



## Development of soy-based beverages with papaya and mango pulps

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**ABSTRACT.** The objective of this study was to elaborate and characterize Soy-Based Beverages (SBB) with papaya and mango flavors. Three formulations of each SBB were produced with soy extract (SE); papaya or mango pulp flavor; sugar and citrus pectin, in which were evaluated with chemical and sensory analysis. The addition of the pulps to SE did not affect the results ( $p < 0.05$ ) of the chemical characterization compared to pure SE. The different proportions of pulp and sugar added to SE interfered only in the values for pH, moisture and total soluble solid. The results of the sensory analysis of preference showed that the most preferred papaya and mango flavors was the formulation containing 62.7% SE, 30% pulp, 7% sugar and 0.3% citrus pectin. The acceptance of the most preferred sample of each flavor represented in the scale used, that the judges 'liked' and / or 'liked a lot' the beverage. It was concluded with the chemical characterization that the addition of pulps to SE did not add nutritional qualities compared to pure SE. With the sensory analyses was possible to put in order the samples, and determine which was the most preferred by judges and quantify the attributes of the chosen sample.

**Keywords:** soy extract, fruit pulps pectin, chemical characterization, preference, acceptance.

## Desenvolvimento de bebidas à base de soja com polpas de mamão e manga

**RESUMO.** O objetivo do trabalho foi elaborar e caracterizar bebidas à base de soja (BBS) com sabores de mamão e de manga. Três formulações de cada BBS foram produzidas com extrato de soja (ES); polpa sabor mamão ou manga; açúcar e pectina cítrica, as quais foram avaliadas com análises químicas e sensoriais. A adição das polpas ao ES não interferiu nos resultados ( $p < 0.05$ ) da caracterização química quando comparada ao ES puro. As diferentes proporções de polpa e açúcar adicionadas ao ES interferiram somente nos valores de pH, umidade e sólidos solúveis totais. Os resultados da análise sensorial de preferência mostraram que a formulação mais preferida sabor mamão e sabor manga foi a contendo 62,7% de ES, 30% de polpa, 7% de açúcar e 0,3% de pectina cítrica. A aceitação da amostra mais preferida de cada sabor representou na escala utilizada, que os julgadores 'gostaram' e/ou 'gostaram muito' da bebida. Com os resultados da caracterização química concluiu-se que a adição das polpas ao ES não acrescentou qualidades nutricionais em relação ao ES puro. Com as análises sensoriais foi possível ordenar as amostras e determinar qual era a mais preferida pelos julgadores e quantificar os atributos da amostra escolhida.

**Palavras-chave:** extrato de soja, polpas de frutas pectina, caracterização química, preferência, aceitação.

### Introduction

Recent studies show an increased interest of consumers for healthier foods, bringing the food industry to the development of new products based on soy, whose aspirations are to go beyond the supply of basic nutrients and the satisfaction of consumer's taste (MOON et al., 2005). The foods produced from soybeans are rich in high quality proteins, have low saturated fat and are free of cholesterol (ANDERSON et al., 1995).

Among derivative soy products, the soymilk is highlighted to be a product ready for consumption, of high nutritional value, relatively low cost and easy to obtain (NELSON et al., 1976). In the past, the

'milk' from soybean had poor acceptance, basically due to its unpleasant taste and aroma to the taste of Brazilian consumers (YING-QIU et al., 2008). The use of Soy Extract (SE) initially was limited to people with lactose intolerance, vegetarians and those with dietary restrictions or religious order. Later, the commercial SE reached considerable insertion in the market, as inexpensive protein source and a substitute to cow milk (HEANEY et al., 2000).

According to Resolution 14/78 of the National Norms and Standards for Food, the soymilk is defined as the "[...] product obtained from the aqueous emulsion resulting from hydration of soy grains, conveniently cleaned, followed by

appropriate processing technology, supplemented with or without optional permitted ingredients, may be subjected to total or partial dehydration”, with its chemical composition thus established: moisture - maximum of 93.0%, proteins - minimum of 3.0%, lipids - minimum of 1.0%, carbohydrates - maximum of 2.8% and ashes - maximum of 0.6% (BRASIL, 1978). Its combination with fruit juices has been successful, indicating that consumers may be changing their attitude in relation to products made from soybeans, because it joins desirable sensory characteristics of fruits with the functional properties of soy (ZULUETA et al., 2007).

