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Formulation and Effectiveness Test of Red Ginger (*Zingiber officinale* var. Rubrum) and Starfruit (*Averrhoa bilimbi* L.) Combination Shampoo Against *Pediculus humanus capitis*

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Abstract

Some of the natural ingredients that have the potential to be developed into a health product for *pediculosis* are red ginger (*Zingiber officinale* var. Rubrum) and star fruit (*Averrhoa bilimbi* L.). Secondary metabolite compounds in red ginger extract and star fruit that can potentially kill head lice *Pediculosis humanus capitis* include alkaloids, flavonoids, and saponins. The purpose of this study was to determine the physical fitness and effectiveness of the lethal power of the combination of red ginger extract and star fruit with formula 1 (F1) 1.5%, formula 2 (F2) 2%, and Formula 3 (F3) 2.5%. The tests carried out were phytochemical screening tests (alkaloids, tannins, saponins, and flavonoids), physical stability of shampoo (organoleptic, homogeneity, foam height, viscosity, and pH) for four weeks of storage, and testing the effectiveness of shampoo killing power against head lice *Pediculus humanus capitis*. Data analysis was carried out descriptively and comparatively using one-way ANOVA. Phytochemical screening of red ginger extract and star fruit was positive for alkaloids, tannins, saponins, and flavonoids. The organoleptic test of the shampoo on all three formulas produced a light brown colour, a distinctive aroma of lemon oil, and a thick shape. The homogeneity test showed a homogeneous shampoo preparation. F1 foam level test (7.7-11 cm), F2 (7.3-11 cm), and F3 (7.2-11 cm). F1 viscosity test (2,010-2,020 cps); F2 and F3 (2,020 cps). *One-way* ANOVA pH F1 test (8.54-8.77); F2 (8.01-8.70); F3 (8.61-8.77) and *One-way* ANOVA results for pH values obtained significant values of 0.096 > 0.05, while the killing power of aphids was 0.02 < 0.05. The three shampoo formulas of red ginger extract and star fruit showed good physical evaluation and still entered the test requirement range for four weeks of storage. Based on the results of statistical analysis, it was shown that the variation in the concentration of the formula did not cause a change in pH during four weeks of storage. The administration of a combination shampoo of red ginger extract and star fruit with a formulation of F1 1.5%, F2 2%, and F3 2.5% was able to have a natural effect on the average number of head lice deaths of *Pediculus humanus capitis.*

Keywords: shampoo; pediculus; red ginger; star fruit; formulation.

INTRODUCTION

One of the infectious diseases in Indonesia that is widely found in school-age children is Pediculosis capitis. This disease is caused by the bite of head lice (*Pediculus humanus capitis*) or head lice. Pediculosis capitis causes decreased confidence and interferes with activities in sufferers. Head lice are included in ectoparasites that can be transmitted through direct physical contact with sufferers, such as cuddling, sitting next to each other, and sharing items (Agistia et al., 2023). Handoko (2016) states head lice can cause human scalp infections (Putu et al., 2023).

According to *The Centers for Disease Control and Prevention* (CDC), in 2016, pediculosis was prevalent in children aged 3 to 11 years around the world. As for Indonesia, data on *Pediculus humanus capitis* infection is still limited (Ramadaniah *et al*., 2023). The study reported the prevalence of Suhesti and Pramitaningrum (2020) *pediculosis capitis* in a housing estate in Cibitung, Bekasi. As many as 85% of girls and 36% of boys were positive for *pediculosis capitis*. Agumsah and Apriani (2021) also reported pediculosis capitis in children aged 3-12, as many as 68%, in the Babakan, Asem village area, Teluk naga. The research results of the Al-Muhajirin Islamic Boarding School, Central Cikarang, reported that 36 out of 41 female students (87.8%) were positive for *pediculosis* (Anindita et al., 2024).

Treatment to overcome head lice in the community still relies on using insecticides with synthetic chemicals such as *permethrin*, *lindane*, *malathion*, and *carbaryl*. Using synthetic chemicals as anti-lice treatment circulating in the community has dangerous side effects and can trigger head lice resistance (Agistia *et al*., 2023).

Therefore, safe and effective prevention efforts are needed to prevent the spread of head lice. One of the efforts to prevent and treat head lice can be done by testing the manufacture of shampoo from natural ingredients that can be insecticides. The accuracy of the concentration and selection of natural ingredients as insecticide active ingredients is because they do not contain side effects and have residues that are easily degraded by the environment (Nurhaini *et al*., 2020).

