RESEARCH ARTICLE | DECEMBER 28 2023

Effect of types and concentrations of stabilizers for organoleptic and nutritional quality of functional food product Velva campolay (*Pouteria campechiana*)

R. Haryo Bimo Setiarto ✉; Lia Amalia; Tiara Handayani

AIP Conf. Proc. 2972, 050013 (2023)
https://doi.org/10.1063/5.0183010

Effect of Types and Concentrations of Stabilizers for Organoleptic and Nutritional Quality of Functional Food Product Velva Campolay (*Pouteria campechiana*)

R. Haryo Bimo Setiarto[1, a)], Lia Amalia[2, b)] and Tiara Handayani[2, c)]

[1]*Research Center for Applied Microbiology, Research Organization for Life Science and Environment, National Research and Innovation Agency, Jl. Raya Jakarta-Bogor Km 46, Cibinong, Bogor, 16911, West Java, Indonesia*
[2]*Department of Food Science and Technology, Faculty of Halal Food Science, Djuanda University, Ciawi No.1 Toll Road, Ciawi-Bogor,16720, West Java, Indonesia.*

[a)]*corresponding author: haryobimo88@gmail.com*
[b)]*lia.amalia@unida.ac.id*
[c)]*tiarahandayani294@gmail.com*

Abstract. Campolay (Pouteria campechiana) is a plant originating from Mexico that can grow in tropical and subtropical climates. Velva is a type of frozen food similar to ice cream but has a low-fat content because it does not use milk fat and has high vitamin C and fiber content. This study aims to analyze the effect of the type and concentration of stabilizers on the organoleptic and nutritional quality of Velva campolay products. Velva campolay uses two variables: the type of stabilizer with three levels of treatment (CMC, carrageenan, and gelatin) and the concentration of stabilizer with three levels of treatment (0.25%, 0.50%, and 0.75%). The type of stabilizer was not affecting the quality of the texture, the panelists' preference for texture, taste, or overall, but it affected the melting power of Velva campolay ($p<0.05$). The concentration of the stabilizer was not affecting the quality of the texture but it affected the melting power of Velva campolay ($p<0.05$). Velva campolay product selected based on melting power that was Velva with a CMC stabilizer of 0.75% ($p<0.05$). Campolay can be used as a raw material for making Velva, with an overall preference level ranging from 6.03-6.87 (somewhat like). The selected Velva campolay product has a moisture content of 75.73%, ash (1.14%), protein (1.71%), fat (0.14%), carbohydrates (21.28%), crude fiber (0.11%), energy value (93.22 kcal/ 100g), vitamin C (21.43 mg/100g), and antioxidant IC50 (542.59 ppm).

Keywords: Campolay (*Pouteria campechiana*), nutrition, organoleptic, stabilizers, velva

INTRODUCTION

Campolay fruit (*Pouteria campechiana*) is a plant originating from Mexico that can grow in tropical and subtropical climates [1,2,3]. The edible portion of the campolay fruit is 60% of the fruit's weight. Ripe campolay fruit per 100 g contains 57.2-60.6 g water, 1.7-2.5 g protein, 0.1-0.6 g fat, 36.7-39.1 g carbohydrates, 0.1-7.5 g fiber, 0.6-0.9 g ash, 26.5-40 mg calcium, 30 g -37.3 mg phosphorus, 0.9-1.1 mg iron, 0.32 mg carotene, 0.02-0.17 mg thiamine, 0.01-0.03 mg riboflavin, 2.5-3.7 mg niacin, and 43-58 mg vitamin C, energy value 580-630 cal/100 g [4,5,6,7]. The use of campolay fruit is currently still limited, which is only used as syrup, jam, flour, or consumed directly [8,9]. The taste is sweet like sweet potato, and the intense aroma makes people not like to eat campolay fruit directly [10,11,12]. Therefore, it is necessary to diversify food preparations from campolay fruit to utilize campolay fruit and extend its shelf life. One alternative to using campolay fruit is making Velva campolay.