The Normative Instruction N° 1 from January 7, 2000 defines fruit pulp as the unfermented, unconcentrated, undiluted product, obtained by crushing fruits with pulp, through an appropriate technological process, with a minimum total solids from the edible part of the fruit, specific for each one of these (BRASIL, 2000). Its use is often as raw material for processing other products such as nectars, juices, jams, ice creams and sweetened fruit products (BRUNINI et al., 2002), and its consumption is expanding, mainly in the industries of dairy products, ice creams, sweet fruit products, etc., which increases the interest of both producers and consumers (KUSKOSKI et al., 2006).

The objective of this study was to elaborate and characterize a Soy-Based Beverage (SBB) with papaya and mango flavors using Soy Extract obtained from cultivar BRS 232, 2010/2011 harvested.

## Material and methods

### Preparation of soy extract (SE)

The Soy Extract was obtained according to the methodology proposed by Mandarino et al. (2003), in proportion soybeans: water (1:10) and pasteurized until boiling (Figure 1). The cultivar used was the BRS 232, 2010/2011 harvest.

### Preparation of soy-based beverages (SBB)

The papaya and mango flavors beverages were elaborated from the homogenization of SE, frozen pasteurized papaya flavor pulp (Polpa Norte) and mango flavor pulp (Redondo), sugar and citrus pectin in industrial blender (Metvisa LQ 15) for 1 minute (Figure 2).

For the formulations of beverages were made five previous tests for the percentage of pulp, sugar and

pectin, in relationship to the total beverage, which were defined the formulations for both flavors (Table 1).

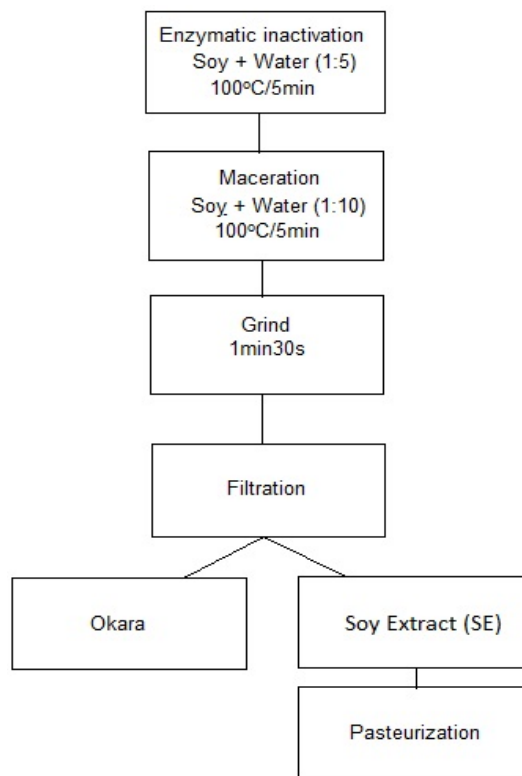


Figure 1. Flowchart for obtaining Soy Extract (SE).

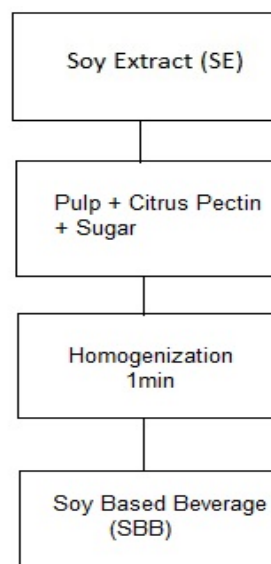


Figure 2. Flowchart for obtaining soy-based beverages (SBB).

Table 1. Formulations of Soy-Based Beverages (BBS) (%).

	Formulations		
	64.7	62.7	59.7
Soy extract	30	30	35
Pulp	5	7	5
Sugar	0.3	0.3	0.3
Citrus pectin			

### Chemical characterization

In SE, pulp and formulations of SBB were performed analyzes of pH, using potentiometer with glass electrode model NT PHM (Tecnopon Equip. Especiais LTDA.); total soluble solids (TSS), expressed in °Brix, measured with Abbe Refractometer; and total titratable acidity (TTA) determined by titration with standardized sodium hydroxide 0.1 M solution, according to the Instituto Adolfo Lutz (IAL, 2008).

