Physical, Chemical, Organoleptic Characteristics, and Antioxidant Activity of Instant Cascara Powder with Additions of Ginger and Sappan Wood

Ardiyan Dwi Masahid*, Resya Elen Yulianingtyas, Yuli Witono, Ahmad Nafi'

Agricultural Product Technology Department, Agricultural Technology Faculty, Jember University,
Kalimantan Street 37, Kampus Tegalboto, Jember 68121, Indonesia
*Corresponding author: Ardiyan Dwi Masahid, Email: ardiyan@unej.ac.id

Submitted: October 12, 2022; Revised: December 23, 2022; Accepted: February 10, 2023

ABSTRACT

The aroma and taste of cascara products are generally mild, and the use of cascara powder also produces a blackish-brown extract color. To enhance both the taste and aroma, it is recommended to add ginger (*Zingiber officinale*) and sappan wood (*Caesalpinia sappan*). Ginger contains essential oils to enhance aroma and has antioxidant activity. On the the hand, the Brazilin compound in sappan wood provides a natural red color, and the polyphenols have antioxidant activity. This study aimed to determine the effects of adding ginger and sappan wood extracts on physical, chemical, and organoleptic properties, as well as the antioxidant activity of instant cascara powder, with a focus on selecting the best and most preferred formulation. A Completely Randomized Design (CRD) was used with one factor, namely concentration of ginger and sappan wood extracts. The treatment consisted of six levels, including F1 as control (cascara 100 g), F2 (cascara 70 g, ginger 5 g, and sappan wood 25 g), F3 (cascara 70 g, ginger 10 g, and sappan wood 20 g), F4 (cascara 70 g, ginger 15 g, and sappan wood 15 g), F5 (cascara 70 g, ginger 20 g, and sappan wood 10 g), and F6 (cascara 70 g, ginger 25 g, and sappan wood 5 g). The results showed that additions of ginger and sappan wood extracts impacted physical property, namely redness value, chemical properties including moisture, polyphenol content, and antioxidant activity, as well as all organoleptic parameters. The best and most preferred formulation was sample F2 which had a redness value of 6,39, moisture content of 2,62%, polyphenol content of 35,41 mg GAE/g, and antioxidant activity amounting to 64,5%. Moreover, the average value of color preference was 5,32 (somewhat like), fragrance 4,32 (neutral), taste 4,8 (neutral – somewhat like), and overall 4,84 (neutral – somewhat like).

Keywords: *Cascara*; ginger; instant drink powder; sappan wood

INTRODUCTION

Coffee production in Indonesia was estimated at 741,657 tons in 2019, with East Java contributing 6,6% to the total production (Directorate of Plantation Statistics, 2020). This abundance resulted in a significant amount of coffee beans and fruit skin. The proportion of coffee fruit skin can reach 50-60% of fruit, consisting of 45% coffee fruit skin, 10% mucilage or slimy layer, and 5% coffee bean skin (Saisa and Syabriana, 2018).

The coffee fruit skin generated from the pulping process has not been optimally utilized. Sastra and Bawono (2018) stated that animal feed, compost, and cascara are some of the processed products derived from coffee fruit skin. Cascara is a dried products usually brewed to make infusion drink, and the result can be brewed to form infusion drink.

Cascara has the potential to be processed into a beverage product due to its content of bioactive components with various benefits. It also possesses sensory characteristics similar to tea (Ariva et al., 2020). The bioactive components of cascara include 226,4 mg/L caffeine, 85,0 mg/L protocatechuic acid, 69,6 mg/L chlorogenic acid, 6,1 mg/L rutin, and 4,3 mg/L

DOI: http://doi.org/10.22146/agritech.78340
ISSN 0216-0455 (Print), ISSN 2527-3825 (Online)

gallic acid, which contributes to the high antioxidant activity (Heeger et al., 2017).

Mahriani et al. (2019) stated that the aroma and taste of cascara products, specifically those produced in Bondowoso Regency, were not yet strong, and only contained a relatively small amount of antioxidant. Muzaifa et al. (2021b) also mentioned that the distinctive taste of cascara does not yet meet consumer preferences due to an unbalanced combination of sweetness and acidity, resulting in a slightly bitter or odd taste. As stated by Pua et al. (2021), cascara from Guatemala could be identified by aromas including honey, caramel, and smoky, which served as the strongest descriptor. The aroma and taste of cascara infusion can be enhanced by adding natural ingredients such as ginger, vanilla, and cinnamon (Mahriani et al., 2019).

Ginger is believed to enhance organoleptic properties of the aroma and taste of instant cascara, attributed to its slightly thick and yellowish essential oil. The essential oil consists of compounds such as oleoresin, zingiberene, limonene, borneol, zingiberal, citral, cineol, sesquiterpene, zingeron, phellandrene, and camphene, which have antioxidant properties (Supriani, 2019). Zingeron can provide sweet taste and spicy sensation (Srikandi et al., 2020).

Sappan wood extract is also added in the production of instant cascara. The using powdered cascara produces a blackish-brown brew. A previous study stated that cascara resulting from drying in the sun for 4-5 days yielded a blackish-brown product (Arpi et al., 2021). This can be improved by adding sappan wood extract, containing the compound brazilin, which provides a natural red color (Azliani and Nurhayati, 2018). Sappan wood also contains flavonoids and polyphenols with antioxidant properties (Supriani, 2019). Based on these considerations, the addition of ginger and sappan extracts is crucial to introduce beneficial bioactive components and improve the organoleptic quality of instant cascara powder.

This study aimed to investigate the effect of adding ginger and sappan extracts on the characteristics of instant cascara powder. Furthermore, the best formulation based on physical, chemical, and organoleptic characteristics was determined.

