SPIN 7 (2) (2025) 152-162

SPIN

JURNAL KIMIA & PENDIDIKAN KIMIA

https://journal.uinmataram.ac.id/index.php/spin

PHYTOCHEMICAL SCREENING AND ORGANOLEPTIC TESTING OF POWDERED SCRUB PREPARATIONS FROM A COMBINATION OF RENGGAK FRUIT PEEL (*Amomum dealbatum*) AND BREADFRUIT PEEL (*Artocarpus altilis*)

Varadila Julianti[*1], Baiq Ayu Aprilia Mustariani[1], Multazam[1]

[1]Tadris Kimia, Universitas Islam Negeri Mataram, Mataram, 83116, Indonesia.

DOI: 10.20414/spin.v7i2.14241

History Article
Accepted:
Aug 17, 2025
Reviewed:
Oct 28, 2025
Published:
Dec 20, 2025

Keywords:
Breadfruit Peel, Ground Scrub, Renggak Fruit Peel, Quality Scrub

ABSTRACT

This study aims to examine the presence of secondary metabolites in powdered scrub formulations made from a combination of renggak fruit peel (Amomum dealbatum) and breadfruit peel (Artocarpus altilis), as well as to evaluate the effect of varying ingredient ratios on scrub quality based on pH and organoleptic characteristics. Additionally, the research seeks to determine the formulation that yields the most optimal results based on pH and organoleptic tests. Data collection methods included observation, documentation, and the distribution of questionnaires. The data were analyzed using descriptive methods, one-way ANOVA parametric analysis, and the non-parametric Kruskal-Wallis test. Phytochemical screening results indicated that formulation F4 was the most optimal, containing secondary metabolites such as alkaloids, flavonoids, tannins, saponins, and steroids. The pH test results ranged from 5.5 to 6.5, which fall within the acceptable range according to the Indonesian National Standard (SNI) 16-4399-1996, which specifies that cosmetic products should have a pH between 4.5 and 8.0. Organoleptic tests showed significant differences in color and texture parameters, but no significant differences in aroma, pH, or irritation potential. Formulation F4 had a pH value of 6.4 and organoleptic scores of 3.15 for color, 3.45 for aroma, and 3.1 for texture. The scrub exhibited a brown color, a distinctive tea-like scent, a moderately coarse and semi-thick texture capable of removing dirt, and caused no skin irritation.

ABSTRAK

Penelitian ini dilakukan untuk mengidentifikasi kandungan senyawa metabolit sekunder pada lulur bubuk yang diformulasikan dari perpaduan kulit buah renggak (*Amomum dealbatum*) dan kulit buah sukun (*Artocarpus altilis*), sekaligus menilai pengaruh variasi komposisi bahan terhadap mutu lulur berdasarkan parameter pH dan sifat organoleptik. Penelitian ini juga bertujuan menentukan formulasi terbaik yang menghasilkan kualitas paling optimal ditinjau dari hasil uji pH dan organoleptik. Pengumpulan data dilakukan melalui observasi, dokumentasi, serta penyebaran kuesioner. Data yang diperoleh dianalisis secara deskriptif, menggunakan uji ANOVA satu arah sebagai analisis parametrik, serta uji Kruskal–Wallis sebagai analisis non-parametrik. Hasil skrining fitokimia menunjukkan bahwa formulasi F4 merupakan formulasi unggul karena mengandung alkaloid, flavonoid, tanin, saponin, dan steroid. Pengujian pH menunjukkan seluruh formulasi berada pada kisaran 5,5–6,5, sesuai dengan ketentuan SNI 16-4399-1996 yang menetapkan pH kosmetik antara 4,5–8,0. Uji organoleptik memperlihatkan perbedaan signifikan pada warna dan tekstur, namun tidak pada aroma, pH, dan potensi iritasi. Formulasi F4 memiliki pH 6,4 dengan skor warna, aroma, dan tekstur masing-masing 3,15; 3,45; dan 3,1, serta karakteristik lulur berwarna coklat, beraroma khas seperti teh, bertekstur agak kasar dan setengah kental, efektif mengangkat kotoran, serta tidak menimbulkan iritasi kulit.

How to Cite

Julianti, V., Mustariani, B. A. A., & Multazam. (2025). Phytochemical Screening and Organoleptic Testing of Powdered Scrub Preparations From a Combination of Renggak Fruit Peel (*Amomum dealbatum*) and Breadfruit Peel (*Artocarpus altilis*). *SPIN-Jurnal Kimia & Pendidikan Kimia*. 7(2). 152 - 162.

