

PHYSICOCHEMICAL PROPERTIES AND ACCEPTANCE OF JELLY AND NECTAR OF ARAZA AND PAPAYA

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The main objective of this work was to evaluate the acceptance of jelly and nectars made from araza (*Eugenia stipitata* Mc Vaugh) and papaya. The following percentages of araza and papaya were, respectively, used: 50:50; 40:60; 30:70 and 20:80. For both pulps and products the variables studied were: acidity, pH, total content of soluble solids. Acceptance tests were conducted for the developed products. An inverse relation was observed between the papaya proportion and the soluble solids content and titratable acidity. The jelly made with skin araza presented higher levels of soluble solids, higher pH and lower titratable acidity compared with those obtained with fruit without the peel. Higher concentrations of papaya pulp improved the acceptance of nectar and jelly in all formulations. It was observed an increased in the acceptance when using araza with skin, until levels of 45% of papaya for the jelly and 24% for the nectar. This was probably due to specific sensorial attributes of the araza skin and it is an indicator for future researches.

Key words: *Eugenia stipitata*, *Carica papaya*, sensorial analysis.

Propriedades físico-químicas e aceitação de geléia e néctar de araçá e mamão.

O objetivo deste trabalho foi avaliar a aceitação de geléias e néctares confeccionadas de araçá-boi (*Eugenia stipitata* Mc Vaugh) e mamão. As seguintes porcentagens usadas foram respectivamente: 50:50; 40:60; 30:70 e 20:80. Tanto as polpas como os produtos foram analisados quanto: acidez, pH, teor de sólidos totais. Para os produtos, foram feitos testes de aceitação. Uma relação inversa foi observada entre a proporção de mamão e o conteúdo de sólidos solúveis e acidez titulável. A geléia feita de araçá com a casca apresentou maiores teores de sólidos solúveis, maiores valores de pH e menores valores de acidez titulável em relação àquela feita com frutos sem a casca. Altas concentrações de polpa de mamão melhoraram a aceitação do néctar e geléia em todas as formulações. Contudo, foi observado um aumento na aceitação quando usado araçá com casca, até os níveis de 45% de mamão para a geléia e 24% para o néctar. Este resultado foi, provavelmente, devido aos atributos sensoriais específicos da casca do araçá e é um indicador para pesquisas futuras.

Palavras-chave: *Eugenia stipitata*, *Carica papaya*, análise sensorial.

Introduction

Araza (*Eugenia stipitata* Mc Vaugh) is a fruit from Mirtaceae family, originated from Peru Amazon region and usually cultivated in Brazil, Peru and Bolivia. This crop is being introduced in modern agriculture since it presents high potential for commerce. Firstly introduced in Bahia, the araza tree showed an excellent behavior, producing practically all over the year. The pulp of this fruit can be used for vegetable juices, ice cream and jelly (Sacramento et al., 2008). The araza fruit presents high acidity, which can be useful in combination with other pulps of low acidity, which is the case of papaya (*Carica papaya* L.), fruit cultivated in Brazil, whose main growing area is located in southeast region of Bahia. Also the use of fruit skin in the processing industry is interesting because it allows maintaining the fruit flavor and aromatic compounds (Chandra and Ramalingam, 2011).

The mixture of an acid pulp (araza) with a low acid one (papaya) may create a new flavor of jelly and nectars. This can provide a niche market for use of surpluses fruits or for those that do not reach the quality for more demanding markets. Fruit jellies may be considered as the second product for the fruit canning industry. The standards for this product are regulated by the resolution N° 272, September 22, 2005, from Brazilian Ministry of Agriculture (Brasil, 2005).

The term nectar is used in the Brazilian legislation to designate a non fermented drink, obtained with the edible part of the plant, sugars or plant extract and sugars with drinking water. It may be added acids and they are produced for direct consumption.

Several formulation of nectars and jelly, made with exotic fruits or very perishable ones have been studied. This is a way of aggregating value to the original product and to improve organoleptic properties. The mixture of fruit juices presents great benefits, such as the possibility to combine different aromas and flavors and different nutritional components (Matsuura et al., 2004). Chisté et al. (2004) formulated an araza jam by adding water in the ratio 1:2. The juice obtained was cooked at 100°C and added sugar in the ratio 1:1, 0.1% potassium sorbate and 0.5% citric pectin in relation to the total mass.

