Effectiveness Extract Temulawak (*Curcuma zanthorrhiza*) as an Insecticide Against Kutu Rambut (*Pediculus humanus capitis*)

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Abstract.

Temulawak (Curcuma zanthorrhiza) contains secondary metabolite compounds that allow this plant to be used as an alternative insecticide. Several secondary metabolite compounds of temulawak, namely phenols, terpenoids, flavonoids, saponins, alkaloids and tannins have insecticidal properties against head lice. This study aims to study the effectiveness of administering temulawak extract against kutu rambut (Pediculus humanus capitis). This study is experimental, namely in the form of administering temulawak extract to head lice. The extract used was divided into 4 concentrations, namely 0% (K0), 7% (P1), 9% (P2) and 11% (P3). The results of the One Way ANOVA analysis showed a significant difference in the average percentage of kutu rambut deaths between the control group and the treatment group with a value ($p = 0.001 < \alpha$ (0.05)). The Bonferroni post hoc test revealed a significant difference in the average percentage of kutu rambut deaths between group K0 and group P1 ($p=0.028$), between group P2 and group P3 ($p=0.045$), between group P1 and group P3 ($p=0.002$), and between group P2 and group P3 ($p=0.048$). However, there was no significant difference in the average percentage of kutu rambut deaths between group P1 and group P2 ($p=0.185$). This is considered effective as an insecticide against kutu rambut at concentrations of 9% and 11%, as the average percentage of kutu rambut deaths at the 9% concentration was 50-60%, and at the 11% concentration the average number of kutu rambut deaths was 80-90%.

Keywords: *Insecticide; Kutu rambut and Javanese Curcuma.*

I. INTRODUCTION

Kutu rambut (Pediculus humanus capitis) are parasites that infest the human scalp. They belong to the Pediculidae family and feed on human blood, causing skin lesions. Kutu rambut are highly disruptive because they can cause itching, erythema, and redness, and in severe cases, secondary infections. Hair strands become stuck together and harden, and pus exudates are found due to inflammation from parasite bites [6].Currently, treatments available for kutu rambut (Pediculus humanus capitis) include topical products such as Pedetox, but these contain many chemicals [8]. Physical treatments can also be used to remove lice and their eggs from the scalp, such as using a lice comb. Systemic treatment with ivermectin is also available; however, this prevention option can cause allergic reactions. Ivermectin is a semi-synthetic macrocyclic lactone compound derived from the soil microorganism Streptomyces avermitilis [1]. Javanese ginger (Curcuma zanthorrhiza) is a rhizome-bearing plant with a growth period of 9-12 months [4]. Screening results indicate several secondary metabolites in Javanese ginger rhizomes, including phenols, terpenoids, flavonoids, saponins, alkaloids, and tannins [4,2].

According to Pritacindy et al. in 2017, saponins, alkaloids, flavonoids, triterpenoids, limonoids, essential oils, tannins, citronellol, acetogenin, phorbolester, curcin, annonain, squamosin, isoflavones, cineole, aliixin, acetic acid, phenylpropanoids, lauric acid, and steroids are known to be insecticidal agents [10].Secondary metabolites such as phenols, terpenoids, and flavonoids are allelochemicals that can inhibit kutu rambut cell division [11]. Saponins act as stomach and respiratory toxins in insecticides and disrupt cell membrane function. Furthermore, it can also be used as a soap to remove the waxy coating that protects kutu rambut from death [3,7].Therefore, the Javanese ginger (Curcuma zanthorrhiza) plant has the potential to be developed as an insecticide against kutu rambut because its metabolites can influence the cell division process in head lice. Based on this, research was conducted on the effectiveness of Javanese ginger (*Curcuma zanthorrhiza*) extract as an insecticide against kutu rambut (*Pediculus humanus capitis*).

