Eksakta : Berkala Ilmiah Bidang MIPA
VOLUME 23 NO 02 2022, pp 117-132
ISSN : Print 1411-3724 — Online 2549-7464
DOI : https://doi.org/10.24036//eksakta/vol23-iss2/320

Eksakta
Berkala Ilmiah Bidang MIPA
http://www.eksakta.ppj.unp.ac.id/index.php/eksakta

Article

Physicochemical Properties of Herbal Tea Bags from Belimbing Wuluh Leaves (*Averrhoa bilimbi*) and Gotu Kola Leaves (*Centella asiatica*) with the Addition of Cinnamon Powder (*Cinnamomun burmanii*)

Article Info

Article history :

Received May 10, 2022
Revised May 25, 2022
Accepted June 01, 2022
Published June 30, 2022

Keywords :

Herbal tea, starfruit leaves, gotu kola leaf, cinnamon powder, antioxidant

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Abstract. This study aims to study the characteristics of herbal teabags from belimbing wuluh leaves and gotu kola leaves with the addition of cinnamon powder. This study used a completely randomized design with 5 treatments, namely differences in the addition of cinnamon powder 0%, 1%, 2%, 3% and 4% with 3 replications. The data obtained were analyzed statistically using ANOVA (Analysis Of Variance) and if they were significantly different, then continued with the DNMRT (Duncan's News Multiple Range Test) test at the 5% level. The results showed that the level of addition of cinnamon powder had a significant effect on antioxidant activity, total water soluble ingredients, total polyphenols, color, taste, and flavor. Differences in the substitution level of cinnamon powder had no significant effect on water content and pH. The best treatment in this study was treatment E with the addition of 4% cinnamon powder, the organoleptic results obtained were the average value of color preference 3.95 (like), taste 3.65 (like), and flavor 4 (like). The results of chemical analysis on tea products are water content 7.88%, total polyphenols 109.32 mg GAE/g, IC50 value 96.71, total water soluble ingredients 19.66% and in steeped tea the pH value is 6.13, and activity antioxidant 36.93%.

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1. Introduction

Starfruit is a plant that grows in tropical climates. This plant can be found in lowland areas such as the Pariaman area. People in Pariaman use wuluh starfruit as an additional ingredient in making food such as curry because the sour taste gives a fresh effect on food. The part of the star fruit plant that can be used not only for the fruit but also for other parts that contain chemicals that can have a health impact on the body, namely the leaves. Starfruit leaves are known as a type of leaf that has a complete nutritional content and high antioxidants. Flavonoids, saponins, tannins, formic acid, sulfur, calcium oxalate, and potassium citrate are the active compounds contained in star fruit leaves [1,2,3,4]. In addition, there is another plant that has many benefits and its content is rarely known by the public, namely the gotu kola plant.

Gotu kola is designated as a medicinal plant in various countries and has been used for generations to treat various diseases [5,6,7,8,9]. Gotu kola can be consumed in various forms, people believe that consuming gotu kola in the form of extracts, fresh leaves or decoction can treat various diseases and one of them is memory loss. The ability of gotu kola to stimulate memory is thought to be caused by the triterpenoid saponin compounds (asiaticoside) contained in it [10,11]. This compound is known to repair damaged blood vessels so as to facilitate blood circulation to the brain and is able to regenerate cells and heal wounds [12].

One of the derivative products from starfruit leaves and gotu kola is herbal tea, including starfruit leaf tea (Averrhoa bilimbi, L.) and gotu kola leaf tea (Centella asiatica, L. Urban). Previous research stated that these two leaves have the same character, namely they both have the same taste. One of the efforts to utilize these two leaves in the same product is to add other ingredients to give flavor and taste and can add nutritional value and still maintain the expected properties of tea products, namely cinnamon powder. Cinnamon powder functions as a natural flavor that has antioxidant activity [13]. The main component of cinnamon is cinnamaldehyde [14].