### Proximate composition

The determinations of moisture, ashes and proteins of beverages and SE were performed according to AOAC (1995). The moisture determination was done in an oven at 105°C with air circulation, ashes were quantified by incineration in the furnace at 550°C, proteins were determined by calculating the nitrogen content by the Microkjeldahl method using correction factor 6.25. Lipids of SE and beverages were quantified with an acid hydrolysis followed by Soxhlet extraction with petroleum ether, according to methodology described 033/IV by the Instituto Adolfo Lutz (IAL, 2008). Carbohydrates were calculated by difference.

### Sensory analysis

A preference test was performed with 50 non-trained judges, of both sexes, where the judges ordered the three formulations in preference increasing order using the method proposed by Friedman, using the table of Newell and MacFarlane (1987). If the difference between the sums of the orders is greater than or equal to the value tabulated, it is concluded that there is significant difference between samples corresponding to the significance level (ABNT, 1994). The preference test was conducted separately in accordance to each flavor.

In the most preferred formulation of each flavor, was performed a sensory acceptance test using a hedonic scale of 10 points proposed by Villanueva et al. (2005), regarding to color, flavor, texture and overall acceptability. For these formulations was also conducted a survey of purchase intention with a 5-point scale, where 5 is certainly would buy and 1 certainly would not buy, and frequency of consumption of soy products. The sensory acceptance was made with 50 non-trained of both sexes. These analyses have the approval by Bioetic and Etic Committee of the Irmandade Santa Casa de Londrina – Bioisical, through the Project n° 355/10 = CAAE: 0015.0.083.000-10.

### Statistical analysis

The data of chemical analysis and proximate composition were analyzed by the software Statistica 10.0, using analysis of variance (ANOVA) and comparing the averages with the Tukey test at 5% significance (STATSOFT, 2005).

### Results and discussion

The Soy Extract was made with 1:10 dilution (soybean: water), because several authors and industrial processes report that this is the most frequently used to formulations of Soy-based beverage (SBB). The results of chemical analysis of SE are shown in Table 2, revealing that the higher proportion is moisture (94.33%), followed by lipids (2.30%) and carbohydrates (1.95%).

**Table 2.** Chemical characterization of Soy Extract (SE).

Analysis	SE
pH	6.71 ± 0.01
Total Titratable Acidity (g citric acid 100 g <sup>-1</sup> )	0.05 ± 0.01
Total Soluble Solids (°Brix)	2.05 ± 0.07
Proteins (%)	0.99 ± 0.19
Lipids (%)	2.30 ± 0.27
Moisture (%)	94.33 ± 0.58
Ashes (%)	0.43 ± 0.08
Carbohydrates (%)	1.95 ± 0.68

Values are mean ± Standard Deviation of three replicates.

The pH and total titratable acidity of SE were close to values found by Abreu et al. (2007), respectively (6.78 e 0.05g citric acid 100 g<sup>-1</sup>), who analyzed a sample of pure soy extract. These values are also close to those found by Tashima and Cardello (2003) (7.0 e 0.063 g citric acid 100 g<sup>-1</sup>) that analyzed a commercial sweetened soybean extract, but the value of total soluble solids (TSS) in this study differed from that found by these authors (10°Brix), fact which can be explained by the presence of sucrose and sucralose in the sample. The value of SST (9.45°Brix) found by Abreu et al. (2007) was also higher for the determined for SE of this study.

The protein content (0.99%) differed from those found by Caus et al. (2008) and Branco et al. (2007), whose values were respectively 1.85% and 1.9% and approached the mean value (1.06%) found by Jaekel et al. (2010) for beverages formulated with 30% soybean extract and 70% rice extract. The lipid content found was larger than the content analyzed by Caus et al. (2008) (1.95%), which SE was made from the same cultivar BRS 232.

The moisture content is similar to that obtained by Branco et al. (2007) (95.94%), and ashes content was lower when compared with the same author (0.54%). These contents are shown larger than those obtained

by Silva Júnior and Demonte (1997) (85.62% and 0.37%), which can be explained by factors ranging from the composition of raw materials until the processing of SE. The carbohydrates content approaches the value found by Uliana and Venturini Filho (2010), 2.05%.

