Vanessa Bordin Viera
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(Organizadoras)

Avanços e Desafios da Nutrição 4

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APRESENTAÇÃO

O *e-book* Avanços e Desafios da Nutrição no Brasil 4, traz um olhar multidisciplinar e integrado da nutrição com a Ciência e Tecnologia de Alimentos. A presente obra é composta de 66 artigos científicos que abordam assuntos de extrema importância relacionados à nutrição e a tecnologia de alimentos. O leitor irá encontrar assuntos que abordam temas como as boas práticas de manipulação e condições higiênico-sanitária e qualidade de alimentos; avaliações físico-químicas e sensoriais de alimentos; rotulagem de alimentos, determinação e caracterização de compostos bioativos; atividade antioxidante, antimicrobiana e antifúngica; desenvolvimento de novos produtos alimentícios; insetos comestíveis; corantes naturais; tratamento de resíduos, entre outros.

O *e-book* também apresenta artigos que abrangem análises de documentos como patentes, avaliação e orientação de boas práticas de manipulação de alimentos, hábitos de consumo de frutos, consumo de alimentos do tipo lanches rápidos, programa de aquisição de alimentos e programa de capacitação em boas práticas no âmbito escolar.

Levando-se em consideração a importância de discutir a nutrição aliada à Ciência e Tecnologia de Alimentos, os artigos deste *e-book*, visam promover reflexões e aprofundar conhecimentos acerca dos temas apresentados. Por fim, d*esejamos* a todos uma *excelente leitura!*

Natiéli Piovesan e Vanessa Bordin Viera

SUMÁRIO

CAPÍTULO 18

PHYSICAL-CHEMICAL, MICROBIOLOGICAL AND SENSORY CHARACTERISTICS OF JELLIES PREPARED WITH PETALS OF ROSES

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RESUMO: Rosas (*Rosa x grandiflora* Hort.) e hibisco (*Hibiscus sabdariffa* L.) são espécies que se destacam na área ornamental, mas nos últimos anos vêm ganhando espaço na área alimentícia. Assim, o objetivo deste estudo foi elaborar geleias a partir de pétalas de rosas e hibisco e avaliar suas características físico-químicas, microbiológicas e sensoriais. Quatro geleias foram elaboradas, a partir de pétalas de rosas em chá e em pó, hibisco cultivado e hibisco comercial em chá. As geleias apresentaram umidade entre 19% e 30,7%, atividade de água entre 0,742 e 0,882, teor de sólidos solúveis totais entre 67ºBrix e 69ºBrix, teores totais de açúcar entre 59% e 71% e pH entre 3,01 e 4,64. As geleias apresentaram contagem de bolores e leveduras <4 log UFC g^{-1} no sexto mês de armazenamento. A geleia de chá de pétala de rosas, preferida pelos provadores, diferiu significativamente da geleia feita de pó de pétala de rosas, em relação à cor, sabor e aparência geral. A geleia de hibisco comercial diferiu significativamente da geleia de hibisco cultivada em todos os atributos. Além disso, a avaliação sensorial mostrou boa aceitação pelos consumidores.

PALAVRAS-CHAVE: Teste de aceitação, composição química, flores comestíveis, *Hibiscus sabdariffa* L., *Rosa x grandiflora* Hort.

ABSTRACT: Roses (*Rosa x grandiflora* Hort.) and hibiscus (*Hibiscus sabdariffa* L.) are species

that stand out in the ornamental area, but in recent years have been gaining space in the food area. Thus, the objective of this study was to prepare jellies from petals of roses and hibiscus and to evaluate their physical-chemical, microbiological and sensory characteristics. Four jellies were made, from rose petals in tea and in powder, cultivated hibiscus and commercial hibiscus in tea. The jellies presented humidity between 19% and 30,7%, water activity between 0.752 and 0.882, total soluble solids contents between 67ºBrix and 69ºBrix, total sugar contents between 59% and 71% and the pH ranged from 3.01 to 4.64. The jellies showed mold and yeasts counts < 4 log CFU g-1 in the sixth month of storage. The rose petal tea jelly, preferred by tasters, differed significantly from the jelly made of rose petal powder, in relation to color, taste and overall appearance. The commercial hibiscus jelly significantly differed from the cultivated hibiscus jelly on all attributes. Moreover, sensory evaluation showed good acceptance by consumers.
KEYWORDS: Acceptance test, chemical composition, edible flowers, *Hibiscus sabdariffa* L., *Rosa x grandiflora* Hort.

