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FORMULATION AND TESTING OF ANTI DANDRUFF HAIR TONIC LEAF EXTRACT OF GEDONG MANGO (*Mangifera indica L.var.*Gedong) AGAINST MUSHROOMS *Pityrosporum ovale*

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ABSTRACT

Gedong mango plant (*Mangifera indica L.var.Gedong*) is a plant that has potential as herbal medicine, especially in its leaves because it contains many secondary metabolites such as flavonoids, saponins, gallic tannins, catecat tannins, quinones and steroids or triterpenoids which can be used as antioxidants, antimicrobial and dandruff. This study aims to gedong mango leaf extract concentrations of 5%, 7%, and 10% in hair tonic preparations and to test the antidandruff activity. Gedong mango leaf simplicia (*Mangifera indica L.var.Gedong*) was extracted using the Microwave Assisted Extraction (MAE) method with Natural Deep Eutectic Solvents (NADES) sodium acetate dan lactic acid solvents with a molar ratlactic1:3. Hair tonic preparations are made in three formulas with the active ingredient of mango gedong leaf extract at a concentration of 5%, 7%, and 10%. Evaluation of hair tonic pr, separation air tonic preparation evaluation includes organ anoleptic, homogeneity, pH, and viscosity and eststy test of hair tonic anti-dandruffas carriedtestt by the healthy method against the fungus Pityrosporhealthyvale. Hair tonic of mango gedong leaf extract with concentrations of 5%, 7%, and 10% on organoleptic observations, homogeneity, pH, and viscosity met the requirements. The hair tonic has the potential as an antidandruff because it has antidandruff activity against the fungus Pityrosporum ovale and is classified as moderate to strong.

Keywords: Hair tonic; Mangifera indica L.var Gedong; Microwave Assisted Extraction; Natural Deep Eutectic Solvents

1. INTRODUCTION

Hair is essential for humans because its function is more oriented to harmony and aesthetics. Therefore, the hair is said to be a crown. Nevertheless, only some have healthy hair. The characteristics of unhealthy hair include dull hair, frizzy hair, oily hair, grey hair, split ends, and the most common is hair loss. Indonesian people often complain about oily hair, which is thought to be the cause of dandruff on the scalp, which is supported by the tropical climate (Putri, 2020). Hot weather also causes the development of fungus on the scalp, which can exacerbate the problem of dandruff in the hair (Rahmadani, 2012). The leading cause of dandruff is the fungus Pityrosporum ovale. This fungus is a normal flora on the scalp, but in hair conditions with excessive oil glands, this fungus can thrive (Mahataranti et al., 2012).

It is common practice in India to use hair oil before bathing to maintain healthy hair. The analysis states that hair treatment with oil-based herbal hair tonic can reduce the presentation of frictional forces from the comb and the formation of split ends—several hair tonic preparations with oil carriers, including oil solution and microemulsion forms. An oil solution is a

homogeneous mixture of two or more substances in a solvent. The solvent used is oil (Putri, Prihandono & Supriadi, 2015). The microemulsion is a thermodynamically stable and transparent liquid dispersion system with a droplet size of 20-200 nm consisting of water, oil, surfactants and cosurfactants (Suhery et al., 2018).

A hair tonic is a cosmetic preparation needed by the hair, roots, and scalp (Aini, 2017). Hair tonic is also an excellent and valuable alternative to hair cosmetics. The form is a solution, so it is easy to apply, quickly rubbed on the scalp, and not sticky. In addition, hair tonic does not leave residue on the scalp, so no crust causes dandruff.