Comparing the results of the chemical characterization of papaya and mango pulp flavor (Table 3) with current legislation, noted that the values of SST and acidity are below the required, and the pH within the range provided. Because the Technical Regulation for Establishment of Standards of Identity and Quality establishes parameters for papaya pulp: SST - minimum of 10.0 °Brix; pH - minimum of 4.0; TTA - minimum of 0.17g citric acid 100 g<sup>-1</sup>. And for mango pulp: SST - minimum of 11.0°Brix; pH - minimum of 3.3 and maximum of 4.5; TTA - minimum of 0.32g citric acid 100 g<sup>-1</sup> (BRASIL, 2000).

**Table 3.** Chemical characterization of papaya and mango pulps.

Pulps	pH	Total Titratable Acidity (g citric acid 100 g <sup>-1</sup> )	Total Soluble Solids (°Brix)
Papaya	4.96 ± 0.01 <sup>a</sup>	0.14 ± 0.04 <sup>a</sup>	9.07 ± 0.38 <sup>a</sup>
Mango	4.58 ± 0.05 <sup>a</sup>	0.23 ± 0.07 <sup>a</sup>	8.67 ± 0.01 <sup>a</sup>

The values are mean ± Standard Deviation of three replicates; Means followed by the same letter in the same column, there are not significantly different by Tukey test ( $p \leq 0.05$ ).

The pH, TSS and acidity average of papaya pulp flavor were close to the values found by Parker et al. (2009) (4.9, 8.30°Brix, 0.10 g citric acid 100 g<sup>-1</sup>), which featured a papaya pulp whose fruit was irradiated. The pH and acidity for mango pulps were respectively higher and lower (4.04 and 0.78 g citric acid 100 g<sup>-1</sup>) of values found by Brunini et al. (2002), who analyzed frozen mango pulps, but the TSS value was near (9.48°Brix).

In order to develop a natural product, beverages were obtained without addition of preservatives,

flavorings and colorants, giving preference to natural pulps of papaya and mango because they are not traditionally marketed as soy juices flavors. Both formulations were produced in the same proportions and under the same conditions, to verify if the difference of the pulp used influenced in the values of characterization. The differences in the proportions of pulp and sugar in both flavors interfered in pH, moisture and TSS. The higher the proportion of sugar, lower were the moisture values and higher the values of TSS, in the case of the addition of mango pulp these values increased further. In other analyzes the results did not differ regardless the type and proportions of pulp and sugar employed (Tables 4 and 5).

The pH values of the SBB papaya and mango formulations were near average (5.11) of the values found by Caus et al. (2008) who analyzed beverages based of soybean extract with strawberry pulp. The values for TTA and TSS for both flavors differ from that found by Abreu et al. (2007) (0.34g citric acid 100 g<sup>-1</sup> and 15.20°Brix) for a commercial mixed drink with pineapple and soy, variation that may be due to the difference of the fruit used in the formulation of SBB.

The moisture content for all formulations of SBB were close to the values found by Uliana and Venturini Filho (2010) (89.67%) in a mixed drink made in proportion SE and cranberry juice 1:2, and the ashes content of mango flavored beverage were lower, compared with this same beverage (0.45%). Rodrigues and Moretti (2008) found values of 0.61% lipids for a peach flavor SBB, while Caus et al. (2008), values from 1.97% to 2.62%, for SBB with strawberry and passion fruit pulps, which is closer to the values found in SBB with mango and papaya pulp of the present study.

**Table 4.** Chemical characterization of papaya and mango soy-based beverages (SBB).

Formulations	pH	Total Titratable Acidity (g citric acid 100 g <sup>-1</sup> )	Total Soluble Solids (°Brix)
Papaya SBB (30% pulp 5% sugar)	5.45 ± 0.02 <sup>c</sup>	0.09 ± 0.01 <sup>a</sup>	7.57 ± 0.32 <sup>b</sup>
Papaya SBB (30% pulp 7% sugar)	5.64 ± 0.01 <sup>a</sup>	0.10 ± 0.01 <sup>a</sup>	8.03 ± 0.15 <sup>bc</sup>
Papaya SBB (35% pulp 5% sugar)	5.44 ± 0.02 <sup>c</sup>	0.10 ± 0.01 <sup>a</sup>	7.03 ± 0.15 <sup>b</sup>
Mango SBB (30% pulp 5% sugar)	5.48 ± 0.02 <sup>c</sup>	0.08 ± 0.01 <sup>a</sup>	9.17 ± 0.76 <sup>dc</sup>
Mango SBB (30% pulp 7% sugar)	5.45 ± 0.01 <sup>c</sup>	0.07 ± 0.01 <sup>a</sup>	10.83 ± 0.29 <sup>a</sup>
Mango SBB (35% pulp 5% sugar)	5.18 ± 0.01 <sup>b</sup>	0.09 ± 0.01 <sup>a</sup>	10.00 ± 0.50 <sup>da</sup>

The values are means ± Standard Deviation of three replicates; Means followed by the same letter in the same column, there are not significantly different by Tukey test ( $p \leq 0.05$ ).

