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Reseach Paper

An Innovative Herbal Hair Tonic Derived from Purslane *(Portulaca oleracea)*

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Abstract: The rising demand for natural and eco-friendly personal care products has driven innovation in plant-based formulations. Portulaca species, rich in bioactive compounds, are potential candidates for use in hair tonic products due to their hair growth-promoting properties. This study aims to analyze the phytochemical content of two Portulaca species and evaluate the effects of extract concentration on hair tonic formulation quality; Methods or process: The research was conducted at the Research Laboratory of FTI-UMI and involved several steps: sample preparation, extraction using the Soxhlet method, qualitative phytochemical analysis, formulation of hair tonic, and testing of pH, viscosity, density, and organoleptic properties; Results: The phytochemical screening confirmed the presence of active compounds beneficial for hair care. Among the formulations, Portulaca oleracea L. extract in Formulation 1 demonstrated the most suitable characteristics, with a pH of 4.13, fulfilling the Indonesian National Standard (SNI) for cosmetic products. Similarly, Portulaca grandiflora H. extract in Formulation 1 exhibited acceptable quality with a pH of 4.25; Conclusion: The study highlights the innovative potential of Portulaca-based hair tonics as environmentally friendly alternatives in the cosmetic industry. These findings support the development of sustainable herbal products with scientifically proven efficacy.

Keywords: Purslane, Succulent, Portulaca, Phytochemicals, Hair tonic.

1. Introduction

Healthy and shiny hair is a universal desire. However, many individuals are unaware that their daily habits may contribute to hair damage and neglect. Among the most commonly reported hair-related issues is hair loss, a condition characterized by excessive shedding beyond the normal rate. According to previous studies, hair loss is one of the most frequent complaints among both men and women [1][2]. The formulation of an innovative herbal hair tonic derived from Purslane (Portulaca oleracea) extract can be substantiated by a comprehensive analysis of its bioactive compounds and inherent benefits for hair health. Purslane is recognized for its diverse phytochemical constituents, including alkaloids, terpenoids, flavonoids, and organic acids, which contribute to various pharmacological activities such as anti-inflammatory, antioxidant, and antimicrobial properties [3][4][5].This rich composition makes Purslane a compelling candidate for inclusion in hair care products aimed at promoting hair growth and enhancing scalp health.

Purslane (Portulaca spp.) is a wild plant known for its rich content of pharmacologically active compounds with potential benefits for stimulating hair growth. Among these bioactive constituents, saponins play a key role in enhancing blood circulation to the scalp, thereby promoting hair follicle activity and growth. Flavonoids, on the other hand, act as powerful antioxidants that protect hair cells from oxidative stress caused by free radicals. Additionally, phenolic compounds present in purslane exhibit keratolytic properties, which help in removing dead skin cells and improving scalp health.

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These attributes suggest that purslane extract holds significant promise as an innovative, natural ingredient in eco-friendly hair tonic formulations [6]. So this plant has the potential to be utilized as a basic ingredient for making hair tonics [7].

Previous studies have demonstrated that hair tonic formulated from Portulaca extract using the maceration method possesses microbiologically safe properties, exhibits a non-acidic pH, and has shown effectiveness in promoting hair growth and increasing hair weight in animal models, particularly rabbits [8].

2. Research and Methodology

2.1 Materials

The instruments used in this study included a Soxhlet apparatus set, analytical balance, petri dishes, 250 mL and 500 mL beaker glasses, oven, 100 mL and 500 mL measuring cylinders, pH meter, mortar and pestle, 100 mL Erlenmeyer flasks, Oswald viscometer, tweezers, spatula, test tubes, and graduated pipettes. The materials used were Portulaca spp. (commonly known as "bunga jam 9"), 96% ethanol, distilled water (aquadest), propylene glycol, sodium metabisulfite, methylparaben, menthol, Tween 80, cotton, and aluminum foil. The independent variables in this study were the type of Portulaca species (bunga jam 9) and the concentration of Portulaca extract used in the hair tonic formulations. The dependent variable was the mass of the plant simplicia used in the extraction process.

