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Development Of Banana Stem Extract Cream Formulation (Musa Acuminata X Musa Balbisiana) As An Antioxidant

Sugiarti Windarsih[1)], Kartika Sari[2)]
[1,2)] Bachelor of Pharmacy Study Program, Institut Tarumanagara

*Corresponding Author
Email : sugiartiwindarsih3010@gmail.com

Abstract

According to the Central Statistics Agency for 2021, this year's banana harvest reached 2.39 million tons. Banana tree trunk waste has been thrown away, but it turns out it has the potential to be used as a cosmetic product. If you want to achieve the desired effect from a preparation, you must use the right formulation. The aim of this research is to obtain a cream preparation formula containing jackfruit banana tree stem extract that is safe, effective and stable. The research method used was an experimental method. Making the extract used the maceration method with 70% ethanol solvent. The cream preparation formula is made from jackfruit banana tree trunk extract, namely formulas 1, 2 and 3, the formula process uses the method of melting and mixing the ingredients and active substances. An evaluation was carried out on the cream preparation and its stability was tested, including observing homogeneity, measuring pH, organoleptics, testing the type of emulsion, testing the stickiness of the cream and testing the spreadability. In the physical evaluation, creams F0, F1, F2 and F3 meet the physical stability requirements. Meanwhile, the stability test for F1 and F2 creams was unstable after 1 month of storage. Based on the research results, it can be concluded that jackfruit banana tree stem extract can be formulated into a cream preparation.

Keywords: Waste, Extract, Formulation, Preparation.

INTRODUCTION

Banana is a plant that is very familiar to the community. In Indonesia, bananas grow very abundantly and exist in many varieties. The part of the banana plant most commonly utilized is the fruit, which is consumed as food. According to data from the Central Statistics Agency (Badan Pusat Statistik/BPS) in 2021, Indonesia produced 8.74 million tons of bananas. With the increase in banana production, household consumption of bananas also rose to 2.39 million tons. Meanwhile, banana stem waste has not been utilized optimally. The banana stem waste that has long been discarded actually has potential benefits as medicine, food, animal feed, and cosmetic preparations. Previous studies on banana stem waste have shown that it can be utilized. For example, banana stems can be processed into chips and consumed by some people. Chopped banana stems can also be used as plant compost. In addition, previous studies have shown that banana stems can be used as cosmetic cream preparations.

Jackfruit banana (*Musa acuminata* × *Musa balbisiana*) grows abundantly in Indonesia. Previous research has shown that the stem of jackfruit banana contains flavonoid compounds that have potential as antioxidants. Antioxidants can work by neutralizing the effects of free radical reactions. Research results indicate that jackfruit banana stems possess antioxidant properties, with an IC50 value of 34.12 ppm, indicating very strong antioxidant activity.

Traditionally, jackfruit banana stems cannot be stored for long periods; therefore, they can be developed into pharmaceutical preparations such as lotions, gels, ointments, and creams. Cream is a cosmetic product commonly used on the skin as a protective agent, such as sunscreen cream used to protect against sun exposure, wound-healing creams, and moisturizers. Cream has a semi-solid texture because it is an emulsion containing drugs or active substances. Many people prefer using creams because they are practical; they only need to be applied to the skin, produce a cooling sensation, provide comfort (non-irritating), are non-sticky, and are easy to clean from the skin.

Based on previous research indicating that jackfruit banana stems have very strong antioxidant activity, the researchers intend to conduct a study using jackfruit banana stem extract formulated into

an antioxidant cream preparation. The study will also include stability evaluation tests, phytochemical tests, and cream quality tests to ensure the resulting product is good, safe, and of high quality.