**Table 5.** Proximate composition of papaya and mango soy-based beverages (SBB) (%).

Formulations	Proteins	Lipids	Moisture	Ashes	Carbohydrates
Papaya SBB (30% pulp 5% sugar)	0.78 ± 0.02 <sup>a</sup>	1.65 ± 0.08 <sup>a</sup>	92.35 ± 0.05 <sup>a</sup>	0.20 ± 0.07 <sup>a</sup>	5.01 ± 0.05 <sup>a</sup>
Papaya SBB (30% pulp 7% sugar)	0.60 ± 0.02 <sup>a</sup>	2.26 ± 0.35 <sup>a</sup>	89.87 ± 0.07 <sup>b</sup>	0.49 ± 0.03 <sup>a</sup>	6.77 ± 0.37 <sup>a</sup>
Papaya SBB (35% pulp 5% sugar)	0.78 ± 0.02 <sup>a</sup>	2.53 ± 0.95 <sup>a</sup>	92.03 ± 0.70 <sup>a</sup>	0.63 ± 0.65 <sup>a</sup>	4.03 ± 0.97 <sup>a</sup>
Mango SBB (30% pulp 5% sugar)	0.76 ± 0.15 <sup>a</sup>	1.45 ± 0.05 <sup>a</sup>	91.51 ± 0.23 <sup>a</sup>	0.15 ± 0.20 <sup>a</sup>	6.13 ± 0.20 <sup>a</sup>
Mango SBB (30% pulp 7% sugar)	0.77 ± 0.08 <sup>a</sup>	1.93 ± 0.35 <sup>a</sup>	90.16 ± 0.05 <sup>b</sup>	0.21 ± 0.02 <sup>a</sup>	6.93 ± 0.36 <sup>a</sup>
Mango SBB (35% pulp 5% sugar)	0.74 ± 0.11 <sup>a</sup>	2.60 ± 0.30 <sup>a</sup>	91.52 ± 0.07 <sup>a</sup>	0.20 ± 0.07 <sup>a</sup>	4.93 ± 0.31 <sup>a</sup>

The values are means ± Standard Deviation of three replicates; Means followed by the same letter in the same column, there are not significantly different by Tukey test ( $p \leq 0.05$ ).

The proteins content analyzed remained low compared to the value of SE, concluding that none of the pulps interfere with the amount of proteins. This value was also lower than the values found by Uliana and Venturini Filho (2010) ranging from 1.49% to 1.58% for a soy drink with cranberry juice 1:2 (extract: juice). The values for carbohydrates were below the values (8.9%, 10.8% and 11.85%) found by Uliana and Venturini Filho (2010) for mixed drink made with 10°Brix, 12°Brix and 14°Brix, respectively.

Separately, in the three formulations of soy beverages of each flavor were done the preference tests by ordering (Table 6). The most preferred formulation for both flavors was the one containing 62.7% SE, 30% pulp, 7% sugar and 0.3% citric pectin. Although the papaya flavor formulations 2 and 3 did not differ among themselves, it was decided to choose the formulation 2 as the most preferred because it got a smaller sum of the preference responses, which means that it obtained the highest score number 1 (most preferred). Formulations with mango pulp did not differ in preference, but it was decided to choose the formulation 2 as most preferred, as this also obtained fewer answers 1 (most preferred).

**Table 6.** Preference test by ordering of papaya and mango flavor formulations.

Formulations	Sum of orders papaya flavor *	Sum of orders mango flavor *
(1) 64.7%SE 30%pulp5%sugar 0.3%citrus pectin	123 <sup>a</sup>	115 <sup>a</sup>
(2) 62.7%SE 30%pulp7%sugar 0.3%citrus pectin	86 <sup>b</sup>	82 <sup>a</sup>
(3) 59.7%SE 35%pulp5%sugar 0.3%citrus pectin	91 <sup>b</sup>	104 <sup>a</sup>

\*1 to most preferred and 3 to least preferred.

