

ORIGINAL ARTICLE

# Sensory acceptance of mango ice cream added with whey protein by consumers affected and not affected by cancer

Andrea Pissatto Peres<sup>1\*</sup> , Emanuele Batistela dos Santos<sup>1</sup>, Maressa Caldeira Morzelle<sup>1</sup>, Priscila Becker Siqueira<sup>1</sup>, Julia Santos da Cunha<sup>1</sup>, Aline Magalhães Assis Cerzosimo<sup>1</sup>, Weza Kissanga Kya Kapitango-a-Samba<sup>1</sup>

<sup>1</sup>Universidade Federal de Mato Grosso (UFMT), Departamento de Alimentos e Nutrição, Cuiabá/MT - Brasil

\*Corresponding Author: Andrea Pissatto Peres, Universidade Federal de Mato Grosso (UFMT), Departamento de Alimentos e Nutrição, Av. Fernando Corrêa da Costa, 2367, Boa Esperança, CEP: 78060-900, Cuiabá/MT - Brasil, e-mail: andrea.peres@ufmt.br

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## Abstract

The study aimed to develop a mango ice cream (*Mangifera indica* L. cv. Bourbon) added with whey protein and evaluate its acceptability, using a 9 points hedonic scale. The participants were 157 tasters not affected by cancer and 75 patients undergoing chemotherapy at the Cancer Hospital in Cuiabá, in the state of Mato Grosso. The last group also evaluated the ice cream through sensory and well-being perceptions using the "Check all that apply" - CATA method. The ingredients for the ice cream formulation were mango, passion fruit, whey protein, and unflavored coconut oil. The attributes for the overall assessment established by tasters not affected by cancer were as follows: aroma, appearance, flavor, texture, and overall impression. The mango ice cream was free of contamination, with 4.6% of protein. In fact, 96.8% of participants reported liking the taste of ice cream. Even though the ice cream did not have added sugar, 87.26% of the participants rated the ideal sweetness level. Furthermore, more than 95% of them reported that they would buy the product. Regarding the tests carried out with patients undergoing chemotherapy treatment, 32% said the ice cream relieved their symptoms of nausea and 90% responded that they liked it in the affective test, validating the acceptability of the ice cream. The study proved the healthiness and sanity of consuming this ice cream, which is a well-accepted food, bringing benefits to patients undergoing the chemotherapy treatment. Still, above all, it used a fruit that has a regional and comfort food appeal, since for many patients, consuming mango ice cream brought back memories of their childhood.

**Keywords:** Iced products; Hedonic scale; Product development; Check all that apply (CATA); Acceptability test; Chemotherapy.

## Highlights

- The mango ice cream had high acceptability and it had hygienic-sanitary quality
- The sugar-free mango ice cream was evaluated with just about the right sugar
- The ice cream provided a sense of well-being and alleviated symptoms of chemotherapy



## 1 Introduction

The National Cancer Institute – INCA (Instituto Nacional de Câncer, 2018) and the WHO - World Health Organization (2014) conceptualize cancer as a generic term for a group of more than 100 diseases and is characterized by disorderly and accelerated cell growth, being a multicausal chronic disease. Due to their rapid division, tumor cells invade adjacent tissues and organs and can spread to other regions of the body.

The presence of malignant cells can lead the individual to develop metabolic alterations, classifying him in a state of nutritional risk. Malnutrition is frequent among people affected by cancer, and this implication is three times more constant in patients with cancer compared to those without the diagnosis (Poltronier & Tusset, 2016).

Chemotherapy drugs target rapidly dividing cells, a hallmark of cancer cells. However, these drugs can also affect other rapidly dividing cells in the body, such as those in the bone marrow, digestive tract, and hair follicles, which leads to side effects. (Queiroga et al., 2017).

The side effects of chemotherapy make it difficult to maintain nutritional balance. Nausea, changes in taste, vomiting, and lack of appetite are some of the factors that interfere with the possibility of eating properly. This nutritional imbalance generates weight loss, reduces the effectiveness of antineoplastic agents, increases drug toxicity, reduces the survival rate, and worsens the quality of life of patients. Thus, nutritional intervention is of fundamental importance, as it develops strategies to mobilize a greater supply of food that can alleviate and collaborate with the reduction of side effects of chemotherapy treatment (Kim et al., 2019).