Proceedings of the 9th International Symposium on Innovative Bioproduction Indonesia on Biotechnology and Bioengineering 2022
AIP Conf. Proc. 2972, 050013-1–050013-7; https://doi.org/10.1063/5.0183010
Published by AIP Publishing. 978-0-7354-4781-3/$30.00

Campolay fruit has an unpleasant odor, making it less attractive to consumers [13,14]. The unpleasant smell of campolay is the main problem that must be solved in processing campolay fruit [15]. The production of Velva campolay can be an alternative solution to improve the organoleptic and nutritional quality of campolay fruit as a functional food. One effort to reduce the unpleasant odor is to add lime juice. Lime juice is also added as an additional flavoring ingredient, thus giving the Campolay Velva fruit flavor [4].

Velva is a type of frozen food similar to ice cream but has a low-fat content because it does not use milk fat and has a high vitamin C and fiber content [7]. Velva is said to be good if it has a smooth texture and low melting speed, so it is necessary to add a stabilizer to produce a good quality product [5]. The role of the stabilizer in Velva is to bind the water in the dough to form fine ice crystals. Stabilizers function to maintain the body and texture of the product during storage. The use of stabilizers is determined by the characteristics of the material to be processed. This study aims to determine the type and concentration of the best stabilizer in the production of Velva Campolay based on consumer preference and to analyze the nutritional value and antioxidant activity of selected products of Velva Campolay.

MATERIAL AND METHODS

Materials

The materials used in this study include overripe campolay fruit with five months of harvest which is yellow and soft from Cipatat West Bandung West Java, Indonesia, lime, CMC, carrageenan, gelatin, sucrose, aquadest, hexane, H_2SO_4.

Research Design

The experimental design used in this study was a two-factor, Completely Randomized Design (CRD). The first factor (A) is the type of stabilizer with three treatment levels (CMC, carrageenan, and gelatin). The second factor (B) is the concentration of stabilizer with 3 treatment levels (0.25%, 0.50%, and 0.75%). Each experiment was replicated twice, so 18 experimental units were obtained.

Campolay Fruit Puree Production Process

Campolay fruit used in making campolay fruit puree is the fruit that is overripe and not rotten. Campolay fruit is washed, peeled, and then separated between flesh and seeds. Then, the fruit's flesh was blanched by steaming at a temperature of 80^{o}C for 3 minutes. Furthermore, the flesh of the campolay fruit was added with water and crushed with a blender until smooth [7].

The Process of Production Velva Campolay

Velva campolay is made by using two variables: the type of stabilizer with three levels of treatment (CMC, carrageenan, and gelatin) and the concentration of stabilizer with three levels of treatment (0.25%, 0.50%, and 0.75%). Campolay fruit puree was added with 15% sucrose, 5% lime juice, and stabilizer treatment, then mixed with a mixer for 15 minutes. Then cooled at 5-6^{o}C for 45 minutes. After that, it was packaged and frozen at -18^{o}C for 24 hours.

Velva Campolay Product Analysis

Organoleptic test (Hedonic test) for *Velva Campolay Product*

Sensory testing is a way of testing using the senses humans as the main tool to see the quality of food products that have undergone processing. The hedonic test is a method used to measure the level of preference for the product using an assessment sheet. In determining the quality level based on a scale of 1 as the lowest and 9 as the highest value [9]. The organoleptic test was carried out using the hedonic test method, which included the panelist's response to color, aroma, texture, taste, and overall (overall). The scale used is 9 = very much like, 8 = very much

like, 7 = like, 6 = somewhat like, 5 = neutral, 4 = slightly dislike, 3 = dislike very much, 2 = very much dislike, 1 = very much not like. Thirty semi-trained panelists carried out the hedonic test [9].

Melting power for Velva Campolay Product

The measurement of melting power is based on the time it takes for Velva to melt entirely at room temperature. Measurements were made by taking one spoon of Velva (±2.00 g) and placing it on a plate, then leaving until the Velva melted entirely at room temperature. Melting time was measured using a stopwatch [16].

