

Formulation and Physical Stability Of Raspberry Fruit Extract Shampoo

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ARTICLE HISTORY

Received: 30 August 26
Final Revision: 26 September 26
Accepted: 27 September 26
Online Publication: 30 September 26

KEYWORDS

Formulation, Fruit Extract, Physical Stability, Raspberry Fruit, Shampoo

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DOI

10.37034/medinftech.v4i3.172

ABSTRACT

Raspberry fruit (*Rubus rosifolius* Sm.) contains bioactive compounds with potential for use in hair care products, but the physical properties and stability of a shampoo containing its extract require evaluation. This study aimed to formulate raspberry fruit extract shampoo and assess the effects of extract concentration on its physical characteristics and stability. The fruit was extracted by maceration with 96% ethanol and incorporated into four shampoo formulations containing 0% (F0), 5% (F1), 10% (F2), and 15% (F3) extract. Organoleptic properties, homogeneity, pH, foam height, viscosity, spreadability, and adhesion were evaluated. Physical stability was assessed over six cycles of alternating storage at $4 \pm 2^\circ\text{C}$ and $40 \pm 2^\circ\text{C}$. Selected parameters were compared before and after the cycling test using paired t-tests. From 500 g of dried material, 114 g of concentrated extract was obtained, corresponding to an extraction yield of 22.8%. All formulations remained visually homogeneous, with pH values ranging from 6.09 to 6.39. Increasing extract concentration was associated with higher viscosity and adhesion and lower spreadability and foam height. Foam height in F2 fell below the study's stated range in weeks 3 and 4, while F3 remained below it throughout observation. No statistically significant differences were reported between measurements before and after the cycling test for pH, foam height, viscosity, spreadability, or adhesion ($p > 0.05$). Raspberry fruit extract could be incorporated into shampoo, but further formulation work is needed to improve foam height at higher extract concentrations.

1. Introduction

Indonesia's tropical climate, with its generally hot weather, can cause various scalp problems. Hot conditions can increase oil production on the scalp, making it easier for dust and dirt to accumulate. The buildup of oil, dust, and dirt on the scalp can trigger various conditions such as dandruff, itching, and hair health problems. Regular hair and scalp care is necessary to help maintain cleanliness and reduce these issues. One of the most commonly used cosmetic products for cleansing the hair and scalp is shampoo [1].

Shampoo is a cosmetic formulation that generally contains surfactants and is used to remove dirt and oil from the hair and scalp [2]. In addition to its cleansing function, shampoo can also be formulated with specific

active ingredients to provide additional benefits for hair care [3]. The development of shampoo formulations utilizing natural ingredients is one alternative that can be pursued to produce natural-based hair care products [4].

One natural ingredient with potential for use in shampoo formulations is the raspberry (*Rubus rosifolius* Sm.). Raspberries are known to contain various active compounds, including flavonoids, anthocyanins, tannins, and phenolic compounds [5], [6]. These components support the potential use of raspberries as a natural ingredient in the development of cosmetic formulations. Extracts of *Rubus rosifolius* fruit have shown antioxidant activity and antibacterial activity against *Staphylococcus aureus* in laboratory tests [7].

The use of natural ingredient extracts in shampoo formulations requires consideration not only of the potential of the active ingredients but also of the physical characteristics of the resulting formulation. The physical quality of shampoo can be assessed through several parameters, including organoleptic properties, homogeneity, pH, viscosity, spreadability, foam height, and adhesion [8], [9]. Previous herbal shampoo research has similarly evaluated physical appearance, pH, viscosity, foam stability, and changes during storage, supporting the use of multiple parameters to characterize formulation quality [10]. In this study, raspberry fruit extract was formulated using several concentration variations to observe the effect of increasing extract concentration on the physical characteristics of the shampoo [11].

Physical stability is a critical aspect in the development of cosmetic formulations because changes during storage can affect the quality and consumer acceptance of the product [12]. This thesis employed a cycling test to assess the formulation's stability under temperature fluctuations, accompanied by statistical analysis using a Paired Sample T-Test to compare physical quality parameters before and after exposure to extreme temperatures.

