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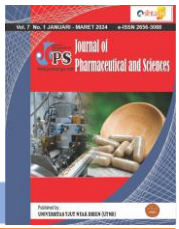

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Formulation, physical stability, and changes in skin hydration after use of a body scrub cream containing moringa leaf extract (*Moringa oleifera*) and black glutinous rice (*Oryza sativa* var. *glutinosa*)

Formulasi, stabilitas fisik, dan perubahan kelembapan kulit setelah penggunaan krim body scrub ekstrak daun kelor (*Moringa oleifera*) dan beras ketan hitam (*Oryza sativa* var. *glutinosa*)

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Abstract

Background: Moringa leaf extract and black glutinous rice are potential ingredients for body scrub formulations. This study evaluated their incorporation into a cream, its physical stability and sensory acceptability, and changes in skin hydration. **Methods:** Dried moringa leaves were macerated in 96% ethanol. F1, F2, and F3 contained 1, 2, and 3 g of extract, respectively, and 5 g of black glutinous rice powder. F0 was the negative control, and a commercial rice body scrub was the comparator. Physical characteristics were evaluated over four weeks and after three temperature cycles at 4 ± 2 °C and 40 ± 2 °C. Hedonic testing involved 20 panelists; skin hydration, oil, and softness were assessed in five volunteers over four weeks. **Results:** Extraction yielded 60.73 g (20.24%); alkaloids, flavonoids, saponins, and tannins were detected. During storage, pH ranged from 4.84 to 6.49, spreadability from 4.90 to 6.40 cm, and adhesion from 4.27 to 6.56 s. No visible changes in color, consistency, or odor occurred during temperature cycling. No redness, itching, or swelling was observed within 24 h of the irritation test. F1 had the highest descriptive preference scores for four sensory attributes; aroma differed among formulations in the reported Kruskal–Wallis analysis ($p = 0.003$). F3 had the largest observed hydration increase among experimental formulations, from 28.8% to 46.2% at week 4 (relative increase, 60.4%); the reported between-group test yielded $p = 0.001$. **Conclusion:** The formulations retained their observed physical characteristics under the tested conditions. F1 was preferred in the sensory evaluation, whereas F3 showed the largest observed improvements in hydration and softness. These exploratory findings do not establish comparative clinical efficacy or long-term safety.

Keywords: Moringa oleifera; black glutinous rice; body scrub cream; physical stability; skin hydration; sensory acceptability.

Abstrak

Latar belakang: Ekstrak daun kelor dan beras ketan hitam berpotensi digunakan dalam formulasi krim body scrub. Penelitian ini bertujuan mengevaluasi formulasi, stabilitas fisik, penerimaan sensoris, dan perubahan kelembapan kulit setelah penggunaan sediaan. **Metode:** Serbuk daun kelor dimaserasi menggunakan etanol 96%. F1, F2, dan F3 masing-masing mengandung 1, 2, dan 3 g ekstrak serta 5 g serbuk beras ketan hitam. F0 merupakan kontrol negatif, sedangkan body scrub beras komersial digunakan sebagai pembanding. Karakteristik fisik dievaluasi selama empat minggu dan setelah tiga siklus suhu pada 4 ± 2 °C dan 40 ± 2 °C. Uji hedonik melibatkan 20 panelis; kelembapan, minyak, dan kehalusan kulit dinilai pada lima sukarelawan selama empat minggu. **Hasil:** Ekstraksi menghasilkan 60,73 g ekstrak (20,24%) dengan hasil positif untuk alkaloid, flavonoid, saponin, dan tanin. Selama penyimpanan, pH berkisar 4,84–6,49, daya sebar 4,90–6,40 cm, dan daya lekat 4,27–6,56 detik. Tidak teramati perubahan warna, bentuk, atau bau setelah siklus suhu. Tidak ditemukan kemerahan, gatal, atau pembengkakan selama pengamatan iritasi 24 jam. F1 memperoleh skor kesukaan deskriptif tertinggi pada empat atribut sensoris; analisis Kruskal–Wallis yang dilaporkan menunjukkan perbedaan aroma antarformula ($p = 0,003$). F3 menunjukkan peningkatan kelembapan terbesar di antara formula uji, dari 28,8% menjadi 46,2% pada minggu ke-4 (peningkatan relatif 60,4%); uji antarkelompok yang dilaporkan menghasilkan $p = 0,001$. **Kesimpulan:** Sediaan mempertahankan karakteristik fisik yang diamati pada kondisi pengujian. F1 lebih disukai secara sensoris, sedangkan F3 menunjukkan peningkatan kelembapan dan kehalusan terbesar secara deskriptif. Temuan eksploratif ini belum membuktikan efektivitas klinis komparatif ataupun keamanan jangka panjang.