Proximate Analysis for Velva Campolay Selected Products

Proximate analysis was carried out on selected Velva Campolay products. The proximate analysis method referred to the research of Amalia et al. [6], which included moisture, ash, fat, protein, dietary fiber, and carbohydrate content.

Analysis of vitamin C of Velva Campolay Products

Determination of vitamin C levels in Velva Campolay products using a modified Iodometry (titration) method [16]. 10 g of the sample was weighed and then put in a 100 mL volumetric flask and added with distilled water up to the mark. Add five drops of starch indicator, then titrate with 0.01 N iodine (I2) until it turns blue. The formula can calculate the content of vitamin C:

$$\textit{Vitamin C content (mg/100g)} = \textit{((Vol } I_2 \textit{ x 0.88 x Dilution factor) x 100)/(Weight sample (g))} \quad 1)$$

Analysis of the Antioxidant activity of Velva Campolay Products

The sample weighed as much as 50 mg, then put into a 100 mL volumetric flask and dissolved in methanol to the limit mark (500 ppm). Then a series of 50 is made; 100, 150, 200, and 250 ppm in a 10 mL volumetric flask and diluted with methanol to the mark. 2 mL of each sample was taken, and 2 mL of 50 ppm DPPH solution was added. The test solutions were allowed to stand for 30 minutes at room temperature. The test solutions and blanks were measured for absorption with a spectrophotometer at 517 nm [10]. The antioxidant activity of the sample is determined by the magnitude of the DPPH radical absorption inhibition by calculating the percentage of DPPH absorption inhibition using the formula: *%Inhibition = (Control Abs-Sample Abs)/(Control Abs) x 100%*

Data Analysis

Statistical analysis used the analysis of variance (ANOVA) with a completely randomized design (CRD) to determine whether the type and concentration stabilizer significantly affected the organoleptic quality of Velva Campolay products. If the results obtained from the ANOVA test $p<\alpha$ (significantly different), then they need to be examined by the Duncan test. The level of confidence or significance used is 95% (level = 0.05).

RESULTS AND DISCUSSION

Sensory Quality and Hedonic Tests of Velva Campolay Products

The type of stabilizer has no significant effect ($p>0.05$) and the concentration of the stabilizer has no significant impact ($p>0.05$), and the interaction of the two does not have a significant effect ($p>0.05$) on the overall level of preference for Velva Campolay. This means that the type of stabilizer can not affect the level of preference of the panelists on Velva Campolay as a whole. The primary purpose of stabilizers in frozen dessert products is to produce a good smoothness and texture, inhibit or reduce the formation of ice cream crystals during storage, and produce a uniform texture. The panelists' level of preference for Velva Campolay overall ranged from 6.03-6.87 (somewhat like). The most preferred Velva campolay is velva with 0.75% CMC stabilizer treatment. It means that in terms of melting power Velva,, with the addition of 0.75% CMC, was the most preferred and was the best velva product,

according to the panelists ($p<0.05$).The Velva has the softest texture compared to other treatments, has the right combination of sweet and sour taste, and the characteristic aroma of Campolay does not smell and is dark yellow.

Texture of Velva Campolay Products

Table 1 shows that the type of stabilizer has no significant effect ($p>0.05$), and the concentration of stabilizer has no significant impact ($p>0.05$) on the panelists' preference level on the Velva Campolay texture. Meanwhile, the interaction between the type of stabilizer and the concentration of stabilizer had no significant effect ($p>0.05$) on the panelists' preference level for the Velva Campolay texture. The panelists' preference level for the resulting velva campolay texture ranged from 5.90-7.30 (Neutral to likes). The panelists' preference level was not significantly higher on the texture of Velva Campolay with CMC stabilizer compared to carrageenan and gelatin. ($p>0.05$).The results of the organoleptic quality test (texture) of Velva Campolay showed that Velva with a CMC stabilizer had no softer texture than carrageenan and gelatin ($p<0.05$). These results did not indicate that the panelists prefer velva, which has a silky texture ($p>0.05$). Velva is said to be good if it has a smooth texture and low melting speed, so it is necessary to add a stabilizer to produce a good quality product. The analysis did not show that the panelist's most preferred velva texture was velva with a 0.75% CMC stabilizer ($p>0.05$). Carboxyl methyl cellulose has several other advantages, including binding water, quickly dissolving in ice cream dough, and maintaining a smooth texture.

