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The Formulation and Evaluation of Anti-Aging Tamarind Leaf (*Tamarindus Indica L.*) Extract Cream

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ABSTRACT

This study aims to formulate and evaluate the anti-aging tamarind leaf (*Tamarindus Indica L.*) extract cream due to the increasing demand for the anti-aging product day by day. In this study, tamarind leaf extract was tested to find out its phytochemicals, antioxidant activity using a 1,1-diphenyl-2-picrylhydrazyl method, and anti-aging activity using a UV spectrophotometer. Anti-aging cream was formulated based on the antioxidant and anti-aging potential of tamarind leaf extract and its evaluation. The cream was formulated with tamarind leaf extract, carboxymethylcellulose, and base cream with different emulsion types (water in oil and oil in water). This study revealed that tamarind leaf extract contains alkaloid, flavonoid, saponin, phenol, and tannin. Tamarind leaf extract also has an antioxidant and an anti-aging activity. The cream evaluation showed that cream with extract concentration at 80 ppm emulsion types W/O and O/W placed in outdoor and indoors were to be stable during 4 weeks of stability studies. The creams still have antioxidant activity, do not experience a significant change in their physical appearance at organoleptic test, homogeny, pH range at 4.5-8, spreadability range at 5-7 cm in weight 0-50 gram, and are not separated during centrifugation test.

Keyword: antioxidant, anti-aging, tamarind leaf, DPPH, cream

1. INTRODUCTION

As a tropical country, Indonesia has an abundance of sunlight all year. Sunlight is a valuable source of energy for humans. Sunlight emits two types of rays: those that cannot be seen (ultraviolet) and those that can be seen (visible). Visible rays have wavelengths of up to 400 nm, whereas invisible rays have wavelengths ranging from 10 nm to 400 nm. UV light is classified into three types based on its wavelength: UV A, UV B, and UV C, all of which have negative effects on skin health. Some of these adverse effects include the acceleration of redness or red rashes on the skin, skin burning, the activation of cancer cell growth, and premature aging of the skin (Isfardiyana & Safitri, 2014). Skin aging is a natural process that takes place in the human body. Aside from being aesthetically unappealing, skin aging can also be detrimental to skin health because it can lead to skin cancer.

The anti-aging is a cosmetic product that is commonly applied topically and is known to treat or relieve symptoms caused by UV ray exposure (photoaging), or it could be interpreted as a product that can delay or prevent the onset of photoaging symptoms (Farage, 2010). The anti-aging products containing antioxidants are prominent and growing in popularity. Synthetic antioxidants are antioxidants that are synthesized and used for commercial purposes. Some examples of synthetic

antioxidants include butylhydroxytoluene (BHT), butylhydroxyanisol (BHA), and propylgallate (Mukhopadhyay, 2006). However, there are several side effects when using synthetic antioxidants (Fitriana *et al*., 2015). Synthetic antioxidants are indicated, causing harmful side effects to the human body such as liver damage and carcinogenic (Munir *et al*., 2013).

The tamarind plant (*Tamarindus indica L.*) is very easy to find in Indonesia. Tamarind plants are widely used in traditional medicine or herbal medicine. The skin, leaf, stems, fruit, and seeds of tamarind plants are frequently used for medicinal purposes (Faradiba *et al*., 2016). Tamarind leaf contain natural antioxidants that can be used as medicine to treat a variety of medical conditions. Tamarind leaf consist of various chemical compounds, including terpenoids, organic acids, phenols, tannins, saponins, and flavonoids, according to several studies (Munim *et al*., 2009). Based on pharmacological data, the tamarind leaf is efficacious for curing diarrhea, dysentery, abdominal pain, worm infections, fever, constipation, inflammation, wound healing, and malaria (Kuru, 2014).

According to previous research, through the DPPH test, tamarind leaf have antioxidant activity with a DPPH-Scavenging Activity value of 61.50±1.56% at 30%v ethanol solvent concentration (Buanasari, Sugiyo Warlan, 2018). However, the IC_{50} value was not determined and was not compared to the antioxidant activity of the positive control. The formulation and evaluation of tamarind leaf extract cream have not been carried out, in addition to testing the anti-aging exercise.