2.2 Sample Preparation

Fresh Portulaca plants were collected, with the stems and leaves (herbal parts) selected for further processing. Prior to extraction, the plant material was thoroughly cleaned to remove impurities and then washed with clean water. The samples underwent size reduction followed by a two-stage drying process. In the first stage, the samples were sun-dried to allow for the complete evaporation of residual moisture from washing. To prevent contamination from dust and to minimize photodegradation of chemical compounds, the samples were covered with a black cloth during sun-drying. In the second stage, the partially dried samples were placed in an oven at a controlled temperature of 60–80°C until fully dried. The drying process was considered complete when the plant material became brittle and could be crumbled into flakes by hand. The dried samples were then ground into a fine powder using a grinder, and stored in airtight containers for subsequent extraction..

2.3 Phytochemical Test

Chemical compounds identified in purslane plant extract samples (9 o'clock flowers) are flavonoids, saponins, and tannins. Flavonoid compounds are carried out by taking 3 drops of extract then adding 0.1 g Mg powder and 2 drops of concentrated HCl. If there is a color change to red then the extract is positive for flavonoids. Saponin compounds can be done by taking 5 drops of extract into a test tube. After that add 10mL of hot water (refrigerate). Then shake vigorously for 10 seconds. It is said to be positive for saponins if there is foam that does not disappear for a few minutes, add 2N HCl, then observe the changes that occur. Tannin compounds are carried out by taking 3 drops of extract and then adding 2 mL of 5% $FeCl_3$ solution. It is said to positively contain tannins if there is a color change to greenish brown or blue-black.

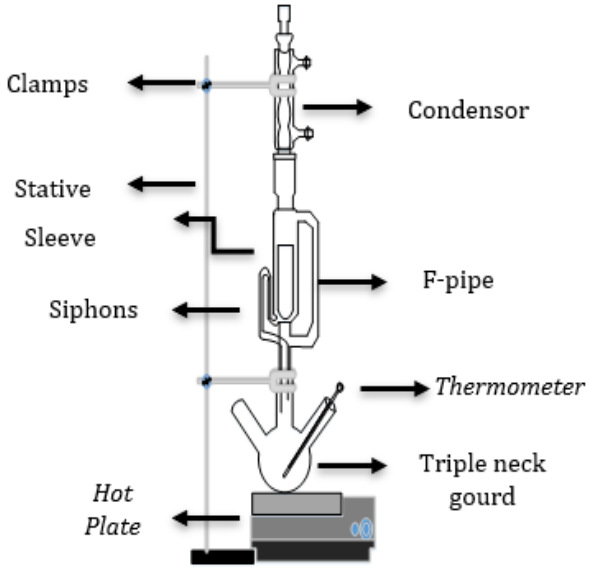

Figure 1. Soklet Apparatus Set

2.4 Hair Tonic Maker

The first stage is to weigh tween 80, then dissolve it in ethanol and stir until dissolved. The second stage is weighing the thick extract of purslane plants, then dissolving it into the first stage solution until it is completely dissolved. The third stage is to dissolve sodium metabisulfite in distilled water, then mix it into the solution in the second stage and stir until homogeneous. The fourth stage is weighing ethanol, methyl paraben and menthol. After that, dissolve each methyl paraben and menthol into ethanol until dissolved. Then mix and stir until homogeneous. The fifth stage is weighing propylene glycol and then adding propylene glycol to the fourth stage solution little by little and stirring until homogeneous. The sixth stage is to add a mixture of tween 80 solution, purslane plant extract and sodium metabisulfite to a mixture of methyl paraben, menthol and propylene glycol solution little by little and mix until homogeneous. The last stage is to fulfill the weight with distilled water until it reaches 100 grams.

2.5 Hair Tonic Evaluation

Organoleptic observations of hair tonic preparations were observed for odor, color, and homogeneity during storage for 9 days at room temperature (25°C). The pH test was carried out using a pH meter indicator. The purpose of the pH test is to determine the pH of the preparation. The way the pH meter works is to start by calibrating the pH meter at pH 4 and 6. After that, dip the pH meter into the preparation. Then read the pH listed. The pH of the hair tonic preparation is adjusted to the pH of the scalp, which is around pH 4.5-6.5. If it is too acidic it will cause skin irritation. If it is too alkaline, it will cause itching and scaly skin. The specific gravity of hair tonic is calculated by weighing the empty weight of the pycnometer.

