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Article

The Effect of Additional Fruit Eggplant (*Solanum betaceum cav.*) Juice on the Characteristics of Black Tea (*Camelia sinensis*) Beverage

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Abstract. This study aims to determine the effect of adding Dutch eggplant juice on the characteristics of black tea drinks. This study used a completely randomized design (CRD) with 5 treatments and 3 replications. The data was analyzed statistically with the F test, if it was significantly different, it was continued with Duncan's new Multiple Range Test (DNMRT) at the level of 5%. The addition of Dutch eggplant juice was 6%, 8%, 10%, 12%, 14%. This study showed the effect of adding Dutch eggplant juice to vitamin C, PH, antioxidants, polyphenols, flavonoids, alkaloids, tannins, saponins and sensory analysis (color, aroma and taste). The best product was the product with treatment E (addition of 14% Dutch eggplant extract) with antioxidant characteristics of 77.67%, polyphenols 393.37 mg GAE/g, flavonoids 296.83 mg QE/g, vitamin C 168.96 mg/100g, pH 4, alkaloid (+), tannin (+), saponin (+), color 3.05, aroma 3.90 and taste 3.75.

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1. Introduction

The tea commodity is produced from the tea plant (Camellia Sinensis)[1,2,3,4,5]. The tea contains bioactive components called polyphenols[6,7,8,9,10]. In general, the polyphenols in the tea plant consist of flavonoids and phenolic acids[11,12,13,14,15]. Flavonoids are the largest group of polyphenols which are antioxidants that can protect the body from free radicals. free [16,17].

Based on the principle of processing, tea is divided into several types, namely black tea, green tea, white tea, and olong tea [18,19,20,21,22,23]. The difference is in the rate of fermentation and oxidation of polyphenols during processing. Black tea is a type of tea that is processed through an enzymatic oxidation process[24,25,26,27]. The black is grouped into several quality classes, namely Flowery Orange Pekoe (FOP) which is a tea leaf with very good quality in the form of tea tree flower buds. Orange Pekoe (OP) is a large and whole tea leaf but there is no tea tree flower in it [28,29]. Broken Orange Pekoe (BOP) is tea in the form of small and large pieces of tea leaves, the quality is categorized as medium. Faming is tea leaves in the form of small pieces, this tea includes low quality tea [30,31,32]. Dust is the lowest grade of black tea, this tea consists of small pieces of tea leaves and tea stalks [33].

Tea with low quality class usually contains bioactive compounds, such as flavonoid compounds that function as low antioxidants as well. Antioxidant activity is very influential on body health. If the antioxidant activity is low, it is necessary to add antioxidants by adding fruit juice to the tea drink. One fruit that has the potential to be added is the Dutch eggplant juice. Dutch eggplant contains vitamin C, vitamin A and flavonoids which are sources of antioxidants [34,35,36,37,38,39]. Dutch eggplant has a sour taste, so it can improve the taste of tea drinks. According to [40], the best concentration of fruit juice added to low quality black tea is 10%, which has a significant effect on antioxidant activity and the appearance and color of low quality black tea produced. The purpose of this study was the addition of Dutch eggplant juice to improve the quality of black tea drinks by its application as a functional drink with an innovative taste of Dutch eggplant.

2. Experimental Section

2.1 Materials and Tools

The raw material used in this study was Dust III black tea which was obtained from PT Perkebunan Nusantara IV, Kayu Aro Business Unit, West Sumatra. Dutch eggplant fruit is obtained from Kerinci Regency. The chemicals used in this study were ethanol, methanol, Folin Ciocalteu reagent, sodium carbonate, gallic acid, Diphenylpicrylhydrazyl (DPPH), Aluminum chloride, iodine.

The tools used in this research are analytical balance, water bath, filter, spoon, pH meter, scale, ultrasonic bath, UV – 1800 spectrophotometer, vortex, pipette micrometer, 250 ml volumetric flask, measuring cup, burette, aluminum foil, dropper and filter paper.

