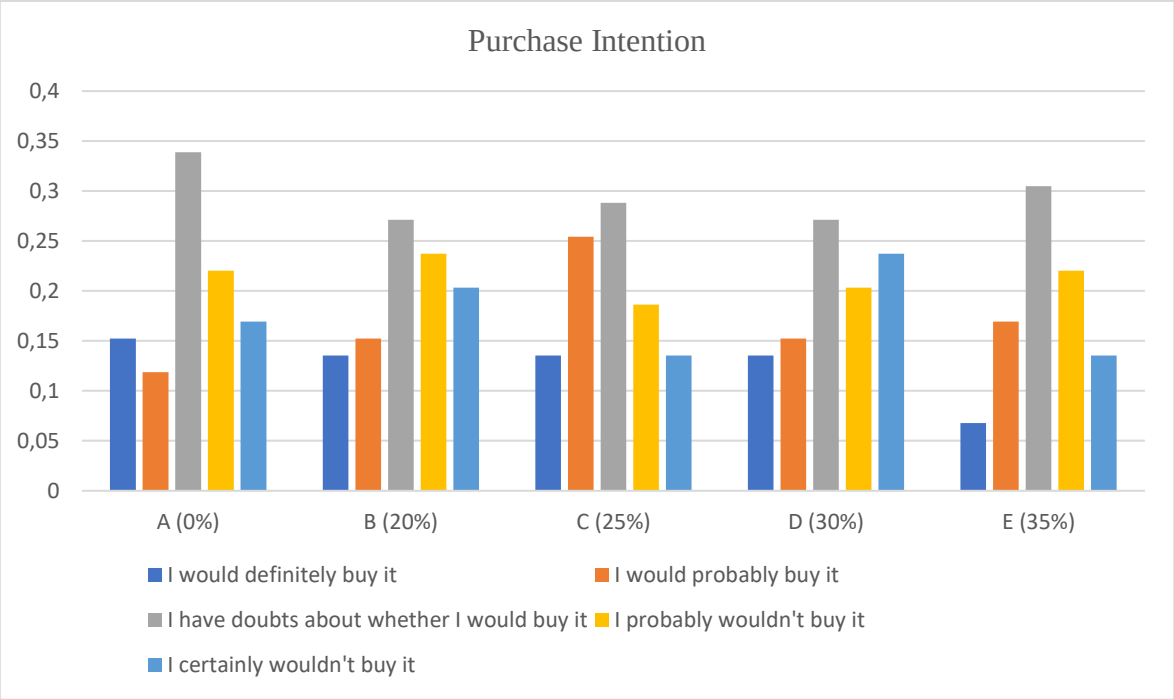
	Sample A (0%)	Amostra B (20%)	Amostra C (25%)	Amostra D (30%)	Amostra E (35%)
Appearance	5,86 ± 1,98	6,32 ± 1,96	6,49 ± 1,75	6,49 ± 1,73	6,78 ± 1,61
Colour	6,06 ± 1,86	6,35 ± 2,01	6,60 ± 1,76	6,45 ± 1,75	6,86 ± 1,59
Texture	5,98 ± 1,85	5,96 ± 2,23	6,06 ± 2,04	6,13 ± 2,02	6,44 ± 1,81
Taste	5,44 ± 2,27	5,24 ± 2,17	5,40 ± 1,96	5,47 ± 2,21	5,42 ± 2,04
Global acceptability	5,45 ± 2,08	5,48 ± 2,14	5,78 ± 2,02	5,53 ± 2,09	5,51 ± 2,14

Source: Prepared by the author (2023)

According to the data obtained and analyzing the appearance item, sample E with 35% mozzarella cheese obtained the highest score of acceptance by consumers 6.78, while sample A that has 0% mozzarella cheese obtained the lowest score 5.86. Regarding color, sample E also obtained the highest acceptance 6.86 and sample A the lowest acceptance 6.06. As the amount of mozzarella cheese in peanut spreads increases, the appearance and color of the products made become more attractive. It was observed that the greater the amount of mozzarella cheese in the peanut pastes, the more spreadability, uniformity and there is also no oil formation on the surface of the product. . In the texture attribute, sample E had the highest acceptance score: 6.44, while sample B, containing 20% mozzarella cheese, had the lowest acceptance rate. This may be due to the fact that the greater the amount of mozzarella cheese present in the peanut butter, the better the structure, consistency, firmness and adhesiveness in said prepared product. In the flavor attribute, sample D with 30% mozzarella cheese had the highest score of acceptance by the tasters 5.57 and sample B the least acceptance 5.24. In the global acceptance, sample C with 25% mozzarella cheese obtained the best acceptance 5.78 and sample A obtained the lowest acceptance.

