The Physicochemical Properties of the Jelly Drink Produced by Mixing Pedada (Sonneratia caseolaris) and Young Coconut Juices with Carrageenan

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Abstract. This research was conducted to determine the physicochemical properties of the jelly drink produced using the pedada and young coconut fruit juices with carrageenan. A Completely Randomized Design was used with two factors consisting of pedada : young coconut juice ratio at 60:40, 70:30, and 80:20 as well as the addition of carrageenan at 0.25, 0.30, and 0.35% which are replicated twice with 5% of DMRT. The best mixture was 60:40 pedada to young coconut fruit juice with 0.35% carrageenan due to its ability to produce jelly drinks with a total acid content of 0.50%, antioxidant activity at 43.87%, total sugar at 19.00%, syneresis at 1.81%, gel strength at 1.16 N, and dietary fibre at 9.20%. Moreover, the organoleptic test showed the score of taste was 3.64, the texture was 3.64, the aroma was 3.20, and the colour was 3.76 and this generally means the drink was much flavoured by the panellists.

Keywords. Jelly drink, Pedada fruit juice, Young coconut juice, Carrageenan

1 Introduction

Jelly drink is a soft gel drink produced by mixing pectin, agar, carrageenan, gelatine or other hydrocolloids with sugar, and acids with or without other food additives. Its texture is soft, easily broken, and consumed using a straw with the gel felt in the mouth [1]. The purpose of this study was, therefore, to develop processed pedada (Sonneratia caseolaris) fruit into jelly drink products due to its sour taste, distinctive aroma, several nutritional contents including vitamin A 11.21 mg/100g, vitamin B1 5.04 mg/100g, vitamin B2 7.65 mg/100g, and vitamin C 56.74 mg/ 100g [2], and pectin. The fruit was also reported by Duke & Jakes (1987) [3] to contain 11% pectin which is useful in the formation of gels and stabilizers [4] and widely used as a thickening and stabilizing agent in drinks [5].

The beverages produced from pedada fruit are usually in the form of syrup to increase their functional value and the pectin content provides the fruit with the potential to be used in producing jelly drinks. Meanwhile, carrageenan is usually used as a gelling agent in industrial food products and also expected to provide the jelly drink with a smoother gel due to its higher sulphate level which makes the gel structure to be more elastic [6]. Moreover, Gania et al. (2014) reported that the addition of 0.30% carrageenan was able to produce acceptable jelly drinks [7].
This means the sour taste of pedada fruit needs to be reduced with the addition of young coconut juice which contains carbohydrates, calcium, protein, Vitamins A and B1, and also easy to digest. It also has some other nutritional compositions such as calcium, sodium, nitrogen, total sugar content of 5.20% which has the ability to reduce the acid taste in fruit, and vitamin C which serves as an antioxidant to slow down or inhibit the occurrence of oxidation in jelly drinks formulation [8]. Moreover, Erkaya et al. (2012) showed the addition of young coconut fruit juice up to 75% was able to produce an ice cream pedada acceptable by panellists [9].

2 Materials and Method

The materials used in this study include pedada fruit, young coconut fruit, carrageenan, sugar, and water as well as 1M NaOH, KI, 1% starch, buffer Na-phosphate, HCl, ethanol, acetone, iodine solution, DPPH, pancreatin enzyme, pepsin enzyme, termamyl enzyme, anthrone reagent, ethanol, 1% pp, alcohol, $CaCl_2$, $AgNO_3$, and H_2SO_4.

2.1 Pedada and Young Coconut Juices

A mature pedada fruit was peeled, washed, and blanched at 60°C for 15 minutes after which it was crushed with water at 1:3 ratio and filtered to produce the pedada juice. Meanwhile, young coconuts were obtained and the flesh was blended with water at 3:1 ratio.

