EVALUATION, IN A SENSORY PANEL, OF A CEREAL BAR ENRICHED WITH ATTA SEXDENS (LINNAEUS, 1758)

https://doi.org/10.56238/sevened2024.029-044

Ana Beatriz Conti[1], Ana Carolina Siqueroli[2], Ana Lídia Pires Teixeira[3], Cristiellen Elisa Silva Batista[4], Daiane de Oliveira Teixeira[5], Eduarda Moro Alexandre[6], Gabrielly Quito Campos[7], Giana Maria Silva Aveiro[8], Isabela Pereira Roque[9], Juliana Cassaro Vieira[10], Lara Quintiliano de Carvalho[11], Maria Carolina de Souza Minholi[12], Pedro Machado Pelli[13], Ramon Marques Macedo[14], Stefany Letícia Coutinho Lima[15], Tainá Ribeiro Silva[16], Thiago Humberto da Silva Pires[17], Wanessa Eduarda Ribeiro de Jesus[18] and Afonso Pelli[19]

ABSTRACT

Insects represent the most species-rich group of living beings. They participate in the functioning of ecosystems, providing essential services to our well-being, such as pollination, production of products such as silk and honey, and being a direct source of food. Entomophagy is the term used to describe the use of insects in the human diet. This resource is fully realized because insect farming requires few resources, generates few impacts, and has a low cost/benefit ratio, thus contributing to food security. Cereal bars containing or not containing insects were used to evaluate the possibility of including this item in the menu. The species used in cereal bars was the leafcutter ant Atta sexdens (Linnaeus, 1758). The experiments involved 120 participants. Evaluations were made in five categories: Aroma, Flavor, Texture, Overall Impression, and Purchase Intention. The three sensory panels included recipes A and B. Sometimes, discrepancies were observed between the two recipes, particularly regarding “Purchase Intention,” even though the recipes were the same. Recipe 3B was the only one with the presence of parts of insects of the species Atta sexdens (Linnaeus, 1758). Apparently, the participants noticed the presence of insects, since parts of them were added in a significant proportion. The chi-square test was performed to analyze the data between the parameters in each experiment. Despite the differences observed, they were not significant for experiments 1

[1] Undergraduate in Biomedicine, Federal University of Triângulo Mineiro
[2] Undergraduate in Biomedicine, Federal University of Triângulo Mineiro
[3] Undergraduate in Biomedicine, Federal University of Triângulo Mineiro
[4] Undergraduate in Biomedicine, Federal University of Triângulo Mineiro
[5] Master's student in Environmental Sciences, Federal University of Triângulo Mineiro
[6] Undergraduate in Biomedicine, Federal University of Triângulo Mineiro
[7] Undergraduate in Biomedicine, Federal University of Triângulo Mineiro
[8] Undergraduate in Biomedicine, Federal University of Triângulo Mineiro
[9] Undergraduate in Biomedicine, Federal University of Triângulo Mineiro
[10] Undergraduate in Biomedicine, Federal University of Triângulo Mineiro
[11] Undergraduate in Biomedicine, Federal University of Triângulo Mineiro
[12] Undergraduate in Biomedicine, Federal University of Triângulo Mineiro
[13] Undergraduate in Medicine, University of Ribeirão Preto
[14] Master in Ecology, Federal University of Uberlândia
[15] Undergraduate in Biomedicine, Federal University of Triângulo Mineiro
[16] Undergraduate in Biomedicine, Federal University of Triângulo Mineiro
[17] Master's student in Environmental Sciences, Federal University of Triângulo Mineiro
[18] Undergraduate in Biomedicine, Federal University of Triângulo Mineiro
[19] Postdoctoral Fellow in Sciences - Materials Physics, Federal University of Triângulo Mineiro