RESEARCH METHODS

Research Conceptual Framework

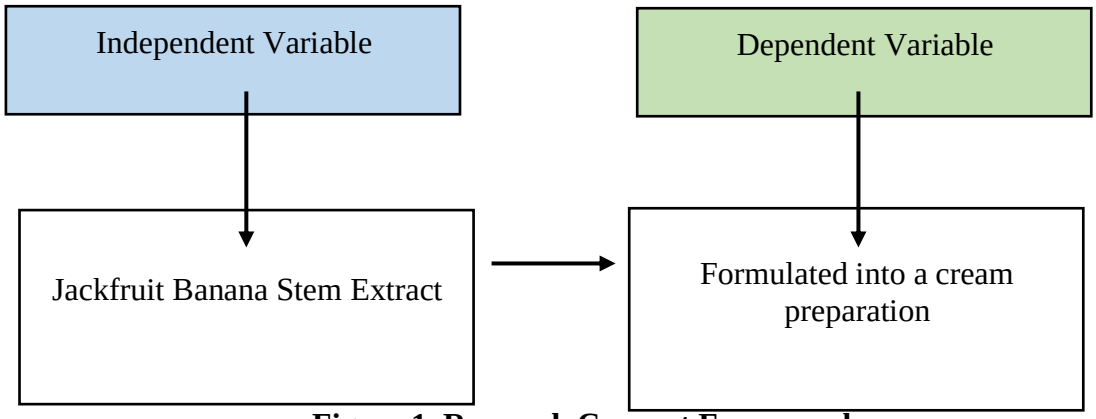

Figure 1. Research Concept Framework

Time and Location of the Research

This research was conducted at the Pharmacognosy and Pharmaceutical Technology Laboratory, Tarumanagara Institute, DKI Jakarta, from June to July 2024.

Research Tools and Materials

Tools

The tools used in this research included: a blender (Miyako), an analytical balance (Kern ABJ 220-4NM), a vacuum rotary evaporator (Heidolph), a water bath (LabTech), a glass jar, a glass stirrer, filter paper, a porcelain cup, a 50ml beaker (Iwaki), a 100ml beaker (Iwaki), a 250ml beaker (Iwaki), a 500ml measuring cylinder (Iwaki), a mortar and pestle (Haldenwanger), a spatula, and a cream pot.

Ingredients

The ingredients used include: Jackfruit banana stem extract, 70% ethanol, stearicum acid, glycerin, Adeps lanae, TEA (triethanolamine), distilled water, pH 4 and 7 buffers.

RESULTS AND DISCUSSION

Plant Determination

Plant determination conducted at the National Research and Innovation Agency (BRIN) in Cibinong, Bogor, West Java, indicated that the plants used were Musa acuminata x Musa balbisiana (Group AAB) cv 'Pisang Nangka'. The determination results can be seen in Appendix 1.

Extract Yield

From a total of 700g of the crude drug used in this study, 101g of thick extract was obtained. This resulted in an extract yield of 14.42%.

Table 1. Extract Yield Results

Examination	Simplicia	Extract	Yield
Jackfruit Banana Stem Extract	700 grams	101 grams	14.42%

Phytochemical Screening

The chemical composition of jackfruit banana stems was tested to determine the presence of saponins, alkaloids, flavonoids, tannins, and triterpenoids. The testing was conducted at PT. Palapa Muda Perkasa, Depok, West Java. The phytochemical screening results were as follows:

Table 2. Phytochemical Screening Result

	Chemical Content				
	Saponins	**Alkaloids**	**Flavonoids**	**Tannins**	**Triterpenoids**
Jackfruit Banana Stem Extract	+ (Formation of a brick-red to orange-yellow precipitate)	Dragendorff reagent (−): no brick-red to reddish-orange solution formed. Mayer reagent (++): formation of a white to yellowish precipitate. Wagner reagent (++): formation of a brown color.	++++ (Formation of a brick-red to orange-yellow precipitate)	++++ (Formation of a green to dark green-black solution)	++++ (Formation of a brick-red to reddish-orange to yellowish-orange solution)

Preparation Evaluation Results

Organoleptic Test Results

Organoleptic evaluation of the cream formulation was conducted to determine the texture, color, and odor of the prepared preparation. The results were as follows:

Table 3 Organoleptic Test Results

Formula	Texture	Color	Odor
F0	Semi-solid	White	Odorless
F1	Semi-solid	Brownish white	Odorless
F2	Semi-solid	Light brown	Characteristic extract odor
F3	Semi-solid	Light brown	Characteristic extract odor

Description:
F0: Cream formulation without jackfruit stem extract (negative control)
F1: Cream formulation with 5% jackfruit stem extract
F2: Cream formulation with 7.5% jackfruit stem extract
F3: Cream formulation with 15% jackfruit stem extract

Homogeneity Test Results

The homogeneity evaluation of the cream formulation was conducted to determine whether the formulation was homogeneous. The results were as follows:

