EUROPEAN ACADEMIC RESEARCH
Vol. VIII, Issue 1/ April 2020

Impact Factor: 3.4546 (UIF)
DRJI Value: 5.9 (B+)

ISSN 2286-4822
www.euacademic.org

Mixed Tropical Juice of Cocona and Pineapple Has Market Potential

CÉSAR AUGUSTO TICONA-BENAVENTE
Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil
RÂNDREA GRAZZIELLA VERÇOSA GUIMARÃES
Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil.
THIAGO MORAES PANTOJA E SILVA
Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil
LEANDRO SOUZA E SILVA
LUCIA SCHUCH BOEIRA
Instituto Federal de Ensino, Pesquisa e Extenção, Manaus, Brazil

Abstract

The Amazon is a world leader in terms of plant diversity. However, many Amazonian fruits have not entered in the market, as for example, the cocona (Solanum sessiliflorum Dunal). The objective of this work was to select one fruit, widely commercialized such as orange, tangerine, pineapple, passion fruit, strawberry, guava or pitaia, to use in combination with cocona to develop a mixed juice with a high potential market. The juice of each fruit employed was obtained using a domestic processor and diluted with water in a 1:1 ratio. The juice combinations to prepare the mixed juice also followed a 1:1 ratio. The seven mixed juices were evaluated using the preference test and the combination of cocona + pineapple was selected by 84% of the untrained tasters. Then, three mixed juices were prepared with both fruits: i) whole cocona + pineapple, ii) whole cocona blanched + pineapple and iii) cocona placenta + pineapple. The mixed juices (i) and (ii) were composed of both fruits plus water in 1:1:2 ratio and (iii) 1:1:20 ratio with 120 g/L of sugar added. The results obtained by the scores of 52 to 58 untrained tasters showed no difference in both acceptability and purchase intent tests for three mixed juices. The acceptance index for the mixed juices (i) and (ii) were 81% and 83%,

respectively, demonstrating a high potential to be commercialized. Also, the blend (iii) showed a high market potential (81%) being an alternative for the manufacture of mixed sweetened drinks or soft drinks.

Key words: *Solanum sessiliflorum*, cubiu, *Ananas comosus,* pineapple cv. Turiaçu, tropical fruit, mixed juice.

INTRODUCTION

The Amazon is a world leader in terms of plant diversity. However, very few species have entered in the fruit market. One fruit that has market potential is the cocona (*Solanum sessiliflorum* Dunal) (Figure 1). This fruit is well adapted to the Amazon and has a peculiar and characteristic flavor and aroma, quite different from other fruits.

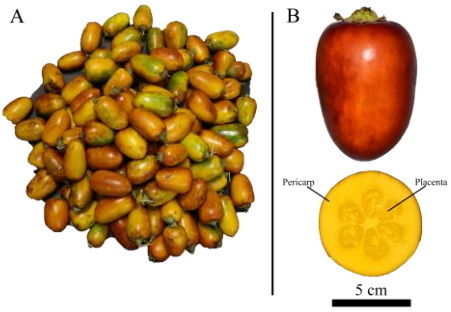

Figure 1. Fruits of cocona. A- Freshly picked cocona, as it is a climacteric fruit it can be picked partially ripened. B- Fully ripe fruit, CUB-08 genotype. (Photos of César Ticona)

The cocona is a species of the *Solanaceae* family and it is distributed in the Amazon of Peru, Colombia and Brazil, being known is these countries as topiro, cocona and cubiu, respectively. In Peru and Colombia, it is often used as a refreshing cold drink. In Brazil it is still unknown, although there are phytotechnical recommendations (Silva Filho 1998, 7-10) and well-characterized genotypes at the Instituto Nacional de Pesquisas da Amazônia, plant breeding laboratory (Silva Filho et al. 2005). The fruit yield of these varieties range between 50

to 100 t/ha, in an average cycle of 10 months, three months in a greenhouse making seedlings and seven months in the field, harvesting fortnightly since the fifth month. The fruit size, flavor and aroma vary between varieties (Andrade Júnior et al. 2016, 1193).