2.2 Research design

This study used a completely randomized design (CRD) with the addition of Dutch eggplant, consisting of 5 levels, namely 6%, 8%, 10%, 12%, 14% with 3 replications. The data obtained were analyzed using variance and if there was an effect of treatment on the observed variables followed by the DNMRT test Concentration of adding Dutch eggplant juice for black tea drinks used in this study:

A = 6% addition of Dutch eggplant juice
B = addition of 8% Dutch eggplant juice
C = 10% addition of Dutch eggplant juice
D = addition of 12% Dutch eggplant juice
E = addition of Dutch eggplant juice 14%

2.3 Research Implementation

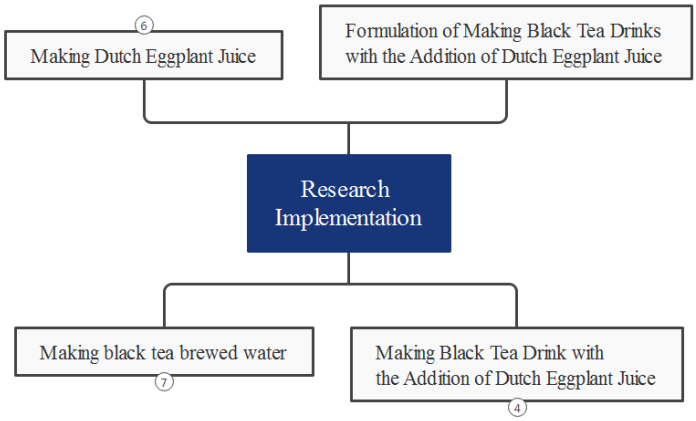

Figure 1. Schematic/Flowchart of research implementation

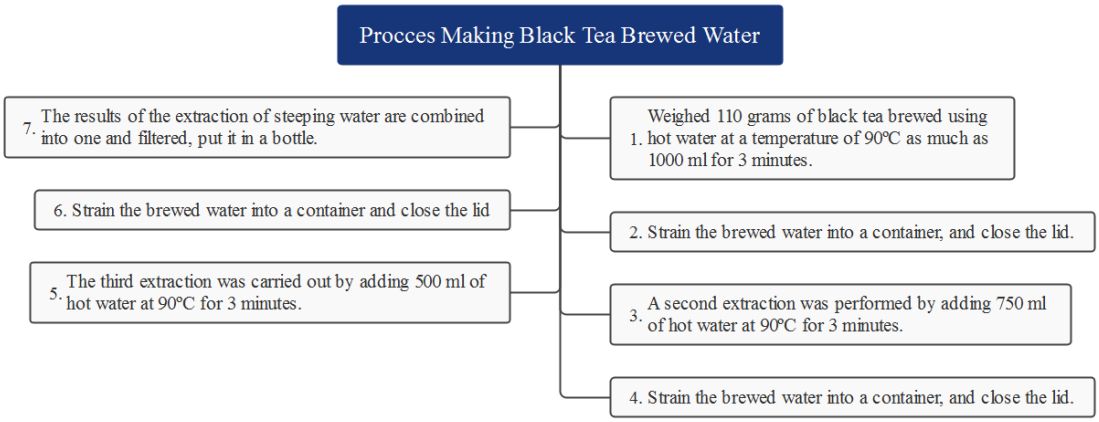

Figure 2. Procces Making Black Tea Brewed Water

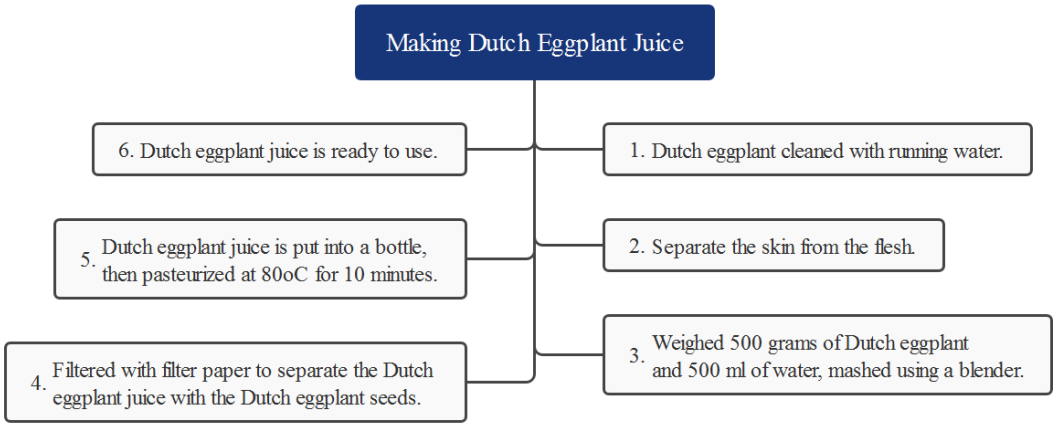

Figure 3. Making Dutch Eggplant Juice

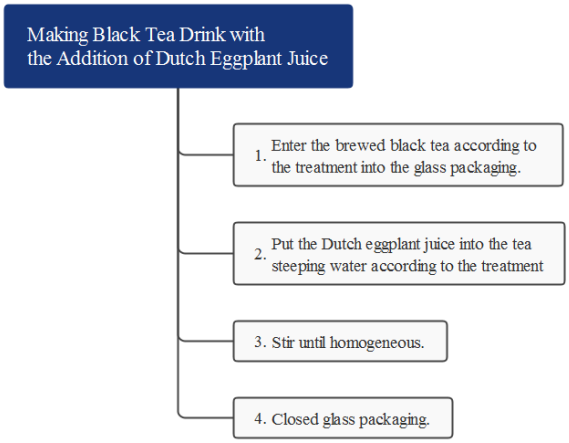

Figure 4. Making Black Tea Drink with the Addition of Dutch Eggplant Juice

Making black tea brewed water [40] starts with weighing 110 grams of black tea brewed using hot water at a temperature of 90°C as much as 1000 ml for 3 minutes. Then strain the brewed water into a container, and close the lid. A second extraction was performed by adding 750 ml of hot water at 90°C for 3 minutes. Then strain the brewed water into a container, and close the lid. After that, the third extraction was carried out by adding 500 ml of hot water at 90°C for 3 minutes. Then strain the brewed water into a container and close the lid. The results of the extraction of steeping water are combined into one and filtered, put it in a bottle.

Making the dutch eggplant juice begins with the dutch eggplant cleaned with running water. Then separate the skin from the flesh. Weighed 500 grams of Dutch eggplant and 500 ml of water, mashed using a blender. Filtered with filter paper to separate the Dutch eggplant juice with the Dutch eggplant seeds.Dutch eggplant juice is put into a bottle, then pasteurized at 80oC for 10 minutes. Dutch eggplant juice is ready to use.

