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Effects of paraffin wax and loess on skin hydration and texture

Hyo Lyun Roh[1], Hyo Taek Lee[2*]

[1]*Department of Physical Therapy, Kangwon National University, Republic of Korea.*
[2]*Department of AI & Big Data, Sehan University, South Korea.*

Corresponding author: Hyo Taek Lee (*Email: take1682@sehan.ac.kr*)

Abstract

This study aimed to evaluate the effects of a paraffin wax and loess mixture compared to paraffin wax alone on skin hydration and texture enhancement. A total of 20 adult male and female participants were involved. Two types of treatments—pure paraffin wax and a paraffin-loess mixture—were applied to the dorsal side of the participants' hands. Skin hydration, oil-moisture balance, and texture (softness) were measured before and after treatment using a validated skin analysis device. Both treatments led to improvements in skin moisture and softness. However, the paraffin-loess mixture demonstrated significantly greater benefits in terms of moisture retention, oil balance, and overall texture enhancement. These effects are attributed to the far-infrared radiation and antibacterial properties of loess, which may improve blood circulation and skin barrier function. The combination of paraffin wax and loess outperformed paraffin wax alone in improving skin properties, offering a synergistic effect. This combined treatment can be considered a promising approach for hydration-focused skincare and may have potential applications in dermatological therapy and cosmetic formulations.

Keywords: Loess, Oil content, Paraffin wax, Skin hydration, Skin softness, Skincare treatment.

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1. Introduction

Skin care and appearance are essential aspects of modern life and are regarded as crucial social factors. Environmental factors and lifestyle habits contribute to various skin problems, such as dryness and irritation, leading to the development of diverse skincare methods to maintain healthy skin [1]. The skin, consisting of the epidermis, dermis, and subcutaneous

tissue, plays a vital role in protecting internal organs, regulating body temperature, absorbing substances, and producing vitamin D [2]. Approximately 70% of the skin is composed of water, along with 25–27% protein, 2% lipids, and traces of carbohydrates, vitamins, enzymes, minerals, and hormones. Adequate hydration of the skin is crucial for maintaining its barrier function and elasticity, whereas loss of moisture can lead to impaired barrier function and rough texture. Moisturizers and treatments that improve skin hydration are therefore fundamental in skincare. Paraffin wax is a mineral oil-derived substance known to enhance skin moisture and strengthen the skin barrier, promoting overall skin health [3]. Its extensive skin benefits have been reviewed in detail, particularly for its moisturizing and protective properties [4]. It creates a protective layer on the skin that prevents trans epidermal water loss, making it particularly beneficial for individuals with dry skin [3]. Paraffin's heat-retention properties help improve blood circulation and relax muscles, and it has been effectively used to improve the biomechanical properties of grafted skin after burns [5]. Accordingly, paraffin wax treatments are widely used in skincare—especially for the hands and feet—due to their softening and moisturizing effects [6]. Mineral oils like paraffin have been reviewed to offer extensive skin benefits with a favorable safety profile in cosmetic use, underscoring the value of paraffin as a base for skin treatments [1]. Loess, also known as "hwangtoh" in Korea, is a mineral-rich soil that has been utilized in construction materials, cosmetics, and health products. It possesses fine particles capable of penetrating the skin, cleansing pores, and adsorbing impurities such as heavy metals and toxins [7]. Moreover, loess emits far-infrared radiation, which enhances heat transfer and improves blood circulation, providing various minerals beneficial for skin regeneration [8, 9]. Its antibacterial properties can inhibit microbial growth, and it is believed to release negative ions that reduce oxidative stress and aid physical recovery. The far-infrared radiation from loess penetrates deeply into tissues, promoting microcirculation and reducing inflammation [10]. Based on these properties, loess has been traditionally used in therapeutic beauty treatments—such as warm loess packs in spas or clinics—to soothe muscles and improve skin conditions [8]. It is even incorporated into facial masks and spa therapies as a natural detoxifying agent [7]. Previous studies, however, have largely focused on the individual effects of either paraffin wax or loess. Research on their combined use remains scarce due to methodological constraints and a lack of comparative studies evaluating their synergistic effects. Considering the complementary properties of paraffin wax and loess, it is hypothesized that a combination of the two could produce additive or synergistic benefits for skin hydration and texture. This study aims to evaluate the impact of a paraffin wax and loess mixture on skin health and assess its potential applications in skincare. By comparing the effects of paraffin-loess mixture against paraffin wax alone, we seek to provide scientific evidence for any synergistic improvements in moisture retention, oil balance, and skin softness. This research also aligns with the growing interest in integrating traditional ingredients like loess into modern skincare products [11] potentially leading to innovative therapeutic and cosmetic applications.