Despite the underuse of peach tomato, there is a promising future for this Amazonian species. Considering the data already published in the literature related to nutritional, functional, technological, agricultural and economical aspects of this fruit, it has clear potential for development of new food products in line with the five category groups regarding the demands and trends of global food consumers and market.

According to the Brasil Food Trends 2020 project, the demands and trends of global food consumers have been divided into five categories of groups: i) "sensoriality and pleasure", ii) "healthiness and well-being", iii) "convenience and practicality", iv) "reliability and quality " and v)" sustainability and ethics ". The trends of "sensoriality and pleasure" emphasize the interest in new flavors. Trends in "healthiness and well-being" have led to the demand for functional foods and the growth of a new generation of natural products. The trends of "convenience and practicality" have led to the consumption of products in small portions, with easy-to-open, closed and discarded packaging, products suitable for eating in different places and situations. These trends converge with the needs for healthiness and well-being, resulting in an increased demand for convenient foods based on plant products (fruits, vegetables, flowers and medicinal plants). The trends related to "reliability and quality" demand products developed based on good manufacturing practices and risk control to build the credibility of the product brands and gain the trust and preference of consumers. Trends related to "sustainability and ethics" have led to the emergence of consumers concerned with the environment and interested in products linked to social causes. In the Brazilian market, it was observed that trends tend to occur in a similar way to the international trends. Of the four trends found in Brazil, three of them are similar to the global ones (i, ii and iii), and the fourth would be a merger between iv and v (Barbosa et al. 2010, 43-47).

The cocona fruits have high moisture content and low concentrations of protein, lipids and carbohydrates and, consequently,

has low energy values (Yuyama et al. 2007, 427-428). It is an important source of soluble functional fibers (pectin), citric acid and ascorbic acid (Andrade Júnior et al. 2016, 1192). In addition, peach tomato has carotenoids (ß-carotene and lutein), flavonoids and other phenolic compounds. The 5-caffeoylquinic acid was the major and represented more than 78% of the total phenolic compounds (Rodrigues, Mariutti and Mercadante 2013, 3022). Other secondary metabolites found were *p*-cumaric acid, p-hidroxidihidric-cumaric acid (Cardona, Cuca and Barrera 2011, 197). In relation to minerals, depending on ethnovariety it contains potassium (513.5 mg/100g), calcium (18.8 mg/100g), magnesium (13.3 mg/100g), iron (564 µg/100g), chrome (99 µg/100g), copper (596 µg/100g), manganese (181 µg/100g) and selenium (3,93 µg/100g) (Yuyama et al. 2007, 428; Almeida and Pereira 2011, 13-15). Also, cocona has been shown to possess hypolipidemic properties (Maia et al. 2015, 118) and antimicrobial activity effective against bacteria and yeasts, including strains of *Shigella, Pseudomonas, Salmonella, Staphylococcus, Escherichia coli* and *Candida* (Gonçalves et al. 2013, 1031-1032) and *Helicobacter pylori* growth *in vitro* (Sandoval 2010, 32).

Therefore, a mixed fruit juice of cocona with another fruit with a market already established and known by the population could be a way to boost the consumption and cultivation of cocona. To develop a mixed fruit juice, it is necessary to observe the legislation of each country as the definitions of juice and tropical juice may change. In the case of Brazil, the Instruction Normative Nº.12 (Brazil 2003, 2) defines tropical juice as the product obtained by dissolving the pulp in drinking water through an appropriate technological process, not fermented, with the characteristic color, aroma and flavor of the fruit, submitted to treatment that ensures its conservation and presentation until the moment of consumption. The minimum percentage of pulp in the tropical juice must be 50% and in the case of sweetened tropical juice is 12%, depending on the fruit. For cocona, the minimum amount of pulp for the preparation of tropical juice has not yet been fixed in specific technical regulation.

The objective of this work was to select one fruit, already widely commercialized such as orange, tangerine, pineapple, passion fruit, strawberry, guava or pitaia, to use in combination with cocona to develop a mixed juice with a high potential market.