and 2. For experiment 3, the only one in which insects were actually added, the test was statistically significant at the 5% level, for “Taste”; “Texture”; “Overall Impression” and “Purchase Intention”. The results provide valuable insights into how cultural factors affect the evaluation of new foods and highlight important methodological considerations in conducting experiments of this type. The central finding was the strong influence of the suggestion on the sensory acceptance of the participants. This highlights the importance of cultural beliefs and expectations in the formation of food preferences. In contrast, those who were open to the idea of consuming insects were more receptive and, in some cases, reported positive acceptance, suggesting that familiarity and a favorable predisposition can lessen the negative impact of psychological suggestion. However, society has evolved, demands have increased, and new values can be instilled in people, such as healthier or more environmentally friendly food. A few decades ago, in Brazil, there were few restaurants that sold oriental food, which contains raw fish. Today, this practice is deeply rooted in our culture. A relevant fact that should be highlighted is the lack of reports of diseases transmitted by insects used in human food, unlike what happens with vertebrate meat, which often, when prepared without cooking, can transmit etiological agents of various diseases.

Keywords: Entomophagy. Biodiversity. Sustainability.

INTRODUCTION

Insects represent a taxon with a wide variety of organisms1. These animals have very diverse ecological relationships, occupying strategic positions in food webs. They are found on land and in water, with varying degrees of sociability; developed as a response to evolutionary pressures, allowing them to live in diverse environmental conditions2. They are essential for various ecological functions and ecosystem services: nutrient recycling, pollination and dispersal of seeds and plants. They transfer matter and associated energy, as they are a source of food for fish, amphibians, reptiles, birds and mammals. They also bring indispensable benefits to the survival of the human species, through pollination, production of products such as silk and honey, being a direct source of food, in addition to contributing directly to agribusiness2. Entomophagy is the term that characterizes the use of insects in the human diet. This resource is satisfactory insofar as insect cultivation requires few financial resources, generates less environmental impacts, in addition to being easier to produce; in contrast to the great value in mass and nutrients that these animals offer; thus contributing to ensuring food security3.

Around 1,509 species of edible insects have already been catalogued and are distributed in more than 120 countries. The classes that concentrate the largest number of edible species are Coleoptera, Hymenoptera, Orthoptera and Lepidoptera. The practice of entomophagy is very old and is described in the Bible, in Leviticus 11:20-23, probably between 300 and 500 BC. However, with the cultural colonization of Europeans, the diet based on these animals became commonplace. Similarly, today there is a certain stigma regarding the ingestion of some arthropods4. Eating marine shrimp is somewhat elegant, but their ecological equivalents, or similar terrestrial detritivores, are not so much. The aversion to insects can be explained by the view that insects are dangerous, dirty, disease-carrying and, therefore, inedible. At the same time, the interpretation of what constitutes food influences individuals' decisions about whether or not to accept food, and social, cultural and economic factors give rise to this perspective. For example, there are religions in which the gods do not allow insects to be eaten by their followers, or even when these animals are represented as totems and, therefore, prohibited from being consumed4.

The negative view of these animals is concentrated in Western culture, while in Eastern culture they are seen in a more pleasant way and are included more routinely in the diet5. Naturally, these choices are influenced by environmental factors, which also shape cultures. In this sense, it is clear that the dietary individuality of each social group culturally determines the consumption habits of a given source of supply, thus, what is seen as banal for one group may be censored for another3.

Secondly, it is worth noting that taste, which is a sociocultural characteristic, is a preponderant factor in choosing to practice entomophagy. From this perspective, there are several flavors related to insects, for example: when Marco Polo visited China he found that grasshoppers acquired the taste of the seasoning that was used; in a region of Africa, when a fly is crushed it resembles the taste of caviar; it was also observed that insects that live in water have a flavor similar to marine animals; a caterpillar, in northeastern Brazil, resembles the taste of roasted pig intestines. Therefore, depending on the social context, there may be variations in people's willingness to practice entomophagy4.

One of the variables that influences the aversion to insects lies in their aesthetics. This fact is proven by analyzing a survey of university entomology students, which found that the more disguised the dish in which the insect was found, the more readily the students were interested in trying it4. However, this aversion has recently been deconstructed. At the XXIX Brazilian Congress of Entomology and XIII Latin American Congress, which took place in September 2024 in Uberlândia, the subject was addressed and discussed (Figures 1 and 2).