The benefits of the tamarind plant, including leaf, fruit, and seeds, have long been recognized, but it has not been fully used. Tamarind leaf extract was used in this study to create an anti-aging cream. The cream is an emulsion that is applied to the skin and consists of a water phase and an oil phase. The benefits of creams or emulsions include their ability to penetrate the skin quickly, increase the spread of active ingredients, and remain stable during long-term storage.

According to previous research, the DPPH method of antioxidant activity against radicals was found to be the most effective and efficient among the test methods used 1,1-diphenyl-2-picrylhydrazyl (DPPH), Ferric Reducing Antioxidant Power (FRAP), Ferrous Ion Chelating (FIC)), while the FIC method was found to be the least effective and efficient due to its very low sensitivity and chelating power of less than 20% (Maesaroh *et al*., 2018).

In this study, antioxidant activity of tamarind leaf extract was measured using the DPPH method, which calculated the percentage of inhibition (% inhibition), half maximal inhibitory concentration (IC_{50}) and antioxidant activity index (AAI). Using a UV spectrophotometer, the anti-aging activity was determined by calculating the Sun Protection Factor (SPF), erythema transmission percentage (% ET), and pigmentation transmission percentage (% EP). Furthermore, the research examines the formulation and evaluation of an anti-aging tamarind leaf extract cream (*Tamarindus Indica L.*).

2. RESEARCH METHOD

2.1. Materials

The tamarind leaf were purchased in Ngawi, Indonesia, along with chemicals such as ethanol (96% purity, CAS 64-17-5 Merck, Germany), DPPH (2,2-diphenyl-1-picrylhydrazyl) (CAS 1898-66-4 Merck, Germany), chloroform (CAS 67-66-3 Merck, Germany), distilled water (CAS 7731-18-5 Merck, Germany), ammonia (CAS 1336-21-6 Merck, Germany), acetic acid (CAS 64-19-7 Merck, Germany), Wagner's reagent, Magnesium powder (CAS 7439-95-4 Merck, Germany), Concentrated HCl (CAS 100317 Merck, Germany), 5% $FeCl_3$ (CAS 7705-08-0 Merck, Germany), 10% $FeCl_3$ (CAS 7705-08-0 Merck, Germany), O/W base cream, base cream W/O, CMC 5% (CAS 9000-11-7 Merck, Germany), butylated hydroxytoluene (BHT) (CAS 128-37-0 Merck, Germany).

2.2. Instruments

The instruments used in this study included a glass funnel, measuring cup, beaker, test tube, glass stirrer, dropper pipette, measuring pipette, measuring flask, vortex, rotary evaporator, incubator, pH meter, analytical scales, centrifuge (Centrifuge H-103n R.P.M 5000, Kokusan, Japan), and centrifuge tube. The antioxidant and anti-aging activity test used a UV spectrophotometer (UV Spectrophotometer Shimadzu UV 2450, Shimadzu, Japan).

2.3. Sample Preparation

Fresh tamarind leaf were first separated and washed several times with water. Following that, the leaf were dried in the airflow before being crushed and ground for extraction preparation.

2.4. Sample Extraction

The 750 grams of tamarind leaf were put in a closed vessel, then added 3 L of ethanol 96%. The immersion was carried out for 24 hours. The filtrate obtained was collected and evaporated using a rotary evaporator to obtain a crude extract. In this study, tamarind leaf extract was made in 3 variations of concentration, namely 20 ppm, 40 ppm, and 80 ppm with ethanol solvent.

2.5. Qualitative Phytochemical Screening of Tamarind Leaf Extract.

2.5.1. Alkaloid Test

The alkaloid test was performed by dissolving a few mL of tamarind leaf extract in 10 mL of. distilled water and then adding acetic acid. The mixture was then boiled and filtered. 2 mL of dilute ammonia and 5 mL of chloroform were added to the filtrate. The mixture was then shaken and allowed to stand until two layers formed. The top layer was transferred to a different test tube, where 4-5 drops of Wagner's reagent were added. The formation of a brown precipitate indicates a positive test.

2.5.2. Flavonoid Test

The flavonoids were tested qualitatively by heating a few mL of tamarind leaf extract for 5 minutes. Regarding that, 10 drops of concentrated HCl and 0.02 grams of Mg powder were added. A positive test resulted in the formation of a red, yellow, or orange color.