MATERIALS AND METHODS

The experimental work was carried out at the Food Technology Laboratory of the Institute Federal of Education, Science and Technology of Amazonas (IFAM), Manaus, Brazil.

Fruits employed

The cocona fruits used were selected by their average mass (200 g) from a mutant population of generation M_2 (n = 600) of the genotype CUB-08, which belongs to the germplasm bank of the Instituto Nacional de Pesquisas da Amazônia – INPA, located in Manaus, Brazil. The pineapple (*Ananas comosus* var. Comosus) cv. Turiaçu, was supplied by the Cooperative of the Novo Remanso – COOPANORE, located in Itacotiara, Amazonas state, Brazil. The other fruits employed (orange cv. Pear, tangerine, pitaia, strawberry, sour passion fruit and guava) were purchased in local stores.

Juice elaboration

The fruits were selected, washed, sanitized and the juice was obtained using a domestic processor (Juicer Compact Philips Walita). All juices were diluted with water in a 1: 1 ratio.

Mixed juice elaboration

The tested combinations for develop the mixed juice were cocona + orange, cocona + tangerine; cocona + sour passion fruit, cocona + pineapple, cocona + guava, cocona + strawberry and cocona + pitaia. All combinations for elaboration of the mixed juice also followed a 1:1 ratio. The mixed juices elaborated were immediately submitted to sensory analysis through the use of a preference test by a team of twenty untrained tasters.

Mixed juice of cocona and pineapple elaboration

In these experiments it was employed the whole cocona fruit and cocona placenta for elaboration of mixed juices. The blanching of the whole cocona fruits was carried out in water at 90 ºC for 5 minutes. The combinations for elaboration of mixed juices were i) whole cocona (WC) + pineapple, ii) whole cocona blanched (WCB) + pineapple and iii) cocona placenta (CP) + pineapple. All juices were diluted with

water (1: 1) and the elaborated combinations also followed a 1:1 ratio, with exception of combination with the cocona placenta. The cocona placenta was mixed with pineapple juice and water (1:1:20) and 120 g/L of sugar was added.

The three formulations i, ii and iii were subjected to sensory analysis by a team of 54, 52 and 58 untrained tasters respectively, using both acceptability and purchase intention tests. For the acceptability test it was used a balanced hedonic scale with nine points: (9) like extremely, (8) like very much, (7) like moderately (6) like slightly, (5) neither like nor dislike, (4) dislike slightly, (3) dislike moderately, (2) dislike very much and (1) dislike extremely (Meilgaard et al., 2016, 326). Based on the data from the sensory analysis, the Acceptance Index (AI) calculated according to the equation AI (%) = (NMA x 100) / NA, where: NMA = average grade of the attribute and NA = highest grade observed in the evaluated attribute. To assess the purchase intention, it was used a balanced hedonic scale with five points: (5) certainly would buy, (4) possibly would buy, (3) perhaps would buy / perhaps would not buy, (2) possibly would not buy and (1) certainly would not buy (Meilgaard et al., 2016, 326).

Physico-chemical analyses of mixed juices

The prepared drinks were subjected to analyses of pH, TSS content (Total Soluble Solids) and titratable acidity. All analyses were performed in duplicate. The TSS content (° Brix) was determined by direct reading in a portable refractometer (ATAGO) and the pH in pHmeter (HANNA). Titratable acidity (AT) was determined by potentiometric titration in 10 mL of the sample with 0.1 M sodium hydroxide solution to a pH range (8.2-8.4) and the results were expressed in g of citric acid per 100 g of sample (IAL, 2008).

Statistical analysis

The data obtained were subjected to analysis of variance and their averages were tested by the Scott and Knott test (P = 0.05) using the SAS 9.1.3 statistical program. With the preference test means of six mixed juice it was built a biplot of principal components based on correlations. This analysis was performed using JMP 10 software.

RESULTS AND DISCUSSION

Among the seven combinations of fruits tested to develop the mixed juice, the preferred by the tasters were cocona + pineapple cv. Turiaçu (86%), followed by cocona + orange cv. Pear (7%) and cocona + sour passion fruit (7%). The other mixed juices elaborated were not preferred by none of the tasters that participated in the panel (Figure 2).