Fig. 1. Products sold on a large scale, with insects added to their composition.

Fig. 2. Master chef, with a high level of entomophagy skills, presenting dishes and menus during a scientific event of international repercussion; the XXIX Brazilian Congress of Entomology and XIII Latin American Congress, which took place in September 2024 in Uberlândia/MG.

Although academia presents the benefits of entomophagy, and the practice is rooted in traditional cultures in Brazil, there is a strong aversion to insects as food. A study was carried out in a municipal elementary school in Rio Grande do Sul, with two classes of eighth graders. In this analysis, a questionnaire was presented that required, as one of its components, that students select the adjectives that characterize this group of animals and, after a lecture on insects, this questionnaire was redone with the aim of verifying possible changes. Before the lecture, the majority of students saw insects in a negative light. However, after teaching about the diversity and importance of insects, the students' perspective made them opt more for adjectives such as: beautiful and useful, increasing the positive aspect1. It is seen, therefore, that the construction of the image regarding animals occurs from the beginning of the individual's formation4. However, the nutritional combination of using insects in human food is favorable for consumption due to their nutritional properties, which vary depending on the specimen, as many contain high levels of vitamins, proteins and minerals, with a predominance of unsaturated fats, which are healthier6.

Insects have a generous dose of nutrients, containing the same substances that are found in vertebrates common to human food, such as cattle, fish and chicken. However, there is a marked difference in the concentration of these compounds between these animals, since in insects the presence of proteins is more expressive, manifesting up to 43% of this component, in contrast to 20% in chicken and 20 to 30% in beef. In addition to proteins, a variety of minerals essential to the human body are also found, such as: lipids and vitamins that are capable of promoting healthy development4.

From this perspective, it is possible to see that insects are an advantageous source of nutrients for animals, such as cattle and chicken, when in the form of feed. Likewise, it is possible that it could also be a viable alternative for humans, since its production would affect landscapes much less than livestock farming, for example. 7 Thus, the study on the quantification of proteins in insects is of economic, social and environmental interest given the benefits in production. 6 Even so, it is clear that entomophagy presents itself as an excellent habit to include in daily meals, even helping to guarantee food security. 4 Thus, entomophagy shows, with its studies, the potential advancement of food sources in a world where hunger is still one of the main problems, even though access to food is a right for everyone. Finally, the viability of including this group in our diet is possible.

It is estimated that in the near future, the practice of entomophagy will increase due to population growth and the need to obtain more food sources, especially protein sources, where current agriculture alone will not be able to meet the needs of feeding the entire

population9. This scenario will require other sources to obtain nutrients for everyone, and thus entomophagy will expand in the future, with more foods based on various insects that have a higher nutritional and protein value than other sources of animal protein being sold in markets and restaurants, and people's repulsion towards this habit will decrease, and it will become something more present in the culture of several countries10.

Among the options of insects used in human food is the Order Hymenoptera. This order is highly diverse and includes insects such as bees, wasps and ants. This taxon is of extreme ecological importance, as they participate in plant pollination, pest control, are prominent in beekeeping and agriculture, and also participate in human nutrition. This order has mouthparts ranging from sucking to chewing, and they are projected either ventrally or forward. The antennae are large and articulated and are folded anteriorly or dorsally. The Apocrita, a suborder of the Hymenoptera, have the propodeum to constitute the mesosome. Another characteristic of the Apocrita is due to a constriction or petiole, found in the second abdominal segment2.

In this sense, cereal bars containing insects were used to evaluate the possibility of including insects in the human diet. The species used in the cereal bars was the leafcutter ant Atta sexdens (Linnaeus, 1758), belonging to the Order Hymenoptera. The leafcutter ant is present in the diet of indigenous groups and also in some urban areas of Brazil11. This species is normally a substitute for meat and is served whole or only in the abdominal region4. A certain group of individuals in the Northeast region claim that they consume the mesosoma and gaster, the rest is discarded and served fried12. The nutritional value of Atta spp. consists of a low protein content (~13%) and medium lipid content (34.5%), however, it presents an adequate nutritional quality, since the amino acids provided have a high nutritional value13.

