

Sunscreen Cream Formulation from Corn Cob Extract (*Zea mays* L.) and Robusta Coffee Bean Extract (*Coffea canephora Pierre ex A. Froehner*)

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ABSTRACT—The results of previous studies on each concentration of 4000 ppm SPF value of sunscreen cream corn cob extract (*Zea mays* L.) of 5.40 and SPF value of coffee bean extract cream (*Coffea canephora Pierre ex A. Froehner*) of 8.54. Both of these plant research results have SPF values that are still below 8-15, so that further research is carried out using a mixture of the two extracts on a sun cream basis based on M/A basis.

Methods: Making extracts of corn cob mixture and Robusta coffee using a dose of 10% and 15% and using a type A/M cream base. Cream testing includes physical and stability tests. Determination of the effectiveness of sunscreen cream preparations is done by testing the SPF value, antioxidant content and total phenolics in vitro using a UV/Vis spectrophotometer.

Results: Cream stability test meets cream requirements. Formula 1 has an IC_{50} value of 198.61 ppm, a total phenol of 46 mgAE/g, at an SPF value of 35. Formula 2 has an IC_{50} value of 101.57 ppm, a total phenol of 59.9 mgAE/g, an SPF value of 38. Formula 3 has an IC_{50} value of 150.26 ppm, a total phenol of 51.45 mgAE/g and SPF 37.

Conclusion: Sunscreen cream corn cobs extract and Robusta coffee has good stability, strong antioxidants, the highest phenol in formula 2, and are categorized as ultra sunblock

Keywords— cream, sunscreen, corncobs, coffee beans

1. INTRODUCTION

Skin that is exposed to ultraviolet light from the sun continuously will cause changes in skin pigmentation, erythema, photosensitivity, even the long-term effects of premature aging or even skin cancer². The existence of these problems, special protection is needed to protect the skin from the negative effects of UV rays, namely sunscreen or which can be known as sunscreen. Sunscreens contain substances that can absorb or reflect UV radiation so that the radiation energy that penetrates the skin can be reduced⁴.

Sunscreen (sunscreen or sunblock) or UV filters have two main mechanisms. Namely scattering and reflecting energy from UV rays and absorbing energy from UV rays. At first, the sunscreen was designed to protect the wearer when going to the beach. Nowadays UV filters are used together with everyday products, such as moisturizing creams, other skin treatments before using make-up⁶. The SPF (Sun Protection Factor) value has maximum protection with a value of 8-15, which offers extra protection from sun burning and only causes little or no skin darkening^{5,8}.

To meet the need for sunblock, continually developed and sought after materials that have the potential as a sunscreen. Natural preparations are considered safer to use and have fewer negative impacts compared to chemical use². Natural materials that can be used to make sunscreen preparations are corn cobs and robusta coffee beans. Corn cob extract has a phenolic content that can increase the SPF value and produce the highest SPF value of 17.78 at a concentration of 200 µg/ml with 80% ethanol solvent⁷. Robusta coffee is known to contain many phenolic compounds and alkaloids which in addition to being antioxidants also have the potential as a sunscreen. Robusta coffee bean extract as a sunblock obtained SPF 27 at a concentration of 600 ppm⁸.

Based on the results of research conducted by previous researchers, the SPF value of sunscreen cream of corn cob extract (*Zea mays* L.) at a concentration of 4000 ppm was 5.40 using a sunscreen base⁹. While the SPF value of

sunscreens cream of coffee bean extract (*Coffea canephora* Pierre ex A. Froehner) at a concentration of 4000 ppm is 8.54¹⁰. Both of these plant research results have SPF values that are still below 8-15⁵.