*Correspondence Author:
Email: 200109039.mhs@uinmataram.ac.id

p-ISSN: 2580-2623
e-ISSN: 2745-6854

INTRODUCTION

Today, the use of chemicals in cosmetic products that may harm health is increasingly prevalent. According to data from the Indonesian Food and Drug Monitoring Agency (BPOM), several substances categorized as hazardous include mercury, hydroquinone at concentrations above 2%, retinoic acid, diethylene glycol, and synthetic dyes such as Rhodamine B, Red K_3, and chlorofluorocarbons (CFCs). In addition to negatively impacting users' health, the use of these ingredients can also cause environmental problems. One solution to address this problem is to develop natural-based cosmetic products or utilize organic waste as a safer and more environmentally friendly alternative (Ningsi et al., 2015).

One plant that contains secondary metabolites in the flavonoid and phenolic groups is the breadfruit (*Artocarpus altilis*). Research by Ulayya (2022) found that the skin of the breadfruit (*Artocarpus altilis*) contains flavonoid, steroid, and phenolic compounds that contribute to its antioxidant activity. The dichloromethane extract from breadfruit peel showed powerful antioxidant potential with an IC_{50} value of 13.34 ppm, more effective than vitamin E, which has an IC_{50} of 30.23 ppm. Compared to other parts of the breadfruit plant, the peel has the highest antioxidant activity. In comparison, the methanol extract of the fruit showed moderate activity (IC_{50} = 121.96 ppm), while the ethyl acetate fraction of the leaves and the methanol fraction of the bark were classified as very weak (IC_{50} = 4196.53 ppm and 201.33 ppm, respectively). The body scrub formulation from the fraction of breadfruit peel at a concentration of 0.9% also exhibited potent antioxidant activity (IC_{50} = 22.45 ppm), approximately 1.92 times more effective than a commercial body scrub (IC_{50} = 43.03 ppm). These findings indicate that breadfruit peel has high potential for application in antioxidant-based body scrubs.

Besides breadfruit, another plant species rarely studied for its secondary metabolite content is Hanggasa or Renggak (*Amomum dealbatum*). Recent research has shown that renggak fruit contains flavonoid compounds with antioxidant activity, which play a role in neutralizing free radicals. Renggak is known as an aromatic plant belonging to the *Zingiberaceae* (ginger) family, characterized by its sweet-sour fruit and distinctive aroma (Mustariani & Hidayanti, 2021). This plant is native to Indonesia and is known by various local names, such as *wresah* in Javanese and *hanggasa* or *renggak* in Lombok. The fruit is generally consumed fresh, while the stubble, young shoots, and inflorescences are often processed as vegetables or as an accompaniment to chili sauce. In India, renggak is often used as an alternative to cardamom, while in China, it is used as an ingredient in traditional herbal remedies. In Indonesia, the most widely known species of cardamom is cardamom (*Amomum cardamomum Willd*), whose seeds produce essential oils with various benefits, including helping to loosen phlegm, providing a warm sensation, facilitating gastric secretions, relieving pain, purifying the blood, and acting as a natural stimulant and aromatizer. In Lombok, the renggak plant is generally known only for its edible fruit and as a traditional remedy for headaches.

Renggak plant extract contains various secondary metabolites, including alkaloids, steroids, flavonoids, terpenoids, and saponins. A study by Azim et al. (2023) reported that phytochemical screening of renggak fruit peel extract yielded positive results for flavonoids, saponins, alkaloids, and tannins.

Research conducted by Mustariani & Hidayanti (2021) showed that phytochemical tests on the ethanol extract of renggak leaves (*Amomum dealbatum*) revealed the presence of various secondary metabolites, including flavonoids, alkaloids, steroids, saponins, and phenolic compounds. Furthermore, this extract exhibits potential as an antioxidant agent, as evidenced by antioxidant assays that showed increased effectiveness with increasing extract concentration. The IC_{50} value obtained was 149.59 ppm, which falls into the category of moderate antioxidant activity.

Based on the explanation above, researchers will create a combination body scrub preparation from renggak fruit peel and breadfruit peel, as no research has yet been conducted on the renggak plant, especially its fruit peel.

METHODS

An experimental study employing qualitative and quantitative methods was conducted. The results of a cosmetic scrub formulated from a combination of breadfruit and renggak fruit peels, including phytochemical and irritation tests, provided qualitative data for this study. The quantitative data used in this study were obtained from pH and organoleptic tests of a cosmetic scrub prepared from a combination of breadfruit and renggak fruit peels.

