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# Elaboração de néctar misto de manga e maracujá

# Elaboration of mixed nectar of mango and passion fruit

# Elaboración de néctar de mango mixto con maracuyá

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**Resumo**

As bebidas compostas por mais de uma fruta são uma tendência no mercado nacional e internacional, apresentando vantagens como maior valor nutricional e desenvolvimento de novos sabores. Assim, o objetivo foi elaborar seis formulações de néctar misto de manga e maracujá, variando a porcentagem de cada polpa e teor de sólidos solúveis, além de avaliar suas propriedades físico-químicas, microbiológicas, sensoriais e estabilidade. Os néctares foram preparados pelo processo de enchimento a quente e acondicionados em frascos de vidro de 500 ml, sendo então submetidos às análises. Os néctares apresentaram pH entre 2,86 ± 0,05 e 3,33 ± 0,15, sólidos solúveis de 10,00 a 14,83 ºBrix, acidez de 0,59 a 0,78g de ácido cítrico / 100g de néctar e vitamina C de 15,36 a 33,66 mg / 100g. As análises microbiológicas apresentaram valores de acordo com a legislação vigente. As formulações estavam dentro da zona de aceitação sensorial para os provadores, com um equilíbrio nos atributos avaliados. F4 (10g de maracujá e 20g de manga) foi escolhido entre as formulações devido maior aceitação e utilização de menor porcentagem de maracujá, reduzindo o custo do produto. Em relação à estabilidade, nenhum dos atributos sensoriais apresentou diferença no intervalo de 150 dias; no entanto, para os atributos físico-químicos, observou-se diferença no pH, acidez total, vitamina C e sólidos solúveis totais. Diante disso, faz-se necessário uma melhor avaliação das características físico-químicas, com o intuído de elevar o índice nutricional do produto.

**Palavras-chave:** Frutas tropicais; Suco de fruta; Formulação; *Blends.*

**Abstract**

Drinks composed of more than one fruit are a trend in the national and international market, presenting advantages such as greater nutritional value and the development of new flavors. So, the objective was to elaborate six formulations of mixed nectar of mango and passion fruit, varying the percentage of each pulp and soluble solids content, as well as evaluating its physicochemical, microbiological, sensorial and stability properties. The nectars were prepared by the hot fill process and packed in 500 ml glass bottles, and then submitted to the analyzes. The nectars presented pH between 2.86±0.05 and 3.33±0.15, soluble solids of 10.00 to 14.83 ºBrix, acidity of 0.59 to 0.78g acid citric/100g nectar, and vitamin C from 15.36 to 33.66 mg/100g. The microbiological analyzes presented values according to the current legislation. The formulations were within the sensory acceptance zone for the tasters, with a balance in the evaluated attributes. F4 (10g of passion fruit and 20g of mango) was chosen among the formulations due to greater acceptance and use of a lower percentage of passion

fruit, reducing the cost of the product. In relation to the stability, none of the sensorial attributes presented differences in the interval of 150 days, however, for the physical-chemical attributes, it was observed difference in pH, total acidity, vitamin C and total soluble solids. Therefore, it is necessary to better assess the physical and chemical characteristics, with the intention of increasing the nutritional index of the product.

**Keywords:** Tropical fruits; Fruit juice; Formulation; *Blends*.

**Resumen**

Las bebidas compuestas por más de una fruta son tendencia en el mercado nacional e internacional, presentando ventajas como un mayor valor nutricional y el desarrollo de nuevos sabores. Así, el objetivo fue elaborar seis formulaciones de néctar mixto de mango y maracuyá, variando el porcentaje de cada pulpa y contenido de sólidos solubles, además de evaluar sus propiedades físico-químicas, microbiológicas, sensoriales y de estabilidad. Los néctares se prepararon mediante el proceso de llenado en caliente y se colocaron en matraces de vidrio de 500 ml, y luego se sometieron a análisis. Los néctares mostraron un pH entre 2.86 ± 0.05 y 3.33 ± 0.15, sólidos solubles de 10.00 a 14.83 º Brix, acidez de 0.59 a 0.78 g de ácido cítrico / 100 g de néctar y vitamina C de 15.36 a 33.66 mg / 100g. Los análisis microbiológicos mostraron valores de acuerdo con la legislación vigente. Las formulaciones estaban dentro de la zona de aceptación sensorial para los catadores, con un equilibrio en los atributos evaluados. Entre las formulaciones se eligió F4 (10g de maracuyá y 20g de mango) por mayor aceptación y uso de un menor porcentaje de maracuyá, reduciendo el costo del producto. Con respecto a la estabilidad, ninguno de los atributos sensoriales mostró una diferencia en el intervalo de 150 días; sin embargo, para los atributos fisicoquímicos, hubo una diferencia en el pH, la acidez total, la vitamina C y los sólidos solubles totales. Por tanto, es necesario evaluar mejor las características físicas y químicas, con la intención de elevar el índice nutricional del producto.