Some natural ingredients that can be productive as anti-head lice include red ginger, star fruit, and lemon oil. Red ginger plants (*Zingiber officinale* var. rubrum) and star fruit (*Avverhoa Bilimbi* L.) contain alkaloids, tannins, saponins, flavonoids, and triterpenoids that function as stomach, respiratory, and nerve toxins against insects (Qatrinide *et al*., 2021) (La Asi *et al*., 2022). Lemon oil contains *limonoids* that function as *antifeedants* that can inhibit chemoreceptors in the mouth of insects (Haifania *et al*., 2022)

Some of the studies on the formulation of shampoo preparations against head lice with natural ingredients include research that formulates shampoo preparations using the active ingredients of neem leaves, *hibiscus*, henna, amla fruit, *reetha* fruit, and *urad da* beans (Deeksha *et al.*,2020), research that uses mustard leaves as an active ingredient in the manufacture of shampoo preparations against head lice (Saikia *et al*., 2022). According to previous studies, no formula for anti-head lice shampoo uses red ginger extract, star fruit, and lemon oil. The novelty of this research is the combination formula of red ginger extract and star fruit with concentrations of 1.5%, 2%, and 2.5% and the addition of lemon oil with a concentration of 10% for each formula. This study aims to determine the physical stability and effectiveness of a combination of red ginger extract and star fruit shampoo against *Pediculus humanus capitis*.

MATERIALS AND METHODS

Tools and materials

Red ginger extract, star fruit extract, lemon oil, sodium lauryl sulfate, COCAMIDE DEA, NaCl, Na-CMC, citric acid, propylene glycol, glycerin, propyl paraben, methyl paraben, aquadest, chloroform, ammonia, H2SO4, HCl, NaOH, FeCl3, Mg powder, amyl alcohol, Dragendorff reagent, Meyer reagent, and Wagner reagent. Analytical scales (*Ohaus*), watch glass (*Pyrex*®), beaker (*Pyrex®), measuring cup (Pyrex®), stirring rod (Iwaki Pyrex*), *mixer* (IKA RW 20), digital pH meter (ATC), viscometer (*Labo*), *hot plate* (IKA C-MAG*).*

Sample preparation

Sample preparation: plant determination (PT. Palapa Muda Perkasa No. 996/IPH.1.01/If.02/1/2024), wet sorting, dry sorting, drying, and powder making. Extraction using the maceration method and evaporation using the rotary evaporator method.

Phytochemical screening of red ginger and star fruit extract

Phytochemical screening of red ginger and star fruit extract, including Alkaloid using Dragendorff reagent, Meyer reagent, and Wagner reagent (Srikandi *et al*., 2020), Tannin, Saponin, and Flavonoid (Kusuma *et al*., 2023)

Formulation shampoo red ginger extract and star fruit

The formula shampoo combining red ginger extract, star fruit, and lemon oil modified research of Dalming et al. (2022) shown in Table 1.

Table 1. Shampoo Formula Red Ginger Extract and Star Fruit.

Material	Concentration		
	F1	F2	F3
Red ginger extract	0,75%	1%	1,25%
Star fruit extract	0,75%	1%	1,25%
Lemon oil	10%	10%	10%
Sodium lauryl sulfate	15%	15%	15%
Cocamide DEA	8%	8%	8%
NaCl	5%	5%	5%
Na-CMC	1%	1%	1%
Citric acid	0,1%	0,1%	0,1%
Propylene glycol	1%	1%	1%
Glycerine	1%	1%	1%
Propyl paraben	0,5%	0,5%	0,5%
Methyl paraben	0,02%	0,02%	0,02%
Aquades	Ad 150 mL	Ad 150 mL	Ad 150 mL

Based on Table 1, shampoo formulations change in the concentration and use of natural ingredients. This study uses natural ingredients combined with red ginger extract and star fruit 1.5%, 2%, and 2.5% and the addition of lemon oil 10%.

Shampoo made of red ginger and star fruit extract

A combination of red ginger extract and star fruit is made by developing Na-CMC using aqua*dest containing citric acid that has been heated to form mucilage (mixture 1). Add DEA cocamide, propylene glycol, glycerin, propylparaben, and methylparaben to mixture 1, stirring until homogeneous. Sodium lauryl sulfate is mixed with NaCl in aquadest to taste and stirred until evenly mixed (mixture 2). Then, red ginger extract, star fruit extract, and lemon oil are mixed into mixture two and stirred until homogeneous. Combine the results of mixtures one and two using a mixer for 5 minutes, add the remaining aquadest, and stir again using a mixer for 5 minutes until homogeneous.