Kata kunci: Moringa oleifera; beras ketan hitam; krim body scrub; stabilitas fisik; kelembapan kulit; penerimaan sensoris.

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Introduction

A body scrub cream is a semisolid cosmetic preparation that combines a cream base with exfoliating particles to help remove dead cells from the skin surface. Its development requires not only particles with suitable characteristics but also a base that spreads readily, remains stable, and is acceptable to users. Various plant-derived materials, including coffee grounds, papaya peel, coconut residue, and a combination of white turmeric and date seeds, have been investigated as body scrub ingredients [1–4].

The use of moringa (*Moringa oleifera*) is supported by the availability of plant material and advances in its cultivation [5]. Its application in skin care has been introduced through community outreach activities, including education on hyperpigmentation and the preparation of facial masks; these activities provide a context for use rather than evidence of clinical efficacy [6,7]. Studies of moringa leaf extracts and reviews of their phytochemical composition have reported compounds with antioxidant potential [8,9]. Tutik et al. reported an IC_{50} of 103.98 µg/mL for an ethanolic moringa leaf extract in the DPPH assay [10]. Work on the development of moringa extracts into gels also supports their relevance to topical formulation research, although extract activity cannot be directly equated with the performance of the finished product [11].

Black glutinous rice (*Oryza sativa* var. *glutinosa*) has been used in the development of body scrubs and masks, including combinations with honey and clay mask formulations [12,13]. In body scrub creams, the powder primarily serves as exfoliating particles, whereas its pigments provide a rationale for potential antioxidant activity. Research on combinations of black glutinous rice and cinnamon has also examined their use in moisturizing preparations [14]. Such potential should be distinguished from direct measurements of pigment content, antioxidant activity, or the exfoliating performance of the finished formulation.

Base selection is important because emulsion characteristics influence the physical properties of the preparation. Studies of banana peel creams and jicama body scrubs highlight the importance of evaluating emulsion-forming components [15,16]. From a skin care perspective, emollient use is associated with improved hydration and maintenance of the skin barrier, as discussed in a clinical review of atopic dermatitis [17]. This rationale supports the inclusion of hydration as a formulation outcome but does not make the present cosmetic study evidence for the treatment of skin disease.

The combination of moringa extract and rice in a body scrub has previously been reported [18]. Accordingly, this study does not seek to establish the novelty of combining these ingredients in general. Rather, it evaluates varying amounts of moringa extract with black glutinous rice powder and distinguishes physical characteristics, sensory preference, and changes in skin parameters. The study aimed to formulate a body scrub cream containing moringa leaf extract and black glutinous rice, assess its physical stability and sensory acceptability, and observe changes in skin hydration, oil, and softness over four weeks.

Methods

Materials, sample preparation, and extraction

The materials comprised moringa leaves, black glutinous rice, 96% ethanol, distilled water, stearic acid, Tween 60, cetyl alcohol, propylene glycol, liquid paraffin, lanolin, methylparaben, propylparaben, and green tea fragrance. Reagents for phytochemical screening included ammonia, chloroform, concentrated sulfuric acid, Mayer and Wagner reagents, 70% ethanol, magnesium powder, hydrochloric acid, and $FeCl_3$. The equipment comprised a rotary evaporator, an oven, glassware, a pH meter, glass slides, a mortar and pestle, a No. 60 sieve, a Memmert WNB-45 water bath, an analytical balance, and a skin analyzer.

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Moringa leaves were obtained from Pasia, Ampek Angkek District, Agam Regency, West Sumatra, and identified at Herbarium ANDA, Universitas Andalas, Padang. The leaves were washed under running water, dried at room temperature away from direct sunlight, and ground into powder. A total of 300 g of powder was macerated in 96% ethanol for three days. The macerate was filtered, and the filtrate was concentrated using a rotary evaporator at 50 °C. Extraction yield was calculated as the mass of concentrated extract expressed as a percentage of the initial mass of dried powder.