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2.2 Jelly Drinks Production Process

Jelly drink was made by mixing the juices of pedada and young coconut at 60:40, 70:30, and 80:20 with 0.25, 0.30, 0.35 carrageenan and 20% of sugar. The mixture was boiled at 80°C, evenly stirred, cooled, packaged, and stored in the refrigerator at 6-9°C for 24 hours. The final product was, however, analysed for gel strength, syneresis, dietary fibre, total acid, antioxidants, total sugar, and organoleptic contents.

3 Results and Discussion

3.1 The Raw materials of the juices produced from the pedada fruit and young coconut

The raw materials of the product were analysed and the 2.13 % pectin discovered in the pedada fruit juice was also similar with the 2.28% obtained in the previous study conducted by Sudaryati et al., (2017) [10] while the young coconut has 0.14% as shown in Table 1. The total acid was also found to be 1.05% for pedada fruit and 0.06% for young coconut and this also almost the same with 0.09% reported by Mahayothee et al. (2016) [11] while the total sugar was 0.74% and 1.16% respectively but Barlina (2004)[8] found the young coconut to have approximately 5.20%. This variation is due to the environment, varieties, processes, temperature, and climate factors associated with the fruits [12].

Table 1. The pedada and young juice analysis.

Composition per 100 g / ml	Pedada (%)	Young coconut (%)
Pectin	2.13	0.14
Total Acid	1.05	0.06
Total Sugar	0.74	1.16
Antioxidant Activity	60.10	33.61
Dietary Fibre	2.66	3.17

Table 1 also shows the antioxidant activity of pedada fruit juice was 60.10% while the young coconut fruit had 33.61% and these were found to be slightly lower than the 69.4% reported by Lee et al., (2016) [13] for pedada fruit. Moreover, the dietary fibre was found to be 2.66% and 3.17% respectively but a higher value of 9.8% was reported by Jariyah et al. (2014) [14] for the pedada fruit. It is, however, important to note that the components of the pedada fruit are affected by the extraction method, varieties, and environment [15].

3.2 Syneresis, antioxidant, and gel strength of the jelly drink product

The pedada : young coconut juice rate as well as the quantity of carrageenan added were observed to have a significant effect at p>0.05 on the syneresis, antioxidant activity, and gel strength of the products as shown in Table 2.

The antioxidant activity of the jelly drink was observed to have ranged from 42.38% - 51.32% with those with the higher activity associated with the content of the initial ingredients such as the flavonoid which acts as an antioxidant [16]. Moreover, carrageenan has sulphate polysaccharides which inhibit the radical formation and hydroxyl groups to increase the antioxidant activity and its double helix also protects the phenolic compounds from damage due to heating process and oxygen access [6].

The syneresis was observed to be between 2.16 and 1.44% for different ratios of the mixture with the lower values found with an increase in the ratio and addition of carrageenan. The pectin in the pedada extract forms a gel which leads to the esterification of the carboxyl polymer groups by the methoxyl group, sugar, and acid at high temperatures. Moreover, the carrageenan is a hydrocolloid with water-binding properties and phenomenon to cross-link polymer chains to form a three-dimensional mesh and, subsequently, gel [4]. A greater concentration of carrageenan has the ability to form a strong double helix which traps and binds water at the same time to reduce the occurrence of syneresis [7].

Table 2. Syneresis, sntioxidant activity and gel srenght of the jelly drink product.

Treatment				
Pedada : Young coconut (%)	Carrageenan (%)	Syneresis (%)	Antioxidant activity (%)	Gel strength (N)
60 : 40	0.25	2.16 ^{g}	42.38^{a}	0.95^{a}
60 : 40	0.30	2.01 ^{f}	43.21^{b}	1.10^{b}
60 : 40	0.35	1.81 ^{d}	43.87^{bc}	1.16^{c}
70 : 30	0.25	2.03 ^{f}	44.54^{c}	0.98^{a}
70 : 30	0.30	1.72 ^{c}	45.36^{d}	1.21^{d}
70 : 30	0.35	1.64 ^{b}	46.36^{e}	1.32^{e}
80 : 20	0.25	1.92 ^{e}	47.52^{f}	1.06^{b}
80 : 20	0.30	1.61 ^{b}	49.17^{g}	1.34^{e}

$^{a-g}$ (alphabet index) = describe the average value of each parameter at a significant difference of p <0.05.

