
VOLUME | ISSUE | YEAR
1 2 2016
EISSN : 2506-8016
European Journal of
Engineering Research & Science
EJERS

Editorial Team

African-Stevia Leaves Herbal Tea as a Low Calorie Antioxidant Source

Rallentendo E. Lee, Elisabeth A. Rini, Siswi Astuti and Eko Y. Setyawan

***Abstract*—This paper discusses how to produce herbal teabags as a source of low-calorie antioxidants made from African leaves and stevia leaves. This study aims to determine the antioxidant content of herbal teabags made from African leaves (Vernonia amygdalina Del.) and Stevia leaves (Stevia Rebaudiana) by drying and varying drying time by 90 minutes, 110 minutes, 130 minutes, 150 minutes, 170 minutes and composition of 60:40, 65:35, 70:30, 75:25, 80:20 then the product is analyzed for antioxidants, calories, Fe, organoleptic, microbes, pH, and minerals contained in the mixture. In general, when compared with the SNI 3753: 2014 quality standard regarding teabag, the results of this study are better than the standard as it produces teabags with the highest antioxidant content characteristics at the time of drying 110 minutes with a composition of 65:35. In that condition, tea with the largest antioxidant content was 93.1005%/mg, after being brewed with water at a temperature of 700 ºC the antioxidant content dropped to 51.1345%, pH neutral 7, the organoleptic test that consumers liked was a composition of 65:35, Fe content obtained 12.07 mg/100gram. The group of diabetics who consume Sumatran tea has decreased blood sugar levels which tend to be normal. The results of calorie analysis of brewing tea are 0.2289 kcal/100 grams of sample. Sumatran tea contains minerals Na, Mg, K, Ca and has a durability of 3 months.**

***Index Terms*—African Leaves, Stevia Leaves, Teabags, Antioxidants.**

I. Introduction

In Indonesia, African Leaves (Vernonia amygdalina Del) are plants that are used as natural medicine [1]. People uses it as an anticancer drug, antimalarial, antidiabetic, relieves fever, abdominal pain, hypertension, gout, reduces cholesterol, hardens the liver even liver cancer, body detoxification, reomatic, insomnia, tingling, fever, dizziness, eliminates black cylindrical spots, throat infection, removing phlegm, launching urination, strengthening gastric function, coughing, and strengthening lung function [2, 3, 4].

Phenolic compounds including flavanoids contained in African Leaves have high antioxidant content as IC_{50} which is 87.992 ppm. With the presence of Flavonoids, the activity of disease-causing bacteria can be hampered because of its function as an antibacterial and anti-inflammatory.

Tea leaves (Camellia Sinensis) that we consume daily contain antioxidants that are useful for repairing damaged cells, preventing cancer, sliming the body, preventing heart disease, reducing cholesterol in the blood and promoting blood circulation [5]. These tea leaf products went through various processing methods that produce distinctive and distinct colors, aromas, flavors. The types of tea are green tea, black tea, Oolong tea and white tea. Herbal teas mixed with African leaves and Stevia leaves are included in black tea which goes through the process of drying which can help treat a disease and work as a body refreshing drink [6, 7]. To reduce the side effects of using sugar as a sweetener in brewing teabags, this teabag product uses stevia leaves as a natural sweetener [8] which contains lower calories than other sweeteners and is safe for consumption by diabetics [9]. The main components of sweet flavor are Stevioside and Rebaudioside compounds which have a steviol group acts as glucose carrier and has a total phenolic component of 25.18 mg/g leaves (in dry weight), flavonoids 21.73 mg/g (in dry weight), and total antioxidant capacity (TAC) ranged from 9.66 to 38.24 mg eq. Stevia is useful for antihypertensive, anti-hyperglycemic and anti-human rotavirus activities [10].

Based on the background above, it is important to do research on producing African leaf tea as an herbal drink with the addition of Stevia leaves that can treat diabetes mellitus disease by reducing insulin levels and blood sugar levels after consuming Stevia. Therefore, based on the benefits described above, African leaves can be used as herbal drinks that can prevent and treat diseases

II. Materials and Method

A. Materials and Tools Needed

1) Materials:

African Leaves and Stevia Leaves

2) Tools:

Aluminum Foil, 8 mesh sieve, basin, Cabinet Dryer, UV sterilization cup, glass, ph. paper, baking sheet, spoon, Blender, label paper, stove, pan, knife, plastic clip, disposable gloves, sealer, spoon, stopwatch, thermometer, analytical scale, tissue, polystyrene bag.

B. Procedures

1) Preparation and Pre-treatment

African leaves and fresh Stevia leaves are sorted and washed with running water and then drained. The clean leaves are then swayed at room temperature ± 25ºC for 48 hours. Next, the leaves are cut into small pieces measuring 0.5 cm and dried at a temperature of 50ºC with variations in drying time of 90, 110, 130, 150 and 170 minutes.

Published on December 16, 2019.

R. E. Lee is a student at the National Institute of Technology Malang in Chemical Engineering, Indonesia. (e-mail: leepiterson02@gmail.com).

E. A. Rini is a student at the National Institute of Technology Malang in Chemical Engineering, Indonesia. (e-mail: ayudyaelisabeth@gmail.com).

S. Astuti is with Chemical Engineering Department, National Institute of Technology Malang, Indonesia. (e-mail: siswiastuti@lecturer.itn.ac.id).