Materials

5% ferric chloride ($FeCl_3$) solution, concentrated sulfuric acid (H_2SO_4), and anhydrous acetic acid (CH_3CO_2O), label paper, tissue, plaster, sterile gauze, renggak fruit peel, breadfruit peel, water, distilled water, chloroform, Meyer's reagent, 2N hydrochloric acid, magnesium powder, concentrated hydrochloric acid.

Equipment

Test tubes, oven, dropping plate, pH meter, scissors and spatula, knife, basin, blender, plastic container (bowl), stirring rod, beaker (beaker), 200-mesh sieve, measuring cylinder, watch glass, test tube rack, analytical balance, and dropper.

Research Design

This study employed a quantitative experimental approach, using a completely randomized design (CRD), to develop a body scrub formulation from a combination of breadfruit (*Artocarpus altilis*) and renggak (*Amomum dealbatum*) peels. Testing of pH parameters and phytochemical screening were conducted three times for each formulation to ensure consistency of results.

Sampling Technique

The sampling technique in this study used a random sampling method.

Variables

Three types of variables were used in this study. The independent variable in this study was the mass ratio of breadfruit peel powder to renggak fruit peel powder, varied at four proportions: 0 g: 5 g, 2 g: 3 g, 3 g: 2 g, and 5 g: 0 g. The dependent variables included the results of phytochemical, pH, organoleptic, and irritation tests. Meanwhile, the control variables in this study were the volume of distilled water used (35 mL) and the oven heating temperature, which was held constant.

Data Collection Techniques

Data collection techniques in this study included observation, questionnaires, and documentation. Observations were conducted to record and analyze the results of phytochemical screening, irritation, pH, and organoleptic evaluations of the body scrub preparations. A questionnaire instrument was used to assess panelists' preferences for the organoleptic aspects of the body scrub formulated from a combination of breadfruit peel (*Artocarpus altilis*) and renggak fruit peel (*Amomum dealbatum*). The assessments were conducted by 20 panelists using a questionnaire containing a preference scale. Documentation in this study was conducted by taking photographs at every stage of the research process, from sampling to the final stage, using a Samsung J4+ mobile phone camera as a visual recording tool.

Research Analysis

Data were analyzed in SPSS 25 for Windows using standard one-way ANOVA. The data analysis technique used in this study was a parametric One-Way ANOVA (Analysis of Variance) with a significance level of 0.05. The analysis was continued with the Least Significant Difference (LSD) test to determine significant differences between treatment groups. Additionally, the nonparametric Kruskal-Wallis test was used, with the Dunn-Bonferroni test being used as a further test.

Procedure

The body scrub production process consists of two main stages. The initial stage is ingredient preparation, which comprises the following steps: sterilization, selection or sorting, washing, cutting or slicing, drying, grinding, and sieving to obtain a powder with a fine, uniform texture. The second stage is the formulation of the body scrub, with each combination prepared as follows: Formulation F1 comprises 0 grams of breadfruit peel powder and 5 grams of renggak fruit peel powder. Formulation F2 contains 2 grams of breadfruit peel powder and 3 grams of renggak fruit peel powder. Formulation F3 consists of 3 grams of breadfruit peel powder and 2 grams of renggak fruit peel powder, while Formulation F4 uses 5 grams of breadfruit peel powder without the addition of renggak fruit peel powder (0 grams). Each formulation is then mixed with 35 mL of distilled water to achieve the appropriate scrub consistency. (Warnis, et.al., 2020).

Scrub Testing Stage

Scrubs prepared with various formulations were tested using the following tests:

pH Test

The pH of the scrub preparations was tested using a pH meter. A small sample of the scrub was taken and diluted with distilled water. The pH meter electrode was then dipped into the solution to measure its acidity. According to Indonesian National Standard (SNI) 16-4399-1996, the recommended pH for skin cosmetic products is between 4.5 and 8.0 (Yuliati and Binarjo, 2010). However, the ideal pH range compatible with human skin is generally between 4.5 and 6.0.

Phytochemical Screening Test

Phytochemical screening is a qualitative analysis method used to detect the presence of secondary metabolites in a material. In this study, testing was conducted on six groups of compounds: alkaloids, flavonoids, tannins, saponins, steroids, and terpenoids. The results of this test are presented in the following data format:

Alkaloid Test

A 0.5 gram sample was placed in a test tube, then 1 mL of 2 N hydrochloric acid solution and 9 mL of distilled water were added. The mixture was heated in a water bath for 2 minutes, then cooled and filtered. The resulting filtrate was then used for alkaloid testing by adding two drops of Mayer's reagent. A positive indication of alkaloids is indicated by the appearance of a white or yellow precipitate (Handayani, et. al., 2020).