After that, the hair tonic sample was carefully introduced into a clean and dry pycnometer. The pycnometer was then weighed using an analytical balance, and the resulting weight was recorded for further analysis. This step is crucial in determining the density of the liquid, which is a supporting parameter for viscosity calculations. Viscosity itself is defined as a measure of a liquid's resistance to flow. A higher viscosity indicates that the liquid flows more slowly due to internal friction between its molecules, while a lower viscosity suggests it flows more easily. In this experiment, the viscosity of the hair tonic was measured using an Ostwald viscometer, a simple and widely used instrument for this purpose. The procedure began by introducing the hair tonic into the lower bulb (reservoir) of the

Ostwald viscometer. Using a rubber bulb, suction was applied to draw the liquid up past the upper timing mark (upper tendon) on the capillary tube. Once the liquid reached this point, the top of the capillary was sealed with a finger. After stabilizing the liquid level, the finger was gradually removed to allow the liquid to flow downward through the capillary under the influence of gravity. A stopwatch was started precisely when the liquid passed the upper timing mark and stopped when it reached the lower timing mark. This measured the flow time, which is directly related to the viscosity. The measurement was repeated several times to ensure consistency and accuracy of the recorded flow time. This entire process was repeated for each sample, allowing comparison of viscosities among different hair tonic formulations.

Table 1. Composition of Hair Tonic Formulation

Material	% Concentration (w/w)					
	Blank	**1**	**2**	**3**	**4**	**5**
Ekstrak tumbuhan krokot (gr)	-	5	10	15	20	25
Etanol 96 % (gr)	20	20	20	20	20	20
Propolen Glikol (gr)	10	10	10	10	10	10
Natrium Metabisulfit (gr)	0,25	0,25	0,25	0,25	0,25	0,25
Metil Paraben (gr)	0,3	0,3	0,3	0,3	0,3	0,3
Mentol (gr)	0,1	0,1	0,1	0,1	0,1	0,1
Tween 80 (gr)	2	2	2	2	2	2
Aquadest (gr)	add 100	add 100	add 100	add 100	add 100	add 100

3. Results and Discussion

3.1 Phytochemical Test

Phytochemical tests were carried out to determine the content of phytochemical compounds contained in each extract. Phytochemical testing on purslane plant extracts includes flavonoid, saponin and tannin tests which are carried out qualitatively. From the results of the flavonoid content test contained in plant extracts of the type of Portulacca Oleracea L. and Portulacca Grandiflora H. where it is proven to contain flavonoids which are marked by a change in the color of the extract to a red color for Portulacca Oleracea L. and orange color for the extract. From the results of the saponin content test contained in plant extracts of the type of Portulacca Oleracea L. and Portulacca Grandiflora H. where it is proven to contain saponins which are characterized by the appearance of foam in both types of extracts after the addition of hot water and then shaken for 10 seconds and the addition of 1 drop of HCl 2 N. If there is foam that does not disappear for a few minutes, it is positive for the presence of saponins [9]. From the results of the tannin content test contained in both types of plant extracts. where it is proven to contain tannins which are marked by changing the color of the extract to greenish brown for Portulacca Oleraceae L. and dark blue for Portulacca Grandiflora H. after adding about 2mL of 5% $FeCl_3$ solution. Positive results will show greenish brown or blackish blue [10].

3.2 Specific gravity test

The results of specific gravity analysis on hair tonic formulations with variations in purslane plant extract concentration can be seen in the following figure.

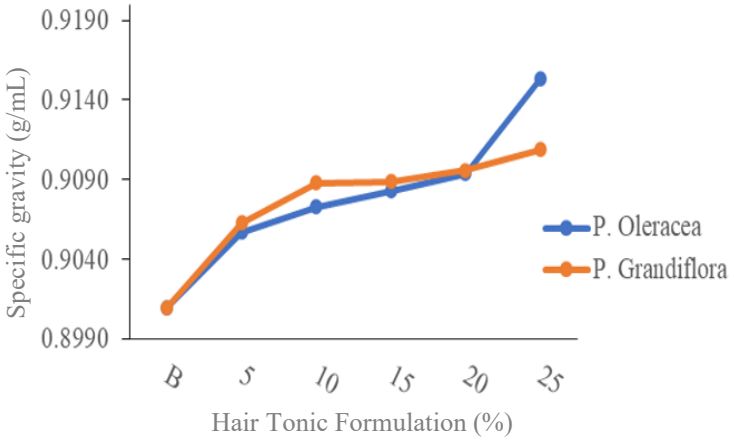

Figure 2. Graph of the Relationship Between the Addition of Purslane Plant Extract and the Specific Weight of Hair Tonic