In the food industry, sensory analysis can be useful to direct marketing decisions concerning not only products, for example product positioning with respect

to competitors, but also market segmentation, customer relationship management, advertising strategies and price policies (Iannario et al., 2012). During the development of new products, it is extremely important to evaluate sensory attributes, which will define the food's acceptance in the market (Souza et al., 2012). Sensory evaluation is a tool widely used to evaluate the characteristics, acceptance and purchase intent of a product by consumers and it is an important analysis for development of the agribusiness sector (Lanzillotti e Lanzillotti, 1999). Thus, for the formulation of products, especially as new slurry mixture to produce jelly mixed is of importance, not only the evaluation of the technological and nutritional characteristics, but mainly the sensory (Ferreira et al., 2011)

The objective of this work was to evaluate sensorial and analytical properties for both jellies and nectars prepared with four different formulations of mixing araza (with and without skin) and papaya.

Materials and Methods

The araza was produced in Ouro Verde Farm, municipality of Una, Brazil. The papaya (Sunrise solo cultivar) was obtained in the markets in the city of Itapetinga, Brazil. In the case of papaya, the fruits were type 9, and maturity stage 5, according to the standard classification made by the bilateral agreement between the Secretariat of Agricultural Protection (SDA) of the Ministry of Agriculture and Food Supply of Brazil and the U.S. Department of agriculture in 1999 (USDA) as described by Oliveira (2002). There is no maturity official classification for Araça-boi whose fruits were utilized having 100% yellow peel, analyzed by the naked eye.

Araza pulp was prepared using a pulp extractor after the removal of seeds in two different ways: 1) fruits with skin and 2) fruits without skin. The papaya pulp was prepared using a liquefier. The jams and nectars were made with mixtures of pulps of araza (with and without skin) and papaya in concentrations (%), respectively: 50:50; 40:60; 30:70 and 20:80.

Jelly was cooked in stainless steel pans with continuous manual stirring. After that it was placed in plastic packaging and stored under refrigeration at 4°C during 12 hours. Finally jellies were served for sensorial

analysis in the formulations presented in Table 1. Concerning the nectar, after mixing the pulps, sugar and water were added and the mixture was triturated in a liquefier. The next step jams was packed in plastic bags and stored. In all formulations (Table 1) citric acid was added in sufficient quantity to get a pH value equal to 3.0. Fruits such as apple and guava don't require any additional pectin to be processed into jam (May, 1997). So, as an attempt, no Pectin was used.

Analyses evaluated the pH, titratable acidity (Instituto Adolfo Lutz, 1985), soluble solids and water activity. Acceptance tests were performed in individual booths. The samples were evaluated concerning the taste, color, consistency and aroma using a score board with hedonic scale structured in 9 points (1=disliked extremely; 2=disliked very; 3=disliked moderately; 4=disliked slightly; 5=non disliked, neither liked; 6=liked slightly; 7=liked moderately; 8=enjoyed very much; 9=enjoyed extremely).

Fifty not trained tasters randomized amount faculty, staff and students participated in the acceptance tests. The nectar was served cold (7°C) and the jelly at ambient temperature (22°C), both on cream-cracker

biscuits in paper plates. Samples were identified by a four digit code

The experimental design was randomized in blocks with 8 treatments and 3 repetitions. Data were submitted to the test of normality for the distribution of errors by using Kolmogorov-Smirnov and Shapiro-Wilk tests and the Levene test for homogeneity of variances. ANOVA analysis and Tukey test were performed for averages comparison.

Results and Discussion

Table 2 presents the physiochemical analysis values for jellies, nectars and papaya and araza pulps. The water activity (Aw) was the same (0.989) for all the nectar formulations while papaya present 0.993Aw and Araça 0.994. The results of papaya pulp are in agreement with the work of Grizzoto et al. (2005) found values of Aw = 0.994, pH = 4.19 and 9.6 °Brix. It was not found, in literature, values of Aw for Araça-boi pulp. The little reduction in the Aw content is due to sugar addition. The chemical characteristics of the

Table 1 - Formulations of jellies and nectars of araza and papaya

Product	Formulations*	Ingredients (% in weights)				
		Araza		Papaya	Sugar	Water
		With skin	Without skin			
Jelly	G11	37.5	-	37.5	25.0	-
	G12	30.0	-	45.0	25.0	-
	G13	22.8	-	52.0	25.2	-
	G14	15.0	-	60.0	25.0	-
	G21	-	37.5	37.5	25.0	-
	G22	-	30.0	45.0	25.0	-
	G23	-	22.8	52.0	25.2	-
	G24	-	15.0	60.0	25.0	-
Nectar	N11	20.0	-	20.0	15.0	45.0
	N12	16.0	-	24.0	15.0	45.0
	N13	12.0	-	28.0	15.0	45.0
	N14	8	-	32.0	15.0	45.0
	N21	-	20.0	20.0	15.0	45.0
	N22	-	16.0	24.0	15.0	45.0
	N23	-	12.0	28.0	15.0	45.0
	N24	-	8.0	32.0	15.0	45.0