Table 4. Homogeneity Test Results

Formula	Homogeneity
F0	Homogeneous
F1	Homogeneous
F2	Homogeneous
F3	Homogeneous

Description:
F0: Cream formulation without jackfruit stem extract (negative control)
F1: Cream formulation with 5% jackfruit stem extract
F2: Cream formulation with 7.5% jackfruit stem extract
F3: Cream formulation with 15% jackfruit stem extract

pH Test Results

The pH of the cream formulation was evaluated to determine whether it met the pH standard for cream formulations according to the Indonesian National Standard (SNI), which is 4.5–6.5. The results were as follows:

Table 5. pH Test Results

Formula	Hasil Pengukuran pH	Literatur Standar SNI 16-4399-1996
F0	5.33	4,5-6,5
F1	5.39	4,5-6,5
F2	5.39	4,5-6,5
F3	6.14	4,5-6,5

Description:
F0: Cream formulation without jackfruit banana stem extract (negative control)
F1: Cream formulation with 5% jackfruit banana stem extract
F2: Cream formulation with 7.5% jackfruit banana stem extract
F3: Cream formulation with 15% jackfruit banana stem extract

Spreadability Test

Table 6. Spreadability Test Result

Formula	Replication 1	Replication 2	Replication 3	Average
F0	5.4 cm	5.3 cm	5.3 cm	5.3 cm
F1	5.3 cm	5.4 cm	5.6 cm	5.4 cm
F2	5.6 cm	5.7 cm	5.1 cm	5.4 cm
F3	5.8 cm	5.5 cm	5.9 cm	5.7 cm

Description:
F0: Cream formulation without jackfruit stem extract (negative control)
F1: Cream formulation with 5% jackfruit stem extract
F2: Cream formulation with 7.5% jackfruit stem extract
F3: Cream formulation with 15% jackfruit stem extract

Adhesion Test

Table 7. Adhesion Test

Formula	Replication 1	Replication 2	Replication 3	Average
F0	17.37 seconds	16.43 seconds	17.20 seconds	17.00 seconds
F1	17.20 seconds	17.22 seconds	16.56 seconds	16.99 seconds
F2	16.40 seconds	17.39 seconds	17.59 seconds	17.12 seconds
F3	17.39 seconds	16.48 seconds	16.55 seconds	16.80 seconds

Description:
F0: Cream formulation without jackfruit stem extract (negative control)
F1: Cream formulation with 5% jackfruit stem extract
F2: Cream formulation with 7.5% jackfruit stem extract
F3: Cream formulation with 15% jackfruit stem extract

Emulsion Type Testing of Cream Preparations

The purpose of the emulsion type test is to determine the emulsion type of the cream preparation. The test used a dilution method and obtained the following results.

Table 8. Emulsion Type Test Results

Formula	Measurement Result
F0	M/A
F1	M/A
F2	M/A
F3	M/A

Description:
F0: Cream formulation without jackfruit stem extract (negative control)
F1: Cream formulation with 5% jackfruit stem extract
F2: Cream formulation with 7.5% jackfruit stem extract
F3: Cream formulation with 15% jackfruit stem extract

Results of Stability Testing

Organoleptic Testing Results

Organoleptic testing of the cream formulation was conducted by observing the shape, color, and odor of the formulation. Testing was conducted on formulations stored at room temperature for one month and evaluated weekly, with the following results:

Table 9. Organoleptic Stability Test Results

F0	Week 1	Week 2	Week 3	Week 4
Odor	Odorless	Odorless	Odorless	Odorless
Color	White	White	White	White
Form	Semi-solid	Semi-solid	Semi-solid	Semi-solid
F1				
Odor	Odorless	Odorless	Odorless	Odorless
Color	Brownish white	Brownish white	Brownish white	Brownish white
Form	Semi-solid	Semi-solid	Semi-solid	Semi-solid with the presence of small light-brown particles
F2				
Odor	Characteristic odor	Characteristic odor	Characteristic odor	Characteristic odor
Form	Semi-solid	Semi-solid	Semi-solid	Semi-solid with the presence of small light-brown particles
Color	Light brown	Light brown	Light brown	Light brown
F3				
Odor	Characteristic odor	Characteristic odor	Characteristic odor	Characteristic odor
Form	Semi-solid	Semi-solid	Semi-solid	Semi-solid
Color	Light brown	Light brown	Light brown	Light brown

Description:
F0: Cream formulation without jackfruit stem extract (negative control)
F1: Cream formulation with 5% jackfruit stem extract
F2: Cream formulation with 7.5% jackfruit stem extract
F3: Cream formulation with 15% jackfruit stem extract

