Phytochemical screening and spectrum profile of functional group from Banana (*Musa paradisiaca* L.) stem waste extract using Fourier-transform Infrared (FTIR) Spectroscopy method

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Abstract. Banana (*Musa paradisiaca* L.) is plant that contain secondary metabolites compounds such as tannins and flavanoids. Tannins and flavanoids have various properties for human health. Research had been conducted to identify secondary metabolite compounds (tannins, flavanoids, and saponins) with phytochemical screening methods and to look at the spectrum profile of the functional group found in the waste extract of banana stem. The waste of banana stem extracted with 96% ethanol. From the obtained extract, evaporation and phytochemical screening were carried; consecutively. From the screening results, tannin compounds were characterized by a greenish-black result, and flavanoids created a deep red color. Saponins were expressed negatively because the formed foam had a height of 0.3 cm and did not meet the requirements of saponins expression (foam height 1-3 cm and stable for 5 minutes). After that, the identification of the functional group found in the banana stem waste extract was carried out using Fourier-transform Infrared (FTIR) spectroscopy. Banana stem waste obtained the form of compound function clusters supported by o-H bound absorption data in the area of 3284.91 cm\(^{-1}\), c=O in the area of 1643.06 cm\(^{-1}\), bend CH\(_2\) in the area 1409.25 cm\(^{-1}\), and C - C in the area 1078.56 cm\(^{-1}\).

1. Introduction
Bananas are one of the most plantation commodities in Indonesia. One of the provinces producing enough bananas is in Lampung Province. Bananas are plants that have many functions ranging from roots, stems, brench, leaves, and especially bananas themselves. Banana stems that have come to fruition are usually not used and only become waste. Therefore, research is needed on the waste content of banana stems. Whether it still has the content of compounds that can be beneficial to humans or not. The compounds contained in banana stems include Flavanoids, Tannins, and Saponins. Flavanoids are compounds found in plants as a mixture and are very rare to encounter flavanoids in a single form. Usually in the form of sugar i.e. as glycosides and aglicon flavonoids. Generally bound as glycosides, therefore the examination of hydrolyzed plant extracts is directed at the flavanoid aglicon. Flavanoids contain conjugated aromatic systems.

Tannins are water-soluble phenolic compounds weighing 500-3000 moles, provide a common reaction to phenol compounds, and have special properties such as precipitation of alkaloids, gelatin, and other proteins. Tannins form not only complexes with alkaloids and proteins, but also with
polysaccharides. Tannins include complex compounds, usually polyphenol mixtures, and do not crystallize. Tannins are simply polyphenol polymerations.

Saponins are compounds in the form of glycosides that are widespread in high-level plants as well as some marine animals and are a diverse group of compounds in their structure, physical properties and biological effects. Saponins are steroid glycosides or triterpene compounds found in various plants. Saponins have characteristics in the form of froth. So that when reacted with water and skocked it will form a froth that can last a long time. Saponins are easily soluble in water and insoluble in ether.

2. Research Methodology

2.1 Tools
Erlenmeyer, stirbar, glove, spatula, test tube, rotary evaporator, drip pipette, petri dish, autoclave, laminar water flow, spiritus lamp, capillary pipette, FTIR, oven, pH meter, plate reader.

2.2 Materials
Banana stem waste, 96% ethanol, NaOH 10%, distilled water, n-hexane, ethyl acetate, methanol, FeCl₃ reactor, 70% alcohol, lactose, fruit flavoring, aspartame, citric acid, tartratic acid, sodium bicarbonate, enzyme α-glucosidase, DMSO, sodium carbonate, KLT plate, paper, strain, tissue, aluminum foil.

![Figure 1. Banana Stem Waste.](image)

3. Research Procedures

3.1 Banana Stem Waste Extraction
Extracts from banana stems are made by maseration method. Banana stems are taken 10 cm, washed, cut into small pieces, dried in room temperature / in the wind, then made into powder form. Simplisia that is dry in the form of the powder, maserated using ethanol solvent 96% to 1 cm above the powdered banana stem for 24 hours. The extract obtained is then filtered and the oil is maserated again with 96% ethanol. This work is repeated until all metabolites are thought to have been extracted. All 96% ethanol extracts are combined and evaporated using rotary vacuum evaporators until they are obtained by dry ethanol extract and then weighed and calculated.

3.2 Phytochemical Screening
Phytochemical screening is a test conducted to identify the content of metabolite compounds in the banana stem of flavonoids, tannins and saponins. Identification of flavonoids using NaOH 10% added to ethanol extract obtained using the maseration method, added NaOH 10% as much as 2 drops (Farnsworth,N.H, 1996). The absence of flavonoids is characterized by a yellow-orange-red discoloration. Saponin identification (foam test) is carried out with the simplisia of banana stems added distilled water so that the whole part is submerged and simmered for 2 minutes. Once it is
cooled and shake firmly. The absence of saponins is characterized by the onset of stable froth/foam. Tannin identification is done by first diluting the banana stem extract (Musa paradisiacal L) with solvents (n-hexane, ethyl acetate and methanol) then pipetted into porcelain drops and added FeCl$_3$. Positive results are characterized by the formation of white deposits.