**Palabras clave**: Frutas tropicales; Jugo de fruta; Formulación; Mezclas.

## 1. Introduction

Brazil has a prominent role in fruit growing, due to the great variety of fruits produced in all regions of the country, however, due to perishability, much of it is lost during transportation and storage (Lima, Silva, Ferreira, Nunes, & Carvalho, 2018). However, studies indicate that Brazilians consume a quantity of fruit below the values recommended by

the World Health Organization (WHO). The suggested amount is 400 g/day, with minimum consumption of five days of the week. Therefore, the expansion of this market is extremely necessary, especially for processed fruit, which is an option for consumers. Fruit juices, pulps and nectars are among the highlights, which besides being a good nutritional source, help reduce waste and can also bring economic returns to farmers (Owolade et al., 2017).

A trend in the world market for fruit drinks, which has also attracted consumers, are those based on fruit blends or inclusion of functional components, because in addition to increasing the nutritional value, they still bring health benefits (Lima et al., 2018; Moura, Figueirêdo, & Queiroz, 2014; R. M. da Silva, Figueirêdo, Queiroz, & Feitosa, 2016; Zheng et al., 2017).

Mixed nectar is the drink obtained from the dilution in drinking water of the mixture of edible parts of plants, their extracts or a combination of both, and added sugars, for direct consumption, with or without acid addition (Brasil, 2003). Among these are cashew, mango and acerola (L. M. R. Silva et al., 2017) pineapple juice with fruit pulp (cupuassu, taperebá and guava) (D. C. S. Silva, Braga, Lourenço, Rodrigues, & Peixoto Joele, 2017) imbu and mangaba (Lima et al., 2018);  nda c and grape (Tomaz, Ferreira, Mesquita, & Oliveira Filho, 2019);  nda ca  nda cai, added with fructo oligosaccharides (Jesus, Ferreira, Santos, Silva, & Carvalho, 2019); pineapple and green tea (Alvarenga, Abreu, Pereira, & Lemos, 2016).

So, the mixture of different fruits has been studied in order to improve the physical, chemical and nutritional characteristics (Curi et al., 2017; Sousa et al., 2014). Some of them have a higher percentage of one nutrient in relation to others, making it favorable for their concentration in a single product, as is the case of the mango-passion fruit mixture, due to an increase in vitamin C, in relation to nectars containing only one fruit (R. M. da Silva et al., 2016; Sousa et al., 2014).

The yellow passion fruit (*Passiflora edulis*) is native from South America, and Brazil is the world's largest producer, and despite having a great demand for the fresh fruit market, this species is also used in the production of jams, sweets, ice cream and juices (Gomes et al., 2019). *Passiflora edulis* is widely appreciated due to its organoleptic characteristics, in addition to having antioxidant, antimicrobial, anti-diabetic and neuroprotective effects (Rotta, Rodrigues, Jardim, Maldaner, & Visentainer, 2019).

Mango (*Mangifera indica L*) is one of the most important and popular tropical fruits in the world, due to its pleasant smell and high nutritional value (Wang, Liu, Xie, & Sun, 2020). It is rich in macro and essential phytonutrients, and is usually converted into juices, jams, nectar and candies (Adedeji & Ezekiel, 2020).

Thus, the objective was to develop mixed nectar formulations of mango and passion fruit and to perform the physicochemical, microbiological, sensorial and stability characterization.

