



Determination of SPF Value of Extract and Fraction Gel Corncob (*Zea mays* L.)

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ABSTRACT

The climate in Indonesia, which tends to be hot due to sunburn, can cause various skin problems. Although sunlight can be beneficial in the synthesis of vitamin D for the body, its adverse effects can also cause atrophy, pigment changes, wrinkles, sunburn, and malignancy (cancer), so the use of sunscreen is essential. The development of cosmetics now leads to natural ingredients, one of which is corn cobs. Corn cobs contain phenolic compounds that have been proven to have the ability as antioxidants that play a role in preventing the adverse effects of sunlight. This study aimed to determine the extract and water fraction SPF value and corncob chloroform originating from the Klaten area. This research was conducted in-vitro using UV-Vis spectrophotometry to assess the SPF of the test material. The results showed that the average SPF of the extracted gel, chloroform fraction gel, and corncob water fraction gel were 9.92; 9.56; 9.08, which means that corn cobs have sunscreen with a maximum SPF value category (SPF between 8-15).

I. INTRODUCTION

Indonesia has a tropical climate and is traversed by the equator causing the region to have hot weather due to sunburn. Exposure to sunlight contains ultraviolet (UV)-A, -B, and -C rays. Each component of UV radiation can exert various effects on cells, tissues, and molecules. UV rays are beneficial for

human health by mediating the natural synthesis of vitamin D and endorphins in the skin. However, UV radiation can also have adverse effects. The acute effect of UV-B rays on the skin is the induction of inflammation, and this occurs because UV-B stimulates a cascade of cytokines, vasoactive and neuroactive mediators in the skin [1].

Excessive UV exposure carries enormous health risks, including atrophy, pigment changes, wrinkling, sunburn, and malignancy. UV light is epidemiologically and molecularly linked to the three most common types of skin cancer, namely basal cell carcinoma, squamous cell carcinoma, and malignant melanoma, which together affect more than one million Americans each year [1]. Prevention of the adverse effects of UV radiation on the skin can be done by using sunscreen. Sunscreen contains ingredients that can ward off solar radiation, such as benzophenone, titanium dioxide, and zinc oxide. These materials are chemicals, while the current development, the concept of alternative therapies using herbs is increasing. The use of herbal ingredients for cosmetics continues to be studied, and many benefits have been explored to provide a protective effect against solar radiation, one of which is corn cobs [2].

The world community mostly does the utilization of corn because corn is one type of food crop. According to the Ministry of Agriculture, maize production in Indonesia has increased since 2017 from 28.9 million tons to 30 million tons in 2018 [3]. Meanwhile, in Central Java province, data from the Central Statistics Agency shows the compatibility of production increases with the national level, namely 3.2 million tons to 3.4 million tons from 2015 to 2018 [4]. This increase in production also causes a continuous accumulation of corn cobs after harvest. Most corn cobs only become waste, although some use it traditionally as fuel in the kitchen, animal feed, and fumigation to repel mosquitoes [5]. This raises new problems that need attention.

From a cosmetic perspective, corn cobs contain one active compound, namely phenolic [6]. Phenolic compounds are potentially effective in the treatment of various skin disorders, including signs of aging (wrinkles, hyperpigmentation marks) and skin injuries seen in various animal studies (rats and mice) [7]. The results showed that corn cobs phenolic compounds had high values in total antioxidant capacity, DPPH test, reducing power, and superoxide radical scavenging, which means that they describe solid antioxidant activity [8, 9]. Furthermore, corn cob extract can be used as an active sunscreen compound [10]. The phenolic content correlates with the SPF (Sun Protection Factor) value [11]. A study showed red corn cob ethanol of extract test at a concentration of 150µg/mL categorized as ultra SPF with a value of 16.542 [12]. The benefits of corncob extract as sunscreen are also supported by other studies [8,9,10,13,14,15]. However, there has never been a study using extracts and fractions of water and chloroform in the SPF test of corn cob extract with corn varieties from the Klaten area.