Evaluation of the physical stability of the shampoo

Organoleptic test

The organoleptic test was carried out by visual observation of the colour, smell, and shape of the shampoo preparation at room temperature with a storage period of 4 weeks(Nurhaini et al., 2020).

Homogeneity test

This test was carried out by applying a shampoo preparation to the watch glass and observing a preparation that showed a uniform mixing of ingredients and no visible coarse particles (Annisanur and Musfiroh, 2022).

Foam height test

The foam height measurement is done by making a solution of shampoo preparation in aquades, shaking it in a container, and then measuring it using a measuring device. The height of the foam shampoo meets the requirements if the height of the foam is in the range of 1.3 cm – 22 cm (Agistia et al., 2023).

Viscosity test

Viscosity testing was carried out using Brookfield viscometers. A shampoo of 150 mL is placed under a viscometer with the appropriate spindle and speed. The viscosity value of shampoo preparations ranges from 400 – 4,000 cps. (Annisanur and Musfiroh, 2022)

pH Test

The pH value measurement is done by dipping the pH meter into the shampoo preparation and then observing the number listed on the pH meter. The pH value requirement of shampoo preparations determined by SNI is between 5 – 9 (Agistia et al., 2023).

Shampoo test against head lice Pediculus humanus capitis

The treatment design in this study included positive control using the editor (Permethrin 1%), negative control (sterile aquades), F1 shampoo 1.5%, F2 2%, and F3 2.5%. Each treatment was placed in a petri dish containing 12 lice with three repetitions so that the total sample was 180 head lice. All treatments were observed for 10 minutes, and the number of head lice deaths was recorded during each treatment.

Data analysis

Data analysis using descriptive and comparative analysis. Descriptive analysis: the phytochemical screening test of red ginger and star fruit extract, organoleptic test, homogeneity, foam height, and viscosity test. Comparative analysis was carried out on the data from the pH test and mortality of head lice using One-way ANOVA statistical test.

RESULT AND DISCUSS

The results of the determination test of red ginger and star fruit plants were conducted at PT. Palapa Muda Perkasa, Depok City, identified that red ginger comes from the Zingiber officinale (Zingiberaceae family), while star fruit comes from the *Averrhoa bilimbi* L. (*Oxalidaceae family*). The results of the determination of red ginger and star fruit plants can be seen in Table 2.

Table 2. Results of Determination of Red Ginger and Star Fruit Plants.

Local Name	Species	Family
Red Ginger	*Zingiber officinale*	*Zingiberaceae*
Star fruit	*Averrhoa bilimbi* L.	*Oxalidaceae*

In the organoleptic test, the red ginger extract obtained brownish-yellow results, aromatic odor and concentrated extract. In contrast, in star fruit extract, the results were brownish-green, aromatic, and in the form of a concentrated extract. The results of organoleptis can be shown in Table 3.

Table 3. Results of Organoleptis Tests of Red Ginger Extract and Star Fruit.

Sample	Colour	Smell	Form
Red Ginger Extract	Brownish-yellow	Aromatic	concentrated extracts
Star Fruit Extract	Brownish green	Aromatic	concentrated extracts

In accordance Indonesia Herbal Pharmacopoeia Edition II states that red ginger extract has a brownish-yellow colour, aromatic smell, concentrated extract form, and spicy taste, and star fruit extract has a blackish-green

colour, aromatic smell, concentrated extract form, and acid taste. The characteristics of the extracts used are complemented by the results of the yield of red ginger and star fruit extracts, which can be seen in Table 4.

Table 4. Results of Rendement of Red Ginger Extract and Star Fruit.

Sample Name	Powder Weight (g)	Extract Weight (g)	Extract Yield (%)
Red Ginger	1.250	284	22,72
Star Fruit	1.200	236,4	19,7

Based on Table 4, the yield value of red ginger extract was 22.72%, while star fruit was 19.7%. In accordance with the Herbal Pharmacopoeia Indonesia Edition II, the yield of red ginger extract is>17%, and star fruit extract is>3.3%. The results of extract yield are related to the content of active compounds in the sample. If the yield value of the resulting extract is high, the sample's active compound content is also high. Several factors affect the yield value extract, including extraction time and selection of extraction method. The more optimal the extraction process time, the greater the yield obtained. This is because the contact time between the solvent and the simplicia is getting longer, so the weight of the extract from the simplicia is higher (Subaryanti *et al*., 2022). Another factor that affects the results of the extract yield value is the selection of the extraction method. Extraction methods that use room temperature tend to be long but can retain thermolabile secondary metabolite compounds. In contrast, extraction methods that involve heating at 60-70 ºC tend to be faster but risk reducing thermolabile secondary metabolite compounds (Ramayani *et al*., 2021).