Based on these results, the researchers felt interested in continuing to make cream preparations by using a mixture of corncob and Robusta coffee bean extracts. Researchers chose a sun cream base that is based on the nature of the cream that is not sticky, gives softness and moisture to the skin, on the basis of A / M (water base in oil) has a much stronger penetration than the base M / A (oil in water) because the components oil makes the dosage form last a long time on the surface of the skin and is able to penetrate the skin layer even further¹¹. In addition, in the A / M phase because the fat content is high enough, it can increase the feeling of softness and supple on the skin, but does not cause oily skin, is not too liquid, easily spreads throughout the skin surface, moisturizes the skin longer, and is easy to clean with water^{5,12}.

2. METHODOLOGY

Corn cobs and Robusta coffee beans obtained from the Bogor Medicinal and Aromatic Plant Research Institute (Balitro) and have been determined at LIPI (Indonesian Institute of Sciences) Cibinong. Robusta coffee beans that have been obtained and then extracted using a maceration method to obtain thick extract. For the basic ingredients of the cream used cera alba, cetaceum, adeps lanae, methylparaben, aqua and perfume.

2.1 Extraction

Extract of corn cobs and Robusta coffee beans were obtained by smoothing corn cobs and Robusta coffee beans until they became powder. Then the powder is weighed as much as 300 grams with a scale and put into a maceration vessel. Then added 1200 ml of 96% ethanol, *Simplicia* soaked for six hours while stirring every thirty minutes with a minimum stirring time of five minutes. Then *Simplicia* is allowed to stand for 3x24 hours. Then the extraction solution is filtered using filter paper and collected in a container. The filter results are then evaporated in a water bath with a temperature of 50-60 ° C until it becomes a thick extract^{9,10}.

2.2 Formulation

The production of a mixture of corn cobs and Robusta coffee uses a dose of 10%, and 15% and uses a cream base type A / M.

Table 1. Cream formulations for a mixture of Corn Cobs and Robusta Coffee.

Formulation 1		Formulation 2		Formulation 3	
Corn cob extract	10%	Corn cob extract	10%	Corn cob extract	15%
Robusta coffee bean extract	10%	Robusta coffee bean extract	15%	Robusta coffee bean extract	10%
Cera alba	0.5	Cera alba	0.5	Cera alba	0.5
Cetaceum	2	Cetaceum	2	Cetaceum	2
Adeps Lanae	15	Adeps Lanae	15	Adeps Lanae	15
Nipagin	0,06 %	Nipagin	0,06 %	Nipagin	0,06 %
Aqua ad	25	Aqua ad	25	Aqua ad	25

2.3 Cream Formulation Extract corn cobs and Robusta coffee beans

Making cream is made using A / M cream base. All necessary substances are weighed as needed. The process of making a mixture of corncob cream and Robusta coffee:

- Ingredients in the oil phase such as cera alba, cetaceum, and adeps lanae are fed into the steam dish. (preparation 1)
- Materials in the water phase such as Aqua. (preparation 2)
- Ingredients in the oil phase are fused onto the water bath
- Preparations 1 and 2 are stirred separately at 70 ° C-75 ° C until homogeneous.
- Homogeneous preparations are mixed at 70 ° C because emulsification occurs at these temperatures
- The stirring process is carried out at 40 ° C until the homogeneous preparation.
- Preservatives, Aqua, and extracts of corncob mixture and Robusta coffee were put into the preparation at 35 ° C then stirred until homogeneous and then given 2 drops of perfume.

2.4 Extract identification

- Phenol Identification

- The extract is put into a test tube then into the test tube added 2 drops of purple colored 5% FeCl₃
- b. **Flavonoid Identification**
The extract was added with magnesium powder and 2 mL hydrochloric acid, then shaken with 10 ml of amyl alcohol. A positive reaction is indicated by the formation of orange, yellow, or red in the amyl alcohol layer.
- c. **Alkaloid Identification**
The extract was put into a test tube, then added a few drops of Dragendorff reagent and Mayer reagent to another tube. A positive reaction if the addition of Dragendorff formed brick-red sediment or white sediment on the addition of Mayer reagents.
- d. **Saponin Identification**
The extract was put into a test tube, then added 10 ml of hot water, let cool, then shaken vigorously for 10 seconds. If a stable 1-10 cm high foam is formed for not less than 10 minutes and does not disappear with the addition of 1 drop of 2 N hydrochloric acid indicating the presence of saponins.
- e. **Tanin Identification**
The extract is put into a test tube and reacted with a 1% iron (III) chloride solution if a blackish-blue color indicates the presence of tannin.