Given the potential of raspberries as a source of natural active ingredients and the need to develop natural hair care formulations, further research is needed on the use of raspberry (*Rubus rosifolius* Sm.) extract in shampoo formulations. This study was conducted to determine whether varying extract concentrations can produce a shampoo formulation that meets physical quality requirements and remains stable during storage. The study used four formulations: F0 (without extract), F1 (with 5% extract), F2 (with 10% extract), and F3 (with 15% extract). Evaluations were conducted on organoleptic properties, homogeneity, pH, viscosity, spreadability, foam height, adhesion, and physical stability.

This study is important because increasing the extract concentration can affect the physical characteristics of the formulation. The results showed that increasing the extract concentration tended to increase viscosity and adhesion but decreased spreadability and foam height. Nevertheless, all tested formulations continued to meet physical quality requirements and demonstrated stability during testing [13].

This study aims to formulate raspberry fruit extract (*Rubus rosifolius* Sm.) into a shampoo formulation, to determine the physical characteristics of the formulation based on organoleptic parameters, homogeneity, pH, viscosity, spreadability, foam height, and adhesion, and to assess the physical stability of the formulation during storage. In addition, this study aims to determine the effect of varying concentrations of raspberry fruit extract on the physical characteristics of the shampoo formulation.

Based on these objectives, the research questions posed are: Can raspberry fruit extract (*Rubus rosifolius* Sm.) be formulated into a shampoo preparation that meets physical quality requirements? What are the physical characteristics of each formulation? How stable is the preparation during storage? And how do variations in extract concentration affect the physical characteristics and stability of the preparation?

2. Research Method

2.1. Type and Location of the Study

This study is a laboratory-based experimental study that includes the preparation of raspberry (*Rubus rosifolius* Sm.) fruit extract, the formulation of a shampoo, the evaluation of physical characteristics, and physical stability testing. The study was conducted from January to May 2026 at the Phytochemistry Laboratory, Chemistry Laboratory, and Pharmaceutical Technology Laboratory of the Al-Fatah College of Health Sciences in Bengkulu. Plant identification was performed at the Biology Laboratory, Faculty of Mathematics and Natural Sciences, Bengkulu University.

2.2. Equipment and Materials

The equipment used included a rotary evaporator (Biobase®), a magnetic stirrer, a hot plate, an analytical balance (Mettler®), a pH meter (Shimadzu®), a Brookfield DV-E viscometer, a maceration vessel, 10 mL measuring flasks, dropper pipettes, glass beakers, funnels, spatulas, measuring cups, dishes, and watch glasses. The materials used consisted of raspberries (*Rubus rosifolius* Sm.), 96% ethanol, sodium lauryl sulfate (SLS), propylene glycol, carbomer, triethanolamine (TEA), glycerin, Na-EDTA, nipagin, raspberry oil, and distilled water.

2.3. Preparation of Crude Drug and Extract

Raspberries were harvested in the morning, followed by wet sorting to remove impurities and unwanted materials. The samples were washed with water until clean, drained, and then dried indirectly in the sun until a dry crude drug was obtained. After the drying process, dry sorting and weighing of the crude drug were performed.

Extraction was performed by maceration using 96% ethanol. A total of 350 g of crude drug powder was macerated with 3.5 L of 96% ethanol at a 1:10 ratio. Maceration was carried out for 3 × 24 hours at room temperature, with stirring every 12 hours for 15 minutes each day. After filtration, the residue was re-macerated for 2 × 24 hours using fresh solvent. The filtrates from the maceration and re-maceration were combined, then concentrated using a rotary evaporator at a temperature of approximately 50°C until a thick extract was obtained [14]. The amounts of dried

material and concentrated extract, along with the calculated extraction yield, are presented in Table 1.