Homogeneity Test Results

A homogeneity test was conducted to determine the mixing of the ingredients used in the formulation. The test was conducted on formulations stored at room temperature for 1 month and evaluated weekly, yielding the following results:

Table 10. Homogeneity Stability Test Results

	Week 1	Week 2	Week 3	Week 4
F0	Homogeneous	Homogeneous	Homogeneous	Homogeneous
F1	Homogeneous	Homogeneous	Homogeneous	Not homogeneous
F2	Homogeneous	Homogeneous	Homogeneous	Not homogeneous
F3	Homogeneous	Homogeneous	Homogeneous	Homogeneous

Description:
F0: Cream formulation without jackfruit stem extract (negative control)
F1: Cream formulation with 5% jackfruit stem extract
F2: Cream formulation with 7.5% jackfruit stem extract
F3: Cream formulation with 15% jackfruit stem extract

pH Test Results

A pH test was conducted to determine whether the pH of the cream formulation was stable during storage. Testing was performed on formulations stored at room temperature for one month and evaluated weekly, with the following results:

Table 11. pH Stability Test Results

	Week 1	Week 2	Week 3	Week 4
F0	5.23	5.30	5.33	5.40
F1	5.33	5.38	5.41	5.32
F2	5.40	5.47	5.50	5.53
F3	5.71	5.58	5.67	6.37

Description:
F0: Cream formulation without jackfruit stem extract (negative control)
F1: Cream formulation with 5% jackfruit stem extract
F2: Cream formulation with 7.5% jackfruit stem extract
F3: Cream formulation with 15% jackfruit stem extract

Spreadability Test Results

The spreadability test aims to determine the ability of the cream base to spread, thus assessing the ease of application to the skin. Testing was conducted on formulations stored at room temperature for 1 month and evaluated weekly. The following are the results of the spreadability test:

Table 12. Spreadability Stability Test Results

	Week 1	Week 2	Week 3	Week 4
F0	5.0 cm	5.1 cm	5.3 cm	5.6 cm
F1	5.3 cm	5.2 cm	5.3 cm	5.4 cm
F2	5.1 cm	5.4 cm	5.5 cm	5.7 cm
F3	5.5 cm	5.0 cm	5.2 cm	5.5 cm

Description:
F0: Cream formulation without jackfruit stem extract (negative control)
F1: Cream formulation with 5% jackfruit stem extract
F2: Cream formulation with 7.5% jackfruit stem extract
F3: Cream formulation with 15% jackfruit stem extract

Adhesion Test Results

The adhesion test aims to determine the time required for the cream to adhere to the skin. Good adhesion for topical preparations is required to be more than 4 seconds. Testing was conducted on preparations stored at room temperature for 1 month and evaluated weekly.

Table 13. Adhesion Stability Test Results

	Week 1	Week 2	Week 3	Week 4
F0	16.30 seconds	16.24 seconds	17.47 seconds	17.22 seconds
F1	17.22 seconds	16.34 seconds	16.30 seconds	17.20 seconds
F2	16.55 seconds	17.33 seconds	17.20 seconds	17.31 seconds
F3	17.20 seconds	16.57 seconds	16.69 seconds	17.43 seconds

Description:
F0: Cream formulation without jackfruit stem extract (negative control)
F1: Cream formulation with 5% jackfruit stem extract
F2: Cream formulation with 7.5% jackfruit stem extract
F3: Cream formulation with 15% jackfruit stem extract

Discussion

The research stages began with the collection of jackfruit banana stems, which were then identified through determination at the National Research and Innovation Agency (BRIN), Cibinong, Bogor, to ensure that the plant species was indeed *(Musa acuminata × Musa balbisiana)* from the Musaceae family. The next step was wet sorting to separate unnecessary materials such as dried stems. The fresh banana stems were then dried by air-drying for approximately ±4 weeks without direct sunlight exposure, as sunlight could reduce the chemical compound content. After drying, dry sorting was conducted to remove unwanted materials such as dust or mold until jackfruit banana stem simplicia was obtained, which was then powdered. Chemical content testing of the powder and extract of jackfruit banana stems was conducted to determine the presence of chemical compounds such as alkaloids, flavonoids, saponins, triterpenoids, and tannins.