E. Y. Setyawan is with Mechanical Engineering Department, National Institute of Technology Malang, Indonesia. (e-mail: yohanes@lecturer.itn.ac.id).

2) Producing the Teabag Mixed with African Leaves and Stevia Leaves

The determination of the proportion of mixed variations between African leaves and stevia leaves used a ratio of 80: 20, 75:25, 65:35, 70:30, and 60:40. Then the tea leaves of African leaves and stevia leaves are packed into a 2-gram polystyrene bag, then the four variations are brewed by adding 200 mL of hot water at 90ºC for 2 minutes and doing further research with brewing temperature variations of 60, 70, 80, 90 and 100ºC for 15 minutes.

3) Organoleptic Analysis

Tea bag samples (± 2 grams) were brewed with 200 mL of hot water at 90ºC for 2 minutes moving the bag up and down then performing organoleptic testing including color, smell, and taste for 10 panelists, then the assessment of the teabag product was given.

4) Water Content Analysis

In the initial stage, heat the cup and the lid in an oven at 105ºC for ± 1 hour then cool in the desiccator for 20 minutes to 30 minutes. Next, weigh the analytic balance (cup and lid) (W0) then insert 5 grams of sample into the cup, close and weigh (W1). The next treatment is to heat the cup containing the sample open by placing the cup next to the cup in the oven at a temperature of (105 ± 2) ºC for 3 hours then close the cup while still in the oven and immediately move it to the desiccator. The next step is to cool the sample for 20-30 minutes and weigh. Then reheat for 1 hour and weigh until the weight reaches a fixed weight. After getting a fixed weight then do duplicate work by calculating the water content in the sample.

$$\text{kadar air} = \frac{W_1 - W_2}{W_1 - W_0} \times 100\% \quad (1)$$

Where:

W_0 = weight of empty cup and lid (gram)
W_1 = cup weight, lid and sample before working (gram)
W_2 = cup weight, lid and sample after drying (gram)

5) PH Analysis

This stage done by producing brewing tea and doing pH test using pH paper by dipping pH paper into brewed tea for 5 seconds and reading the pH indicated by the color indication found on the pH paper. Lastly, record the pH read from all samples of the brewed tea.

6) Antioxidant Analysis

DPPH powder was weighed as much as 4 mg to be dissolved in 100 mL of methanol in a dark volumetric flask or brown measuring flask, therefore a DPPH solution with a concentration of 40 ppm (parts per million) was obtained in the test. The solution is stored in a tightly closed place and protected from light. The methanol extract of African leaves was made into 5 series of concentrations namely 50, 100, 150, 200 and 250 ppm. Each test solution was taken 2 mL of extract and then added with 2 mL of 40 ppm DPPH solution into a closed test tube, blank testing is also carried out. This mixture is homogenized using vortex and left in a dark place at room temperature for 30 minutes. Then the absorbance is measured at a wavelength of 514 nm. From this absorbance data, it can be determined% inhibition of African leaf extract using the formula:

$$\%\,\text{inhibisi} = \frac{\text{A blanko} - \text{A sampel}}{\text{A blanko}} \times 100\% \quad (2)$$

IC_{50} values were calculated using regression equation formulas which were then categorized into categories of antioxidant strength levels.

TABLE I. LEVEL OF ANTIOXIDANT STRENGTH

Intensity	IC_{50} Value
Very Strong	< 50 ppm
Strong	50-100 ppm
Moderate	101-250 ppm
Weak	250-500
Inactive	>500 ppm

7) Fe Analysis

In the preparation phase of the test sample, firstly, insert 100 mL of the test sample which has been shaken until it is homogeneous into the cup of glass. Then add 5 mL of nitric acid. Next, heat the electric heater until the sample solution is almost dry; then, add 50 mL of distilled water. Put it in a 100 mL volumetric flask through filter paper and adjust 100 mL with distilled water.

The second stage is making a standard solution of ferrous metal, Fe 100 mg/L. First step is piping 10 mL of ferrous metal mother liquor, Fe 1000mg/L into a 100mL volumetric flask. Then match the diluent solution to the limit level in the volumetric flask.

The third stage is producing a standard solution of iron metal, Fe 10mg/L. Firstly, pipe 50 mL of standard iron metal solution, Fe 100 mg/L into a 500 mL volumetric flask and adjust it with the diluent solution to the limit level.

The fourth stage is producing a working solution of iron metal, Fe. Firstly, pip 0 mL; 5 mL; 10 Ml; 20 mL; 30 mL; 40 mL; 60 mL of standard iron solution, Fe 10 mg/L each into a 100 mL volumetric flask. Then add the diluent solution to the exact mark so that the iron metal concentration of 0.0 m/L is obtained; 0.5 mg/L; 1.0 mg/L; 20 mg /L; 30mg/L; 40 mg/L and 6.0 mg/L.

At the procedure stage and making a calibration curve, firstly, optimize the ASS tool according to the instructions for using the tool. Then measure each tool that has been made at a wavelength of 248.3 nm. Then make a calibration curve to get the regression line equation. Continue the process by measuring the test sample that has been prepared.