The ice cream can be a strategy to contribute to the reduction of secondary side effects of chemotherapy treatment. According to the Cancer Institute of the State of São Paulo (Instituto do Câncer do Estado de São Paulo, 2022), some gastrointestinal symptoms are alleviated when acidic, liquids or pasty, chilled, or at room temperature foods are consumed. Ice creams meet the characteristics of cancer patients' favorite foods, that is, sweet, that contain fruit and are cold (Valmorbida et al., 2019). Furthermore, they are an attractive option for patients living in hot cities, as refreshing.

Ice cream is a product that pleases the most varied palates, of all age groups and any social class. It is considered refreshing food that combines very well with the tropical climate of the country. It is a product with good sensory acceptance, appreciated by the Brazilian population, and, therefore, a potential vehicle for the incorporation of functional ingredients (Rodrigues et al., 2018; Genovese et al., 2022).

In Cuiabá, a Brazilian municipality in the state of Mato Grosso (MT), the mango (*Mangifera indica* L. cv. Bourbon) is a fruit even present in the backyards. In a study carried out in this city, it was found that mango is present in 66.7% of backyards in the Nossa Senhora Aparecida neighborhood (Silva et al., 2021).

The mango is a pulpy fruit, of variable size, color, and very pleasant aroma (Bally, 2011). A fruit belonging to the Anacardiaceae family, cultivated for thousands of years in the Indian subcontinent. Source of minerals, fibers and carbohydrates; it is also an important source of bioactive phytochemicals and antioxidant vitamins such vitamins A, C and E (Mirza et al., 2021). All these nutrients are essential in nutritional therapy, as chemotherapy is aggressive to the immune system, due to its toxicity caused by antineoplastic drugs (Melo & Araujo, 2011).

To obtain a product that contributes to relieving the symptoms of patients undergoing chemotherapy treatment, using a food known and easily accessible to the local population, a mango ice cream added with sugar-free and *whey protein* was developed. It enables the use of highly available mangoes in the city of Cuiabá (MT), Brazil, reducing food waste. The product developed is a highly energetic food supplementation strategy that contains high biological value protein, it is free of trans fats and added sugars. In addition to assisting in meeting the nutritional needs of the patient, it can also contribute to the reduction of secondary side effects of chemotherapy treatment by providing a treatment that takes into account the entirety of the individual.

Therefore, the objective of the present study was to develop a mango ice cream (*M. indica*) added with *whey protein* and to evaluate its acceptability by tasters not affected by cancer and by patients undergoing chemotherapy at the Cancer Hospital in Cuiabá (MT). The latter group also evaluated the ice cream through sensory and well-being perceptions using the “*Check all that apply*” - CATA method. Physical-chemical

analysis for lipids, proteins, carbohydrates estimated by difference, ice cream total solids and microbiological analysis to validate the sanitary quality were carried out.

## 2 Materials and methods

The study was characterized as cross-sectional and quantitative and was approved by the Research Ethics Committee of the Federal University of Mato Grosso (CAAE 12803619200008124) and by the Research Ethics Committee of the Cancer Hospital of Cuiabá (MT).

The mango ice cream was added with passion fruit, sugar-free, *whey protein*, and coconut oil. The mangoes (*M. indica*) were collected in the city of Cuiabá (MT), Brazil, and the other ingredients were purchased in the local market. The experiments were carried out in the laboratories of the Faculty of Nutrition of the Federal University of Mato Grosso. The fruits were selected, washed, and sanitized, then peeled and pulped. The pulps were processed in a blender and sieved, the sieved part was pasteurized at 85 degrees Celsius for 15 minutes, then cooled to 10 degrees within 2 hours, then frozen until the time of use, which did not exceed 30 days.

The ice cream was made in partnership with an ice cream parlor located in Cuiabá (MT). The frozen mango and passion fruit pulps were transported in an isothermal box at freezing temperature (-18 °C) to the production site (ice cream parlor). The coconut oil, the *whey protein*, the mango, and passion fruit pulps were homogenized, then they were shaken in a discontinuous ice cream machine brand Alphagel L40 vertical, previously cooled, and kept under agitation for 15 minutes at a temperature of -16 °C. Thus, a formulation was obtained with 82% of pasteurized mango pulp, 7% of pasteurized passion fruit, 6% of *whey protein* and 5% of coconut oil. The ice cream was packed in containers and stored at -18 °C.