Making black tea drink with the addition of dutch eggplant juice. Starting from putting the brewed black tea according to the treatment into the glass packaging.Put the Dutch eggplant juice

into the tea steeping water according to the treatment.Stir until homogeneous.Closed glass packaging.

Formulation of Making Black Tea Drinks with the Addition of Dutch Eggplant Juice

The formulation of the ingredients used for making black tea functional drinks with the addition of Dutch eggplant juice for each treatment can be seen in Table 1.

Table 1. Formulation of Making Black Tea Drink with the Addition of Dutch Eggplant Juice

Ingredients	Treatment				
	A (6%)	B (8%)P	C (10%)	D (12%)	E (14%)
Steeping tea (ml)	100	100	100	100	100
Fruit juice (ml)	6	8	10	12	14
Sugar (grams)	30	30	30	30	30

4) Observation

Observations made on black tea powder were antioxidant activity and total phenol. Flavonoid levels, pH, antioxidant activity and organoleptic tests.

3. Results and Discussion

3.1 Raw Material Analysis

The raw material used is Dust III type black tea obtained from PT. Perkebunan Nusantara VI Kayu Aro Business Unit, Jambi. The analysis was carried out on the infusion of black tea type Dust III. The results of chemical analysis can be seen in Table 2.

Table 2. Raw Material Analysis

Analysis	Black Tea (Mean ± Standard Deviation)
Antioxidant Activity (%)	26% ± 0,014
Total Phenol (mg GAE/g)	240,92 ± 3.88

Antioxidant activity was measured by calculating the reduction in the intensity of the purple light of DPPH which was equivalent to a reduction in the concentration of DPPH. DPPH attenuation is caused by the reaction of the diphenyl picryl hydrazyl (DPPH) molecule with the hydrogen atoms released by the sample component molecules, causing a reduction in the color of DPPH from purple to yellow [42]. In the analysis of antioxidants using the DPPH method on raw materials, the percentage of inhibition was 26%.

