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ANTI-DANDRUFF SHAMPOO FORMULATION FROM RAMBUTAN LEAF EXTRACT (*Nephelium lappaceum L.*) AS ANTIFUNGAL MALASSEZIA FURFUR

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ABSTRACT

A shampoo is a product that is used to maintain hair. The most common hair problem is dandruff. A microorganism that causes dandruff is *Malassezia furfur*. *Malassezia furfur* is the causative microorganism that infects the skin and scalp into dandruff. This fungus can grow quickly if the head has excess oil glands. Rambutan leaf extract contains secondary metabolites that can inhibit fungal growth. Alkaloids can inhibit the growth of fungi because fungi can grow well at a pH of 3,8 – 5,6. Flavonoids and tannins can cause damage to cell membrane proteins, causing changes in membrane permeability and fungal cell membrane lysis. Saponins can break down fungal cells. A shampoo formulation from Rambutan leaf extract sets it apart from other anti-dandruff shampoos because its herbal composition is safe and increases bioavailability benefits. The method used is laboratory experimental. This research procedure is making rambutan leaf extract using a rotary evaporator, making shampoo by compounding the formulation components, growing test mushrooms on PDA media, making test mushroom suspensions, and conducting the research and data collection. The result showed that shampoo from rambutan leaf extract has an inhibition zone diameter of 0.3 cm to 0.6 cm had a moderate growth inhibition response. The results of the antifungal activity test showed that the rambutan leaf extract shampoo concentration of 10%, 15% and 30% can inhibit the growth of fungi with the best inhibitory concentration at 30% in a strong category.

Keywords: Shampoo, Malassezia furfur, Rambutan leaf extract

INTRODUCTION

Humans have hair as a head protector from heat and cold. Hair is also useful for influencing in terms of aesthetics. Healthy hair will give a positive impression on someone. Therefore, many men and women do hair care to care for their hair's health [1]. However, not a few also realize that hair sometimes has problems. Dandruff is a common hair problem in tropical areas with high temperatures, like Indonesia [2].

Dandruff is a form of scalp disorder characterized by excessive flaking of the stratum corneum of the scalp to form fine scales. This disorder is accompanied by irritation, dry and oily hair [3]. The main cause of dandruff is excessive sweat gland secretion on the scalp or the emergence of microorganisms [4]. Dandruff cannot be fully cured with the aid of chemicals. Dandruff is a non-inflammatory and chronic condition which is characterised in the most common dermatological skin problem, related to the scalp that is eminent by an excessive range of scalp tissue being affected. Dandruff is also caused by secretion of glandula sebacea [5].

Sakinah in [6] stated that *Malassezia furfur* is a microorganism diagnosed as the cause of dandruff. *Malassezia furfur* is a natural microflora on the scalp, but in the case of hair with excess sebaceous glands, this fungus can grow excessively and cause dandruff. *Malassezia furfur,* formerly known as *Pityrosporum*, may be a yeast that infects the skin and scalp [7].

Malassezia furfur, which the main fungal causes dandruff, can grow under special conditions such as temperature, humidity, high oil content, and low immune factors. The treatment for dandruff that is most often used is usually a shampoo product. However, the success of dandruff treatment is also determined by the cleanliness of the hair and scalp and the regularity with which the treatment is carried out, which is supported by a good lifestyle [8].

Malassezia, which affects dandruff is a common problem in world's population. Dandruff affects nearly 50% of the world's population without race and gender predisposition. Several factors influence dandruff, namely sebaceous gland activity and individual susceptibilities, such as immunological factors, emotional stress, nutritional factors, genetic factors, environmental factors, and haircare practice [9].

Natural shampoo can be used as an alternative to shampoo that can solve scalp problems without causing chemical side effects. However, using natural raw materials is believed to affect the scalp's sebaceous (oil) glands. One of them is the use of shampoo derived from rambutan leaf extract. A shampoo formulation from Rambutan leaf extract sets it apart from other anti-dandruff shampoos in the market because its herbal compotition that safe and increase the benefits of bioavailability, so this research can optimizing the potential of rambutan leaf extract as a natural ingredient for anti-dandruff shampoo.