2.5.3. Saponin Test

The qualitative test of saponins was performed by taking a few mL of tamarind leaf extract, adding distilled water, and shaking it for 30 seconds to observe the changes. A positive test was indicated by the formation of foam that did not disappear after 30 seconds.

2.5.4. Phenolic Test

A phenolic qualitative test was performed using 1 mL of tamarind leaf extract and 2 drops of 5% $FeCl_3$ solution. The presence of phenolic compounds in the extract was indicated by the formation of a green or bluish-green color.

2.5.5. Tannins Test

The tannins were tested qualitatively by taking a few mL of tamarind leaf extract and adding 10 drops of 10% $FeCl_3$.

2.6. Cream Formulation

The extract with the highest antioxidant and anti-aging activity had a concentration of 80 ppm, as determined by testing the concentration of tamarind leaf extract. The concentration is transformed into a cream formulation. The fusion method was used to create the tamarind leaf extract cream formulation. In this study, the variations of base cream were performed using O/W and W/O emulsion base cream. Each base cream was mixed with 0.008 grams of tamarind leaf extract to make the cream. Before adding the extract to the mortar, it was first dissolved in 5 percent CMC and mixed with a mortar. The formulation can be seen in Table 1.

Table 1. The formulation for making tamarind leaf extract cream

Materials	F(-) O/W	F(-) W/O	F O/W	F W/O
Tamarind leaf extract	-	-	0.008 gr	0.008 gr
CMC 5%	-	-	Add dissolved	Add dissolved
Base cream O/W	100 gr	-	Add 100	-
Base Cream W/O	-	100 gr	-	Add 100

2.7. Evaluation of Cream

The anti-aging tamarind leaf extract cream was stored for four weeks in both outdoor and indoor conditions to determine its stability.

2.7.1. Qualitative Antioxidant Activity Test

A qualitative test for the antioxidant activity of cream was performed using 2 mL of tamarind leaf extract cream and the DPPH method. Two mL of 50 ppm DPPH was mixed into the antioxidant cream. The mixture was vortexed and incubated for 30 minutes at 27°C in a dark room. Then the color shift was noticed. A positive test was indicated by a color change in the mixture from purple to yellow or colorless after incubation.

2.7.2. Organoleptic Test

Organoleptic test were conducted to examine the physical appearance of the creams by observing their state, color, texture, and odor.

2.7.3. Homogeneity Test

The homogeneity test was used to determine whether the cream's made were successful or not. To examine the homogeneity of the creams, cream from various parts of the cream, namely the top, middle, and bottom, was applied to a transparent glass. Following the application of the cream to the glass, it was directly closed with another transparent glass. The absence of coarse grains could indicate homogeneity.

2.7.4. pH of Cream

The pH test was performed to determine the cream's acidity level and to ensure that the cream did not cause skin irritation. A pH meter was used to determine the cream's pH. The pH meter stick was immersed in a diluted cream sample, which was made by weighing 1 gram of cream and dissolving it in 10 mL of distilled water. Then, after a few moments, examine the numbers printed on the pH meter. The pH that met the SNI 16-4399-1996 quality requirements for sunscreen cream was in the range of 4.5 to 8.0.

2.7.5. Spreadability Test

The spreadability test was carried out to ensure the flattening distribution of the cream when applied to the skin. The cream was weighed as much as 1 gram and then placed in the middle of a round glass. Another round glass was placed on top of the cream. Then the cause is measured at 0 grams, 50 grams, 100 grams, 150 grams, and 200 grams. Then let stand for 1 minute, and record the diameter of the spread. Good spreadability of cream between 5-7 cm.

2.7.6. Centrifugation test

This test was carried out by placing the cream in a centrifugation tube, rotating it at 2500 rpm for 15 minutes with a centrifuge, and then observing any physical changes such as separation.

3. RESULTS AND DISCUSSION

3.1. Phytochemical test results of tamarind leaf extract

Based on Table 2, tamarind leaf extract gave positive alkaloid reactions with Wagner's reagent because it produced a brownish sediment. The principle of this test method is the precipitation reaction that occurs due to ligand replacement. The lone pair of the nitrogen atom in the alkaloid can replace the iodo ion in the reagent. A positive alkaloids result in the Wagner test is evinced by the formation of light brown to yellow sediment, which is thought as potassium-alkaloids. In the preparation of Wagner's reagent, iodine reacts with I^- ions from potassium iodide and produces I^{3-} ions which is brown in color. In the Wagner test, the K^+ metal ion will form a coordinate covalent bond with nitrogen in the alkaloid to form a potassium-alkaloid complex which then undergoes precipitation.