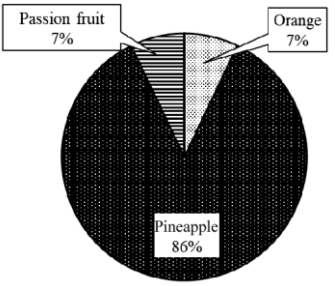

Figure 2. Preference obtained for the mixed juices of cocona (*Solanum sessiliflorum*) with different fruits (n = 20).

The fruits used in combination with cocona to prepare the mixed juice have very different chemical compositions and sensory characteristics. The data found in the literature for the pH, titratable acidity and TSS content in the fruits used in combination with cocona are demonstrated in Table 1.

Table 1. Data found in the literature for the pH, titratable acidity (TA, expressed in g of citric acid/ 100 mL) and TSS content (° Brix) in the fruits used for elaboration of mixed juice with cocona.

	pH		TA		TSS	
Fruit	Min.	Max.	Min.	Max.	Min.	Max.
Orange[1]	3.50	3.90	0.65	1.50	10.50	10.60
Tangerine[1]	3.85	4.05	0.80	1.02	14.33	19.00
Pitaia of red pulp[2]	5.09	5.60	0.26	0.35	12.10	13.80
Strawberry[3]	3.45	3.54	0.76	0.86	6.43	6.90
Guava[4]	3.47	3.80	0.55	1.03	6.80	8.00
Pineapple cv. Turiaçu[5]	3.69	4.10	0.41	0.90	13.84	17.11
Sour passion fruit[6]	3.04	3.08	6.46	7.24	12.68	13.58
Lemon cv. Tahiti[7]	2.06	2.75	5.56	6.75	8.16	8.90

[1](Couto and Canniatti-Brazaca 2010, 17); [2](Cordeiro et al. 2015, 24); [3](Marques et al. 2011, 209); [4](Bialves et al. 2014, 3); [5](Pereira 2013, 54); [6](Abreu et al. 2009, 490); [7](Pedrão et al. 1999) e (Brito et al. 2017, 67).

The pineapple cv. Turiaçu is characterized by being one of the sweetest in Brazil, with 13-17 °Brix (Pereira 2013, 54) and acidity of 0.41 to 0.90% citric acid (Araujo et al. 2012, 1273). Probably, these chemical characteristics could have contributed to balancing the cocona acidity (2.41%), increasing its palatability and reaching the preferred combination (Figure 1). These findings are according the traditional consumption of cocona juice in Iquitos, Peru, which occurs with sugar addition.

The pH, titrate acidity and TSS content in whole cocona, whole cocona bleached, cocona placenta, pineapple and mixed juices were determined and the results are shown in Table 2.

Table 2. Determination of pH, titratable acidity and TSS content (°Brix) in cocona and pineapple fruits and in the mixed juices.

Material	pH	Acidity (g citric acid / 100 mL)	TSS (°Brix)
Whole cocona (pulp + placenta) - WC	3.72	2.41	6
Whole cocona bleached - WCB	3.88	2.23	6
Cocona Placenta - CP	3.54	4.80	5
Pineapple cv. Turiaçu	3.88	-	16
Mixed juice WC + Pineapple[1]	3.89	0.99	-
Mixed juice WCB + Pineapple [1]	3.94	0.99	-
Mixed juice CP + Pineapple [2]	3.77	0.52	-

[1] Ratio of cocona, pineapple and water was 1:1:2 without added sugar.

[2] Ratio of placenta, pineapple and water was 1:1:20 with addition of 120 g/L of sugar

The three mixed juices of cocona + pineapple were analyzed considering the scores obtained in the acceptability and purchase intention tests (Table 3). Analysis of variance revealed that there was no difference on the scores obtained in the acceptability ($F = 1.96$, gl = 2 and 161, $P = 0.14$) and purchase intention ($F = 0.83$, gl = 2 and 161, $P = 0,44$) tests. Even so, it was observed that the three mixed juices had acceptance index above the average, with an acceptance index from 81% to 83%, values considered as indicators of a high potential to be commercialized in the market (Table 3).

