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Manufacturing Analysis of Anti-shedding Shampoo from Ambon Banana Peel Extract and Tea Leaf Extract

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Abstract*. This research aims to make environmentally friendly shampoo products from natural waste. The waste used is ambon banana peel with variations of green tea leaves. The choice of ambon banana peel as the essential ingredient for making shampoo is motivated by the problem of banana peel waste, which has many properties but needs to be correctly utilized by the community. The method used in this research is maceration extraction. The Extract was then subjected to a phytochemical screening test, after which it was mixed in a shampoo preparation and tested for its characteristics. Based on the experiment results, the shampoo made from ambon banana peel waste and tea leaves showed positive characteristic test results and was safe to use to overcome hair loss problems. The viscosity measurement results show that the second and third formulations are optimal because they are within the viscosity range of 446 cp and 767 cp.*

Keywords: *Banana peel; Maceration; Shampoo; Organic waste.*

1. INTRODUCTION

Indonesia's tropical climate is suitable for banana cultivation. The community widely uses various types of bananas for various processed foods; however, the scale of production of processed bananas not only from the community but also on an industrial scale raises the problem of banana peel waste that has not been appropriately utilized (Yolanda, 2019). Based on data from the Central Statistics Agency (BPS), Indonesia produced 8.74 million tons of bananas in 2021. As a result of the abundant banana production, the amount of banana peels is equally abundant. Unfortunately, people are still not fully able to optimize the utilization of banana peel waste, which is often only used as animal feed or thrown into the trash. (Ibnu et al., 2022) . Tambusai et al. (2021) explain the presence of antioxidant compounds that can help overcome hair loss.

Antioxidant compounds play an active role in preventing hair damage due to exposure to free radicals from sun exposure (Himawan et al., 2018). Banana peels contain antioxidant compounds such as oleic acid and pinocembrin, which are in the flavonoid compound class. This oleic acid serves to slow hair loss and accelerate the growth process in the hair. Pinocembrin has a significant role in maintaining hair health. It contributes to repairing damaged hair cells, supports hair growth by promoting consistent skin tissue growth, and improves blood circulation, which is essential for healthy hair. Banana peels also contain tannins, alkaloids, triterpenoids, and vitamin A, which are very high in hair health (Aryani et al., 2018). Therefore, this study will focus on the problem of hair growth and hair loss. It should also be noted that the banana peel compounds contained in each type of banana peel are

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different. So, it is necessary to choose a suitable banana type with a high compound content to overcome the problem of hair growth and loss.

The choice of banana type for making shampoo extract needs to be considered. The banana chosen is the ambon banana, which has been reviewed based on the percentage of compounds in the banana peel. Based on phytochemical tests, ambon skin extract contains flavonoid compounds that act as antioxidants (Himawan et al., 2018). The test results of the SPF value of ambon banana peel using ethanol solvent extract are in the high category, namely 11.579 when compared to water and ethyl acetate solvent extracts, which amounted to 3.57 and 2.018 (Noviardi et al., 2020). Using Ambon banana peel as a shampoo has a scent that could be fresher. In order to increase interest in use, it is necessary to add ingredients that have a distinctive aroma.

Tea leaf extract was chosen because, in addition to having a distinctive aroma, tea leaves also contain compounds beneficial to hair, such as antioxidant content. The active compounds contained in tea leaves are polyphenols, flavonoids, tannins, vitamin E, and minerals (Rahmawati, 2014). Green tea leaves are selected because they have higher antioxidants than other leaves. Tests on green tea leaves have an IC50 value of 58.61 μg/ml, while white tea leaves and black tea are 74.75 μg/ml and 137.60 μg/ml, respectively (Leslie & Gunawan, 2019). The lower the IC50 value of a substance, the higher the antioxidant compounds contained. Based on research, the content of antioxidant compounds is declared strong if the IC50 value is 50-100 ppm (Nasution, 2017)

This article aims to develop an innovative shampoo product made from banana peel with a tea aroma to overcome hair loss. The wider community can use this shampoo product innovation to reuse banana peel waste, which is still minimally utilized by the community. In addition, the benefits of this research are that it can increase the selling value of plantations, especially in ambon banana plants, be able to increase community economic activities through regional MSMEs, and be able to create superior and halal products (Pradigdo et al., 2022).