*G11,G12,G13,G14,N11,N12,N13,N14 used araza without skin

Table 2 - Physiochemical properties of the jelly and nectar mixed of araza (with skin and without skin) and papaya, papaya and araza fresh fruits

Product	Formulations (%)*	Properties			
		SS (°Brix)	pH (% citric acid)	AT	SS/AT
Jelly	G11 (37.5:37.5:25.0)	75	3.17	3.68	20.38
	G12 (30.0:45.0:25.0)	69	3.23	2.85	24.21
	G13 (22.8:52.0:25.2)	66	3.39	2.25	29.33
	G14 (15.0:60.0:25.0)	63	3.59	2.05	31.03
	G21 (37.5:37.5:25.0)	72	3.13	4.67	15.41
	G22 (30.0:45.0:25.0)	69	3.26	2.89	23.87
	G23 (22.8:52.0:25.2)	66	3.39	2.26	29.20
	G24 (15.0:60.0:25.0)	60	3.62	2.14	28.04
	N11 (20.0:20.0:15.0)	19	3	2.86	6.64
	N12 (16.0:24.0:15.0)	18	3	2.82	6.38
	N13 (12.0:28.0:15.0)	17	3	2.72	6.25
	N14 (8.0:32.0:15.0)	17	3	2.59	6.56
Nectar	N21 (20.0:20.0:15.0)	19	3	3.30	5.76
	N22 (16.0:24.0:15.0)	18	3	2.87	6.27
	N23 (12.0:28.0:15.0)	17	3	2.85	5.96
	N24 (8.0:32.0:15.0)	17	3	2.81	6.05
Papaya		9.0	5.2	0.12	75.0
Araza without skin		4.5	2.7	2.3	1.9
Araza with skin		4.0	2.7	2.1	1.9

*G11,G12,G13,G14,N11,N12,N13,N14 used araza without skin

papaya pulp were very similar with those found by Matsuura et al. (2004) and Grizzoto et al. (2005) although the pH herein found was greater than the value found by this last author. Concerning the araza, results were similar with others obtained by Sacramento et al. (2008).

For both jelly and nectar formulations higher papaya content reduced the values of soluble solids and titratable acidity (Table 2). Although not found in literature references for comparison, all concentrations used in the pH and titratable acidity varied little. They are suitable for children and senior consumption (DeBruyne et al., 2012). These pH value can avoid *C. botulinum* toxin formation (pH < 4.5) (Anderson et al., 2011). and reduce stomach and blood pH (pH<4.0), allowing best digestion and amino acid absorption (Mayer, 1996). Chiste et al. (2004) found content of soluble solids equal 69 °Brix and titratable acidity of 3.10 for

araza jelly. These values are greater than those found in this work, at the same concentration, probably due presence of the papaya.

Results obtained with araza (with and without skin) were very similar (Table 2). However jellies made with araza with skin presented larger contents of soluble solids and pH values and smaller values of titratable acidity than those made with fruits without skin. Whereas in the nectar, due to its own formulation with pH control, the titratable acidity was a little larger. The decrease of the acidity with the increase of the papaya content was also observed by Matsuura et al. (2004) in the passion fruit nectar.

The normality tests of errors distribution and variances homogeneity wasn't significant (P>0.05). This result indicates that the errors present good adjustment to normal distribution and the difference among the variances of each group can be attributed

at random. This way the presuppositions of ANOVA were assisted in all the cases (Norusis, 2004).

Figure 1 shows the average points obtained in the sensorial analysis and Table 3 presents the average comparison test resume. The averages for general parameters were 7.8 and 7.7 to the nectar and jelly, respectively, corresponding to a position between “I liked moderately” and “I liked a lot”, in the hedonic scale. Mattiello et al. (2007) considered good a global acceptance of 7.63 that was obtained for mixed nectar of hog plum and umbu. Values above 7.0 for the global acceptance were also considered good for Matsuura et al. (2004). Therefore the acceptance for both jellies and nectars achieved in this work can be considered good.

The increase of the papaya pulp concentration improved the acceptance for nectar and jelly for the formulations with and without skin araza (Table 3). However attention should be given to some details, for example, the product and the presence of the skin araza. The acceptance test in the formulations with skin araza had fast change. The second formulation (45% of papaya for jelly and 24% for nectar) obtained light increments while other concentrations decrease.