Qualitative phytochemical screening was performed for alkaloids using Mayer and Wagner reagents, flavonoids using the magnesium–hydrochloric acid reaction, saponins by foam formation, and tannins using $FeCl_3$. Black glutinous rice was washed and sorted, dried in an oven at 90 °C for two hours, and then ground and passed through a No. 60 sieve. The use of black glutinous rice as a body scrub ingredient has been reported previously [12].

Formulation and preparation of the body scrub cream

Four formulations, designated F0, F1, F2, and F3, were prepared. F0 served as the negative control without moringa extract, whereas F1–F3 contained 1, 2, and 3 g of extract, respectively, and 5 g of black glutinous rice powder each. Their compositions are presented in Table 1. The rice variant of Herborist body scrub was used as the commercial comparator and is hereafter designated K+. The formulation approach was based on the development of a body scrub cream combining moringa and rice [18].

Table 1. Composition of the body scrub creams containing moringa leaf extract and black glutinous rice.

Ingredient	F0	F1	F2	F3	Function
Moringa leaf extract	0 g	1 g	2 g	3 g	Test ingredient
Black glutinous rice powder	—	5 g	5 g	5 g	Exfoliant
Stearic acid	5 g	5 g	5 g	5 g	Consistency agent
Tween 60	2 g	2 g	2 g	2 g	Nonionic emulsifier
Cetyl alcohol	3 g	3 g	3 g	3 g	Emollient and stabilizer
Propylene glycol	0.5 g	0.5 g	0.5 g	0.5 g	Humectant
Liquid paraffin	5 g	5 g	5 g	5 g	Emollient
Lanolin	5 g	5 g	5 g	5 g	Emollient
Methylparaben	0.1 g	0.1 g	0.1 g	0.1 g	Preservative
Propylparaben	0.05 g	0.05 g	0.05 g	0.05 g	Preservative
Green tea fragrance	3 drops	3 drops	3 drops	3 drops	Fragrance
Distilled water to	100 mL	100 mL	100 mL	100 mL	Solvent/aqueous phase

F0: negative control without moringa extract; F1–F3: formulations containing increasing amounts of extract; K+: commercial comparator, not included among the compounded formulations. —: amount not available.

The creams were prepared by emulsification. The oil phase, comprising stearic acid, lanolin, cetyl alcohol, and liquid paraffin, was heated in a water bath at approximately 70 °C; propylparaben was then added and stirred until homogeneous. The aqueous phase was prepared by dissolving methylparaben and propylene glycol, followed by the addition of hot distilled water and Tween 60. The aqueous phase was incorporated into the oil phase and mixed using a mortar and pestle until an emulsion formed. Moringa extract was added gradually. After the mixture had partially cooled, black glutinous rice powder and three drops of fragrance were added, and the preparation was mixed until uniformly dispersed [18].

Physical evaluation, stability, and volunteer assessments

Physical evaluation was conducted over four weeks. Organoleptic assessment included consistency, color, and odor. Homogeneity was assessed by spreading the preparation on a glass slide to observe the uniformity of the base and particle distribution. The pH was measured using a pH meter and compared with the study reference range of 4.5–6.5. Spreadability was determined from the diameter of the spread preparation after a 100 g load had been applied for one minute. Adhesion was measured by placing approximately 0.1 g of the preparation between two glass slides, applying a 50 g load for five minutes, and recording the time until the slides separated. These parameters characterized the physical properties of the preparation rather than directly measuring clinical efficacy [3,4,16].

Temperature cycling was performed by storing each preparation in a plastic container at 4 ± 2 °C for 24 h, followed by storage at 40 ± 2 °C for 24 h. This sequence constituted one cycle and was repeated for a

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total of three cycles. Organoleptic characteristics, pH, and spreadability were evaluated at the end of each cycle. Temperature cycling was used to assess physical resistance to changes in storage conditions [19].

Irritation assessment involved five female volunteers aged 20–30 years. Approximately 1 g of the preparation was applied to the inner upper arm, and the application site was assessed for redness, itching, and swelling over 24 h. The results were evaluated descriptively according to the presence or absence of observed reactions; local reaction assessment has also been used in research on coffee-based body scrub preparations [20].

The hedonic test involved 20 panelists who applied the preparations to the inner upper arm and rated color, aroma, texture, stickiness, and moisture sensation. The rating scale was 5 = like very much, 4 = like, 3 = moderately like, 2 = dislike, and 1 = dislike very much. Results were expressed as percentage preference scores [14,18]. Changes in skin hydration, oil, and softness were observed over four weeks in five volunteers aged 18–25 years with normal skin. The preparations were applied to the inner upper arm. Measurements using a skin analyzer were obtained before use and at weeks 0–4; the instrument outputs were recorded as moisture, oil, and soft. The terms hydration, oil, and softness used in reporting the results refer to the readings of these respective parameters.

