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Formulation And Evaluation Of Instant Drink Made From Mangosteen (*Garcinia mangostana* L.) Fruit Powder.

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ABSTRACT

Instant drink from natural product become new trend over the last decade. Mangosteen fruit, especially its pericarp has high content of polyphenols and posses antioxidant. Utilizing of all part of mangosteen for the instant drink aim to improve the customer satisfaction and ingredient functionality. Formulas of instant drink of mangosteen were composed from mangosteen juice powder, 2.5% mangosteen pericarp powder, 50-60% sucrose and 0.5-1% citric acid. Physicochemical and sensory analysis were carried out to determine the best and acceptable formula. Water content of all formula ranged between 1.31-1.63%. Solubility of all mangosteen instant drink formula ranged between 43.15-44.32%. The best total phenolic content owned by formula 1 and 3, and antioxidant activity owned by formula 1 and 2. Sensory evaluation showed that formula 3 was the best in visual appearance, sweetness and aftertaste, and it was the most preference formula chosen by panelists. From these results, we can conclude that instant drink from whole part of mangosteen enhance functionality in phenolic content and antioxidant capacity and acceptable to consumers. It is recommended to use extracted mangosteen pericarp to improve phenolic content and antioxidant capacity.

Keywords: antioxidant activity, pericarp, phenolic content, radical scavenging, sensory analysis, solubility

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INTRODUCTION

Over the last decade, trend on natural and organic products encourage people to consume natural products including drinks. People are interested in products that have benefits for the body. It is supported by the presence of beverage products that contain natural antioxidant [1]. In the production of mangosteen pericarp extract, the fruit aril was thrown away as useless garbage. Whereas, a whole of mangosteen fruit, including pericarp, containing large amount of polyphenols [2]. It is potential to be processed and produced become functional beverage with enhanced polyphenol content and antioxidant capacity [1].

Nowadays, dynamic and active lifestyle of modern society requires practically in everything. It is great opportunity for functional products including instant drink that are claimed for health benefits. Instant drink powder from vegetables or fruits are worldwide produce. Instant drinks are ease of distribution, longer shelf life in storage and practically in serving by dissolving into water[1][3].

In this study, the production of powdered mangosteen was attempted in order to develop functional instant drink that ease to serve. Mangosteen fruit juice were dehydrated using spray drying method to obtain dry powder. Spray drying method was selected since it is suitable for products containing heat-sensitive compound [4], capable for drying large quantities of liquid rapidly with minimal negative impact on product, lowest capital and operating costs [5][6].

Mangosteen pericarp powder was proposed in instant drink formulation as one of main ingredient since it has high content of polyphenols and antioxidant capacity. The good formula of instant drink was good in physical chemical characteristics and good results on sensory analysis. Therefore, the objective of this study was to evaluate physicochemical and sensory properties of an instant drink powder formulated from mangosteen fruit and pericarp as main material.

EXPERIMENTAL PROCEDURES

Materials

Mangosteen fruit is harvested from Sukabumi, West Java. Maltodextrin DE 18-20 was purchased from Zhuceng Dongxiao Biotechnology Co., Ltd. (China), 2,2-dihenyl picrylydrazil (DPPH), Folin Ciocalteau reagent, ascorbic acid, gallic acid were purchase from Sigma Co (St. Lous, MO, USA). Sodium carbonate, citric acid, methanol, ethanol were purchased from Merck (Germany). Sucrose were purchased from local market.
Instruments used for this research were spray drying (Lab Plant, UK Ltd., UK), spectrophotometer (Helios α, Thermo Spectronic, USA), refractometer pocket (Atago, Atago Co. Ltd., Japan), oven (Memmert, Germany), tap density tester (Sotax TD2, Switzerland), Karl Fischer moisture titrator (Kyoto Electronic Manufacturing, Japan), blade mill (Fomac, Indonesia), analytical balance (Radwag, Poland) and hot plate (Heidolph, Heidolph Instruments GmbH. & Co., Germany).