Table 1. Extract Yield

Parameter	Result
Dried material	500 g
Concentrated extract	114 g
Yield	22.8%

2.4. Shampoo Formulation

A 100 mL batch of shampoo was prepared for each formula with four variations in extract concentration: F0 (0%), F1 (5%), F2 (10%), and F3 (15%). The base components used in all formulations consisted of 10% propylene glycol, 10% SLS, 10% glycerin, 2% carbomer, 2% TEA, 0.2% nipagin, 0.1% Na-EDTA, raspberry oil as needed, and distilled water to make up 100 mL. The composition of each shampoo formulation is presented in Table 2.

Table 2. Shampoo formulation containing 96% ethanol raspberry fruit extract

Ingredient / Function	Concentration (F0 / F1 / F2 / F3)
Raspberry fruit extract / Active ingredient	0% / 5% / 10% / 15%
Propylene glycol / Humectant	10% / 10% / 10% / 10%
Sodium Lauryl Sulfate / Surfactant	10% / 10% / 10% / 10%
Glycerin / Emollient	10% / 10% / 10% / 10%
Carbomer / Thickening agent	2% / 2% / 2% / 2%
Triethanolamine / pH buffer	2% / 2% / 2% / 2%
Nipagin / Preservative	0.2% / 0.2% / 0.2% / 0.2%
Na EDTA / Chelating agent	0.1% / 0.1% / 0.1% / 0.1%
Raspberry oil / Fragrance	q.s. / q.s. / q.s. / q.s.
Distilled water / Vehicle	ad 100 / ad 100 / ad 100 / ad 100

2.5. Preparation of the Shampoo Formulation

All ingredients were weighed according to the formula. Nipagin, glycerin, and TEA were first dissolved in propylene glycol to obtain mixture M1. SLS was dissolved in distilled water as M2, while carbomer was dissolved in distilled water as M3. Once M2 and M3 are dissolved, they are combined, and Na-EDTA is added. The raspberry extract is dissolved in M1, and then M1, M2, and M3 are mixed until homogeneous. Finally, oleum is added as a fragrance, and the formulation is transferred into shampoo.

2.6. Evaluation of Physical Characteristics

The formulation was evaluated for organoleptic properties, homogeneity, pH, viscosity, foam height, spreadability, and adhesion [11].

2.6.1. Organoleptic Test

Organoleptic observations were made regarding the color, aroma, and texture/form of the formulation. Observations were made during storage to determine any changes in the physical characteristics of each formulation [15].

2.6.2. Homogeneity Test

A 1 g sample of shampoo was placed on a glass slide and then covered with another glass slide to form a thin layer. Homogeneity was visually assessed to check for the presence of coarse particles, clumps, or unevenness in the formulation.

2.6.3. pH Test

A 1 g sample of shampoo was dissolved in 10 mL of distilled water. The pH meter was calibrated first, then the electrode was inserted into the sample solution. The pH value was recorded after the instrument reading stabilized [16].

2.6.4. Viscosity Test

The viscosity of the preparation was measured using a Brookfield DV-E viscometer with spindle No. 4 at a speed of 50 rpm. The viscosity value is expressed in centipoise (cP).

2.6.5. Foam Height Test

A total of 0.1 g of shampoo was placed in a 20 mL measuring cylinder, followed by the addition of 10 mL of distilled water. The measuring cylinder was inverted and shaken for 20 seconds. Afterward, the height of the resulting foam was observed and measured in centimeters.

2.6.6. Spreadability Test

A 1 g sample is placed on a round glass slide. Measurements are taken without a load, then a load is gradually applied starting from 50 g up to 250 g. Each load is left in place for 1 minute, after which the diameter of the spread is measured [17].

2.6.7. Adhesion Test

A 0.25 g sample is placed between two glass slides, then a 1 kg load is applied for 5 minutes. Afterward, the glass slides are mounted on a testing device and a 80 g load is applied. The time required for the two glass slides to separate is recorded as the preparation's adhesion time [13].