The extraction stage used the maceration method. This method was selected to avoid damage to the compounds contained in the sample. A 70% ethanol solvent was used because the desired compounds in jackfruit banana stems are polar, allowing them to be extracted effectively by the polar solvent ethanol 70%. Maceration was carried out for 3 × 24 hours; the longer the material is macerated, the more optimal the contact between the material and the solvent. The obtained extract was then filtered to separate the filtrate (macerate) from the residue. The residue underwent remaceration three times to ensure that the compounds in the jackfruit banana stem powder were completely extracted.

The macerate was then concentrated using a rotary evaporator at a temperature of 60°C. Although faster concentration could be achieved at higher temperatures, it could also damage certain compounds contained in the extract. Therefore, the concentration process was continued using a water bath at 60°C until a thick extract was obtained. The thick extract obtained was 101 g from 700 g of dry powder. The yield value was then calculated and found to be 14.42%. A yield is considered good if it exceeds 10%.

Chemical content testing of the powder and extract of jackfruit banana stems was conducted to identify the presence of compounds such as alkaloids, flavonoids, saponins, and triterpenoids. The phytochemical screening test was carried out at PT. Palapa Muda Perkasa because the reagents in the Pharmaceutical Laboratory of Tarumanagara Institute were limited. In this study, it is recommended to evaluate the extract first to determine the moisture content and ash content of the jackfruit banana stem extract.

The cream formulation used stearic acid as an emulsifier, glycerin as a humectant, Adeps lanae as the base, and TEA (triethanolamine) as an emulsifier. The cream base was prepared first, and then for formulas F1, F2, and F3, jackfruit banana stem extract was added. In the cream preparation process, a trial-and-error approach was initially carried out to determine the most suitable method. The oil phase was heated in a water bath at 70°C, then the water phase was added and stirred until homogeneous. The cream preparation was carried out in a heated mortar to prevent the formation of lumps from the oil phase.

Evaluation of the preparation was conducted to determine the quality of the cream formulation. Organoleptic testing showed that preparations F0, F1, F2, and F3 had a semi-solid form. F0 was white and odorless because it did not contain jackfruit banana stem extract. Preparation F1 was odorless and brownish white, while F2 and F3 had a characteristic odor and brown color due to the presence of jackfruit banana stem extract. Evaluation of the cream preparations showed homogeneous results for F0, F1, F2, and F3. The pH test results indicated stable values, as the measured pH ranged within the desired skin pH of 4.5–6.5.

The stability test for homogeneity showed that cream preparations F0 and F3 remained homogeneous during one month of storage, as no lumps or small particles were observed. However, F1 and F2 became non-homogeneous in the fourth week due to the presence of small light-brown lumps. The main factor causing this issue was insufficient mixing during the addition of the extract to the cream base, resulting in uneven distribution between the base and the jackfruit banana stem extract.

The spreadability test was conducted to determine how well the cream spreads on the skin. The greater the spreadability, the greater the amount of active substance delivered into the skin layers

(Voigt, 1995). The results of the spreadability test of jackfruit banana stem extract cream showed relatively stable values during one month of storage. F0 had a spreadability of 5.6 cm, F1 had 5.4 cm, F2 had 5.7 cm, and F3 had 5.5 cm. A good spreadability value ranges from 5–7 cm (Garg et al., 2002).

The adhesion test indicates how long a semi-solid preparation can remain attached to the skin; the longer it adheres, the better the absorption of the active substance into the skin (Ansel, 2008). A good adhesion value for semi-solid preparations is more than 4 seconds. The adhesion test results for jackfruit banana stem extract cream showed good stability during one month of storage. F0 had an adhesion value of 17.22 seconds, F1 had 17.20 seconds, F2 had 17.31 seconds, and F3 had 17.43 seconds. Therefore, cream preparations F0, F1, F2, and F3 were considered to have good adhesion properties during one month of storage.

CONCLUSION

1. Jackfruit banana stems can be processed into a thick extract using the maceration method, and phytochemical compounds were identified in the jackfruit banana stems, namely saponins, alkaloids, flavonoids, tannins, and triterpenoids. The cream preparations F0 and F3 produced physically stable creams and met the requirements of a good preparation.
2. Jackfruit banana stem extract can be formulated as an antioxidant cream because it contains flavonoid compounds.
3. Cream preparations F1 and F2 did not show good stability during one month of storage, whereas cream preparations F0 and F3 remained stable during one month of storage.

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