In previous studies, the addition of cinnamon powder resulted in a non-bitter taste, fragrant flavor and brown color in binahong leaf tea [15].The cinnamon used is AA quality cinnamon, which is the standard quality of cinnamon obtained from the bark. All the ingredients used are mixed and packaged in the form of tea bags so that they can increase the added value of herbal teas and make it easier for the public to serve them. Teabags are processed products that are packaged in bags made of filter paper and can be served quickly and instantly [16,17,18,19].

2. Method

2.1 Materials and Tools

The material used in this study was starfruit leaves obtained from the area around Pariaman City, West Sumatra. The leaves taken are young leaves or pekoe + 3 leaves. The gotu kola leaves used were also obtained from the area around Pariaman City, West Sumatra and cinnamon powder from AA quality cinnamon bark obtained from the area around Padang City, West Sumatra.

The chemicals used in this study were distilled water, buffer solution, methanol, follin's reagent and ciocalteu's phenol, 5% sodium carbonate (Na_2CO_3), gallic acid, and DPPH reagent (*2,2-Diphenyl-1-Picrylhydrazyl*).

The tools used in this study were pH meter, 1 ml pipette, analytical balance, aluminum cup, desiccator, oven, gegep, measuring cup, test tube, measuring flask, aluminum foil, filter paper, beaker, dropper, erlenmeyer, static, spectrophotometer (Shimadzu) and ultrasonic bath (Elma).

2.2 Research Design

This study was designed using a completely randomized design (CRD) with 5 treatment levels and 3 replications. The observed data were analyzed for variance analysis (Anova) if they were significantly different, followed by Duncan's New Multiple Range Test (DNMRT) at a significance level of 5%. Then the treatment given to each group consisted of:

A = No cinnamon powder substitute
B = Cinnamon powder concentration substitution rate 1%
C = Cinnamon powder concentration substitution rate 2%
D = 3% cinnamon powder concentration substitution rate
E = Cinnamon powder concentration substitution rate 4%

Table 1. Composition of Herbal Teabags

Treatment	Starfruit Leaf Powder (g)	Gotu Kola Leaves (g)	Cinnamon Powder (g)
A	50	50	0
B	49.5	49.5	1
C	49	49	2
D	48.5	48.5	3
E	48	48	4