The strength was discovered to range from 0.95 to 1.42 N and those with higher values have a higher proportion of the two juices and the addition of carrageenan. This was associated with the formation of gel through the dissolution of pectin in water which allows the formation of negatively-charged hydrophilic colloids [6]. Meanwhile, the carrageenan, as gelling agent, also has the ability to increase the values and this is due to its gel formation process which involves the bonding between the carrageenan polymer chains in a randomly shaped solution to form a three-dimensional structure, thereby, affecting the strength of the gel [18].

3.3 Syneresis, antioxidant, and gel strength of the jelly drink product

The results showed there was generally no significant interaction (p> 0.05) between the mixture ratio with the carrageenan added and the total acid and total sugar but

each treatment provided some differences ($p<0.05$) as shown in Table 3.

Table 3. Total acid and sugar content of the jelly drink product.

Pedada Young coconut (%)	Total acid (%)	Total sugar (%)
60 : 40	0.55[a]	19.88[a]
70 : 30	0.76[b]	17.48[b]
80 : 20	0.87[c]	16.02[c]
Carrageenan (%)		
0.25	0.80[c]	18.35[c]
0.30	0.72[b]	17.80[b]
0.35	0.67[a]	17.23[a]

Table 3 shows a higher proportion of pedada juice has the ability to increase the total acid due to its total content which was observed to be higher than the values for the young coconut juice as shown in Table 1. The increment was also attached to the presence of ascorbic acid including organic acid molecules in the fruit and this is in line with the findings of the Ettiene et al. (2013) [19] that the higher levels of acid indicate a high content of organic acids.

The addition of carrageenan was, however, discovered to have reduced the total acid in the jelly drink due to its hydrocolloid nature which makes it bind water with the presence of relatively many OH groups as reported by Akesowan (2014) [1]. Meanwhile, the total sugar content was observed to be reduced as the proportion of pedada increased and young coconut juice decreased due to the higher total sugar content in young coconut juice in comparison to the pedada as shown in Table 1. The addition of carrageenan was also found to be reducing the total sugar content in the jelly drink due to the inability of the carrageenan to be hydrolysed by the cooking process.

3.4 Organoleptic test

The organoleptic properties were tested using a scoring scale hedonic quality test to determine the panellist's response to the quality of colour, taste, texture, and aroma and the results presented in Table 4 showed the jelly drink with 60% pedada juice, 40% young coconut juice, and 0.35% carrageenan had the product with the colour, taste, texture, and aroma accepted by the panellists. These properties were, however, associated with the yellowish-white colour, sweet and sour taste, an even gel texture, and typical aroma of the pedada fruit.

Table 4. Organoleptic results for colour, taste, texture and aroma of the jelly drink product.

Treatment		Score			
Pedada : Young coconut (%)	Carrageenan (%)	Colour	Taste	texture	Aroma
60: 40	0.25	3.48	3.44	2.68	2.84
60 : 40	0.30	3.44	3.32	2.96	2.92
60 : 40	0.35	3.76	3.64	3.64	3.20
70 : 30	0.25	3.68	3.36	3.52	3.12
70 : 30	0.30	3.04	3.04	2.76	3.00
70 : 30	0.35	3.00	3.24	3.16	3.04
80 : 20	0.25	3.48	3.12	2.40	3.52
80 : 20	0.30	3.16	3.04	2.76	3.36
80 : 20	0.35	3.24	3.40	3.16	3.16

4 Conclusion

The results showed the proportion of pedada: young coconut juice and the addition of carrageenan concentration had a significant effect on antioxidant activity, syneresis, and gel strength but did not significantly influence the total acid and total sugar. Moreover, the best products were obtained at the mixture with 60:40 ratio and 0.35% carrageenan and this was due to the 0.50% total acid, 43.87% antioxidant activity, 19.00% total sugar, 1.81% syneresis, 1.16 N gel strength, and 1.91% food fibre content found in the products. The organoleptic test also showed the colour was 3.76, the taste was 3.64, the texture was 3.64, and aroma 3.20 all of which were highly favoured by the panellists except for the aroma which was only favoured.