1 I INTRODUCTION

The habit of consuming sweets and jellies come since the Brazilian colonization by Portuguese immigrants. Nowadays, many municipalities from the Brazilian country side have their typical jams and jellies recognized as cultural heritage (Brazil, 2007). Jelly is the product obtained by cooking fruit or vegetables, on the whole, in pieces, the pulp or juice, with added sugar and water until obtaining a semitransparent and gelatinous consistency (Brazil, 1978). Their qualitative characteristics must follow the Technical Regulation n. 272 for products made of vegetables, fruit or edible mushrooms for consumption and commercialization (Brazil, 2005).

The word jelly (geleia in Portuguese) comes from the French gelée, which means to solidify or to gelify (Roriz, 2010). The law classifies them as: common - when prepared at a ratio of 40 parts of fresh fruit, or its equivalent, to 60 parts of sugar; and extra - when prepared at a ratio of 50 parts of fresh fruit, or its equivalent, to 50 parts of sugar (Brazil, 1978).

Brazil is a rich source in plant materials for the preparation of jams and jellies, including edible flowers, which in addition to having the beauty of the color and the shape of their flowers, also have nutritional and medicinal properties (Santos et al., 2012). Roses and hibiscus stand out among edible flowers, being consolidated crops in floriculture agribusiness and with a large opening in the food industry, especially for family farming (Franzen et al., 2016).

The rose (Rosa x grandiflora Hort.) belongs to the Rosaceae family, which has more than 100 species and thousands of varieties, hybrids and cultivars (Prata, 2009). Rose is the most commercialized flower worldwide, especially in the red color. With traditional use in Arab cuisine, it is used in creams, mousses and garnish for salads and cakes. Its aroma and flavor are concentrated by means of infusion, when combined with citrus juices its taste is highlighted (Franzen et al., 2016).

The hibiscus (Hibiscus sabdariffa L.) belongs to the Malvacea family, native to the African continent and widely distributed in tropical regions. Considered Hawaii's state flower, it is used in the preparation of various dishes and typical drinks (Vicente et al., 2014; Franzen et al., 2016). The hibiscus stands out in the ornamental area with a variety of colorful flowers, but in recent years has been gaining ground in the food industry with its edible flowers that have vitamins A and E, quercetin and anthocyanins (Leal, 2008).

Despite the potential use of hibiscus and roses for the production of jellies, their chemical characterization, microbiological quality and nutritional information is still scarce in the literature. Thus, the objective of this work was to prepare jellies from petals of roses and hibiscus and evaluate their physical-chemical, microbiological and sensory characteristics.

2 I MATERIALS AND METHODS

The experiments were performed in three stages. The first stage, the production of the flowers, was done at the Floriculture Sector of the Department of Plant Science at UFSM, located in Santa Maria, RS (29°43'S; 53°43'W and altitude of 95 m). The flowers of the species of roses (*Rosa x grandiflora* Hort.) and hibiscus (*Hibiscus rosa-sinensis* L.) were collected from plants grown in a greenhouse, with two years of cultivation. All species were watered daily and cultivated without the use of fertilizers and chemicals. The flowers were harvested by hand, in the morning period, and allocated in thermal packaging, being then transported to the physics and chemistry laboratory of the Department of Technology and Food Science at UFSM (DTCA). The commercial hibiscus (*Hibiscus sabdariffa* L.) was obtained from a local company in commercial packages with 250g of dehydrated flowers.

The second stage, the preparation of jellies, was carried out in the laboratory of food processing at the DTCA, with the selection and pre-cleaning of rose petals and hibiscus and the preparation of jellies, in accordance with the formulations of jellies and the selection of ingredients as stated in the Technical Regulation n. 272 for products made of vegetables, fruit or edible mushrooms (Brazil, 2005; Licodiedoff, 2008). The other ingredients, such as crystal sugar (Alto Alegre®), pectin (Mago®) and citric acid (Arcólor®), were obtained in a local supermarket. The formulations for the edible flowers jellies are shown in Table 1.

Ingredients	Jams			
	Rose petal tea	Rose powder	Cultivated Hibiscus tea	Commercial Hibiscus tea
Petals (g)	250	46.7	250	25
Sugar (g)	1.000	1.000	1.000	1.000
Water (mL)	1.000	1.000	1.000	1.000
Pectin (g)	10	10	10	10
Citric acid (g)	0.3	0.3	0.3	0.3

Table 1. Formulations of jellies prepared with edible flowers.