2.3 Research Implementation

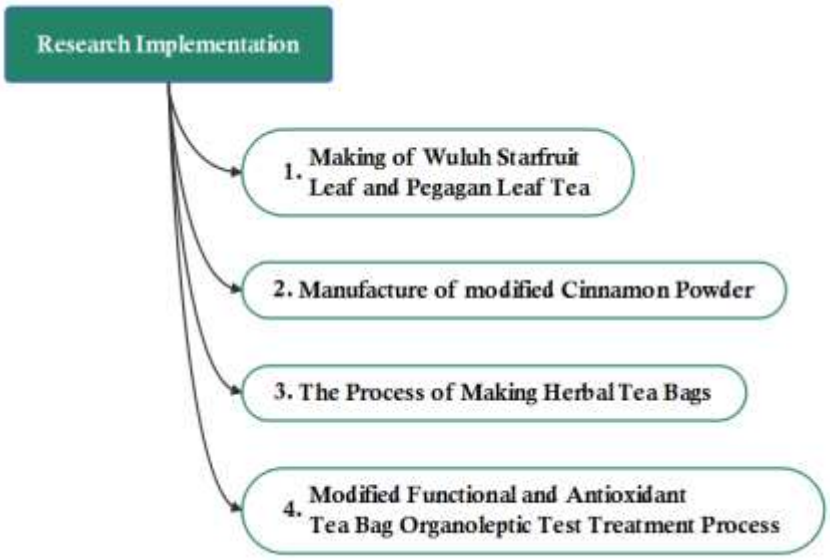

Figure 1. Flowchart of research implementation

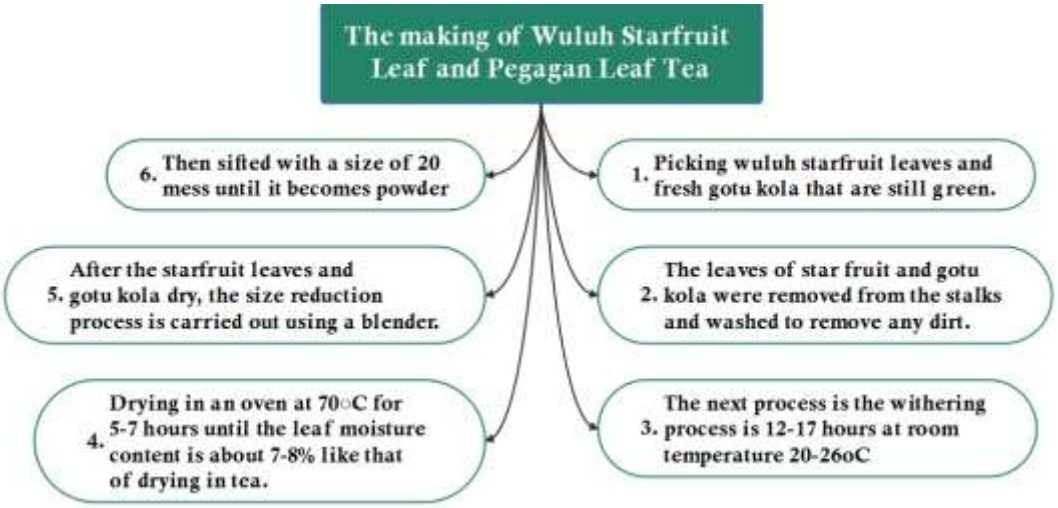

Figure 2. Procces Making of Wuluh Starfruit Leaf and Pegagan Leaf Tea

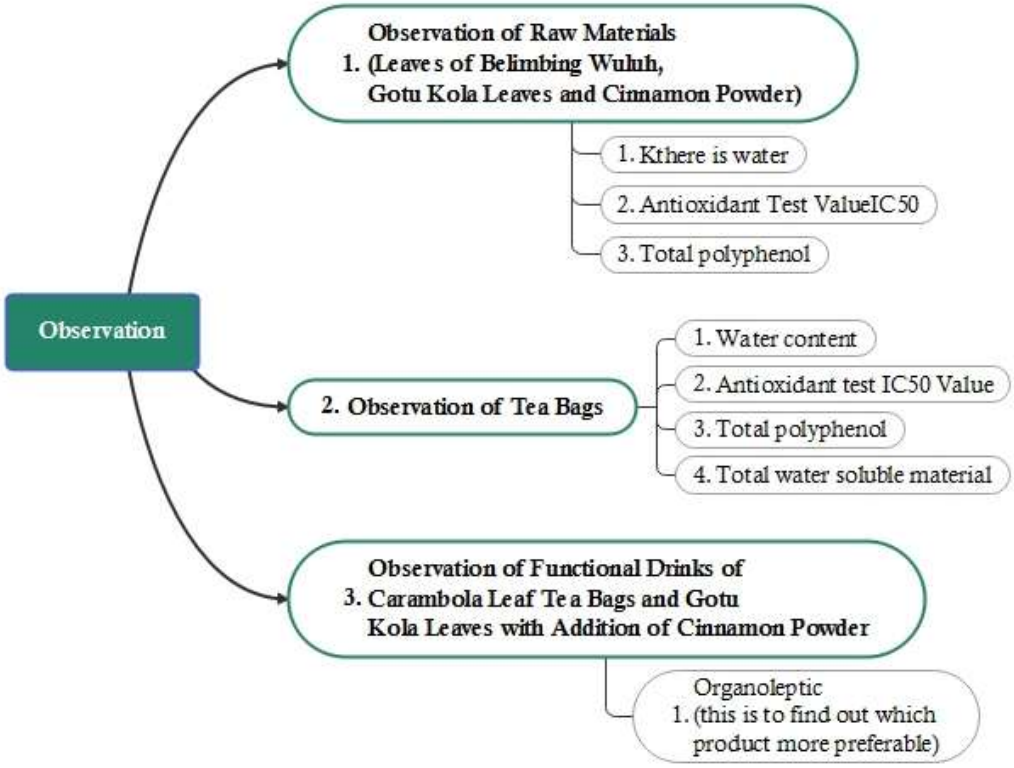

Figure 3. Flowchart of observation research

3. Results and Discussion

3.1 Raw Material Analysis

Analysis of raw materials for water content in fresh starfruit leaves and fresh gotu kola leaves and analysis of raw materials for dried starfruit leaves, dried gotu kola leaves and cinnamon powder

which includes water content, total polyphenols and antioxidant activity. The results of the analysis of raw materials can be seen in Table 2.

Table 2. Results of Raw Material Analysis

Raw material	Test Parameters	Value±SD
Starfruit leaves (fresh)	Water content (%)	75.55±1.34
Starfruit leaves (dried)	Water content (%)	6.66±0.33
	Polyphenols (mg/GAE/g)	89.35±4.31
	Antioxidant Activity (ppm)	111.79
Gotu Kola Leaves (fresh)	Water content(%)	85.44±0.76
Gotu Kola Leaves (dried)	Water content(%)	6.22±1.07
	Polyphenols (mg/GAE/g)	85.04±3.01
	Antioxidant Activity (ppm)	357,41
Cinnamon Powder	Water content (%)	10.77±0.69
	Polyphenols (mg/GAE/g)	101.99±4.33
	Antioxidant Activity (ppm)	12.86

Based on table 2. The results of the analysis of the water content of fresh star fruit leaves with an average of75.55% decreased when drying up to 6.66%, fresh gotu kola leaves with an average of 85.44% decreased when drying up to 6.22% and cinnamon powder with an average of 10.77%. In the manufacture of herbal teas used starfruit leaves and dried gotu kola leaves. According to SNI 03-3836-2012 the quality requirement for dry tea water content is 8%. Wuluh starfruit leaves