The objective of this article was to test the perception and acceptance of cereal bars, which could have insects of the species Atta sexdens as one of their ingredients, among students, teachers and employees of the Federal University of Triângulo Mineiro.

MATERIALS AND METHODS

The research was conducted in the age group of 18 to 60 years. Approval was obtained through documentation signed by the participants (TCLE - Informed Consent Form).

In this experiment, cereal bars were developed with minor changes. The ingredients were homogenized in a Mondial mixer, model Power Mixer500®, and then transferred to a

Mallory cereal bar machine, model Nutritive Cereal Maker 280w®. Recipe 1A was baked for 15 minutes and 1B for 22 minutes (Table 1).

In recipe 2, there was a change in the proportions and baking time, with 30 minutes being used (Table 2). For recipe 3, 38g of the abdomen of the ant Atta sexdens (Linnaeus, 1758) was added to cereal bars “B” (Table 3). These were baked for 30 minutes, using the same preparation method as the previous ones.

Table 1. Recipes 1A and 1B, with ingredients and their respective proportions.

INGREDIENTS		1A	1B
Wheat bran		14 g	14 g
Brown sugar		25 g	25 g
Crystal sugar		20 g	20 g
Cocoa		10 g	10 g
Oat mix		30 g	30 g
Silver banana		80 g	80 g
Margarine		20 g	20 g

Source: organized by the authors.

Table 2. Recipes 2A and 2B, with ingredients and their respective proportions.

INGREDIENTS		2A	2B
Wheat bran		7 g	7 g
Brown sugar		25 g	25 g
Crystal sugar		20 g	20 g
Cocoa		10 g	10 g
Oat mix		30 g	30 g
Silver banana		80 g	80 g
Margarine		20 g	20 g
Raisins		20 g	20 g

Source: organized by the authors.

The base ingredients were whole wheat bran, enriched with iron and folic acid; oat mix; barley flour; enriched with B1, B2 and B6; ascorbic acid; salt and sodium bicarbonate; dehydrated cocoa fruit and silver banana.

Tabela 3. Receitas 3A e 3B, com ingredientes e suas respectivas proporções.

INGREDIENTS		3A	3B
Wheat bran		7 g	7 g
Brown sugar		25 g	25 g
Crystal sugar		20 g	20 g
Cocoa		10 g	10 g
Oat mix		30 g	30 g
Silver banana		80 g	80 g
Margarine		20 g	20 g
Raisins		20 g	20 g
Atta sexdens		0 g	38 g

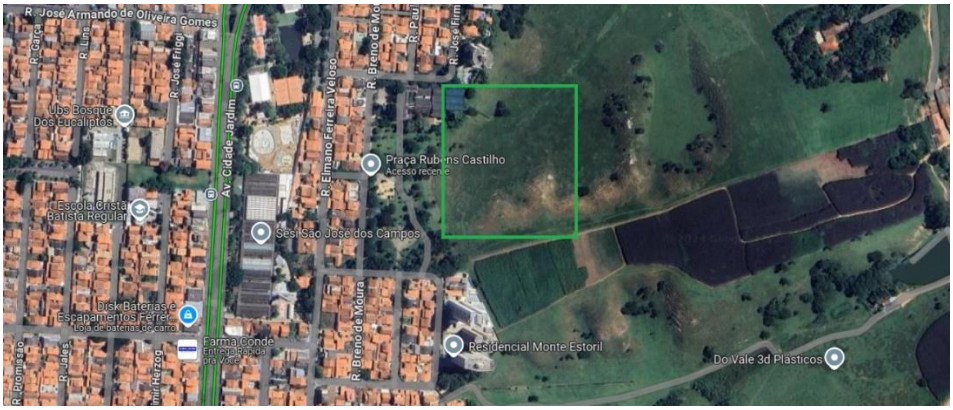
Source: organized by the authors.