Taste of Velva Campolay Products

Table 1 shows that the type of stabilizer and the concentration of stabilizer had no significant effect ($p>0.05$) on the panelists' preference for the taste of velva campolay. Meanwhile, the interaction between the type of stabilizer and the concentration of stabilizer did not have a significant effect ($p>0.05$) on the panelists' preference for the taste of velva campolay. The panelists' choices for the resulting velva campolay taste ranged from 5.72 to 6.47 (Neutral to slightly like). The analysis showed that the panelists' most preferred velva taste was velva with a CMC stabilizer. It is because Velva with CMC stabilizer has the right combination of sweet and sour taste, so it is preferred. Velva with gelatin stabilizer has a sweet taste that is more dominant than a sour taste. In contrast, Velva with carrageenan stabilizer has a sour taste that is more dominant than a sweet taste, so it is not liked.

Flavor of Velva Campolay Products

Table 1 shows that the type of stabilizer and the concentration of stabilizer have no significant effect ($p>0.05$), and the interaction of the two does not have a significant effect ($p>0.05$) on the panelists' preference level on the aroma of velva campolay. The level of panelists' preference for velva campolay aroma was not influenced by the type and concentration of stabilizer. The panelists' level of preference for the velva campolay aroma produced ranged from 6.07 to 6.50 (somewhat like). The unpleasant smell of Campolay tends to be less desirable, so when making Velva, lime is added to cover the unpleasant smell of Campolay. Based on the organoleptic quality test results, the aroma of Campolay Velva leads to the absence of a typical Campolay aroma. Adding lime can cover the unpleasant smell of campolay so that the panelists prefer the fragrance.

Colour of Velva Campolay Products

Table 1 shows that the type of stabilizer and the concentration of stabilizer have no significant effect ($p>0.05$), and the interaction of the two does not have a significant effect ($p>0.05$) on the panelist's preference for the color of Velva Campolay. Using the type and concentration of stabilizer did not give significantly different hedonic results because CMC, gelatin, and carrageenan were colorless stabilizers. The panelists' preference for the color of Velva Campolay ranged from 7,02-7,40 (like). Based on the results of the organoleptic quality test, the color of Velva Campolay leads to dark yellow. It means that the panelists like the dark yellow velva campolay. The color of food products must be attractive and pleasing to consumers, uniform, and type to represent the added taste. Color can also be used as an indicator of whether or not the processing method is suitable.

TABLE 1. The results of sensory quality test, hedonic tests and the melting power of Velva Campolay products.