For the rose petal tea jelly, there was a mixture of petals with hot water and after 5 mins of boiling and infusion, this solution was filtered and used to prepare the jelly. For the rose powder jelly, it was carried out a pre-drying of the petals (250g) in an oven with air circulation at ± 55°C and partially dried petals were obtained (46.7g). After drying, the petals were made into powder with a household blender (Walita Liqfaz®) and added to a previously prepared solution with water and part of the sugar (50%).

Subsequently, with approximate concentration of 20ºBrix, it was added pectin in a mixture with sugar at a ratio of 1:5 (p/p) to provide its dissolution, not to form lumps and to obtain the desired effect of jelly formation. The remaining of the sugar was added to the formulation as well as the citric acid, the last ingredient, added at the end of the concentration process, to avoid the destruction of the pectin and the consistency of the formed jelly.

The hibiscus jellies were prepared only with the solution of the petals in water, equally as described above for the preparation of rose petal tea jelly. As for the preparation of the commercial hibiscus jelly, it was used 25g of petals, in accordance to the producer's recommendation (5g of petals of hibiscus into 200mL of water).

The jellies were concentrated by boiling in an open stainless steel pan, with continuous manual agitation until reaching proper semi-solid consistency, verified by the content of soluble solids higher than 65ºBrix using the Abbé refractometer. The final temperature was 102ºC and the time for the completion of the jelly production varied from 45 to 50 mins.

After this step, the jelly was bottled in glass jars with 500g capacity, previously sterilized at 100°C for 15 mins, then sealed with metal lids sterilized for 5 mins, and then reversed. After 48 hrs, the flower petal jellies were taken for analyzes of chemical and microbiological composition and sensory acceptance and preference in the laboratories of the DTCA/UFSM.

To determine the chemical composition of the jellies, we evaluated humidity contents (012/IV), ashes (018/IV), protein (037/IV) and total sugars as sucrose (039/IV), according to the methodology of the Adolfo Lutz Institute (IAL, 2008). We also evaluated water activity (Aw) by the *Aqualab - Decagon Devices* equipment by quantifying the transience of water and dielectric constant (device with accuracy ± 0.015 and resolution 0.001); the pH, by potentiometry (017/IV-IAL, 2008; pHmeter *Digimed*); and soluble solids content (°Brix) by refractometry.

For the evaluation of the microbiological quality, the parameters of the Resolution - RDC No. 12 of 2001 - Technical Regulations for microbiological standards for food products (Brazil, 2001) were observed. For jellies, it requires the analysis of Yeasts and Molds. This analysis was performed according to the methodology recommended by the *American Public Health Association* (APHA, 1992).

All determinations were performed in triplicate and results were expressed in average. The data were submitted to variance analysis and the averages were compared by Tukey test ($p<0.05$) using the IBM® SPSS® Statistcs software (Version 20).

The third stage of the experiment was the realization of sensory analysis at the Sensory Analysis Laboratory. The sensory tests were approved by the Ethics Committee of the Federal University of Santa Maria (UFSM) under the protocol no. 47807315.1.0000.5346.

The affective acceptance tests were performed according to Lawless and Heymann (2010) and preference tests according to the methodology proposed by the Adolfo Lutz Institute, no.164/IV (2008). The sensory analysis was performed by 80 untrained tasters who agreed to sign the Informed Consent Form. For the acceptance test it was used the hedonic scale (Figure 1) structured with seven points containing defined terms, situated between (1 = I disliked it very much and 7 = I liked it very much). For the calculation of Acceptability Index (AI) of the product, it was adopted the expression AI (%) = A x 100 / B, where A = average score obtained for the product, and B = maximum score given to the product.

Sensory evaluation - Stage I							
Acceptance testing - prove and evaluate the attributes.							
Attributes	I really liked it (7)	I liked it very much (6)	I liked it (5)	Indifferent (4)	I disliked it(3)	I disliked it very much (2)	I really disliked it (1)
Color							
Aroma							
Taste							
Texture and/or consistency							
Overall appearance							
step II							
Preference test - check the sample of your choice.							
Sample A ( )				Sample B ( )			

Figure 1. Sensory evaluation formulary for acceptance and preference testing of flower jellies.

Sensory evaluations were performed in a room with individual cabins, at the Sensory Analysis Lab of the DTCA. The samples were served at appropriate temperature, that is, around 25°C, in disposable transparent plastic cups, with approximately 5g.