2.6.8. Physical Stability Test

The physical stability of the formulation was tested using a cycling test method, which has been applied in previous herbal shampoo formulation studies [8], [12]. The formulation was stored at $4 \pm 2^\circ\text{C}$ for 24 hours, then transferred to an oven at $40 \pm 2^\circ\text{C}$ for 24 hours. This storage sequence was counted as one cycle and was repeated six times, for a total duration of 12 days. After testing, changes in the physical characteristics of the formulation were observed and compared to the conditions prior to treatment.

2.7. Data Analysis

Data from the physical evaluation were analyzed descriptively and presented in the form of tables,

diagrams, and narratives. A statistical analysis using the Paired Sample T-Test was performed to compare the physical quality parameters before and after the cycling test. The parameters compared included pH, foam height, viscosity, spreadability, and adhesion. Differences were considered significant if the p-value was < 0.05 .

3. Result and Discussion

3.1. Raspberry Fruit Extraction Results

The raspberry fruit (*Rubus rosifolius* Sm.) used in this study was first verified to confirm the plant's identity. The verification results indicated that the sample was *Rubus rosifolius* Sm. of the Rosaceae family. The sample was then processed into crude drug material through wet sorting, washing, indirect drying, and dry sorting before the extraction process was carried out.

Extraction was performed using the maceration method with 96% ethanol. Based on the research results, 350 g of crude drug powder was extracted using 3.5 L of 96% ethanol at a 1:10 ratio. Maceration was carried out for 3×24 hours, followed by re-maceration for 2×24 hours. The filtrate was then concentrated using a rotary evaporator at a temperature of approximately 50°C until a thick extract was obtained.

The resulting extract was then used as the active ingredient in shampoo formulations with varying concentrations. These concentration variations were used to determine the effect of increasing the amount of extract on the physical characteristics and stability of the preparations.

3.2. Results of Shampoo Formulation

The shampoo formulations were prepared in four versions: F0 without extract, F1 with 5% extract, F2 with 10% extract, and F3 with 15% extract. All formulations used the same base components, while the raspberry extract was the variable component. The results showed that raspberry fruit extract can be formulated into a shampoo, and all formulations could be evaluated based on physical quality parameters.

Differences in extract concentration resulted in changes to the physical characteristics of the formulations. In general, an increase in extract concentration tended to increase viscosity and adhesion, while spreadability and foam height tended to decrease. The relationship between these parameters indicates that changes in extract concentration affect the physical properties of the shampoo.

3.3. Organoleptic Test Results

The organoleptic characteristics of each formulation during the four-week observation period are presented in Table 3. Organoleptic observations showed that F0 was clear, had a characteristic raspberry aroma, and was liquid in form. F1 was light brown and slightly

viscous, while F2 and F3 were brown and had a thicker consistency. All formulations retained their color, aroma, and form characteristics throughout the four-week observation period.

Table 3. Organoleptic Characteristics of Raspberry Extract Shampoo During Four Weeks

Formula	Observation during Weeks 1–4
F0 (0%)	Clear; characteristic raspberry aroma; liquid; unchanged throughout four weeks
F1 (5%)	Light brown; characteristic raspberry aroma; slightly viscous; unchanged throughout four weeks
F2 (10%)	Brown; characteristic raspberry aroma; viscous; unchanged throughout four weeks
F3 (15%)	Brown; characteristic raspberry aroma; viscous; unchanged throughout four weeks

The absence of significant organoleptic changes indicates that the formulations were relatively stable during storage. No rancid aroma or color changes indicative of formulation degradation were observed. Thus, variations in extract concentration primarily resulted in differences in initial color and consistency, while these characteristics remained stable throughout the observation period.

3.4. Homogeneity Test Results

The homogeneity observations for all formulations over four weeks are presented in Table 4.

Table 4. Homogeneity Characteristics of Raspberry Extract Shampoo During Four Weeks

Formula	Homogeneity (Weeks 1–4)
F0	Homogeneous throughout
F1	Homogeneous throughout
F2	Homogeneous throughout
F3	Homogeneous throughout

All formulations showed homogeneous results from the first week through the fourth week. F0, F1, F2, and F3 showed no coarse particles, clumps, sediment, or phase separation during storage.