II. METHODS

This research was an experimental study with a post-test only control group design. Four groups were used: a group without temulawak extract (K0), a group given a 7% concentration of temulawak extract (P1), a group given a 9% concentration of temulawak extract (P2), and a group given an 11% concentration of temulawak extract (P3). The total sample size was 80 adult head lice, and the sampling method was random. The procedure for studying the effectiveness of temulawak (Curcuma zanthorrhiza) extract as an insecticide against kutu rambut (Pediculus humanus capitis) was as follows:

Preparing Temulawak Extract

The temulawak was cleaned, the skin removed, washed, and cut into small pieces. Then, 300 grams of temulawak was weighed for extraction using the maceration method with 96% ethanol. The sample was put into a maceration container, then soaked with 96% ethanol, then the maceration container was closed and stored for 3 days, repeated 2 times, then filtered to separate the dregs and filtrate, the dregs were re-extracted with the same amount until the soaking was not too thick, the extract obtained was then evaporated using a rotary evaporator. The results of the temulawak extract were put into a glass beaker.

Research Testing Stage

The curcuma extract was then prepared according to the concentrations to be used in the research test: 0% (K), 7% (P1), 9% (P2), and 11% (P3). Adult kutu rambut samples were then placed in petri dishes, covered with filter paper. The filter paper was cut to form a circle around the petri dish, ensuring the filter paper reached the bottom of the dish. Then, 1 ml of the prepared extract for each concentration (0%, 7%, 9%, and 11%) was dripped onto each kutu rambut treatment group. The number of dead lice was counted over a 5-hour period, with two repetitions. The data obtained from the number of dead lice over the 5-hour period was then processed. The extract solution was considered effective in killing kutu rambut and has potential as a natural insecticide if the number of dead lice samples was 50%-100% of the sample used, based on the effectiveness test of botanical insecticides on kutu rambut motility.

III. RESULT AND DISCUSSION

Testing the effectiveness of Javanese turmeric (Curcuma zanthorrhiza) extract as an insecticide against kutu rambut (Pediculus humanus capitis) yielded the following results:

Table 1. Results of Testing the Effectiveness of Javanese Turmeric (Curcuma zanthorrhiza) Extract as an Insecticide against Kutu rambut (Pediculus humanus capitis).

Concentration	Replication	Time	Amount Kutu Deaths	Percentage of Deaths Kutu	Average	Information (E/T)
K0	1	5 hours	0	0%		T
	2	5 hours	0	0%	0%	
P1	1	5 hours	4	40%	35%	T
	2	5 hours	3	30%		
P2	1	5 hours	6	60%	55%	E
	2	5 hours	5	50%		
P3	1	5 hours	8	80%	85%	E
	2	5 hours	9	90%		

Description:
K0 = control
P1 = 7% concentration
P2 = 9% concentration
P3 = 11% concentration
E = Effective (if the average value is >50%)
T = Not (not effective if the average is <50%)

Based on **Table 1**, in the K (Control) group, the average percentage of kutu rambut mortality was 0%, or no kutu rambut died. Meanwhile, at concentrations of 7% (P1), 9% (P2), and 11% (P3), the average percentages of kutu rambut mortality were 35%, 55%, and 85%, respectively. Curcuma zanthorrhiza extract was effective as an insecticide against kutu rambut (Pediculus humanus capitis) at concentrations of 9% and 11%.

Data Analysis

Based on the results of the data normality test using the Kolmogorov-Smirnov test, the probability value was p=0.200>0.05, indicating that the data were normally distributed. Therefore, the data analysis was continued with a One-Way ANOVA test. The results of the One-Way ANOVA test on the mean percentage of kutu rambut (Pediculus humanus capitis) mortality by treatment group are shown in Table 2 below.

Table 2. Results of the One-Way ANOVA Test on the Mean Percentage of Kutu rambut (Pediculus humanus capitis) Mortality by Treatment Group.