II. METHODS

This study uses an in-vitro laboratory experimental design

1.1 Research Tools and Materials

The tools used are UV-Vis Spectrophotometry, Cuvette, Mortar, and medicine pounder stamp, Porcelain cup, Test tube rack, IWAKI test tube, Stirring rod, Dropper pipette, Thermometer, Analytical balance, glass beaker, Electric stove, Glass funnel, Horn spoon, Micropipette, Blue tip, 10ml measuring flask, Oven, wink, Rotary evaporator,

Glass jar, Vacuum, Buchner funnel, Erlenmeyer flask, Wooden stirrer, Blender, Digital scale.

The materials used were corn cobs, 70% ethanol, ethanol p.a, chloroform, aquadest, HPMC, methylparaben, propylparaben, propylene glycol.

1.2 Material Preparation

Corn cobs obtained from farmers in Klaten were then dried to obtain *Simplicia* according to the *simplicia* quality parameters. Furthermore, *simplicia* is powdered according to a certain degree of fineness according to the size of the mesh.

1.3 Extract and Fraction Preparation

The extraction process was carried out by the maceration method using 70% ethanol as solvent. First, one hundred grams of corncob powder was put into a brown glass bottle, and then 1 L of 70% ethanol solvent was added—a process of soaking for five days and stirring for 15 minutes every day. The macerate was deposited overnight and then concentrated using a rotary evaporator at 45°C to obtain a thick extract.

After obtaining the extract, it was continued with liquid-liquid fractionation where the extract was dissolved in 70% ethanol, then added chloroform and then stirred so that two phases separated. First, the non-polar phase of the chloroform was accommodated and then concentrated on becoming the chloroform fraction extract. Then proceed with the ethanol fraction added with water and then shaken using a separating funnel so that two separate layers are obtained, namely the ethanol fraction and the water fraction, after which the water fraction is

accommodated in a container and then concentrated to obtain the water fraction extract from corn cobs.

1.4 Making Sunscreen Gel

The gel was made based on the formulation based on Tsabitah et al. [16]. The process of making the gel begins with preparing the ingredients according to the formula. Next, all ingredients are weighed according to the formulation. Each formulation uses a different active substance, namely extract, water fraction, and chloroform fraction. First, the distilled water is heated until it boils, then removed. Carbopol was developed with 50 ml of boiling aquadest in a mortar while grinding and expanding, adding propylene glycol, stirring until homogeneous, then adding TEA, stirring until homogeneous. Then in a different container, dissolve the methylparaben and propylparaben with aquadest, then mix them and stir until homogeneous with the addition of the active substance so that a total gel weight of 25 grams is obtained.

Table 1. Sunscreen gel formula

No	Material	Concentration (%)
1	Active substance	1,3
2	Carbopol	1
3	TEA	0,7
4	Propilen glikol	9,3
5	Metil paraben	0,18
6	Propil paraben	0,05
7	Aquadest	Ad 100

1.5 Determination of SPF Value of Sunscreen Gel

The SPF value is done by measuring the absorbance of the solution from each

formula using a UV-Vis spectrophotometer at a wavelength of 290-320 nm. The preparation was weighed as much as 0.02 grams in 5 mL of ethanol p.a then diluted to 200 ppm. The determination of the SPF value was carried out three times for each formula. Then the data obtained is processed by equation [17].

$$SPF = CF \times \sum_{290}^{320} \frac{EE(\lambda)}{I(\lambda)} \times I(\lambda) \times abd(\lambda) \quad (1)$$

Keterangan:

CF = Correction factor (10)

EE = Erytemal Effect Spectrum

I = Intensity Spectrum from the Sun

Tabel 2. EE x I Value

Long wave	EE x I
290	0,0150
295	0,0817
300	0,2874
305	0,3278
310	0,1864
315	0,0839
320	0,0180
Total	1

III. RESULT

Corn cobs extraction was carried out by maceration method using 70% ethanol as a solvent that dissolves compounds that tend to be polar to semipolar and eliminate interfering compounds. The maceration method is simple and easy. Sa'adah et al. (2017) showed that the flavonoid content was higher in the maceration extraction method, namely

1.09%, than the soxhlet extraction method, which was 0.81% and significantly different [18]. The macerate produced from a maceration of corn cobs is evaporated using a rotary evaporator so that compounds that cannot withstand heating are not damaged. Fractionation was carried out to compare the effectiveness of sunscreen activity between the water fraction, which tends to be polar, and the chloroform fraction, which tends to be non-polar, and the ethanol extract. Fractionation is done by the liquid-liquid separation method.