Research on the formulation of Arumanis mango leaf extract hair tonic (Mangifera indica L.) as an antifungal Candida albicans conducted by (Putri, 2020) stated that the arumanis mango leaf extract hair tonic preparation showed a diameter of the antifungal inhibition zone of 5% concentration with a zone diameter 10.9 mm inhibition is included in the moderate category, 10% concentration with an inhibition zone diameter of 13 mm and 15% concentration with an inhibition zone diameter of 15.4 mm is included in the strong category. The method used in this research is the healthy method of punching holes to make it solid. This research uses the healthy method because it is easy to measure the area of the inhibition zone formed. After all, the isolates are active not only on the top surface of the solid media but down to the bottom (Haryati et al., 2017). Another study by Ningsih et al., 2017 showed that mango leaf extract with methanol solvent produced methanol extract with a yield of 10.55% (w/w) and produced antifungal activity with the largest inhibition zone at a concentration of 1000 ppm with an inhibition zone of 8.12 mm. MIC of mango leaf methanol extracts against C. Albicans at a concentration of 65 ppm with an inhibition zone of 0.64 mm (Ningsih, 2017). Based on this background, the researchers wanted to investigate whether Gedong Mango Leaf Extract (EDMG) could be used as an active ingredient in hair tonic preparations and to test the activity of the hair tonic preparations as an antidandruff against Pityrosporum ovale fungus.

2. METHOD

2.1. Materials

The materials used were gedong mango leaves, 96% ethanol (PT Global Lab), propylene glycol (CV. Clorogreen), methyl paraben (PT. Sumber Berlian Kimia), sodium metabisulfite (CV. Cipta Anugrah), menthol (PT. Sumber Berlian Berlian Kimia), Tween 80 (Technical from PT Global Lab), Na2EDTA (PT Global Lab), Triethanolamin (Technical Pro, PT. Brataco), Aquadest (PT. Indo Daisun Sakti), Mushroom Pityrosporum ovale, HCl (PT Global Lab), concentrated HCl (PT Global Lab), Mayer's reagent, Methanol (PT Global Lab), Mg powder, KOH (PT Global Lab), Liberman-Burchard reagent, FeCl3 (PT Global Lab), KOH (PT Global Lab), Sodium Acetate (PT Global Lab), Lactic Acid (PT Global Lab), Popato Dextrose Agar (PDA), H2SO4 (PT Global Lab), BaCl2 (PT Global Lab), AlCl3, (PT Global Lab), Sodium Acetate (PT Global Lab), Methanol 96% (PT Global Lab).

2.2. Course of Research

2.2.1. Material Collection and Determination

5 Kg of fresh simplicia was obtained from Dawuan village, Tengah Tani District, Cirebon Regency and was determined at IAIN Syekh Nurjati Cirebon.

2.2.2. Preparation of Gedong Mango Leaf Extract (EDMG)Pembuatan Natural Deep Eutectic Solvents (NADES)

Using sodium acetate and lactic acid solvents with a molar ratio of 1:3. Sodium acetate weighing 41 grams is dissolved in 500 mL aquadest, and lactic acid weighing 135 grams is dissolved in 500 mL aquadest. Mix the mixture of each sample and then melt it using magnetic stirrers at 70 ºC until it is homogeneous.

2.2.3. Extraction of Bioactive Compounds Using Natural Deep Eutectic Solvents (NADES)

The extraction process used in this research is the Microwave Assisted Extraction (MAE) method. The process of mixing the dry simplicia was carried out for each sample weighing 50 grams in 1000 mL of the Natural Deep Eutectic Solvents (NADES) solution that had been prepared and then put it in the microwave for 19 minutes and the temperature used was 80 according to the orientation results. After the mixture After the mixture is extracted, it is filtered using filter paper (Ivanovic et al., 2020).

2.2.4. Phytochemical Screening

a. Alkaloid Test

As much as 2 mL of gedong mango leaf extract was dissolved in 2 mL of 2% HCl, heated for 5 minutes, and then filtered. As much as 2-3 drops of Mayer's reagent are added dropwise to the resulting filtrate. The results of the alkaloid test showed the presence of a white precipitate.

b. Flavonoid Test

As much as 2 mL of gedong mango leaf extract was dissolved in 2 mL of methanol, then added Mg powder and five drops of concentrated HCl were. The results of the flavonoid test show a red or orange colour.