8) Sugar Content Analysis

Examination procedure done as follow; Take a strip test from the vial and insert it on the tool by following the arrow and wait until a blood drop appears (insert blood) appears on the screen. Clean the patient's finger with alcohol 70% using cotton. Pin by the patient's finger using the blood lancet. Capillary blood obtained from the fingertips was touched on the tip of the test strip and left to absorb the blood with its capillary capacity (1.5µ). Wait for 10 seconds the glucose levels on the screen and a strip test is issued. Record the fasting blood glucose results before and after given corn sugar. Giving stevia sugar is done after checking the GDP then the respondent is given stevia sugar as much as 20 grams in 100 mL of water and PP blood glucose levels are

examined after 2 hours.

TABLE II. ANTIOXDIDANT TEST RESULTS PRE TREATMENT

Sample Code	Concentration (mg/mL)	Antioxidant Activity (%)
Dry Stevia Leaves	1	71.6485
Dry AfricanLeaves	1	66.052

III. RESULT AND DISCUSSION

A. Pre-treatment Antioxidant Analysis

Meanwhile, Table III shows antioxidant activity on wet leaves.

TABLE III. ANTIOXIDANT TEST RESULTS PRE-TREATMENT ON WET LEAVES

Sample Code	Concentration (mg/mL)	Antioxidant Activity (% inhibition)
Stevia Leaves	10	56.7285
African Leaves	10	23.782

Based on the table of preliminary antioxidant test results and after brewing at 90ºC for 2 minutes, it can be concluded that the antioxidant content in African leaves is 23.72%/mg, the antioxidant content in Stevia leaves is 56.7285%/mg, and the antioxidant content in brewing tea a mixture of African leaves and Stevia leaves of 2.784%/mg. The content of antioxidants in brewing tea is very low because tea is brewed with boiling water temperature of 90ºC. The antioxidant content is reduced due to high temperature brewing. The highest antioxidant with treatment obtained at a temperature of 50ºC. Then the research was carried out using brewing temperature variations of 60, 70, 80, 90 and 100ºC. Then the best antioxidant product of tea is obtained at a temperature of 70ºC for 15 minutes.

TABLE IV: BREWING TEMPERATURE

Sample Code	Antioxidant Activity (%)	Concentration (mg/mL)
Brewing Temperature 60ºC	43.665	100
Brewing Temperature 70ºC	57.1345	100
Brewing Temperature 80ºC	5.7195	100
Brewing Temperature 90ºC	14.022	100
Brewing Temperature 100ºC	12.6075	100

B. After Treatment Antioxidant Analysis

Based on the table of preliminary antioxidant test results and after brewing at 90ºC for 2 minutes, it can be concluded that the antioxidant content in African leaves is 23.72%/mg, the antioxidant content in Stevia leaves is 56.7285%/mg, and the antioxidant content in brewing tea a mixture of African leaves and Stevia leaves of 2.784%/mg. The content of antioxidants in brewing tea is very low because tea is brewed with boiling water temperature of 90ºC. The antioxidant content is reduced due to high temperature brewing. The highest antioxidant with treatment obtained at a temperature of 50ºC. Then the research was carried out using brewing temperature variations of 60, 70, 80, 90 and 100ºC. Then the best antioxidant product of tea is obtained at a temperature of 70ºC for 15 minutes.

TABLE V. RESULTS OF ANALYSIS OF ANTIOXIDANT CONTENT DUE TO EFFECT OF DRYING TIME AND MATERIAL COMPOSITION

Composition Comparison of African and Stevia Leaves	Time (minute)				
	90	110	130	150	170
60 : 40	86462	85.68	85.52	90.88	88.26
65 : 35	8 8.0755	93.10	78.26	86.04	88.74
70 : 30	91.835	91.27	66.54	88.85	86.18
75 : 25	92.2525	62.49	83.77	86.74	80.61
80 : 20	92.7105	86.20	85.93	84.049	91.16

TABLE VI: RESULTS OF TWO-WAY VARIANT ANALYSIS OF DRYING TIME, COMPOSITION OF AFRICAN LEAVES AND STEVIA LEAVES ON ANTIOXIDANT CONTENT

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Rows	8341.207	5	1668.241	7.716271	0.00035	2.71089
Columns	822.8902	4	205.7226	0.951548	0.455174	2.86608
Error	4323.958	20	216.1979			
Total	13488.05	29				

Antioxidant analysis is done as not only African leaves contain antioxidants but according to [10], antioxidant activity of dry stevia leaves contains a total phenolic component of 25.18 mg/g leaves (in dry weight), flavonoids 21.73 mg/g (in dry weight), and total antioxidant capacity (TAC) ranged from 9.66 -38.24 mg eq.

To determine the effect of the composition of African leaves and stevia leaves on antioxidant content, a two-lane variant analysis was carried out. Based on the data analysis, the value of P-value = 0.00035, F count = 7.716271, and F table = 2.71089 for α = 5%. Because P-value <5% and F count> F table, Ha is accepted. This shows that there is a significant influence between the composition ratios to the antioxidant content. This is the same as knowing the effect of drying time on antioxidant content by analyzing the two path variants, so that the P-value = 0.455174 F count = 0.951548, and F table = 2.866081 for α = 5%. Because P-value> 5% and F count <F table, then Ho is accepted and Ha is rejected. This means that there is no significant effect between drying time on the antioxidant content. This is because the temperature used is constant at 50ºC with a long enough time so that the antioxidants contained in it are not reduced or evaporated. Bioactive components such as flavonoids, tannins, and phenols are damaged at temperatures above 50ºC because they can undergo structural changes and produce low, and according to [11] extracts on the Study of Avocado Leaves Time and Temperature in Its Utilization as Herbal Tea explains that decreasing macromolecules such as flavonoids during heating is influenced by temperature and time used. Heating processing can affect the phytochemical compounds and the integrity of cell structure which results in the migration of components causing losses due to leakage or damage through various chemical reactions involving enzymes, light and oxygen.