Rambutan (*Nephelium lappaceum* L.) is a widely distributed plant in Indonesia. Aside from eating the fruit, this plant has numerous health benefits as an antioxidant, antidiabetic, antimicrobial, antiviral, and anticancer agent [10]. In addition, rambutan leaves contain several ingredients, including tannins and saponins [11]. Saponins play a role in inhibiting microbial growth [12], while tannins are natural pigments in plants soluble in water [13].

According to previous research from [14], plant extracts are used in anti-dandruff shampoos. In that research, hibiscus flower extract can cure Dandruff as skin conditions that mainly affect the scalp include flaking and mild itchiness. Previous research also tested the effect of cabbage extract in combination with pandan leaf extract and other research, namely the effect of green tea leaf extract as an

anti-dandruff shampoo [15,16]. Therefore, the researcher innovated by testing the formulation of an anti-dandruff shampoo from rambutan leaf extract (*Nephelium lappaceum*) as an antifungal for *Malassezia furfur*, which was supported by data on the efficacy of rambutan leaves and their abundant availability and had not been used optimally.

The shampoo preparation product was chosen because it has the right consistency for dandruff caused by the fungus, is easy to use, and has a positive effect. In addition, shampoo preparations are suitable for application to the hair. Thus, the novelty and advantage of this research is the utilization and optimization of the potential of rambutan leaf extract as a natural ingredient to make shampoo products that are expected to be antifungal shampoos for *Malassezia furfur* that causes dandruff. Shampoo from rambutan leaf extract contains saponin used to treat dandruff [17]. Saponins are natural ingredients that have properties as foaming agents and natural antibacterial agents [18]. This shampoo has an inhibition zone diameter of 0.3 cm to 0.6 cm had a moderate growth inhibition response. Researcher use variation of concentrations; 10%, 15%, and 30%. All of concentrations can inhibit the growth of the *Malassezia furfur* fungus in a strong category. Therefore, the novelty of this research is increasing the benefits of bioavailability from rambutan leaf in Indonesia.

METHOD

Materials

The tools needed are a rotary evaporator, an autoclave, 2 stirring rods, 2 pairs of mortar and pestle, 4 100 mL beakers, 2 10 mL measuring cups, 4 250 mL Erlenmeyer, 2 horn spoons, an analytical balance, 2 glass containers, 4 ose needles, 4 shampoo containers, an oven, blender, hot plate, and indicator paper. The ingredients needed: 2 kg of rambutan leaves (*Nephelium lappaceum*), 10 L of distilled water, 2 L of 96% ethanol from Merck brand, 30 grams of potato dextrose agar (PDA) from Merck brand, 100 g NaCl, 5 grams of BaCl2, *Malassezia furfur* fungus, 10 mL H_2SO_4, 20 mL SLS, 10 grams of HPMC, 15 mL of glycerol, 3 grams of methylparaben, 3 grams of propylparaben, and enough fragrance (pink rose). The following are the stages of research.

Making Rambutan Leaf Extract

The required rambutan leaves are washed with running water until all the dirt is gone. Then they are finely chopped to speed up the drying process. Then it is dried to reduce the water content, avoid enzymatic reactions, and preventing the quality of rambutan leaves from decreasing. When drying the sample, the sample is covered with a dark (black) cloth to avoid direct sunlight, which can damage the chemical properties of the dried rambutan leaves. Rambutan leaf extraction was carried out by the maceration method for approximately 2-3 days at room temperature and protected from light, stirring occasionally to avoid saturation. Using ethanol as a solvent the resulting liquid extract was then evaporated until thickened using a rotary evaporator at a temperature of 60°C.

Making Shampoo Formulation

Prepare the materials and tools needed, and weigh the materials to be used.