2. LITERATURE REVIEW

The utilization of organic waste as a base material for the manufacture of cosmetic products, such as shampoo, is an increasingly developed research topic. This aligns with efforts to reduce dependence on conventional chemicals and utilize underutilized community waste. Products based on natural ingredients have the advantages of more environmentally friendly ingredients, lower potential for irritation, and additional benefits from natural active ingredients.

Previous research has shown the potential of various organic materials to be used as shampoo formulations. Research from (Mahataranti et al., 2012) successfully developed an anti-dandruff shampoo formulation based on celery extract (Apium graveolens). Celery extract contains active compounds such as flavonoids, saponins, and tannins with antimicrobial activity, effectively overcoming dandruff. Other research conducted by (Lailiyah et al., 2022) created a shampoo innovation based on kersen leaf extract (Muntingia calabura L.) designed to overcome dandruff and repair hair damage. Kersen leaves contain tannins, flavonoids, and polyphenols that support scalp regeneration while maintaining healthy hair.

Additionally, research by Pradigdo et al. (Pradigdo et al., 2022) utilized kepok banana peel (Musa acuminata x balbisiana) as an essential ingredient for shampoo formulation. Banana peels are rich in bioactive compounds such as antioxidants, vitamins, and minerals that support hair care. The banana peel-based shampoo formulation was declared suitable for use based on parameter tests such as pH, homogeneity, and organoleptic.

From various previous studies, organic waste has great potential to be used as the main ingredient for shampoo production. Based on the results of these studies, further development can be done by combining banana peel extract with other natural ingredients to increase its benefits. One of the innovations proposed in this study is a shampoo preparation that combines banana peel extract with tea leaf extract. Tea leaves contain catechins, tannins, and polyphenols, which are antioxidants and antimicrobial, thus providing additional benefits to scalp and hair health. With this approach, it is expected that the shampoo formulation produced will be effective in maintaining hair hygiene and health and support environmental sustainability by utilizing abundant organic waste in the community.

3. METHODS

Tools

This study used various glassware such as a beaker, measuring cup, watch glass, maceration container, test tube, dropper pipette, Brookfield Viscometer, evaporator, petri dish, analytical balance, blender, sieve, Buchner funnel, filter cloth, hot plate, drip plate, and pH meter.

Material

This study uses various materials, including distilled water, 96% ethanol, 70% ethanol, 1% iron (III) chloride solution, 3% iron (III) chloride solution, 5% iron (III) chloride, ambon banana peel, green tea leaves, hydroxypropyl methylcellulose (HPMC), methylparaben,

sodium lauryl sulfate, tea leaf perfume oil, 70% alcohol, HNO3 (Merck), NaCl, and propylene glycol.

Sample Extraction

The banana peels and leaves are washed and cut into small pieces. Then, dried in a warm environment or an oven at 50^{o}C. Blend to produce banana peel powder. Weigh the pulverized powder as much as 100 grams each. Then, put it into the maceration container. 1000 mL of 96% ethanol solvent was added. The mixture of ambon banana peel was soaked using a maceration container for 3 x 24 hours, while the leaves were soaked for 2 x 24 hours with continuous stirring every 1 hour. After that, the filtrate was filtered using a filter cloth and concentrated using the evaporation method at 50°C until it thickened.

Phytochemical Screening

Phytochemical tests on ambon banana peels focus on testing the content of flavonoids, saponins, triterpenoids, and tannins. As for tea leaves, flavonoids, tannins, polyphenols, and vitamin E were tested.

Formulation

The formulation of hair loss prevention shampoo in this study was based on the research method from Tee and Badia (2019). First, 2 grams of sodium lauryl sulfate, 0.075 grams of C8H8O3 (methylparaben), and 0.5 grams of hydroxy propyl methyl cellulose (HPMC) were weighed. After that, sodium lauryl sulfate was dissolved in hot water. HPMC was crushed and then included in the mixture of sodium lauryl sulfate and 20 ml of 60 hot water, stirring until mucilage (Mixture 1). Methylparaben was dissolved using a small amount of ethanol until dissolved (Mixture 2). Mixtures 1 and 2 were homogenized to form mixture 3. Banana peel and tea leaf extracts were added to the mixture 3. Tea leaf extract was dissolved first in enough propylene glycol to make it homogeneous with the mixture. NaCl and perfume were added and then homogenized (mixture 4). Each formulation has a volume of 50 ml, with distilled water adjusted to the amount of ingredients added The levels of ingredients used in making shampoo formulations can be seen in Table 1.1.