From the results of the above analysis it can be concluded that antioxidants are compounds that can inhibit the rate of oxidation. These antioxidants have many components and are natural substances that can be obtained from the drinks we consume. Antioxidants are beneficial to stop the formation of free radicals, neutralize and repair the damage that occurs. Flavonoids are the largest group of natural phenol compounds and are polar compounds because they

have a number of hydroxyl groups, so they will dissolve in polar solvents such as ethanol and methanol. Flavonoids are active compounds that can be used as antioxidants. The relationship between the drying time and the composition of tea is obtained by the results that at the time of 110 minutes drying and composition 65:35 will produce the tea with the largest flavonoid content, 93.1005%/mg.

According to the results of a study conducted by [3], the drying of soursop leaves at 50°C with a drying time of 150 minutes produced the best soursop leaf tea with the highest antioxidant activity of 76.06% and the lowest EC_{50} value of 82.16µg / ml. Whereas according to [7], drying Senna alata leaves at 50°C with a drying time of 130 minutes positively contains phenolic compounds and flavonoid groups, strong antioxidant activity with IC50 value of 60.18µg / mL. According to [12], drying fragrant pandan leaves at 50° C with 150 minutes drying time produced the best tea with the highest antioxidant activity with IC_{50} value of 5.68 ppm or 5.68 µg/mL. From the result, it can be concluded that the temperature used in the drying process of leaves to be used as tea should be at a temperature of ± 50°C and the time used is around 120-150 minutes. Drying uses low temperatures and long periods of time so that the content of flavonoids contained does not decrease [7].

In a study conducted by [13] on the effect of Galohgor products on antioxidant activity and decreased oxidative stress in patients with diabetes mellitus, the intervention of chamomile tea for 8 weeks significantly reduced MDA levels by -2.02 nmol / ml in people with type DM 2. MDA is one of the secondary products of lipid damage, especially in the class of Polyunsaturated Fatty Acid (PUFA) in cell membranes. The total content of 2 grams of galoh gor contributes to the intake of flavonoids of 5.52 mg. The condition of oxidative stress will cause damage to various components of the body's cells such as protein, lipids and Deoxyribonucleic Acid (DNA). Endogenous antioxidants such as Superoxide Dismustase (SOD), Glutathione Peroxidase (GPx), Glutathione (GSH), Catalase (CAT), are the first defenses to overcome the negative effects of free radicals. DM patients are reported to have decreased endogenous antioxidant activity in the body, thereby increasing oxidative stress conditions. Therefore, when compared with herbal teas that used African leaves it will show more significant results because the levels of antioxidants are higher which can reduce MDA levels in DM patients.

The consumption of flavonoids in research respondents according to [14] was 141.1 ± 101.4milligrams/person/h while everyone to maintain their potential health needed 50-150 milligrams/day. The composition 65:35 (African leaves:Stevia leaves) used produces antioxidants of 93.1005% therefore it can be concluded that these results are still safe for consumption. So the best sample that has the highest antioxidant content is at the time of drying 110 minutes which is intended to reduce the water content as much as possible so that it can increase the shelf life of the ingredients.

For the test of antioxidant content in brewing African leaves and stevia leaves, the results obtained were 2.784% / mg inhibition for 100 ml samples. The content of antioxidants in brewing tea is very low because tea is brewed withboiling water at a temperature of 90ºC. The antioxidant content is reduced due to brewing using high temperatures that exceed the optimum antioxidant temperature limit.

In SNI, the minimum tea content of polyphenols is 9% while the temperature of brewing does not produce antioxidants that meet SNI requirements, so it is recommended that brewing tea be done at a temperature of 75-80ºC to obtain a higher antioxidant content of 2.784% /mg inhibition.

C. Calorie Analysis

TABLE VII: RESULTS OF CALORIE ANALYSIS OF MIXED SAMPLES OF AFRICAN TEA LEAVES AND STEVIA LEAVES

No.	Sample Name	Calorie Total (per 100 gram sample)
1.	Before brewing Tea	0.3879 kkal
2.	After brewing Tea	0.2289 kkal

According to [15] Stevia leaf itself is widely used as a natural sweetener for diabetics or for those who do a diet program because stevia has a sweet taste on the tongue without producing excessive calories for the body compared to using other sweeteners. Stevia can still be consumed by people with diabetes mellitus. Based on observations of blood sugar levels in the group that consumed stevia, the researchers also concluded that stevia is safe for consumption in obese patients. In general, the average daily calorie intake in adult men is 2.500 kcal, while adult women are around 2,000 kcal, for children ranging from 1.000 to 2.000 kcal, teenagers range from 1.400 to 3.200 kcal per day. Based on the results of the calorie analysis carried out, the number of calories contained in the brewing sample is 0.2289 kcal, therefore the value is still in safe condition or does not affect the average daily calorie intake when consuming one tea bag (2 grams) worth 0.004578 kcal is according to the standard.