The cups were coded with three random digits to avoid the induction to error. Furthermore, all tasters were offered toasts to be eaten with the samples of jelly, and a glass of water at room temperature to provide the cleaning of the taste buds between the evaluations. In the acceptance test, the attributes of color, aroma, taste, texture and overall appearance were evaluated by tasters, aged between 18 and 70 years old.

3 I RESULTS AND DISCUSSION

Table 2 shows the results of the physical-chemical analyzes made with the edible flowers jellies.

Determinations	Jellies			
	Rose in tea	Rose powder	Cultivated Hibiscus tea	Commercial Hibiscus tea
Humidity (g $100g^{-1}$)	$20.37\pm0.507^{b*}$	19.03 ± 0.431^{c}	30.73 ± 0.623^{a}	20.20 ± 0.318^{bc}
Water activity	0.807 ± 0.001^{b}	0.781 ± 0.001^{c}	0.882 ± 0.001^{a}	0.752 ± 0.001^{d}
Dry matter (g $100g^{-1}$)	79.62 ± 0.507^{b}	80.97 ± 0.431^{a}	69.27 ± 0.623^{c}	79.80 ± 0.318^{ab}
Ashes (g $100g^{-1}$)	0.10 ± 0.008^{a}	0.13 ± 0.029^{a}	0.09 ± 0.008^{a}	0.13 ± 0.025^{a}
Protein (g $100g^{-1}$)	0.05 ± 0.008^{b}	0.26 ± 0.028^{a}	0.10 ± 0.046^{b}	0.08 ± 0.010^{b}
Total Sugars **	69.76 ± 0.858^{a}	70.98 ± 3.260^{a}	59.00 ± 1.784^{b}	68.94 ± 0.201^{a}
Soluble Solids ° Brix	68^{a}	69^{a}	67^{a}	69^{a}
pH	3.95 ± 0.065^{b}	3.89 ± 0.155^{b}	4.64 ± 0.055^{a}	3.01 ± 0.032^{c}

Table 2. Physical-chemical analysis of edible flower petal jellies

*Averages in the same row with different letters are significantly different, at the level of 5% by Tukey test ($p<0.05$). ** g% in Sucrose.

Due to the scarcity of studies on the composition and characterization of flower petal jellies, the values obtained in this study were compared to fruit jellies (pears, pineapple, apple and guava) and some exotic jellies (cubiu, cajá-mango, cambuci pepper, yacon and acerola berry).

The humidity values ranged from 19.03% (rose powder formulation) to 30.73% (cultivated hibiscus formulation) showing significant differences between them. These values are similar to those reported by Foppa *et al.* (2009) who obtained 21% humidity for jelly made with the Housui pear and 23% for the water pear. The humidity values of a product are important for its storage, since high levels favor the growth of yeasts and filamentous fungi (Damiani *et al.*, 2009; Leão *et al.*, 2012).

The humidity variations in the products are probably due to differences in chemical bonding to the viscous jelly formation, which is influenced by different anions and their ionic fractions toward the ability to bind to water in the jelly due to the presence of calcium and/or sugar (Santos, 2012).

The water activity values varied significantly between formulations with values between 0.752, for the commercial hibiscus jelly, and 0.882, for the cultivated hibiscus jelly. This variation may be explained by the different types of flowers used in the formulations.

The formulation with the rose petals powder was cooked equally long, but the procedural differences (addition of powder) favored the reduction of humidity. In addition to that, the sugar retention capacity reduces the free water concentration, reflecting in the parameters of water activity and humidity. It is noteworthy that the current Brazilian legislation for fruit products established by the National Health Surveillance Agency sets no limit for humidity in jellies (Brazil, 2005).

Regarding the results of ashes or mineral residues, it may be observed that there were no significant differences ($p>0.05$) between samples. The rose powder jelly and the commercial hibiscus jelly obtained 0.13% of ashes, while the rose tea jelly and cultivated hibiscus tea jelly obtained 0.10% and 0.09%, respectively, indicating that different preparation methods (tea or powder) did not affect the ashes content in the product.

Similar values were observed by Polesi *et al.* (2011), which in mango jellies obtained ashes content of 0.24% for the control jelly and 0.44% for the *diet* jelly, in this case the difference may be explained by the use of sodium based sweeteners added to the formulations. The results are also similar to those observed in common pineapple and apple jellies, with 0.3% and 0.2% of ashes, respectively (USP, 2008).

The protein content of the jelly made with rose petals powder was significantly higher ($p<0.05$) than the jellies prepared with tea, which may be explained by the presence of the flower into the formulation.