METHODS

Materials

The main materials used included powdered cascara from robusta coffee beans sourced from Java Ijen Republic Coffee, Bondowoso, East Java, through an e-commerce platform, emprit ginger from Pandawa fruit store in Jember, sappan wood shavings from Surabaya obtained through e-commerce, water, local sugar from PG. Semboro, gallic acid (Merck 99%, Darmstadt, Germany), DPPH (2,2-diphenyl-1-picrylhydrazyl) (Tokyo Chemical Industry (TCI) 99%, Tokyo, Japan), Folin Ciocalteu reagent (Merck KgaA 99%, Darmstadt, Germany), and Na2CO3 (Merck KgaA 99%, Darmstadt, Germany).

The tools used consisted of a digital balance (PX2202 Pioneer Ohaus, Parsippany, NJ, Amerika Serikat), colorimeter (AMT507 HKNA Tlead, Shandong, China), pH meter (Hanna HI 98107 pHep, Smithfield, Rhode Island, Amerika Serikat), hot plate (IKA C-MAG HS 7, Staufen im Breisgau, Baden-Wurttemberg, Germany), analytical balance (Sartorius BSA224S-CW, Goettingen, Germany), moisture analyzer (Sartorius MA 150, Goettingen, Germany), UV Vis spectrophotometer (Thermo Scientific Genesys 10S UV-Vis, Waltham, MA, Amerika Serikat), vortex (IKA Genius 3, Staufen im Breisgau, Baden-Wurttemberg, Germany).

Analysis Procedure

This study used a Completely Randomized Design (CRD) with a single factor, namely the difference in concentrations of added ginger and sappan wood. This factor resulted in six levels or formulations, with each replicated three times for treatment, and the analysis was performed in duplicate.

The study stages started with the preparation of instant cascara powder using emprit ginger and sappan wood, followed by testing of physical, chemical, and organoleptic characteristics, as well as effectiveness. Instant cascara powder was formulated with the following gram ratios of cascara: emprit ginger: sappan wood, F1 (100:0:0), F2 (70:5:25), F3 (70:10:20), F4 (70:15:15), F5 (70:20:10), and F6 (70:25:5). Sappan wood and formulated cascara were steeped for 15 minutes with 500 ml of water at 100 °C, and filtered. The resulting filtrate was left to settle for four hours, then the sediment and obtained extract were separated. Sappan wood and cascara extracts were added to the clear filtrate from the emprit ginger extract. The homogenized extracts of sappan wood, cascara, and ginger were subjected to crystallization with additions of 500 g sugar. The resulting crystals were reduced in size using a mortar and sieved through a 40-mesh sieve.

The analysis of physical characteristics for instant cascara powder included color assessment using a colorimeter, producing L (brightness), a (redness), and b (yellowness) values (Hutchings, 1999), as well as solubility in hot water (100 °C) and cold water (16±2 °C) (SNI 2983-2014). Chemical characteristics analysis included testing for moisture content using the thermogravimetric method with a moisture analyzer

(Anwar and Kunz, 2011). The pH value was measured using a calibrated meter with pH 7 buffer solution (Butt et al., 2011), while polyphenol content was assessed through UV-Vis spectrophotometry with a standard curve of gallic acid solution at concentrations of 0 μL, 25 μL, 50 μL, 75 μL, 100 μL, 125 μL, and 150 μL (Yuwanti et al., 2018; Marjoni et al., 2015 with modifications). Additionally, antioxidant activity was tested using the DPPH method with a concentration of 0,1 mM DPPH. The results were calculated as the percentage inhibition of DPPH (Fauzi et al., 2019; Hasan et al., 2022).

Organoleptic analysis comprised color, aroma, taste, and overall hedonic tests. A sample of 1 g was brewed using 15 ml of hot water at 90 °C. Each sample was labeled with a random three-digit number code to avoid bias, and the panelists used were 25 untrained individuals. The assessment was carried out by giving a score of 1 to 7 for each sample. The score values used were 1 = strongly dislike, 2 = dislike, 3 = somewhat dislike, 4 = neutral, 5 = somewhat like, 6 = like, and 7 = strongly like (Setyaningsih et al., 2010). In addition, the effectiveness test was used to determine the best formulation based on the parameters that have been analyzed (Garmo et al., 1984). This method is based on the procedure as follows: variables are sorted by priority and contribute to results. Give value weight to each variable (BV) according to its contribution with relative numbers 0-1. This weight differs depending on the importance of each variable whose results are obtained as a result of treatment. Normal weight (BN) is determined from each variable by dividing the variable weight (BV) by the sum of all value weights. Divide the variables analyzed into two groups, namely: (1) group A, consists of variables in which the greater the average the better the value (desired for the treated product) and (2) Group B consists of variables which are the greater the worse (not desired).

Determined the effectiveness value (Ne) of each variable, using the formula: the treatment value - the worst value and the best value - the worst value, for the variable with the greater average the better, so the lowest value as the worst and the highest value as the best. Conversely for the variable with the smaller value the better, the highest value as the worst value and the lowest value as the best. Calculate the result value (Nh) of each variable obtained from the normal weight multiplication (BN) with the value of effectiveness (Ne). Add the results value of all variables and the best combination is chosen from the treatment combination which has the highest result value (Nh) (Equation 1).

$$\text{Result Value (Nh)} = \frac{\text{treatment value - the worst value}}{\text{the best value - the worst value}} \times \text{BN} \qquad (1)$$

Physical and chemical test data were statistically processed using one-way ANOVA (Analysis of Variance). When the results showed a significant difference, further analysis was conducted using the Duncan Multiple Range Test (DMRT) with a significance level of $\alpha \leq 0{,}05$. Organoleptic test data were analyzed using Chi-Square at a significance level of $\alpha \leq 0{,}05$. Data processing was carried out with Microsoft Excel 2016 and SPSS 23.