Mangosteen fruit powder preparation

Mangosteen fruit aril was separated from its pericarp, washed with water and steamed for 15 minutes [7]. Furthermore, it was crushed and separated from the seed to get mangosteen juice. Maltodextrin was added to mangosteen juice in ratio of 70:30 (w/w, which mangosteen juice is equivalent to total solid 100%). In case of mangosteen juice have 15% total solid, the ratio of maltodextrin: mangosteen juice (TS 15%) becomes 70:200. Mixture of mangosteen juice and maltodextrin was filtered through mesh 100 and spray dried under the condition of inlet temperature of 75°C and outlet temperature of 160°C.

Mangosteen pericarp was separately prepared. It was cut to a thickness of 1 cm, blanched and dried in the oven temperature of 60°C for about 24 hours. Dried mangosteen pericarp was crushed using blade mill 2800 rpm for 30 minutes.

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Formulation of instant drink of mangosteen

Mangosteen fruit and pericarp powder was used as main ingredient (Table 1). In the preliminary test, mangosteen pericarp powder was used in concentration of 2.5%. Sucrose was added as sweet taste in concentration of 50% (formula 1 & 2) and 60% (formula 3 & 4). Citric acid was added as acid enhancer in concentration of 0.5% (formula 1 & 3) and 1% (fromula 2 & 4).

Table 1. Formula of instant drink of mangosteen (%)

Composition	Formula (%)			
	1	2	3	4
Mangosteen juice powder	47	46.5	37	36.5
Mangosteen pericarp powder	2.5	2.5	2.5	2.5
Sucrose	50	50	60	60
Citric acid	0.5	1	0.5	1

Evaluation of instant drink of mangosteen

Water content was determined using Karl Fischer moisture titrator by electronic titrating of water contained in the sample [8]. Bulk density was calculated by weighing 20 gram sample powder and gently loading into 100 ml graduated cylinder (ρ_{bulk}). For the determination of tapped density (ρ_{tapped}), the cylinder was tapped for 250 times using tapped density tester and the volume of sample was read [9][10]. Hausner's ratio (HR) and Carr index (CI) were calculated to determine the cohesiveness and flowability property of the powder samples.

$$HR = \frac{\rho_{tapped}}{\rho_{bulk}}$$

$$CI = \frac{\rho_{tapped} - \rho_{bulk}}{\rho_{tapped}} \times 100\%$$

The solubility was determined by mixing the sample powder with distilled water (1:10 w/v). Sample and water mixture was stirred for 1 h at room temperature and centrifuged at 1500 rpm for 10 minutes. The supernatant was collected and dried at 105°C until constant weight. Solubility (%) was measured by dividing weight of dried supernatant by weight of sample and multiplied with 100% [11].

Determination of antioxidant activity by DPPH radical scavenging

Antioxidant activity was measured by DPPH radical scavenging activity based on Ghafar *et al* (2010) method with some modification. A mixture of 50 µL of sample and 1 mL of 0.04 M DPPH in 80% ethanol was shaken and incubated at room temperature for 30 minutes. The negative control consisted only DPPH solution, while the blank was 80% ethanol. DPPH scavenging activity was measured using spectrophotometer at 517 nm. The scavenging effect was determined by the ratio of DPPH absorption decrease against the absorption of DPPH solution (negative control) using the following equation :

$$\text{Scavenging (\%)} = \frac{\text{Abs}_{(\text{control})} - \text{Abs}_{(\text{sample})}}{\text{Abs}_{(\text{control})}} \text{ x } 100$$

Inhibition concentration 50 (IC_{50}) value was obtained from the plotted graph of scavenging against concentration of sample (µg/ mL) [12].

Determination of total phenolic content

A 200 µL of sample was mixed with 750 µL of Folin-Ciocalteau reagent and incubated for 5 minutes. To the mixture, 750 µL of 6% sodium carbonate solution was added and continued to incubate for 60 minutes

at room temperature. The absorbance was measured by UV-Vis spectrophotometer at 725 nm. Standard of gallic acid (10-60 µg/mL) was prepared by the same procedure. Total phenolic content was expressed as mg gallic acid equivalent (GAE) per gram sample [12].