D. SEM-EDX Analysis

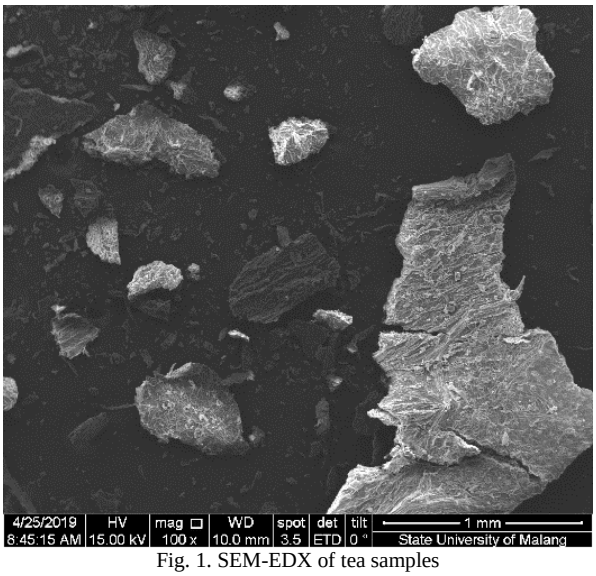

Fig. 1. SEM-EDX of tea samples

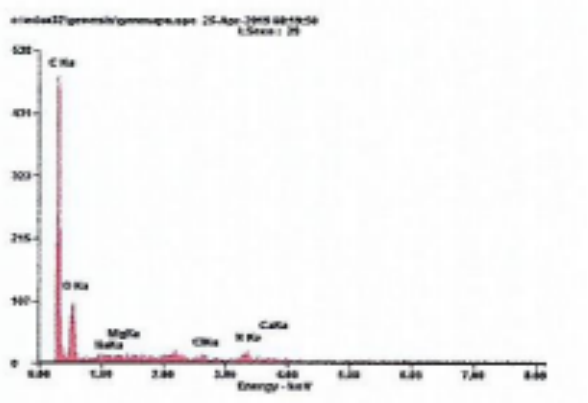

Fig. 2. Anatomical structure of tea samples

TABLE VIII: RESULTS OF SEM-EDX ANALYSIS

Elemen	Wt%	At%
Ck	62,57	71,3
Ok	30,33	26,02
NaK	0,56	0,33
MgK	0,32	0,183
ClK	1,05	0,41
KK	4,76	1,68
CaK	0,72	0,25

The results of SEM-EDX analysis were used to identify the presence of mineral components in the best tea samples and it was found that the components contained in it were C, O, Na, Mg, Cl, K, and Ca. From the results of the analysis could be concluded that in African leaves contains dangerous components that can be consumed for all adult women.

E. Microbial Analysis

The results of the research on the identification of microbes contained in tea samples were carried out in the Chemical Engineering Microbiology Laboratory, ITN Malang.

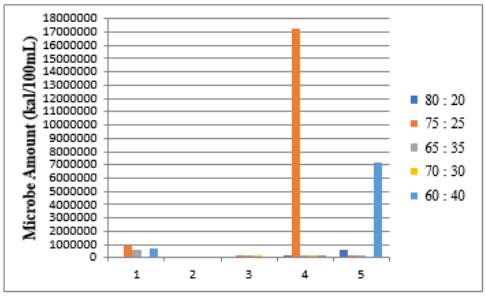

Fig. 3. Microbial Analysis Result

From the table it can be seen that the number of microbes at most at 150 minutes drying time with the composition ratio of African leaves and leaves of Stevia 75:25 with the amount of 173 × 105 colonies / 100mL. The large number of bacteria caused by the storage time is quite long, namely for 3 weeks before the analysis process so that bacteria grow rapidly at the time before the analysis. Consequently, the best determination for African leaf tea (Vernonia amygdalina Del.) and Stevia leaves (Stevia Rebaudiana) in order to produce healthy herbal teabag brewing is determined that the brewing temperature should be done at 70ºC because the bacteria at this temperature are dead and the antioxidant content in brewing tea is higher than 2.784%/mg inhibition.

The results of microbial analysis found to determine the storage time can be seen in the following table:

TABLE IX: MICROBIAL ANALYSIS TO DETERMINE THE STORAGE TIME

Storage time	Types of microbes	Amount of microbes
14 days	*Bacillus Subtilus*	28×10^4
28 days	*Bacillus Subtilus*	21×10^4
42 days	*Bacillus Subtilus*	150×10^4
56 days	*Bacillus Subtilus*	35×10^4
70 days	*Bacillus Subtilus*	3×10^4

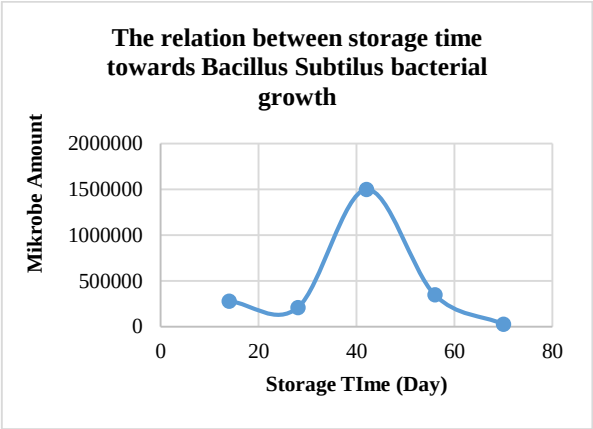

Fig. 4. Relationship curve for storage time towards bacillus subtilus bacterial growth

It can be concluded that the storage life of the tea is about 3 months with the identified bacteria, Bacillus Subtilus, which decreases every 2 weeks. This is because there is an ethanolic extract in African leaves that has a high enough concentration so that it can affect microbial susceptibility, where the higher the concentration the higher the chemical activity as an antibacterial that can kill harmful microbes [2]. With the presence of flavonoids in African leaves and Stevia leaves, the activity of disease-causing bacteria can be hampered because of its function as an antibacterial and anti-inflammatory [9].