### 2.1 Physical-chemical and microbiological analysis

The following ice cream proximal composition analyzes were performed: total solids (429/IV) and ash (485/IV) determined according to the methodology described by Adolfo Lutz Institute (Instituto Adolfo Lutz, 2008), lipids according to Bligh & Dyer (1959) and according to the Association of Official Analytical Collaboration International (1997), the total protein contents described in section 12.1.07, method 960.52, multiplying the total nitrogen content by the conversion factor 6.25 and the quantification of total dietary fiber section 45.4 .07, method 985.29. The total carbohydrate content was estimated by the difference between 100% and the sum of the constituents of the centesimal composition (moisture, ash, lipids, and proteins). The total caloric value was calculated using Atwater factors, 4 kcal g<sup>-1</sup> for proteins and carbohydrates, and 9 kcal g<sup>-1</sup> for lipids. The ice cream was subjected to microbiological analysis, following the parameters in force in 2022, of Normative Instruction N° 161, of the National Health Surveillance Agency (Agência Nacional de Vigilância Sanitária – ANVISA) (Brasil, 2022), according to the methodology described in APHA (American Public Health Association, 1992), for counting *Enterobacteriaceae*, *Staphylococcus aureus* and *Salmonella* sp.

### 2.2 Sensory evaluation

The sensory evaluation of the mango ice cream was carried out through affective tests, in two sessions. The first with regular consumers of ice cream, not affected by cancer, carried out in isolated cabins in the sensory analysis laboratory at the Federal University of Mato Grosso, with white lighting and the absence of odors and noise. Consumers were invited to participate voluntarily in the study and were informed about the risks and benefits of their participation and given an informed consent form (ICF) for signature. The group consisted of 157 individuals of both sexes, aged 18 years or older. Consumers received a portion of approximately 50 mL of ice cream, the evaluation form, a spatula, a pen, a glass of water, and a paper napkin at the booths.

An acceptance test was performed using a 9-point hedonic scale, ranging from “disliked it extremely” to “like it extremely” (Minim, 2006). The established attributes for the evaluation were as follows: aroma, appearance, flavor, texture, and overall impression. Then, the degree of sweetness was evaluated using an

ideal sweetness test (JAR - Just about right) with a structured 9-point scale ranging from "extremely too sweet" to "extremely not sweet enough", and finally, the purchase intention test, with a structured 5-point scale, with the extremes "definitely would buy it" and "definitely would not buy it" (Minim, 2006).

Tasters who had type 1 and 2 diabetes, dyslipidemia, hypertension, intolerance, and food allergy to any ingredient in the formulation were excluded from the research.

The second session was developed for patients undergoing chemotherapy treatment, in a central location. On this occasion, the CATA test was applied, and again an affective test using a 9-point structured hedonic scale, ranging from "dislike it extremely" to "like it extremely" (Minim, 2006). In the CATA test, patients had to choose all the options that applied to ice cream, which contained descriptor terms divided into three distinct perceptions: sensory perception, perception of well-being, and perception to pre-existing symptoms.

Both tests were carried out at the Cancer Hospital of Mato Grosso with 75 tasters, patients undergoing chemotherapy, who received samples of 50 mL of ice cream during the time they were in the reception room of the hospital or in the room where they received chemotherapy.

### 2.3 Statistical analysis

The centesimal composition of nutrients was performed in triplicate and the averages and coefficient of variation were presented. The results of the affective and CATA tests were presented in the form of response frequency histograms, in which the number of responses chosen for each option of the hedonic scale, purchase intention scale, or the terms listed in the different perceptions of the CATA was counted.

The averages were also calculated for the different parameters evaluated in the acceptance test for the group of volunteers not affected by cancer.

## 3 Results and discussion

The physicochemical evaluation results can be seen in Table 1. The evaluated components in the mango ice cream (*M. indica*) were total solids, protein, lipids, carbohydrates, and ash.

**Table 1.** Chemical composition of mango ice cream (*Mangifera indica* L. cv. Bourbon).

Components	(g.100 g <sup>-1</sup> )	CV (%)
Total solids	25.75 ± 0.64	2.50
Proteins (N x 6.25)	4.60 ± 0.24	5.16
Lipids	4.18 ± 0.16	3.80
Ashes	0.60 ± 0.03	4.34
Carbohydrates	16.37	
Total energy value (kcal.100 g <sup>-1</sup> )	121.5	-

The mango ice cream produced with the addition of isolated milk protein has 4.6g of protein in 100 g of the product, that is, a higher protein content than that found by Czaikoski et al. (2016) who developed an ice cream with mango pulp with 2.2 g of protein in 100 g of the product. Proteins contribute to the development of ice cream structure, including emulsification, aeration, and body development (Souza et al., 2010).