Flavonoid Test

A 0.5 gram of powdered medicinal herb was added to 10 mL of hot water, boiled for 5 minutes, and filtered while still hot. 5 mL of the resulting filtrate was then added to 0.1 gram of magnesium powder, 1 mL of HCl, and 2 mL of NaOH. The mixture was then shaken and allowed to separate. The powder contained flavonoids when the filtrate changed from red to yellow or orange to red (Handayani et al., 2020).

Tannin Test

A 0.5 gram sample was boiled in 50 mL of distilled water for 2 minutes, then the solution was cooled and filtered to obtain the filtrate. A 2 mL filtrate was taken, and one to two drops of 5% iron (III) chloride reagent solution were added. The presence of blackish-green or blackish-blue coloration indicates the presence of tannins in the sample. (Mayasari & Laoli, 2018)

Saponin Test

A 0.5 gram sample was placed in a test tube, then 10 mL of hot water was added. After cooling, the mixture was shaken vigorously for 10 seconds. The formation of foam that persisted for at least 10 minutes and did not disappear after the addition of one drop of 2N

HCl solution indicated the presence of saponins in the sample. (Mayasari & Laoli, 2018)

Steroid/Terpenoid Test

A 0.5 gram test sample was mixed with 2 mL of chloroform and shaken until homogeneous. The resulting filtrate was then added with two drops of acetic anhydride and two drops of concentrated sulfuric acid. The presence of steroid compounds was indicated by a color change in the solution, initially red and then gradually changing to blue or green, indicating a positive result. The presence of red or purple coloration indicated the presence of terpenoid compounds (Rumagit et al., 2015).

Organoleptic Testing

Organoleptic testing is part of the physical characteristics testing used to evaluate the quality of body scrub products. This testing involves 20 panelists who assess their liking for the product across three primary organoleptic attributes: color, aroma, and texture. Assessments are conducted using a hedonic scale with the following ranges: 1 = dislike very much, 2 = dislike very much, 3 = like very much, and 4 = like very much. (Lamusu, 2018).

Irritation Testing

Irritation testing is conducted using a closed method: a small sample is applied to the upper arm, then tightly covered with sterile gauze and a bandage. The area is left for 24 hours to observe any potential skin reactions. Each formulation was tested by three volunteers, for a total of 12 participants. During the testing period, participants were allowed to rinse the application area with water without soap. Evaluation of skin reactions includes assessing for erythema or edema, with the following criteria: (–) no reaction; (+) redness; (++) itching; (+++) swelling. (Wijayanti & Swastini, 2010).

RESULT AND DISCUSSION

Phytochemical Test Results

The results of the phytochemical screening test can be seen in table 1 as follows,

Table 1 Phytochemical Screening Test Results

Formulation	Phytochemical Screening					
	Alkaloid	Flavonoid	Tannin	Saponin	Steroid	Terpenoid
F1	+	+	-	+	-	+
F2	-	+	+	+	-	+
F3	+	+	+	+	-	+
F4	+	+	+	+	+	-

Description:
(+) = Contains secondary metabolites
(-) = Does not contain secondary metabolites

Phytochemical screening is a qualitative analytical method used to identify secondary metabolites in a sample. In this study, the test was conducted to determine the active compounds in a powdered body scrub formulated from a combination of breadfruit peel and renggak fruit peel. Based on the data presented in Table 1, formulation F1 tested positive for alkaloids, terpenoids, saponins, and flavonoids, but negative for tannins and steroids. Formulation F2 contained saponins, tannins, terpenoids, and flavonoids, but no alkaloids and steroids. Meanwhile, Formulation F3 was identified as containing alkaloids, tannins, saponins, terpenoids, and flavonoids, and negative for steroids. Formulation F4 tested positive for alkaloids, flavonoids, tannins, saponins, and steroids, but no terpenoids. These findings indicate variations in secondary metabolite content between formulations, influenced by differences in the composition of the raw materials in each mixture.

To date, no previous research has specifically conducted phytochemical tests on body scrub preparations made from a combination of breadfruit peel and renggak fruit peel. Existing research is generally limited to phytochemical testing of each ingredient in isolation, leaving no relevant comparative data for combination body scrub products. In a study by Azim et al. (2023), renggak fruit peel extract was reported to contain secondary metabolites, including alkaloids, flavonoids, saponins, and tannins. These findings are generally in line with the results of the current study, although tannins were not detected in some formulations. Meanwhile, research by Septiana (2018) revealed that breadfruit peel contains various active compounds, including saponins, polyphenols, hydrocyanic acid, acetylcholine, tannins, riboflavin, and phenols, as well as flavonoids such as quercetin, champorol, and artoindonesianin. Breadfruit peel contains steroid, phenolic, and flavonoid compounds. Thus, these results are consistent with existing theory and literature regarding the secondary metabolite content of each ingredient.