For the formulations without the peel araza, it was observed an increase in the acceptance with the increase in the papaya content. These results are according with

Matsuura et al., (2004) which attribute the decrease of the acidity by the presence of the papaya.

The presence of fruit skin in the formulation caused changes in the titratable and, as a consequence, in the soluble solids/titratable acidity ratio. This is, probably due to the greater acidity in araza with skin. The formulations that used skin also shows greater acceptance for the medium concentrations of papaya ($p < 0.05$ by the Tukey test) (Figure 1 and Table 3). These results indicate the need of more detailed studies about the chemical composition of the skin to identify the cause this change.

The best results for jellies were obtained by the formulation G24 followed by G12 and G13, which presented three items with the best marks (Table 3). All formulations presented marks in range from 7.4 to 8.4. These values mean respectively “I liked moderately” and “I liked a lot”. The lowest marks were observed when papaya pulp was mixed with the araza pulp without skin.

While for nectar the best marks were in the formulations with smaller concentrations of araza without skin in practically all the parameters. The best formulation was N24 that presented the smallest acidity (Figure 1 and Table 3).

For the general average of the attributes, for the jelly, the three formulations with larger papaya content

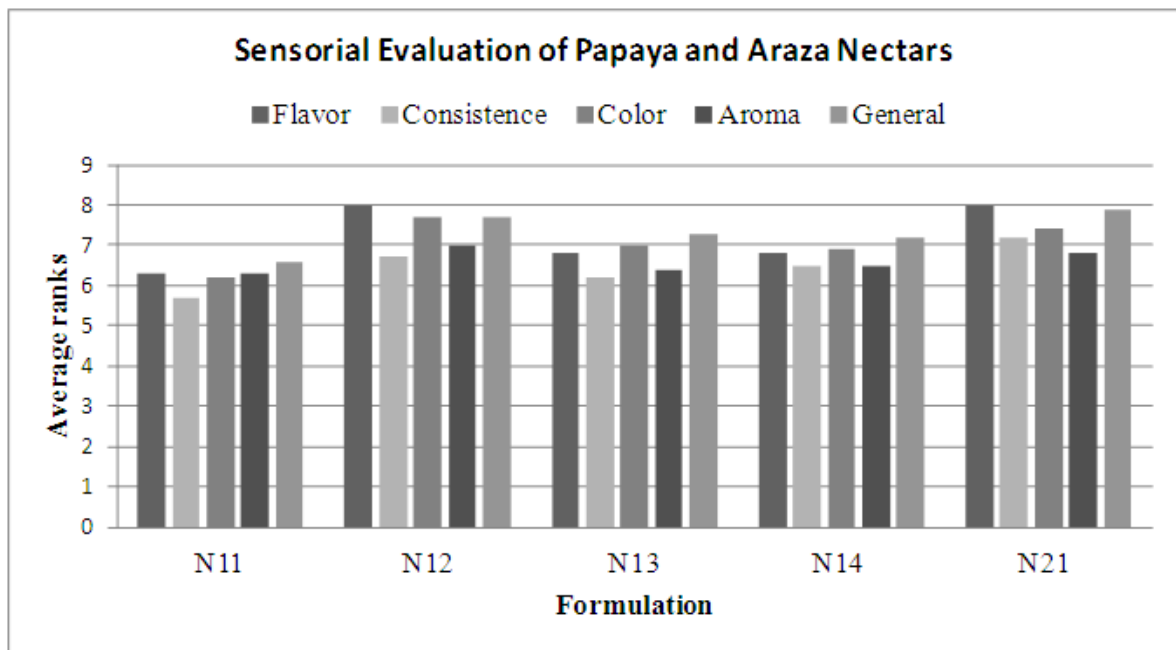


Figure 1 - Average marks of the sensorial evaluation of nectars from papaya with araza.

Table 3 - Summary of the test of comparison of averages of jellies and nectar with different araza concentrations with skin and without skin and papaya