and dried gotu kola leaves have met the existing water content standards. As for the quality requirements for the water content of cinnamon powder as stated in SNI 01-3714-1995, which is 12%, the cinnamon powder used has met the existing moisture content standards. Stated that water content has an important role in determining the characteristics and shelf life of foodstuffs [20]. Removing some of the water from food products can extend the shelf life of a product [21,22,23,24]. The composition of water in foodstuffs, namely free water and bound water can affect the drying time of foodstuffs [25,26]. Free water is water contained in foodstuffs, while bound water is water that is physically bound in a matrix network of materials such as membranes, capillaries, fibers and others.

Analysis of total polyphenols in raw materials obtained on average in dried starfruit leaves, namely89.35 mg/GAE/g, in dry gotu kola leaf it was 85.04 mg/GAE/g and in cinnamon powder it was 101.99 mg/GAE/g.

Analysis of antioxidant activity on raw tea herbal used IC50 (Inhibitor Concentration 50%) values with several concentrations of 50, 100, 150, 200 ppm so that the antioxidant activity value in dried starfruit leaves was 111.79 ppm, dried gotu kola leaf was 357.41 ppm and in wood powder sweet used concentrations of 10, 20, 30 and 40 ppm so that the obtained value of 12.86 ppm. The IC50 value is a parameter that states the size of the sample solution used to reduce 50% free radicals [27]. The smaller the IC50 value, the higher the antioxidant activity obtained. This antioxidant activity can be classified based on the IC50 value obtained. The IC50 value which is below 50 ppm means that the antioxidant activity obtained is very strong,