Table 3. Mean scores obtained in the acceptability and purchase intention tests of the three mixed juices of cocona (*Solanum sessiliflorum*) and pineapple (*Ananas comosus* cv. Turiaçu).

Mixed juice	Acceptability†	Purchase intention††	Acceptance index (%)
WC + pineapple[1]	7.22 a	3.80 a	81
WCB + pineapple[1]	7.50 a	4.02 a	83
CP + pineapple[2]	6.40 a	3.79 a	81
Coef. of variation (%)	20.24	26.83	-

[1] Ration of WC (whole cocona), pineapple and water was 1:1:2 without sugar

[2] Ratio of CP (cocona placenta), pineapple and water was 1:1:20 with 120 g/L of sugar added

Equal letters in the column indicate that there is no significant difference between the means by the Scott and Knott test (P> 0.05)

† Scores varied from 1= dislike extremely to 9= like extremely

†† Scores varied from 1= certainly would not buy to 5= certainly would buy

The scores of the untrained tasters for the three mixed juices of cocona and pineapple in the acceptability and purchase intention tests are demonstrated in Figure 3.

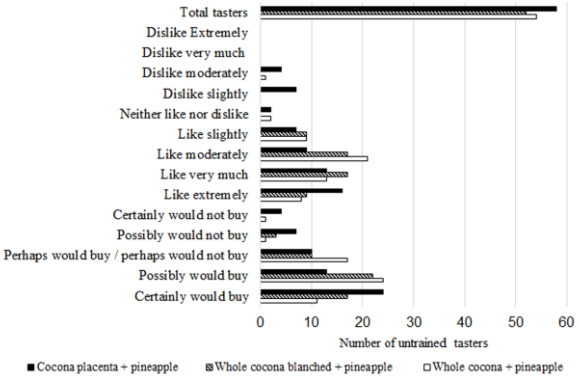

Figure 3. Scores percentage of the tasters for the three mixed juices of cocona and pineapple in the acceptability and purchase intention tests.

The percentage of tasters who scored ¨Like extremely¨ in the mixed juices of WC + pineapple, WCB + pineapple and CP + pineapple was 14,8%, 17.3% and 29.3%, respectively (Figure 3), but there was no significant difference between the mean scores of these three mixed juices (Table 3). For the purchase intention test, the percentage of tasters who scored "certainly would buy" were 20.4%, 32.7% and

41.4%, respectively (Figure 3). These results suggest that cocona placenta + pineapple could be a promising soft drink.

When the percentage equality test was used, a significant difference was only detected for the scores obtained in the purchase intention test between the mixed juices of cocona placenta + pineapple and the others two with whole cocona (Table 4).

Table 4. P-values of the equality test for the percentage of tasters that had the same score for the three mixed juices of peach tomato + pineapple in the acceptability and purchase intention tests

	Score		
Mixed juices	Like extremely	Like very much	Certainly would buy
(WC + pineapple[1]) vs (WCB + pineapple[1])	0.7266	0.3248	0.1503
(WC + pineapple) vs (CP + pineapple[2])	0.0998	0.8353	0.0165*
(WCB + pineapple) vs (CP + pineapple)	0.1990	0.2269	0.0368*

[1] Ration of WPT, pineapple and water was 1:1:2 without sugar

[2] Ratio of PTP, pineapple and water was 1:1:20 with 120 g/L of sugar added

* significant by the two-tailed Z test (P <0.05)

The significant difference encountered when the cocona placenta was used (Table 4) probably can be explained by chemical characteristics difference when compared the placenta and whole cocona (Table 2). The placenta had a higher titratable acidity (4.8%) than the whole cocona (2.41%), as well as a slightly lower TSS content. When the placenta was used to elaborate the juice, the dilution factor with water was higher and sugar was added making the blend less acidic and sweeter. These two characteristics probably interfered in the scores given by the tasters to reach an acceptance index similar to that obtained with the use of the whole cocona. Depending on the maturity of the cocona, there will be an influence on the content of acids and sugars present in the placenta, further sharpening the flavor (Andrade Júnior et al. 2016). Therefore, the use of the placenta can be a potential alternative for the manufacture of mixed sweetened drinks or soft drinks.