3.3. Spectrum Profile of Functional Group Test
Samples of purified peptide compounds are then in the press on KBr pellets with a comparison of samples and KBr 1: 100. The background used is pure KBr pellets. The spectrum is recorded in transmit mode at waves 4000–400 cm$^{-1}$.

4. Data Analysis

4.1 Phytochemical Screening
From the tests conducted, the following phytochemical screening test results are representing in table 1.

Table 1. Phytochemical screening results of Banana Stem Waste Extract

| Phytochemical Screening | Result                                      | Conclusion |
|------------------------|---------------------------------------------|------------|
| Saponins               | Foam is formed as high as 0.3 cm for 10 minutes. | -          |
| Tannins                | Greenish Dark Colour                         | +          |
| Flavonoids             | Dark-Red Colour                              | +          |

4.2 Spectrum Profile of Functional Group Test
From the tests conducted, the following spectrum profile of functional group test results are representing in the pictures below.
5. Discussion
The main reason for this research is the large number of banana stems that are not used especially when the banana harvest period arrives and only becomes waste. To that reason, researchers tried to make use of the banana stem waste by looking at the content of secondary metabolite compounds that still exist in the banana stem waste.

This research is intended to look at the absence of secondary metabolite compounds found in banana stem waste, the compounds that want to be identified in the banana stem waste include saponins, tannins, and flavanoids. These three compounds have many functions and benefits for human life. among these functions are as antiinflammatory, antibiotics, and antidiabetics.

First of all the sample of banana stems that have been taken, is displayed first. In the process of perajangan serves to facilitate the process of drying simplisia. Drying aims to reduce the moisture content in the banana stem so that it is easy to obtain the process of withdrawing chemical compounds contained in the sample. The dried samples are then crushed until smooth aiming to make the extraction process more effective and efficient. The smaller the sample size, the larger the surface area, so the interaction between solvents and dissolved substances will be greater.

The method used to extract banana stems is carried out by means of maceration, maseration is classified as a cold excruciation process used to fine extraction results and prevent chemical content damage to samples due to heating. The principle of maceration is that chemical compounds that have the same properties as solvents will be attracted and dissolved into their solvents so that certain chemical compounds can be separated. The solvent used in this method is 96% alcohol. The reason for the use of this solvent is selective because it only attracts the desired efficacious substances, the absorption is good, the times and khaimir are difficult to grow, volatile and get viscous extract faster than 70% ethanol solvent. It is then tightened with a rotary evaporator until it is obtained a viscous extract.
From the results of the study, phytochemical screening was carried out to see 3 compounds that are in the banana stem waste. Flavanoid and tannin compounds were identified with phytochemical tests and showed positive results. While saponin compounds are expressed negatively. Flavanoid compounds show a deep red color and it can be inferred that banana stem waste has the content of flavanoid compounds. Tannin compounds give the result of a greenish black color and it can be concluded that banana stem waste has the content of tannin compounds. As for saponin compounds, it is expressed negatively. Although the foam appears as high as 0.3 cm for 10 minutes, but the height of the foam does not reach 1 cm. So the researchers concluded banana stem waste has no saponin compound content.

In the world of health tannins have several properties, including: Astringensia. (tannins can shrink and harden the intestinal wall, thus reducing the in and out of the fluid in the intestine. Tannins can also be used to shrink skin pores). Antibacterial (the antibacterial effects of tannins are among others through reactions with cell membranes. Flavonoids in tannins deature and coagulate proteins and damage cell wall membranes). Antioxidant (catechins in tannins has antioxidative properties that play a role in fighting free radicals that are harmful to the body). Antidotum (tannins will secrete insoluble greedy acid and react with alkaloides forming settled tannats).

While flavonoids are active compounds of secondary metabolites that have functions to protect cell structure, increase the effectiveness of vitamins, anti-inflammatory, and as antibiotics. In addition, flavonoids are antioxidant compounds that have a hypoglycemic effect in diabetics mellitus. For cluster profile reading functions, it is performed by the Fourier-transform Infrared (FTIR) spectroscopy method by looking at the absorption data of each cluster's thread. From the results obtained the form of compound function clusters supported by O-H bound absorption data in the area of 3284.91 cm⁻¹, C=O in the area of 1643.06 cm⁻¹, bend CH₂ in the area 1409.25 cm⁻¹, and C - C in the area 1078.56 cm⁻¹.

6. Conclusions
Banana stem waste contains flavanoid compounds. Banana stem waste contains tannin compounds. Banana stem waste does not contain saponin compounds. Banana stem waste obtained the form of compound function clusters supported by O-H bound absorption data in the area of 3284.91 cm⁻¹, C=O in the area of 1643.06 cm⁻¹, bend CH₂ in the area 1409.25 cm⁻¹, and C - C in the area 1078.56 cm⁻¹.

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