3.2 Herbal Tea Bag Analysis

3.2.1 Water content

Water in food products is an important component in influencing the texture, appearance and taste of food products and can determine freshness, durability and freshness, acceptability [28,29,30,31,32]. The results of the analysis can be seen in Table 3 below:

Table 3. Analysis of Water Content

Treatment	Value (%)±SD
A (Addition of 0% cinnamon powder)	6.77±0.69
B (Addition of 1% cinnamon powder)	7.22±0.84
C (Addition of 2% cinnamon powder)	7.55±0.84
D (Addition of 3% cinnamon powder)	7.77±1.01
E (Addition of 4% cinnamon powder)	7.88±1.07
KK = 12.14%	

From table 3 it can be seen that the number of cinnamon powder substitutes in herbal teas is notsignificantly different with respect to water content. The average water content of herbal teas is between 6.77-7.88%. The highest water content was found in treatment E (addition of 4% cinnamon powder) with an average of 7.88% and the lowest water content was found in treatment A (addition of 4% cinnamon).cinnamon powder 0%) with an average of 6.77%.

This shows that the higher the amount of cinnamon powder substitution into herbal tea, the higher the water content produced. The increase in water content was caused by the cinnamon powder used which had a high moisture content of 10.77%, while the starfruit leaf powder was 6.66% and the gotu kola leaf powder was 6.22%. However, with this increase in water content, tea heThe rbal of star fruit wuluh and gotu kola leaves with the addition of cinnamon powder is still in the SNI quality standard.03-3836-2012 which is below 8%.

3.2.2 Total Polyphenol

Total phenol is a phenolic compound that plays a role in preventing oxidation events [33]. Total phenol testing aims to determine the total amount of phenolic compounds contained in the sample because most of the antioxidants in natural ingredients are polyphenolic compounds so that if the content of phenolic compounds in the sample is high, the antioxidant activity will be high as well. The results of the analysis of total polyphenols can be seen in Table 4 as follows:

Table 4. Analysis of total polyphenols

Treatment	Total Polyphenols (mg GAE/g)± SD
A (Addition of 0% cinnamon powder)	89.92 ± 2.37 a
B (Addition of 1% cinnamon powder)	101.56 ± 3.91 b
C (Addition of 2% cinnamon powder)	104.15 ± 5.39 b
D (Addition of 3% cinnamon powder)	107.16 ± 4.52 b
E (Addition of 4% cinnamon powder)	109, 32 ± 3.66 b
KK = 4.00%	

Note: Figures followed by unequal lowercase letters are significantly different at the 5% level according to DMNRT

In table 4 it can be seen thatthe addition of cinnamon powder was significantly different to the total polyphenols obtained. The average total polyphenols were in the range of 89.92 mg GAE/g – 109.32 mg GAE/g. The highest total polyphenols were found in treatment E (addition of 4%

cinnamon powder) with an average total polyphenolic value of 109.32 mg GAE/g and the lowest was in treatment A (0% addition of cinnamon powder) with an average polyphenol value of 89.92 mg GAE/g. It can be concluded that the greater the addition of cinnamon powder to the starfruit leaf tea and gotu kola leaf, the total polyphenols obtained increased. This is because the total amount of polyphenols in cinnamon powder is higher at 101.99 mg GAE/g compared to starfruit leaf powder at 89.35 mg GAE/g and gotu kola leaf powder at 85.04 mg GAE/g. This is reinforced by [34] which states that the addition of cinnamon powder to cherry leaf tea, the more cinnamon powder added to each treatment of cherry leaf herbal tea, the higher the total polyphenols produced. Cinnamon powder contains polyphenolic compounds, namely eugenol from the polyphenol group which has antioxidant activity.