F. Water Content Analysis

Before carrying out the process of further research we carried out an analysis of the water content contained in the best samples. The results of the analysis of water content in African leaves and stevia leaves are equal to 0.8231%. This is the same as the theory we got on SNI Tea which states that the water content is a maximum of 10%. From the results of the analysis it can be concluded that the content of water content contained in the mixture of African leaf tea and stevia leaves meets the quality standards of tea. Water content analysis is carried out on brewing drinks which aims to determine the amount of water content that is very influential on the acceptability, freshness, and durability of the material itself. The addition of stevia leaves affects the percentage of water content analysis of brewed drinks.

According to what was stated by [15] the addition of stevia leaves and cherry leaves are the same, namely 50% cherry leaves and 50% stevia leaves so as to make the water content increase, when two ingredients are mixed with the same amount the percentage of water content increases. But in our study, the composition of the ingredients we used was African leaves:stevia leaves (65:35) did not affect the water content because the two ingredients used as proportions did not have the same amount. The drying we do uses an oven

that affects the analysis of the percentage of water content of brewed drinks. This is because drying using an oven has the principle of conduction, namely the transfer of heat energy is not followed by intermediates. So that drying using the oven can be maximal to remove water from African leaves and stevia leaves.

The results of the water content obtained did not exceed the standards set by Black Tea National Standard (SNI) which had been set to a maximum of 10%, so it was expected that the durability of the product would be longer. The results of the analysis of water content in African leaves and stevia leaves are equal to 0.8231%. From the results of the analysis it can be concluded that the content of water content contained in the mixture of African leaf tea and stevia leaves meets the quality standards of tea.

G. PH analysis

Before carrying out the process of further research, a pH analysis test contained in the tea brewing sample was conducted. The results of the pH analysis on brewing African tea leaves and stevia leaves are equal to 7. From the results of the analysis it can be concluded that the pH contained in brewing tea is neutral. The results of analysis of tea samples conducted stated that the addition of stevia leaves as a mixture of African leaf tea had an effect on the analysis of the acidity of brewed drinks, the interaction of African leaves and stevia leaves significantly affected the analysis of acidity. The addition of stevia leaves affects the pH value of brewed drinks; this is due to the content of tannins in stevia leaves. This is in line with the idea [38] that the properties of tannins in water are colloidal and acidic so that the tannins are neutral. The type of drying affects the pH value of brewed drinks, this happens because the lower the water content of a material the pH value will increase as it is known that the vacuum oven dryer has an average value of water content lower than the oven blower type dryer, this is appropriate with [38] which states that the water content is low then the pH will be greater than 6. In this study the pH obtained was equal to 7, so this study is in accordance with the standard.

H. Fe Analysis

This analysis was carried out on crude tea fiber samples containing the highest antioxidant levels of 5 grams and carried out in the FMIPA UB chemical laboratory in Malang.

TABLE X: RESULTS OF MEASUREMENT OF FE LEVELS IN DRY SAMPLES

No	Code	Parameter	Result Analysis		Method Analysis	
			Level	Unit	Reactor	Method
1	Tea	Fe	12,07 ± 0,06	Mg/Kg	HNO_3	ASS

Analysis of Fe content is carried out because according to [16] African leaf plants contain chemical compounds namely iron at 7.5 mg/100 grams and according to [17]) stevia leaves also contains iron. So it is necessary to analyze the Fe content in a mixture of African leaf tea and Stevia leaves to determine whether Fe content is harmful for consumption or not. If the results of the analysis are 12.07 mg/kg compared with the literature from [5] then the Fe content obtained is 120.7 mg/100gram. The test results are high compared to other sources which say that the Fe content in African leaves is 7.5 mg/100 grams. The test results are high compared to other sources which say that the Fe content in African leaves is 7.5 mg/100 grams. This is because the sample tested is a mixture of African leaves and Stevia leaves, which is known that Stevia leaves also contain Fe but the exact amount is unknown.

As stated in Alodokter blog, iron is usually obtained by someone from food. New supplements are recommended for consumption if the body lacks iron. The maximum dose of iron consumption daily for adults and children over 14 years is 45 mg/day. As for children under 14 years, the maximum dose is 40 mg/day. Iron derived from animal foods is more easily absorbed by the body than plant foods. Taking vitamin C can help absorb iron by the body. The reaction of people to a drug varies. Although iron supplements have good benefits for the body, these supplements can also cause side effects. Some of the common side effects are: Darker stools than usual, Constipation, Nausea, cramps, or abdominal pain, and Diarrhea

TABLE XI: BEST ORGANOLEPTIC ANALYSIS RESULTS (DRYING TIME 110 MINUTE)

Composition Comparison of African and Stevia Leaves	Color	Aroma	Flavor
80 : 20	Common	Like	Dislike
75 : 25	Common	Like	Dislike
65 : 35	Common	Like	Like
70 : 30	Common	Like	Common
60 : 40	Common	Like	Dislike