The phytochemical screening test of red ginger extract included tests on alkaloid compounds, tannins, saponins, and flavonoids. The results are in Table 5.

Table 5. Results of Phytochemical Screening Test of Red Ginger Extract.

Compound	Reagents	Result	Indicator
	Dragendorff Reagent	Positive	white precipitate
Alkaloids	Meyer Reagents	Positive	orange precipitate
	Wagner Reagents	Positive	brown precipitate
Tannins	$FeCl_3$	Positive	blackish-green colour
Flavonoids	NaOH	Positive	orange colour
Saponins	Hcl	Positive	stable foam

The results of the phytochemical screening test of red ginger extract show that it is positive and contains alkaloids, tannins, flavonoids, and saponins. The phytochemical screening test of star fruit extract was carried out on alkaloids, saponins, and flavonoids. The results of the phytochemical screening test of star fruit extract can be seen in Table 6.

Table 6. Phytochemical Screening Test of Star Fruit Extract.

Compound	Reagents	Result	Indicators
	Dragendorff Reagent	Positive	brown to orange deposits
Alkaloids	Meyer Reagents	Positive	white precipitate
	Wagner Reagents	Positive	brown deposits
Saponins	HCl 2N	Positive	stable foam
Flavonoids	Mg Powder + HCl + Amyl Alcohol	Positive	red to orange colours

The results of the phytochemical screening test of star fruit extract show that it contains alkaloid, tannin, flavonoid, and saponin. Physical stability testing of shampoo combining was carried out with a storage period of 4 weeks against F1 1.5%, F2 2%, and F3 2.5%. The organoleptic test shampoo showed no change in colour, odour, or texture, indicating that the shampoo was stable during the 4-week storage period. The results of the organoleptic test shampoo are shown in Table 7.

Table 7. Results of Organoleptic Test.

Week	F1	F2	F3
0	Colour: Light brown Smell: Lemon oil aroma Shape: Viscous	Colour: Light brown Smell: Lemon oil aroma Shape: Viscous	Colour: Light brown Smell: Lemon oil aroma Shape: Viscous
1	Colour: Light brown Smell: Lemon oil aroma Shape: Viscous	Colour: Light brown Smell: Lemon oil aroma Shape: Viscous	Colour: Light brown Smell: Lemon oil aroma Shape: Viscous
2	Colour: Light brown Smell: Lemon oil aroma Shape: Viscous	Colour: Light brown Smell: Lemon oil aroma Shape: Viscous	Colour: Light brown Smell: Lemon oil aroma Shape: Viscous
3	Colour: Light brown Smell: Lemon oil aroma Shape: Viscous	Colour: Light brown Smell: Lemon oil aroma Shape: Viscous	Colour: Light brown Smell: Lemon oil aroma Shape: Viscous
4	Colour: Light brown Smell: Lemon oil aroma Shape: Viscous	Colour: Light brown Smell: Lemon oil aroma Shape: Viscous	Colour: Light brown Smell: Lemon oil aroma Shape: Viscous

Table 7 shows that three shampoo formulations had a light brown colour, the smell of lemon oil, and dence texture during 4-week observation. Homogeneity testing of shampoo during a 4-week storage period showed homogeneous and no coarse particles in all three formulations. The homogeneity test is one of the physical evaluation tests on shampoo to see a homogeneous arrangement with no coarse grains (Asjur *et al*.., 2022). The results of the homogeneity test can be seen in Table 8.

Table 8. Results of Homogeneity Test of Anti-Flea Shampoo Preparation.

Week	F1	F2	F3
0	Homogeneous	Homogeneous	Homogeneous
1	Homogeneous	Homogeneous	Homogeneous
2	Homogeneous	Homogeneous	Homogeneous
3	Homogeneous	Homogeneous	Homogeneous
4	Homogeneous	Homogeneous	Homogeneous

Table 8 shows that all ingredients are well mixed during the preparation process. The results of this study are in accordance with Butar-butter (2023) that antifungal shampoo of shallot ethanol extract can produce homogeneity. The results of the non-homogeneous shampoo can be known in the study by Aida et al. (2022), where the anti-fungal shampoo of mango leaf extract was non-homogeneous and characterized by rough materials at observation for three weeks. Nurhaini *et al*. (2020) reported that shampoo soursop leaf extract results showed the presence of rough granules caused by a lack of water during the carbopol development procedure, so the physical evaluation of the shampoo was not homogeneous.