Furthermore, tamarind leaf extract gave positive flavonoid test results because it produced an orange solution. It has been explained in previous research that the red to orange color is caused by flavone compounds. Thus, there is a possibility that flavone is the type of flavonoid compounds in tamarind leaves. In the qualitative test of flavonoids, heating was done during the test because most of the flavonoids could dissolve in hot water. Meanwhile, Mg powder and HCl were added to reduce the benzopyrone core contained in the flavonoid structure so that red or orange flavilium salt was formed.

Tamarind leaf extract gave positive saponin test results as it produced foam that did not disappear for 30 seconds. The foam created in the Forth test shows the presence of glycosides which can form foam in water that hydrolyzes into glucose and other compounds. Moreover, tamarind leaf extract gave positive phenolic test results because it produced a green-blackish solution. The green-black solution is a sign of the formation of a complex compound between phenolic and Fe^{3+} which results in an intense green, red, purple, blue, or black color.

The tamarind leaf extract gave positive tannin test results because it produced a black-green solution. The blackish-green colored solution indicates the formation of a complex compound between tannins and Fe^{3+}. This process is characterized by a strong green, red, purple, blue, or black color change.

Table 2. Phytochemical test results of tamarind leaf extract

Parameters	Reagent	Result	Conclusion
Alkaloids	Wagner's Reagent	Brown sediment formed	(+)
Flavonoids	HCl + Mg powder	Color becomes orange	(+)
Saponins	Distilled water	Foam formed	(+)
Phenolic	$FeCl_3$ 5%	Color turns green	(+)
Tannins	$FeCl_3$ 10%	The color becomes blackish green	(+)

3.2. Antioxidant activity of tamarind leaf extract

In this study, the antioxidant activity of the tamarind leaf extract sample and the pure antioxidant compound BHT was tested using the DPPH method. Antioxidant activity testing was done using a UV spectrophotometer at a wavelength of 517 nm. The 517 nm wavelength was chosen because the chromophore and auxochrome group of DPPH free radicals gave the maximum absorbance at that wavelength and resulted in purple color. In the antioxidant activity test with the DPPH method, there will be a color change from purple to yellow or colorless. These changes indicate the presence of antioxidant compounds in the sample which can decrease the number of free radicals in DPPH. The free radicals reduction in DPPH is because the single electron in DPPH (radical) pairs with hydrogen of the antioxidant compound. This causes DPPH to experience a reduction which is indicated by a change of the purple color to yellow. The reduction reaction of DPPH radicals by antioxidant compounds can be seen in Fig. 1.

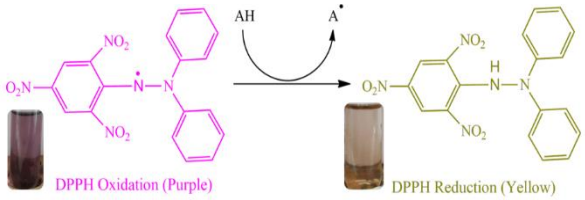

Figure 1. DPPH radical reduction reaction by antioxidant compounds

The reaction can also be described by the reaction equation below:

$$Z\bullet + AH = ZH + A\bullet \qquad (1)$$

Z is the DPPH radical, AH is an antioxidant compound that acts as a reducing agent, ZH is a reduced form of DPPH and A• is the radical produced in the first reaction. These radicals will undergo further reactions and affect the stoichiometry of the whole reaction, making the number of DPPH molecules decrease because one molecule is reduced one by one (Molyneux, 2004).