2.5 Physical Test Cream

- a. **Organoleptic Test**
One of the quality controls for finished product specifications is the appearance or appearance of subjective products. The organoleptic test is done by looking at the results of cream preparations that have been made using the five senses including color, homogeneity, aroma, and thickness. Organoleptic tests were physically carried out on the 0th day, 7th day, 14th day, 21st day and 28th day.
- b. **Homogeneity Test**
A total of 50 mg of cream was applied to the glass of the object and then the mixture was seen after it was seen under an optical microscope at 10 times magnification. Homogeneity test was carried out on day 0, day 7, day 14 and day 28.
- c. **Viscosity Test**
In viscosity testing, the researchers used a Brookfield viscometer and viscosity measurements were made on the 7th day, 14th day, 21st day and 28th day. Measurement of viscosity using a speed of 30 Rpm and using spindle no 4. Procedure for testing the sample at first the sample is input into a 30 ml glass beaker, then attach the spindle and set the speed (Rpm) of the Brookfield viscometer after that turn on the instrument and read the measurement results. Viscosity measurements are read by looking at the most stable number given by the instrument. Measurement of viscosity is carried out in triplo.
- d. **pH Test**
The pH test is carried out using a methormpH meter and is carried out on the 0th day, 7th day, 14th day and 28th day. Before using the tool, the electrodes must be dipped into a buffer solution with a pH of 7. After that, add Roba coffee cream approximately 5 grams into the glass beaker then dilute with aquadistillate as much as ± 10 ml then dip the electrode into the glass beaker and record the results obtained.
- e. **Scattering Test**
This test is carried out using tools such as a pair of round glass plates (extensometer) and weigh grams. Cream weighed ± 0.5 gram is placed in the middle of a round glass, on the glass given a weight child as a weight and left for 1 minute. The diameter of the cream that spreads (by taking the average length of the diameter from several sides) is measured and then added 50 grams, 100 grams, 150 grams, 200 grams as an additional load, each additional load is allowed to stand after 1 minute and recorded the diameter of the cream that spreads as before. The above method is repeated for each cream formula that is inspected 3 times each. The first test is done on the day the cream preparation is made, then stored for one week and again tested for its spread, and so on every week for one month.
- f. **Particle Size Test**
Test the average particle size using an optical microscope. Cream is placed on the slide and covered with glass cover, then observed using a microscope with magnification 100 times.

2.6 Cream Stability Test

- a. **Low-Temperature Storage Test ($4^{\circ} \pm 2^{\circ} \text{C}$)**
The cream that has been made is put into a tightly closed container then the cream is kept at a low temperature ($4^{\circ} \pm 2^{\circ} \text{C}$) in the refrigerator for 28 days. Creams were observed for stability on the 7th day, 14th day and 28th day.

b. Storage Test At Room Temperature ($25^{\circ} \pm 2^{\circ} \text{C}$)

The cream that has been made is put into a tightly closed container then the cream is stored at room temperature ($25^{\circ} \pm 2^{\circ} \text{C}$) in the room for 28 days. Creams were observed for stability on the 7th, 14th, 21st and 28th days.

c. High-Temperature Storage Test ($40^{\circ} \pm 2^{\circ} \text{C}$)

The cream that has been made is put into a tightly closed container then the cream is stored at room temperature ($40^{\circ} \pm 2^{\circ} \text{C}$) in the oven for 28 days. The cream was observed for stability on the 7th day, 14th day, 21st day and 28th day.