As well as Uliana and Venturini Filho (2010) who analyzed a mixed beverage of extract of soy and cranberry juice, it was established that the different concentrations of SE and juice did not affect the overall score, more over the higher sugar content the higher grades obtained.

In the most preferred formulation of each flavor was performed the sensory acceptance test and the profile of the judges who evaluated the soy beverages was very similar. To papaya formulation, 62% were women under 20 years and high school graduate, who consume juices daily. For the mango formulation most of the judges were women (64%), between 20 and 30 years, high school graduates, which consume juices weekly. Among the judges of papaya formulation, 69.4% consume soy-based products, and of mango flavor 74% consume this type of product.

Analyzing the data of the most preferred sample flavor papaya, its observed that the highest averages were color (7.67) and texture (7.60), followed by global acceptance (6.56) and flavor (5.95), in which there was higher variation. All this scores corresponding to a degree of acceptance 'liked' and/or 'liked a lot' the beverage in the hedonic scale used (Table 7).

**Table 7.** Sensory acceptance test of papaya and mango flavor formulations.

Attribute	Papaya	Mango
Color	7.67 ± 1.64	6.01 ± 2.21
Flavor	5.95 ± 2.07	5.92 ± 2.63
Texture	7.60 ± 1.81	6.74 ± 1.91
Global acceptance	6.56 ± 1.93	6.14 ± 2.51

The values are means ± standard deviation of fifty evaluations.

Regarding the most preferred mango flavor sample, the highest means were for texture (6.74) and overall acceptability (6.14), followed by color (6.01) and flavor (5.92), corresponding to a degree of acceptance 'liked' and/or 'liked a lot' the beverage in the hedonic scale. Thus, the beverages of different flavors are sensorily alike. The biggest difference is in color, where the papaya formulation had higher mean (7.67).

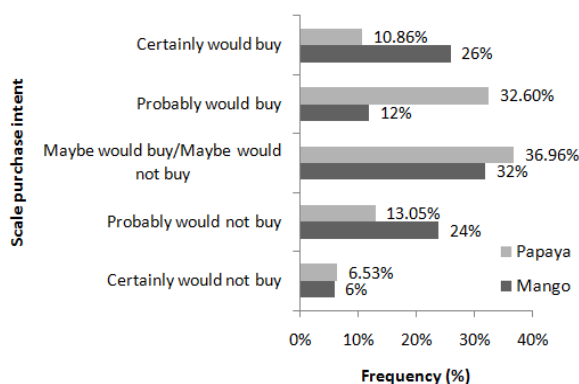
Means for papaya and mango flavor formulations are near the means found (6.09) by Branco et al. (2007) for a soy-based beverage with 20% strawberry and 10% sucrose. The mean of color to the mango formulation was also near the mean found (6.19) by Branco et al. (2007), however for a soy-based beverage with 25% strawberry and 15% sucrose.

As for global acceptance, the averages of both formulations were greater than the average analyzed (5.7) by Felberg et al. (2004) for a mixed drink extract of soybean and 30% extract of Brazil nut.

Moreira et al. (2010) found lower averages for the flavor (4.69) and color (6.65) in a chocolate drink containing 77.36% of soy extract. The two evaluations are proportionally smaller than those found for drinks of papaya and mango because the authors used a sensory scale of up to 9 points.

Analyzing the intention of purchase of papaya SBB (Figure 3), most of judges (43.5%) would 'definitely or probably buy' the beverage, as well as to mango SBB, in which the majority of judges (38%) also would 'definitely or probably buy' the beverage.

It is also noticed that the two beverages had low rejection, because only 6.53% and 6% of the judges would 'certainly not buy' the papaya and mango beverage, respectively.



**Figure 3.** Percentage of notes regarding the purchase intent of papaya and mango SBB.

Among the judges who responded that consume soy products (69.4%) for the formulation papaya flavor, it was noted that 46% would definitely or probably buy the product and only 6% said they would not buy the product. For the mango flavor formulation, it was noted that 74% of the judges who consume soy products, 43.24% would certainly or probably buy the product and only 0.01% said they would not buy the product, proving the acceptability of tasters for beverages of papaya and mango flavors, being the papaya flavor even more accepted.