The tanajuras, known as "içá" in the region where they were collected (Fig. 3), are a very popular food among the elderly. Fried, seasoned and served with flour, it is a very

popular dish in the months of October and November, despite the culture of not collecting ants after November 2nd (All Souls' Day). The iças were collected manually and frozen until the recipe was prepared.

The land in question is part of the cerrado biome and serves as pasture for cattle, popularly called "fazendão", located in the Estoril neighborhood, in the city of São José dos Campos/SP.

Figure 3. Location where the tanajuras used in the experiment were collected. Approximate geodetic location: 23.2509141, -45.882297



Source: Google Maps.

Only the abdomen of the ants was used to produce the cereal bars (Fig. 4).

Figure 4. Atta sexdens (Linnaeus, 1758) used in the production of Cereal Bars.

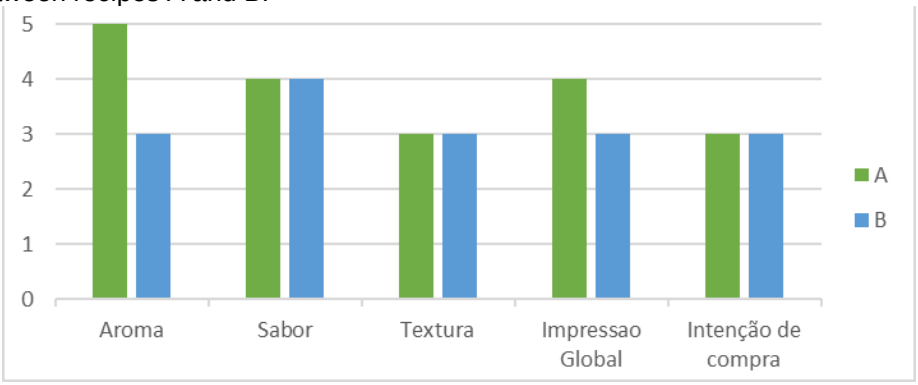
Source: the authors.

RESULTS AND DISCUSSION

The experiments involved 120 participants, divided into 19 for recipe 1, 51 for recipe 2 and 50 for recipe 3. Evaluations were made in five categories: Aroma, Flavor, Texture, Overall Impression and Purchase Intention. The three sensory panels included recipes A

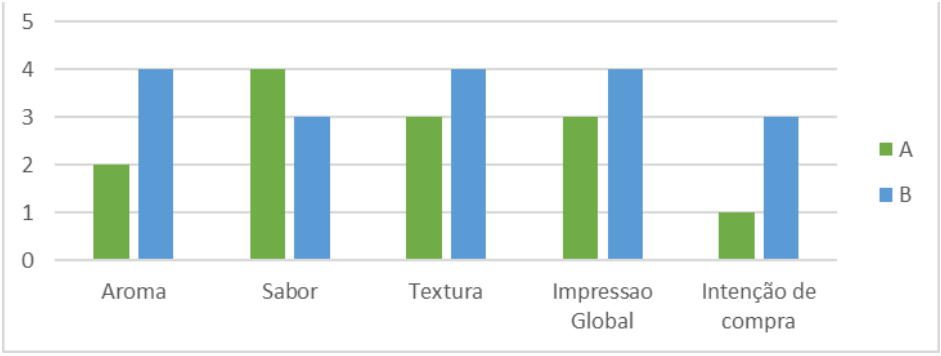
and B, and experiment 3B was the only one with the presence of insects. However, there was no indication of which recipe contained insects or not. The results can be seen in Figures 5 to 7. From Experiment 1, it can be seen that recipe 1A was the one that received the highest approval. The “Taste”, “Texture” and “Purchase Intention” between bars A and B were the same, which was expected, since both did not contain insects and were exactly the same, except for the cooking time. According to the differences between “Aroma” and “Overall Impression”, cereal bar A presented greater satisfaction among the participants, which may have been influenced by the difference in cooking time.

Figure 5. Results of the Sensory Panel, carried out in Experiment 1, with cereal bars, in which insects of the species Atta sexdens (Linnaeus, 1758) were not included and the difference between the bars was only the cooking time between recipes A and B.