Homogeneity indicates that the formulation's components are evenly distributed. This is supported by the stepwise mixing process and the use of Carbomer as a gelling agent, which helps maintain the formulation's structure. These results indicate that the addition of raspberry extract up to a 15% concentration did not cause any visually detectable physical heterogeneity during the observation period.

3.5. Foam Height Test Results

The weekly foam height measurements and their mean values for each formulation are presented in Table 5.

Table 5. Foam Height of Raspberry Extract Shampoo During Four Weeks

Formula	Week 1 / Week 2 / Week 3 / Week 4 / Mean $\pm$ SD
F0	22.28 / 19.28 / 18.54 / 17.72 mm / 19.46 ± 2.03 mm
F1	16.56 / 15.75 / 15.46 / 15.12 mm / 15.72 ± 0.62 mm
F2	14.64 / 13.16 / 11.98 / 11.03 mm / 12.70 ± 1.60 mm
F3	10.46 / 10.06 / 9.00 / 6.38 mm / 8.98 ± 1.90 mm

The test results show that the average foam height for F0 was 19.46 mm, for F1 was 15.72 mm, for F2 was 12.70 mm, and for F3 was 8.98 mm over the four-week observation period. F0 and F1 remained within the required range, while F2 decreased to below the standard in the third and fourth weeks, and F3 remained below the range from the start of the observation period.

This pattern indicates that an increase in extract concentration leads to a decrease in foam height. The decrease in foam height may reflect changes in interactions among the extract, surfactant, and polymer components, as shampoo performance depends on the combined behavior of these ingredients [18]. However, the specific mechanism underlying this trend was not directly investigated in the present study. F0, which contained no extract, produced the highest foam height, whereas F3, with the highest extract concentration, produced the lowest foam height.

These results indicate that foam height does not always increase with an increase in the amount of active ingredient. The composition of surfactants and additives also influences foam-forming ability. In this study, SLS was used as the primary surfactant; therefore, changes in extract concentration can alter the system's characteristics and ultimately affect foam height.

3.6. pH Test Results

The pH measurements recorded over four weeks for each formulation are presented in Table 6.

Table 6. pH of Raspberry Extract Shampoo During Four Weeks

Formula	Week 1 / Week 2 / Week 3 / Week 4 / Mean $\pm$ SD
F0	6.39 / 6.36 / 6.32 / 6.30 / 6.34 $\pm$ 0.04
F1	6.28 / 6.27 / 6.24 / 6.22 / 6.25 $\pm$ 0.03
F2	6.18 / 6.17 / 6.15 / 6.13 / 6.16 $\pm$ 0.02
F3	6.12 / 6.12 / 6.10 / 6.09 / 6.11 $\pm$ 0.015

The pH values of all formulations fell within the range of 6.09–6.39, thus remaining within the range specified in the study. The reported average pH values were 6.30 for F0, 6.25 for F1, 6.15 for F2, and 6.10 for F3.

There is a trend showing that as the concentration of added raspberry extract increases, the pH value of the formulation decreases. This indicates that the natural components of the extract contribute to the formulation's acidic nature. During storage, there was also a tendency for the pH to decrease; however, the changes were relatively minor and did not significantly affect the formulation's characteristics.

In addition to the extract, other formula components can also affect pH. TEA in the formula acts as a pH regulator and neutralizes Carbomer, thereby helping to maintain the formulation's structure and pH. Thus, pH stability results from the interaction between the extract and the other formula components.

3.7. Viscosity Test Results

The viscosity measurements recorded over four weeks for each formulation are presented in Table 7.