The cocona placenta has an acidity of 4.8% (Table 2), which is midway between that found in lemon (minimum = 5.56) or sour passion fruit (minimum = 6.46) and the rest of the fruits (maximum = 1.50). Using the values found in the literature (Table 1) with those of the cocona determined in this work and shown in Table 2, a principal

component analysis was performed based on correlations and then a biplot (Figure 2) was generated.

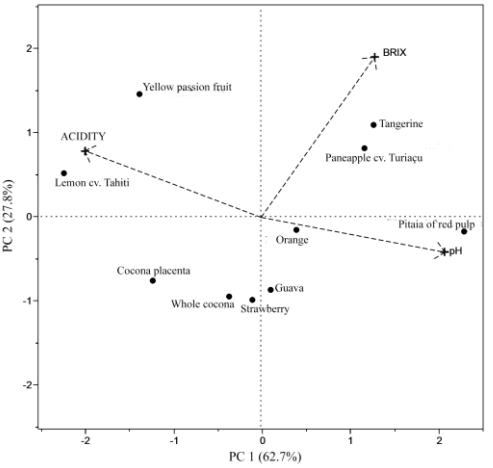

Figure 4. Biplot explain the variation observed in juices of some fruits in relation to titratable acidity, TSS content and pH.

The biplot (Figure 4) was able to explain 88.5% of the total variation and in it can be seen that the directions of vectors of TSS content (°Brix), pH and acidity are different, indicating that these parameters are capable of differentiating the juices from the tested fruits and perhaps this is the reason why they are used in technical standards. Analyzing the variability of the fruits, it is observed that the placenta of the cocona differs from the rest. On the other hand, the whole cocona (pulp + placenta) tended to resemble the strawberry and guava, which if in combination with cocona would leave the mixed juice low in sugar, which could be one possible explanation for the lack of preference for these combinations (Figure 1).

CONCLUSION

Considering the experimental conditions employed and the results obtained, it can be stated that among the fruits tested (orange, tangerine, pineapple, passion fruit, strawberry, guava or pitaia) the pineapple cv. Turiaçu was the selected fruit to use with cocona to produce a mixed juice with a high potential market. Future work will

be performed to identify the cocona genotype more adequate and to optimize the concentration of both fruits in the formulation of mixed juice developed. Also, the blend prepared with cocona placenta, sugar addition and higher dilution factor showed a high market potential and it can be an alternative for the manufacture of mixed sweetened drinks or soft drinks.

Acknowledgment
To the INPA (Instituto Nacional de Pesquisas da Amazônia) for financial and logistical support and to the IFAM **(**Institute Federal of Education, Science and Technology of Amazonas) by the PADCIT (Programa de Apoio ao Desenvolvimento de Pesquisa Científica aplicada à Inovação Tecnológica).

REFERENCES

1. Abreu, Simone P. M., José R. Peixoto, Nilton T. V. Junqueira, and Marcelo A. D. Sousa. 2017. "Características físico-químicas de cinco genótipos de maracujazeiro-azedo cultivados no Distrito Federal." *Revista Brasileira de Fruticultura* 31, no. 2 (June): 487-491. https://doi.org/10.1590/S0100-29452009000200024
2. Almeida, Sylvia R. O., and Isabela R. O. Pereira. 2011. "Estudo da composição de macro e micro nutrientes do fruto peach tomato." In Anais da VII Jornada de Iniciação Científica. I Mostra de Iniciação em tecnologia e Inovação, São Paulo, 2011. São Paulo: Universidade Presbiteriana Mackenzie. https://docplayer.com.br/10477882-Estudo-da-composicao-de-macro-e-micro-nutrientes-do-fruto-peach%20tomato-solanum-sessiliflorum.html
3. Andrade Júnior, Moacir C., Jerusa S. Andrade, and Suely S. Costa. 2016. "Biochemical changes of cubiu fruits (*Solanum sessiliflorum* Dunal, Solanaceae) according to different tissue portions and ripening stages." *Food and Nutrition Sciences* 7, no. 2 (October): 1191-1219. https://doi.org/10.4236/fns.2016.712111
4. Araujo, José. R. G., Rozalino A. A. Júnior, Afonso M. S. Chaves, Fabrício O. Reis, and Moisés R. Martins. 2012.