Make mucilage HPMC by heating 30 mL of distilled water to a boil, adding 54 mg of methylparaben and 0.9 grams of HPMC, stirring until well mixed, and adding 1/5 part of hot water into the mortar and letting it stand for 15 minutes. Then, it is crushed vigorously to form mucilage. The ethanol extract of rambutan leaves was mixed into the HPMC mucilage and then ground. In a porcelain cup, combine 1.5 mL of glycerol and 6 mg of propylparaben, then add to the mortar and mix until well combined. Gradually add 3 mL of SLS, grind gently so as not to form foam, add enough fragrance (pink rose) to the mortar and stir until well blended. Place it in a shampoo formula container and label it.

Making Potato Dextrose Agar (PDA) Media

The growing medium was made by mixing Potato Dextrose Agar (PDA) with distilled water in an Erlenmeyer flask. The medium is heated with a hot plate while stirring until it boils so that the medium is homogeneous. Sterilize the media in an autoclave for 15 minutes at a temperature of 120°C [19]. PDA is used to obtain the pure fungal strain by transferring *Malassezia furfur* as fungi into it, so the fungi could be isolated solely [20].

Test Mushroom Rejuvenation

Using an ose needle, I scraped a pure culture of *Malassezia furfur* on PDA media. Then incubate the media at 37°C for 18–24 hours to get *Malassezia furfur* colonies [19].

McFarland Standard Manufacturing

A standard McFarland solution was made by mixing 9.5 mL of 1% H_2SO_4 with 0.5 mL of 1% $BaCl_2$ until the volume became 10 mL, then mixing and shaking until the solution was well mixed. When comparing mushroom suspensions, the solution should always be shaken.

Mushroom Suspension Manufacturing

Take one ose of *Malassezia furfur* colony, then put it in a test tube filled with 5 ml of 0.9% NaCl. Next, shake the test tube until it is homogeneous.

Test Media Creation

Testing the effect of shampoo on the growth of *Malassezia furfur* fungus using the pour plate technique. 100 of the test mushrooms were poured evenly on the PDA media and then smeared on the media using a sterile L rod. The media was then incubated again for ± 1 day. After incubating, put 5 paper discs on the media and adjust the distance so that the right and left are equal. Drop each control and extract it onto a paper disc. For positive control, shampoo with rambutan leaf extract at concentrations of 10%, 15%, and 30% was used. Meanwhile, for the negative control, shampoo with rambutan leaf extract was used at a concentration of 0%. Then, incubate the test media that has been treated for ± 20 hours at a room temperature of 37°C.

Research and Data Collection

The parameters studied in this research were the diameter of the inhibition zone due to the treatment of rambutan leaf extract shampoo formulations with different extract levels as the independent variable and the growth medium in the form of PDA as the dependent variable. First, the inhibition test was observed through a clear zone scattered around the paper disc. Next,

measure the diameter of the inhibition zone (cm) using a scale ruler.

The procedure of this research is as follows: (a) Treatment 1: Control, shampoo with 0% rambutan leaf extract was applied to PDA media containing *Malassezia furfur* fungus; (b) Treatment 2: Shampoo with 10% rambutan leaf extract was applied to PDA media containing *Malassezia furfur* fungus; (c) Treatment 3: Shampoo with 15% rambutan leaf extract was applied to PDA media containing *Malassezia furfur* fungus; and (d) Treatment 4: Shampoo with 30% rambutan leaf extract was applied to PDA media containing *Malassezia furfur* fungus.

This study uses the *One Way Analysis* of Variance testing technique with a 95% confidence level. This test was conducted to determine the effectiveness of the formulation of anti-dandruff shampoo from rambutan leaf extract as an antifungal for *Malassezia furfur*. Furthermore, the Least Significance Difference (LSD) and Duncan further tests were carried out to see significant and insignificant differences in each treatment [21].