Previous research concluded that breadfruit peel contains saponins, tannins, steroids, and flavonoids. Meanwhile, renggak fruit peel contains alkaloids, saponins, flavonoids, and tannins. However, the phytochemical test results for the combination of breadfruit peel and renggak fruit peel differed from those for either plant. After the two plants were combined, the F2 plant, a combination of 2 grams of breadfruit peel and 3 grams of renggak fruit peel, lost alkaloid compounds. In contrast, the single plant, as previously studied in phytochemical screening of renggak fruit peel, was found to contain these alkaloids. Furthermore, steroid compounds were absent, whereas steroids were found in the single plant, as previously studied in phytochemical screening of breadfruit peel. Meanwhile, in the F3 combination of 3 grams of breadfruit peel and 2 grams of renggak fruit peel, no steroid compounds were found, even though previous research on phytochemical screening of breadfruit peel showed steroid compounds in the single plants. This also aligns with research by Kafelau et al. (2022), which found that the phytochemical test results for the combination differed from those for the individual plants.

Organoleptic Test Results

Organoleptic test results can be seen in the following table:

Table 2. Organoleptic Test Results

Formulation	Organoleptic Parameters				
	Colour	Aroma	Texture	Total	Avarages
F1	2	3,5	2,25	7,75	2,58
F2	2,55	3,15	2,4	8,1	2,7
F3	2,95	2,9	2,85	8,7	2,9
F4	3,15	3,45	3,1	9,7	3,23

The first parameter assessed in the organoleptic aspect is color, which is the initial visual impression and plays an important role in attracting consumer interest. Attractive colors can increase the appeal of a cosmetic product. Based on the evaluation results involving 20 panelists, the formulation with the highest average value for the color parameter was F4 with a score of 3.15, followed by F3 at 2.95, F2 at 2.55, and F1 as the lowest with a value of 2.00. The results of the data indicate that formulations F4 and F3 received a higher level of preference from the panelists, because both were considered to have a more attractive and striking visual appearance compared to the other formulations. The color difference in each formulation was caused by variations in the proportion of raw materials. Formulations F1 (5 grams of renggak fruit peel) and F2 (3 grams of renggak fruit peel: 2 grams of breadfruit peel) produced a cream color, while F3 (2 grams of renggak fruit peel: 3 grams of breadfruit peel) and F4 (5 grams of breadfruit peel) produced a brown color. The greater the proportion of breadfruit peel in the formulation, the darker or more intense the scrub color tends to be.

Aroma is an important parameter in organoleptic evaluation, assessed through the sense of smell. A product is categorized as having a good aroma if it produces a distinctive and pleasant odor. Aroma is also subjective because its perception depends on individual sensitivity and preference. Based on the test results, the highest average value for aroma parameters was obtained for formulation F4 at 3.45, followed by F1 at 3.5, F2 at 3.15, and F3 at 2.9, the lowest. Panelists showed a higher preference for F1 and F4. Formulation F1, which contains 5 grams of breadfruit peel, has a distinctive, spicy aroma resembling ginger. This aroma is considered calming and refreshing due to its natural aromatic properties. However, some panelists disliked the aroma because it tends to be strong and resembles plants from the Zingiberaceae family. Meanwhile, formulations F2 and F3 have a milder breadfruit aroma due to the mixture of breadfruit peel. F4, consisting of 5 grams of breadfruit peel, exhibits a distinctive tea-like aroma, which was considered mild and more neutral by most panelists, making it particularly appealing.

Texture is a sensory property of a product, specifically its tactile perception. Based on the data in Table 2, the highest average value for texture parameters was observed for formulation F4 (3.1), followed by F2 (2.85), F3 (2.4), and the lowest for F1 (2.25). These results indicate that the F4 formulation was the panelists' most preferred texture. This can be attributed to the physical characteristics of the F4 preparation: its semi-solid consistency, soft and homogeneous texture, and moderately rough, making it effective in assisting the exfoliation process, which removes dead skin cells and impurities from the skin's surface. Furthermore, F1 had the lowest average in the organoleptic test due to the texture of the formulation preparation, which is not semi-solid. This preparation is a 5-gram skin preparation that, when mixed with distilled water, is quickly absorbed, so it cannot be too thick. However, when more distilled water is added, the preparation becomes more liquid. However, all formulations can remove dirt, including dead skin cells.