The use of concentrated protein sources, such as powdered whey protein, in the production of ice cream has the potential to positively influence the final quality of the product by increasing the nutritional content and adding more ice cream value. Proteins are capable of promoting improvements in stability, viscosity, and air incorporation in ice cream, properties of great value for products with reduced levels of fat and/or sugars (Goff & Hartel, 2013).

Some effects already observed from the addition of whey protein in ice cream with reduced fat content were greater resistance to melting and increase in apparent viscosity, in addition to not demonstrating a significant influence on the evaluation of sensory properties of flavor and odor of ice cream (Danesh et al., 2017).

The beneficial effect of whey protein concentrate (WPC) occurs through the stimulation of protein synthesis due to the greater supply of essential amino acids. Soluble whey proteins have bioactive peptides containing a high content of essential amino acids, especially branched-chain ones, such as leucine, isoleucine, and valine, which are related to growth factors, muscle reconstruction and repair (Vasconcelos et al., 2018).

For critical cancer patients, the protein value of food is relevant, as they are in a hypermetabolic and hypercatabolic state, accompanied by proteolysis, lipolysis and neoglycogenesis. These alterations lead to a negative nitrogen balance, which is directly related to an increase in complications and mortality. Thus, in view of this catabolic response, the patient needs to receive an adequate amount of energy and proteins (Instituto Nacional de Câncer, 2016).

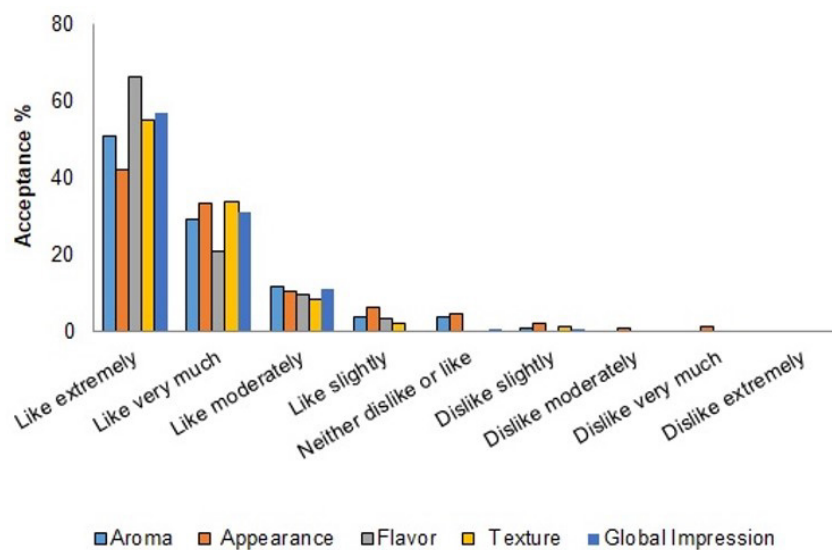
The Brazilian legislation prohibits the use of partially hydrogenated oils and fats for use in foods and foods formulated with these ingredients. This legislation generated the need to search for fat substitutes traditionally used by the industry (Brasil, 2019). Coconut oil is a more nutritious alternative to ice cream. It is capable of producing ice cream with an appearance, texture, and taste that is compatible with conventional ice cream. In addition, it is a functional food made up of medium-chain triglycerides that, when in contact with the stomach, are transformed into monolaurin – a potent antibacterial, antifungal, and antiviral agent, that is, it acts directly on immunity. It is also rich in fat-soluble vitamins (A, D, E, and K), which control cholesterol, increase HDL (good fat), and reduce LDL (bad fat). Therefore, coconut oil has anti-inflammatory and antithrombotic effects. It is considered a complementary food with numerous properties beneficial to health, strengthening the immune system, and facilitating the digestion and absorption of nutrients (Choo et al., 2010; Santos et al., 2013).