Sensory analysis

Instant drink of mangosteen was diluted in drinking water (12 g for 100 ml water). Panels (32 members) given rating on five point hedonic scale to visual appearance, taste, flavor, aftertaste in each formula and preference formula [3].

Statistical analysis

Water content, Carr index, solubility, antioxidant activity, total phenolic content and sensory analysis of each formula was compared to each other using Student's t test. Significance level was set up at $p < 0.05$.

RESULTS AND DISCUSSION

Preliminary test on formulation of instant drink of mangosteen was carried out to determine the percentage of mangosteen pericarp powder, sucrose and citric acid. Based on preliminary sensory evaluation (data not shown), 2.5% of mangosteen pericarp powder was acceptable. Higher concentration of mangosteen pericarp powder cause unpleasant aftertaste. Sucrose was added at concentration of 50-60% (equivalent to 6-7.2% in ready to serve drink) and citric acid was added at concentration of 0.5 - 1% [13].

Figure 1. Instant drink of mangosten
Note: 1- 4 presented formula 1-4

All ingredients in formula were dry mixed using blender. Instant drink of mangosteen formula 1, 2, 3 and 4 were fine powder, light brown in color, specific flavour and very sour in taste if not serve in water. Visual appearance of all formulas can be seen in Figure 1. Instant drink was formulated as it has longer shelf life, volume reduction, simple packaging and suitable for transport and storage at room temperature [10][9]. Long shelf life of dried powder is affected by water content, and dry matter is important parameter which can affect solubility, bulk and tapped density [10]. Physical evaluation of instant drink mangosteen included water content, bulk density (Hausner ratio and Carr index) and solubility, which can bee seen in Table 2.

Table 2. Physical evaluation of instant drink of mangosteen

Parameters	Formula			
	1	2	3	4
Water content (%)	1.58 ± 0.05^{a}	1.57 ± 0.25^{ab}	1.31 ± 0.12^{b}	1.63 ± 0.32^{ab}
Carr index	26.96 ± 0.82^{c}	30.77 ± 0.46^{b}	28.75 ± 1.59^{bc}	32.95 ± 0.76^{a}
Hausner's ratio	1.37 ± 0.02^{c}	1.44 ± 0.01^{b}	1.40 ± 0.03^{bc}	1.49 ± 0.02^{a}
Solubility (%)	43.15 ± 0.11^{d}	44.32 ± 0.01^{a}	43.57 ± 0.02^{b}	43.52 ± 0.02^{c}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant ($\alpha = 5\%$)

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Water content range was between 1.31-1.63%. It showed that water content value similar to each other, but statistically, water content of formula 3 was significantly difference from formula 1. The lower water content was considered as stable from microbial growth or enzymatic reaction [14]. Hausner's ratio ranged between 1.37-1.49 and Carr index ranged between 26.96-32.95%. According to the classification of powder flowability based on Carr index and Hausner's ratio data, formula 1, 2 and 3 powder were poor flowability powder, while formula 4 powder was very poor flowability powder [15]. Poor flowability might be due to the water content and moisture content. Iqbal and Fitzpatrick (2008) reported that increasing the mositure content will increase the cohession of powder particle, so it could be lower the powder flowability [16]. Addition of citric acid might be affect the flowability of powder. Nishad *et al* (2017) reported that addition of citirc acid in sugarcane juice decreased the flowability of sugarcane powder [17]. Solubility of mangosteen instant drink ranged from 43.15 to 44.32%. Statistically, solubility of each formula was significantly different to each other.

