

Formulation and Physical Test of Hair Tonic with Mangosteen Peel Extract (*Garcinia mangostana L.*)

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Abstract

Hair Tonic is made from the extract of mangosteen peel (*Garcinia mangostana L.*) and other additional ingredients, which are beneficial in addressing hair loss and nourishing the hair. Scientifically, mangosteen fruit is known to contain Xanthones and flavonoids that function as antioxidants essential for hair health. These compounds can repair damaged hair cells and promote a conducive skin environment for hair growth. The research employed an experimental method involving the creation of four formulations. The mangosteen peel was extracted through maceration using ethanol as a solvent and then evaporated using a rotary evaporator. Subsequently, it was formulated into a Hair Tonic, and the formulation underwent evaluation. Data analysis was conducted through both qualitative and quantitative analyses. Qualitative analysis included organoleptic testing and homogeneity testing, while quantitative analysis involved pH testing, viscosity testing, specific gravity testing, and stability testing using the freeze-thaw cycling method. The results of the research on the organoleptic test for four formulations showed insignificant color differences, ranging from brown, light brown, and dark brown to transparent brown. Homogeneity evaluation indicates that concentration variations in the hair tonic do not affect the stability of its homogeneity. Observations of pH changes during the cycling test (cycles 1 to 6) show an increase in pH values but still within the standard limits. The viscosity values of the Hair Tonic before and after cycling comply with the standard. In conclusion, the overall physical characteristics of the Hair Tonic are that all formulations are suitable to be used, and all of them comply with the requirements.

Keywords: Hair Tonic; Physical Test of Hair Tonic; Mangosteen Peel Extract

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INTRODUCTION

Hair loss is a natural phase that occurs in everyone because hair has phases, namely the anagen phase (growth), the catagen phase (preparing to fall out), and the telogen phase (falling out).¹ Hair tonic is a medication used to strengthen hair roots, stimulate hair growth, remove hair

impurities on the scalp, and help lubricate the hair. Hair tonic is usually made from plant extracts. The mechanism of action of hair tonic is to stimulate the growth of the base of the hair that contains melanocyte cells sufficient to produce melanin (hair color or pigment) and cells that synthesize hard keratin as the basis for hair

formation, making it appear shiny black, easy to manage, and having strong hair roots.²

Hair tonics have been shown to be effective in promoting hair growth through several key mechanisms of action, including improving blood circulation in the scalp, stimulating hair follicles, providing nutrients to the hair roots, and creating an optimal environment for hair growth.³ The effectiveness of hair tonics is influenced by various factors such as consistency of use, quality of active ingredients, initial condition of hair and scalp, individual genetics, and proper application methods. However, there are some limitations, such as variable results between individuals and the need for long-term regular use. For optimal results, the use of hair tonics needs to be combined with proper hair care, a healthy diet and lifestyle, and regular monitoring of success indicators such as reduced hair loss.⁴

One of the plants suspected to be used for this purpose is the mangosteen fruit (*Garcinia mangostana* L.), especially using extracts from the mangosteen peel. Mangosteen (*Garcinia mangostana*, *Garcinia mangosteen*) is a great fruit with up to 300 species.⁵ Indonesia is one of the countries producing *Garcinia mangostana*, which can be exported up to 300 tons to various countries every month. This fruit is round, has thick, dark purple flesh on the inner skin, and is white on the inside. The mangosteen peel, which has been discarded as waste after consuming the fruit pulp, is found to be rich in antioxidants such as Xanthonenes and anthocyanins.⁶ ⁷ Xanthonenes in the mangosteen peel are known to enhance angiogenesis and have vasorelaxant properties, suggesting a potential to promote hair growth. The peel also contains complex phenolic compounds, namely proanthocyanidins and

proanthocyanidins, which are known to induce hair growth by inducing the anagen phase of the hair follicle cycle.⁸ ⁹ Anthocyanidin as a sugar-free anthocyanin analogue is a pigment that is naturally soluble in polar solvents and is included in the flavonoid group which acts as a pigment in various types of plants¹⁰. Mangosteen shell has a varied chemical composition. There have been many studies to isolate its chemical content, especially xanthonenes, which have extraordinary properties and provide many biological effects: antioxidant¹¹, antibacterial, neuroprotective,¹² anti-obesity,¹³ anticancer,¹⁴ ¹⁵ and anti-inflammatory.¹⁶

Based on the above background on hair loss and the discovery of the benefits of mangosteen fruit with activities in hair growth, the researcher formulates mangosteen peel extract as a Hair Tonic for hair nourishment. It is expected that by formulating mangosteen fruit into a Hair Tonic preparation, a more practical application can be obtained.

METHOD

The research design used in this study was the True Experimental Laboratory type. The experiment was employed to determine the optimal proportion of active ingredients with variations of mangosteen peel extract in the preparation of Hair Tonic as a hair nourisher.