Parameter analysis	Treatment								
	CMC 0.25%	CMC 0.50%	CMC 0.75%	Gelatin 0.25%	Gelatin 0.50%	Gelatin 0.75%	Carragenan 0,25%	Carragenan 0,50%,	Carragenan 0,75%
Sensoric quality test									
Texture	5.73±0.12^{a}	5.90±0.24^{a}	6.11±0.20^{a}	4.73±0.14^{a}	5.00±0.08^{a}	5.60±0.13^{a}	5.39±0.28^{a}	5.76±0.17^{a}	6.02±0.11^{a}
Taste	5.60±0.07^{a}	5.50±0.10^{a}	5.38±0.15^{a}	5.75±0.08^{a}	5.85±0.23^{a}	5.50±0.19^{a}	5.28±0.17^{a}	5.33±0.05^{a}	5.74±0.07^{a}
Flavor	4.45±0.02^{a}	4.39±0.06^{a}	4.51±0.10^{a}	4.97±0.24^{a}	4.75±0.20^{a}	4.47±0.16^{a}	4.88±0.14^{a}	4.41±0.09^{a}	4.63±0.14^{a}
Colour	7.10±0.27^{a}	7.14±0.16^{a}	7.36±0.11^{a}	7.33±0.13^{a}	7.19±0.04^{a}	7.54±0.14^{a}	7.35±0.29^{a}	7.35±0.19^{a}	7.53±0.18^{a}
Hedonic test									
Texture	6.67±0.16^{ab}	6.43±0.13^{bc}	7.30±0.19^{a}	6.22±0.24^{bc}	6.30±0.18^{bc}	6.80±0.09^{ab}	6.37±0.29^{bc}	5.90±0.25^{c}	6.80±0.14^{ab}
Taste	6.38±0.06^{a}	6.30±0.19^{a}	6.47±0.23^{a}	5.72±0.13^{a}	5.92±0.11^{a}	6.03±0.07^{a}	5.85±0.15^{a}	5.75±0.29^{a}	5,63±0.10^{a}
Flavor	6.23±0.08^{a}	6.30±0.23^{a}	6.50±0.18^{a}	6.12±0.05^{a}	6.23±0.24^{a}	6.23±0.13^{a}	6.35±0.17^{a}	6.07±0.07^{a}	6.12±0.19^{a}
Colour	7.40±0.15^{a}	7.20±0.25^{a}	7.28±0.12^{a}	7.03±0.07^{a}	7.03±0.13^{a}	7.07±0.08^{a}	7.35±0.11^{a}	7.03±0.03^{a}	7.02±0.05^{a}
Overall	6.63±0.20^{a}	6.57±0.27^{a}	6.87±0.10^{a}	6.32±0.21^{a}	6.20±0.14^{a}	6.48±0.26^{a}	6.52±0.13^{a}	6.25±0.05^{a}	6.03±0.07^{a}
Melting power (minutes)	4.17±0.05^{e}	5.35±0.1^{b}	6.07±0.12^{a}	3.49±0.07^{g}	4.28±0.11^{d}	5.36±0.18^{b}	3.54±0.09^{f}	4.15±0.14^{e}	4.35±0.19^{c}

Notes: Different letter notation shows significantly different at 5% level.

The Melting Power of Velva Campolay Product

Melting power is the time it takes frozen food to melt entirely at room temperature. Melting power measurements were carried out at room temperature. This melting speed is one of the parameters to determine the quality of frozen food. High-quality Velva is somewhat resistant to melting when served at room temperature. The melting rate of ice cream is generally influenced by stabilizers, emulsifiers, the balance of sugar and milk ingredients, and manufacturing and storage conditions that can cause protein damage. Table 1 showed that the type of stabilizer, the concentration of stabilizer, and the interaction of the two have a significant effect ($p<0.05$) on the melting power of Velva Campolay. The melting power of Velva campolay ranged from 3.49 to 6.07 minutes. The highest melting power is found in Velva Campolay with 0.75% CMC. It is because the stabilizer has the function of binding water, causing water molecules to become trapped in the gel structure formed by the stabilizer. Velva melting is said to be good if the melted Velva has similar properties to the original dough [4,7,11]. The ice crystals found on the valve can dissolve if they receive heat transfer from room temperature, causing the ice to melt. Velva of good quality shows that it is resistant to melting when served at room temperature. Velva, which melts quickly, is less favored by consumers because it melts quickly at room temperature. However, it is also noted that the difficult-to-melt velva is also not liked by consumers.