## 2. Material and Methods

The processing of the mixed nectars of passion fruit and mango as well as the physicochemical analyzes, sensorial and microbiological analyses were conducted in the laboratories of Vegetable Technology, Food Chemistry, Sensory Analysis, and Microbiology, of Food Engineering course of the Federal University of Maranhão, Imperatriz, Maranhão.

This work consists of qualitative laboratory research (Pereira, Shitsuka, Dorlivete Moreira Parreira, & Shitsuka, 2018), through physical-chemical, microbiological and sensory analyzes based on the methodologies cited below.

The research project was registered at Brazil Platform and approved by the Research Ethics Committee under number 3.641.514.

### 2.1 Ingredients

The nectars were formulated with pasteurized and frozen pulp, mineral water and commercial sucrose, purchased from local commerce in the city of Imperatriz, Maranhão.

### 2.2 Product formulation

Six formulations of mixed nectars of mango and passion fruit were prepared using as variables the pulp concentration and the total soluble solids content (Table 1). The quantities of pulp were based on the current legislation for fruit nectar, which is prescribed in Art. 3 of Normative Instruction nº. 12 of September 4, 2003, of MAPA (Ministry of Agriculture, Livestock, and Supply). In addition to the legislation, the formulations were based on a previous study of the literature on mixed tropical fruit nectars (R. M. da Silva et al., 2016).

To obtain the nectars, the pulps were thawed under refrigeration, weighed and diluted according to the formulations described in Table 1, in water and then mixed with sugar, and then homogenized in a domestic blender (KD Eletro – Brand: LAR-2) for one minute.

**Table 1** - Formulations of the nectars according to the amounts of soluble pulp and solid

| Formulations | Amount of pulp (g/100ml) | | Soluble solids (°Brix) |
|---|---|---|---|
| | Passion fruit | Mango | |
| **F1** | 10 | 20 | 11 |
| **F2** | 15 | 25 | 11 |
| **F3** | 10 | 30 | 11 |
| **F4** | 10 | 20 | 13 |
| **F5** | 15 | 25 | 13 |
| **F6** | 10 | 30 | 13 |

Source: Authors.

Then, the nectars were submitted to pasteurization (90 °C for the 60 s) in aluminum pots in conventional stoves (PROGÁS). The container was hotly filled, manually with shells in 500 ml glass bottles previously sterilized and closed with plastic lids. Subsequently, the nectars were cooled in ice water to room temperature (25ºC) and kept under refrigeration at 7 to 10 °C until physicochemical, microbiological and sensory analyses were performed.

### 2.3 Physicochemical analysis

The physicochemical characterization of the nectars was carried out by pH, soluble solids (ºBrix), titratable acidity (ml/100ml) and vitamin C content (ml/100ml), and compared to the identity and quality standards established by normative instruction nº. 01 of January 7, 2000 (Brasil, 2000). All physicochemical analyzes were performed in triplicate, according to the methods recommended by Instituto Adolfo Lutz (IAL, 2008).

### 2.4 Microbiological analysis

The microbiological evaluation was carried out as determined by RDC Resolution nº. 12, dated January 2, 2003 (Brasil, 2003) and normative instruction nº. 01, of January 7, 2000 (Brasil, 2000), in triplicate and using the most probable number per gram of sample (NMP $g^{-1}$) of total coliforms and coliforms at 45°C (term tolerant) and the number of colonies forming units (CFU) of molds and yeasts using the methodologies indicated by (APHA, 2015).

**2.5 Sensory analysis**

Sensory evaluation was performed with 80 untrained testers, of both genders, and of different age groups. It was used a structured hedonic scale of 9 points, being 1 highly disagreeable and 9 liked very much to evaluate flavor, color, body, aroma, appearance and overall impression, besides purchase intention, according to the method described by Stone & Sidel (2004).

**2.6 Stability test**

With the formulation best accepted in sensory analysis, a stability test was carried out for 150 days with microbiological, physical-chemical and sensory analyzes every month.

**2.7 Statistical analysis**

For the evaluation of the results of the sensory analysis, a randomized block experiment was used, where the mixed nectar and passion fruit nectar were treatments (1, 2, 3, 4, 5 and 6) and the tasters were the blocks that the evaluated variables were: color, aroma, flavor, body, appearance, overall impression and purchase intention. Shapiro-Wilk normality tests and Bartlett's homogeneity tests of variance were performed, both at 5% significance to verify the possibility of performing Variance Analysis in randomized blocks.