Table 7. Viscosity of Raspberry Extract Shampoo During Four Weeks

Formula	Week 1 / Week 2 / Week 3 / Week 4 / Mean $\pm$ SD
F0	1,620 / 1,653 / 1,760 / 1,826 cP / 1,714.75 $\pm$ 95.49 cP
F1	2,073 / 2,140 / 2,200 / 2,266 cP / 2,169.75 $\pm$ 82.68 cP
F2	2,426 / 2,480 / 2,573 / 2,626 cP / 2,526.25 $\pm$ 90.91 cP
F3	2,840 / 2,946 / 2,993 / 3,013 cP / 2,948.00 $\pm$ 79.66 cP

The test results show that all formulations have viscosities within the 400–4000 cPs range, which is used as a quality requirement for shampoo. F0 exhibits the lowest viscosity, while F3 exhibits the highest viscosity. This indicates a trend of increasing viscosity as the concentration of raspberry extract increases.

Stability data show viscosity values before and after the cycling test of approximately 1,660 and 1,667 cPs for F0, 2,120 and 2,122 cPs for F1, 2,470 and 2,475 cPs for F2, and 2,930 and 2,931 cPs for F3, respectively. These changes were relatively small, indicating that the physical structure of the formulation remained intact after exposure to extreme temperatures.

The increase in viscosity in formulations with higher extract concentrations can be attributed to the increased amount of dissolved solids in the system. The presence of compounds such as flavonoids, tannins, anthocyanins, pectin, natural sugars, and phenolic compounds in the extract can increase intermolecular interactions, thereby increasing flow resistance. Additionally, Carbomer acts as a gelling agent, while TEA aids in gel formation through the neutralization of Carbomer.

3.8. Spreadability Test Results

The weekly spreadability measurements for each formulation are presented in Table 8.

Table 8. Spreadability of Raspberry Extract Shampoo During Four Weeks

Formula	Week 1 / Week 2 / Week 3 / Week 4 / Mean $\pm$ SD
F0	6.4 / 6.4 / 6.4 / 6.4 cm / 6.40 $\pm$ 0.00 cm
F1	5.9 / 5.8 / 5.8 / 5.7 cm / 5.80 $\pm$ 0.08 cm
F2	5.6 / 5.6 / 5.5 / 5.5 cm / 5.55 $\pm$ 0.06 cm
F3	5.4 / 5.4 / 5.3 / 5.3 cm / 5.35 $\pm$ 0.06 cm

The test results showed an average spreadability of 6.4 cm for F0, 5.8 cm for F1, 5.5 cm for F2, and 5.3 cm for F3. All values fell within the 5–7 cm range used as the spreadability requirement in this study.

An increase in extract concentration showed a tendency toward decreased spreadability. F0 had the highest spreadability, while F3 had the lowest value. This condition is related to the increased viscosity of the formulation. The higher the viscosity, the greater the flow resistance, resulting in reduced spreadability of the shampoo.

The relationship between viscosity and spreadability was also evident in the study results following the cycling test. The spreadability values before and after testing were approximately 6.41 and 6.38 cm for F0, 5.77 and 5.65 cm for F1, 5.62 and 5.59 cm for F2, and 5.31 and 5.27 cm for F3, respectively. These changes were relatively small, indicating that the formulation's spreadability was maintained.

3.9. Adhesion Test Results

The adhesion times measured over four weeks for each formulation are presented in Table 9.

Table 9. Adhesion of Raspberry Extract Shampoo During Four Weeks

Formula	Week 1 / Week 2 / Week 3 / Week 4 / Mean $\pm$ SD
F0	1.79 / 1.91 / 2.00 / 2.08 s / 1.95 ± 0.13 s
F1	2.53 / 2.72 / 2.79 / 2.94 s / 2.75 ± 0.17 s
F2	4.04 / 4.14 / 4.24 / 4.35 s / 4.19 ± 0.13 s
F3	5.68 / 5.75 / 5.85 / 5.93 s / 5.80 ± 0.11 s

The average adhesion time over four weeks was 1.95 seconds for F0, 2.75 seconds for F1, 4.19 seconds for F2, and 5.80 seconds for F3. All formulations had an adhesion time of more than 1 second, thus meeting the minimum threshold used in this study.