RESULTS AND DISCUSSION

Physical Characteristics of Instant Cascara Powder with Different Additions of Ginger and Sappan Wood

Solubility

Solubility is defined as the time required for powdered drinks to dissolve completely in water. This parameter is crucial and serves as a quality requirement for instant powdered beverages (Mursalin et al., 2019). The solubility analysis of instant cascara powder with varying additions of ginger and sappan wood showed consistent results across all samples, each showing complete dissolution in hot water (100 °C) in less than 30 seconds and in cold water (16±2 °C) in less than 3 minutes. The solubility was influenced by the filler material, namely sugar used in the crystallization process. Sucrose or sugar has high solubility, making it highly effective in completely dissolving the samples. As stated by Haryanto (2017), the solubility of sugar in water is high, hence, products with high concentration of sugar have high solubility.

Color

Color is one of the essential parameters in a food product because it influences consumer preferences (Fauzi et al., 2019). Quantitative color analysis was conducted using a colorimeter and based on statistical analysis, additions of varying amounts of ginger and sappan wood did not have a significant effect ($\alpha \leq 0{,}05$) on the lightness values produced. The average lightness values of instant cascara powder ranged from 75,01±3,41 to 80,08±3,26. The color of the product was influenced by cascara powder used, which had a brownish color due to the drying process. According to Nafisah and Widyaningsih (2018), drying leads to a slightly darker color in cascara due to activity of the polyphenol oxidase enzyme that oxidizes polyphenol compounds. The L* values or lightness of instant cascara powder with varying additions of ginger and sappan wood are presented in Figure 1 (a).

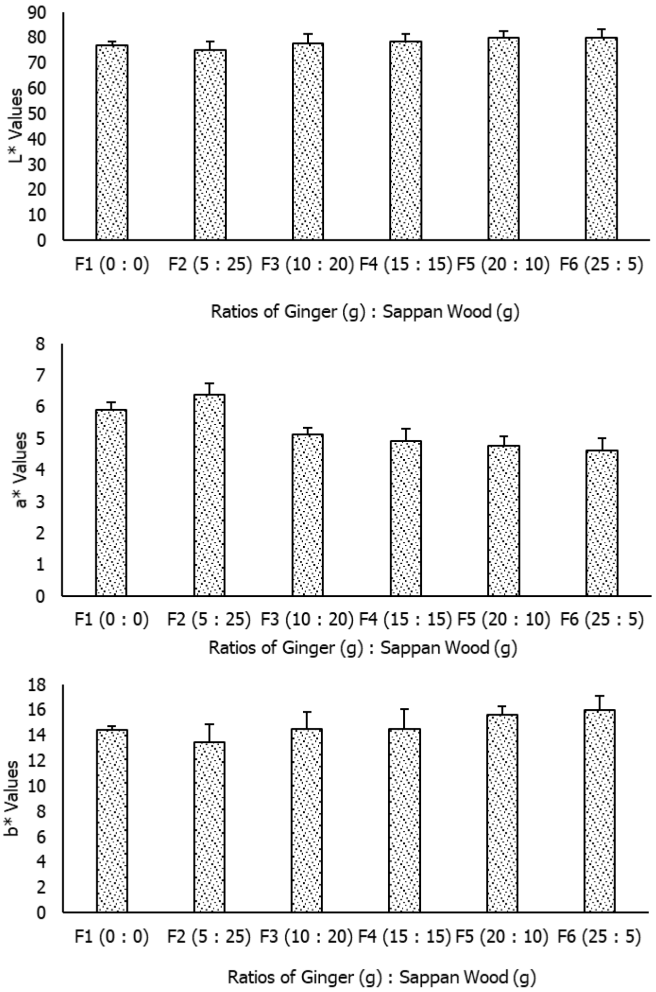

Figure 1. (a) Diagram of the brightness level (b) redness value (c) yellowness level of instant cascara powder with different additions of ginger and sappan wood

The redness value (a*) of instant cascara powder with additions of ginger and sappan wood in different concentration ranged from 4,62±0,39 to 6,39±0,37. Based on statistical analysis, the varying additions of ginger and sappan wood had a significant effect (α ≤ 0,05) on the redness values. The average redness value of sample F2 was the highest due to the higher additions of sappan wood, namely 25 g. Sappan wood contains a natural red pigment derived from the compound, brazilin (Supriani, 2019; Azliani and Nurhayati, 2018). The oxidation of brazilin in water can lead to a color change to reddish-brown (Pujilestari and Salma, 2017; Failisnur et al., 2019). On the other hand, sample F6 had the lowest concentration of sappan wood (5 g) and the highest additions of ginger (25 g), resulting in a product with a slightly reddish color and a dominant yellow hue. This was attributed to the emprit ginger which has a higher content of essential oil and yellow in color. The yellow color tended to reduce the redness value of the product. The a* values or redness of instant cascara powder with different additions of ginger and sappan wood are presented in Figure 1 (b).