The data was obtained from measuring the clear zone with a scale ruler. The wider the inhibition zone, the better the effectiveness of the anti-dandruff shampoo derived from rambutan leaf extract as an antifungal for *Malassezia furfur*. If H_0 is rejected, shampoo from rambutan leaf extract affects the antifungal *Malassezia furfur* that triggers dandruff (H_1 is accepted). If H_0 is accepted, then shampoo from rambutan leaf extract does not affect the antifungal *Malassezia furfur* that triggers dandruff (H_1 is rejected).

Data Analysis

The data analysis technique in this study used the ANOVA test in SPSS, which aims to determine the effect of treatment with shampoo having various concentrations of rambutan leaf extract on the growth of the fungus *Malassezia furfur*. The next stage is to carry out a post hoc least significance difference (LSD) and Duncan follow-up test to determine whether each treatment has significant or insignificant differences.

RESULTS AND DISCUSSION

Sample Preparation

Sample preparation impacts nearly all the later steps in the analytical process, as it is critical for identifying, confirming, and quantifying analytes [22]. The main objectives of sample preparation are: (1) to remove potential interferents; (2) to preconcentrate analytes; (3) to convert (if needed) the analyte into a more suitable form for detection or separation; and (4) to provide a robust, reproducible method independent of variations in the sample matrix [22]. The rambutan leaf samples are fresh samples from the rambutan plant [23].

The sample preparation method in this study is as follows. Take the rambutan leaves, clean them with running water, dry them in the oven, grind them in a blender to a powder form, and weigh them to determine the mass of the rambutan leaves [19]. Rambutan leaves were cleaned with running water and heated in an oven so that the rambutan leaves were sterile and dry from impurities before the leaves were used in the study. Next, refining rambutan leaves is carried out to increase the surface area of the

leaves with a solvent during the extraction process and to make the withdrawal of the active substances in rambutan leaves easier. The rambutan leaf powder obtained was in the form of green powder with a mass of 251 grams.

Extraction

Extraction was done by putting 251 grams of rambutan leaf Simplicia powder into a container, soaking it in a 96% ethanol solution with a volume of 2150 ml, then closing it and leaving it for three days while stirring it periodically. After three days, filter the soaked samples with filter paper. Next, solvent evaporation was carried out using a rotary evaporator until a thick, dark green extract is formed. The next step is to weigh the extract and then save the extract at room temperature [19].

Organoleptic Test

The addition of rambutan leaf extract showed some differences rather than shampoo without the extract. The color of shampoo formulation with 0% rambutan leaf extract was clear. Meanwhile, the shampoo formulation with 10%, 15%, and 30% rambutan leaf extract was dark green because it matched the color of the rambutan leaf extract used. That level of dark green was also different for each concentration of rambutan leaf extract. From the shampoo with 10%, 15%, and 30% extract, the higher concentration of extract, the darker the shampoo colour. For the smell, all formulations with and without rambutan leaf extract smelled of roses due to the addition of pink rose fragrance in the shampoo formulation. The thickness of the shampoo formulations is very thick at 0% extract, thick at 10% extract, and liquid at 15% or 30% extract. The organoleptic properties of the shampoo with rambutan leaf extract may affect consumer acceptance and efficacy. [24] showed that the herbal shampoo had no significant difference from commercial shampoo in terms of physical appearance like color and odor. Other than that, more research is required to study further spesifically about shampoo with rambutan leaf extract. An active role in popularizing and educating the consumers about the safety and efficacy of herbal shampoo need to emphasize the quality of shampoo.

The viscosity was obtained from the addition of HPMC which in this study was used as a stabilizer and thickener of shampoo formulations. HPMC (Hydro Propyl Methyl Cellulose) was added because it is a gelling agent that can thicken and provide the texture of the shampoo through gel formation [25].

pH test

Shampoo formulations were measured using indicator paper. The pH measurement results showed that the pH of the 0% extract shampoo formulation was 8 and that of the 10%, 15%, and 30% extract shampoo formulations was 7. Therefore, the anti-dandruff shampoo was safe and did not irritate the scalp. Irritation, according to Indonesian National Standard No. 06-2692-1992, has a pH of 5.0 – 9.0. Therefore, the four shampoo formulations in this study met the pH standard of anti-dandruff shampoo [26].

