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Development of A Combination of Red Ginger, Cinnamon, and Honey as Antioxidant Functional Drinks

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ABSTRACT

Background: Degenerative diseases are one of the biggest causes of death in the world. One of the causes is free radicals. Prevention can be done by increasing the intake of antioxidants in spices such as red ginger and cinnamon and adding rambutan honey through spice functional drinks. Analyzing antioxidant activity to determine its ability as an anti-radical and test panelists' preference for taste, aroma, and color parameters. **Methods:** This type of research is an experimental design with a completely randomized design (RAL) with 3 factorial formulations with comparisons of red ginger and cinnamon F1 (25: 25), F2 (25: 50), and F3 (50: 25). Antioxidant activity test by DPPH method and panelists preference by hedonic test. Statistical analysis of hedonic using SPSS with Kruskal Wallis test ($\alpha \leq 0.05$) and Mann Whitney follow-up test. **Results:** Antioxidant activity of F1(73,41%), F2(74,26%) and F3(60,42%). The panelists' best preference was on the F1(25:25) formulation for the taste parameter 3.17; 3.37 fragrance and 3.1 color in the like category. There was a significant difference in the hedonic assessment of the taste and aroma parameters ($p = 0.000 < 0.05$), but there was no significant difference in the color parameter ($p = 0.869 > 0.05$). **Conclusion:** The overall antioxidant activity of the formulation was said to be active as antiradical (% inhibition 50%).

Keywords: antioxidant activity, red ginger, cinnamon, honey, spice drinks

INTRODUCTION

Degenerative diseases are one of the biggest causes of death in the world. Some examples of degenerative diseases include heart disease, cancer, cataracts, diabetes mellitus, hypertension, and liver cirrhosis. According to the *World Health Organization* (WHO), there are almost 17 million people die from degenerative diseases every year. Free radicals are one of the causes of the emergence of degenerative diseases (Syahara &; Vera, 2020).

Free radicals react with surrounding cell molecules to acquire electron pairs to become more stable. However, the process makes the body's cell molecules that have lost electrons turn into free radicals (Parwata, 2016). If left unchecked, this condition can cause oxidative stress. If the amount of free radicals is excessive it can provoke pathological effects. Antioxidant intake is needed because it can capture and neutralize free radicals (Maharani et al., 2021).

Antioxidants are compounds that can absorb or neutralize free radicals. In addition, antioxidants also prevent damage caused by free radicals to normal cells (Maharani et al., 2021). Long-term use of synthetic antioxidants can cause inflammation, liver damage, and increase the risk of carcinogenesis (Parwata, 2016). Natural exogenous antioxidants are more advisable for long-term consumption. Natural antioxidants found in plants are also known to avoid degenerative diseases (Parwata, 2016).

Indonesia has abundant natural plant wealth, one of which is spices. Indonesia contributed 21.06% of the total spice market in the world in 2013 (Hermawan, 2015). Spices have good antioxidant content (Latief et al., 2013). The spices in question include red ginger and cinnamon.

Indonesia has three types of ginger clones (cultivars), namely empirrit ginger, red ginger, and elephant ginger. Ginger contains *non-volatile* phenol active compounds, namely *gingerol*, *zingeron,* and *shoganol* (Ryadha, 2021). The antioxidant activity of red ginger is known to be 80.91% (Mayani *et al*., 2014). Reducing the size of red ginger by shredding is known to have the highest antioxidant activity compared to crushed and sliced. The addition of water also affects, antioxidant activity in red ginger tends to be high with the addition of water 1:10 (b / v) (Mayani *et al*., 2014).

Another spice that contains antioxidants is cinnamon. The chemical components contained in cinnamon are polyphenols in the form of tannins and flavonoids which are the main antioxidant compounds (Ryadha, 2021). The antioxidant activity of cinnamon is 45.42% (Wang *et al*., 2009). Cinnamon contains polyphenolic compounds (flavonoids, tannins) and phenol group essential oils (Ervina *et al*., 2016).

The addition of honey as a natural sweetener can improve the taste of ginger and cinnamon spice drinks. Honey can cause the formation of phenol glycoside bonds that will affect antioxidant levels (Pebiningrum &; Kusnadi, 2018). The use of honey as a sweetener is the main choice because sugar (granulated sugar, rock sugar, and palm sugar) can reduce its antioxidant activity (Andriani *et al*., 2012). The level of use of rambutan honey in red ginger extract drinks as much as 10% was well received by panelists (A. M. Ibrahim *et al*., 2015).