c. Saponin Test

As much as 2 mL of mango gedong leaf extract was dissolved in distilled water and then added ten drops of 0.1 N KOH were in a test tube, heated in a water bath at 50° for 5 minutes, and shaken for 15 minutes. If foam bubbles are formed as high as 1 cm and remain stable for 15 minutes, this indicates the presence of saponin compounds.

d. Steroids and Terpenoids

As much as 1 mL of Liberman-Burchard reagent was added to 2 mL of gedong mango leaf extract. The results of this test indicate the presence of dark blue or blackish green.

e. Polifenol Test

As much as 2 mL of gedong mango leaf extract was dissolved in 10 mL of distilled water, heated for 5 minutes, and then filtered. The resulting filtrate was added 4-5 drops of 5% FeCl3. The results show the presence of a blue or green-black colour.

f. Tannin Test

A total of 2 mL of gedong mango leaf extract was added with FeCl3 reagent. The results show the presence of dark blue or blackish green (Ningsih et al., 2017).

2.2.5. Determination of Total Flavonoid Content

a. Preparation of Quercetin Standard Solution

Quercetin mother standard solution 1000 ppm, then pipetted as much as 0.3 mL; 0.4mL; 0.5mL; 0.6 mL and dissolved in 5 mL of 70% ethanol. After that, quercetin standard solutions were prepared with concentrations of 60 ppm, 80 ppm, 100 ppm, and 120 ppm. As much as 1 mL of quercetin standard solution was added to 10% AlCl3, and 8 mL of 5% CH3COOH, then left for operating time. Furthermore, the absorbance of each solution concentration was measured using the UV-Vis spectrophotometry method (Asmorowati & Lindawati, 2019). Where the results of the absorbance calculated by calculating the concentration of quercetin are:

$$y = a + bX \quad (1)$$

y = absorbance (A)

x = Concentration (C)

b. Measurement of EDMG Flavonoid Levels

A total of 100 mg of gedong mango leaf extract was weighed and dissolved in 10 mL of 70% ethanol; the mixture was sonicated for 10 minutes until homogeneous and then allowed

to stand for 30 minutes. 1 mL of the test sample was added with 1 mL of 10% AlCl3 and 8 mL of 5% CH3COOH, then left for 12 minutes. Furthermore, the absorbance of each solution concentration was measured using a UV-Vis spectrophotometer (Asmorowati & Lindawati, 2019).

c. Calculation of the Coefficient of Variation (% CV)

The purpose of calculating % CV is to determine the ratio between the deviation of total flavonoid levels and the average levels of gedong mango leaf extract samples expressed in percent. The value of the coefficient of variation is declared good if it is less than 2% (Asmorowati & Lindawati, 2019).

2.2.6. Hair Tonic Formulation and Manufacturing Method

The hair tonic was made in 3 formulas with varying concentrations of gedong mango leaf extract 5%, 7% and 10%. The hair tonic formula refers to research by Hindun (2017), and the concentration of gedong mango leaf extract refers to research (Putri, 2020). The formula can be seen in **Table 1**.

Table 1. Hair Tonic Formulas

Ingredients	Base	Formulas (%)		
		1	2	3
Gedong mango leaf extract		5	7	10
Ethanol 96%	35	35	35	35
Propylene glycol	15	15	15	15
Methylparaben	0.075	0.075	0.075	0.075
Propyl paraben	0.025	0.025	0.025	0.025
Sodium metabisulfite	0.05	0.05	0.05	0.05
Menthol	0.2	0.2	0.2	0.2
Tween 80	1	1	1	1
Na_2EDTA	0.2	0.2	0.2	0.2
TEA	0.1	0.1	0.1	0.1
Aquadest	ad 100	ad 100	ad 100	ad 100

The first time to make a hair tonic is to weigh all the ingredients according to the calculations. Dissolve sodium metabisulfite, Na_2EDTA, and propylparaben with distilled water (m_1). Prepare a glass beaker of methylparaben and menthol dissolved in 96% ethanol (m_2). Prepare a cup to mix the tween, propylene glycol and TEA (m3). Then mix m_1, m_2, and m_3 and stir until homogeneous. Add mango leaf extract little by little, and stir until homogeneous. Added aquadest up to 100% (Hindun et al., 2017).