Antifungal Activity Test

Data analysis techniques in this study used the normality test, homogeneity test, *One Way* ANOVA test, and post hoc test in the SPSS version 26 application. The normality test and homogeneity test are prerequisite tests. The function of the normality test is to determine whether the sample under study is normally distributed by using the Chi-square test equation [27]. The homogeneity test determines whether some population variants are identical [28]. The underlying assumption in the analysis of variance (ANOVA) is that the variance of the population is the same [28]. The *One Way* ANOVA test aims to determine the effect of shampoo treatment with various concentrations of rambutan leaf extract on the growth of the *Malassezia furfur* fungus. The next step is to carry out the post hoc least significant difference (LSD) and Duncan's further test to obtain results whether there are significant or not significant differences in each treatment.

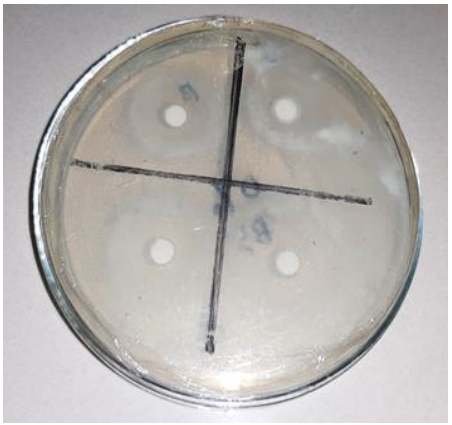

Figure 1. Results of the antifungal activity of *Malassezia furfur* shampoo anti-dandruff rambutan leaf extract with a concentration of 0%.

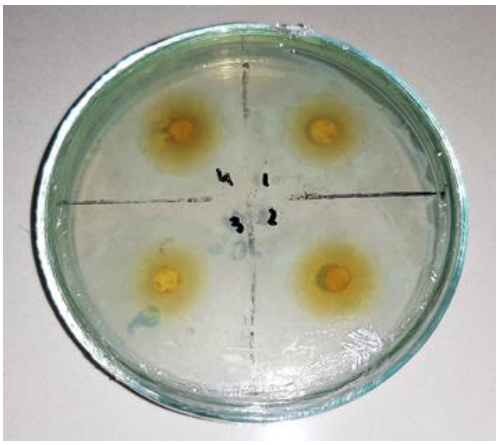

Figure 2. Results of the antifungal activity of *Malassezia furfur* shampoo anti-dandruff rambutan leaf extract with a concentration of 10%.

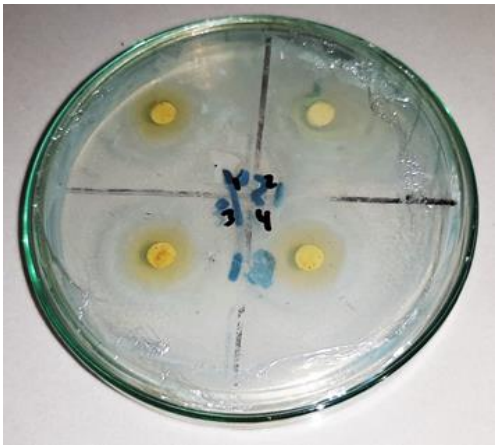

Figure 3. Results of the antifungal activity of *Malassezia furfur* shampoo anti-dandruff rambutan leaf extract with a concentration of 15%.