Polesi *et al.* (2011) analyzed low-calorie mango jellies and found levels of protein similar to those found in rose petals and hibiscus tea jellies of this study, where the control obtained 0.06% and diet jelly obtained 0.04%, possibly caused by the composition and purity of hydrocolloids. Granada *et al.* (2005), working with a light pineapple jelly, found protein values (ranging from 0.21 to 0.28%) not far from those of the rose petal powder jelly (0.26%) from this study.

The results referring to sugars ranged between 59% to 70.98% of total sugars in the formulations. Yuyama *et al.* (2008) when analyzing sugars in Cubiu jelly, a fruit native to the Amazon, showed 67.15% of total sugars and pH of 3.34. Lago-Vanzela *et al.* (2011) reported for caja-mango jelly 65.5% of total sugars, 66ºBrix and pH of 3.28. Nascimento *et al.* (2012) evaluated the composition of Cambuci pepper jelly and showed total carbohydrates of 55.65%, pH at 4.83 and 58°Brix. According to Prati *et al.* (2005), there is a proportional relation between soluble solids and sugars, the higher the content of soluble solids, the higher the sugar content.

The total soluble solids (°Brix) showed values between 67º and 69ºBrix. The amount of added sugar in the formulations was established at the proportion of 50% for the formation of a firm jelly and soluble solids objectified in the final product. Observing the results of the produced flower jellies, it is noted that the flower petals did not increase the concentration of soluble solids in the products, and that these values are lower than those found in the Housui pear jelly (79ºBrix) and water pear jelly (77ºBrix) (Foppa *et al.* 2009), indicating the addition of a high concentration of commercial sugar in the processing of pear jellies.

The pH values for the formulations of flower petal jellies varied between 3.01 and 4.64. All jelly formulations, except the one with commercial hibiscus, obtained pH values above the values found by Prati *et al.* (2005) in jellies made with *Yacon*, guava and acerola berry, with values of 3.45. Foppa *et al.* (2009), when preparing Housui pear and water pear jellies, found similar pH values (4.42 and 3.75, respectively). Furthermore, the jellies obtained pH values above 3.0, which were suggested by Lago *et al.* (2006).

The determination of pH, as well as the acidity and the concentration of soluble solids is important in the formation of the viscosity in the jellies. The degree of esterification of pectin also influences on the characteristics of the jellies, pectin with a high degree of methoxylation is used to make conventional jellies and form a strong and stable jelly in solutions with soluble solids content higher than 55% and pH ranging from 2.8 to 3.5. Higher pH values result in soft jellies, lower pH values (until pH = 2.0) result in very hard jellies and in very low pH (less than 2.0) the pectin is hydrolyzed (Seravalli and Ribeiro, 2004).

For the production of jellies, the acidity is important in order to obtain a good viscosity and to enhance the natural flavor of the raw material, and it also prevents sugar crystallization. These added acids are normally organic, are naturally found in fruits, such as the citric acid and the malic acid (Krolow, 2005).

The jellies were microbiologically evaluated on day 0 (zero) and on the 180th day of storage in environment-like conditions of light and temperature. The produced jellies showed counts of molds and yeasts on day 0 <4 log CFU g^{-1} (1.30 Log), and on the 180th day (6th month), the counts remained <4 log CFU g^{-1} (2.30 Log). Furlanetto (2015) produced four different types of *maná cubiu* jellies and evaluated their shelf-life (molds and yeasts counts) during 120 days and found counts <4 log CFU g^{-1} (1.0 Log).

The results showed that the jellies were within the microbiological quality standards required by law (Brazil, 2001) and that the standards of Good Manufacturing Practices (GMP) were followed satisfactorily during the preparation of the products.

In sensory analyses, the jellies showed a firm consistency, with a good spreadability to be handled, taste and aroma characteristic of the flowers, and attractive colors.

The results of the sensory analysis of acceptance of the jellies prepared with petals of roses and hibiscus showed that the formulation with rose petal tea differed significantly ($p<0.05$) from the formulation with rose petal powder, in relation to color, taste and overall appearance (Table 3).