Table 1.1 Shampoo Formulation

Material	Formulation (%)			
	F1	**F2**	**F3**	**F4**
Banana Peel Extract	3	5	7	9
Green Tea Leaf Extract	1	1	1	1
Sodium Lauryl Sulfate	4	4	4	4
HPMC	1	1	1	1
Methyl Paraben	0,15	0,15	0,15	0,15
Perfume	1	1	1	1
Propylene glycol	0,15	0,15	0,15	0,15
NaCl	1,5	1,5	1,5	1,5

Shampoo Characteristic Test

The characteristic test on this shampoo preparation follows the work procedure from Warahmah (2021) which focuses on organoleptic tests, homogeneity, pH content, viscosity, and foam height.

4. RESULT AND DISCUSSION

This Ambon banana peel anti-loss shampoo is made to protect the environment with the principle of green chemistry. The use of banana peel waste and the organic aroma of green tea leaf extract are environmentally friendly solutions to reduce the use of chemical shampoos. The content of compounds in ambon banana peel shampoo can help overcome the problem of loss by maintaining the health of the head of hair.

3.1. Sample Preparation

The ambon banana peels and tea leaves used here have undergone washing and sorting to obtain high-quality extracts. Then, the samples are subjected to a drying process, which aims to stop enzymatic reactions that could lead to decomposition or changes in the chemical composition of the banana peels and tea leaves. The next step involves powdering and sieving, which aims to facilitate the extraction of active antioxidant compounds during the maceration process.

3.2. Extraction

The extraction method on ambon banana peel and tea leaves was carried out using a maceration process using 96% ethanol solvent. Ethanol is a common solvent often used to dissolve certain substances, such as polar, semi-polar, and nonpolar. 96% ethanol is used because the material used is in the form of dry powder. Solvents are needed so that the active substances contained in the ambon banana peel and the leaves easily enter the cells and attract existing compounds. Long soaking during maceration allows compounds to be bound all in the solvent. The longer the soaking, the better the resulting filtrate.

The filtrate from maceration was evaporated using a rotary evaporator at 50°C. The temperature setting of the rotary evaporator is kept at 50°C because high temperatures can cause damage to secondary metabolites in the sample. This is also supported by previous research by Asshidiqy et al. (2020), which shows that the safe temperature for most secondary metabolites is around 50 ° C because higher temperatures can potentially damage secondary metabolites. This evaporation serves to separate the solvent from the compounds. The result is a thick green solution for tea leaves and brown for banana peel. Store the Extract in the refrigerator to maintain its quality for a long time.

3.3. Phytochemical Screening

The concentrated banana peel and tea leaf extracts underwent phytochemical screening tests. Two drops of Extract were mixed with a 5% iron (III) chloride solution to test the presence of flavonoids. The results showed the presence of flavonoids characterized by a change in color to yellow (Nurmila et al., 2019). This color change occurs due to the formation of a bond between the benzene ring and Fe3+ ions (Zaini & Shofia, 2020).

The saponin content in banana peel extract is assessed by dissolving the Extract in water, then heating and shaking until foam forms. The appearance of foam indicates the presence of saponins in the banana peel extract. Saponins can produce foam because hydrophile groups interact with water, and hydrophobic groups interact with air, forming foam when shaken (Marpaung & Romelan, 2019). Triterpenoid testing is done by adding Liebermann-Burchard reagent, which shows a brown color change. The change in color to brown indicates an oxidation reaction in compounds containing triterpenoids (Asmara, 2017).