The foam height measurements of three formulas with a storage period of four weeks still entered the range of foam height requirements of shampoo. This test aims to assess shampoo ability to produce foam. The results of measuring the height of the shampoo foam can be seen in Table 9.

Table 9. High the foam of Shampoo.

Week	The average high value of foam (cm)		
	F1	F2	F3
0	7.7 ± 0.5	7.3 ± 0.2	7.2 ± 0.2
1	7.7 ± 0.2	7.8 ± 0.6	8.5 ± 0.7
2	8.7 ± 0.5	9 ± 0.0	9 ± 0.0
3	10.5 ± 0.7	10 ± 0.0	10.7 ± 0.5
4	11 ± 0.0	11 ± 0.0	11 ± 0.0

Results of measuring height test of foam shampoo on F1, F2, and F3 increasing values. This affected the speed of the shaking process at any time. Overall, the foam height value obtained from the shampoo is consistent with SNI 1.3 – 22 cm (Elianasari and Fauziah, 2023); (Annisanur and Musfiroh, 2022). Viscosity testing showed stable results with a storage period of 4 weeks at room temperature. The average viscosity value obtained F1: 2,010-2,020 cps, F2 and F3: 2,020 cps. Viscosity measurement was used to determine the viscosity value of shampoo. Viscosity value can affect the stability of the storage period, flowability, and shampoo spread when used on hair (Bhavani *et al*., 2023). The results of the viscosity test of shampoo can be seen in Table 10.

Table 10. Viscosity Test.

Week	Average viscosity value (cps)		
	F1	F2	F3
0	2,010 ± 14,14	2,020 ± 0,000	2,020 ± 0,000
1	2,020 ± 0,000	2,020 ± 0,000	2,020 ± 0,000
2	2,020 ± 0,000	2,020 ± 0,000	2,020 ± 0,000
3	2,020 ± 0,000	2,020 ± 0,000	2,020 ± 0,000
4	2,020 ± 0,000	2,020 ± 0,000	2,020 ± 0,000

Based on the results of viscosity measurements for four weeks of the storage period indicate that shampoo has a stable viscosity. The results of this study are in accordance with the research by Guidance et al. (2021) that the viscosity of the anti-dandruff shampoo of jamblang fruit extract has a good shampoo viscosity value of 400 – 4,000 cps. The results of this test are also

based on a study by Rasyadi et al. (2023) that reported that the anti-dandruff shampoo of Arabica coffee leaf ethanol extract has an average viscosity value of 1,247 – 3,011 cps with storage for six weeks.

Testing the pH value with a storage period of 4 weeks showed results that were still in the pH range of good shampoo. The pH test aims to determine the preparation's acid or base value. The results of measuring the pH value of shampoo can be seen in Table 11.

Table 11. pH Test of Shampoo.

Sunday	x̄ ± SD			*Sig.* Normality	*Sig.* Homogeneity	*Sig.* *One-Way* ANOVA
	F1	F2	F3			
0	8.54a ± 0.28	8.01a ± 0.42	8.61a ± 0.21			
1	8.63a ± 0.28	8.37a ± 0.16	8.68a ± 0.11	F1 = 0.510		
2	8.77a ± 0.13	8.63a ± 0.14	8.70A ± 0.02	F2 = 0.218	0,081	0,096
3	8.57a ± 0.08	8.66a ± 0.09	8.74a ± 0.03	F3 = 0.780		
4	8.62a ± 0.05	8.70A ± 0.08	8.77A ± 0.02			

Table 11 shows that each formulation has a stable pH value and, according to SNI, a range of 5.0 – 9.0. (Firdaus and Arief, 2019). The normality and homogeneity test results on the pH value data showed that the value of Sig. > 0.05 or the pH test data was distributed normally and homogeneously. The results of One-Way ANOVA showed that the Sig. 0.096 > 0.05 or the pH value of the shampoo during four weeks of storage did not change significantly in the shampoo formula of F1 1.5%, F2 2%, and F3 2.5%. The results of this study by Erwiyani *et al*. (2023) and Lara *et al*. (2023) state that the foaming agent can influence the pH value, namely sodium lauryl sulfate with a pH of 7.5 – 8.5 and the use of DEA cocamide influences the pH value because it has a pH value of 9.5 – 10.5 which is higher than sodium lauryl sulfate, the pH value is not much different from the pH value obtained in this study. The pH value of a shampoo can affect the quality of the preparation; the pH range of the shampoo should not be too acidic or alkaline because it minimizes irritation to the eyes and damage to the scalp and hair (Pundkar and Ingale, 2020).