Data analysis

Physical data were summarized as mean ± standard deviation. The reported analysis used two-way ANOVA to evaluate formulation and storage time after assessing normality and homogeneity of variance, with Tukey HSD for selected post hoc comparisons. Hedonic data were analyzed using the Kruskal–Wallis test. Changes in skin parameters over time were analyzed using the Friedman test, whereas between-group comparisons at week 4 used the Kruskal–Wallis test. Statistical significance was set at $p < 0.05$. Inferential findings were considered alongside the magnitude of numerical changes and the limitations of the study design.

Results

Extraction and phytochemical screening

Maceration of 300 g of moringa leaf powder in 96% ethanol yielded 60.73 g of concentrated extract, corresponding to a yield of 20.24%. Phytochemical screening was positive for alkaloids, flavonoids, saponins, and tannins (Table 2). These findings indicate the qualitative presence of the tested metabolite classes but provide no information on their concentrations.

Table 2. Phytochemical screening of the moringa leaf extract.

Compound class	Result	Observation
Alkaloids	+	Orange precipitate
Flavonoids	+	Red color in the ethanol layer
Saponins	+	Foam formation
Tannins	+	Blackish-green color

The + sign indicates a positive qualitative reaction.

Organoleptic characteristics and homogeneity

All formulations remained semisolid throughout the observation period from week 0 to week 4. F0 was white; F1 and F2 were dark purple; and F3 was dark green to brownish. Organoleptic characteristics are summarized in Table 3, and the appearance of the preparations is shown in Figure 1. The cream base appeared uniform, with black glutinous rice particles in F1–F3 representing the deliberately incorporated scrub component.

Table 3. Organoleptic characteristics of the preparations over four weeks.

Formula	Consistency	Color	Odor
F0	Semisolid	White	Green tea; weaker after week 3
F1	Semisolid	Dark purple	Characteristic of black glutinous rice
F2	Semisolid	Dark purple	Characteristic of black glutinous rice
F3	Semisolid	Dark green/brownish	Characteristic of black glutinous rice, with a slight moringa odor

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Figure 1. Physical appearance of the body scrub cream preparations.

pH, spreadability, and adhesion

During storage, pH ranged from 4.84 to 6.49, with all values within the formulation reference range used in this study (Table 4). F3 had the highest pH at week 4, at 6.49. The reported two-way ANOVA showed effects of formulation, time, and their interaction (all $p < 0.001$); the Tukey HSD comparison between F0 and F1 also yielded $p < 0.001$. Changes in mean pH are shown in Figure 2.

Table 4. pH of the body scrub creams during four weeks of storage.

Formula	Week 0	Week 1	Week 2	Week 3	Week 4
F0	5.35 ± 0.01	4.92 ± 0.01	4.92 ± 0.01	4.84 ± 0.01	5.85 ± 0.01
F1	5.43 ± 0.01	5.27 ± 0.01	5.96 ± 0.01	5.71 ± 0.01	6.00 ± 0.01
F2	5.44 ± 0.01	5.27 ± 0.01	6.11 ± 0.01	5.90 ± 0.01	5.98 ± 0.01
F3	5.69 ± 0.01	5.27 ± 0.01	6.23 ± 0.01	5.93 ± 0.01	6.49 ± 0.01

Data are presented as mean ± standard deviation, as reported in the measurement records.

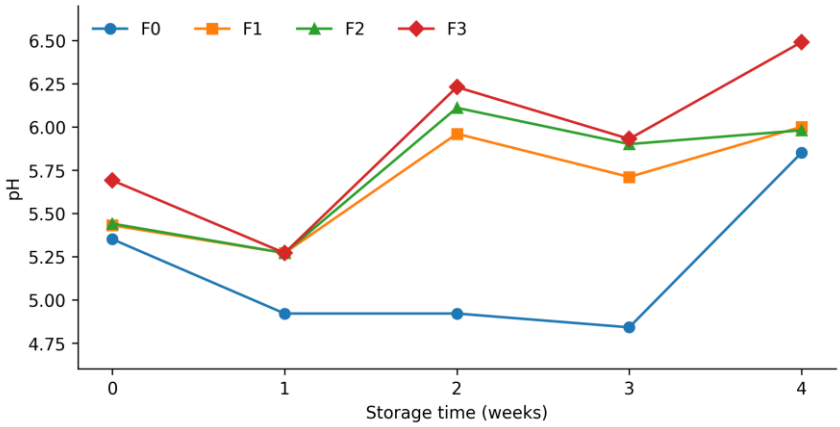

Figure 2. Changes in mean pH of F0–F3 during four weeks of storage. The graph was constructed from the values in Table 4; error bars are not shown.