The antioxidant activity was expressed by the value of % inhibition (% I), IC_{50}, and AAI against DPPH radicals. After obtaining the absorbance value, the percentage of inhibition value, and AAI can be calculated using Eq. 2 and Eq. 3.

$$\%\ I = \frac{\text{A control } (-) - \text{A Sample}}{\text{A control } (-)} \times 100\% \qquad (2)$$

$$AAI = \frac{\text{Final Concentration of DPPH } (\frac{\mu g}{mL})}{\text{IC50 } (\frac{\mu g}{mL})} \qquad (3)$$

This % inhibition value was obtained from the difference in absorption between the DPPH radicals and the sample as measured by a UV spectrophotometer. After obtaining the % inhibition value for each sample concentration, the IC_{50} value thus could be determined.

The antioxidant testing of the tamarind leaf extract was conducted with a concentration of 20 ppm, 40 ppm, and 80 ppm. The test results of the antioxidant activity of tamarind and BHT leaf ethanol extract are displayed in Table 3. Based on Table 3, it can be seen that the greater the concentration of the tamarind leaf extract sample, the greater the value of % inhibition. In testing the antioxidant activity, BHT was also used as a positive control. Butylatedhidroxytoluene or BHT is an antioxidant which has various characteristics: a solid crystal form, white color, a distinctive odor, insoluble in water and propylene glycol, and easily dissolved in ethanol. BHT has the chemical formula $C_{15}H_{24}O$, and the chemical name 2,6-di-tert-butyl-4-methyphenol.

Table 3. Determination of the antioxidant activity of tamarind leaf ethanol extract

Sample	Absorbance *	% Inhibition
20 ppm	0.472±0.017	36,983%
40 ppm	0.345±0.008	53,894%
80 ppm	0.156±0.009	79,172%
BHT 5 ppm	0.515±0.011	17.149%
BHT 10 ppm	0.440±0.022	29,314%
BHT 20 ppm	0.309±0.022	50,322%

* Results are expressed in terms of average (n = 3)

The use of positive control in this test was to determine whether the method used was correct, as well as how strong the antioxidant potential was in the ethanol extract of tamarind leaf in comparison to BHT. If the sample IC_{50} and AAI values are the same or close to the IC_{50} and AAI BHT values, the sample might have the potential to be one of the very strong alternative antioxidants. In this test, BHT was made in 3 variations of concentration, namely 5 ppm, 10 ppm, and 20 ppm with ethanol pa solvent.

Different concentration variations were thus used as BHT is a pure antioxidant compound that has been proven to have high antioxidant activity.

IC_{50} is a concentration known to reduce 50% of free radicals in DPPH. The value of IC_{50} can be calculated using the standard curve method made with the concentration variation data as the X value and the percent inhibition as the Y value, as seen in Fig. 2 for relationship between % inhibition and concentration tamarind leaf extract and Fig.3 for relationship between % inhibition and concentration BHT. Based on the test, it is revealed that the IC_{50} of the tamarind leaf extract is 37.02 ppm and IC_{50} of BHT is 19.75 ppm. The IC_{50} of the tamarind leaf extract and BHT is in the category of very strong antioxidant activity.

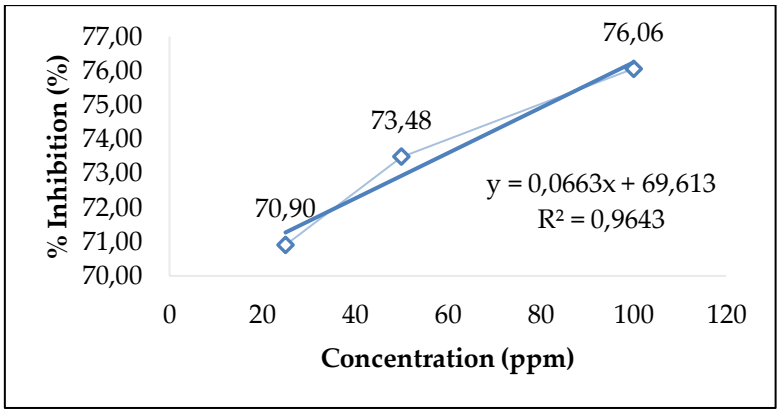

Figure 2. Relationship between % inhibition and concentration tamarind leaf extract