These assumptions were rejected in all cases, so the Friedman nonparametric test (more than two dependent samples) was used at 5% significance, where there are no assumptions about the data distribution, as described in Gibbons & Chakraborti (2010). The significantly different variables among the samples followed the Dunn test at 5% significance. All data were tabulated in the Excel 2013 worksheet and the tests performed in the SAS program (SAS Institute Inc., 2004).

A completely randomized design experiment was used to evaluate the stability of sensory attributes (color, aroma, taste, viscosity, acidity, sweetness, overall impression) and the attitude of purchase of passion fruit and mango nectar. Every month a sensorial analyzes were performed between 0 and 150 days.

Also, the physicochemical characteristics (ºBrix, pH, Vit C, Acidity, Total Sugar, Reducing Sugar and Non-Reducing Sugar) were studied for the stability too (0, 30, 60, 90, 120 and 150 days) for the best formulation. The stability was evaluated by means of the

regression analysis at 5% significance using the procedure (PROC REG) of the statistical package SAS (SAS Institute Inc., 2004). Only models of up to third degree (cubic) with a coefficient of determination ($R^2$) above 0.70 were considered.

## 3. Results and Discussion

Table 2 shows the physicochemical characterization of mixed mango and passion fruit nectars.

**Table 2** - Mean values of physicochemical determinations of the six formulations of mixed nectar of mango and passion fruit

| Formulations | pH | Total soluble solids (°Brix) | Titratable total acidity (ml/100ml) | Vitamin C (ml/100ml) |
|---|---|---|---|---|
| **F1** | 3.14±0.32 | 12.20±0.26 | 0.62 ±0.01 | 19.61±0.00 |
| **F2** | 3.33±0.15 | 11.53±0.25 | 0.78±0.03 | 15.36±5.03 |
| **F3** | 3.27±0.22 | 10.00±0.00 | 0.62±0.03 | 33.66±5.03 |
| **F4** | 2.94±0.01 | 14.83±0.29 | 0.59 ±0.04 | 26.14±11.32 |
| **F5** | 2.90±0.01 | 14.07±0.11 | 0.74±0.02 | 19.61±9.80 |
| **F6** | 2.86±0.05 | 14.83±0.29 | 0.74±0.03 | 19.61±0.00 |

Values given on average of 3 replicates ± standard deviation.
F1: 10g passion fruit/20g mango; F: 15g passion fruit/25g mango; F3: 10g passion fruit/30g mango; F4: 10g passion fruit/20g mango; F5: 15g passion fruit/25g mango; F6: 10g passion fruit/30g mango.
Source: Authors.

Considering that the formulations were processed with 30 to 40 g/100ml of water and with a higher percentage of mango pulp comparing with the passion fruit, the results were satisfactory and were within the acid range (below 4.5), in accordance with the legislation, which establishes a pH of 2.7 to 3.8 for the passion fruit pulp and 3.3 to 4.5 for the mango pulp, contributing to the food safety of the elaborated nectars.

The soluble solids values of the formulated nectars ranged from 10 to 11.53 °Brix (Table 2) for the formulations standardized to 11 °Brix (F1, F2, and F3), but F3 (10g/100ml of passion fruit and 30g/100ml of mango) did not reach an expected result, being below the established values legislation and also standardization. On the other hand, F4 (10g/100ml of passion fruit and 20g/100ml of mango), F5 (15g/100ml of passion fruit and 25g/100ml of mango), and F6 (10g/100ml of passion fruit and 30g/100ml of mango) obtained the highest

averages, varying from 14.07 to 14.83, justified by the initial standardization at 13 °Brix. This increase can be explained by the pasteurization stage, because as the nectar is subjected to high temperatures, the solids may undergo a change in concentration. The minimum values established by the legislation for pulps and nectars of mango and passion fruit are at least 10 °Brix for mango nectar and 11 °Brix for passion fruit nectar.

For titratable acidity, the values varied from 0.59 to 0.78 g citric acid/100g nectar in the six formulations elaborated, being within the established by the legislation for mango nectar and passion fruit nectar, having at least 0.20 and 0.25 for mango and passion fruit nectar, respectively. The legislation does not establish a maximum value.