Attributes	Jellies			
	Rose petal tea	Rose powder	Cultivated Hibiscus tea	Commercial Hibiscus tea
Color	5.94[a*]	5.57[c]	4.94[d]	5.83[b]
Aroma	5.06[c]	5.11[b]	4.80[d]	5.27[a]
Taste	5.58[b]	5.12[c]	4.80[d]	5.95[a]
Texture	4.83[b]	4.85[b]	4.17[c]	5.94[a]
Overall appearance	5.60[b]	5.10[c]	4.61[d]	5.87[a]

Table 3. Averages of the values attributed to jellies made of petals of roses and hibiscus in sensory evaluations using hedonic scale of seven points

*Averages followed by the same letters in the same line do not differ statistically by variance analysis (ANOVA) at 5% ($p<0.05$).

The most accepted formulation was the one prepared with rose petal tea, it received the best judgments, reaching averages between 5 and 6 on the hedonic scale, corresponding to “I liked it” and “I liked it very much”, respectively. The formulation with rose petal powder showed no significant difference ($p<0.05$) for the taste and texture variables, differing on the other variables, where the formulation with rose petal tea achieved higher average (5.60) in the overall appearance of the product, corresponding to “I liked it very much”.

The results also show that the jelly formulation with commercial hibiscus differed significantly ($p<0.05$) from the jelly formulation with cultivated hibiscus, in relation to all evaluated attributes. The mostly accepted formulation was the one with commercial hibiscus, as it received the best ratings, reaching averages between 5 and 6 on the hedonic scale. The jelly formulation with commercial hibiscus reached higher average on all attributes, averaging 5.87 in overall appearance, corresponding to “I liked it very much”.

In order for a product to be accepted in terms of its sensory properties by the consumer, it is necessary to obtain an acceptance rate of at least 70% (Dutcosky, 2011). The rates of acceptability of the jellies were 80.71%, for the jelly made with rose petal tea, 73.57% for the one made with rose petal powder, 68.21% for the one made with cultivated hibiscus tea, and 85.71% for the one made with commercial hibiscus tea. The mentioned percentage of 70% of acceptability is equivalent to ≥ 5 ratings in the hedonic scale adopted. In this context, it may be affirmed that the commercial hibiscus jelly showed the highest acceptance rate for all attributes evaluated, and the lowest acceptance rate was presented by the cultivated hibiscus jelly. According to this criterion, it is noted that the formulations of jellies with roses and commercial hibiscus would be well accepted by the consumer market if they were available for sale.

In the comparison between the rose petal tea jelly and the rose powder jelly for the preference test with bilateral paired comparison, the rose petal tea jelly obtained the preference of 50 out of 80 tasters. And when comparing the jellies of cultivated and commercial hibiscus, both in tea, the preference test with bilateral paired comparison showed the preference for the commercial hibiscus jelly in 68 out of the 80 tasters; the minimum number required to obtain significant preference at the level of 5% of significance, and according to the table of bilateral paired comparison test, is of 42 to 80 tasters (Newell and Macfarlane, 1987). There was a significant difference in the overall appearance in the samples of rose petal tea jelly, cultivated hibiscus jelly and commercial hibiscus jelly.

4 I CONCLUSIONS

Edible flowers are viable raw materials for the development of new products and present a good potential for the preparation of jellies. The physical-chemical analysis of the jellies showed that these formulations meet the Brazilian legislation, as well as microbiological standards. The acceptance analysis showed that the formulation with rose petal tea and commercial hibiscus had higher acceptance averages in all attributes when compared to formulations with rose petal powder and cultivated hibiscus, making them the preferred jellies in this study.

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REFERENCES

American Public Health Association – APHA. 1992. **Technical committee on microbiological methods for food.** In: Vanderzant, C.; Splittstoesser, D. F. Compendium of Methods for the Microbiological Examination of Foods. 3rd ed. Washington. USA. 336-383 p.

Brasil. Agência Nacional de Vigilância Sanitária. Ministério da Saúde. 1978. **Resolução Normativa nº. 15 de 4 de maio de 1978. Define termos sobre geléia de frutas.** Diário Oficial da União, Brasília, DF, 4 mai. 1978.

Brasil. Agência Nacional de Vigilância Sanitária. Ministério da Saúde. 2001. **Resolução RDC nº. 12, de 02 de janeiro de 2001. Regulamento Técnico sobre os Padrões Microbiológicos para Alimentos.** Diário Oficial da União, Brasília, DF, 10 jan. 2001.

Brasil. Agência Nacional de Vigilância Sanitária. 2005. **Regulamento Técnico Para Produtos de Vegetais, Produtos de Frutas e Cogumelos Comestíveis. RDC nº 272, de 22 de setembro de 2005.** Diário Oficial da República Federativa do Brasil, Poder Executivo, Brasília, DF, 23 set. 2005.