The microbiological parameter that determines the hygienic-sanitary quality of ice cream was within the acceptable parameter (Table 2) (Brasil, 2022). The hygienic and sanitary quality of food for patients undergoing chemotherapy is important due to the risk of infection due to neutropenia (reduced neutrophil count in the blood). Other factors that contribute to immunosuppression and/or risk of infection in this population include impaired integrity of mucocutaneous barriers — catheters or mucositis; type of treatment or conditioning regimens; metabolic disorders such as diabetes or uremia; the presence of immunomodulatory viruses and disruption of the microbiome (Taplitz et al., 2018). The ice cream presented satisfactory hygienic-sanitary conditions, being suitable for consumption and therefore allowing sensory analyzes to be carried out.

**Table 2.** Microbiological parameters of mango ice cream (*Mangifera indica* L. cv. Bourbon).

Pathogens	Mango ice cream	Microbiological standard (Brasil, 2022)
Enterobacteriaceae/g	< 3.0	10 NPM/g (Max)
<i>Coagulase</i> -positive staphylococci (CFU/g)	< 10	5 x 10 <sup>2</sup> CFU/g (Max)
<i>Salmonella</i> sp./25 g	Absence	Absence

The results of the first sensory evaluation of the mango-based ice cream, carried out with 157 participants not affected by cancer, are shown in Figures 1, 2 and 3. Figure 1 shows the histogram of the frequency of responses to the acceptance test with a hedonic scale, in which the value 1 corresponded to “dislike it extremely” and 9 to “like it extremely”. The analyzed variables were appearance, aroma, flavor, texture, and overall impression.



**Figure 1.** Frequency histogram of responses by tasters not affected by cancer for the mango ice cream acceptance test (n = 157).

For all attributes evaluated, more than 40% of these individuals answered “like it extremely” (>40%). Regarding the aroma variable, 91.7% of the participants reported liking the aroma of the ice cream (51.0% “like it extremely”, 29.3% “like it very much”, and 11.5% “like it moderately”), and 0.6% marked “dislike it slightly”. As for the appearance variable, the result of respondents who liked it was 85.3% (42.0% “like it extremely”, 33.1% “like it very much” and 10.2% “like it moderately”), and 3.8% disliked (1.9% “dislike it slightly”, 0.6% “dislike it moderately” and 1.3% “dislike it very much”). The flavor analysis showed a high approval rating among the participants, 96.8% (66.2% “like it extremely”, 21.0% “like it very much” and 9.6% “like it moderately”), and 3.2% marked it as “like it slightly”, with no negative results. Regarding the texture variable, 96.7% of the participants approved it (54.8% “like it extremely”, 33.7% “like it very much” and 8.3% “like it moderately”), with only 1.27% “dislike it slightly”.

In the general analysis of the global impression variable, they presented the highest positive results, with a total of 98.7% (56.7% “like it extremely”, 31.2% “like it very much” and 10.8% “like it moderately”) and 0.6% rated it as “dislike it slightly”, and 0.6% “neither dislike nor like it”.

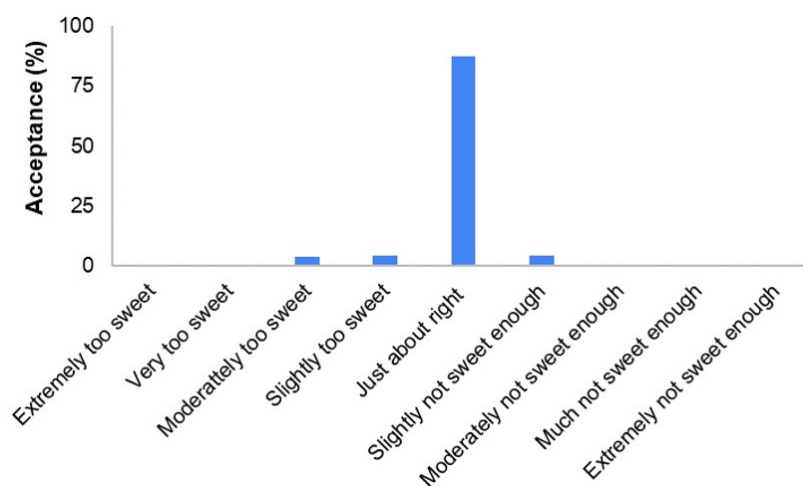
In a study carried out by Junqueira et al. (2012), it was noted that edible fruit ice cream formulations were prepared, including mango, which had the highest acceptability among the tasters, in the acceptance test 44% of the tasters who liked it moderately, the elaborated formulations and 38% of the tasters like slightly the ice cream formulations. Edible ice creams are widely consumed products in Brazil due to the tropical climate and because they please the most varied palates, comprising different age groups and social classes. Due to its sweet characteristics, and smooth and creamy texture, this product is attractive to consumers and a trade with great growth potential for the food industry (Renhe et al., 2015).