The yellowness value (b*) of instant cascara powder with different additions of ginger and sappan wood ranged from 13,42±1,42 to 16,00±1.1. Based on statistical analysis, the varying additions of ginger and sappan wood did not have a significant effect (α ≤ 0,05) on the yellowness value. The average yellowness value increased with additions of emprit ginger. Sample F2 was found to have the lowest value because it had the least amount of emprit ginger (5 g) and the highest proportion of sappan wood added (25 g). The yellowness value was influenced by the essential oil content in ginger. Supriani (2019) stated that the essential oil in ginger had a slightly thick consistency and was yellow in color. Furthermore, Widiyana et al. (2021) mentioned that additions of emprit ginger powder to herbal tea made from ciplukan leaves at the highest concentration (40%) resulted in yellow color in ranking tests. The b* values or yellowness of instant cascara powder with different additions of ginger and sappan wood are presented in Figure 1 (c).

Chemical Characteristics of Instant Cascara Powder with Different Additions of Ginger and Sappan Wood

Moisture content

The moisture content in food products is a crucial parameter, specifically for dry products. Statistical analysis showed that the varying additions of ginger and sappan wood had a significant effect (α ≤ 0,05) on the moisture content of instant cascara powder, ranging from 2,25±0,20 to 4,12±0,77. In previous study, the moisture content of dried coffee husks or cascara for 4-7 hours reportedly ranged between 4,96% and 8,03% (Hutasoit et al., 2021), while sappan wood simplicia had 10,349% (Febriyenti et al., 2018) and emprit ginger had 52,15% (Aditya et al., 2018). Among these three ingredients, ginger was found to have the highest moisture content. The higher additions of emprit ginger, the greater the moisture content of instant cascara powder product. Aditya et al. (2018) stated that the moisture content of instant ginger powder added with beetroot juice ranged from 1,36% to 2,93%. Rifkowaty and Martanto (2016) also mentioned that additions of liquid red onion extract as a natural colorant at the highest concentration of 40% resulted in instant ginger powder with a moisture content of 4,02%. Additions of liquid extract during the crystallization process led to an increase in the liquid volume, causing a longer crystallization time and resulting in higher moisture content.

Instant cascara powder tended to have a moisture content of more than 3%. According to the Indonesian National Standard (SNI) 01-4320-1996 for traditional powdered drinks, the product is required to have a maximum moisture content of 3%. For instant (SNI 7707-2011) and packaged dry tea (SNI 01-3836-2013), the maximum moisture content is set at 5%, and 8% respectively. Based on the results, the moisture content of instant cascara powder exceeded the requirement for traditional powdered drinks but remained below the standards for instant and packaged dry tea, making it safe for consumption. The moisture content values of instant cascara powder with different additions of ginger and sappan wood are presented in Figure 2.

pH value

The pH value is a unit used to measure the level of acidity in a substance or product (Muzaifa et al., 2021a). The value increases as the total acidity of the substance or product decreases (Subeki et al., 2019). Statistical analysis showed that the varying additions of ginger and sappan wood did not have a significant effect ($\alpha \leq 0,05$) on the pH value, ranging from 6,03±0,24 to 6,53±0,15. The pH value of instant cascara powder was influenced by its composition. Adhayanti and Ahmad (2020) state that the quantity and type of ingredients added during processing can affect the pH value of powdered beverage. Sample F1 had the lowest pH value because its composition consisted of cascara with the highest concentration (100 g). The pH value of cascara is lower compared to ginger and sappan wood because coffee husks contain acidic compounds such as protocatechuic acid and chlorogenic acid. Heeger et al. (2016) stated that cascara beverages contained 85,0 mg/L of protocatechuic acid and 69,6 mg/L of chlorogenic acid. In addition, Subeki et al. (2019) mentioned that robusta coffee husk tea had a pH value with low acidity (pH 5,61). Sample F2 had the highest pH value because the amount of cascara used was less than in sample F1, and the concentration of added sappan wood was also very high (25 g). Red to violet-colored sappan wood extract had a pH value above 7 (7-8) (Saraswati, 2016), while ginger showed a neutral value of 6,76 (Anastasia et al., 2022). The pH values of instant cascara powder with additions of ginger and sappan wood are presented in Figure 3.

Polyphenol content

Polyphenols are secondary metabolites of plants (Neswati and Ismanto, 2018) that play a crucial role in maintaining body health. Statistical analysis using ANOVA with a significance level of $\alpha \leq 0,05$ showed that the varying additions of ginger and sappan wood had a significant effect on the polyphenol content of instant cascara powder, ranging from 25,56±0,71 to 35,41±1,12. The highest polyphenol content was found in sample F2, while the lowest occurred in F6.

Instant cascara powder product consisted of three ingredients namely cascara, ginger, and sappan wood, each with different polyphenol content. The total phenol content of Arabica Gayo cascara resulting from steeping for 4, 6, and 8 minutes ranged between 36,38 to 42,67 mg GAE/ml (Muzaifa et al., 2019). On the other hand, arabica cascara beverage from Barahona, Dominican Republic was found to have a polyphenol content of 19,53 mg GAE/g dry weight (Jaric et al., 2021). Sholichah et al. (2019) stated that the extraction of robusta cascara samples yielded higher polyphenol levels and antioxidant activity compared to Arabica cascara samples. Suryani (2012) also mentioned that fresh ginger had a phenol content of 17,86 mg/g GAE dry weight. Additionally, Pranata et al. (2021) using sappan wood powder extracted with water and heated

Figure 2. Diagram of the moisture content of instant cascara powder with different additions of ginger and sappan wood

Figure 3. Diagram of the pH value of instant cascara powder with different additions of ginger and sappan wood

Figure 4. Diagram of the polyphenol content of instant cascara powder with different additions of ginger and sappan wood

Figure 5. Diagram of antioxidant activity values of instant cascara powder with different additions of ginger and sappan wood

to 100°C for 15 minutes, obtained a polyphenol content of 35,2403 mg GAE/g of the sample. The polyphenol content values of instant cascara powder are presented in Figure 4.