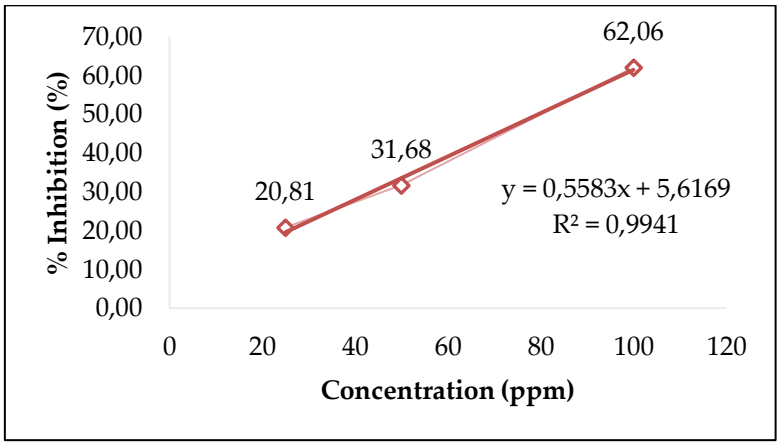

Figure 3. Relationship between % inhibition and concentration BHT

The Antioxidant Activity Index (AAI) shows the antioxidant activity capacity of a sample. The antioxidant activity capacity of an extract or compound based on AAI can be divided into 4, namely AAI <0.5 which means low antioxidant activity, AAI 0.5-1 which means moderate antioxidant activity, and AAI 1-2 which means strong antioxidant activity and AAI> 2 means that the antioxidant activity is very strong. Antioxidant Activity Index is also a method for standardizing the results of antioxidant testing using the DPPH method (Munir *et al*., 2013). Based on the test, it is revealed that the amount of AAI of the tamarind leaf extract is 1.351 (1-2) which is within the category of strong antioxidant activity. Furthermore, the amount of AAI BHT is 2.532 (>2) which is in the category of very strong antioxidant activity.

If the IC_{50} value of tamarind leaf extract is compared with some herbal ingredients presented in Table 4, it can be seen that tamarind leaf have stronger antioxidant activity. This is indicated by a

lower IC_{50} value. Therefore, the tamarind leaf have a large enough potential to be used as an anti-aging agent.

Table 4. Antioxidant activity of tamarind leaf ethanol extract reported for some another herbal extract

Sample*	IC_{50} (ppm)	References
Tamarind leaf extract	37.02	
BHT	19.75	
Matoa leaf extract	45.78	Martiningsih *et al*., 2016
Guava leaf extract	47.80	Nurhasnawati *et al*., 2017
Bay leaf extract	89.63	Hasanah, 2015
Kajajahi leaf extract	455.57	Ipandi *et al*., 2016

*Ethanol solvent, DPPH method

3.3. Anti-aging activity of tamarind leaf extract

In this study, the anti-aging activity was tested on samples of tamarind leaf extract and BHT compounds. Anti-aging activity test was conducted using a UV spectrophotometer. The SPF value, percent erythema transmission (% ET), and percent pigmentation transmission are used to express the anti-aging activity that can be calculated using Eq. 4, Eq.5, and Eq. 6.

$$\text{SPF}=CFx\sum_{290}^{320}(\text{EE}(\lambda)xI(\lambda))xAbs(\lambda) \quad (4)$$

Where CF is correction factor (10), EE is spectrum of erythema effect, I is spectrum of solar intensity, and Abs is absorbance of sample.

$$\%\ \text{ET}=\frac{\sum_{292,5}^{317,5} T\ x\ Ef}{\sum_{292,5}^{317,5} Ef}\text{x}100\% \quad (5)$$

$$\%\ \text{EP}=\frac{\sum_{322,5}^{372,5} T\ X\ P_f}{\sum_{322,5}^{372,5} P_f}\text{x}100\% \quad (6)$$

Where T is the transmission value, E_f is erythema flux and P_f is pigmentation flux. The assessment of the anti-aging activity was done on negative control, BHT and tamarind leaf extract. Measurement of negative control was conducted to determine whether the solvent used to dissolve the extract and give an effect to the measurement. Measurements on positive control were done to determine whether the method was correct and also able to be used as a comparison. Based on Table 5, it can be observed that tamarind leaf extract with a concentration of 80 ppm has the greatest anti-aging activity in comparison to concentrations of 20 and 40 ppm.