Source: Data collected through a questionnaire answered by volunteers in a common area of the Federal University of Triângulo Mineiro.

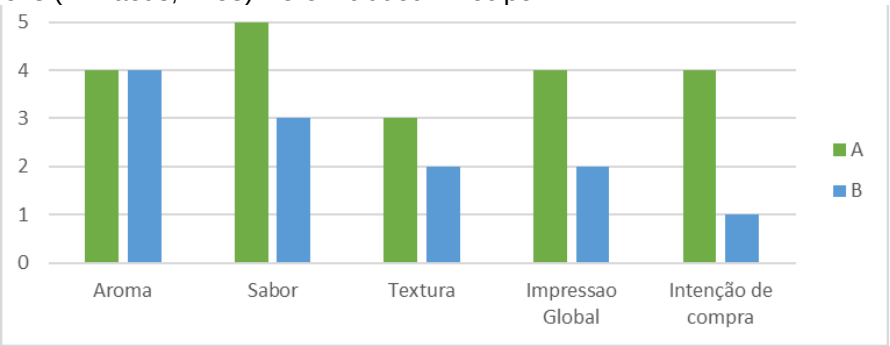
Figure 6. Results of the Sensory Panel, carried out in Experiment 2, with cereal bars, in which insects of the species Atta sexdens (Linnaeus, 1758) were not included and there was no difference between cereal bars A and B.



Source: Data collected through a questionnaire answered by volunteers in a common area of the Federal University of Triângulo Mineiro.

In experiment two, both recipes (2A and 2B) were identical and did not contain insects. However, large discrepancies were observed between the two recipes, particularly regarding “Purchase Intention”.

Figure 7. Results of the Sensory Panel, carried out in Experiment 3, with cereal bars, in which insects of the species Atta sexdens (Linnaeus, 1758) were included in recipe B.



Source: Data collected through a questionnaire answered by volunteers in a common area of the Federal University of Triângulo Mineiro.

Recipe 3B was the only one with the presence of parts of insects of the species Atta sexdens (Linnaeus, 1758); however, there were no changes in the other ingredients between cereal bars 3A and 3B. In this sense, this fact was not exposed at the time of testing. Apparently, the participants noticed the presence of insects, since parts of them were added in a significant proportion. Recipe 3B was the one with the lowest approval in four of the five categories. The aroma between the two recipes was identical. The chi-square test was performed to analyze the data between the parameters in each experiment. Despite the differences observed, they were not significant for experiments 1 and 2. For experiment 3, the only one in which insects were actually added, the test was statistically significant at the 5% level for “Taste”; “Texture”; “Overall Impression” and “Purchase Intention”.

CONCLUSION

The results of the experiments demonstrated a variation in the sensory responses of the volunteers in relation to bars A and B. In Experiment 1, bar A received a higher evaluation in almost all sensory attributes, with emphasis on aroma, which received the highest score. This preference for aroma may have positively influenced the overall impression and purchase intention. However, bar B received a lower evaluation in aroma and overall impression, suggesting that these factors negatively impact product acceptance. In Experiment 2, a reversal in the results was observed, since bar B performed better in aroma, texture and overall impression. This higher performance resulted in a higher purchase intention for bar B compared to bar A, which received a lower sensory evaluation in aroma and a lower purchase intention. Since the recipes were identical, it can be concluded that the participants were induced to believe that there were insects in one of the two recipes. It is also likely that one participant could influence others. This is why the level of evaluations was different between them. These data corroborate the literature, as

they indicate that cultural aspects can interfere with the acceptance of insect-based products4.

Experiment 3 reflects a preference for the sensory attributes of bar A, especially in terms of taste and overall impression, resulting in a higher purchase intention compared to bar B, which, despite presenting a competitive aroma, obtained a low evaluation in terms of overall impression and purchase intention.

The results provide valuable insights into how cultural factors affect the evaluation of new foods and highlight important ethical and methodological considerations when conducting experiments of this type.

The central finding was the strong influence of psychological suggestion on the sensory acceptance of participants. Even though they were identical to the control bars (without insects), those who believed they were consuming leafcutter ants reported different perceptions regarding taste, texture and appearance.