Table 3 presents the mean scores attributed by tasters not affected by cancer for the parameters evaluated in the sensory analysis of the mango ice cream formulation. The average scores of the evaluated variables of the mango ice cream were higher than those found in the literature (Junqueira et al., 2012; Czaikoski et al., 2016; Parreiras et al., 2019).

In relation to the analysis of the sweetness of mango ice cream, it could be stated that 87.3% of the tasters considered the sweetness as “just about right (JAR)” (Figure 2), and when the purchase intention was evaluated, 68.2% of participants not affected by cancer said they would certainly purchase the ice cream, and 27.4% probably would buy it (Figure 3). These results demonstrated the consumption potential of this formulation, which would be interesting from a health perspective, since the ice cream was not added with sugar, relying only on the degree of sweetness of the ripe mango.

**Table 3.** Mean scores assigned by tasters not affected by cancer of the mango ice cream formulation (n = 157).

Evaluated parameters	Grade point average
Appearance	7.87
Aroma	8.17
Flavor	8.50
Texture	8.30
Global impression	8.40

**Figure 2.** Evaluation of the ideal sweetness level of mango ice cream by tasters not affected by cancer (n=157).

Sugars give body and texture to the ice cream, increasing the viscosity and representing 25% of the amount of total solids. Its main purpose is to provide a pleasant flavor to ice cream, increasing its acceptability by consumers. Sucrose is the most used type of sugar among traditional ice creams, in addition to being the most commonly used sugar in food (Cadena, 2008). However, in the human organism, sugar is converted into energy through reactions that can lead to the depletion of vitamins such as thiamine, niacin, and riboflavin, necessary for the oxidation of glucose.

High intake of added sugars favors the development of health problems, including nutritional deficiencies, dental caries, arterial hypertension, type 2 diabetes, cardiovascular diseases, metabolic syndrome, and non-alcoholic fatty liver disease (Braz et al., 2019). Debras et al. (2020) found that sugar consumption is associated with a higher risk of cancer, especially breast cancer. The same study points out that sucralose, sugary drinks, and milk-based desserts are associated with an increased risk of breast cancer. Therefore, it is recommended to reduce or completely restrict sugar consumption.

Figure 3 shows the evaluation of purchase intention for mango ice cream performed by tasters not affected by cancer.

Regarding purchase intention, it could be noted that 68.15% (n = 107) of the tasters would buy the mango ice cream according to this assessment. In addition, 27.38% (n = 43) probably would buy it. Only 4.45% of the tasters probably would not buy the product. Certainly, the study indicated that the mango ice cream sales would do well.

Figure 4 shows the results of the sensory perceptions reported by the 75 patients undergoing chemotherapy performed at the Cancer Hospital in Cuiabá (MT). The most frequent terms were yellow color (79%), creamy (74%), sweet (69%), mango aroma/flavor (61%), passion fruit aroma/flavor (51%), and firm (39%).

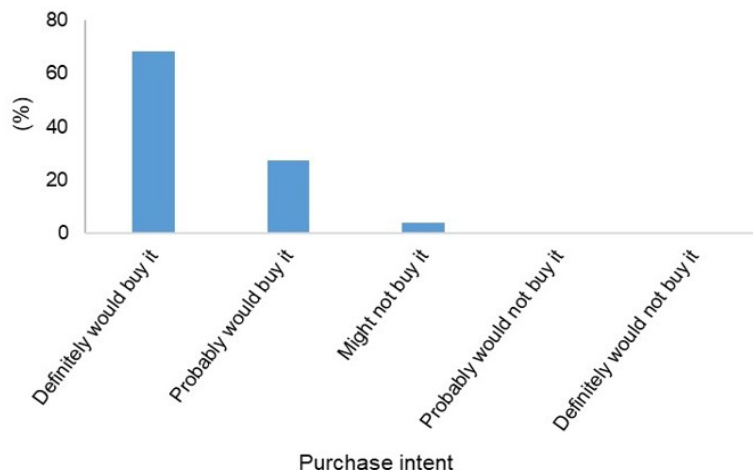


Figure 3. Evaluation of purchase intention for mango ice cream performed by tasters not affected by cancer (n = 157).