3.2.3 Antioxidant Activity

Antioxidants are compounds that can donate electrons (hydrogen atom donors) to free radicals, thereby stopping chain reactions, and converting free radicals into stable forms [35,36,37,38]. The results of the analysis can be seen in Table 5 as follows:

Table 5. Analysis of Antioxidant Activity

Treatment	Value (%) ± SD
E (Addition of 4% cinnamon powder)	96.71 ± 6.49 a
D (Addition of 3% cinnamon powder)	109.96± 6.14 ab
C (Addition of 2% cinnamon powder)	123.89± 5.86 b
B (Addition of 1% cinnamon powder)	153.86± 14.37 c
A (Addition of 0% cinnamon powder)	171.24± 10.31 d
KK = 7.05%	

Note: Figures followed by unequal lowercase letters are significantly different at the 5% level according to DMNRT

From table 5, it can be seen that the substitution of cinnamon powdersignificantly different from the resulting IC50 value, which is in the range of 96.71 ppm – 171.24 ppm. The treatment that had the highest antioxidant activity was treatment E (addition of 4% cinnamon powder) which was 96.71 ppm while the treatment that had the lowest antioxidant activity was treatment A (addition of 0% cinnamon powder) which was 171.24 ppm. This is based on the lower the value obtained, the stronger the antioxidant activity.

The chemical compounds contained in starfruit leaves as a contributor to antioxidant activity are flavonoid compounds. Flavonoids are compounds that can capture free radicals which act as a source of antioxidants which also have anti-inflammatory properties, prevent oxidative damage to cells and have strong anticancer activity [39,40,41,42]. Added that flavonoids are potential antioxidants as free radical scavengers and fat oxidation inhibitors [43,44,45,46,47,48,49]. The antioxidant content of gotu kola leaves comes from triterpenoids and the main compounds that have strong antioxidant activity are asiaticoside compounds [50,51,52].

The amount of addition of cinnamon powder to herbal tea of belimbing wuluh and gotu kola leaves has an effect, namely the more addition of cinnamon powder used, the stronger the antioxidant activity as evidenced by the smaller the IC50 value obtained. According to [53,54,55,56] this is because cinnamon contains chemical compounds in the form of phenols, terpenoids and saponins which are sources of antioxidants. One of the derivative compounds from polyphenols found in cinnamon powder is cinnamaldehyde [57,58,59,60,61]. This is confirmed by [62,63,64,65,66] which states that cinnanamaldehyde compounds have antioxidant activity that acts

as a hydroxyl radical scavenger. The cinnamaldehyde content in cinnamon bark powder (Cinnamomum burmanii, L.) reaches 90.9% [67].

3.2.4 Total Water Soluble Ingredients

Total water soluble substances are materials dissolved in water that are not filtered by filter paper, namely milipore paperwith a pore size of 0.45 m. These materials consist of organic and inorganic compounds that are soluble in water, minerals and salts contained in solution [68]. The results of the analysis can be seen in Table 6.

Table 6. Analysis of Total Water Soluble Substances

Treatment	Value (%) ± SD
A (Addition of 0% cinnamon powder)	15.00±0.00 a
B (Addition of 1% cinnamon powder)	17.00±1.00 b
C (Addition of 2% cinnamon powder)	18.00±1.00 b
D (Addition of 3% cinnamon powder)	18.33±0.57 b
E (Addition of 4% cinnamon powder)	19.66±0.57 c
KK = 4.14%	

Note: Figures followed by unequal lowercase letters are significantly different at the 5% level according to DMNRT

In table 6, it can be seen that the amount of cinnamon powder substitution was significantly different to the total water soluble ingredients for herbal teas from starfruit leaves and gotu kola leaves. The amount of water soluble material obtained was between 15,00% - 19,66%. The highest water soluble material obtained was in the E . treatment(Addition of 4% cinnamon powder) is 19.66% and the lowest amount of water soluble material is in treatment A (Addition of 0% cinnamon powder) which is 15%.