Materials

Mangosteen Peel Simplisia, 70% Ethanol, 96% Ethanol, Propylene Glycol, Sodium Metabisulfite, Propyl Paraben, Menthol, and Distilled Water.

Equipment

Erlenmeyer Flask, Rotary Evaporator, Porcelain Dish, Filter Paper, pH Meter, Pycnometer, Cloth Filter, Oven, Analytical Balance, Measuring Glass, Dropper Pipet, Stirring Rod, Mortar and Pestle, Analytical

Balance, Watch Glass, Beaker Glass,
Dropper Pipet, Stirring Rod, Spray Bottle,
and Plastic Bottle.

Table 1. Hair Tonic Formulation

Ingridient	Quantity of Ingredients				Purpose
	Control -	F1	F2	F3	
Ekstrak Kulit Manggis	2	2	2	2	Active Ingridient
Etanol 96%	30	30	30	30	Cosolven, anti mikroba
Propylene glycol	-	10	20	40	Humectant
Natrium Metabisulfite	0.01	0.01	0.01	0.01	Antioksidan
Propil Paraben	0.01	0.01	0.01	0.01	Preservative
Metil Paraben	0.1	0.1	0.1	0.1	Preservative
Menthol	0.3	0.3	0.3	0.3	Penetration Enhancer
Aquadest	Ad 120 mL	Ad 120 mL	Ad 120 mL	Ad 120 mL	Solvent

Hair Tonic Making Procedure

Weigh the required ingredients. Mix the extract with methyl paraben and propyl paraben. Add a little ethanol and stir until evenly distributed. Next, pour the mixture into a bottle (bottle 1) and shake until homogenous. Dissolve menthol in the remaining ethanol, then add it to (bottle 1). Dissolve sodium metabisulfite in distilled water and pour it into (bottle 2). Mix propylene glycol with distilled water

gradually, then add it to (bottle 2). After that, slowly pour the contents of (bottle 2) into (bottle 1), and shake until homogenous.

RESULTS AND DISCUSSION

After completing the formulations, the subsequent stage is the physical evaluation of the preparations. The results of this evaluation are recorded in the following table:.

Table 2. Results of Hair Tonik Test

No	Type of Test	Control (-)	F1	F2	F3
1	Organoleptic Test				
	Shape	Liquid	Liquid	Liquid	Liquid
	Color	Brown	Light Brown	Dark Brown	Clear
	Scent	Distinctive aroma of the extract	Distinctive aroma of the extract	Distinctive aroma of the extract	Brown Distinctive aroma of the extract
2	Homogeny Test	Homogene	Homogene	Homogene	Homogene
3	pH Test	4.2	4.3	4.5	4.8
4	Viscosity Test	1.1 cPs	1.3 cPs	1.7 cPs	2.5 cPs
5	Specific Gravity Test	0.945	0.951	1.007	1.058

Note :

Control (-) = Hair Tonic preparation without propylene glycol

F1 = hair Tonic preparation with propylene glycol concentration of 10%

F2 = hair Tonic preparation with propylene glycol concentration of 20%

F3 = hair Tonic preparation with a propylene glycol concentration of 40%

Organoleptic testing was conducted as part of the evaluation process based on human senses. The eyes, ears, taste buds, sense of smell, and sense of touch play a role in sensory perception.¹⁷ The organoleptic examination was carried out to assess the physical condition of the preparation. The results of the organoleptic test for each formulation indicate a non-significant variation in color, ranging from brown, light brown, and dark brown to transparent brown. The Hair Tonic formulation that was produced exhibits a distinctive scent of menthol and the characteristic aroma of mangosteen peel. There is a tendency that the higher the concentration of Propylene Glycol in a formula, the clearer the color becomes.

The Homogeneity Test was conducted using a glass object, where each preparation was dropped onto the glass object with 1-2 drops using a pipette and then covered with a glass cover. Subsequently, it was observed whether the preparation contained foreign particles or foreign objects. The homogeneity test aims to determine whether the prepared preparation is homogeneous overall, which can be observed through visual observation of undissolved particles.¹⁸ From the data, it is evident that formulations 1, 2, 3, and the

control formulation provide homogeneity data without the presence of foreign particles or objects. The criteria for good hair tonic, based on the quality standards of SNI, are homogeneity and freedom from foreign particles.

The pH test was conducted by turning on the pH meter using the on button, then inserting the pH meter into the container containing the preparation and observing the scale displayed on the digital screen. The test for acidity or alkalinity (pH) is a physicochemical parameter that must be performed in the testing of topical preparations (dermal). This is because the pH of the preparation can affect its effectiveness, stability, and user comfort on the skin.¹⁹ The pH value of the preparation used can influence skin absorption. If the pH of the preparation is too acidic, it can cause skin irritation, and if it is too basic, it can cause the skin to flake. The results of the pH measurement are presented in the table above, indicating that the higher the concentration of propylene glycol, the higher the pH value obtained. Based on the research conducted, it can be concluded that propylene glycol can increase the pH value due to its basic nature. Therefore, the pH value of Hair Tonic with mangosteen peel extract still

falls within the pH range that does not cause skin irritation, which is desired between 3-7. Thus, it can be concluded that each pH value has characteristics of good pH.