Functional foods are foods, beverages, and foodstuffs that can provide additional benefits in addition to the basic functions of these foods (Clydesdale, 2005). Functional drinks as functional foods, equipped with other functions such as reducing and preventing the risk of certain diseases (Herawati *et al*., 2012). Functional drinks need to provide nutritional intake, sensory satisfaction (good taste and good texture), and have functional properties (Suter, 2013). Spices have great potential as a source of functional foods and beverages containing rich antioxidants (Hakim, 2011). This study aims to determine the composition of red ginger, cinnamon, and honey that can be used as functional drinks with antioxidant roles.

METHODS

The research included in the field of food nutrition was carried out from May to July at the Nutrition Laboratory and Chemical Laboratory. This research design is a quantitative study with a complete randomized design (RAL). The formulation of the spice drink uses a mass variation of red ginger (*Zingiber officinale* var *rubrum)* and cinnamon (*Cinnamomum verum)*. There were 3 formulations of red ginger and cinnamon used in this study, namely F1 (25:25), F2 (25:50), and F3 (50:25). The formulation determination is based on previous research, presented in Table 1.

Table 1. Formulation of Herbs Drink

Formulation	Ginger (gr)	Cinnamon (gr)
F1	25	25
F2	25	50
F3	50	25

1. The Making of Red Ginger, Cinnamon and Rambutan Honey Herbal Drink (Mayani et al., 2014 dan Setiawan et al., 2018)

The samples used in this study were spice drinks made from red ginger, cinnamon, and rambutan honey. The processing of spice drinks is carried out in the Nutrition Laboratory. The ingredients used are water, red ginger, cinnamon, and rambutan honey. The tools used are bottles, knives, filters, containers, pots, graters, and cutting boards. The manufacturing process begins by sorting red ginger using running water to remove impurities on the ginger rhizome. Ginger is reduced in size by grating. Then, cinnamon is reduced in size by cutting it into small pieces. Red ginger that has been grated and cinnamon that has been adjusted to the formulation is then boiled using 500 ml of water for ± 10 minutes with a temperature of 95º. After that, a solution of red ginger and cinnamon is added honey as much as 10% (50 gr) in each formulation. Then, the spice drink is put into a bottle.

2. Antioxidant Activity Test using DPPH Method

The antioxidant activity test was performed using the DPPH test. DPPH test is a test method based on the purple DPPH free radical reduction process using free radical inhibitors at a wavelength of 517 nm (maximum) (Leaves, 2014). The materials used are PA methanol, aquadest, quarcetin powder, and 1,1-diphenyl-2-picrylhydrazyl powder (DPPH). The tools used are a set of glassware, analytical balance, volume pipette, and UV-Vis spectrophotometer (Kawiji et al., 2011). The DPPH test is performed in the following steps:

A. DPPH Solution Preparation

The DPPH solution is prepared by weighing 2.4 mg of DPPH powder, then the DPPH powder is dissolved with PA methanol in a flask to a limit of 100 ml.

B. Determination of Antioxidant Activity

A sample solution of 0.1 ml is inserted into the test tube using a micropipette. Then, 3 ml of DPPH solution is added to the same test tube and homogenized. The solution is incubated for 30 minutes in a dark place with no light. Next, the absorption of the solution was measured using a UV-Vis spectrophotometer at a wavelength of 517 nm.

Antioxidant activity can be determined based on the magnitude of DPPH radical uptake inhibition through the calculation of the percentage (%) of DPPH uptake inhibition. A material can be said to be active as an anti-free radical if the percentage of absorption is more than or equal to 50% (Parwata, 2016). The percentage (%) of inhibition can be calculated using the formula (Molyneux P, 2004):

$$\% \text{ DPPH radical inhibition} = \frac{Absorban\ kontrol - Absorban\ bahan\ uji}{Absorban\ kontrol} \text{ x } 100\%$$

Information:
Absorban kontrol: DPPH 50 μM radical absorption at a maximum wavelength of 517 nm.
Absorban bahan uji: sample absorption in the DPPH radical 50 μM at a maximum wavelength of 517 nm.