Group	Average ± SD	*P*
K0	00. ± 0.00	*0,001*
P1	3.50 ± 0.707	
P2	5.50 ± 0.707	
P3	8.50 ± 0.707	

Description:
K0=Control
P1=Concentration 7%
P2=Concentration 9%
P3=Concentration 11%

Based on Table 2, the results of the One-Way ANOVA test obtained a p-value <0.05, indicating a significant difference in the mean percentage of kutu rambut (Pediculus humanus capitis) mortality in each treatment group. To determine which groups had significant differences in the mean percentage of kutu rambut (Pediculus humanus capitis) mortality, a Bonferroni post-hoc test was used. The results of the Bonferroni post-hoc test on the mean percentage of kutu rambut (Pediculus humanus capitis) mortality between the study groups can be seen in Table 3 below.

Table 3. Results of the Bonferroni Post-hoc Test on the Mean Percentage of Kutu rambut (Pediculus humanus capitis) Mortality Between Study Groups.

Group	K0	P1	P2	P3
K0	_	0.028	0.005	0.001
P1	0.028	_	0.185	0.007
P2	0.005	0.185	_	0.048
P3	0.001	0.007	0.048	_

Description:
K0=Control
P1=Concentration 7%
P2=Concentration 9%
P3=Concentration 11%

Based on Table 3, the Bonferroni post hoc test results revealed a significant difference in the mean percentage of kutu rambut mortality between the K0 and P1 groups (p=0.028). There was no significant difference between the P1 and P2 groups (p=0.185). There were significant differences between the P2 and P3 groups (p=0.045), between the P1 and P3 groups (0.002), and between the P2 and P3 groups (p=0.048).

Discussion

Based on the results of the research, it was shown that temulawak (Curcuma zantorrhiza) extract has insecticidal properties against kutu rambut (Pediculus humanus capitis). There were differences in the average lice mortality rate among the four concentrations tested.In the group without temulawak extract (K0), the average lice mortality rate was 0%. In treatment group 1, with a 7% concentration of temulawak extract, the average lice mortality rate was 40%, while repeated treatments yielded similar results, at 30%. In

treatment group 2, with a 9% concentration of temulawak extract, the average lice mortality rate was 60%, while repeated treatments yielded 50%. In treatment group 3, with an 11% concentration of temulawak extract, the average lice mortality rate was 80%, while repeated treatments yielded 90%. To see the level of effectiveness, you can look at the average percentage of kutu rambut deaths. Insecticide use against kutu rambut is considered effective if the average mortality rate is 50-100%. Research has shown that a 7% concentration of Javanese turmeric extract is ineffective as an insecticide against kutu rambut (Pediculus humanus capitis) because the average mortality rate is only around 30-40%.

Concentrations of 9% and 11% Javanese turmeric extract meet the criteria for effectiveness as an insecticide against head lice, with average mortality rates of 50-60% and 80-90%, respectively.The results of this study indicate that the higher the concentration of Javanese turmeric extract used, the higher the percentage of kutu rambut mortality. This is because the higher the concentration of Javanese turmeric extract used, the higher the chemical compounds contained in the extract, thus increasing its insecticidal potential. This increase in kutu rambut mortality is due to the higher concentration of the extract, which also has higher toxic levels [12].The most important factor determining the potential danger or safety of a compound is the relationship between the chemical content and the resulting effects. The length of time the extract is stored also affects the active compound content in an extract, which can decompose if stored for too long. This prolonged storage of the extract causes extract toxicity [5]. In addition to these factors, the solvent used also affects kutu rambut mortality. This is related to the type of solvent used to dissolve the active compounds contained in the plant [5]. In the study, the extract was not stored for a long time and the solvent used was 96% ethanol [13]. The active compounds found in Javanese turmeric, namely saponins, alkaloids, tannins, flavonoids, phenols, and terpenoids, can be fully extracted. The use of the right solvent maximizes the extraction of the active compounds, which directly affects the mortality rate of head lice.

IV. CONCLUSION

Based on the research results, it can be concluded that Javanese turmeric (*Curcuma zanthorrhiza*) extract is effective as an insecticide against kutu rambut (Pediculus humanus capitis) at concentrations of 9% and 11%.This study also showed that the highest mortality rate was at the 11% concentration, while the lowest mortality rate was at the 7% concentration. It can be concluded that the higher the concentration of Javanese turmeric extract administered, the higher the mortality rate.

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