Viscosity testing is conducted to assess the level of thickness of a substance. The higher the viscosity value, the higher the level of thickness of that substance.²⁰ Viscosity testing is performed using the Brookfield Viscometer with spindle 1 at a speed of 60 rpm on the Hair Tonic preparation.

The measurement results indicate that with an increase in the concentration of propylene glycol, the viscosity of the preparation also increases. This finding is consistent with the research by Febriani,²⁰ which states that propylene glycol can enhance its viscosity.

The viscosity value of Hair Tonic still falls within the range deemed suitable for use on the scalp, in accordance with the National Standardization Agency (1998) standard number SNI 16-4955-1998, which is below 5 cPs.

The purpose of specific gravity observation is to assess the purity of a preparation, especially those in liquid form. Specific gravity measurement is conducted using a pycnometer. The specific gravity values for F1 are 0.951, F2

is 1.007, and F3 is 1.058. The measurement results indicate that with an increase in the concentration of propylene glycol, the specific gravity of the preparation also increases. This finding aligns with the research conducted by Indriyani & Endrawati,²¹ which states that a higher concentration of propylene glycol leads to a higher specific gravity of Hair Tonic preparation. Only F1 meets the requirements for the specific gravity of Hair Tonic, as formulations 2 and 3 yielded specific gravity values greater than 1.

Results should be clear and concise. Results were presented in a format that was easily understood in the form of 2D figures. The titles of tables and figures should be stated briefly.

The sample used is the skin of mangosteen fruit (*Garcinia mangostana* L.), totaling 1.5 kg. The extract is produced using the maceration method, resulting in an extract quantity of 89.70 grams. The yield of Mangosteen Fruit Peel Extract (*Garcinia Mangostana* L.) is obtained at 5.98%.

The next step involves the preparation of Hair Tonic using the extract from mangosteen fruit peel, formulated as a solution with four variations, including a negative control, F1, F2, and F3. These formulations have different

concentrations of propylene glycol, namely 0%, 10%, 20%, and 40%.

Xanthone, the main compound in mangosteen extract, works through several interrelated mechanisms to inhibit and kill microorganisms. The main mechanism starts from the lipophilic ability of xanthone to penetrate microbial cell membranes, causing disruption of membrane permeability and leakage of intracellular components such as K⁺ ions, ATP, and genetic material. Furthermore, xanthone inhibits macromolecular synthesis by disrupting the formation of proteins, DNA, and RNA and disrupts energy metabolism by inhibiting enzymes in the electron transport chain, which results in energy deficiency in microbial cells. These compounds are also effective in preventing the formation of bacterial biofilms and damaging existing biofilm structures while working as antioxidants that counteract free radicals and protect host cells. Xanthenes have selectivity towards microbial cells and can modulate the immune system by increasing cytokine production and phagocytic activity. They have multiple target actions that make it difficult for microbes to develop resistance, although their effectiveness can vary depending on concentration,

type of target microorganism, and environmental conditions²².

Parabens and methyl parabens as cosmetic preservatives show high effectiveness in inhibiting the growth of a broad spectrum of microorganisms, including gram-positive and negative bacteria and fungi, and work optimally at pH 4-8 with good stability at high temperatures. From a technical point of view, this compound has good solubility in water and alcohol and high compatibility with various other cosmetic ingredients at a relatively economical price. Regarding its safety, the FDA has set a safe usage limit of a maximum of 0.4% for single parabens and 0.8% for paraben mixtures. However, some studies have shown potential risks such as skin irritation in sensitive individuals and possible endocrine disruption, as well as controversy regarding its association with breast cancer which still requires further research. Special consideration is needed, especially for baby products and sensitive areas, as well as ongoing monitoring of long-term effects, but overall, parabens are still considered an effective and relatively safe preservative when used according to applicable regulations²³.

CONCLUSION

Based on the conducted research, it can be concluded that the extract of mangosteen peel (*Garcinia mangostana* L) can be formulated into a Hair Tonic preparation. This preparation meets the quality testing standards through the tested physical characteristics, including the Organoleptic Test, Homogeneity Evaluation, pH Examination, Viscosity Test, and Specific

Gravity Test. Among the various formulations tested, the best formulation that meets these standards is Formulation 1, with a 10% concentration of propylene glycol.

CONFLICT OF INTEREST

Authors declare that there is no potential conflict of interest with the research, authorship, and/or article publication.

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