3. Panelists' Favorability Level using Hedonic Test (Wagiyono, 2003)

The hedonic test is used to measure the level of panelists' liking of products (Suryono *et al*., 2018). The hedonic test was conducted by a panel of 30 untrained panelists aged 22-50 years (adult age). Taste, aroma, and color parameters are assessed using a hedonic scale. The value scale for assessing products is 1 (strongly dislike), 2 (dislike), 3 (like), and 4 (very like) (Nathasya *et al*., 2020). Hedonic testing is carried out with the following stages:

A. Material Sample Preparation

Three types of samples (F1, F2, and F3) are prepared in a flask. Next, each sample is put into a plastic cup of 10 mL to be served. Each glass is labeled with a name according to the variation of its formulation using a paper label. Furthermore, mineral water, tissues, hand sanitizers, and pens are prepared as complementary tools. Questionnaire sheets used in the research process were also given to panelists.

B. Implementation of Hedonic Testing

First, panelists were interviewed about their activities before testing. Next, the form is distributed to the panelists. Panelists are asked to fill out an existing format in the form. The available formats are in the form of panelists' biodata and assessment tables. Panelists were asked to sample the samples provided. Then, the panelists write their test results in the test format provided.

4. Data Analysis

Data analysis of DPPH test results was processed using Microsoft Office Excel software to obtain an average value. Hedonic test results were analyzed with IBM SPSS *Statistics* 20 software with statistical testing of the Kruskal-Wallis test. The analysis is continued with the Mann-Whitney test if the results of the Kruskal-Wallis test show that there is a real effect shown by the P value or *sig* P value is smaller than 0.05 ($p < 0.05$).

RESULTS AND DISCUSSION

a. Antioxidant Activity of the Herbal Drink

The antioxidant activity of spice drinks in each formulation showed varying results. Antioxidant activity in the form of percent (%) inhibition. Presented in Table 2.

Table 2. Antioxidant Activity

Formulation	Antioxidant Activity (%)
F1	73,41
F2	74,26
F3	69,42

Antioxidant activity of spice drink formulation F1 formulation with a ratio of red ginger ingredients: cinnamon (25: 25) has antioxidant activity of 73.41%; F2 formulation with a ratio of red ginger and cinnamon ingredients (25: 50) has antioxidant activity of 74.26%; and the F3 formulation with a ratio of red ginger and cinnamon ingredients (50: 25) has antioxidant activity of 69.42%. The overall antioxidant activity of red ginger, cinnamon, and honey spice drink formulations is said to be active as an anti-free radical because the % inhibition is greater than 50%. A substance is said to be active as an anti-free radical if the percentage of inhibition is more than or equal to 50% (Parwata, 2016).

The difference in the results of antioxidant activity in red ginger can occur due to several factors. Some of these factors are differences in the content of chemical components in plants which can be influenced by factors of extraction, cultivation, weather climate conditions, harvesting processes, maturity levels of harvest time, and the process of storing materials after harvest time (Anggraini, 2014). The next factor is the content of essential oils in ginger rhizomes which have varying chemical components. This varied chemical component is influenced by environmental factors (geography, climate, and season), the age of rhizomes, the adaptation of metabolites in plants, the extraction process, and plant parts used (ginger rhizomes, leaves, or stems) (Anwar *et al*., 2009).

The highest antioxidant activity in a variety of beverage formulations is known to be in F2 with a ratio of red ginger and cinnamon of 25:50. It is known that more use of cinnamon can increase the antioxidant activity in red ginger, cinnamon, and honey spice drinks. This result is not in line with the research of Hastuti &; Rustanti, (2014) which states that the addition of cinnamon ingredients cannot increase antioxidant activity in functional drinks. This is because cinnamon contains phytochemical components that are antagonistic. The cinnamon plant parts used are also able to affect antioxidant activity. The highest antioxidant activity in cinnamon is found in the bark of twigs when compared to the bark and bark of tree branches (Latief et al., 2013). In addition to the antioxidant components in red ginger and cinnamon, the use of honey is known to have a role in increasing antioxidant activity. Honey can cause the formation of phenol glycoside bonds which will affect the increase in the total value of phenol and its antioxidant levels (Pebiningrum &; Kusnadi, 2018).

b. Preference Level of Herbal Drinks

The results of the panelists' assessment of the level of liking of red ginger, cinnamon, and honey spice drinks were obtained through hedonic tests on panelists with parameters of taste, aroma, and color. Test results are presented in Table 3.