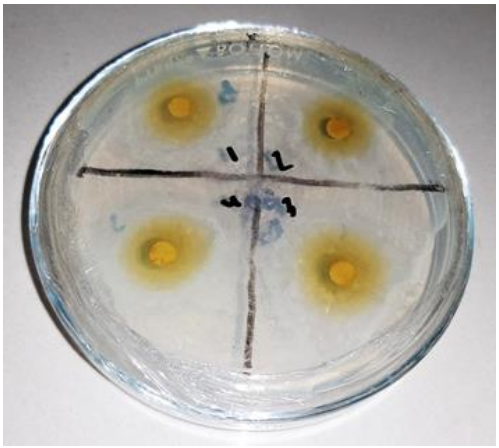

Figure 4. Results of the antifungal activity of *Malassezia furfur* shampoo anti-dandruff rambutan leaf extract with a concentration of 30%.

Table 1. Results of the antifungal activity of the anti-dandruff shampoo from rambutan leaf extract (*Nephelium lappaceum* L.)

Descriptives

Diameter of the inhibition zone of *Malassezia furfur*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	Upper Bound	Minimum	Maximum
10%	12	.842	.1564	.0452	.742	.941	.6	1.1
15%	12	.875	.1288	.0372	.793	.957	.7	1.1
30%	12	1.225	.1765	.0509	1.113	1.337	1.0	1.5
Total	36	.981	.2315	.0386	.902	1.059	.6	1.5

Table 2. Normality test results

		Kolmogorov-Smirnov			Shapiro-Wilk		
	Concentration of rambutan extract in shampoo	Statistic	df	Sig.	Statistic	Df	Sig.
Diameter of inhibition zone of *Malassezia furfur* (cm)	10%	.188	12	.200*	.932	12	.397
	15%	.220	12	.114	.920	12	.284
	30%	.177	12	.200*	.918	12	.267

*This is a lower bound of the true significance
a. Lilliefors Significance Correction

Table 3. Homogeneity test results

		Levene Statistic	df1	df2	df3
Diameter of inhibition zone of *Malassezia furfur* (cm)	Based on Mean	.752	2	33	.479
	Based on Median	.422	2	33	.659
	Based on Median with adjusted df	.422	2	30.127	.660
	Based on trimmed mean	.726	2	33	.491

Table 4. Results of *One-Way Anova* analysis

Diameter of inhibition zone of *Malassezia furfur* (cm)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.082	2	.541	22.485	.000
Within Groups	.794	33	.024		
Total	1.876	35			

Table 5. LSD and Duncan Post Hoc test results

Multiple Comparisons

Dependent Variable : Diameter of the inhibition zone of *Malassezia furfur* (cm)

	(I) Concentration of rambutan extract in shampoo	(J) Concentration of rambutan extract in shampoo	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
LSD	10%	15%	-.0333	.0633	.602	-.162	.096
		30%	-.3833*	.0633	.000	-.512	-.254
	15%	10%	.0333	.0633	.602	-.096	.162
		30%	-.3500*	.0633	.000	-.479	-.221
	30%	10%	.3833*	.0633	.000	.254	.512
		15%	.3500*	.0633	.000	.221	.479

*. The mean difference is significant at the 0.05 level.

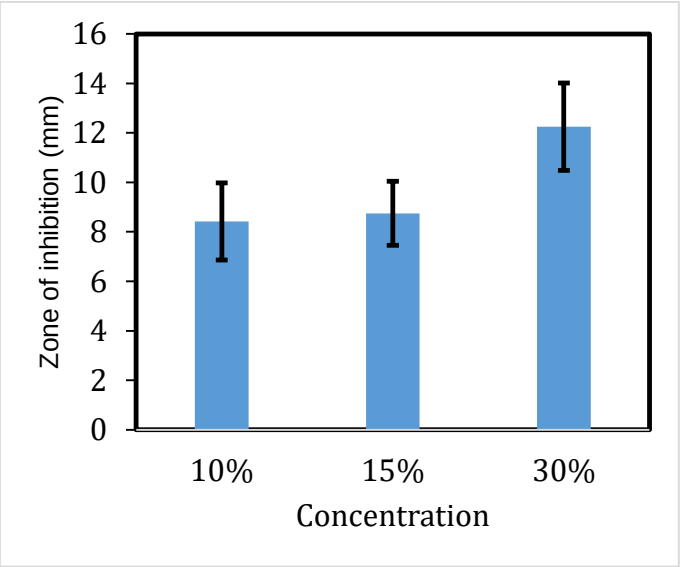

Figure 5. Inhibition zone of shampoo from rambutan leaf extract, error bar represents standard deviation.