Tabel 3. Hasil Uji Penentuan Nilai SPF

No	Formula (F)	Replication	SPF Value	Average SPF ± SD
1.	Ethanol extract gel	1	9,73	9,92 ± 0,20
		2	10,12	
		3	9,90	
2.	Chloroform fraction gel	1	9,66	9,56 ± 0,10
		2	9,54	
		3	9,47	
3.	Water fraction gel	1	9,16	9,08 ± 0,07
		2	9,03	
		3	9,06	

Sediaan Gel Ekstrak & Fraksi Tongkol Jagung

IV. DISCUSSION

Based on the results of the sunscreen activity test in table 3, the SPF value of the corncob extract gel was higher than the chloroform fraction gel and the corncob water fraction gel. Corn cob extract contains flavonoids and phenolics [19]. The content of flavonoids in corn

cobs has also been shown to have an excellent ability to ward off free radicals as antioxidants and have potential as active ingredients in sunscreens [6,9,20,21]. Flavonoids are reducing compounds that can inhibit various oxidation reactions [22]. Flavonoids have potential as sunscreens because of a chromophore group, a conjugated aromatic system that causes the ability to absorb intense light in the range of UV light wavelengths in both UVA and UVA UVB. This chromophore will generally give color to plants. Previous studies have investigated the flavonoid content of corncob ethanol extract of 0.42% [19], while the flavonoid content of the chloroform and water fractions was 0.01% and 0.1%, respectively (Dewi et al., 2021). Therefore, it can be concluded that the ethanol extract has a higher flavonoid content than the chloroform and water fractions; this is in line with the results of the sunscreen activity that has the highest SPF value in the corncob ethanol extract gel. The higher the flavonoid content, the higher the sunscreen activity by determining the SPF value in vitro.

Corn cobs contain syringic acid, the dominant phenolic compound; besides that, it also contains ferulic acid, gallic acid, vanillic acid, and 4-hydroxybenzoic acid [23]. Based on the total phenolic content test conducted by Suryanto and Momuat (2017), it showed that the water fraction of corn cobs was 23.71 g/mL while the ethanol extract was 81.53 g/mL, which means that the phenolic content associated with potential as a sunscreen solar energy was more significant in the ethanol extract than the water fraction. The phenolic structure has an aromatic

ring structure and one or more hydroxyl groups, and this causes phenolic compounds to tend to be polar to semipolar, which is the following compounds extracted in 70% ethanol [24].

According to the FDA (Food Drug Administration), the division of sunscreen capabilities is Minimum (if SPF is 2-4), Medium (if SPF is 4-6), Extra (if SPF is 6-8), Maximum (if SPF is 8-15) and Ultra (when SF is more than 15) [25]. Based on the division of sunscreen capabilities, it can be concluded that the SPF value of corncob extract gel, corncob chloroform fraction gel, and corncob water fraction gel proved to have sunscreen capabilities with the maximum SPF value category. SPF value is a factor that determines the effectiveness of sunscreen protection in counteracting free radicals. The SPF value can also indicate the ability of a sunscreen to protect the skin from exposure to UV radiation. Sunscreen can absorb, scatter, and reflect UV radiation in areas of the body that are often exposed and cause adverse effects on the skin, both acute and chronic [26]. The ability of a sunscreen to capture free radicals, an OH group, is needed in the structure of an anti-free radical compound. It is in line with the study results that the corncob ethanol extract had the highest SPF value because the total phenolic content was relatively high.

V. CONCLUSION

The SPF value of the corncob ethanol extract gel was higher than the chloroform fraction gel and the corncob water fraction gel, with the average SPF value being

9.92, respectively; 9.56; 9.08. All test materials are included in the maximum SPF category. Corn cobs contain phenolic content in

flavonoids with antioxidant activity to be used as active ingredients in sunscreen gels.

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