Considering the physicochemical results, it can be stated that they are within the limits established by the legislation. Observing F4, it can be seen that even containing the lowest total acidity value, is still high in relation to the values found by some authors in their studies (Fonseca, 2014), where the titratable total acidity of the mixed nectars studied ranged from 0.22 to 0.48g of Citric acid/100g. It can be justified by the amount of passion fruit pulp, even not exceeding 15 g/100ml.

The titratable total acidity is related to pH, since, in high quantities, it prevents the proliferation of pathogenic microorganisms, besides dispensing the use of acids (Lima et al., 2018). However, most fruits that have high acidity, have low acceptance for natural consumption. On the other hand, high acidity is a suitable characteristic for the pulp agroindustry, since it dispenses with the use of organic acids, a conservation method commonly used to avoid the development of microorganisms (Gomes et al., 2019). Therefore, it is believed that the values found for titratable acidity in the six formulations of mixed nectars of mango and passion fruit were satisfactory.

F4 was the one that obtained the lowest mean titratable acidity, being justified as one of the formulations with a lower content of mango pulp in its composition (20 g/100ml). F2 (15g/100ml of passion and 25g/100ml of mango), F5, and F6 obtained higher values since they contained higher levels of mango pulp in their composition.

The vitamin C values are between 15.36 to 33.66 ml/100 ml. The formulation F3 presented higher content since they contained 30% of mango pulp, consequently, those with a lower percentage of pulp had lower vitamin C values.

Based on the legislation, which recommends the daily intake of vitamin C of 45mg for adults (ANVISA, 2012), the values found in this research are close to what is recommended by the legislation. According to some authors (Manasa, Ravali, Bargavi, Mounica, & Prasanna, 2019), vitamin C is a compound extremely unstable to the processing, mainly the

action of heat and oxidation, so the low concentration of this nutrient observed in the mixed nectars can be due to losses occurred during the pasteurization and storage, in addition to the fact that the pulps used have already been pasteurized, further favoring the loss of vitamin C from the elaborated nectars.

No evidence of coliforms was observed at 35ºC, indicating that all samples were in accordance with RDC nº.12 (Brasil, 2001), where it is established that refrigerants and other ready-to-drink liquid compounds, soft drinks, juices, and nectars added or not of frozen preservatives or should not be indicative of "absence" tolerance in all samples.

In relation to molds and yeasts, all the samples evaluated are in the range of $10^2$ to $10^3$, being in accordance with ordinance 451 of the Ministry of Health, dated September 19, 1997 (ANVISA, 1997) regulates microbiological standards for: frozen concentrated juices, juices and preservatives, prepared for soft drinks and soft drinks, concentrated juices with or without preservatives, pulps and fruit products.

The legislation of mold and yeasts establishes values between $10^2$ and $10^4$ CFU/ml as maximum permissible. Therefore, it can be affirmed that the processing of the nectars was carried out in a correct and efficient way, thus guaranteeing the hygienic-sanitary conditions of the final products.

In the sensory analysis, 44 tasters of the nectars were female, with ages ranging from 18 to over 50 years, with 64 being in the category of 18 to 25 years. This is due to the fact that the sensorial analysis was carried out at the Federal University of Maranhão, where most of the evaluators are students of the institution, followed by employees and visitors.

The sensorial attributes that showed significant differences among the samples were flavor, overall impression and purchase intention (Table 3 and 4).

**Table 3 -** Mean values ± standard deviations of the attributes related to the sensorial analysis of mango and passion fruit nectars.