The results of the antifungal activity of *Malassezia furfur* shampoo anti-dandruff rambutan leaf extract (*Nephelium lappaceum* L.) are shown in Table 1. Anti-dandruff shampoo with concentrations of 10%, 15%, and 30% as positive controls in each treatment showed clear areas around disc paper called the zone of inhibition. The diameter of the inhibition zone formed grew as the concentration of rambutan leaf extract increased. The inhibition zone with the largest diameter (1.225 cm) was found in shampoos with a 30% rambutan leaf extract concentration. In comparison, the inhibition zone's lowest diameter (0.842 cm) was found in shampoos with 10% concentrated rambutan leaf extract. Thus, the higher the concentration of rambutan leaf extract in the shampoo formula, the greater the antifungal activity of *Malassezia furfur*.

Table 2 shows the normality test results using the Kolmogorov-Smirnov and Shapiro-Wilk tests with a significant value of the concentration of rambutan leaf extract in shampoo > 0.05, so the data is normally distributed. In addition, the data from this study were tested for homogeneity (Table 3) with a significance value of > 0.05, so the data were homogeneously distributed. Furthermore, the *One-Way ANOVA* test was carried out with a 95% confidence level (Table 4) with the results that there was a significant effect with a significance value of 0.000 < 0.005. There was a significant difference between the concentration groups of rambutan leaf extract in anti-dandruff shampoo. The results of the *One-Way ANOVA* test showed that H_0 was rejected, so the next step was to conduct further tests (Post Hoc Tests) to see which test groups were different (Table 5).

There are three groups of antimicrobial inhibition based on the diameter of the inhibition zone. The antimicrobial inhibition group based on the diameter of the inhibition zone was determined as follows: an area with an inhibition zone diameter of 0 cm to 0.3 cm had a weak growth inhibition response, an

area with an inhibition zone diameter of 0.3 cm to 0.6 cm had a moderate growth inhibition response. In comparison, areas with an inhibition zone diameter of more than 0.6 cm had a strong growth inhibition response [29]. Based on these categories, the effectiveness of the anti-dandruff shampoo of rambutan leaf extract with a concentration of 10%, 15%, and 30% had a strong fungal growth inhibition response.

Post Hoc test values in Table 5 indicate that there is a significant difference in antifungal activity between bases (0%) and F1 (10%), F2 (15%), and F3 (30%) because $P < 0.05$. This means that there is a significant difference between the average diameter of the fungus Malassezia furfur inhibition zone (cm) with a concentration of 10% and a concentration of 15% with a concentration of 30%. The trend that can be observed in Figure 5 is that the greater the concentration of rambutan leaf extract in the shampoo, the larger the diameter of the inhibition zone against the *Malassezia furfur* fungus (cm). This follows the research results of [30] that the higher the concentration, the larger the inhibition zone.

A shampoo is a product that is used to maintain healthy and clean hair. The most common hair problem is dandruff. The microorganism that is the main cause of dandruff is *Malassezia furfur*. The presence of this fungus on the scalp is normal, but it will be abnormal if the hair has excess oil glands, so the fungus can grow quickly. Rambutan leaf extract contains steroids, flavonoids, polyphenols, and tannins. The compounds, which are secondary metabolites have the function of inhibiting the growth of fungi. Alkaloids are basic compounds that can inhibit the growth of fungi. This is because fungi can grow well at pH 3.8 – 5.6. Flavonoids and tannins can cause damage to cell membrane proteins, causing changes in membrane permeability and fungal cell membrane lysis. Saponins can break down the lipid layer in cell membranes, making fungal cells swell and burst. The method used in formulating this rambutan leaf extract shampoo is by making rambutan leaf extract, making shampoo from rambutan leaf extract, growing test mushrooms on PDA media, making test mushroom suspensions, and research and data collection.