Tannin testing on tea leaf extract was carried out by adding 1% iron (III) chloride reagent solution, which showed a color change to blue-black. This change occurs because Fe 3+ ions can hydrolyze the OH group in tannins and form complex compounds. Four drops of 1% FeCl 3 solution were added to the polyphenol test on tea leaf extract. Samples containing polyphenols will change color to blackish brown, indicating polyphenols' presence in the Extract (Mondong, 2015). The vitamin E test on tea leaf extract was carried out by heating 1 ml of tea leaf extract, 2 ml of alcohol, and five drops of HNO 3 at 75 ° C for 15 minutes. The results are positive, with the color turning orange (Padamani et al., 2020).

Table 1.2 shows the observation data of a phytochemical screening test of compounds in the ambon banana peel and tea leaves.

Table 1.2. Phytochemical Screening Test Data

Component	Reagents	Observation Results	Description
Ambon Banana Peel			
test	$FeCl_3$ 5%	Turns into a yellow color	+
Saponin test,	equates	There is the foam that lasts the same 10 minutes	+
Tannin test	$FeCl_3$ 1%	Turns greenish yellow	+
Triterpenoid assay	Liebermann-Burchard	Discolored Deep brown	+
Tea Leaves			
Flavonoid assay	$FeCl_3$ 5%	Yellow-green in color	+
Tannin test	$FeCl_3$ 1%	Blue-black in color	+
test	$FeCl_3$ 5%	Blackish Brown	+
Vitamin E test	Alcohol and HNO_3	Orange in color	+

3.4. Shampoo Formulation

Banana peel and tea leaf extract anti-loss shampoo contains hydroxy propyl methyl cellulose (HPMC), sodium lauryl sulfate, methylparaben, and propylene glycol. The function of HPMC as a base is to provide pseudoplastic flow properties to the shampoo so that the foam remains stable and its viscosity increases. In addition, HPMC can thicken the shampoo. When dissolved in water, HPMC's clear color also maintains the original color of the shampoo. Another advantage is that HPMC has a wide pH range and is quickly homogenized with the preservatives used.

Methylparaben, at 0.015%, serves as a preservative in shampoos. In addition, methylparaben inhibits the development of bacteria and fungi. BPOM has set a limit on using methyl parabens in shampoos: 0.4% for individual use and 0.8% for mixed-use. This anti-loss shampoo formulation also utilizes sodium lauryl sulfate or sodium lauryl sulfate (SLS) surfactant. Sodium lauryl sulfate forms foam because it contains microemulsions and can dissolve oils by lowering surface tension.

Propylene glycol is used as a cosolvent to increase the solubility of substances, and distilled water as a solvent (Aini et al., 2016). Propylene glycol helps dissolve the tea leaf extract, which cannot dissolve in distilled water. Adding NaCl with a concentration of 1.5% in the shampoo formulation increases the viscosity of the shampoo. The increase in NaCl concentration increased the viscosity of the shampoo. This is due to the formation of gels in some colloidal systems due to the addition of metal ions. However, after reaching the maximum point of viscosity, adding salt will reduce the viscosity (Kurniawati et al., 2015).

3.5. Shampoo Characteristic Test Results

An organoleptic test aims to determine the color, odor, and form of ambon banana peel extract shampoo. The shampoo results in the organoleptic test had a tea-like odor with a slight banana and tea aroma. The highest concentration had a more potent banana peel aroma in F3 and F4. The color produced from the formulation is clear and greenish brown. The shampoo produced is in the form of a thick liquid and does not clot. The greater the use of extract concentrations, the more it can cause an increase in shampoo viscosity, a more pungent aroma, and a more intense color. The results of the shampoo formulation can be seen in Figure 1.1.

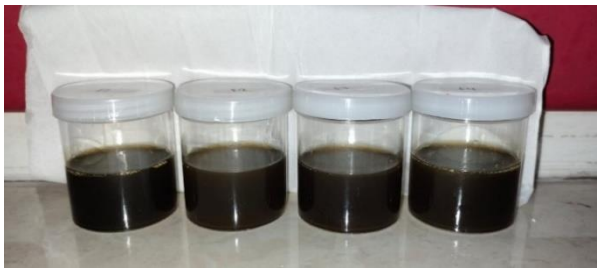

Figure 1.1 Sedimentary Results of Ambon Banana Peel and Tea Leaf Shampoo

The function of the homogeneity test is to determine the homogeneous level of the shampoo preparation. The observation results of the four formulas show that they are all homogeneous. The formulas do not have lumps of ingredients mixed or rough texture and color differences from shampoo preparations.