Water-soluble compounds in belimbing wuluh leaves are saponins, compounds that cause foam when shaken in water, saponins are divided into 2 types, namely triterpenoid glycosides and steroid glycosides. Both types of saponins are soluble in water and ethanol. Flavonoids are compounds that are soluble in water and can be extracted with 70% ethanol and hydrolyzed tannins dissolve in water (especially hot water) to form colloids [69,70,71]. Meanwhile, gotu kola has water-soluble compounds, namely flavonoids and polyphenols [72]. The water-soluble compounds in cinnamon powder are tannins, triterpenoids, saponins and flavonoids. This is in line with research by [73] which states that cinnamon water extract contains tannins, triterpenoids, saponins and flavonoids. Tannins and flavonoids are a group of phenols. The nature of phenolic compounds is that they are easily soluble in water, quickly form complexes with proteins and are very sensitive to enzyme oxidation [74].

The value of the total water soluble material is inversely proportional to the water content, where the higher the water content the lower the total water soluble material obtained. The total water soluble material can be affected by the water content. The decrease in water content will cause the total water soluble material to increase because the amount of water dissolved is getting smaller [75].

3.3 Organoleptic Test (Herbal Tea Bag Analysis)

3.3.1.1 Color

Determining the quality of a product generally depends on several factors such as taste, color, texture and nutritional value. However, color is usually the first factor judged by consumers in choosing a food product [26]. Level of liking forcolors can be seen in Table 7 as follows:

Table 7. Level of Love for Color

Treatment	Value ± SD
D (Addition of 3% cinnamon powder)	3.35±1.08 a
A (Addition of 0% cinnamon powder)	3.70±0.86 ab
B (Addition of 1% cinnamon powder)	3.85±0.87 ab
E (Addition of 4% cinnamon powder)	3.95±0.60 b
D (Addition of 3% cinnamon powder)	4.20±0.60 b
KK = 22.11%	

Note: 1. 1 = dislike very much, 2 = dislike, 3 = normal, 4 = like, 5 = like very much. 2. Figures followed by unequal lowercase letters show a significant difference at the 5% level according to DMNRT

In table 7, it can be seen that the value of happinessColor effect on herbal tea starfruit and gotu kola leaf with cinnamon powder substitution is between 3.35-4.20. The treatment with the most preferred color was treatment C (Addition of 2% cinnamon powder) with a value of 4.20 while the treatment with the lowest preferred value was treatment D (Addition of 3% cinnamon powder) which was 3.35.

3.3.1.2 Taste

According to [32] taste is one of the important factors that affect the level of consumer acceptance of a food and beverage product, even though the flavor, color and texture are good, but if the taste is not good then the food or drink will not be accepted by consumers. The level of preference for taste can be seen in Table 8 as follows:

Table 8. Likelihood of Taste

Treatment	Value ± SD
A (Addition of 0% cinnamon powder)	2.95±0.88 a
B (Addition of 1% cinnamon powder)	3.00±0.56 a
C (Addition of 2% cinnamon powder)	3.25±0.78 ab
E (Addition of 4% cinnamon powder)	3.65±0.65 bc
D (Addition of 3% cinnamon powder)	3.80±0.76 c
KK = 22.31%	

Note: 1 = dislike very much, 2 = dislike, 3 = normal, 4 = like, 5 = like very much. 2. Figures followed by unequal lowercase letters show a significant difference at the 5% level according to DMNRT

In table 8, it can be seen that the preference values for the taste of starfruit leaf tea and gotu kola leaf tea are in the range of 2.95-3.80. The treatment that has the highest value is D (The addition of 3% cinnamon powder) while the treatment with the lowest preference value was A (0% cinnamon powder addition). Stated that the content of cinnamaldehyde and eugenol in cinnamon in addition to causing a fragrant flavor, also causes a distinctive taste of cinnamon [81]. Added that the more cinnamon was added, the stronger the taste [82].