2.2.7. Evaluate Hair Tonic

a. Organoleptic Test

Hair tonic preparations that have been made are physically observed, including shape, colour, smell, and clarity.

b. Homogeneity Test

The homogeneity test was carried out by placing the hair tonic preparation on a glass plate and then seeing whether there were particles that were not dispersed evenly (Indriyani & Endrawati, 2021).

c. pH test

This test uses a pH meter calibrated in advance using pH buffers 4, 7 and 10. Then, dry the pH electrode using tissue paper and rinse it with distilled water (Pratiwi et al., 2018). The test was carried out using 20 mL of hair tonic solution for each formulation, then putting each into a beaker glass, immersing the pH meter in it, and waiting until the reading stabilizes (Putri, 2020).

d. Viscosity Test

This viscosity test uses an Ostwald viscometer. As much as 10 mL of hair tonic solution is put into the Ostwald viscometer tube. Then the preparation is sucked up to the upper limit of the line on the viscometer, and the preparation liquid is allowed to flow from the upper limit to the lower limit. The time required for the preparation to flow is measured with a stopwatch (Hidayat & Suhendy, 2020).

2.2.8. Anti-Dandruff Activity Test

a. Equipment Sterilization

The first step in testing the inhibitory power is to clean the tools used, sterilize them, dry them, wrap them in paper, and put them in the autoclave at 121ºC for 15 minutes. Ose needles burned with Bunsen fire (Putri, 2020).

b. Making Media So Italic

Weight 0.195 grams of Potato Dextrose Agar (PDA), then dissolve it with 5 mL of aquadest in an Erlenmeyer, stir until homogeneous, heat the Potato Dextrose Agar (PDA) solution over low heat until transparent and homogeneous, pour the media into a test tube, then cover with heavy cotton. Wrap in parchment paper and tie with mattress twine. Furthermore, it was sterilized by autoclaving at 121°C for 15 minutes. After sterilising, the media was tilted at 30 °C (Milhah, 2021).

c. Pityrosporum ovale Mushroom Rejuvenation

Rejuvenation of the Pityrosporum ovale fungus is carried out by taking one layer of the Pityrosporum ovale mushroom aseptically and scratching it on the media so that it is slanted, then incubating it for 24 hours (Milhah, 2021).

d. Making Suspension Mc. Farland

Preparation of 0.5 McFarland solution by mixing 9.95 mL of 1% H2SO4 solution with 0.05 mL of 1% BaCl2 solution in an Erlenmeyer flask to obtain a volume of 10 mL. Then shake until a cloudy solution forms. This turbidity is used as a measure of the turbidity of the fungal Suspension.

e. Preparation of Pityrosporum ovale Suspension

Take one ose of the Pityrosporum ovale fungus from the slanted agar culture, put it into each test tube containing 10 mL of 0.9% physiological NaCl solution with pure Pityrosporum ovale culture, shake until homogeneous and adjust the turbidity to be the same as Mc. Farland solution 0,5 (Putri, 2020).

f. Preparation of Agar Media for Petri dishes

To prepare agar media for Petri dishes, weigh 3.12 grams of Potato Dextrose Agar (PDA), then dissolve it in 80 mL of distilled water in an Erlenmeyer, cover the Erlenmeyer tightly using cotton that is coated and then tie it with a string. Then the Potato Dextrose Agar (PDA) agar medium is homogenized over low heat until it boils. Then sterilized by autoclaving at 121ºC for 15 minutes, then the media is ready for mushroom growth after cooling (Milhah, 2021).