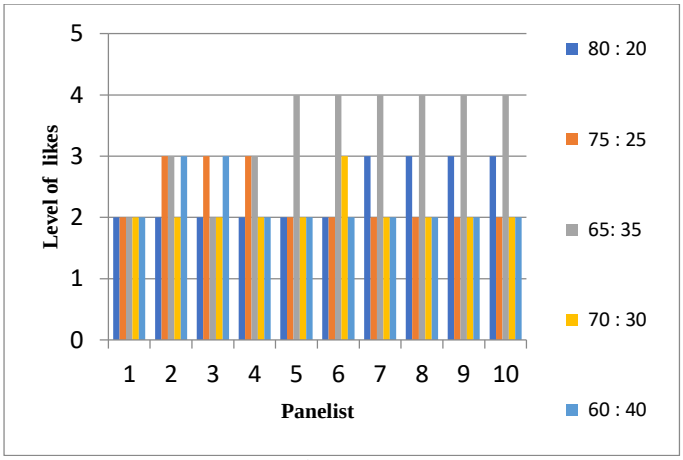

Fig. 5. The results of the organoleptic analysis

Descriptions of likes:
1 = Very Dislike
2 = Dislike
3 = Ordinary
4 = Like
5 = Very Like

The results of the organoleptic analysis are as follows:

a. Color Test: Herbal tea products mixed with African leaves and stevia leaves display a dark yellowish green color.
b. Aroma Test: Herbal tea products mixed with African leaves and stevia leaves give off a distinctive aroma of fresh African leaves.
c. Flavor Test: The herbal tea product mixed with African leaves and stevia leaves produced provides a distinctive taste of fresh African leaves.

According to research conducted by [2] about the formulation of sweet herbal tea (stevia-herbaceous green tea), the formula for sweet herbal tea received by consumers

is the proportion of green tea: stevia (65:35). In this study, the best composition ratio between African leaves (Vernoniaamygdalina Del.) And Stevia leaves (Stevia Rebaudiana) in order to produce brewing herbal teabags which in addition to healthy also had good taste was composition 65 : 35 (African leaves: stevia leaves) with a drying time of 110 minutes producing the highest antioxidant, that is 93.1005% /mg.

The brew color as a whole produces a yellowish-green dark green color. According to [38] the results of variance analysis namely the addition of stevia leaves has a very significant effect on the color of brewed drinks. In the research we did, drying using Tray Dyer did not significantly affect the color of brewed drinks, this is due to the addition of stevia leaves will make the color of the drink brew initially yellow to brownish so the panelists like colors that are not too thick.

The results of variance analysis for flavor parameters showed that the addition of stevia leaves had a very real effect on the taste of brewed drinks so that the taste of tea was not too bitter and favored by panelists. As for aroma parameters, the addition of stevia has no significant effect and the aroma of fresh African leaves is more dominant.

IV. CONCLUSION

1) The variable influence of drying time and composition of ingredients on the content of antioxidants contained in African leaves the longer the drying time, the lower the antioxidant content. In this study the optimum drying temperature was 110 minutes with a comparison of the composition of African leaves and Stevia leaves 65:35 which is the highest anti-oxidant content of 93.10050%/mg.
2) Comparison of the best composition between African leaves (Vernoniaamygdalina Del.) And Stevia leaves (Stevia Rebaudiana) in order to produce brewing herbal teabags which in addition to healthy also have a good taste which is at a 65:35 ratio. Because at that ratio panelists like the taste of herbal teas.
3) Water content in the sample with the highest antioxidant content is at the drying time of 110 minutes and at a ratio of 65:35. In the operating conditions, the content of water content contained in a mixture of African leaf tea and Stevia leaves is 0.8231%. With these results it was declared safe because it had fulfilled the dye black tea SNI.
4) Based on the table about the amount of iron adequacy for each of the Alodokter blog sources, tea should be consumed by adult women aged 14-50 years. So that this tea is not good forconsumption by children under 14 years.
5) The best results of the temperature of African leaf brewing tea (Vernoniaamygdalina Del.) And Stevia leaves (Stevia Rebaudiana) are carried out at 70ºC which has the highest antioxidant content of 57.1345% compared to the temperature of 90ºC which only produces antioxidants as much as 2.784%. In addition, at a temperature of 70ºC it is good to use because the bacteria at this temperature died.