Spreadability ranged from 4.90 to 6.40 cm (Table 5). At week 4, both F1 and F3 reached 6.40 cm. The initial value for F0, 4.90 cm, was slightly below the 5–7 cm reference range used in the evaluation. The reported ANOVA showed an effect of storage time ($p = 0.004$), with differences between week 0 and weeks 3 and 4 in the Tukey HSD comparisons ($p \leq 0.038$).

Table 5. Spreadability (cm) of the body scrub creams during four weeks of storage.

Formula	Week 0	Week 1	Week 2	Week 3	Week 4
F0	4.90 ± 0.10	5.00 ± 0.10	5.10 ± 0.10	5.20 ± 0.10	5.20 ± 0.10
F1	5.90 ± 0.10	5.90 ± 0.10	6.30 ± 0.10	6.40 ± 0.10	6.40 ± 0.10
F2	5.60 ± 0.10	5.60 ± 0.10	5.90 ± 0.10	5.90 ± 0.10	5.90 ± 0.10
F3	5.20 ± 0.10	5.20 ± 0.10	5.90 ± 0.10	6.40 ± 0.10	6.40 ± 0.10

Data are presented as mean ± standard deviation.

Adhesion ranged from 4.27 to 6.56 s and tended to increase during storage (Table 6). F3 showed the highest adhesion at week 4, at 6.56 s. The reported ANOVA yielded $p < 0.001$, while Tukey HSD comparisons across time showed differences between week 0 and week 2 ($p = 0.011$), week 3 ($p < 0.001$), and week 4 ($p < 0.001$).

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Table 6. Adhesion (s) of the body scrub creams during four weeks of storage.

Formula	Week 0	Week 1	Week 2	Week 3	Week 4
F0	4.27 ± 0.01	4.41 ± 0.01	4.47 ± 0.01	4.75 ± 0.01	5.11 ± 0.01
F1	4.70 ± 0.01	4.93 ± 0.01	5.17 ± 0.01	5.16 ± 0.01	5.22 ± 0.01
F2	4.40 ± 0.01	4.67 ± 0.01	4.82 ± 0.01	4.97 ± 0.01	5.18 ± 0.01
F3	4.34 ± 0.01	4.47 ± 0.01	4.69 ± 0.01	5.43 ± 0.01	6.56 ± 0.01

Data are presented as mean ± standard deviation.

Irritation observations and temperature-cycling stability

No redness, itching, or swelling was reported for F0, F1, F2, or F3 in the five volunteers during the 24 h observation period. This finding is limited to reactions assessed at the application site and within the observation period; sensitization and long-term tolerability were not among the reported assessments.

Across three cooling–heating cycles, F0–F3 and K+ showed no changes in color, consistency, or odor. No phase separation was observed in the experimental formulations. The pH and spreadability values after each cycle are presented in Table 7. The pH ranged from 4.6 to 6.5, and spreadability ranged from 4.8 to 7.0 cm; the F0 spreadability of 4.8 cm in the first cycle was slightly below the 5–7 cm reference range.

Table 7. pH and spreadability after three cooling–heating cycles.

Formula	pH cycle 1	pH cycle 2	pH cycle 3	Spread cycle 1	Spread cycle 2	Spread cycle 3
F0	5.4 ± 0.01	6.1 ± 0.01	6.2 ± 0.01	4.8 ± 0.01	6.5 ± 0.01	5.8 ± 0.01
F1	4.6 ± 0.01	4.9 ± 0.01	5.3 ± 0.01	6.0 ± 0.01	6.0 ± 0.01	5.8 ± 0.01
F2	5.2 ± 0.01	5.4 ± 0.01	5.6 ± 0.01	6.0 ± 0.01	6.2 ± 0.01	5.2 ± 0.01
F3	4.6 ± 0.01	4.8 ± 0.01	5.7 ± 0.01	5.4 ± 0.01	7.0 ± 0.01	6.2 ± 0.01
K+	6.2 ± 0.01	6.2 ± 0.01	6.5 ± 0.01	5.2 ± 0.01	5.4 ± 0.01	5.8 ± 0.01

Data are presented as mean ± standard deviation. Spreadability is expressed in cm. K+: commercial comparator. No organoleptic changes were observed in any formulation or cycle.