Figure 4 showed that the polyphenol content in sample F6 was lower due to the minimal amount of sappan woodadded (5 g). The low polyphenol content in sample F6 was also influenced by the high concentration of ginger (25 g). This is because the major phenolic component in ginger, namely gingerol, is not resistant to temperature changes during processing and storage. Gingerol transforms into shogaol and zingerone, leading to a decrease in phenolic compounds within ginger (Dwiyanti et al., 2019). Mardhatilah (2015) also stated that gingerol in ginger was not stable at high temperatures, transforming into shogaol with a spicier aroma.

Antioxidant activity

Antioxidant compounds can stabilize free radicals by donating an electron (Subeki et al., 2019). Statistical analysis using ANOVA with a significance level of $\alpha \leq 0,05$ showed that different additions of ginger and sappan wood significantly affected the inhibition of DPPH or antioxidant activity, ranging from 38,04±5,61 to 64,50±0,73. The highest antioxidant activity was observed in sample F2, while the lowest occurred in F6. Antioxidant activity values for instant cascara powder are presented in Figure 5.

Antioxidant activity in instant cascara powder with additions of ginger and sappan wood corresponded to the polyphenol content. According to Nafisah and Widyaningsih (2018), a high polyphenol content in a substance results in significant rise in antioxidant activity. This is because hydrogen atoms in polyphenolic compounds contribute to the neutralization of free radicals, or the termination of chain reactions, resulting in antioxidant activity (Neswati and Ismanto, 2018).

Sample F2 had the most significant antioxidant activity because the formulation contained the highest polyphenol content and concentration of sappan wood (25 g). Pranata et al. (2021), using sappan wood powder extracted with water and heated at 100°C for 15 minutes obtained a polyphenol content of 35,2403 mg GAE/g. Furthermore, Puspadani et al. (2019) mentioned that synbiotic yogurt products added with sappan wood extract at increasing concentrations (0,5%) had greater antioxidant activity. Sappan wood contains flavonoids, tannins, phenolates, and brazilin, which serve as sources of antioxidant. Brazilin, classified as a polyphenol, can neutralize hydroxyl radicals, translating to antioxidant properties (Fitriyanti et al., 2020).

Antioxidant activity of sample F1, which consisted of 100 g cascara, was higher compared to F6. This is because cascara contains other components such as anthocyanins, flavonoids, beta-carotene, and vitamin C, which have high antioxidant activity. As mentioned by Rosidah et al. (2021), phenols, alkaloids, flavonoids, tannins, saponins, and sterols are compounds present in robusta cascara. Flavonoids also show antioxidant properties by inhibiting oxidation, and robusta cascara contains tannin levels of 2,33–3,46 mg/g as well as phenol of 1,88–2,45 mg/g. Higher tannin and phenol levels have a greater inhibitory effect on oxidation, resulting in higher antioxidant activity. Beta-carotene, vitamin C, and anthocyanin in coffee fruit peel also have antioxidant properties. Arabica coffee peel contains 1217,58 mg/g polyphenols, 560,53 mg/g beta-carotene, 23,76 mg/g vitamin C, 13,498 mg/g anthocyanin, and 60,25% antioxidant activity (Puspaningrum and Sumadewi, 2020). Based on the results, sample F6 had the lowest antioxidant activity because it contained the lowest polyphenol content. This is attributed to the fact that the major phenolic component in ginger, namely gingerol, is not resistant to changes in processing and storage temperatures. Gingerol transforms into shogaol

Table 1. Organoleptic characteristics of instant cascara powder with different additions of ginger and sappan wood ((1 = strongly dislike, 2 = dislike, 3 = somewhat dislike, 4 = neutral, 5 = somewhat like, 6 = like, and 7 = strongly like)

Ratios of Ginger (g) : Sappan Wood (g)	Hedonic color	Hedonic aroma	Hedonic taste	Overall hedonics
F1 (0 : 0)	5,08	4,48	5,04	5,04
F2 (5 : 25)	5,32	4,32	4,80	4,84
F3 (10 : 20)	4,84	4,12	4,68	4,80
F4 (15 : 15)	4,60	3,88	4,56	4,76
F5 (20 : 10)	4,44	4,56	4,64	4,84
F6 (25 : 5)	4,08	4,72	4,00	4,36

and zingerone, leading to a decrease in phenolics within ginger (Dwiyanti et al., 2019).

Organoleptic Characteristics of Instant Cascara Powder with Different Additions of Ginger and Sappan Wood

Hedonic color

Color is an important parameter in a food product because it attracts attention and affects consumer preferences (Fauzi et al., 2019). Based on the Chi-Square test with a significant test level at α ≤ 0,05, different additions of ginger and sappan wood had a significant effect on the color preference of the panelists, which ranged from 4,08 ± 1,38 (neutral) to 5,32 ± 1,07 (rather like). The highest color hedonic test result was in sample F2, while the lowest occurred in F6. The color hedonic value of instant cascara powder brew with additions of ginger and sappan wood is presented in Table 1.

The highest concentration of sappan wood (25 g) in sample F2 produced the most preferred color and additions of more ginger (25 g) in F6 was not preferred by the panelists. The steeping results of sample F2 showed a brownish-red color similar to steeping tea. This color was produced from a combination of sappan wood with a high concentration (25 g) and 70 g cascara. Ramadhani et al. (2020) stated that the brownish red color of tea was most preferred by panelists, while tea with a blackish brown or blackish intense red color was less preferred because it was identical to bitterness. Furthermore, tea with a yellowish-red color was also less preferred by consumers because it had a subtler taste, and the resulting clear color was less attractive. The red color produced by sappan wood originated from the brazilin component, which could be oxidized in water, causing a color change to brownish red (Pujilestari and Salma, 2017; Failisnur et al., 2019).