The shampoo results declared stable were then tested for mortality of the head lice *Pediculus humanus capitis*. The test was carried out on five treatment groups: positive control with Peditox, negative control with aquades, F1 1.5%, F2 2%, and F3 2.5%. Head lice samples for each group totaled 12 with 3x replication. The results of red ginger and star fruit shampoo against *Pediculus humanus capitis* can be seen in Table 12.

Table 12. Results of Mortality Test of Shampoo Against Head Lice for 10 Minutes.

No	Treatment	Replication			x̄ ± SD	F. count	F. table
		1	2	3			
1	Control (+)	2	2	2	2 ± 0	4,35	3,33
2	Control (-)	0	0	0	0 ± 0		
3	F1 1,5 %	2	4	6	4 ± 2		
4	F2 2 %	3	4	8	5 ± 2.67		
5	F3 2.5%	3	6	9	6 ± 3		

Based on table 12. The average mortality of head lice after being given a combination of red ginger and star fruit shampoo for F1 1.5% was four head lice, F2 2% was eight head lice, and F3 was nine head lice. As for the negative control, no head lice deaths were found, while the positive control used editor for as many as two head lice. The results of ANOVA one-way showed that the F-count was 4.35 while the F. table was 3.33 (Fcal.>Ftable), or the combination shampoo had a significant effect on the average mortality of head lice. The results of this study complement the results of the research of Austin Tee and Badia (2019), which resulted in an average number of deaths of 3 head lice during 15 minutes of treatment with 5% soursop leaf extract shampoo. Research by Agistia et al. (2023) regarding the test of lemongrass oil shampoo with concentrations of 5%, 7.5%, and 10% can produce a head lice death time of 3-7 minutes. The 10-minute lime extract shampoo test by Warahmah (2021) showed an average number of deaths of 2-3 lice, while the study by Dalming et al. (2022) using eucalyptus oil shampoo of 15%, 20%, 25%, and 30% for 10 minutes only resulted in the average death of 1 head lice. Based on this, this study is more effective than the previous study because within 10 minutes, with concentrations of 1.5%, 2%, and 2.5%, it produced an average number of deaths of 6-9 head lice.

The selection of red ginger and star fruit as natural insecticide agents in this study refers to the research of Watcharawit and Soonwera (2013), which reported that *Z. officinale* and *A. bilimbi* produced Lethal death Time (LD_{50}) values of 13.62 and 13.14 seconds.

The results of microscopic observation of the morphology of head lice before being given shampoo showed the morphology of the body, legs, and antennae that looked normal, while after being given the shampoo showed the body condition of head lice with antennae and legs that tended to be weak and stiff. The results of the morphological observation can be seen in Figure 1.

Figure 1. Microscopic morphology of head lice. A. Before treatment. B. After treatment.

Based on Figure 1, head lice given a combination of shampoo, red ginger extract, and star fruit left red ginger residue on the abdomen. The results of El-Akkad's (2016) research stated that *Pediculus humanus capitis*, which was treated with several extracts of natural materials, underwent morphological changes, including legs and antennae becoming flaccid/shriveled, distortion of morphology outside the body, damage to antennae, paws, and sensory hair. According to Nurmasari and Aswan (2024), Maisura (2023) contains alkaloids, flavonoids, tannins, and saponins of star fruit and red ginger function as stomach toxins that can enter the body of head lice through the skin or spiracles. The poison then enters the digestive tract, causing death in head lice. Based on this, it can be seen that the higher the concentration of the extract of the combination of red ginger shampoo and star fruit, the more it significantly affects the average number of head lice deaths. The effective shampoo formula for killing 12 head lice is 1.5%, with an average number of deaths of 6 (50%) lice during 10 minutes of treatment.

CONCLUSION

The physical stability evaluation test results showed that the three formulations of anti-head lice shampoo had good organoleptic, homogeneous, and produced average pH values, foam height, and viscosity within the required range. The results of the One-Way ANOVA test of a combination of red ginger extract and star fruit significantly affected the death of head lice for 10 minutes with an effective formula at a concentration of 1.5%.

Competing Interests: The authors declare that there are no competing interests.

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