## Conclusion

The papaya and mango flavored soy based beverages were produced containing soy extract, fruit pulps, sugar and citric pectin. The differences in proportion of pulp and sugar in both flavors interfered in pH, moisture and TSS. The preference order was also influenced by sugar portion, in which the samples with more sugar were preferred. The beverages containing 62.7% SE; 30% of flavor pulp (papaya or mango); 7% of sugar and 0.3% of citric pectin were chosen by judges. And in these were realized the sensory acceptance test, in which the judges 'liked' and/or 'liked a lot' for both beverages.

## Acknowledgements

The authors acknowledge CAPES for the supply students' financial support.

## References

- ABNT-Associação Brasileira de Normas Técnicas. **NBR13170**. Teste de ordenação em análise sensorial. Rio de Janeiro: ABNT, 1994.
- ABREU, C. R. A.; PINHEIRO, A. M.; MAIA, G. A.; CARVALHO, J. M.; SOUSA, P. H. M. Avaliação química

e físico-química de bebidas de soja com frutas tropicais. **Alimentos e Nutrição**, v. 18, n. 3, p. 291-296, 2007.

ANDERSON, J. W.; JOHNSTONE, B. M.; COOK-NEWELL, M. A. Meta-analysis of the effects of soy protein intake on serum lipids. **New England Journal of Medicine**, v. 333, n. 5, p. 1715-1716, 1995.

AOAC-Association of Official Analytical Chemists. **Official methods of analysis**. 16th ed. Arlington: AOAC, 1995. v. 1-2.

BRANCO, I. G.; TEIXEIRA, A. M.; RIGO, M.; BEZERRA, J. R. M. V.; COUTINHO, M. R.; ARGANDONA, E. J. S.; BASTOS, R. G. Avaliação da aceitabilidade sensorial de uma bebida à base de extrato hidrossolúvel de soja, polpa de morango e sacarose. **Revista de Ciências Exatas e Naturais**, v. 9, n. 1, p. 129-141, 2007.

BRASIL. Ministério da Agricultura. Comissão Nacional de Normas e Padrões para Alimentos. **Resolução n.º 14 de junho de 1978**. Estabelecer o padrão de identidade e qualidade para farinha desengordurada de soja, proteína texturizada de soja, proteína concentrada de soja, proteína isolada de soja e extrato de soja. Available form: <<http://www.agricultura.gov.br>>. Access on: April, 2013.

BRASIL. Ministério da Agricultura. Instrução Normativa n.º 1, de 7 jan. 2000. Aprova os Regulamentos Técnicos para fixação dos padrões de identidade e qualidade para polpas e sucos de frutas. **Diário Oficial da União**, Brasília, n. 6, 10 jan. 2000. Seção I, p. 54-58.

BRUNINI, M. A.; DURIGAN, J. F.; OLIVEIRA, A. L. Avaliação das alterações em polpa de manga 'Tommy-atkins' congeladas. **Revista Brasileira de Fruticultura**, v. 24, n. 3, p. 651-653, 2002.

CAUS, S.; CZAİKOSKI, K.; GOMES, G. V. L.; CÓRDOVA, K. R. V.; BEZERRA, J. R. M. V.; RIGO, M. Obtenção de bebidas a base de extrato hidrossolúvel de soja com polpa de frutas. **Revista de Ciências Exatas e Naturais**, v. 10, n.1, p. 115-131, 2008.

FELBERG, I.; DELIZA, R.; GONÇALVES, E. B.; ANTONIASSI, R.; FREITAS, S. C.; CABRAL, L. C. Bebida mista de extrato de soja integral e castanha-do-brasil: caracterização físico-química, nutricional e aceitabilidade do consumidor. **Alimentos e Nutrição**, v. 15, n. 2, p. 163-174, 2004.

HEANEY, R. P.; DOWELL, M. S.; RAFERTY, K.; BIERMAN, J. Bioavailability of the calcium in fortified soy imitation milk, with some observations on method. **American Journal of Clinical and Nutrition**, v. 71, n. 5, p. 1166-1169, 2000.

IAL-Instituto Adolfo Lutz. Normas Analíticas do Instituto Adolfo Lutz. **Métodos químicos e físicos para análise de alimentos**. 4. ed. São Paulo: Imesp, 2008.