Hedonic aroma

The aroma of a product can affect the taste and the level of panelist preference (Nurhayati, 2018). The hedonic value of aroma in instant cascara powder brew with additions of ginger and sappan wood is presented in Table 1. Based on the Chi-Square test with a significant test level at α ≤ 0,05, different additions of ginger and sappan wood had a significant effect on the preference value of instant cascara powder aroma, which ranged from 3,88 ± 0,83 (somewhat dislike to neutral) to 4,72 ± 0,94 (neutral to somewhat like). The highest aroma preference value was in sample F6, while the lowest occurred in F4.

Panelists preferred the aroma of instant cascara powder with the highest ginger concentration (25 g) added. Different additions of ginger resulted in varying values of aroma preference, attributed to the essential oil content. Essential oils in ginger are composed of oleoresin, zingiberen, limonen, borneol, zingiberal, sitral, sineol, seskuiterpen, zingeron, felandren, and kamfena compounds (Supriani, 2019). Mardhatilah (2015) stated that additions of different amounts of ginger (10%, 15%, and 20%) to coffee produced varying aroma preference values. The compounds shogaol, zingeron, and gingerol at the highest ginger concentration (20%) in coffee brew produced a blend preferred by the panelists. At high temperatures, gingerol in ginger is unstable and may transform into shogaol (spicier aroma), resulting in a stronger aroma.

Hedonic taste

According to previous study, consumer tastes of a product determine its acceptance (Nurhayati, 2018). In other words, taste is an important factor for consumers to determine the final decision whether the product is acceptable or not (Rifkowaty and Martanto, 2016). The preference values of panelists for the taste of instant cascara powder with additions of ginger and sappan wood are presented in Table 1. Based on the Chi-Square test with a significant test level at α ≤ 0,05, different additions of ginger and sappan wood had a significant effect on the taste preference value of instant cascara powder, which ranged from 4,0 ± 1,0 (neutral) to 5,04 ± 1,21 (rather like). The highest taste preference value was in sample F1 while the lowest occurred in F6.

Sample F1 featuring the highest cascara concentration of 100 g, received the highest taste preference value, attributed to the sweet and sour taste of cascara, enhanced by additions of sugar, creating a honey-like flavor. Milawarni et al. (2021) stated that cascara had a fruity taste and additions of a certain amount of sugar produced a flavor similar to honey.

Sample F6 with the highest ginger concentration (25 g), on the other hand, was less preferred by panelists because of the spicy taste in the product. This was attributed to ginger essential oil component in the form of gingerol which transformed into shogaol (spicy taste) at high temperature. The higher the amount of ginger added, the more prominent the spicy taste. Instant cascara powder product uses emprit ginger as one of its ingredients. The essential oil in ginger is composed of compounds such as oleoresin, zingiberene, limonene, borneol, zingiberal, citral, cineole, sesquiterpenes, zingerone, phellandrene, and camphene (Supriani, 2019). Gingerol component becomes unstable when exposed to high temperatures and transforms into shogaol. Meanwhile, shogaol and zingeron can cause a spicy taste to ginger (Mardhatilah, 2015; Srikandi et al., 2020).

Overall hedonics

The objective of the overall hedonic test for instant cascara powder product was to determine the acceptance of different formulations of cascara, ginger, and sappan wood. Based on the Chi-Square test with a significance level of α ≤ 0,05, different additions of ginger and sappan wood significantly affected the overall hedonic scores of the panelists, which ranged from 4,36±0,99 (neutral) to 5,04±0,93 (slightly liked). The highest mean overall hedonic score was observed in sample F1, while the lowest occurred in F6. Instant cascara powder with the highest cascara concentration (F1) had a slightly preferred overall hedonic score from the panelists, and the sample with the highest ginger concentration (F6) had a neutral overall hedonic score. The overall hedonic scores of instant cascara powder with variations in additions of ginger and sappan wood are presented in Table 1.

The overall evaluation was in accordance with the taste preference assessment of samples, reinforcing the importance of taste parameters in determining consumer

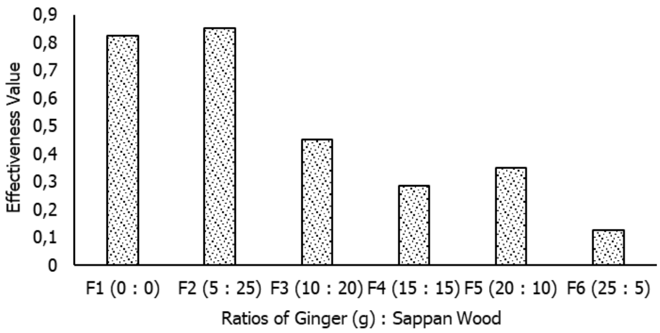

Figure 6. Diagram of the effectiveness value of instant cascara powder with different additions of ginger and sappan wood

acceptance. According to Nurhayati (2017), acceptance of a product is also determined by consumer taste preferences. Taste is an important factor for consumers to determine whether the product is acceptable or not (Rifkowaty and Martanto, 2016). Sample F1 had the highest overall score (5,04) because steeping cascara with added sugar produced a drink taste similar to honey. Similarly, Milwarni et al. (2021) stated that cascara had a fruity taste, and adding a certain amount of sugar led to a taste similar to honey. Additions of ginger to instant cascara in high concentrations caused a spicy taste because gingerol would transform into shogaol when exposed to high temperatures. Shogaol and zingerone give ginger a spicy taste (Mardhatilah, 2015; Srikandi et al., 2020).