g. EDMG Hair Tonic Anti-Dandruff Activity Test

Take 1 mL of Pityrosporum ovale mushroom suspension with a syringe, put it into an Erlenmeyer containing 80 mL of Potato Dextrose Agar (PDA) media, and stir until homogeneous. Pour Potato Dextrose Agar (PDA) into three Petri dishes, as much as 20 mL each, in a warm condition, then let it solidify at room temperature for 15-30 minutes so that the surface is free from the condenser. Before printing the holes in the petri dish, the petri dish was first marked with a label to place the position of the hole to be filled with hair tonic extract of gedong mango leaves at concentrations of 5%, 7% and 10%, positive control and negative control. Once marked, print a hole with a crock borer. The holes in the media were filled with various concentrations of gedong mango leaf extract hair tonic, positive control and negative

control as much as 20 L (0.02 mL) with a micropipette. After that, leave it for 30 minutes, then put it in the incubator at 37ºC for 18-24 hours, in the position of the petri dish, not upside down (Ningsih, 2017).

h. Result Reading
   1) The results are read by looking at the precise area around the hole. Then the diameter is measured using a calliper with an accuracy of 0.05 mm, taking several measurement positions in each hole.
   2) Equipment Disinfection. After the use of rare tools and materials, the next step is the disinfection of tools and materials that have been used during the research. Disinfection is done by immersing the tool. Heat until boiling for about 15 minutes, and let stand for 24 hours. Wash with soap, then rinse thoroughly.

2.2.9. Data Analysis

The data obtained were analyzed by statistical tests using the SPSS 25 program. The normality test used Kolmogorov Smirnov or Shapiro Wilk, and homogeneity used the Lavene test. The homogeneity test showed that the results were not homogeneous, so the next test used the Kruskal Wallis non-parametric test. The results of the Kruskal Wallis non-parametric test, which showed a significant difference, the test continued to the Mann-Whitney non-parametric test.

3. RESULTS AND DISCUSSION

The EDMG extraction process uses the NADES and MAE methods. NADES is an alternative solvent that can replace conventional organic solvents with volatile, flammable and toxic properties. NADES is a liquid from primary metabolites such as sugars, sugar alcohols, organic acids, amino acids, and amines. The use of NADES can help minimize environmental problems because it uses environmentally friendly solvents and minimizes costs (Ahmad et al., 2020). MAE is an extraction technique that uses microwaves to quickly and efficiently heat solvents, speeding up selective extraction. These microwaves can help reduce enzymatic activity that can damage the active ingredients (Nisa et al., 2014). MAE is an extraction method that requires fast extraction time and uses less solvent, so it is advantageous compared to other extraction methods (Enggiwanto et al., 2018).

3.1. Phytochemical Screening

A qualitative phytochemical screening test was carried out as a preliminary test on EDMG extract with the aim of knowing the presence of secondary metabolites using colour reagents. Preliminary tests carried out in this study included testing of flavonoids, alkaloids, saponins, and tannins. The results of the phytochemical screening can be seen in **Table 2**.

Table 2. Results of the Phytochemical Screening Test

Sample	Compound Class	Results
Gedong Mango Leaf Extract	Alkaloids	(+) Yellow precipitate
	Flavonoids	(+) Orange Precipitate
	Saponins	(+) Formed Stable Foam
	Steroids and Terpenoids	(-) Yellow Solution
	Tannins and Polyphenols	(+) Green-Black Solution

The results of the phytochemical screening test showed that EDMG contained positive alkaloids, flavonoids, saponins, tannins and polyphenols. Similar to research conducted by (Haryani et al., 2019), The content of secondary metabolites in mango leaves are alkaloids, flavonoids, saponins, quinones, tannins, steroids and triterpenoids.

3.2. Total Flavonoid Test

Analysis of total flavonoid content using the UV-Vis spectrophotometry method. The standard used is quercetin. Maximum wavelength measurements were carried out in the wavelength range of 400-800 nm. The maximum wavelength of quercetin measured is at a wavelength of 410 nm. The maximum wavelength is used to determine the quercetin series curve and total flavonoid content in the EDMG extract samples. In determining the quercetin standard curve, quercetin was prepared with concentration series of 60 ppm, 80 ppm, 100 ppm, and 120 ppm.