In the analysis of total polyphenols as raw material for black tea, the total polyphenol value was 240.92 mg GAE/100 g. According to research by [43] Dust III black tea has a total phenol content of 225.80 mg GAE/100 g. Tea is known to contain chemical compounds such as tannins or phenolic compounds (5-27%) consisting of catechins (flavanols) and gallic acid. According to [44] and [45] phenol compounds play an important role in antioxidant activity, the higher the phenol content, the higher the antioxidant activity. The higher the phenolic compounds, the more free radicals react so that the concentration of free radicals decreases and the antioxidants are higher.

3.2 Analysis of Dutch Eggplant Tea Drink

3.2.1 Phytochemical Test

Phytochemical qualitative analysis was carried out to test the presence or absence of active compounds in the sample. Phytochemical analysis in this study was carried out on Dutch eggplant tea. The phytochemical tests carried out were the alkaloid test, the saponin test and the tannin test. The results of the phytochemical qualitative test can be seen in Table 3.

Table 3. Qualitative Test (Phytochemical Test)

Treatment	Alkaloids	Phytochemical Test Saponins	Tannins
A (Increase TB 6%)	+	+	+
B (Increase TB 8%)	+	+	+
C (10% TB increase)	+	+	+
D (12% increase in TB)	+	+	+
E (14% increase in TB)	+	+	+

3.2.1.1 Alkaloids

The qualitative test carried out is a positive negative test (false - positive) based on whether or not a precipitate is formed in the solution. The reagent used in the Dutch eggplant tea beverage alkaloid test was Wagner's reagent which all treatments produced a brown precipitate. From the tests that have been carried out, tea drinks with the addition of 6% to 14% Dutch eggplant contain alkaloids. This is because the tea contains an alkaloid that is caffeine. Caffeine is a white alkaloid with the chemical formula C8H10NO2, and the structural formula 1,3,7-trimethylxanthine [46].

3.2.1.2 Saponins

The results of the qualitative test of saponins carried out on tea drinks with the addition of 6%-14% Dutch eggplant showed that the sample contained positive saponins. This can be seen from the ability to form stable foam within 10 minutes after shaking, and after adding 1 drop of 2 N HCl the foam did not disappear. According to [47], saponins act as antimicrobials, stimulate the immune system, and regulate blood pressure.

3.2.1.3 Tannins

Tannin compounds are polar compounds due to the presence of OH groups, therefore when the sample is added 1% FeCl3 there will be a change in color such as dark blue or blackish green which indicates the presence of tannin compounds. The results of the qualitative analysis of tannins showed that tea with the addition of 6%-14% Dutch eggplant juice showed positive samples containing tannin compounds. This can be seen from the change in the color of the sample to blue-black after being added with 1% FeCl3. Tannins are secondary metabolite active compounds which are known to have several properties including astringent, antidiarrheal, antibacterial and antioxidant [48].

3.2.1.4 Vitamin C

The results of the variance of vitamin C in black tea functional drinks with the addition of Dutch eggplant juice showed that the treatment of adding Dutch eggplant juice was significantly different at the level of = 5%. The content of Vitamin C in Dutch eggplant tea can be seen in Table 4.

Table 4. Average Value of Vitamin C Black Tea Functional Drink with the Addition of Dutch Eggplant Juice

Treatment	Vitamin C (mg/100g ingredient) (Mean + Standard deviation)
A (addition of 6% Dutch eggplant)	103,25 ± 10,75 a
B (addition of 6% Dutch eggplant)	113,81 ± 8,85 a
C (addition of 6% Dutch eggplant)	132,58 ± 8,85 b
D (addition of 6% Dutch eggplant)	141,97 ± 8,85 b
E (addition of 6% Dutch eggplant)	1618,96 + 7,04 c
KK = 1,64 %	

Note: The numbers in the same column followed by lowercase letters are not the same, significantly different according to the DNMRT at the 5% significance level.

From the table, it can be seen that the more addition of Dutch eggplant juice, the higher the vitamin levels in the drink. The stability of vitamin C in products can be affected by various factors. Besides its water-soluble ability, vitamin C is also easily oxidized which can be accelerated by heat, light, alkali, enzymes, oxidants and copper and iron catalysts [40]. Therefore, for storage, the product is stored at low temperatures so that the decrease in vitamin C levels can be minimized.

3.2.1.5 pH

The results of the analysis of the acidity level in functional black tea drinks with the addition of Dutch eggplant juice produced can be seen in Table 5 as follows.