Effectiveness Value of Instant Cascara Powder with Different Additions of Ginger and Sappan Wood

The effectiveness test was conducted to determine the formulation that produces the best treatment (Nurhayati et al., 2020). In this study, the test was carried out on parameters such as redness (a*), moisture content, polyphenol content, antioxidant activity, and all organoleptic properties. The effectiveness values of instant cascara powder with variations in additions of ginger and sappan wood are presented in Figure 6.

The effectiveness value of instant cascara powder with different additions of ginger and sappan wood showed that the best formulation was F2 with the treatment ingredients consisting of 70 g cascara, 5 g ginger, and 25 g sappan wood. This sample had the following properties; effectiveness value (0,85), a redness value (6,39), water content (2,62%) polyphenol (35,41 mg GAE/g), antioxidant activity (64,5%), the mean color preference of 5,32 (somewhat like), aroma of 4,32 (neutral), taste 4,8 (neutral - somewhat like), and overall score 4,84 (neutral - somewhat like).

CONCLUSION

In conclusion, different additions of ginger and sappan wood extract to instant cascara powder significantly impacted physical properties, namely redness, chemical properties including moisture, polyphenol, and antioxidant activity, as well as all organoleptic parameters. The higher additions of sappan wood, the greater the values of redness, polyphenol, and antioxidant activity. An increase in additions of ginger led to higher moisture content, while the polyphenol content and antioxidant activity decreased. The optimal and most preferred formulation was F2, consisting of 70 g cascara, 5 g ginger, and 25 g sappan wood. This sample had a redness value (a*) of 6,39, moisture content 2,62%, polyphenol content 35,41 mg GAE/g, antioxidant activity 64,5%, average color preference score 5,32 (slightly liked), aroma score 4,32 (neutral), taste score 4,8 (neutral to somewhat like), and an overall score 4,84 (neutral to somewhat like).

CONFLICT OF INTEREST

There is no conflict of interest between the author and other parties.

REFERENCES

Adhayanti, I., & Ahmad, T. (2019). Karakter mutu fisik dan kimia serbuk minuman instan kulit buah naga yang diproduksi dengan metode pengeringan yang berbeda. *Media Farmasi*, *53*(9), 1689–1699. https://doi.org/10.32382/mf.v16i1.1418

Aditya, Ali, A., & Ayu, D. F. (2018). Minuman fungsional serbuk instan jahe (*Zingiber officinale* R.) dengan penambahan sari umbi bit (*Beta vulgaris* L.) sebagai pewarna alami. *Sagu*, *17*(2), 9–17. http://dx.doi.org/10.31258/sagu.v17i2.7139

Anastasia, D. S., Luliana, S., Desnita, R., Isnindar, I., & Atikah, N. (2022). Pengaruh variasi gula terhadap karakteristik sediaan minuman serbuk instan kombinasi rimpang jahe dan temu putih. *Journal Syifa Sciences and Clinical Research*, *4* (2), 253–262. https://doi.org/10.37311/jsscr.v4i2.14003

Azliani, N., & Nurhayati, I. (2018). Pengaruh penambahan level ekstrak kayu secang (*Caesalpinia sappan* L.) sebagai pewarna alami terhadap mutu organoleptik kue cubit mocaf. *Jurnal Dunia Gizi*, *1*(1), 45. https://doi.org/10.33085/jdg.v1i1.2918

Direktorat Statistik Tanaman Perkebunan. (2020). *Statistik Kopi Indonesia 2019*. Jakarta: Badan Pusat Statistik (BPS).

Dwiyanti, H., Setyawati, R., Siswantoro, S., & Krisnansari, D. (2020). Formulasi minuman fungsional tinggi antioksidan berbasis gula kelapa dengan variasi jenis dan konsentrasi ekstrak rimpang. *Media Pertanian*, *4*(2), 48–58. https://doi.org/10.37058/mp.v4i2.1362

Haryanto, B. (2018). Pengaruh Penambahan gula terhadap karakteristik bubuk instan daun sirsak (Annona muricata L.) dengan metode kristalisasi. *Jurnal Penelitian Pascapanen Pertanian*, *14*(3), 163. https://doi.org/10.21082/jpasca.v14n3.2017.163-170

Heeger, A., Kosińska-Cagnazzo, A., Cantergiani, E., & Andlauer, W. (2017). Bioactives of coffee cherry pulp and its utilization for production of cascara beverage. *Food Chemistry*, *221*, 969–975. https://doi.org/10.1016/j.foodchem.2016.11.067

Jaric, A. M., Pasquino, M. N., Cazalens, E., Šeremet, D., Pudić, R., Cebin, A. V., & Komes, D. (2021). The assessment of bioactive potential and sensory acceptability of coffee and its byproducts- cascara and silverskin. *Croatian Journal of Food Technology, Biotechnology and Nutrition*, *16*(1–2), 35–40. https://doi.org/10.31895/hcptbn.16.1-2.5

Mahriania, Arimurti, S., & Wathon, S. (2019). Peningkatan nilai ekonomi kulit buah kopi robusta (Coffea canephora) melalui produksi teh celup cascara sebagai minuman fungsional kaya antioksidan. *Warta Pengabdian*, *13*(4), 123-135. https://doi.org/10.19184/wrtp.v13i4.10113

Mardhatilah, D. (2015). Pengaruh penambahan konsentrasi jahe dan rempah pada pembuatan sirup kopi. *Agroteknose*, *3*(2), 55–61.