The results obtained from making a calibration curve are linear regression equations y = -0.1381 + 0.00629x. The results of linearity are indicated by the correlation coefficient (r) of r = 0.9879, which indicates that there is a good linear relationship between these variables. Determination of total flavonoid content was carried out using a UV-Vis spectrophotometer by entering the absorbance value of the sample into the quercetin standard curve equation. The results of the EDMG total Flavonoid test can be seen in **Table 3**.

Table 3. EDMG Total Flavonoid Results

Description	Total Flavonoid Levels		
	Replication	Result	
EDMG	1	6,249%	%CV = 0,4894%
	2	6,281%	
	3	6,297%	

In measuring the total flavonoid content of the gedong mango leaf extract, there was a deviation in the results, where the value of the total flavonoid content obtained should have been higher if measured at a higher concentration of 10,000 ppm. The level of total flavonoids is low because gedong mango leaves contain other flavonoids, not only quercetin but flavonoids such as mangiferin, kaemferol and rhamnetin (Suharyanti, 2017). Calculation of % CV is used to determine the ratio between the deviation of total flavonoid levels and the average EDMG level expressed in %. The value of the coefficient of variation is declared good if it is less than 2% (Asmorowati & Lindawati, 2019). In calculating the coefficient of variation of gedong mango leaf extract obtained is 0.4984%, which means that it is declared good according to SNI 16-4955-1998.

3.3. Evaluate Hair Tonic

Gedong manga leaf extract is then formulated into a hair tonic preparation. In making this hair tonic, a hair tonic base and three formulas have been mixed with mango leaf extract for formula I 5%, formula II 7% and formula III 10%. The positive control used is Piroctone olamine (Brand hair tonic Garnier neril antidandruff) which is circulating in the market.

3.3.1. Organoleptic Test

Base Formulas I 5% Formulas II 7% Formulas III 10% Positive Control

Figure 1. EDMG Organoleptic Test Results

By using the human senses as the main tool. The parameters observed were shape, odour, colour and clarity. The results obtained were that the colour of the base was clear (**Figure 1**), formula I was a yellow solution, formula II was an orange solution, and formula III was an orange

(+) solution; this colour change was due to each formula being added with different gedong mango leaf extract, the greater the amount extract in the formula, the resulting colour is getting darker or darker. The positive control of Piroctone olamine is a clear yellow solution.

3.3.2. Homogeneity Test

EDMG organoleptic test results are listed in **Figure 2**. The aim is to see and find out whether the ingredients in the prepared hair tonic are mixed evenly. The results obtained in this homogeneity test were that the base preparation and each formula were homogeneously distributed when it was dropped on the glass plate. According to research (Indriyani & Endrawati, 2021), Homogeneity tests on hair tonic preparations showed that all ingredients could be dispersed evenly without any insoluble particles, so hair tonic preparations had the same therapeutic effect when applied to the scalp.