pH Test Results

The pH measurement results are presented in Table 3 as follows,

Table 3. pH Test Results

No	Formulation	Repetition			Total	Avarages
		I	II	III		
1.	F1	5.5	4.5	5.8	15.8	5.27
2.	F2	5.7	5.4	6.0	17.1	5.7
3.	F3	5.9	6.3	6.6	18.8	6.27
4.	F4	6.5	5.9	6.8	19.2	6.4

The pH test was conducted to measure the acidity or alkalinity of the resulting body scrub preparation and to ensure that the product's pH value is within the skin's natural pH range, thereby preventing adverse effects such as irritation from excessive acidity or alkalinity. Based on the data in Table 3, the pH of the body scrub formulated from a combination of breadfruit peel and renggak fruit peel ranges from 5.5 to 6.5.

The pH value is an important indicator in determining the stability and safety of a cosmetic product. Based on the test results, formulation F4 had the highest pH (6.4), followed by F3 (6.27), F2 (5.7), and F1 (5.27). All formulations fall within the range specified by the Indonesian National Standard (SNI) 16-4399-1996, which is 4.5-8.0 (Sopianti, 2022), indicating that the tested scrub products are safe for skin use. A suitable pH value not only ensures comfort during use but also minimizes the risk of irritation. Products with a pH that is too alkaline can cause dry, flaky skin, whereas a pH that is too acidic can increase skin sensitivity and cause irritation (Sopianti, 2022).

Irritation Test Results

The irritation test results can be seen in the table 4 as follows,

Figure 4. Results of the One-Sample t-Test against the MMC (75)

Observation	Volunteer											
	1	2	3	4	5	6	7	8	9	10	11	12
Redness	-	-	-	-	-	-	-	-	-	-	-	-
Itchy rash	-	-	-	-	-	-	-	-	-	-	-	-
Swollen	-	-	-	-	-	-	-	-	-	-	-	-

An irritation test was conducted to evaluate the product's safety when applied to the skin, ensuring that it does not cause adverse reactions or side effects. The test was conducted on 12 panelists over 24 hours to observe skin symptoms such as redness, itching, or swelling. The 24-hour application time was chosen to allow sufficient time for absorption and the emergence of possible allergic reactions, considering that skin reaction times to various ingredients can vary. Based on the literature (Sulaksmono, 2006), this period is considered representative for testing purposes. The results showed that no irritation symptoms were observed among all panelists, and the scrub preparation was deemed safe for use. In addition, all formulations had pH values in the range of 5.5–6.5, which is within the safe limits of SNI 16-4399-1996 for skin cosmetic products (4.5–8.0). Thus, the scrub product tested was neither too acidic nor too alkaline and did not cause skin irritation (Anggun, H.K., et al., 2020).

Table 1. Descriptive-Inferential Statistics Table

Statistics	Value
Number of Students (n)	30
Average Score	81.00
Standard Deviation	15.17
KKM Score (Comparison)	75
t-value	2.167
df	29
p-value (2-tailed)	0.0386
Minimum Score	40
Maximum Score	100
Median	80
Mode	90

These findings prove that developing interactive e-modules that integrate visual and religious elements, as proposed in this study, has a strong empirical basis for improving students' conceptual understanding in science, particularly chemistry. Descriptive and inferential statistical analyses (Figure 5) also support this interpretation. The mean, standard deviation, minimum, maximum, median, and mode values obtained provide a general overview of student performance in quantitative terms. Meanwhile, the results of the one-sample t-test yielded a t-value of 2,167 with degrees of freedom ($df = 29$) and a significance level ($\alpha = 0,05$). Since the t-calculated value exceeds the t-table value at the corresponding df, and is supported by a p-value of 0,0386 ($p < 0,05$), it can be concluded that there is a significant difference between the average posttest scores of students and the MCC value. This finding provides scientific evidence that the intervention implemented is effective in statistically improving students' learning outcomes (Rahayu et al., 2024).

The effectiveness of this e-module is inseparable from its integrative approach, which combines digital interactivity, STEM principles, and Islamic values. This module presents buffer solution material in a visual, contextual, and value-based manner, enhancing conceptual understanding and supporting students' holistic character development. These findings align with Sahil et al. (2024), who demonstrated that integrating religious values into science education can enhance students' understanding of the material, noble character, and skills (Sahil et al., 2024). nfortunately, most e-modules in circulation still focus on narrative text and do not optimally accommodate interactivity and spiritual values (Asrizal et al., 2022).