| Formulations | Color | Flavor | Taste | Body | Appearance |
|---|---|---|---|---|---|
| **F1** | 7.76 ± 1.02$^{a}$ | 7.39 ± 1.44$^{a}$ | 7.40 ± 1.30$^{ab}$ | 7.30 ± 1.34$^{a}$ | 7.70 ± 1.01$^{a}$ |
| **F2** | 7.83 ± 0.92$^{a}$ | 7.19 ± 1.31$^{a}$ | 6.21 ± 1.58$^{d}$ | 7.04 ± 1.43$^{a}$ | 7.46 ± 1.12$^{a}$ |
| **F3** | 7.96 ± 1.22$^{a}$ | 7.45 ± 1.32$^{a}$ | 6.49 ± 1.83$^{cd}$ | 7.06 ± 1.53$^{a}$ | 7.70 ± 1.19$^{a}$ |
| **F4** | 8.00 ± 0.95$^{a}$ | 7.50 ± 1.48$^{a}$ | 7.75 ± 1.33$^{a}$ | 7.50 ± 1.37$^{a}$ | 7.80 ± 1.23$^{a}$ |
| **F5** | 7.69 ± 1.26$^{a}$ | 7.30 ± 1.36$^{a}$ | 7.15 ± 1.47$^{bc}$ | 7.35 ± 1.33$^{a}$ | 7.76 ± 1.00$^{a}$ |
| **F6** | 7.79 ± 1.01$^{a}$ | 7.48 ± 1.33$^{a}$ | 7.51 ± 1.51$^{ab}$ | 7.41 ± 1.35$^{a}$ | 7.85 ± 1.04$^{a}$ |

Means with different letters in the same column differed statistically ($p < 0.05$) by the Dunn mean test.
F1: 10g passion fruit/20g mango; F: 15g passion fruit/25g mango; F3: 10g passion fruit/30g mango; F4: 10g passion fruit/20g mango; F5: 15g passion fruit/25g mango; F6: 10g passion fruit/30g mango
Source: Authors.

In relation to flavor, F4 presented a higher value than F2, F3, and F5, but did not differ from F1 and F6, which did not differ from each other or in relation to F5 (Table 4). The nectars with the lowest value of passion fruit pulp were those that received the highest flavor notes, according to the results obtained (Table 4).

**Table 4 -** Mean values ± standard deviations for the global impression and purchase intention related to the sensory analysis of mango and passion fruit nectars.

| Formulations | Global impression | Purchase intention |
|---|---|---|
| **F1** | 7.45 ± 1.03$^{ab}$ | 3.72 ± 0.99$^{ab}$ |
| **F2** | 6.96 ± 1.13$^{c}$ | 3.15 ± 0.94$^{c}$ |
| **F3** | 7.10 ± 1.36$^{bc}$ | 3.14 ± 1.27$^{c}$ |
| **F4** | 7.74 ± 1.13$^{a}$ | 4.01 ± 1.02$^{a}$ |
| **F5** | 7.46 ±1.02$^{ab}$ | 3.54 ± 1.05$^{bc}$ |
| **F6** | 7.56 ± 1.08$^{ab}$ | 3.66 ± 1.05$^{ab}$ |

Means with different letters in the same column differed statistically ($p < 0.05$) by the Dunn mean test.
F1: 10g passion fruit/20g mango; F: 15g passion fruit/25g mango; F3: 10g passion fruit/30g mango; F4: 10g passion fruit/20g mango; F5: 15g passion fruit/25g mango; F6: 10g passion fruit/30g mango
Source: Authors.

According to some authors (de Oliveira Rocha & Bolini, 2015), the striking aroma of passion fruit stands out in the aroma of mixed nectar, significantly affecting the grades given to samples with the highest content of passion fruit juice. Most of the notes attributed to the

flavor attribute of the nectars are within the acceptance zone. Averages ranged from 6.21 to 7.75. The formulation F4, which contained 10g/100ml of passion fruit pulp and 30g/100ml of mango pulp, may justify the greater acceptance and preference of the tasters.

As for the overall impression, it was verified that F4 presented a value greater than F2 and F3, but did not differ from F1, F5, and F6, and these did not differ between themselves and nor with respect to F3. In general, the average of the nectars remained in the acceptance range of the hedonic scale (6.96 to 7.74) "I liked it slightly" and "I liked it moderately".

Concerning the purchase intention, it was observed that F4 presented a value higher than F2, F3, and F5, but did not differ from F1 and F6, and these did not differ between themselves and neither in relation to F5. Demonstrating that the requirement taken in greater consideration by consumers is the taste at the time of the purchase decision. Already F5 did not differ from F2 and F3. Thus, it can be concluded that the formulation F4 is one of the preferred by consumers, with grades varying between 3.14 and 4.01, for a scale where 1 represents "certainly would not buy" and 5 "certainly buy."