Sensory acceptability

F1 obtained the highest scores for color (94%), aroma (94%), texture (91%), and moisture sensation (94%), whereas F2 obtained the highest score for stickiness (90%). The complete results are presented in Table 8 and Figure 3. The reported Kruskal–Wallis analysis showed a difference among formulations only for aroma ($H = 13.784$; degrees of freedom = 3; $p = 0.003$). No significant differences were found for color ($p = 0.207$), texture ($p = 0.804$), stickiness ($p = 0.940$), or moisture sensation ($p = 0.091$).

Table 8. Sensory preference scores for the body scrub creams (%).

Formula	Color	Aroma	Texture	Stickiness	Moisture sensation
F0	93	92	90	88	90
F1	94	94	91	89	94
F2	90	91	88	90	86
F3	88	79	89	89	89

The hedonic test involved 20 panelists. Percentages represent the reported preference scores, not the proportion of panelists.

Skin hydration, oil, and softness

All groups showed an increase in mean hydration readings from before use to week 4 (Table 9). F3 showed the largest increase among the experimental formulations, from 28.8% to 46.2%, equivalent to an increase of 17.4 percentage points or 60.4% relative to baseline. K+ reached 47.0% at week 4. Changes over the observation period are shown in Figure 4.

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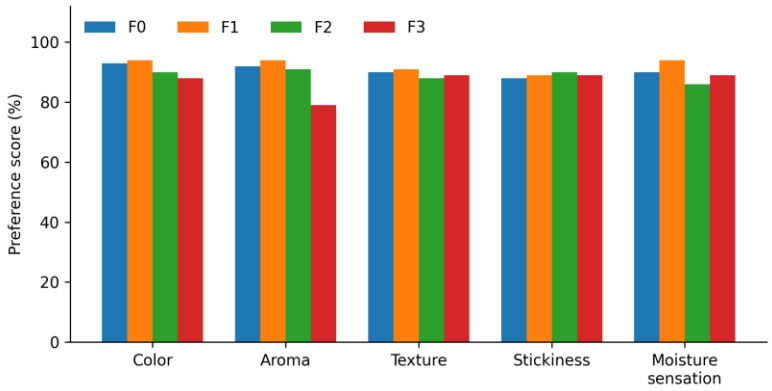

Figure 3. Comparison of sensory preference scores for F0–F3 based on Table 8. Differences in bar height are descriptive and do not represent post hoc pairwise comparisons between formulations.

Table 9. Mean skin hydration readings before and during four weeks of use.

Formula	Before use	Week 0	Week 1	Week 2	Week 3	Week 4	Relative increase (%)
F0	28.8	33.6	34.2	34.4	34.6	36.2	25.7
F1	28.8	33.4	34.2	34.8	36.2	38.8	34.7
F2	28.8	33.4	34.4	36.0	37.0	39.6	37.5
F3	28.8	34.6	36.6	38.0	40.4	46.2	60.4
K+	28.8	45.2	44.6	45.6	46.4	47.0	63.2

Hydration values correspond to the instrument readings reported as %. Relative increase = [(week-4 value − value before use)/value before use] × 100%. K+: commercial comparator.

The reported Friedman tests showed changes over time in F0 ($p = 0.004$), F1 ($p < 0.001$), F2 ($p < 0.001$), F3 ($p < 0.001$), and K+ ($p = 0.003$). At week 4, the Kruskal–Wallis test yielded $H = 18.316$, degrees of freedom = 4, and $p = 0.001$; the mean ranks for F0, F1, F2, F3, and K+ were 5.30, 8.90, 10.10, 19.50, and 21.20, respectively. This overall test does not identify which pairs of formulations differ or establish equivalence between F3 and the commercial product.