JAELKEL, L. Z.; RODRIGUES, R. S.; SILVA, A. P. Avaliação físico-química e sensorial de bebidas com diferentes proporções de extratos de soja e de arroz. **Ciência e Tecnologia de Alimentos**, v. 30, n. 2, p. 342-348, 2010.

KUSKOSKI, E. M.; ASUERO, A. G.; MORALES, M. T.; FETT, R. Frutos tropicais silvestres e polpas de frutas

- congeladas: atividade antioxidante, polifenóis e antocianinas. **Ciência Rural**, v. 36, n. 4, p. 1283-1287, 2006.
- MANDARINO, J. M. G.; BENASSI, V. T.; CARRÃO-PANIZZI, M. C. **Manual de receitas com soja**. Empresa Brasileira de Pesquisa Agropecuária. Londrina: Embrapa, 2003. (Documentos 206).
- MOON, W.; BALASUBRAMANIAN, S. K.; RIMAL, A. Perceived health benefits and soy consumption behavior: two-stage decision model approach. **Journal of Agricultural and Resource Economics**, v. 30, n. 2, p. 315-332, 2005.
- MOREIRA, R. W. M.; MADRONA, G. S.; BRANCO, I. G.; BERGAMASCO, R.; PEREIRA, N. C. Avaliação sensorial e reológica de uma bebida achocolatada elaborada a partir de extrato hidrossolúvel de soja e soro de queijo. **Acta Scientiarum. Technology**, v. 32, n. 4, p. 435-438, 2010.
- NELSON, A. I.; STEINBERG, M. P.; WEI, L. S. Illinois process for preparation of soymilk. **Journal of Food Science**, v. 41, n. 1, p. 57-61, 1976.
- NEWELL, G. J.; MACFARLANE, J. D. Expanded tables for multiple comparison procedure on the analysis of ranked data. **Journal of Food Science**, v. 52, n. 6, p. 1721-1725, 1987.
- PARKER, T. L.; ESGRO, S. T.; MILLER, S. A.; MYERS, L. E.; MEISTER, R. A.; TOSHKOV, S. A.; ENGESETH, N. J. Development of an optimised papaya pulp nectar using a combination of irradiation and mild heat. **Food Chemistry**, v. 118, n. 3, p. 861-869, 2009.
- RODRIGUES, R. S.; MORETTI, R. H. Caracterização físico-química de bebida proteica elaborada com extrato de soja e polpa de pêssegos. **Boletim CEPPA**, v. 26, n. 1, p. 101-110 2008.
- SILVA JÚNIOR, S. I. S.; DEMONTE, A. Avaliação da qualidade nutricional da proteína do 'leite de soja' e do leite integral em pó. Ensaio experimental e discussão mercadológica. **Alimentos e Nutrição**, v. 8, n. 1, p. 105-120, 1997.
- STATSOFT. **Statistica 7.0 Software**. Tucksá: Statsoft, 2005.
- TASHIMA, E. H.; CARDELLO, H. M. A. B. Perfil sensorial de extrato hidrossolúvel de soja (*Glicine max* L. Merrill) comercial adoçado com sacarose e com sucralose. **Boletim CEPPA**, v. 21, n. 2, p. 409-428, 2003.
- ULIANA, M. R.; VENTURINI FILHO, W. G. Análise energética de bebida mista de extrato hidrossolúvel de soja e suco de amora. **Revista Energia na Agricultura**, v. 25, n. 3, p. 94-103, 2010.
- VILLANUEVA, N. D. M.; PETENATE, A. J.; SILVA, M. A. A. P. Performance of the hybrid hedonic scale as compared to the traditional hedonic, self-adjusting and ranking scales. **Food Quality and Preference**, v. 16, n. 8, p. 691-703, 2005.
- YING-QIU, L.; QUN, C.; XIU-HE, L.; ZHENG-XING, C. Inactivation of soybean lipoxygenase in soymilk by pulsed electric fields. **Food Chemistry**, v. 109, n. 2, p. 408-414, 2008.
- ZULUETA, A.; ESTEVE, M. J.; FRASQUET, I.; FRÍGOLA, A. Vitamin C, vitamin A, phenolic compounds and total antioxidant capacity of new fruit juice and skim milk mixture beverages marketed in Spain. **Food Chemistry**, v. 103, n. 4, p. 1365-1374, 2007.

Received on September 20, 2013.

Accepted on October 4, 2013.

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