In the present study, it was observed that the higher the average acceptance in relation to the flavor, the higher the percentage in relation to the purchase intention. Concluding that the flavor is a determining factor in the time of the decision of purchase of the consumers.

The formulations that had higher averages in the acceptance zones were F1 with 49.6 and F4 with 54, both elaborated with 30g/100ml of pulp, being 10g/100ml of passion fruit, emphasizing that nectars with lower content of passion fruit pulp are better accepted, a very relevant point, because reducing the quantity of raw material has a more economical product that meets the legislation as well as the taste of consumers. Already the other sensorial attributes like color, aroma, appearance, and body, had means in the zone of acceptance.

Thus, choosing F4 as the best accepted formulation, stability tests were performed. During the 150 days studied, the products remained in compliance with the legislation on the required microbiological standards. In sensory analyses, neither the sensory attributes or the buying attitude differed according to the time.

As for the stability of the physical-chemical characteristics (Table 5), the SST showed a significant quadratic behavior ($y = 0{,}0002x^2 – 0{,}0308x + 13{,}79$; $R^2 = 0{,}3696$), pH increased with time ($y=0{,}0004x+3{,}25$; $R^2 = 0{,}1158$), however, it still remained within the Identity and Quality Standards for juices, in Normative Instruction nº37 (MAPA, 2020). Vitamin C ($y = -0{,}00694x + 37{,}59$; $R^2 = 0{,}3270$) and total acidity decreased over time, with models, being similar to the result observed by (Tomaz et al., 2019), who found a reduction in acidity during the storage of grape néctar. Such reduction can be justified by its sensitivity through

processing and storage (Barbalho, Otoboni, Marinelli, Bezerra, & Meneghini, 2016; Kaur & Aggarwal, 2015). The other variables did not change during the studied period.

**Table 5** - Regression analysis of the physicochemical characteristics according to the time of minimally processed products.

| | Linear | | Quadratic | |
|---|---|---|---|---|
| | **p-value** | **$r^2$** | **p-value** | **$r^2$** |
| **TSS** | 0.72 | 0.39% | <0.001 | 36.96% |
| **pH** | 0.04 | 11.58% | 0.12 | 11.99% |
| **Vitamin C** | <0.001 | 32.70% | <0.001 | 53.65% |
| **Total Acidy total** | <0.001 | 34.80% | <0.001 | 42.34% |
| **Total Sugar** | 0.77 | 0.26% | 0.96 | 0.26% |
| **Reducing Sugar** | 0.32 | 2.87% | 0.55 | 3.57% |
| **Non-Reducing Sugar** | 0.79 | 0.21% | 0.94 | 0.39% |

Source: Authors (2018).

## 4. Final Considerations

The results of the physicochemical analyses (pH, soluble solids, titratable acidity, and vitamin C) were considered to be satisfactory according to the legislation requirement standard for fruit nectars. The pH analysis revealed that all the samples presented values lower than 4.5, characterizing them as acidic and that the nectars were within the standards established by the legislation in force in Brazil. In the microbiological analyzes, no presence of coliforms was detected at 35 ºC, indicating that all samples were in accordance with the legislation. The same happened for mold and yeast counts. Noting the effectiveness of the processing once the counts performed are within sanitary standards. The sensory analysis (color, aroma, body, and appearance) was within the range of acceptance (“I liked it slightly and” “I liked it very much"), showing important results in the development of mixed nectars and nectars in general. Among the six formulations analyzed, F4 containing 10g/100ml passion fruit pulp and 20g/100ml of mango, with 13 °Brix, had the highest averages in most sensory parameters (color, aroma, taste, body, appearance, overall impression and purchase intention), and in the three parameters that had significant differences between the samples (taste, overall impression and purchase intention), it obtained the highest average among the others, and was therefore chosen as the best of the 6 formulations prepared. Regarding stability, no difference was found between sensory attributes, but in relation to physical-

chemical analyzes, pH, total soluble solids, Vitamin C and total acidity showed a significant difference during the 150 days. Therefore, further analysis would be necessary to ascertain the quality of the product through storage, since there was a significant reduction in some properties.

## Conflicts of interest

All authors declare no competing interests.

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