"Abacaxi 'Turiaçu': cultivar tradicional nativa do Maranhão." *Revista Brasileira de Fruticultura* 34, no. 4 (December): 1270-1276. https://doi.org/10.1590/S0100-29452012000400037

5. Barbosa, Lívia, Luis Madi, Maria Toledo A., Raul A. Rego. 2010. "As tendências da alimentação." In *Brasil Food Trends 2020*, 39-47. 1° edição. São Paulo: Gráfica Ideal. https://alimentosprocessados.com.br/arquivos/Consumo-tendencias-e-inovacoes/Brasil-Food-Trends-2020.pdf
6. Bialves, T. S., V. F. Araujo, M. Vizzotto, A. C. R. Krolow, N. M. L. Ferri, and J. C. Nachtigal. 2012. "Avaliação físico-química e funcional de goiaba (*Psidium guajava* L.) cultivar paluma em diferentes estádios de maturação." In Anais do IV Simpósio de Segurança Alimentar, Gramado, 2012. Gramado: Fundação de Apoio da Universidade Federal do Rio Grande do Sul. https://www.alice.cnptia.embrapa.br/bitstream/doc/940706/1/0000000890GoiabaGramado.pdf
7. Brasil. 2003. "Instrução normativa nº 12, de 4 de setembro de 2003." *Ministério da Agricultura Pecuária e Abastecimento*. Brasília: Governo Federal do Brasil. http://www.idec.org.br/pdf/instrucao-normativa-12.pdf
8. Brito, Kátia D., Josenildo I. S. Filho, Henrique B. L. Oliveira, Bruno G. Araújo, Emmanuel P. Neto, and Flávia C. S. Lima. 2013. "Estudo experimental do limão tahiti (*Citrus latifolia tanaka*): congelamento e caracterização termo-físico-química e sensorial da polpa e aproveitamento do albedo na síntese de pectinase." *Revista Principia*, no. 37 (August): 64-70. http://periodicos.ifpb.edu.br/index.php/principia/article/download/1298/778
9. Cardona, Juliana E. C., Luis E. Cuca, and Jaime A. Barrera. 2011. "Determinación de algunos metabolitos secundários en tres morfotipos de cocona (*Solanum sessiliflorum* Dunal)". *Revista Colombiana de Química* 40, no. 2 (June): 185-200. https://www.redalyc.org/pdf/3090/309026687007.pdf
10. Cordeiro, Maria H. M., Juceliandy M. Silva, Gisele P. Mizobutsi, Edson H. Mizobutsi, and Wagner F. Mota. 2015. "Caracterização física, química e nutricional da pitaia-rosa de

polpa vermelha." *Revista Brasileira de Fruticultura* 37, no. 1 (March): 20-26. http://dx.doi.org/10.1590/0100-2945-046/14