The activity of shampoo with rambutan leaf extract had a better effect than pure extract. Rambutan leaf extract (*Nephelium lappaceum* L.) has secondary metabolites to inhibit the growth of the fungus *Malassezia furfur*. These flavonoids break down proteins and disrupt the lipid layer, which can damage cell walls. The lipophilic nature of these flavonoids will bind to phospholipids in fungal cell membranes and interfere with cell membrane permeability, so smooth cell membranes and compounds penetrate the cell nucleus, preventing fungi from developing [31]. Tannins function to inhibit the biosynthesis of ergosterol, the main sterol for forming fungal cell membranes [32]. Saponins change cell membranes' stability, increasing permeability so that intracellular fluid is pulled out of cells, including nutrients, metabolic substances, enzymes, and cell proteins, so that fungi die [31]. Shampoo with rambutan leaf extract (*Nephelium lappaceum* L.) can inhibit (fungistatic) and kill (fungicide) the growth of the fungus *Malassezia furfur*

because it contains preservatives that help secondary metabolites of rambutan leaves inhibit and kills the growth of *Malassezia furfur* [33].

To see the effectiveness of fungal inhibition with rambutan leaf extract anti-dandruff shampoo, an antifungal test of *Malassezia furfur* anti-dandruff shampoo from rambutan leaf extract was carried out. The data in this study were obtained by measuring the diameter of the inhibition zone of the fungus *Malassezia furfur,* which had been smeared with shampoo from rambutan leaf extract on disc paper placed on PDA media. The data were tested using the SPSS application with the *One-Way* ANOVA test.

The anti-dandruff shampoo from rambutan leaf extract (*Nephelium lappaceum* L.) with concentrations of 10%, 15%, and 30% as positive control in each treatment showed a clear area around the paper disc called the inhibition zone. The diameter of the inhibition zone formed grew as the concentration of rambutan leaf extract increased. The inhibition zone with the largest diameter was found in shampoos with a 30% rambutan leaf extract concentration. In comparison, the lowest diameter of the inhibition zone was found in shampoos with 10% concentrated rambutan leaf extract. Thus, the higher the concentration of rambutan leaf extract in the shampoo formula, the greater the antifungal activity of *Malassezia furfur*.

According to [34], the inhibition zone formed on the growth of the fungus *Malassezia furfur* was due to the presence of compounds attached to the cell surface. This indicates that the compounds contained in rambutan leaf extract diffuse into fungal cells which can cause inhibition of the growth of *Malassezia furfur* due to intracellular leakage in the fungus that interferes with the mitochondrial metabolism of fungal cells.

CONCLUSION

Based on the result of research and discussion, it shows that of the three concentrations of rambutan leaf shampoo, with various concentrations; 10%, 15%, and 30%, it was obtained that the shampoo with a concentration of 30% rambutan leaf extract had the best effectiveness in inhibiting the *Malassezia furfur* fungus with the largest inhibition zone diameter. The data from the *One Way Anova* test results in this study is known to have a significant effect with a significant number of 0.000 < 0.005, so it can be concluded that the average of the three test samples has a significant effect. It means rambutan leaf extract shampoo with these three concentrations was proven to give strong fungal inhibition results. The suggestion from this research is to be further investigated in formulating the most effective and innovative shampoo preparations. It is hoped that the results of this study can be used as reference material for further researchers, namely Anti-Dandruff Shampoo Formulation from Rambutan Leaf Extract (*Nephelium lappaceum* L.).

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