Table 5. Average pH Value of Black Tea Drink with the Addition of Dutch Eggplant Juice.

Treatment	pH (Mean + Standard deviation)
A (addition of 6% Dutch eggplant)	4,54 ± 0,020 e
B (addition of 6% Dutch eggplant)	4,43 ± 0,010 d
C (addition of 6% Dutch eggplant)	4,26 ± 0,152 c
D (addition of 6% Dutch eggplant)	4,22 ± 0,005 b
E (addition of 6% Dutch eggplant)	4,17 ± 0,025 a
KK = 0,00 %	

Note: The numbers in the same column followed by lowercase letters are not the same, significantly different according to the DNMRT at a significant level of 5

The pH value of the Dutch eggplant tea drink is influenced by the organic acid content found in the Dutch eggplant. According to [49] Dutch eggplant contains phytochemicals including -carotene, anthocyanins, flavonols, phenolic acids, and ascorbic acid. The content of ascorbic acid is what affects the pH value of this functional drink. In addition to ascorbic acid in Dutch eggplant, there are also other organic acids that can affect the pH value. This is supported by the opinion of [50] which states that the Dutch eggplant contains organic acids in the form of citric acid and malic acid.

3.2.1.6 Total Phenolic

The results of the variance test on the total phenolic test in black tea with the addition of Dutch eggplant juice showed that the treatment with the addition of Dutch eggplant juice was significantly different at the level of =5%. The results of these observations can be seen in Table 6.

Table 6. Average Total Phenolic Value of Black Tea Drink with the Addition of Dutch Eggplant Juice.

Treatment	Total Phenolics (mg GAE/g) (Mean + Standard deviation)
A (addition of 6% Dutch eggplant)	304,00 + 8,39 a
B (addition of 6% Dutch eggplant)	331,30 + 9,73 a b
C (addition of 6% Dutch eggplant)	341,36 + 11,32 b
D (addition of 6% Dutch eggplant)	356,59 + 11,90 b
E (addition of 6% Dutch eggplant)	393,37 + 28,82 c
KK = 1,36 %	

Note: The numbers in the same column followed by lowercase letters are not the same, significantly different according to the DNMRT at the 5% significance level.

According to [51] Dutch eggplant is considered a good alternative to obtain dietary supplements or functional foods with nutraceutical potential, potential sources of dietary fiber and bioactive compounds. The total polyphenol content was 415.2 mg GAE/100 g, skin 523.8 mg GAE/100 g and Dutch eggplant seeds 179.4 mg GAE/100 g, respectively.

3.2.1.7 Flavonoid Level

The results of analysis of variance showed that the addition of Dutch eggplant had a significantly different effect at the level of = 5% on flavonoid levels. The results of these observations can be seen in Table 7.

Table 7. Flavonoid content of binahong leaf extract

Treatment	Kadar Flavonoid (mg QE/g) (Mean + Standard deviation)
A (addition of 6% Dutch eggplant)	179,74 + 26,04 a
B (addition of 6% Dutch eggplant)	214,44 + 26,04 a
C (addition of 6% Dutch eggplant)	253,33 + 10,42 b
D (addition of 6% Dutch eggplant)	276,93 + 6,62 b c
E (addition of 6% Dutch eggplant)	296,83 + 6,62 c
KK = 0,18 %	

Note: The numbers in the same column followed by lowercase letters are not the same, significantly different according to the DNMRT at the 5% significance level.

From the table it can be seen that the more addition of Dutch eggplant juice, the flavonoid levels in the Dutch eggplant drink will also increase. This is supported by the opinion of [51] which states that Dutch eggplant has flavonoid levels (265.70 mg QE / g) in Dutch eggplant skin, (223.80 mg QE / g) in Dutch eggplant and (175.62 mg QE / g). mg QE / g) in Dutch eggplant seeds.

According to [52], black tea contains a lot of flavanol compounds, namely catechins and their derivatives. Catechins are oxidized to theaflavins and thearubigins. According to [53] the flavonoid

content in black tea after processing in young and old leaves, respectively, was 27.7 g QE/100g and 18.61 g QE/100g.

3.2.1.8 Antioxidant Activity

The results of the analysis of antioxidant activity in black tea drinks with the addition of Dutch eggplant juice showed that the addition of Dutch eggplant juice had a significant difference in the antioxidant activity obtained. The results of these observations can be seen in Table 8.