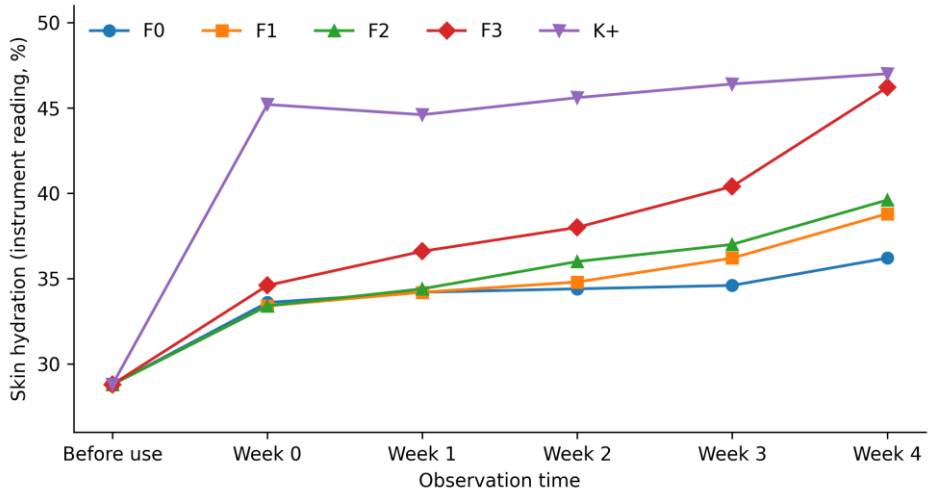

Figure 4. Changes in mean hydration readings before use and at weeks 0–4, based on Table 9. K+ is the commercial comparator. Error bars are not shown because standard deviations for the skin measurements were not available.

Changes in skin oil and softness scores are presented in Table 10. At week 4, F1 had the highest oil score among the experimental formulations (4.4), whereas F3 had the highest softness score (4.2). The Kruskal–Wallis test for week-4 oil scores yielded $p = 0.017$, with mean ranks of 6.50, 15.20, 14.60, 8.70, and 20.00 for F0, F1, F2, F3, and K+, respectively.

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Table 10. Mean skin oil and softness scores and Friedman test results for changes over time.

Formula	Oil before use	Oil at week 4	Friedman p	Softness before use	Softness at week 4	Friedman p
F0	1.0	2.0	0.139	1.0	1.8	0.139
F1	1.0	4.4	< 0.001	1.0	3.2	0.003
F2	1.0	3.8	0.003	1.0	3.2	0.003
F3	1.0	2.8	0.006	1.0	4.2	< 0.001
K+	1.0	5.0	< 0.001	1.0	4.6	0.001

Oil and soft are presented as instrument output scores; their units are not equated with those of the hydration readings. The p values are the reported results of tests across time, not analyses calculated from the two means shown in this table.

The reported additional softness analysis showed differences between F3 and F0 ($p < 0.001$) and between F3 and F1 ($p = 0.048$), as well as a formulation-by-time interaction ($p < 0.001$). Descriptively, the increase in the F3 softness score from 1.0 to 4.2 was not accompanied by the highest oil score, indicating different patterns for these two instrument outputs.

Discussion

The extraction yield of 20.24% reflects the amount of concentrated extract obtained from the starting material under the extraction conditions used, rather than the concentration of active constituents or their biological potency. Positive results for alkaloids, flavonoids, saponins, and tannins are consistent with reports on the phytochemical composition of moringa [9]. Previously reported antioxidant activity supports the selection of moringa extract; however, findings from DPPH assays and its use in an oil matrix cannot be directly translated into antioxidant activity on the skin [8,10]. This study did not quantify flavonoids, anthocyanins, or antioxidant activity in the finished preparation.

Black glutinous rice was used primarily to provide scrub particles. Studies of body scrubs and clay masks indicate that this material can be incorporated into cosmetic preparations, but differences in formulation type, base, and testing methods limit direct comparisons [12,13]. Likewise, a report of reduced blood glucose in mice following administration of black glutinous rice extract concerns a different model and outcome and does not support an inference of moisturizing activity [21]. Reviews of natural ingredients for skin health, including cocoa, should also be regarded as context for ingredient development rather than substitutes for formulation-specific testing [22].

The stability of organoleptic characteristics and the uniformity of the base over four weeks indicate that the macroscopic characteristics of the preparations were maintained during the observation period. The coarse particles visible in F1–F3 are consistent with the intended scrub function and should be distinguished from extract aggregates or a nonuniform emulsion. All pH values were within the formulation reference range, but the numerical changes remain relevant; for example, the pH of F0 increased from 4.84 at week 3 to 5.85 at week 4. Thus, remaining within a specified range does not mean that pH was unchanged. Studies of jicama body scrub stability and the development of other creams underscore the relevance of monitoring physical characteristics during storage [15,16].