Table 5. Determination of anti-aging activity of tamarind leaf extract

Sample	SPF	% ET (%)	% PT (%)
Negative Control	-0.051	101.18	100.57
Extract 20 ppm	0.533	88.41	87.94
Extract 40 ppm	1,041	78.59	79.04
Extract 80 ppm	2,439	56.77	59.41
BHT 5 ppm	0.020	99.50	99.95
BHT 10 ppm	0.027	99.38	99.83
BHT 20 ppm	0.098	97.79	99.05

3.4. Evaluation of Tamarind Leaf Extract Cream

The Cream is made with a concentration of 80 ppm using O/W and W/O base cream emulsion, stored in different locations, outdoors and indoors, for one month and tested every one week.

3.4.1. Qualitative Antioxidant Activity Test

Based on the data obtained from the qualitative test results of the antioxidant tamarind leaf, all negative controls gave negative test results and all creams containing extracts gave positive test results.

3.4.2. Organoleptic Test

In the organoleptic test, based on the results of organoleptic observations, the cream does not experience a significant change in its physical appearance.

3.4.3. Homogeneity Test

In the homogeneity test, based on the results of tests carried out for 4 weeks with testing every one week, all creams are known to have a homogeneous mixture.

3.4.4. pH of Cream

In the pH test, the measurement results and the average pH results show that the pH of the cream is in a safe pH range, namely between 4.5-8.0, so it can be deduced the cream is safe and in accordance with SNI and the data shown in Table 6.

3.4.5. Spreadability test

In the spreadability test, the tamarind leaf extract creams with both O/W base cream placed outdoors and indoors have an average value of dispersion congruent with the dispersion requirements for topical preparations, namely in the range 5-7 cm and the data shown in Table 7.

3.4.6. Centrifugation test

In the centrifugation test, after being centrifuged for 15 minutes at 2500 rpm, none of the samples undergoes separation.

Table 6. pH of creams

Formulations	pH per Week				Average
	1	2	3	4	
F(-)O/W Outdoor	7,28	7,33	7,38	7,38	7,34±0,05
F(-)O/W Indoor	7,47	7,18	7,27	7,45	7,34±0,14
F(-)W/O Outdoor	7,28	7,21	7,27	7,34	7,28±0,05
F(-)W/O Indoor	7,36	7,26	7,26	7,34	7,31±0,05
F O/W Outdoor	7,34	7,36	7,38	7,33	7,35±0,02
F O/W Indoor	7,40	7,27	7,26	7,42	7,34±0,08
F W/O Outdoor	7,40	7,18	7,29	7,38	7,31±0,10
F W/O Indoor	7,40	7,17	7,30	7,37	7,31±0,10

Table 7. Spreadability of creams

Formulations	Weight (gram)				
	0	50	100	150	200
F(-)O/W Outdoor	5,4±0,2	6,5±0,1	7,2±0,3	8,1±0,2	8,8±0,2
F(-)O/W Indoor	5,5±0,3	6,7±0,5	7,5±0,5	8,2±0,6	9,0±0,5
F(-)W/O Outdoor	6,6±0,5	7,8±0,6	9,0±0,7	9,6±0,9	10,3±0,5
F(-)W/O Indoor	6,9±0,4	8,1±0,5	9,3±0,6	10,0±0,7	10,8±0,3
F O/W Outdoor	5,2±0,2	6,3±0,2	6,9±0,1	7,6±0,2	8,0±0,1
F O/W Indoor	5,1±0,3	6,1±0,4	6,9±0,4	7,5±0,4	8,0±0,4
F W/O Outdoor	6,4±0,3	7,6±0,4	8,7±0,5	9,5±0,9	10,1±0,7
F W/O Indoor	6,4±0,2	7,5±0,3	8,6±0,4	9,5±0,5	10,1±0,6

4. CONCLUSION

In this study, the anti-aging tamarind leaf (*Tamarindus Indica L.*) extract cream is successfully formulated. The evaluation of anti-aging tamarind leaf (*Tamarindus Indica L.*) extract cream confirms that creams with extract concentration at 80 ppm emulsion types W/O and O/W placed outdoor and indoors are stable during 4 weeks of stability studies. The creams still have antioxidant activity, do not experience a significant change in their physical appearance at organoleptic studies, homogeny, pH range at 4.5-8, spreadability range at 5-7 cm in weight 0-50 gram, and are not separated during centrifugation test.

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