Purchase intention is an important criterion for the development of a new product (SOUZA, 2022), and the results are shown in graph 1.

Graph 1 - Purchase intention



Based on the results for the purchase intention test, peanut butters flavored with mozzarella cheese in the proportions of 20, 25 and 30% were the ones that presented the highest score in purchase intention. After adding the criteria "would certainly buy" and "probably buy", samples B, C and D had respectively 28.79%, 38.97% and 28.79%. Samples A and E had lower scores, with sample E having the lowest percentage 23.71%, followed by sample A with 27.11%. Using acceptability parameters It is then noted that none of the samples present satisfactory results and are not well accepted by the tasters.

CONCLUSION

According to the results obtained, it was possible to conclude that the peanut butters enriched with mozzarella cheese did not reach the satisfactory result in relation to the sensory parameters analyzed (appearance, color, texture, flavor and global acceptance) with the average 7 (seven) being the expected result. It was highlighted that sample E with 35% mozzarella cheese was the one that came closest to the minimum sensory requirements, while for the purchase intention it was sample C with 25% mozzarella cheese. That said, it was noticeable the need for a better adaptation in the formulation or addition of extra components that increase the sensory qualities of the product, it was also notorious that the product developed is unusual to the Brazilian palate, thus causing a high deviation in relation to sensory requirements.

REFERENCES

1. ANVISA. (2019). *Instrução Normativa – IN nº 60, de 23 de dezembro de 2019. Estabelece as listas de padrões microbiológicos para alimentos*. Diário Oficial Da União. Disponível em: https://cvs.saude.sp.gov.br/zip/U_IN-MS-ANVISA-60_231219.pdf. Acesso em: 21 de jun. 2023.

2. ANVISA. (2020). *Resolução da Diretoria Colegiada – RDC nº 429, de 08 de outubro de 2020. Dispõe sobre a rotulagem nutricional dos alimentos*. Disponível em: http://antigo.anvisa.gov.br/legislacao#/ visualizar/434473. Acesso em: 12 mar. 2023.

3. Araújo, B. C. O., et al. (2019). Desenvolvimento de biscoito à base de abóbora (Cucurbita spp.). *Research, Society and Development*, 8(7), 1-13. https://doi.org/10.33448/rsd-v8i7.1128. Disponível em: https://www.redalyc.org/journal/5606/560662198024/html/. Acesso em: 23 mar. 2023.

4. Bertioli, D., Seijo, G., Freitas, F., Valls, J., Leal-Bertioli, S., & Moretzsohn, M. (2011). Uma visão geral do amendoim e seus parentes selvagens. *Plant Genetic Resources*, 9(1), 134-149. https://doi.org/10.1017/S1479262110000444. Disponível em: https://www.cambridge.org/core/journals/plant-genetic-resources/article/abs/an-overview-of-peanut-and-its-wild-relatives/71710A486070A228C92D826E70CF89A3. Acesso em: 21 mai. 2023.

5. Brasil. (2020). *Tabela Brasileira de Composição de Alimentos – TACO* (4ª ed.). Universidade Estadual de Campinas. Disponível em: https://www.cfn.org.br/wpcontent/uploads/2017/03/taco_4_edicao_ampliada_e_revisada.pdf. Acesso em: 06 nov. 2023.

6. Brasil. (2012). *Resolução nº 466, de 12 de dezembro de 2012. Diretrizes e normas regulamentadoras de pesquisa envolvendo seres humanos*. Conselho Nacional de Saúde. Disponível em: https://conselho.saude.gov.br/resolucoes/2012/Reso466.pdf. Acesso em: 27 jun. 2023.

7. Buriti, F. C. A., Cardarelli, H. R., & Saad, S. M. I. (2008). Textura instrumental e avaliação sensorial de queijo fresco cremoso simbiótico: Implicações da adição de Lactobacillus paracasei e inulina. *Revista Brasileira de Ciências Farmacêuticas*, 44, 75-84. Disponível em: https://www.scielo.br/j/rbcf/a/NxZqC5RLQHj6878554MMRyN/?format=pdf&lang=pt. Acesso em: 04 nov. 2023.