Spreadability and adhesion provide complementary information about the behavior of the preparations under the test conditions. Increased spreadability in F1 and F3 may facilitate application, whereas longer slide-separation times indicate changes in adhesive properties under the experimental conditions. However, adhesion time on glass is not equivalent to residence time on the skin, particularly for a product intended to be rubbed onto the skin and rinsed off. Studies of body scrubs made from coffee, coconut, and a combination of white turmeric and date seeds also use physical testing to characterize preparations; comparisons should therefore account for the procedures and compositions used [1,3,4,20].

Three cooling–heating cycles produced no observable organoleptic changes, although pH and spreadability continued to fluctuate. These findings support physical resilience only under the conditions and for the parameters tested. Temperature cycling is one approach to evaluating the stability of topical preparations [19], but it does not replace assessments of shelf life, chemical stability, microbiological quality, preservative efficacy, or packaging compatibility. Similarly, the absence of observed irritation over 24 h does not establish that the preparations pose no allergy risk or are safe for long-term use.

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The hedonic findings distinguish sensory acceptability from changes in skin parameters. F1 had the highest descriptive scores for four attributes, whereas F2 was preferred for stickiness. The lower aroma score for F3 indicates that increasing the amount of extract does not necessarily improve acceptability. The overall test for aroma does not identify which formulation pairs differ without an appropriate post hoc analysis. Preference percentages represent sensory scores and should not be equated with the proportion of panelists who liked the preparation.

The largest increase in hydration among the experimental formulations was observed with F3. The relative increase of 60.4% should be considered alongside the absolute change of 17.4 percentage points in the instrument reading to avoid overstating its magnitude. F0 also showed an increase in hydration, indicating that the contribution of the base cannot be disregarded. Propylene glycol, lanolin, and liquid paraffin were included in the formulations as humectant or emollient ingredients. The relevance of emollients to hydration and the skin barrier is discussed in the clinical review by Clebak et al. [17]; a study in healthy volunteers also showed that vehicle ingredients such as petrolatum can increase stratum corneum hydration [23]. These sources support a possible contribution from the base but do not establish the specific mechanism of the creams evaluated here.

Recent reports provide additional context for the use of moringa extracts in moisturizing preparations. Nasution et al. investigated an ethanolic moringa leaf extract in a lotion, supporting the relevance of hydration testing for moringa-based topical formulations [24]. Fitriani et al. reported the use of a 3% moringa extract cream in patients with type 2 diabetes mellitus and xerosis in a single-group, before-and-after pilot study [25]. Those findings cannot be directly equated with the present results because of differences in population, formulation type, concentration, application procedures, and instruments. The 3 g of extract in F3 also does not automatically represent a concentration of 3% w/w until the basis of the formulation calculation has been confirmed.

Formulation type and evaluation methods are important when interpreting evidence across studies. The development of moringa extract into gels, black glutinous rice combined with cinnamon into body scrubs, and Job's tears seed extract into toners illustrates the diversity of formulation approaches [11,14,26]. The performance of one formulation type cannot be directly extrapolated to another. In this study, the differences between oil and softness scores indicate that these instrument outputs are not interchangeable and cannot be combined on a single scale with hydration readings.

The limited sample size and four-week observation period restrict the generalizability of the findings. The higher readings observed with F3 provide a preliminary indication of formulation performance but do not establish a causal dose–response relationship, comparative superiority, or equivalence to K+. Skin assessment was limited to three instrument outputs and did not include transepidermal water loss measurements. Exfoliating activity and antioxidant synergy were also not directly assessed. Accordingly, the combination of the two ingredients is better understood as a formulation designed to provide complementary functions rather than demonstrated synergy. Further evaluation using a clearly defined comparator design, validated measurements, and broader safety assessments is required to determine the benefits of the preparations more conclusively.

Conclusion

Moringa leaf extract and black glutinous rice powder can be incorporated into semisolid body scrub creams that retain their observed organoleptic characteristics over four weeks and three cooling–heating cycles. The pH values were within the formulation reference range, and no redness, itching, or swelling was observed during the 24 h irritation assessment in the volunteers tested. F1 achieved the highest descriptive sensory preference scores for four attributes, whereas F3 showed the largest increases in hydration and softness among the experimental formulations. These exploratory findings do not establish long-term safety, comparative clinical efficacy, or synergy between the two ingredients.

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