11. Couto, Meylene A. L., and Solange G. Canniatti-Brazaca. 2010. "Quantificação de vitamina C e capacidade antioxidante de variedades cítricas. " *Ciência e Tecnologia de Alimentos* 30, no. 1 (May): 15-19. https://doi.org/10.1590/S0101-20612010000500003
12. Gonçalves, Karla M., Pedro P. Soldati, Annelisa F. Silva, Rodrigo P. Venâncio, Maria G. A. M. Chaves, and Nádia R. B. Raposo. 2013. "Biological activities of *Solanum sessiliflorum* Dunal." *Bioscience Journal* 29, no. 4 (August): 1028-1037. http://www.seer.ufu.br/index.php/biosciencejournal/article/view/17325/12927
13. IAL (Instituto Adolfo Lutz). 2008. "Frutas e produtos de frutas – Determinação da acidez titulável por volumetria potenciométrica." In *Métodos físico-químicos para análise de alimentos*, coordinated by Odair Zenebon, Neus S. Pascuet and Paulo Tiglea, 580-581. São Paulo: Instituto Adolfo Lutz. http://www.ial.sp.gov.br/resources/editorinplace/ial/2016_3_19/analisedealimentosial_2008.pdf
14. Maia, J. R. P., M. C. Schwertz, R. F. S. Sousa, L. K. O. Yuyama, and E. S. Lima. 2015. "Efeito hipolipemiante da suplementação dietética com a farinha do cubiu (*Solanum sessiliflorum* Dunal) em ratos hipercolesterolêmicos." *Revista Brasileira de Plantas Medicinais* 17, no. 1 (June): 112-119. https://doi.org/10.1590/1983-084X/11_163
15. Marques, Débora. F., Andréa C. Gonçalves, Maria C. S. Anjos, Thayana L. Faskomy, Adriana M. Miranda, Henriqueta T. G. Barboza, Marcos J. O. Fonseca, Antonio G. Soares. 2011. "Características físicas e químicas de morango orgânico 'camino real' colhido em dois estádios de maturação." In Anais do III Simpósio Brasileiro de Pós-colheita, Rio de Janeiro, 2011. Piauí: Universidade Federal do Piauí. https://www.alice.cnptia.embrapa.br/bitstream/doc/973222/1/2011302.pdf
16. Meilgaard, Morten R., Gail V. Civille, and B. T. Carr. 2016. *Sensory evaluation techniques*. CRC Press: Boca Raton.

17. Pedrão, Maika R.; Adelaide Beleia, Regina C. D. Modesta, and Sandra H. Prudencio-Ferreira. 1999. "Estabilidade físico-química e sensorial do suco de limão Tahiti natural e adoçado, congelado." *Ciência e Tecnologia de Alimentos* 19, no. 2 (August): 282-286. http://dx.doi.org/10.1590/S0101-20611999000200023
18. Pereira, Ana P. A. 2013. "Qualidade pós-colheita de frutos de abacaxi "Pérola" e "Turiaçu": influências das condições de armazenamento e avaliação sensorial." MS thesis, Universidade Estadual do Maranhão.
19. Rodrigues, Eliseu, Lilian R. Mariutti, and Adriana Z. Mercadante. 2013. "Carotenoids and phenolic compounds from *Solanum sessiliflorum*, na unexploited Amazonian fruit, and their scavenging capacities against reactive oxygen and nitrogen species." *Journal of Agriculture and Food Chemistry* 61, no. 12 (February): 3022-3029. https://doi.org/10.1021/jf3054214
20. Sandoval, María A. P. (2010). "Efecto *in vitro* del extracto de *Solanum sessiliflorum* ¨cocona¨ sobre el crecimiento de *Helicobacter pylori*." *Ciéncia e Investigación* 13, no. 1 (January-June): 30-33. http://200.62.146.19/BVRevistas/ciencia/v13_n1/pdf/a06v13n1.pdf
21. Silva Filho, Danilo F. 1998. *Cocona (*Solanum sessiliflorum *Dunal): Cultivo y utilización*. Caracas, Venezuela: Secretaria Pro-Tempore. Tratado de Cooperación Amazônica. http://www.otca-oficial.info/assets/documents/20161219/e5ee903f6fe1735bd71394f0b7c545ae.pdf
22. Yuyama, Lúcia K. O., Sonja H. M. Macedo, Jaime P. L. Aguiar, Danilo F. Silva Filho, Kaoru Yuyama, Déborah I. T. Fávaro, and Marina B. A. Vasconcellos. 2007. "Quantificação de macro e micronutrientes em algumas etnovariedades de cubiu (*Solanum sessiliflorum* Dunal)." *Acta Amazônica* 37, no. 3 (July-September): 425-430. https://doi.org/10.1590/S0044-59672007000300014