Table 3. Hedonic Test Results

Formulation	Mean ± SD		
	Flavor	Aroma	Color
F1	3,17 ± 0,592[b]	3,37 ± 0,490[b]	3,10 ± 0,607[a]
F2	2,47 ± 0,776[a]	2,70 ± 0,535[a]	3,10 ± 0,607[a]
F3	2,20 ± 0,805[a]	3,00 ± 0,743[a]	3,03 ± 0,556[a]

Information : 1 = strongly dislike; 2 = dislike; 3 = likes; 4 = very likes
a,b = similar letter notation means there is no noticeable difference in the Mann-Whitney test grade with a value of 5%.

Flavor

The results of the hedonic testing of taste parameters showed that the average level of favorability of panelists was on a scale of 2.20-3.17 with categories from dislike to like. The average rating from a scale of 1–4 obtained the highest spice drink assessment in the F1 formulation with a numeric scale of 3.17 included in the like category; continued formulation F2 with a numeric scale of 2.47 included in the dislike category; and the lowest in the F3 formulation with a numeric scale of 2.2 is included in the dislike category.

Statistical results of taste parameters with the Kruskal-Wallis test showed a significance value (sig.) of 0.000 ($p<0.05$). From these data, it is known that there is a real difference between the 3 treatments (F1, F2, and F3) on the taste of red ginger, cinnamon, and honey spice drinks. Based on the significance value of the Kruskal-Wallis test, the Mann-Whitney test was carried out on the color parameter result data. Through the results of the Mann-Whitnney test between formulations with taste parameters, it is known that F2 and F3 formulations have a significance value (sig.) of 0.185 ($p>0.05$) which shows no real difference. However, there are significant differences in the formulations of F1 and F2 as well as F1 and F3 indicated by the significance value (sig.) of both 0.000 ($p<0.05$).

The highest use of cinnamon in the composition of the formula results in a more concentrated taste compared to other formulations. In cinnamon, there are cynamaldehid and eugenol compounds that can cause the distinctive taste of cinnamon (Qin *et al*., 2010). The distinctive taste of cinnamon is a slightly sweet, slightly spicy, and chelate taste (Idris &; Mayura, 2019). The distinctive taste of cinnamon is known to be able to disguise the sweetness of the sweetener used so that the resulting taste is not too sweet (Parera *et al*., 2018).

The highest use of red ginger in the composition of the formula results in a spicier taste compared to other formulations. Ginger rhizomes have oleoresin compounds that can provide spicy and bitter flavors (Prasetyo & Cantawinata, 2010). Red ginger has a taste twice as spicy as emprit ginger and elephant ginger (Tangkeallo & Widyaningsih, 2014). The dominant spicy taste of red ginger is produced from the content of oleoresin and terpenoid derivative compounds, namely zingiberene. Zingiberene also gives sensory warmth (Armansyah, *et al*., 2017). The spicy and bitter taste of red ginger comes from oleoresin components such as zingiberene, shaogol, gingerol, resin, and essential oil (A. M. Ibrahim *et al*., 2015). Ginger also contains tannin components that have an astringent taste (Srikandi et al., 2020). Red ginger juice has aromatic compounds with a spicy taste typical of ginger (Hari Purnomo *et al*., 2009).

Rambutan honey has a dark color. Honey with a dark color has a strong taste compared to honey that has a bright color (Chayati, 2008). Honey that has a lighter color has a less desirable taste (Evahelda et al., 2017). Darker-colored honey has a higher sugar content due to its high phenolic content (Eleazu *et al*., 2013).

Aroma

The results of hedonic testing of aroma parameters showed the average level of favorability of panelists was on a scale of 2.70-3.37 with dislike to like categories. The average assessment from a scale of 1 – 4 obtained the highest assessment of red ginger, cinnamon, and honey spice drinks in the F1 formulation with a numeric scale of 3.37 included in the category of likes; continued formulation F3 with a numeric scale of 3 included in the category of likes; and the lowest in the F2 formulation with a numeric scale of 2.7 is included in the dislike category.

The results of the favorability level of aroma parameters with the Kruskal-Wallis test showed a significance value (sig.) of 0.000 ($p<0.05$), so it can be seen that there is a real difference between 3 treatments (F1, F2, and F3) on the aroma of red ginger, cinnamon, and honey spice drinks. Based on the significance value of the Kruskal-Wallis test, the Mann-Whitnney test was carried out on the aroma parameter result data. The results of the Mann-Whitnney test with aroma parameters showed that the formulations F2 and F3 had a significance value (sig.) of 0.102 ($p>0.05$). This shows that there is no noticeable difference in the two parameters. However, there are significant differences in the formulations of F1 and F2 as well as F1 and F3 indicated by significance values (sig.) of 0.000 and 0.045 ($p<0.05$) respectively.