REFERENCES

[1] Febrianti, Petrina., Wisnu Cahyo Prabowo dan Laode Rijai, "AktivitasAntioksidan Dan Tabir Surya Ekstrak Daun Afrika (Vernoniaamygdalina Del.)," Fakultas Farmasi on Universitas Mulawarman, April.2017.
[2] Adetunji.,Olaniyidan Ogunkunle, "Bacterial Activity of Crude Extracts of VermoniaAmygdalina on Clinical Isolates, Journal of Microbiology and Antimicrobials Nigerian, Vol. 5, No. 6, pp. 60-64, June. 2013.
[3] Ijeh, Ifeoma dan Chukwunonso, "Current Perspectives on the Medicinal Potentials of VernoniaAmydalina Del," College of Natural and Applied Sciences on Department of Biochemistry, Vol. 5, No. 7, pp. 1051-1061, April. 2011.
[4] Muzaki, Dedy Dan Rekna Wahyuni., "Pengaruh Penambahan Gingger Kering (ZingiberOfficinale) terhadap Mutu dan Daya Terima Teh Herbal Daun Afrika Selatan (VernoniaAmygdalina)," Fakultas Pertanian on Universitas Yudharta, Vol.6, No.2, Nov. 2015. Obat Kumur Herbal Alami menggunakan Metode Infundasi," Program Studi Teknik Kimia, Universitas Muhammadiyah, 2017.
[5] Sukmawati, Harira Hadidan Aminah, "PotensiSenyawa Flavonoid Daun Afrika (Vernonia Amygdalina Del.) Asal Ternate sebagai Antioksidan," Fakultas Farmasi on Universitas Muslim Indonesia, Vol. 9, No. 2, pp. 195-200, Des. 2017.
[6] Towaha, Juniaty, "Kandungan Senyawa Kimia Pada Daun Teh (Camellia sinensis)," Journal of Warta Penelitian dan Pengembangan Tanaman Industri, 2013.
[7] Yamin, Muhammad., Dewi Furtuna Ayu dan Faizah Hamzah, "Lama Pengeringan Terhadap AktivitasAntioksidan Dan Mutu Teh Herbal Daun Ketepeng Cina (Cassia Alata L.)," Fakultas Pertanian on Universitas Riau, Vol. 4, No. 2, Oct. 2017.
[8] Dewi, Jovita Kurnia., L.M. Ekawati Purwijantiningsih., dan F. Sinung Pranata, "Kualitas Teh Celup dengan Kombinasi Teh Oolong dan Daun Stevia (Stevia Rebaudiana Bertonii)," Fakultas Teknologi on UniversitasAtma Jaya, 2016.
[9] Tahir, Mulyati M,. Mariyati Bilang dan Nurmitasari, "Pembuatan Minuman Seduh Daun Kersen (Muntigia Calabura. L) dengan Penambahan Daun Stevia (Stevia Rebaudiana) sebagai Pemanis Alami Rendah Kalori." Teknologi Pangan on Universitas Hasanuddin, 2017.
[10] Ariviani, Setyaningrumdan Dwi Ishartani, "Formulasi Teh Herba Manis (Teh Hijau-Stevia-Herba): Organoleptik, Antioksidandan Total Kalori," Fakultas Pertanian onUniversitasSebelasMaret, Vol. 2, No. 2, August.2009.
[11] Widarta, Wayan Rai I dan Dewa Gede Mayun Permana, "Kajian Waktu dan Suhu Pelayuan Daun Alpukat dalam Upaya Pemanfaatannya sebagai Teh Herbal," Program Studi Ilmu dan Teknologi Pangan, Fakultas Teknologi Pertanian on Universitas Udayana, Vol. 2, No.2, 2018.
[12] Angraiyati Dewi dan Faizah Hamzah,"Lama Pengeringan Pada Pembuatan Teh Herbal DaunPandan Wangi (Pandanus Amarylifolius Roxb.,) Terhadap Aktivitas Antioksidan," Journal of UniversitasAndalas, 2017.
[13] Setyaningsih, Sulasyi., Katrin Roositadan Evy Damayanthi, "Efek Produk Galohgor Terhadap Aktivitas Antioksidan Dan Penurunan Stres Oksidatif Pada Penderita Diabetes MelitusTipe 2," Program Studi Ilmu Gizi on Institut Pertanian Bogor, Vol. 13, No. 4, Des. 2017.
[14] Rahmawati,Widia, "Hubungan Konsumsi Makanan Fungsional Sumber Antioksidan dengan Fungsi Kognitif dan Kadar 4-Hydroxynonenal (4-HNE) Plasma Lansia," Fakultas Kedokteran on UniversitasAndalas, Vol. 5, 2016
[15] Suryani Chatarina Lilis dkk, "Aktivitas Antioksi dan Ekstrak Etanol Daun Pandan (Pandanus Amaryllifolius) dan Fraksi-Fraksinya," Journal of Universitas Mercu Buan, 2017.
[16] Sukmawati, Harira Hadidan Aminah, "PotensiSenyawa Flavonoid Daun Afrika (Vernonia Amygdalina Del.) Asal Ternate sebagai Antioksidan," Fakultas Farmasi on Universitas Muslim Indonesia, Vol. 9, No. 2, pp. 195-200, Des. 2017.
[17] Tahir, Mulyati M,. Mariyati Bilang dan Nurmitasari, "Pembuatan Minuman Seduh Daun Kersen (Muntigia Calabura. L) dengan Penambahan Daun Stevia (Stevia Rebaudiana) sebagai Pemanis Alami Rendah Kalori." Teknologi Pangan on Universitas Hasanuddin, 2017.

Elisabeth Ayudya Rini was born in Malang on August 13, 1997. Currently she is a student at the Malang National Institute of Technology in Chemical Engineering study program.

Rallentendo Eva Lee was born in Malang on February 17, 1997. Currently it is a trial of the Malang National Institute of Technology in Chemical Engineering study program.

Ahmad Mujahid was born in Malang on March 17, 1997. He is currently a student at the Malang National Institute of Technology in Chemical Engineering study program.

Lecturer Chemical Engineering, Faculty of Industrial Technology, National Institute of Technology Malang, Indonesia

Lecturer Mechanical Engineering, Faculty of Industrial Technology,National Institute of Technology Malang, *Indonesia*