Product	Formulations (%)**	Flavor*	Consistence*	Color*	Aroma*	General*
Jelly	G11 (37.5:37.5:25.0)	7.4 c	6.6 e	6.4 c	7.0 ab	7.5 c
	G12 (30.0:45.0:25.0)	8.2 b	7.1 abcd	8.0 a	7.1 ab	8.1 ab
	G13 (22.8:52.0:25.2)	8.3 ab	7.4 a	7.6 b	7.1 a	8.2 a
	G14 (15.0:60.0:25.0)	8.0 b	7.3 ab	7.6 b	6.9 b	8.3 a
	G21 (37.5:37.5:25.0)	7.1 c	5.3 f	6.3 c	6.1 d	6.8 d
	G22 (30.0:45.0:25.0)	7.4 c	6.8 cd	6.3 c	6.8 b	7.4 c
	G23 (22.8:52.0:25.2)	8.0 b	7.0 bc	7.6 b	6.6 c	7.9 b
	G24 (15.0:60.0:25.0)	8.6 a	7.2 abc	7.9 ab	7.3 a	8.4 a
Average		7.9	6.8	7.2	6.9	7.8
DMS		0.38	0.39	0.32	0.35	0.29
Nectar	N11 (20.0:20.0:15.0)	6.3 d	5.7 e	6.2 c	6.3 c	6.6 e
	N12 (16.0:24.0:15.0)	8.0 b	6.7 c	7.7 ab	7.0 b	7.7 c
	N13 (12.0:28.0:15.0)	6.8 c	6.2 d	7.0 b	6.4 c	7.3 d
	N14 (8.0: 32.0: 15.0)	6.8 c	6.5 c	6.9 b	6.5 c	7.2 d
	N21 (20.0:20.0:15.0)	8.0 b	7.2 ab	7.4 ab	6.8 b	7.9 bc
	N22 (16.0:24.0:15.0)	8.5 a	7.1 a	7.3 b	6.8 b	8.0 b
	N23 (12.0:28.0:15.0)	8.7 a	7.3 a	7.4 ab	6.9 b	8.1 b
	N24 (8.0: 32.0: 15.0)	8.7 a	7.4 a	8.0 a	7.4 a	8.4 a
Average		7.7	6.8	7.2	6.8	7.7
DMS		0.23	0.21	0.60	0.23	0.21

* means followed by the same letter in columns do not differ statistically by Tukey test at 5% of probability level

**G11,G12,G13,G14,N11,N12,N13,N14 used araza without skin

and those that used araza with skin, were the best accepted ($p < 0.05$ by the Tukey test). For the formulations of the mix with araza pulp without skin and with larger papaya content were the best accepted. The largest average mark was attributed to the formulation with 60% of papaya and 15% of araza without skin. However there wasn't statistical difference among the 4 best formulations ($P > 0.05$ by Tukey test). In the case of the nectar, the greater preference was by formulations that used araza without skin and the three larger papaya contents were most accepted ($p < 0.05$ by the Tukey test).

Concerning the flavor, the results accompanied the general average of the attributes, enhancing, in a similar way, the differences among the formulations with and without skin for jelly and nectar. The physiochemical characteristics allow evaluating the predilection for the less acid formulations, in the case formulations of araza

without skin. Similar results were observed by Mattiello et al. (2007), Matsuura et al. (2004) and Mota (2006). However, this tendency was not observed for jam formulations araza with skin, confirming the need of more studies about these formulations.

For the jelly consistence, just the formulation with contents similar of papaya and araza without skin statistically differed from the others ($P < 0.05$ Tukey test) obtaining the lower medium mark for this attribute (Table 3).

For nectar consistence, the predilection was observed by the formulations araza without skin, obtained superior marks than those attributed to the formulations fruit with skin (Table 3). The worst formulation was that with similar proportions of the two fruits and use of the skin. In the case of jelly, as the thermal treatment changes the consistence of the pulp and leads to a product closer of solid, the influence

of the skin presence was minimized what didn't happen, in the case of the nectar. The results of texture measurements evidence jelly and nectar are tixotropic fluids. The consistence result depends on other factors as the temperature and tension that the product was submitted, therefore these results can be considered informative.

The best predilection for jellies was aroma close to the papaya, although this attribute didn't differ statistically ($P>0.05$ by the Tukey test) for formulations with skin. Just in the formulations without skin with smaller papaya concentration there was statistically different. For the nectar, the formulation with larger papaya content and araza with skin obtained largest predilection average mark. However this result has not been statistically different from the formulation with 16% of araza with skin. Probably the consistence the thermal treatment might have caused this alteration, in function of the composition of the skin.

For the parameter color, the increase of the papaya content increased the acceptance for the jellies and nectar, although in a smaller way than other parameters. However, the formulations that used araza with skin showed greater preference in the second concentration.

Conclusions

The amount of araza used in jelly and nectar formulations slightly affect the values of pH, titratable acidity. However, all formulations presented good acceptance.

The increase of the concentration of papaya pulp in the formulations with and without araza skin improves the acceptance of both jelly and nectar. However, the formulations with skin modified some requirements showing greater acceptance for medium concentrations of papaya.

More detailed studies of the chemical composition of the skin should be carried to identify the cause of that change.

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