In the Blank, 5, 10, 15, 20, and 25% treatment with Portulacca Oleraceae L. plants obtained respectively 0.9010, 0.9057, 0.9073, 0.9083, 0.9094, and 0.9153 g/mL and Portulacca Grandiflora H. plants obtained respectively 0.9010, 0.9063, 0.9088, 0.9089, 0.9096, and 0.9109 g/mL. From these data, it can be seen that the effect that occurs on the specific gravity of the formulation towards the addition of purslane plant extract is increasing. This is in accordance with [11], namely the specific gravity of hair tonic must be less than 1 or not more than the specific gravity of water. This is in accordance with research conducted by [12] regarding the manufacture of hair tonic with the addition of hibiscus leaf extract where the higher the concentration of the extract, the greater the specific gravity. The increase in specific gravity as the extract increases in the hair tonic formulation occurs because purslane plant extract contains phenolic compounds in the form of flavonoids and tannins that are easily soluble in water so that it can increase the weight fraction contained in the hair tonic formulation. According to [10], the number of substance components affects the specific gravity of the substance, where the more weight fractions contained, the greater the specific gravity.

3.3 Viscosity Test

The results of viscosity analysis on hair tonic formulations with varying concentrations of purslane plant extract can be seen in the following figure.

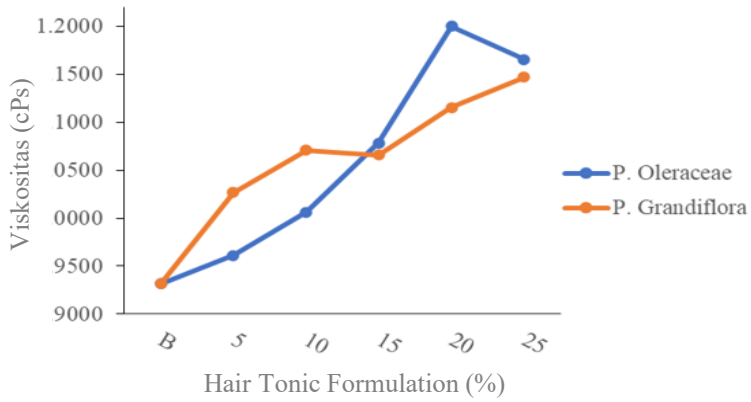

Figure 3. Graph of the Relationship Between the Addition of Purslane Plant Extract to the Viscosity of Hair Tonic

In the Blank, 5, 10, 15, 20, and 25% treatment with Portulacca Oleraceae L. plants obtained successively 0.9318, 0.9613, 1.0062, 1.0768, 1.2001, 1.1656 cPs and Portulacca Grandiflora H.

plants obtained successively showed 0.9318, 1.0268, 1.0707, 1.0658, 1.1154, 1.1469 cPs. This is in accordance with the Indonesian National Standard [11], namely the viscosity of hair tonic at room temperature (25°C) is below 5cPs.

The greater the concentration of extract added to the formulation, the more particles in the mixture so that it can increase friction between particles. And in accordance with research conducted by [13], that hair tonic which has a high viscosity can leave crusts that can trigger the onset of dandruff.

3.4 pH Test

The results of pH analysis on hair tonic preparations with varying concentrations of purslane plant extract can be seen in the following figure.

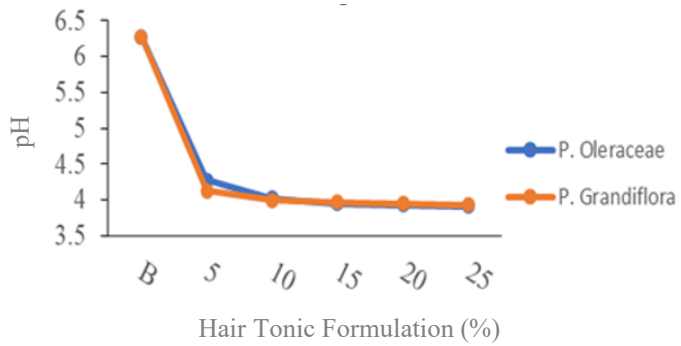

Figure 4. Relationship graph between the addition of purslane plant extract and the pH of hair tonic.