The highest use of cinnamon in the composition of the formula results in a stronger aroma than other formulations. Cinnamon has a distinctive aroma and fragrant odor derived from the compounds cinnamaldehyde and eugenol (Qin *et al.*, 2010). The distinctive aroma of cinnamon derived from cinnamaldehyde comes from phenol derivatives (antioxidants) that have aromatic rings (Andriyanto *et al.*, 2013). The more cinnamon is used, the sharper the aroma will be (Umami &; Afifah, 2015). The distinctive aroma of cinnamon is the aromatic distinctive aroma (Idris &; Mayura, 2019). The aroma of cinnamon is known to be interesting to be used as a fragrance (Nicolae *et al.*, 2015). The highest use of red ginger in the composition of the formula produces a pungent spicy aroma compared to other formulations. Red ginger has terpenoid compounds that can produce the aroma in red ginger (Wohlmuth *et al.*, 2005). Ginger has a fragrant aroma derived from essential oils. The main components in essential oils that can produce a fragrant aroma are zingiberene and zingiberole (Prasetyo, 2016). Ginger juice has aromatic compounds with a distinctive spicy aroma (Hari Purnomo *et al*., 2009).

Color

The results of the color parameter hedonic test showed that the average panelists' favorability level was on a scale of 3.03-3.10 with the likes category. Based on the average value of the favorability level based on the panelists' assessment with a color parameter, it is known that the F1 formulation has the same value as the F2 formulation, while the F1 and F2 formulations have different values from the F3 formulation. The average assessment from a scale of 1–4 obtained the highest assessment of red ginger, cinnamon, and honey spice drinks in F1 and F2 formulations with a numeric scale of 3.1 included in the category of likes; and the lowest in the F3 formulation with a numeric scale of 3.03 is included in the like category.

The statistical results of the Kruskal-Wallis test of color parameters showed a significance value (sig.) of 0.869 ($p>0.05$) so it can be seen that there is no real difference between the 3 treatments (F1, F2, and F3) on the color of red ginger, cinnamon and honey spice drinks.
Cinnamon has the main component in the form of cinnamaldehyde. The components of simaldehyde have properties as a source of antioxidants and can also give aroma and color to the appearance of the drink. The more cinnamon is used, the darker the resulting color. This is due to the increasing number of cinnamaldehid components that dissolve in beverages (Rizal Yulianto &; Dewanti Widyaningsih, 2013).

The decoction of red ginger has a reddish-brown color. The intensity of the red color in red ginger juice drinks increases along with the high temperature and length of time in the extraction process. Ginger rhizomes contain endulan II carotenoid compounds that can produce a red color in carrots and tomatoes (H. Purnomo *et al.*, 2010). Red ginger contains oleoresins that give it its bright yellow, yellow, and dark brown colors (A. martua Ibrahim *et al.*, 2015). The longer the time needed in extraction, the higher the oleoresin content extracted (Daryono, 2012). Ginger extract has the main ingredients of α-zingiberene, shogaol, and gingerol (Zancan *et al.*, 2001). The brightness level in ginger juice drinks decreases with increasing temperature and boiling duration. The high temperature and boiling time can cause the extraction rate to be higher which causes the darker brightness of the color of the ginger juice drink (A. martua Ibrahim *et al.*, 2015).

Honey affects the color produced by ginger juice. The more honey used, the color produced will be more yellow (close to the color of honey) (A. martua Ibrahim *et al.*, 2015). Rambutan honey has a dark color with the highest red intensity due to its high viscosity (Chayati, 2008).

CONCLUSION

Based on the research that has been done, it was concluded that in the formulation of red ginger herbal drinks, cinnamon in each formulation is F1 (25:25) of 73.41%; F2 (25:50) is 74.26% and F3 (50:25) is 60.42%. Based on the hedonic test, the formulation of red ginger, cinnamon, and honey herbal drinks most preferred by panelists based on taste, aroma, and color parameters was at F1 (25:25) with consecutive values of 3.17; 3.37 and 3.1 with the category "like". There was a significant difference in taste and aroma parameters ($p = 0.000 < 0.05$), but no real difference in color parameters ($p = 0.869 > 0.05$).

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