Adhesion time increased with rising extract concentration. F3 exhibited the highest adhesion time, while F0 had the lowest value. This trend is related to the increase in formulation viscosity. Formulations with higher viscosity are able to maintain contact with the surface longer, resulting in a longer time required for the formulation to detach.

These results demonstrate a consistent relationship between viscosity, adhesion, and spreadability. Formulations with higher viscosity tend to have greater adhesion but lower spreadability. Thus, changes in physical characteristics resulting from increased extract concentration do not occur in isolation but are interrelated within the formulation system.

3.10. Results of Physical Stability Testing

Stability testing was conducted using a cycling test involving alternating storage at $4 \pm 2^\circ\text{C}$ and $40 \pm 2^\circ\text{C}$ for six cycles. The test results showed that none of the formulations experienced phase separation or sediment formation after treatment. Organoleptic parameters, homogeneity, pH, foam height, viscosity, spreadability, and adhesion generally remained stable.

In observations following the cycling test, F0, F1, and F2 showed no significant changes in characteristics. F3 exhibited a change in consistency from thick to more viscous after treatment. This change was attributed in the thesis to increased interactions between Carbomer, surfactants, and the solid components of the extract during alternating temperature changes.

Although there were changes in some parameter values, these changes were relatively minor. This is

evident from a comparison of the viscosity, spreadability, and adhesion values before and after the cycling test. Therefore, overall, the formulation demonstrated the ability to maintain its physical characteristics during the stability testing.

3.11. Statistical Analysis of Physical Stability

To determine whether changes in physical parameters before and after the cycling test were statistically significant, an analysis was conducted using a Paired Sample T-Test. The significance values obtained were 0.069 for pH, 0.347 for foam height, 0.072 for viscosity, 0.086 for spreadability, and 0.080 for adhesion. All of these values were greater than 0.05.

Based on these results, there were no significant differences between the conditions before and after the cycling test for the parameters tested. The statistical results reinforce the physical observations that the changes occurring during the extreme temperature treatment did not show statistically significant differences.

Overall, the study demonstrates that raspberry fruit extract (*Rubus rosifolius* Sm.) can be formulated into a shampoo preparation with evaluable physical characteristics. An increase in extract concentration is associated with increased viscosity and adhesion, as well as decreased spreadability and foam height. All formulations exhibited good homogeneity and stability during testing, while the results of the Paired Sample T-Test showed no significant differences before and after the cycling test.

4. Conclusion

Based on the research results, raspberry (*Rubus rosifolius* Sm.) fruit extract can be formulated into shampoo preparations with concentrations of 0% (F0), 5% (F1), 10% (F2), and 15% (F3). The evaluation results showed that all formulations exhibited good organoleptic characteristics and homogeneity during observation.

Variations in extract concentration affected the physical characteristics of the formulations. An increase in extract concentration tended to increase viscosity and adhesion but decreased spreadability and foam height. The pH values of all formulations ranged from 6.09 to 6.39, while spreadability ranged from 5.3 to 6.4 cm. F3, with a 15% extract concentration, exhibited the highest viscosity and adhesion as well as lower spreadability compared to the other formulations.

The results of the cycling test showed that all formulations were relatively stable against temperature changes over six cycles. Analysis using the Paired Sample T-Test yielded significance values of 0.069 for pH, 0.347 for foam height, 0.072 for viscosity, 0.086 for spreadability, and 0.080 for adhesion, all of which

were greater than 0.05. Thus, there were no significant differences between the conditions before and after the cycling test for the parameters tested. F3 (15%) can be considered for further development based on the physical characteristics obtained.

Further research is recommended to conduct additional testing on the activity of the active ingredient in the raspberry extract in the shampoo formulation, as well as safety and user acceptance testing to support product development.

Acknowledgments

The author would like to thank all those who provided support, assistance, and contributions throughout the research process and the preparation of this article. Special thanks are extended to the institutions and laboratories that provided facilities and assisted in conducting the research, thereby ensuring the successful completion of the study on the formulation and physical stability testing of a shampoo preparation made from raspberry fruit extract (*Rubus rosifolius* Sm.).

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