The acceptance or rejection of foods is shaped by cultural and psychological factors. In this study, participants who already had an aversion to the idea of consuming insects tended to describe a less pleasant sensory experience, even though the bars did not contain leafcutter ants. This highlights the importance of cultural beliefs and expectations in the formation of food preferences. In contrast, those who were open to the idea of consuming insects were more receptive and, in some cases, reported positive acceptance, suggesting that familiarity and a favorable predisposition may lessen the negative impact of psychological suggestion14,15.

The main limiting factor of this study is related to acceptance and rejection by participants, as many people approached to taste the cereal bars refused to participate in the research. This refusal is largely due to cultural factors that are already deeply rooted in the population, which directly influence individuals' willingness to try new products. These cultural aspects, which shape consumers' preferences and resistance, therefore prove to be a significant obstacle in collecting data and obtaining more comprehensive and representative results in the context of this study. In addition, aspects related to the production of the cereal bar must be taken into account when looking at acceptance or rejection14,15. In the recipe containing the abdomen of the ant, Atta sexdens (Linnaeus, 1758), due to the quantity of insects present, the presence of parts of these was perceived. This caused the participants to feel strange, causing them to not try the sample or to eat only part of it and throw the rest away. They also reported the peculiar flavor present, leading them to believe that the sample contained insects. The possibility of a consumer market for a cereal bar made with insects is linked to factors such as cultural acceptance,

the search for innovative foods, and interest in sustainable practices. In Brazil, although still uncommon, the consumption of insects in food has been gaining ground, especially among those seeking protein alternatives and more ecological diets14,15. In addition, there is an increase in interest in exotic and differentiated products. Thus, there may be an audience interested in this type of product, especially if it is well positioned and accompanied by a campaign that highlights its nutritional, social, economic, and environmental benefits15.

It is concluded that the acceptance of insect-based foods, such as cereal bars, is influenced by cultural and psychological factors of the individual. The simple suggestion that the cereal bar could contain the insect already caused a change in the sensory perception of the participants, reflecting a deep-rooted cultural aversion. On the other hand, improved sensory aspects, such as flavor and texture, can mitigate this initial repulsion, suggesting that the acceptance of these foods can be improved over time and with appropriate sensory and educational approaches. Market acceptance may change if the population comes to accept entomophagy in their diet, but based on the experiment carried out, it can be observed that in experiment 3, bar B, the only recipe that contained ants, received a purchase intention score of 1. This analysis suggests that most people would not buy the bar if it were introduced to the market, which would not result in immediate profit from the sale of bars containing insects. However, society has evolved, demands have increased, and new values can be instilled in people, such as healthier or more environmentally friendly food. 16 A few decades ago, in Brazil, there were few restaurants that sold oriental food, which contains raw fish. Today, this practice is deeply rooted in our culture. A relevant fact that should be pointed out is the lack of reports of diseases transmitted by insects used in human food, unlike what happens with vertebrate meat, which often, when prepared without cooking, can transmit etiological agents of various diseases.

REFERENCES

1. Lopes, L. A., Valduga, M., Athaydes, Y., & Dal-Farra, R. A. (2014). As concepções sobre insetos no ensino fundamental em escola pública de Sapucaia do Sul, RS. *Revista de Ensino de Ciências e Matemática*, 16(4). http://www.periodicos.ulbra.br/index.php/acta/article/view/1276/1028

2. Gullan, P. J., & Cranston, P. S. (2023). *Insetos. Fundamentos da entomologia* (5th ed.). Rio de Janeiro: Roca.

3. Cheung, T. L., & Moraes, M. S. (2016). Inovação no setor de alimentos: insetos para o consumo humano. *Interações (Campo Grande)*, 17(3). https://www.scielo.br/j/inter/a/nCXbbgXydfNrRBDxY57DjzJ/#

4. Costa-Neto, E. M. (2003). Insetos como fontes de alimentos para o homem: valoração de recursos considerados repugnantes. *INCI*, 28(3). https://ve.scielo.org/scielo.php?script=sci_arttext&pid=S0378-18442003000300004