References

[1]. Akesowan A (2014) Optimization of Textural Properties of Konjac Gels Formed with κ-Carrageenan or Xanthan and Xylitol as Ingredients in Jelly Drink Processing. Journal of Food Processing and Preservation **39(6)**

[2]. Manulu RDE (2011) Levels of several vitamins in fruit Pedada (Sonneratia caseolaris) and their processed products. Description. Dept. Techn. Aquatic. FPIK-IPB

[3]. Duke NC, Jackes BR (1987) A Systematic Revision of The Mangrove Genus Sonneratia (Sonneratiaceae) In Australia. Blumea **32**: 277-302

[4]. Gawkowska D, Cybulska J, Zdunek A (2018) Structure-Related Gelling of Pectins and Linking with Other Natural Compounds. Polymers **10(762)**: 2-25

[5]. Cardenas A, Goyocoolea FM, Rinaudo M (2008) On the gelling behaviour of 'nopal' (Opuntia ficus indica) low methoxyl pectin. Carbohydrate Polymers **73(2)**:212-222

[6]. Saha D and Bhattacharya S (2010) Hydrocolloids as thickening and gelling agents in food: a critical review. J Food Sci Technol **47(6)**:587–597

[7]. Gania YF, Putut Susenoa TI, Surjoseputroa S (2014) Differences of carrageenan concentration on physicochemical and organoleptic properties of rosella-soursop jellydrink. Journal of Food Technology and Nutrition **13(2)**: 87-93

[8]. Barlina R (2004) The potential of young coconuts for health and processing. Other Plant and Palma Research Institute. Litri Manado. Indonesia Coconut and Palmae Research Institute **13(12)**:73-80

[9]. Erkaya T, Dağdemir E, Şengül M (2012) Influence of Cape gooseberry (Physalis peruviana L.) addition on the chemical and sensory characteristics and mineral concentrations of ice cream. Food Research International **45**: 331–335

[10]. Sudaryati HP, Jariyah, Afina N (2017) Physiochemical Characteristics of Pedada Fruit Jelly Candy (Soneratia caseolaris). Journal of Food Technology **11(1)**: 50-54

[11]. Mahayothee B, Koomyart I, Khuwitjaru P, Siriwongwilaichat P, Nagle M, Muller J (2016) Phenolic Compounds, Antioxidant Activity, and Medium Chain Fatty Acids Profiles of Coconut Water and Meat at Different Maturity Stages. International Journal of Food Properties **19**: 2041-2051

[12]. Hatfield JL and Prueger JH (2015) Temperature extrems : Effect on plant growth and development. Weather and Climate Extrems **10** :4-10

[13]. Lee JTJ, Dely A, Ramanayake M, Adasuriyya I, Ginjom IR (2016) 2nd International Conference on Suatainable Global Agriculture and Food "Safeguarding Global Consumers: Innovation in Food Science and Technology" Semarang, 9-10th August 170-183

[14]. Jariyah, Widjanarko SB, Yunianta, Estiasih T (2014) Pasting properties of mangrove fruit flour and starches mixtures **21(6)**: 2161-2167

[15]. Liu W, Dongxue Y, Li N, Hou X, Wang D, Li D, Li D (2016) Influence of Environmental Factors on the Active Substance Production and Antioxidant Activity in Potentilla fruticosa L. and Its Quality Assessment. Scientific Reports **6**:28591

[16]. Lotito SB, and Fraga CG (2000) Catechins delay lipid oxidation and alpha-tocopherol and beta-carotene depletion following ascorbate depletion in human plasma. Proceeding of The Society for Experimental Biology and Medicine **225**: 32–38