Brasil. Ministério da Educação. 2007. Secretaria de Educação Profissional e Tecnológica. **Doces e geleias.** Brasília, novembro de 2007. Disponível em: <http://portal.mec.gov.br/setec/arquivos/pdf3/publica_setec_doces_geleias.pdf> Acesso em: 07 dez. 2017.

Damiani, C., Vilas Boas, E. V. B., Soares Junior, M. S., Caliari, M., Paula, M. L., e Asquier, E.R. 2009. **Avaliação química de geleias de manga formuladas com diferentes níveis de cascas em**

substituição à polpa. Ciência e Agrotecnologia, Lavras. 33(1), 177-184. Retrieved from https://www.researchgate.net/publication/250050274_Avaliacao_quimica_de_geleias_de_manga_formuladas_com_diferentes_niveis_de_cascas_em_substituicao_a_polpa

Dutcosky, S. D. 2011. **Análise sensorial de alimentos.** 3. ed., rev. e ampl. Champagnat. Curitiba. Brasil. 426 p.

Foppa, T., Tsuzuki, M. M., e Santos, C. E. S. 2009. **Caracterização físico-química da geleia de pêra elaborada através de duas cultivares diferentes: pêra d'água (*Pyrus communis* L.) e housui (*Pyrus pyrifolia* nakai).** Revista Brasileira de Produtos Agroindustriais, Campina Grande, 11(1), 21-25. Retrieved from http://www.deag.ufcg.edu.br/rbpa/rev111/Art1114.pdf

Franzen, F. L., Richards, N. S. P. S., Oliveira, M. S. R., Backes, F. A. A. L., Menegaes, J. F., e Zago, A. P. 2016. **Caracterização e qualidade nutricional de pétalas de flores ornamentais.** Acta Iguazu, Cascavel, 5(3), 58-70. Retrieved from http://e-revista.unioeste.br/index.php/actaiguazu/article/view/15834/10752

Furlaneto, K. A. 2015. **Qualidade nutricional e aceitabilidade da geleia convencional e light de maná cubiu.** 69f. (Dissertação de Mestrado) – Universidade Estadual Paulista, Botucatu, Brasil.

Granada, G. G., Zambiazi, R. C., Mendonça, C. R. B., e Silva, E. 2005. **Caracterização física, química, microbiológica e sensorial de Geleias light de abacaxi.** Ciência e Tecnologia de Alimentos, Campinas, v.25, n.4, 629-635. Retrieved from http://www.scielo.br/pdf/cta/v25n4/27628.pdf

Instituo Adolfo Lutz – IAL. 2008. **Métodos físico-químicos para análise de alimentos.** Coordenadores Zenebon O., Pascuet, N.S., e Tiglea, P. 4ª Edição, São Paulo. Brasil. 1020p. Retrieved from http://www.crq4.org.br/sms/files/file/analisedealimentosial_2008.pdf

Krolow, A. C. R. 2005. **Preparo artesanal de geleias e goleadas.** Empresa Brasileira de Pesquisa Agropecuária - Embrapa. 1° edição, Embrapa Clima Temperado. Pelotas. RS. Brasil.

Lago, E. S., Gomes, E., e Silva, R. 2006. **Produção de geléia de jambolão (*Syzygium cumini* Lamarck): Processamento, Parâmetros físico-químicos e avaliação sensorial.** Ciência e Tecnologia de Alimentos, Campinas, v.26, n.4, out.-dez. 847-852. Retrieved from http://www.scielo.br/pdf/cta/v26n4/20.pdf

Lago-Vanzela, E. S., Ramin, P., Umsza-Guez, M. A., Santos, G. V., Gomes, E., e Silva, R. 2011. **Caracterização química e sensorial de geléia da casca e polpa de cajá-manga (*Spondias cytherea* Sonn.).** Revista Ciência e Tecnologia de Alimentos, v.31, n.2, 398-405. Retrieved from http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0101-20612011000200018

Lawless, H. T., e Heymann, H. 2010. **Sensory Evaluation of Food: Principles and Practices.** 2ª Ed. Springer. New York. USA. 596 p.

Leal, R. S. 2008. **Estudo etnofarmacologico e fitoquímico das espécies *Cleome spinosa* Jacq, *Pavonia varions* Moric e *Croton cajucara* Benth.** 430f. (Tese Doutorado em Química) Universidade Federal do Rio Grande do Norte. Natal. Brasil.