Nutritional Value and Antioxidant Activity of Selected Product Velva Campolay

Table 2 shows that the moisture content in the selected Velva Campolay is 75.73%. It is supported by Awang-Kanak [4] that reported the water content in the selected ripe campolay fruit Velva is 73.51%. The high moisture content comes from adding water to produce puree Campolay and other ingredients used when making Velva Campolay. Moisture content in the product is an essential component that can affect the texture, taste, and appearance, and the water content is related to the product's shelf life [13]. Ash content is a mineral element as a residue left after the material is burned until it is free of carbon. Ash content can also be interpreted as a non-volatile component that remains in the combustion and igniting of organic compounds. The ash content contained in the selected Velva Campolay is 1.14%. It is in line with Amalia et al. [6] which reported that the ash content in the Velva of the selected ripe Campolay fruit is 1.10%. The protein content contained in the selected campolay Velva is 1.71%. According to Pertiwi et al [7], the protein content in 100 grams of ripe campolay fruit is 1.7-2.5%. It means that there is not much decrease in protein content in the manufacture of Velva. The fat content in the selected campolay Velva is 0.14%. Molyneux [10] reported the carrot-orange Velva fat content was 3.0%, while the coconut Velva fat content in Aseervatham et al. [11] study was 11.49%. These differences occur due to the use of different Velva raw materials. Based on the calculation by difference, the carbohydrate content in the selected Velva campolay was 21.28%. It is supported by Amalia et al. [6] who reports that the carbohydrate content in the Velva of

selected overripe campolay fruit is 22.53%. Panelists prefer velva campolay products with the addition of 0.75% CMC stabilizer, which is not easy to melt with a soft texture. The addition of 0.75% CMC stabilizer is responsible for influencing the panelists' preferences for the hedonic test results of Velva Campolay products.

TABLE 2. The nutritional content and antioxidant activity of selected Velva Campolay products (100 g).

Nutritional content	Value
Moisture content (%)	75.73±0.67
Ash conten (%)	1.14±0.03
Protein (%)	1.71±0.05
Fat (%)	0.14±0.03
Carbohydrate (%)	21,28±0.19
Crude fiber (%)	0,11±0.02
Total Energy (Kkal/100 g)	93,22±1.45
Vitamin C (mg/100 g)	21,43±0.28
Antioxidant (IC_{50}) (ppm)	542,59

Fiber can avoid constipation by helping pass food scraps faster due to its excellent absorption capacity for fluids [1]. The crude fiber content contained in the selected Campolay Velva is 0.11%. Elsayed et al. [3] reported that the fiber content in 100 grams of ripe campolay fruit was 0.1-7.5%. The total energy value contained in the selected campolay Velva is 93.22 kcal/100g Velva. Costa et al. [2] reported that the energy value in 100 grams of campolay fruit reached 630 kJ with a conversion of 150.574 kcal. The decrease in energy value can be caused because the campolay fruit used is overripe, so the nutritional content in 100 g of campolay fruit has decreased. It follows the study of Pino [14], the carbohydrate, protein, and fat content of red fruit from 3 clones varied at several maturity levels, tending to decrease in the late ripe fruit phase.

Vitamin C is water-soluble and easily oxidized in the presence of Fe, Cu catalysts, ascorbate oxidase enzymes, light, and high temperatures. Oxidation of vitamin C will produce dehydroascorbic acid. The level of vitamin C contained in the selected Velva campolay was 21.43 mg/100g. Lia et al. [13] reported that the vitamin C content in 100 grams of ripe campolay fruit was 43-58 mg. Decreased levels of vitamin C in Velva campolay can occur during the process of making Velva. Nur et al [15] reports that processing steps such as storage, cutting, and milling with a blender can affect vitamin C levels in tomatoes, red chilies, guavas, and pineapples. Sunila and Murugan [8] reported that vitamin C is a perishable vitamin during processing, such as blanching, washing, cutting, and blending.

The amount of DPPH inhibition is stated in IC_{50} (inhibitory concentration), namely the ability of the extract concentration to inhibit DPPH activity by 50%. Meilgard et al. [9] reported that the level of strength of antioxidant compounds is very strong if the IC_{50} value is less than 50 ppm; for a strong level when it is in the range of 50 ppm to 100 ppm, a moderate level is between 100 ppm to 150 ppm and a weak category is between 150 and 200 ppm. The antioxidant activity (IC_{50}) of selected Velva campolay was 542.59 ppm. Velva campolay is classified as having very weak antioxidant power. Lanerolle et al. [12], Campolay fruit flesh has antioxidant activity with an IC_{50} value of 2656 ppm. Campolay Velva has a lower IC_{50} value than campolay pulp, which means an increase in antioxidant activity. The increase in antioxidant activity could be due to the addition of lime in the manufacture of Velva. Pertiwi et al. [7] reported that lime (*Citrus aurantiifolia*) has an IC_{50} of 49.589 ppm and is a very strong antioxidant.