The pH values obtained from the hair tonic formulations using Portulaca oleracea L. and Portulaca grandiflora extracts at concentrations of 0% (Blank), 5%, 10%, 15%, 20%, and 25% were recorded respectively as follows: for Portulaca oleracea L., the pH values were 6.27, 4.13, 3.99, 3.97, 3.95, and 3.93; and for Portulaca grandiflora, the values were 6.27, 4.25, 4.02, 3.95, 3.93, and 3.91. These results indicate that all formulations are acidic (pH < 7). Interestingly, as the concentration of plant extract increases, the pH of the formulation tends to decrease. This phenomenon is attributed to the hydrolysis reaction occurring in the formulation, which releases hydrogen ions (H^+) into the solution, thereby lowering the pH. Additionally, a further reduction in pH could also result from the absorption of carbon dioxide (CO_2) from the air into the sample container during measurement, which can lead to the formation of carbonic acid and contribute to the acidic nature of the preparation [14].

Each formulation of hair tonic preparations complies with (SNI, 1998) where the pH range set ranges from 3.0-7.0. The pH value should not be too acidic because it can cause skin irritation, and also should not be too alkaline because it can cause scaly skin. However, according to research conducted by [15] the pH value of a topical preparation must be in the pH range that matches the pH of the skin, which is 4.5-7.5. So from the formulation approaching the best skin pH, namely in plants of the type Portulacca Oleraceae L. there is formulation 1 with a pH (4.13) and in plants of the type Portulacca Grandiflora H. there is formulation 1 with a pH (4.25).

3.5 Organoleptic Observation

The results of organoleptic observations on hair tonic preparations with varying concentrations of purslane plant extract can be seen in the following figure.

Table 2. Organoleptic Observation Result of Plant Type Portulacca Grandiflora H.

Parameters	Day	Hair tonic preparations					
		Blank	F1	F2	F3	F4	F5
Odor	3	M	M	M	M	M	M
	6	M	M	M	M	M	M
	9	M	M	M	M	M	M
Color	3	C	LY	Y	OY	LO	DO
	6	C	LY	Y	OY	LO	DO
	9	C	LY	Y	OY	LO	DO
Homogeneity	H	H	H	H	H	H	H
	H	H	H	H	H	H	H
	H	H	H	H	H	H	H

Remarks :

M	: Menthol	OY	: Orange Yellow
C	: Clear	LO	: Light Orange
LY	: Light Yellow	DO	: Dark Orange
Y	: Yellow	H	: Homogeneous

Table 3. Organoleptic Observation Results of Portulacca Oleraceae Plant Types.

Parameters	Day	Hair tonic preparations					
		Blank	F1	F2	F3	F4	F5
Odor	3	M	M	M	M	M	M
	6	M	M	M	M	M	M
	9	M	M	M	M	M	M
Color	3	C	OY	DO	BO	B	DB
	6	C	OY	DO	BO	B	DB
	9	C	OY	DO	BO	B	DB
Homogeneity	H	H	H	H	H	H	H
	H	H	H	H	H	H	H
	H	H	H	H	H	H	H

Remarks :

M	: Menthol	BO	: Brown Orange
C	: Clear	B	: Brown
OY	: Orange Yellow	DB	: Dark Brown
DO	: Dark Orange	H	: Homogeneous

Based on the results of organoleptic observations that the 10 hair tonic formulas from day 3 to day 9 did not show any hair tonic preparations. In organoleptic observations of the 10 formulas of the plant species Portulacca Oleracea L. and Portulacca Grandiflora H. smelled of menthol, this was due to the addition of menthol solution to the hair tonic preparation formulation. The homogeneity examination of the 10 formulas of the plant species Portulacca Oleracea L. and Portulacca Grandiflora H. showed that the 10 formulas were physically homogeneous.

4. Conclusion

Based on the results of observations and research, the following conclusions can be drawn. Evidence of secondary metabolite compounds or phytochemical compounds contained in purslane plant extracts of Portulacca Oleraceae L. and Portulacca Grandiflora Hook. The content of these

compounds is flavonoid compounds, saponin compounds, and tannin compounds. The effect of adding purslane plant extract in each formulation meets the quality standards set by SNI.

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