The application of interactive technology in this e-module also contributes to strengthening 21st-century skills. A study by Kain et al. (2024) confirms that the integration of technology in the learning environment can stimulate critical thinking, problem solving, and creativity (Kain et al., 2024). With engaging content and opportunities for independent exploration, this e-module can help students become better prepared to face global challenges. This explanation is also supported by Fatma et al. (2024), who found that the ubiquitous learning model—learning that utilizes technology—can improve students' argumentative abilities(Fatma et al., 2024). Additionally, visualization and flexibility of access are key to the success of meaningful self-directed learning (Yang & Wang, 2023).

The use of communicative language, Islamic narratives, and representative visual media creates an inclusive and relevant learning experience (Healey, 2023). According to De Bruijn-Smolders & Prinsen (2024), interactive e-modules and synchronized learning media between online and offline environments that can be used in both conditions can enhance cognitive and affective engagement (De Bruijn-Smolders & Prinsen, 2024). This view aligns with the national education mission, emphasizing the development of students' character and self-efficacy (Go et al., 2024).

Overall, students' posttest results indicate that this interactive e-module significantly impacts learning outcomes. This result is due to concept reinforcement, spiritual engagement, and technology integration that promote more meaningful and contextual learning (Rusdi et al., 2023). This study supports the importance of policies that lead to more humanistic and religious digitalization of education (Zakaria, 2025; Zhang et al., 2025).

These results also encourage teachers to abandon passive lecture methods that are less responsive to the needs of modern students and adopt a more active, technology-based learning approach. However, this is strongly supported by training and technical support to achieve a deep understanding and support so that teachers can effectively lead digital transformation in education to improve interaction with students (Wohlfart & Wagner, 2024). The transformation of teachers from passive users to content developers who can improve the quality of learning is greatly supported by collaboration between teachers, learning designers, and Islamic studies experts (Suartama et al., 2024; Tajeddin & Asadnia, 2023). Therefore, ongoing training and digital literacy support are also of great importance (Malla et al., 2023; Sukino, Muhammad, 2025)

The development of this e-module opens up opportunities to integrate spiritual values into science subjects, resulting in a balanced learning experience between intellectual and moral development. Recent studies indicate that leadership in Islamic schools promotes educational innovation that not only enhances students' academic performance but also fosters religious character rooted in moral values (Ismail et al., 2025; Nifasri, 2025; Sliwka et al., 2024). Support from Islamic-based schools is crucial to encourage learning innovations that not only pursue academic achievement but also the formation of strong character oriented toward moral values.

Finally, this research opens up opportunities for further exploration of the impact of integrating Islamic values in science education on student motivation, character, and achievement. Previous research has shown that this interactive e-module approach can increase student learning motivation and character building (Raisah et al., 2023 Additionally, a literature review by Loso and Yusniar (2025) also found that integrating Islamic values into STEM education can support students' development in terms of ethics, spirituality, and academic achievement (Raisah et al., 2023; Yusniar dan Judijanto, 2025). Therefore, the results of this research not only provide practical contributions to the development of value-based teaching media in renowned Madrasah Aliyah environments in Pekanbaru but also offer a conceptual basis for determining the direction of educational innovation that is in line with religious values and the needs of the 21st century.

CONCLUSION

Based on the results of the research conducted, it can be concluded that the powdered body scrub preparation, a combination of breadfruit peel (Artocarpus altilis) and renggak fruit peel (Amomum dealbatum), contains various secondary metabolites. Formulation F1 shows the presence of alkaloids, flavonoids, saponins, and terpenoids; formulation F2 contains flavonoids, tannins, saponins, and terpenoids; formulation F3 is identified as containing alkaloids, flavonoids, tannins, saponins, and terpenoids, while formulation F4 shows the content of alkaloids, flavonoids, tannins, saponins, and steroid compounds. The combination of the two ingredients has a significant effect on organoleptic parameters, particularly color and texture. However, it does not show significant differences in aroma parameters, pH values, or irritation potential. All formulations have pH values within the standard range specified in SNI 16-4399-1996, namely 4.5–8.0. The best formulation was obtained in F4, with an average organoleptic score of 3.23, which is characterized by a brown color, a distinctive aroma resembling tea, a slightly rough and semi-thick texture, so that it is effective in removing dirt on the skin, and does not cause irritation to users.

REFERENCES

Azim, M., Hariadi, P., & Yuliana, T. (2023). Aktivitas Antioksidan Dan Antibakteri (Staphylococus epidermidis) Ekstrak Kulit Buah Renggak (*Amomum dealbatum*) Tanaman Khas Lombok. *Journal Of Chemistry*. 17(1). 79.

Dewi, N. K. (2017). Potensi Senyawa di-(2-etilheksil) ftalat Sebagai Antioksidan Dari Ekstrak Diklorometana Kulit Buah Sukun (Artocarpus altilis). (Skripsi). Program Sarjana Universitas Jambi, Jambi.