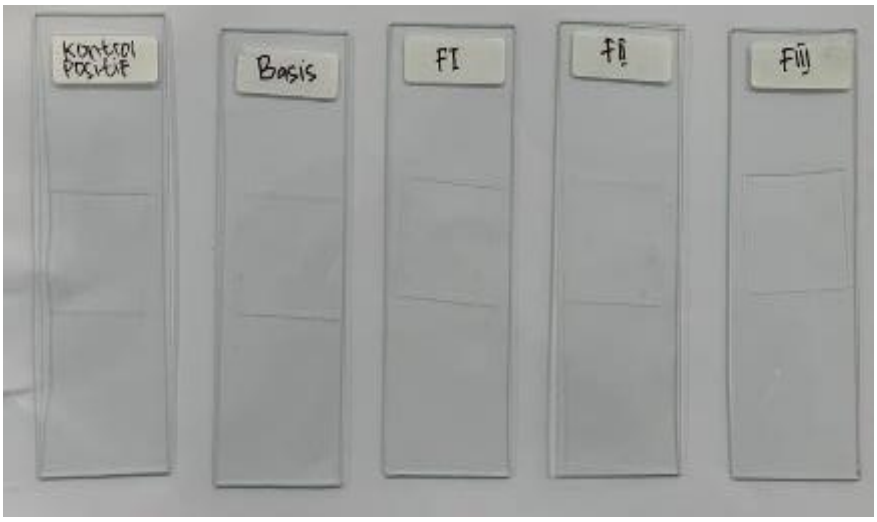


Figure 2. EDMG Organoleptic Test Results

3.3.3. pH test

The third test is the pH which is carried out using a pH meter. This test aims to determine whether the hair tonic preparations made are in accordance with the pH of the hair tonic and the pH of the scalp. The pH range that is suitable for hair tonic preparations is in the range of 3.0-7.0 according to SNI standard number 16-4955-1998 (Putri, 2020), while the appropriate pH for the scalp is 4.5-5.5 (Permadi & Mugiyanto, 2018). Based on the results of the three formulas in **Table 4**, it can be seen that, in general, they have a pH within the range according to SNI standards.

Table 4. pH Test Results for Hairtonic EDMG Preparations

	Replication			Average
	1	2	3	
Base	5,04	5,00	4,99	5,01
FI	4,53	4,52	4,50	4,51
FII	4,60	4.60	4.60	4,60
FIII	4,65	4,64	4,64	4,64
(+)	4,96	4,95	4,95	4,95

Data from the pH test results were statistically analyzed using the normality test using the Kolmogorov Smirnov method showing that the data were normally distributed (sig 0.200 (>0.05)) and the homogeneity test using the lavene test method showed it was not homogeneous (sig 0.008 (<0.05)). The test was continued with the Kruskal Wallis non-parametric statistical test showing no difference (sig 0.143 (> 0.05)), which means that the pH showed stable results.

3.3.4. EDMG Viscosity Test

Prior to testing the viscosity using Ostwald viscosity, specific gravity measurements were carried out. The hair tonic viscosity test of gedong mango leaf extract was carried out using an Ostwald viscometer, with the aim of knowing the thickness level of the preparation. Viscosity results can be seen in **Table 5**.

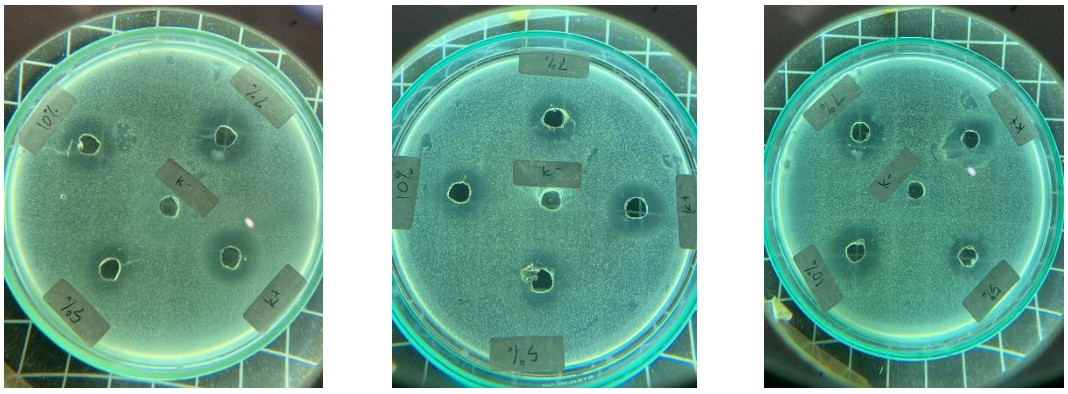
Table 5. EDMG Viscosity Results

	Replication(cp)			Total	Average	SD
	1	2	3			
Basis	1,81286	1,83335	1,78716	5,43337	1,81112	± 0,023
FI	1,91718	1,94527	1,87652	5,73897	1,91299	± 0,034
FII	1,92306	1,95125	1,90537	5,77968	1,92656	± 0,023
FIII	2,01933	2,02181	1,97403	6,01517	2,00505	± 0,026
(+)	2,30689	2,38425	2,33399	7,02513	2,34171	± 0,039