Table 3 showed the antioxidant activity and total phenolic content of mangosteen instant drink. Mangosteen pericarp powder was added to formula to enhance total phenolic content and antioxidant activity. It is known that mangosteen pericarp was abundant resource of phenolic compound such as xanthones, anthocyanins, proanthocyanidins, tannins and phenolic acid [18][19]. In the research of Afifah and Niwat (2015), mangosteen pericarp capable to increase antioxidant activity in greentea drink [20]. Total phenolic content of formula 1, 2 and 3 were not significantly different. Total phenolic content of formula 1 was higher and significantly different with total phenolic content of formula 4. Antioxidant activity was represented by IC_{50}, where the value describes the total antioxidants needed to reduce 50% of initial DPPH radical. Lower of IC_{50} means higher antioxidant activity. Antioxidant activity of formula 1 and 2 were not significantly different, but formula 3 and 4 were significantly different compared with formula 1. Formula 1 and 2 were better in antioxidant activity compared with formula 3 and 4. It showed that not only mangosteen pericarp powder that increased the antioxidant activity, mangosteen juice powder contributed to improve the antioxidant activity. Higher concentration of mangosteen juice powder had higher antioxidant activity.

Table 3. Chemical evaluation of instant drink of mangosteen

Parameters	Formula			
	1	2	3	4
Total phenolic content (mg EAG/g sample)	1.58 ± 0.16^{a}	1.46 ± 0.20^{ab}	1.57 ± 0.24^{ab}	1.31 ± 0.04^{b}
Antioxidant activity/ IC_{50} (mg/ml)	91.5 ± 8.4^{a}	92.1 ± 12.7^{ab}	110.3 ± 5.0^{bc}	117.5 ± 6.4^{c}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant ($\alpha = 5\%$)

Sensory evaluation was carried out by hedonic scale method and involved 32 panels at the age of 25-40 years old. Table 4 showed that visual appearance of each formula were not significantly different, indicated that they had similar visual appearance. The visual appearance ranged between 3.00-3.31, flavour 3.25-3.41, sweetness 3.09-3.56, sourness 3.00-3.25 and aftertaste 2.91-3.34 of 5 points hedonic scale. It indicated that panelists like slightly of all formulas. Generally, formula 3 was the chosen formula because it better in visual appearance, sweetness and aftertaste compared with other formula. It was supported by preference test (like/dislike), where 13 panelists chosen formula 3, 6 panelists chosen formula 4, 4 panelists for formula 1 and 4 panelists for formula 2.

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Table 4. Sensory evaluation of instant drink of mangosteen

Parameters	Formula			
	1	2	3	4
Visual appearance	3.00 ± 0.88[a]	3.19 ± 0.69[a]	3.31 ± 0.78[a]	3.25 ± 0.84[a]
Flavour	3.28 ± 0.89[a]	3.25 ± 0.84[a]	3.31 ± 0.82[a]	3.41 ± 0.84[a]
Sweetness	3.13 ± 0.98[ab]	3.09 ± 0.93[a]	3.56 ± 0.84[b]	3.19 ± 0.97[ab]
Sourness	3.00 ± 0.95[a]	3.25 ± 1.02[a]	3.19 ± 0.90[a]	3.25 ± 1.16[a]
Aftertaste	3.13 ± 1.10[a]	2.94 ± 0.88[a]	3.34 ± 0.90[a]	2.91 ± 0.96[a]

Note: data is presented as mean ± standard deviation (n=32); sensory evaluation parameters were on a scale of 1–5 (Like very much = 5, like = 4, like slightly = 3, dislike slightly = 2 and dislike very much = 1); the same characters (denoted above), the difference between them was not significant (α = 5%)

CONCLUSION

Mangosteen is tropical fruit that cultivated in Indonesia. Mangosteen fruit was fresh consumed and mangosteen pericarp was extracted to become food supplement. Utilizing of all part of mangosteen for the instant drink production aim to improve the customer satisfication of taste and ingredient functionality. Formulation of mangosteen instant drink using the main ingredient of mangosteen fruit juice and pericarp powder enhanced functionality in phenolic content and antioxidant activity and consumer acceptance.

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