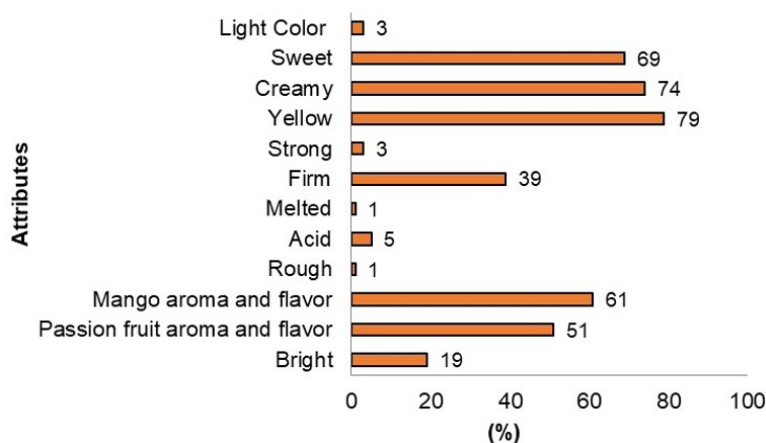


Figure 4. Frequency of responses chosen in the CATA test for sensory perceptions by patients undergoing chemotherapy (n = 75).

When observing perceptions of well-being, it is noticed that the terms “it is healthy and nutritious”, “it is good to share with family/friends”, “makes me feel good”, and “makes me feel happy” stand out, with percentages of responses ranging from 68 to 87%; while the terms “makes me feel bad”, “it is nauseating”, “makes me feel sad” had only 1% of the answers. This result indicates that the product was pleasant for patients (Figure 5).

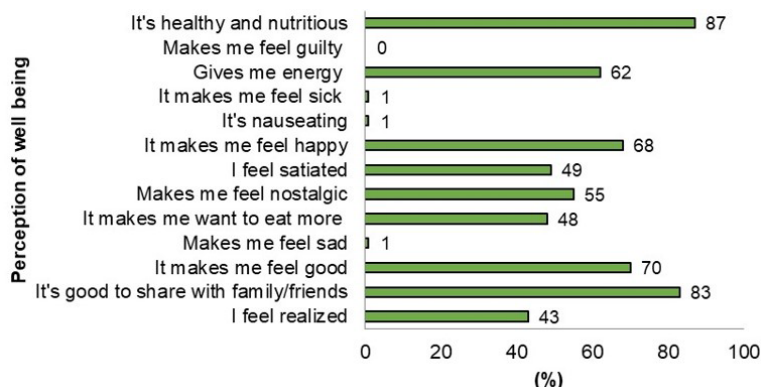
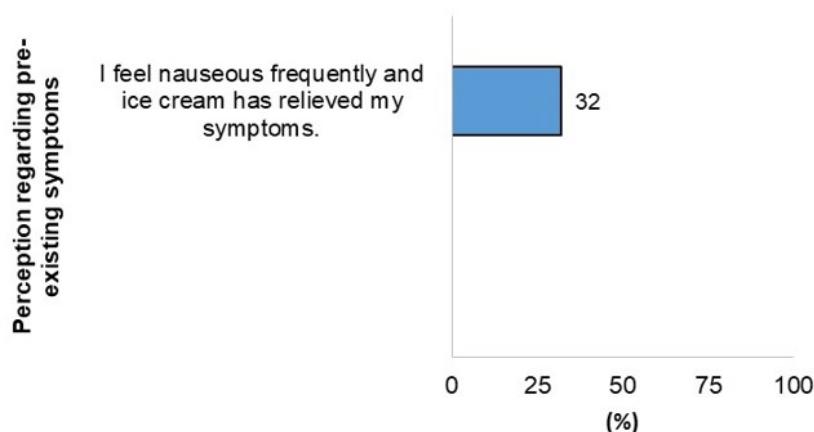


Figure 5. Frequency of responses chosen in the CATA test for perceptions of well-being by patients undergoing chemotherapy (n = 75).