The pH test of the shampoo preparation that has been made is carried out to determine the amount of pH produced. The importance of an appropriate pH significantly impacts the comfort of using shampoo and the health of the scalp and hair (Nasmety et al., 2019). Shampoos with a pH that is too low or too high can irritate the scalp. (Malonda, 2017). Based on the test results using a pH meter, the pH of F1, F2, F3, and F4 are 5.180, 5.178, 5.115, and 5.020, respectively. The pH decrease is due to the acidic banana peel extract with a pH of 4 (Himawan et al., 2018).

The foam height test aims to determine the ability of shampoo to form foam. Foam in shampoo plays an important role in binding dirt in the hair because it can mix water and oil so that it easily cleans dirt that sticks to the hair due to oily. Measurement of the foam height of the shampoo preparation obtained the results of 6.8 cm, 8.0 cm, 8.5 cm, and 9.0 cm. A good shampoo is used when the height is 1.3-22 cm (Lestari et al., 2021). The increasing foam height is produced from the saponin content contained in the ambon banana peel extract.

The ability of saponins to produce foam is due to the presence of hydrophilic groups that can interact with water and hydrophobic groups that can interact with air, thus forming foam during the shaking process (Lestari et al., 2021; Syamsul et al., 2020). The ability of shampoo to produce high foam is influenced by the presence of sodium lauryl sulfate, which is one type of surfactant in shampoo. Sodium lauryl sulfate is included in the alkyl sulfate surfactant group, which can form foam. Alkyl sulfate belongs to the class of organic esters of sulfuric acid, which has a variety of hydrocarbon chain lengths (Nasmety et al., 2019).

Viscosity testing is used to measure the viscosity of the shampoo that has been produced. Viscosity describes how much resistance the shampoo experiences in flowing, and the higher viscosity value indicates that the shampoo has a greater resistance in flow (Novitasari & Amboro, 2021). When the concentration of the Extract is added, the viscosity of the shampoo will increase proportionally. F1 and F4 shampoo preparations are not considered good shampoos because they have low viscosity. Meanwhile, F2 and F3 are included in the criteria for good shampoos because they have high viscosity. The SNI standard of viscosity of shampoo preparations is 400-4000 cP. The observation data of anti-fall shampoo characteristics can be seen in Table 1.3.

Table 1.3. Characteristics of Anti-fall Shampoo

Characteristics	Shampoo			
	F1	F2	F3	F4
Organoleptic	Chocolate	Chocolate	Chocolate	Chocolate
Color	Greenish brown	Greenish brown	Greenish brown	Greenish brown
Form	Thick liquid	Thick liquid	Thick liquid	Thick liquid
Smell	The scent of tea	The scent of tea	The scent of tea	The scent of tea
Homogeneity	Homogeneous	Homogeneous	Homogeneous	Homogeneous
Foam height	6.8 cm	8.0 cm	8.5 cm	9.0 cm
pH	5,180	5,178	5,115	5.020
Viscosity	266 cp	446 cp	767 cp	223 cp

5. CONCLUSION

Ambon banana peel extract and green tea leaves can prepare a stable shampoo. Judging from the formulation of homogeneous shampoo preparations, there is no change in color or odor. Based on the characteristic test results of the four formulations, the second and third formulations can meet the standards because they have viscosity test results of 446 cP and 767 cP. Meanwhile, formulations 1 and 4 have viscosity values below 400 cP. In addition, the pH stability test on shampoo preparations also meets the standards, so overall, this shampoo can be used safely

LIMITATION

The limitations of this study are that the researcher only conducted up to the quality testing and characterization stage. The limitations include the lack of effective testing, encompassing both in-vivo and in-vitro tests. Clinical and statistical testing on the shampoo sample were also not conducted. These limitations were due to time and budget constraints in conducting the research. Therefore, future research could continue to the stage where the banana peel and green tea leaf shampoo can be used commercially.

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