Table 8. Average Antioxidant Activity of Dutch Eggplant Tea Drink

Treatment	Antioxidant Activity (%) **(Mean + Standard deviation)**
A (addition of 6% Dutch eggplant)	40,00 + 3,00 a
B (addition of 6% Dutch eggplant)	44,67 + 0,57 a b
C (addition of 6% Dutch eggplant)	50,00 + 4,00 b
D (addition of 6% Dutch eggplant)	65,00 + 5,00 c
E (addition of 6% Dutch eggplant)	77,67 + 2,51 d
KK = 4,89 %	

Note: The numbers in the same column followed by unequal lowercase letters are significantly different according to the DNMRT at the 5% significance level.

From the table, we can also see that the concentration of added Dutch eggplant juice greatly affects the antioxidant activity produced. The more addition of Dutch eggplant juice, the higher the antioxidant activity. This is due to the influence of the chemical content contained in the Dutch eggplant fruit. Dutch eggplant fruit contains high natural antioxidants such as phenolic compounds, ascorbic acid and carotenoids [51].

Dutch eggplant is believed to be a source of natural antioxidants, because it contains vitamin E, vitamin A, vitamin C, vitamin B6, carotenoids, anthocyanins, and fiber. Ascorbic acid (Vitamin C) is a secondary antioxidant that has the ability to capture free radicals and prevent chain reactions. Various studies conducted on vitamin C were used in several levels of concentration to determine antioxidant activity, namely the ability to reduce free radicals using the DPPH method [54].

3.2.2 Sensory Test

3.2.2.1 Color

The panelists' preference for the color of the Dutch eggplant tea drink was A (3.65), B (3.45), C (3.35), D (3.20), E (3.05). The color of the Dutch eggplant tea drink is influenced by the theaflavin and thearubigin content and is also influenced by the carotenoids and anthocyanin content contained in the Dutch eggplant. Theaflavins and thearubigim are the products of polyphenol oxidation which affect the color and brightness of the brewed water, the strength of the taste and the freshness of the tea water. According to [51], Dutch eggplant contains the main carotenoid content, namely =cryptoxantin, -carotene and 3 anthocyanin compounds, namely delphinidin 3-rutinoside, cyanidin 3-rutinoside and pelargondin 3-glucoside-5-rhamnoside.

3.2.2.2 Aroma

Panelists' preference values for the aroma of Dutch eggplant tea drinks A (2.70), B (2.90), C (3.05), D (3.60), E (3.90) , the average panelists liked the aroma Dutch eggplant tea with the addition of 14% Dutch eggplant juice. The aroma of tea drinks is closely related to the aromatic substances found in tea. [55] stated that these aromatic compounds include linalool, pfhenuethanol, geraniol, benzyl alcohol, methyl salicylate, n-hexanal and cis-3-hexenol. In addition to the volatile compounds found in tea, Dutch eggplant also contains volatile compounds. According to [56] the

green and fresh herbs of mint from the Dutch eggplant are caused by the presence of C6-aliphatic compounds, aliphatic esters and terpenols.

3.2.2.3 Taste

The value of panelists' preference for the taste of Dutch eggplant tea drinks, A (2.75), B (2.95), C (3.30), D (3.50), E (3.75). On average, the panelists liked the taste of Dutch eggplant tea with the addition of 14% Dutch eggplant juice. The astringent and bitter taste of steeping tea will decrease with the addition of Dutch eggplant juice, thus giving a sour taste to the drink due to the presence of ascorbic acid in Dutch eggplant.

4. Conclusion

Based on the results of the research that has been done, the following conclusions is addition of Dutch eggplant juice in black tea had a significant effect on antioxidant activity, total polyphenols, flavonoids, vitamin C, pH and sensory tests on taste, aroma and color. Based on the results of sensory tests and chemical analysis of tea drinks with the addition of 14% Dutch eggplant juice, the panelists preferred the product, with an average sensory test value of 3.75, aroma 3.90, color 3.65. The results of chemical analysis with the following average values of vitamin C 168.96 mg/100g, pH 4.17, total polyphenols 393.37 mg GAE/g, flavonoids 296.83 mg GAE/g, antioxidant activity 77.67%, alkaloids (+), tannins (+), saponins (+).

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