Handayani, F., Apriliana, A., & Novianti, I. (2020). Karakterisasi dan Skrining Fitokimia Simplisia Daun Selutui Puka (*Tubernaemontana Macracarpa Jack*). *As syifaa Jurnal Farmasi*. 12(1). 9 - 15.

Kafelau, M. M., Kopon, A. M., Baunsele, A. B., Tukan, M. B., Leba, M. U., Komisia, F., & Boelan, E. G. (2022). Phytochemical Screening and TLC Profiling of Combination Extracts of Avocado (Persea americana Mill.) and Papaya (Carica papaya) Leaves from Timor Island. Indo. J. Chem. Res., 10(1), 32–37. https://doi.org/10.30598/ijcr.2022.10-boe

Kusumawati, A. H., Yonathan, K., Ridwanuloh, D., & Widyaningrum, I. (2020). Formulasi Dan Evaluasi Fisik Sediaan Masker Sheet (Sheet Mask) Kombinasi Vco (*Virgin Coconut Oil*), Asam Askorbat dan A-Tocopherol. *Jurnal Pharma Xplore*. 5(1). 8-14.

Lamusu, D. (2020). Uji Organoleptik Jalangkote Ubi Jalar Ungu (Ipomoea batatas L) Sebagai Upaya Diversifikasi Pangan. *Jurnal Pengolahan Pangan*. 3 (1). 12-42.

Mayasari, U., & Laoli, M. T. (2018). Karakterisasi Simplisia dan Skrining Fitokimia Daun Jeruk Lemon (*Citrus limon (L.) Burm.f.*). *e-Jurnal Ilmu Biologi dan Terapan*. 2(1). 10.

Mustariani, B. A. A & Hidayanti, B. R. (2022). Skrining Fitokimia Ekstrak Etanol Daun Renggak (*Amomum dealbatum*) dan Potensinya Sebagai Antioksidan", *SPIN-Jurnal Kimia & Pendidikan Kimia*, hlm. 144-152.

Ningsi,, S. Nonci, F. Y., & Sam, R. (2015). Formulasi Sediaan Lulur Krim Ampas Kedelai Putih dan Ampas Kopi Arabika. *Jurnal Farmasi FIK UINAM*. 3 (1). 2.

Rumagit, H. M., Runtuwene, M. R. J., & Sudewi, S. (2015). Uji Fitokimia dan Uji Antioksidan Dari Ekstrak Etanol Spons (*Lamellodysidea Herbacea*). *Jurnal Ilmiah Pharmacon*. 4(3).186.

Septiana, E. (2018). Uji Anti Lalat Rumah (*Musca domestica*) Dari Sediaan Elektrik Kulit Buah Sukun (*Artocarpus altilis*). (KTI). Program Sarjana Universitas Muhamadiyah Surabaya, Surabaya.

Sopianti, D. S. (2022). Valuasi Antioksidan Dari Lulur *Body Scrub* Ekstrak Rumput Laut Merah (*Gelidium Sp*). *Jurnal Ilmiah Pharmacy*. 9 (1). 16-96.

Sulaksmono, M. (2006). Keuntungan dan Kerugian Patch Test (Uji Tempel) Dalam Upaya Menegakkan Diagnosa Penyakit Kulit Akibat Kerja (Occupational Dermatosis). *Journal Unair*. 3.

Ulayya, C. Z. (2022). Formulasi dan Uji Aktivitas Antioksidan Lulur *Body Scrub* Fraksionat Diklorometan Kulit Buah Sukun (*Artocarpus altilis*) Dengan Kombinasi Niacinamide dan Alfa Tokoferol Secara In Vitro. (skripsi). Program Sarjana Universitas Jambi, Jambi.

Warnis, M., Aprilina, L. A., Maryanti, L. (2020). Pengaruh Suhu Pengeringan Simplisia Terhadap Kadar Flavonoid Total Ekstrak Daun Kelor (*Moringa Oleifera L.*). *SNAPAN*. 265.

Wijayanti, W., & Swastini, L. (2010). Uji Iritasi Ekstrak Etanol Kulit Buah Manggis (*Garcinia Mangostana L.*). (Skripsi). Program Sarjana Universitas Udayana, Denpasar.

Yuliati, E., & Binarjo, A. (2010). Pengaruh Ukuran Partikel Tepung Beras Terhadap Daya Angkat Sel Kulit Mati Lulur Bedak Dingin", (Skripsi). Program Sarjana Universitas Ahmad Dahlan, Yogyakarta.