2.7 Antioxidant Activity Test with DPPH

a. Making DPPH reagent solutions

Weighed as much as 19.8 mg DPPH and dissolved with methanol p.a in the flask to 50 ml to obtain a solution with a concentration of 1 mM. From the 1 mM concentration pipette as much as 5 ml then methanol p.a was added in a 50 ml volumetric flask to obtain a solution with a concentration of 0.1 mM. DPPH 0.1 mM solution in methanol p.a is the solution that will be used until the antioxidant activity test is complete.

b. Solution Making

A pipette as much as 2 ml DPPH 0.1 mM solution and add 2 ml of methanol p.a.

c. Determination of Antioxidant Activity

- Extract

The extract mixture was weighed as much as 50 mg and dissolved in 50 ml of methanol and 50 ml into a mixture of 1000 ppm extract solution, from a solution of 1000 ppm pipette 5 ml and dissolved with 50 ml of methanol p.a and into a mixture solution of 100 ppm extract. From the 100 ppm solution diluted to 40 ppm, 60 ppm, and 80 ppm. Absorption is measured by spectrophotometry at a maximum wavelength of DPPH that is 516 nm after incubation at room temperature and dark space during the obtained operating time. Vitamin C is used as a comparison standard.

- Cream samples

Sunscreen cream samples were weighed as much as 100 mg and dissolved in 50 ml of methanol and then into a cream solution of corn cobs and robusta coffee beans 2000 ppm, from 2000 ppm solution diluted to 600 ppm, 800 ppm, 1000 ppm, and 1200 ppm. Absorption is measured by spectrophotometry at a maximum wavelength of DPPH 516 nm after incubation at room temperature and dark space during the obtained operating time. Vitamin C is used as a comparison standard.

d. Determination of Percent Damping and IC_{50} Value

The ability of antioxidants is measured as a decrease in DPPH solution uptake due to the addition of test samples. The DPPH solution infiltration value before and after the addition of the test sample is calculated as a percent reduction. Specifically, a compound is said to be a very strong antioxidant if the IC_{50} value is less than 50 ppm, strong for IC_{50} is 50-100, while if IC_{50} is 101-250, weak if IC_{50} is 251-500 and inactive if it is more than 500. Calculations DPPH free antiradical capacity as a percent absorbing absorbance at the peak of 516 nm using the following calculation:

$$\% \text{ DPPH reduction} = \frac{A \text{ calculate DPPH} - A \text{ calculate the test material}}{A \text{ calculate DPPH}} \times 100\%$$

2.8 Determination of phenol content using the Folin-Ciocalteu method

The total phenol content was determined by the Folin-Ciocalteu method. Weighed 2 mg of the extracted sample then dissolved in 2 mL methanol ($1000 \mu\text{g} / \text{mL}$). A pipette as much as $500 \mu\text{L}$ extract solution and standard solution of $1000 \mu\text{g} / \text{mL}$ gallic acid as much as 50, 100, 150 200 and $250 \mu\text{L}$ into the test tube, then add 3.5 ml of distilled water and $250 \mu\text{L}$ Folin-Ciocalteu and shake. Let stand for eight minutes, then add $750 \mu\text{L}$ 20% Na_2CO_3 and shake homogeneously. The solution is allowed to stand for two hours at room temperature. then the absorption is measured at a wavelength of 765 nm. The phenol content obtained was obtained as an equivalent mg gallic acid/grams sample. The phenol content is expressed as the equivalent mg of gallic acid per kg sample (mg GAE / kg sample), calculated using the formula:

$$\text{TPC} = \frac{C \times V \times \text{FP}}{W}$$

Information :

TPC = Total Phenolic Compounds

C = phenolic concentration (value x) in ppm (mg / L)

V = volume of extract used (mL)

FP = dilution factor

W = sample weight (g)