3.3.1.3 Flavor

Flavor is one of the parameters in determining the quality of a food product [83,84]. The flavor of a food product can be assessed by smelling the odor produced from the product [32]. The food

industry considers flavor to be very important to be tested because it can provide an assessment of the results of its production. The level of preference for flavor can be seen in Table 9 as follows:

Table 9. Likelihood of Flavor

Treatment	Value ± SD
A (Addition of 0% cinnamon powder)	2.75±0.71 a
B (Addition of 1% cinnamon powder)	3.30±0.57 b
C (Addition of 2% cinnamon powder)	3.55±0.51 b
D (Addition of 3% cinnamon powder)	3.55±0.51 b
E (Addition of 4% cinnamon powder)	4.00±0.72 c
KK = 17.90%	

Note: 1 = dislike very much, 2 = dislike, 3 = normal, 4 = like, 5 = like very much. 2. Figures followed by unequal lowercase letters show a significant difference at the 5% level according to DMNRT

In table 11 it can be seen that the preference value for the flavor of herbal tea leaves starfruit and gotu kola leaves withthe addition of cinnamon powder in the range of 2.75-4.00. The treatment with the highest preference value was E (4% addition of cinnamon powder) while the treatment with the lowest preference value was A (0% additional cinnamon powder). According to [85] the distinctive flavor of cinnamon comes from the ecinnamaldehyde compound contained in cinnamon powder by 70%. Added that cinnamon can be used as a binder for the taste of food or drinks, the main component of flavor in cinnamon is ecinnamaldehyde [86].

The effect of the concentration level of cinnamon powder substitution on the color, taste, and flavor according to the panelists can be seen in the picture:

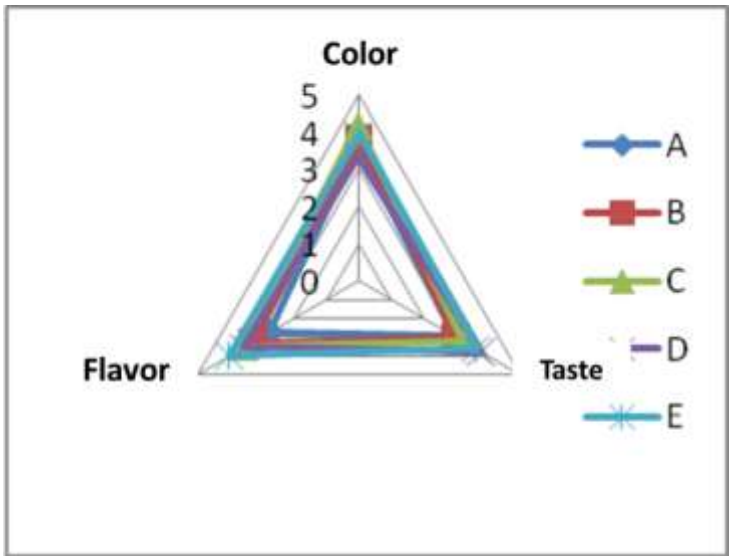

Figure 4. Graph The Best Treatment of Herbal Tea Bags

Based on the radar graph in the image, which is calculated based on the average preference level, the panelists tend to choose herbal tea products with treatment E, namely with a concentration of 4% cinnamon powder addition. With the average value of preference for color 3.95, taste 3.65, and flavor 4.

4. Conclusion

Based on the research that has been done, the following conclusions can be drawn the amount of addition of cinnamon powder in making herbal tea had a significant effect on antioxidant activity, total polyphenols, total water soluble ingredients but did not have a significant effect on water content and pH. Panelists acceptance of herbal tea starfruit leaves, gotu kola leaf and cinnamon powder organoleptically gave results on color, taste, and flavor with the best treatment in this study was treatment E with a substitution level of 4% cinnamon powder, the organoleptic results were the average value color preference is 3.95 (ordinary), 3.65 (ordinary), and flavor is 4 (like). The results of chemical analysis on tea products are water content 7.88%, total polyphenols 109.32 mg GAE/g, IC50 96.71, total water soluble ingredients 19.66% and in steeped tea the pH value is 6.13, and antioxidant activity 36.93%.

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