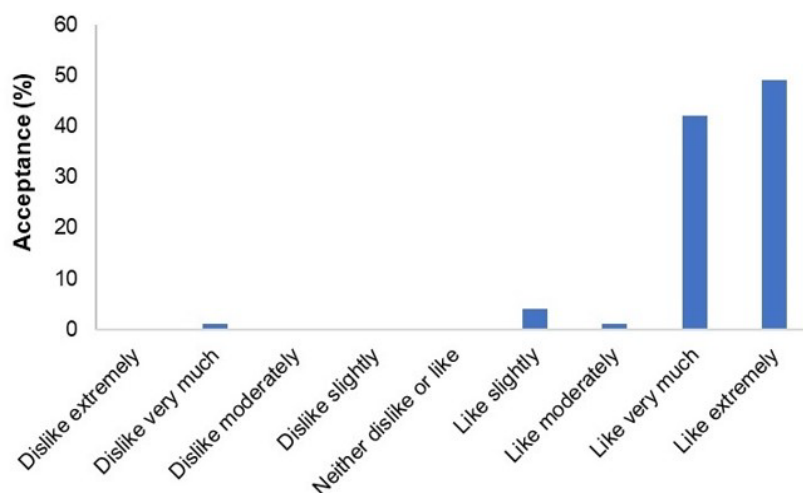
Regarding the perception of pre-existing symptoms, two aspects were evaluated “I feel nauseous frequently and the ice cream relieved the symptoms” and “I have a sore in the mouth and the ice cream relieved the symptoms”. Of the 75 participants, no one claimed to have a sore in the mouth, however, 32% (n = 24) stated that the ice cream relieved their symptoms who felt nauseous (Figure 6). To manage nausea and vomiting, patients undergoing chemotherapy report consuming cold foods such as ice cream and a preference for fruits, sour juices, and ginger drinks and keeping sour fruits in the mouth (Phianmongkol & Suwan, 2008).



**Figure 6.** Frequency of responses about perception regarding pre-existing symptoms by patients undergoing chemotherapy (n = 75).

Studies have shown that oral lesions resulting from chemotherapy can be prevented or attenuated with cryotherapy, which is the therapeutic use of ice or frozen foods. Cold foods or ice attenuate mucositis as they cool the temperature of the oral mucosa, which leads to vasoconstriction, activates mechanisms to preserve core body heat and a decrease in drug circulation in the oral mucosa. In this way, it prevents the chemotherapeutic agent from reaching the oral tissues in large quantities, reducing local toxicity and severity of damage to the mucosa.

Figure 7 shows the frequency of responses to the acceptance test with a hedonic scale of patients undergoing chemotherapy (n = 75), in which the value 1 corresponded to “dislike it extremely” and 9 to “like it extremely”.



**Figure 7.** Frequency of responses in the acceptance test performed by patients undergoing chemotherapy (n = 75).

The values for the term “like it extremely” corresponded to almost 50% of the 75 patients who responded to the survey or rather, more than 90% of respondents responded that they liked the product presented to them very much or extremely. Eating foods from a common diet provides a sense of autonomy and normality to patients undergoing chemotherapy. Ice cream is tasty, familiar, and acceptable food, as it is safe and can be nutritionally adequate. Soft ice creams, dense in energy and proteins can be an important addition to their diet.

This study had some limitations seeing that it was carried out in just one reference center for cancer treatment in a municipality, which prevents the generalization of the results. Furthermore, a cross-sectional design was used, which did not allow the monitoring of patients undergoing chemotherapy treatment for a period sufficient to identify the presence of symptoms not expressed at the time of the mango ice cream acceptability test. For example, not all patients reported symptoms such as nausea at the time of sensory analysis. Therefore, the result found regarding the relief of symptoms provided by ice cream could be more evident if the patients had been followed up for a period. However, a strong point is the fact that the study proved the healthiness and sanity of consuming ice cream, which is a well-accepted food, bringing benefits to patients undergoing chemotherapy treatment. Still, above all, it used a fruit that has a regional and comfort food appeal, since for many patients, consuming mango ice cream brought back memories of their childhood.

## 4 Conclusion

In this study, it was developed a sugar-free mango ice cream added with whey protein and coconut oil, and its acceptability by tasters not affected by cancer and by patients undergoing chemotherapy was investigated. The mango ice cream was evaluated with high acceptability by both groups and it had hygienic-sanitary quality within the acceptable for the legislation. In addition, it can be said that it has properties beneficial to health due to the high content of fruit pulp, 4.6% proteins, and the non-addition of sugar in its composition.

The mango ice cream demonstrated the ability to provide a sense of well-being and mildly alleviate uncomfortable symptoms during chemotherapy treatment in patients undergoing chemotherapy who participated in the affectivity test. It presented an excellent way to encourage the consumption of mango, a typical fruit of Mato Grosso culture.

## Acknowledgements

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