Leão, K. M. M., Boudou, F. S. T., Castro, A. A., e Figueiredo, A. V. D. 2012. **Formulação e avaliação físico-química de geleia de mamão (*Carica papaya* L.).** Scientia Plena, Sergipe, v. 8, n. 3, 1-3. Retrieved from https://www.scientiaplena.org.br/sp/article/view/925

Licodiedoff, S. 2008. **Influência do teor de pectinas comerciais nas características físico-químicas e sensoriais da geleia de abacaxi (*Annas comosus* (L.) Merrill).** 119f. (Dissertação Mestrado em Tecnologia de Alimentos) Universidade Federal do Paraná. Curitiba. Brasil.

Nascimento, K. O., Vicente, J., Saldanha, T., Barbosa Júnior, J. L., e Barbosa, M. I. M. J. 2012.

Caracterização química e informação nutricional de geléia orgânica de pimenta "Cambuci". Revista Verde de Agroecologia e Desenvolvimento Sustentável. Revista Verde, v. 7, n. 2, abr-jun. 283-288. Retrieved from http://www.gvaa.com.br/revista/index.php/RVADS/article/view/1304/1265

Newell, G. J., e Macfarlane, J. D. 1987. **Expanded Tables for Multiple Comparison Procedures in the Analysis of Ranked Data.** Journal of Food Science, 52, 1721-1725. Retrieved from http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2621.1987.tb05906.x/abstract

Polesi, L. F., Matta Junior, M. D., Matsuoka, C. R., Ceballos, C. H. M., Anjos, C. B. P., Spoto, M. H. F., e Sarmento, S. B. S. 2011. **Caracterização química e física de geleia de manga de baixo valor calórico.** Revista Brasileira de Produtos Agroindustriais, Campina Grande, v.13, n.1, 85-90. Retrieved from http://www.deag.ufcg.edu.br/rbpa/rev131/Art13111.pdf

Prata, G. G. B. 2009. **Compostos bioativos e atividade antioxidante de pétalas de rosas de corte.** (Dissertação Mestrado Ciência e Tecnologia de Alimentos) - Universidade Federal da Paraíba. João Pessoa. Brasil.

Prati, P., Moretti, R. H., e Cardello, H. M. A. B. 2005. **Elaboração de bebida composta por mistura de garapa parcialmente clarificada-estabilizada e suco de frutas ácidas.** Revista Ciência e Tecnologia de Alimentos, Campinas, v. 25, n.1, 147-152. Retrieved from http://www.scielo.br/pdf/cta/v25n1/a23v25n1.pdf

Roriz, V. 2010. **Nutrição em Foco.** São Paulo. Brasil.

Santos, O. S., Melo, E. F. R. Q., e Menegaes, J. F. 2012. **Cultivo hidropônico de nastúrcio.** In: Santos, O. S. Cultivo Hidropônico. UFSM/Colégio Politécnico. Santa Maria. Brasil. 264p.

Santos, C. O. 2012. **Aproveitamento Industrial de "mel" de cacau (*Theobroma cacao* L) na produção de geleia sem adição de açúcar.** (Dissertação Mestrado Ciência de Alimentos). Universidade Federal da Bahia, Salvador. Brasil.

Seravalli, E. A. G., e Ribeiro, E. P. 2004. **Química de alimentos.** Edgard Blucher Ltda. São Paulo. Brasil.

Universidade de São Paulo – USP. 2008. **Tabela brasileira de composição de alimentos (TBCA-USP 5.0).** Disponível em: <http://www.intranet.fcf.usp.br/tabela/>. Acesso em: 07 dez. 2017.

Vicente, J., Nascimento, K. O., Saldanha, T., Barbosa, M. I. M. J., e Barbosa Júnior, J. L. 2014. **Composição química, aspectos microbiológicos e nutricionais de geléias de carambola e de hibisco orgânicas.** Revista Verde de Agroecologia e Desenvolvimento Sustentável, Revista Verde. Pombal. Brasil, v 9. , n.3. 137 – 143. Retrieved from http://www.gvaa.com.br/revista/index.php/RVADS/article/view/2681/2378

Yuyama, L. K. O., Pantoja, L., Maeda, R. N., Aguiar, J. P. L., e Silva, S. B. 2008. **Desenvolvimento e aceitabilidade de geleia dietética de cubiu (*Solanum sessiliflorum* Dunal).** Ciência e Tecnologia de Alimentos, v.28, n.4. 929-934. Retrieved from http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0101-20612008000400026

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