From the results of these data, the greater the concentration of gedong mango leaf extract added to the formula, the greater the viscosity value of the hair tonic. The results of statistical analysis of normality in the Shapiro Wilk test viscosity showed that the data were normally distributed for formula I (sig 0.799 (> 0.05)), formula II (sig 0.749 (> 0.05)), formula III (sig 0.088 (> 0.05))), basis (sig 0.876 (> 0.05)), positive control Piroctone olamine (sig 0.673 (> 0.05)) and statistical analysis results of the homogeneity of the lavender test showed homogeneity (sig 0.0795 (> 0.05)). Based on the results of the one-way ANOVA parametric statistical test, there was a difference (sig 0.000 (> 0.05)).

3.3.5. EDMG Anti Dandruff Activity Test

After further evaluation, the hair tonic preparation was tested for antidandruff activity against the Pityrosporum ovale fungus. The following are the results of hair tonic testing of gedong mango leaf extract at concentrations of 5%, 7% and 10% against the Pityrosporum ovale fungus using the good method, which can be seen in **Figure 3** and **Table 6**.



Replication I Replication II Replication III

Figure 3. EDMG Hairtonic Anti-Dandruff Activity Test Results

Table 6. Antidandruff activity test results

	Diameter (cm) Replication			Total	Average	SD
	1	2	3			
(-) Base	-	-	-	-	-	-
FI	1.34	1.27	1.38	3.99	1.33	+0.05
FII	1.44	1.62	1.51	4.57	1.52	+0.09
FIII	1.51	1.59	1.76	4.86	1.62	+0.12
(+) *Hair Tonic*	1.80	1.90	1.82	5.52	1.84	+0.05

Description: Control (-): Hair tonic base; Control (+) Proctone olamine

From the data above, the hair tonic preparation of gedong mango leaf extract has activity against the Pityrosporum ovale fungus. The results of these negative data control do not produce a clear zone, which means it does not have activity against the fungus Pityrosporum ovale. The formula I and formula II are included in the medium category. Formula III and positive control are included in the strong category.

Flavonoid compounds contained in gedong mango leaf extract have antifungal activity related to the ability of flavonoids to inhibit mitochondrial activity, causing disruption in the process of diffusion of food into cells and causing cell death. Unfulfillment of the need for food needed by the fungus to survive causes the death of the fungus. In addition, the mechanism of action of flavonoids as antifungals is their ability to inhibit fungal growth by forming complex bonds with proteins that can cause denaturation in processes that can cause cell permeability disorders (Jihad et al., 2020). The hydroxyl groups present in flavonoid compounds cause changes in organic components and nutrient transport, which in turn cause toxic effects on fungi (Komala & Siwi., 2020).

The results of the statistical normality analysis of the Shapiro Wilk test showed that the data were normally distributed for formula I (sig 0.702 (> 0.05)), formula II (sig 0.756 (> 0.05)), formula III (sig 0.609 (> 0.05)) and positive control Piroctone olamine (sig 0.363 (> 0.05)) and the results of the statistical analysis of the homogeneity of the lavender test showed homogeneity (sig 0.364 (> 0.05)) which showed that the data was distributed homogeneously. Based on the results of the one-way ANOVA parametric statistical test, there was a difference (sig 0.001 (<0.05), where formulas I, II and III containing gedong manganese leaf extract had a significant difference with the negative control.

4. CONCLUSION

EDMG can be formulated into hair tonic preparations with concentrations of 5%, 7% and 10%. EDMG hair tonic preparation has antidandruff activity against Pityrosporum ovale fungus. The hair tonic formula with a concentration of 5% and 7% is included in the medium category, and a 10% concentration of hair tonic is included in the strong category. Based on these conclusions, suggestions that can be given in future research on mango gedong leaf extract need to isolate more specific secondary metabolite content and increase the concentration in the formulation preparation to be made so that it can provide more robust antidandruff properties.

5. CONFLICT OF INTEREST

There is no conflict of interest in this research.

6. ACKNOWLEDGMENTS

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