2.9 Determination of SPF (Sun Protection Factor) Value

Determination of the effectiveness of UV-B by in vitro using UV/ Vis spectrophotometry at 290-320 nm waveforms²³. Absorbance measurements at wavelengths from 290 to 320 nm and measured every 5 nm with thickness A = 1 cm. The solvent used was 96% ethanol and the samples were measured at 400 ppm, 500 ppm, and 600 ppm dilutions. SPF values are calculated using mathematical equations, using constants that are determined based on formulas. SPF

value determination formula: $SPF = CF \times \sum_{290}^{320} EE(\lambda) \times I(\lambda) \times Abs(\lambda)$

Information :

CF = Correction factor (correction factor = 10)

EE = Erythema spectrum effect on wavelength (λ),

I = The intensity of the sun's spectrum at wavelength (λ),

Abs = Absorbance of solution at wavelength (λ)

3. RESULTS AND DISCUSSION

All three formulas give a black dosage forms especially formula 2, because of the greater coffee content. Based on qualitative identification, the two positive extracts contained phenolic compounds, flavonoids, alkaloids, saponins, and tannins. This shows that both extracts contain phenolic contents, namely flavonoids and tannins which act as natural antioxidants because they contain hydroxyl groups that are able to capture free radicals.

Table 2. IC₅₀ value

Sample	IC ₅₀ (ppm)
Corn cob Extract	71,9
Robusta Coffee Bean Extract	47,2
Mixture of Corn and Coffee Bean Extract	30,2
Formula 1 Sunscreen Cream	198,61
Formula 2 Sunscreen Cream	101,57
Formula 3 Sunscreen Cream	150,26
Vitamin C	5,4

Based on table 2. sunscreen cream formulation 2 is the best antioxidant with an IC₅₀ value of 101.57 ppm.

Table 3. Total Phenolic Levels of Sunscreen Cream

Sample	As 1	As 2	As 3	Average	Total Phenolic (mgGAE/g sample)
Base	0,0242	0,0255	0,0246	0,0248	-19
Formula 1	0,1546	0,1547	0,1551	0,1548	46
Formula 2	0,1821	0,1827	0,1830	0,1826	59,9
Formula 3	0,1653	0,1658	0,1660	0,1657	51,45
Extract	0,2358	0,2364	0,2367	0,2363	289,17

Based on table 3. formulation 2 sunscreen has the greatest phenolic content of 59.9 compared to formulations 1 and 3.

Table 4. SPF Sunscreen Cream Test

Formula	SPF value		
	2000 ppm	3000 ppm	4000 ppm
1	24.38	33.765	35.171
2	36.07	36.471	38.138
3	36.91	36.359	37.582

Based on table 4. Sunscreen cream formulation 2 with variation 3 concentrations has the highest SPF value compared to formulations 1 and 3. This is because the SPF value of Robusta coffee bean extract is greater than corn cob extract.^{7,8}

The results of the three formulations of sunscreen cream get the result that sunscreen cream formula 2 has the result of high total phenolic content as well as its antioxidant activity, while the lowest phenolic content is owned by formula 1 sunscreen cream as well as its antioxidant activity.

4. CONCLUSION

- a. The stability test of the three sunscreen cream formulas from corn cob extract and robusta coffee beans has homogeneity results, pH values and viscosity values that meet the requirements.
- b. Of the three formulas, sunscreen cream from corn cob extract and Robusta coffee beans, the best formula is formula 2 with strong antioxidants (IC₅₀ of 101.57 ppm), the highest total phenol is 59.9 mgAE / g sample, and has a value SPF of 38.

5. ACKNOWLEDGEMENT

This research was funded from the RISBINAKES (Research in the Development of Health Workers) program. We would like to thank the Director, Head of Department, Lecturers and Poltekkes Health Ministry of Health II Jakarta, as well to all parties who have contributed to this research.

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