CONCLUSION

Campolay fruit can be used as raw material for Velva production with an overall preference ranging from 6.03 to 6.87 (somewhat like). The stabilizer was not significantly affecting the quality of the texture and the level of preference of the panelists on the texture, taste, overall, but it significantly affect the melting power of Velva Campolay. The concentration of stabilizer was not significantly affecting the quality of texture but it significantly affect to melting power of Velva Campolay. Velva Campolay product was selected based on no the sensory quality test, or hedonic test, but based on melting power was Velva with a CMC stabilizer of 0.75%. The selected campolay Velva has 75.73% water content, 1.14% ash, 1.71% protein, 0.14% fat, 21.28% carbohydrates, 0.11% crude fiber, energy value 93.22 kcal/100g , vitamin C 21.43 mg/100g, and antioxidants activity (IC50) 542.59 ppm.

ACKNOWLEDGMENTS

The author would like to deepest thank all parties who have helped in the completion of this research.

AUTHOR CONTRIBUTIONS

R. Haryo Bimo Setiarto is the main contributor to this proceeding manuscript. Lia Amalia and Tiara Handayani are member contributors in this proceeding manuscript.

REFERENCES

[1] Karsinah and Rebin, Horticulture Science and Technology **9**, 11-15 (2013).
[2] T. S. A, Costa, D. C. Wondracek, R. M. Lopes, R. F. Vieira, F. R. Ferreira, Rev. Bras. Frutic. **32(3)**, 903-906 (2010).
[3] A. M. Elsayed, N. D. El-Tanbouly, S. F. Moustafa, R. M. Abdou and S. A.W. El Awdan, Journal of Medicinal Plants Research **10(16)**, 209-215 (2016)
[4] F. Awang-Kanak and M. F. Abu Bakar, *Exotic Fruits* (Academic Press, USA, 2018), pp. 107-111.
[5] A. Pai and C. Shenoy, Journal of Applied Biology & Biotechnology **8(4)**, 90-97 (2020).
[6] L. Amalia, R. H. B. Setiarto, T. Fitrilia and S. Masyrifah, Afr. J. Food Agric. Nutr. Dev. **20(7)**, 17063-17080 (2020).
[7] S. R. Pertiwi, S. Nurhalimah and A. Aminullah, Brazilian Journal of Food Technology. 2020; 23: e2019056.
[8] A. V. Sunila and K. Murugan, Trends in Biosciences **10(20)**, 4020-4026 (2017).
[9] M. C. Meilgaard, G. V. Civille and B. T. Carr, *Sensory evaluation techniques* (CRC Press, Boca Raton, 2006).
[10] P. Molyneux, Songklanakarin J. Sci.Technol. **26(2)**, 211-219 (2004).
[11] S. B. Aseervatham, V. Manthra, C. Ireen, S. Thilagameena, S. Akshay, A. C. Mary, S. Giriprashanthini and T. Sivasudha, Biocatalysis and Agricultural Biotechnology **18**, 101031 (2019)
[12] M. Lanerolle, A. M. Priyadarshani, D. B. Sumithraarachchi and E. R. Jansz, Journal of the National Science Foundation of Sri Lanka **36(1)**, 95-98. (2008).
[13] B. Lia, L. Zhu, Y. Wang, Y. Zhang, C. Huang, Y. Zhao, F. Xu, K. Zhu, G. Wu, Food Hydrocolloids **124 (A)**, 107284 (2022).
[14] J.A. Pino, Journal of Essential Oil Bearing Plants **13(3)**, 326-330 (2010).
[15] M. A. Nur, M. Khan, S. Biswas, K. M. D. Hossain, M. Z. Amin, Journal of Agriculture and Food Research **8**, 100296 (2022).
[16] AOAC, *Official methods of analysis of the association of the analytical chemists* (Maryland, USA, 2010).