Mursalin, Nizori, A., & Rahmayani, I. (2019). Sifat fisiko-kimia kopi seduh instan liberika tungkal jambi yang diproduksi dengan metode kokristalisasi. *Jurnal Ilmu Terapan Universitas Jambi*, *3*(1), 71–77. https://doi.org/10.22437/jiituj.v3i1.7344

Muzaifa, M., Andini, R., Sulaiman, M. I., Abubakar, Y., Rahmi, F., & Nurzainura. (2021b). Novel Utilization of Coffee Processing By-Products: Kombucha Cascara Originated from "Gayo-Arabica." *IOP Conference Series: Earth and Environmental Science*, *644*(1). https://doi.org/10.1088/1755-1315/644/1/012048

Muzaifa, M., Hasni, Di., Arpi, N., Sulaiman, M. I., & Limbong, M. S. (2019). Kajian pengaruh perlakuan pulp dan lama penyeduhan terhadap mutu kimia teh cascara. *Jurnal Teknologi Pertanian Andalas*, *23*(2), 136–142. https://doi.org/10.25077/JTPA.23.2.%25P.2019

Nafisah, D., & Widyaningsih, T. D. (2018). Kajian metode pengeringan dan rasio penyeduhan pada proses pembuatan teh cascara kopi arabika (Coffea arabika L.). *Pangan dan Agroindustri*, *6*(3), 37–47. https://doi.org/10.21776/ub.jpa.2018.006.03.5

Nurhayati, N. (2018). Karakteristik sensori kopi celup dan kopi instan varietas robusta dan arabika. *Jurnal Ilmiah Inovasi*, *17*(2), 80–85. https://doi.org/10.25047/jii.v17i2.547

Nurhayati, N. (2020). Karakteristik fisikokimia dan preferensi cascara terbuat dari kulit kopi robusta var. Tugu Sari dan BP 42. *Jurnal Ilmiah Inovasi*, *20*(2), 28–33. https://doi.org/10.25047/jii.v20i2.1880

Pua, A., Choo, W. X. D., Goh, R. M. V., Liu, S. Q., Cornuz, M., Ee, K. H., Sun, J., Lassabliere, B., & Yu, B. (2021). A systematic study of key odourants, non-volatile compounds, and antioxidant capacity of cascara (dried coffee arabica pulp). *LWT Food Science and Technology*, *138*, 1-13. https://doi.org/10.1016/j.lwt.2020.110630

Pujilestari, T., & Salma, I. R. (2017). Pengaruh suhu ekstraksi warna alam kayu secang (Caesalpinia sappan Linn) dan gambir (Uncaria gambir) terhadap kualitas warna batik. *Dinamika Kerajinan dan Batik*, *34*(1), 25–34. http://dx.doi.org/10.22322/dkb.v34i1.1651

Rifkowaty, E. E., & Martanto. (2016). Minuman fungsional serbuk instan jahe (Zingiber officinale Rosc) dengan variasi penambahan ekstrak bawang mekah (Eleutherine Americana Merr) Sebagai pewarna alami. *Jurnal Teknik Pertanian Lampung*, *4*(4), 315–324.

Rosidah, U., Sugito, S., Yuliati, K., Abdiansyah, A., Anggraini, F. (2021). Identifikasi senyawa fitokimia dan aktivitas antioksidan minuman fungsional cascara dari kulit kopi dengan fermentasi terkendali. *Jurnal Universitas Sriwijaya*, 611–620.

Saraswati, I. (2016). Pengaruh nilai pH terhadap warna dari kayu secang (Caesalpinia sappan L.) sebagai indikator alami baru. *Media Medika Muda*, *1*(3), 151–156. https://ejournal2.undip.ac.id/index.php/mmm/article/view/2607

Sholichah, E., Apriani, R., Desnilasari, D., Karim, M. A., & Hervelly, H. (2019). By-product kulit kopi arabika dan robusta sebagai sumber polifenol untuk antioksidan dan antibakteri. *Jurnal Industri Hasil Perkebunan*, *14*(2), 57-66. https://doi.org/10.33104/jihp.v14i2.5195

Srikandi, S., Humaeroh, M., & Sutamihardja, R. (2020). Kandungan gingerol dan shogaol dari ekstrak jahe merah (Zingiber officinale Roscoe) dengan metode maserasi bertingkat. *Al-Kimiya*, *7*(2), 75–81. https://doi.org/10.15575/ak.v7i2.6545

Subeki, Winanti, D. D. T., Nauli, P., & Rahmawati, S. H. (2019). Kandungan Polifenol dan Kualitas Cascara (Teh Ceri Kopi) Fine Robusta sebagai Rintisan Perusahaan Pemula Berbasis Teknologi. *Semnas Tektan Polinela 7 November 2019.* Bandar Lampung, Indonesia.

Supriani, A. (2019). Peranan minuman dari ekstrak jahecang untuk meningkatkan kesehatan masyarakat. *Jurnal SainHealth*, *3*(1), 30-39. https://doi.org/10.51804/jsh.v3i1.370.30-39

Suryani, C. L. (2012). Optimasi metode ekstraksi fenol dari rimpang jahe emprit (Zingiber officinalle var. Rubrum). *Jurnal AgriSains*. *3*(4), 63–70.

Widiyana, I. G., Yusa, N. M., & Sugitha, I. M. (2021). Pengaruh penambahan bubuk jahe emprit (Zingiber officinale var. Amarum) terhadap karakteristik teh celup herbal daun ciplukan (Physalis angulata L.). *Jurnal Ilmu dan Teknologi Pangan (ITEPA)*, *10*(1), 45-55. https://doi.org/10.24843/itepa.2021.v10.i01.p05