5. Amaral, K. O. D., & Medeiros, M. D. A. (2015). Análise das concepções de estudantes do ensino fundamental sobre insetos, por meio da metodologia do Discurso do Sujeito Coletivo. *BG Journal*, 6(1). https://seer.ufu.br/index.php/braziliangeojournal/article/view/28068

6. Bisconsin-Junior, A., Januario, L. A., Netto, F. M., & Mariutti, L. R. B. (2018). Composição de insetos comestíveis. O uso consciente da biodiversidade: perspectiva para o avanço da ciência e tecnologia de alimentos. https://www.researchgate.net/publication/327118458_Composicao_de_insetos_comestiveis/citation/download

7. Khalifah, A., Abdalla, S., Rageb, M., Maruccio, L., Ciani, F., & El-Sabrout, K. (2023). Could insect products provide a safe and sustainable feed alternative for the poultry industry? A comprehensive review. *Animals*, 13(9). https://pubmed.ncbi.nlm.nih.gov/37174571/

8. Luke, S. H., Roy, H. E., Thomas, C. D., Tilley, L. A. N., Ward, S., Watt, A., et al. (2023). Grand challenges in entomology: Priorities for action in the coming decades. *Insect Conservation and Diversity*, 16(2). https://pubmed.ncbi.nlm.nih.gov/38505358/

9. Elaine, E. O. (2019). Entomofagia: alimentação à base de insetos. I Congresso Brasileiro de Insetos Alimentícios e Tecnologias Associadas II Simpósio de Antropoentomofagia. https://pt.scribd.com/document/437709778/Anais-Insetec-2019

10. Gonçalves, C., Chavez, K., & Jorge, R. (2022). Entomofagia - consumo atual e potencial do futuro. *Associação Portuguesa de Nutrição*, 29. https://www.researchgate.net/publication/363694304_ENTOMOFAGIA_-_CONSUMO_ATUAL_E_POTENCIAL_DE_FUTURO

11. Neto, E. M. C., & Ramos-Elorduy, J. (2006). Los insectos comestibles de Brasil: etnicidad, diversidad e importancia en la alimentación. *Etnoentomologia*, 1(38). http://sea-entomologia.org/PDF/GeneraInsectorum/GE-0062.pdf

12. Salgado, G. A. T., Salgado, A. G. A. T., Pinheiro, Y. V. F., & Martins, C. (2024). Você come formigas? Um estudo de caso de entomofagia na serra da Ibiapaba, Ceará,

Nordeste do Brasil. *Gaia Scientia*, 17(2). https://periodicos.ufpb.br/index.php/gaia/article/view/67672

13. Fontes, V., Santos, C. M. M., & Henrique, V. S. M. (2018). Composição e aplicação da formiga Içá na culinária brasileira. *2018 Brazilian Technology Symposium*, 1. https://pt.scribd.com/document/541157097/083

14. Macedo, R. M., Neves, N. M., Sabino, R. M., & Pelli, A. (2022). Insetos na alimentação humana: avaliação sensorial de barras de cereais com *Tenebrio molitor* Linnaeus, 1758. *Acta Biologica Brasiliensia*, 5(1), 75–86. https://doi.org/10.18554/acbiobras.v5i1.7202

15. Peixoto, P. G., Oliveira, R. V., Miranda, V. S., Paulino, T. P., de Andrade, R. M., & Pelli, A. (2016). Avaliação proteica e parâmetros populacionais de *Cynaeus angustus* Le Conte (Coleoptera: Tenebrionidae). *EntomoBrasilis*, 9(2), 108–113. https://doi.org/10.12741/ebrasilis.v9i2.561

16. Macedo, R. M., Ribeiro, R. L., Souza, F., & Pelli, A. (2020). Adição do Coleoptera *Cynaeus angustus* LeConte, 1851 em barras proteicas para consumo humano. *Revista SODEBRAS*, 15(179), 44–51. https://doi.org/10.29367/issn.1809-3957.15.2020.179.44