8. CONAB. (2021). *Boletim da Safra de Grãos*. Disponível em: https://www.conab.gov.br/infoagro/safras/graos/boletim-da-safra-de-graos. Acesso em: 21 mai. 2023.

9. De Pieri, H. (2019). *Gestão das inovações tecnológicas na agroindústria do amendoim do estado de São Paulo* (Dissertação de mestrado, Universidade Federal de São Carlos). Disponível em: https://repositorio.ufscar.br/handle/ufscar/11453. Acesso em: 21 mai. 2023.

10. Lopes, G. A. Z. (2012). *Caracterização química, física e sensorial de produtos à base de amendoim* (Tese de doutorado, Universidade Estadual Paulista, Faculdade de Ciências Farmacêuticas). Disponível em: https://acrobat.adobe.com/id/urn:aaid:sc:VA6C2:77720f76-53a2-460b-9512-

f4d881148d01. Acesso em: 14 abr. 2023.

11. Duarte, P., Teixeira, M., & Silva, S. C. (2021). Healthy eating as a trend: Consumers' perceptions towards products with nutrition and health claims. *Revista Brasileira de Gestão de Negócios, 23*(3), 405-421. https://doi.org/10.7819/rbgn.v23i3.4113. Acesso em 06 de mai. 2023.

12. Lima, J. R., Saraiva, S. C. de O., & Sousa, A. V. de. (2009). Preparação e características de pastas de amêndoas de castanha de caju e amendoim. *Comunicado Técnico on-line*, Fortaleza, CE, dez. Disponível em: https://www.embrapa.br/busca-de-publicacoes/-/publicacao/580691/preparacao-e-caracteristicas-de-pastas-deamendoas-de-castanha-de-caju-e-amendoim. Acesso em 18 de jun. 2023.

13. Luu, H. N., et al. (2015). Prospective evaluation of the association of nut/peanut consumption with total and cause-specific mortality. *JAMA Internal Medicine, 175*(5), 755–766. Disponível em: https://lume.ufrgs.br/bitstream/handle/10183/240018/001141465.pdf?sequence=1&isAllowed=y. Acesso em 03 mai. 2023.

14. Maciel, R. T. (2018). Elaboração e análise sensorial de pasta de amendoim saborizada com chocolate e enriquecida com Spirulina platensis: Uma alternativa para praticantes de atividade física (Trabalho de Conclusão de Curso – Monografia). Universidade Federal de Campina Grande, Cuité – Paraíba, Brasil. Disponível em: http://dspace.sti.ufcg.edu.br:8080/jspui/handle/riufcg/7123. Acesso em 21 de mai. 2023.

15. Maguire, L. S., Sullivan, S. M., Galvin, K., Connor, T. P., & Brien, N. M. (2004). Fatty acid profile, tocopherol, squalene and phytosterol content of walnuts, almonds, peanuts, hazelnuts and the macadamia nut. *International Journal of Food Sciences and Nutrition, 55*(3), 171-178. Disponível em: https://pubmed.ncbi.nlm.nih.gov/15223592/. Acesso em 18 de mai. 2023.

16. Spinelli, L., Longoni, L., & Beneduzi, A. (2018). Análise microbiológica de amostras de amendoim provenientes do mercado público de Porto Alegre/RS. *Revista de Ciências Ambientais, 12*(39). https://doi.org/10.18316/rca.v12i2.4365. Acesso em 21 de mai. 2023.

17. Souza, G. M. de. (2022). Além das aparências: Um estudo experimental sobre a intenção de compra de alimentos subótimos (Trabalho de Conclusão de Curso – Bacharelado em Administração). Universidade de Brasília, Brasília. Disponível em: https://bdm.unb.br/handle/10483/31663. Acesso em 04 de jun. 2023.

18. USDA. (2021). Nutrient database for standard reference. Disponível em: https://fdc.nal.usda.gov/fdcapp.html#/food-details/1100541/nutrients. Acesso em 21 de mai. 2023.

19. Wilson, R. F. (2015). Outlook for high-oleic peanuts and peanut products in 21st century markets. *Lipid Technology, 27*(12), 282–285. https://doi.org/10.1002/lite.201500062. Acesso em 21 de mai. 2023.