2. Research Method

2.1. Participants

This study included 20 healthy adult participants (10 males and 10 females). The mean age of the male participants was 24.7 ± 1.34 years, and the mean age of the female participants was 23.0 ± 1.32 years, with an overall mean age of 23.89 ± 1.56 years (Table 1). All participants were briefed on the study's objectives, procedures, and potential risks, including the right to discontinue participation at any time for personal reasons or adverse skin reactions. Individuals with open wounds, active dermatological conditions, or a history of topical dermatologic medication use within the past three months were excluded from the study. Participants were required to maintain a consistent basic skincare routine for one week before the experiment to minimize external variables affecting skin condition. The study protocol was approved by the Sehan University Institutional Review Board (SH-IRB 2024-011) and was conducted in compliance with relevant ethical guidelines. All participants provided written informed consent prior to participation.

2.2. Materials and Procedure

Medical-grade paraffin wax (N-care, Korea) and cosmetic-grade loess powder (Chamtowon, Korea) were used as the intervention materials. The loess powder was thoroughly mixed with melted paraffin wax in a 1:3 ratio (loess: paraffin by weight) to create the paraffin-loess mixture, ensuring a uniform consistency and optimal absorption properties. For each participant, both hands were cleansed with mild soap and water and fully dried before treatment. Baseline skin measurements (moisture content, oil level, and softness) were taken on the dorsum of both hands using a validated skin analysis device (a portable skin moisture and elasticity analyzer, RoHS, China). Each participant's left hand was treated with the paraffin-loess mixture and the right hand with paraffin wax alone for comparison. The left-hand treatment involved applying a generous layer of the warm paraffin-loess mixture with a sterile brush to coat the skin evenly. The right hand was dipped into a bath of melted paraffin wax five times to form a solid paraffin glove on the skin. Once the coatings were applied, both hands were kept still with the treatment in place for 15 minutes at room temperature (~25°C) to allow the warmth and ingredients to take effect. After 15 minutes, the paraffin wax glove and the paraffin-loess coating were removed simultaneously. Immediately after removal, skin measurements (moisture, oil content, and softness) were repeated on both hands using the same skin analysis device. Figure 1 illustrates the overall experimental procedure, from initial measurement to treatment application and post-treatment measurement. Figure 1. Schematic diagram of the experimental procedure for paraffin wax and loess treatment. (Both hands were measured for baseline skin parameters. The right hand

was treated with paraffin wax alone, and the left hand was treated with the paraffin-loess mixture. After 15 minutes of treatment, the coatings were removed and skin parameters were measured again.).

3. Research Validation

3.1. Data Analysis

Collected data were analyzed using IBM SPSS Statistics software (version 25.0). Descriptive statistics (mean ± standard deviation) were calculated for skin moisture, oil content, and softness before and after each treatment. Normality tests indicated that the data did not follow a normal distribution. Therefore, non-parametric statistical tests were employed. The Kruskal-Wallis H test was used to compare differences among the three conditions (pre-treatment, paraffin wax, and paraffin-loess) for each outcome measure. When the Kruskal-Wallis test showed a significant difference, post hoc pairwise comparisons were performed using Mann-Whitney U tests with Bonferroni correction to identify specific group differences. A significance level of $p < 0.05$ was set for all analyses.

4. Results and Discussion

4.1. Participant Characteristics

A total of 20 participants completed the study, consisting of 10 males and 10 females. Table 1 summarizes the general characteristics of the subjects. The average age of male participants was 24.72 ± 1.34 years, and the average age of female participants was 23.03 ± 1.32 years. The combined mean age of all participants was 23.89 ± 1.56 years. All participants were in their early to mid-twenties, and no notable gender differences in age were present.

Table 1.
General characteristics of study participants (age in years).

Gender	N	Age (Mean ± SD)
Male	10	24.72 ± 1.34
Female	10	23.03 ± 1.32
Total	20	23.891.56

4.2. Changes in Skin Moisture

Prior to treatment, the average skin moisture level of participants (on the dorsum of the hands) was 17.95%. After treatment, there was a substantial increase in skin moisture in both treatment groups. In the paraffin-loess group, the mean moisture content rose to 35.40%, while in the paraffin wax group it rose to 30.55%. Statistical analysis confirmed that the increases in moisture level from pre-application to post-application were highly significant in both groups (overall $p < 0.001$). The paraffin-loess mixture produced a greater improvement in moisture than paraffin alone. Post hoc analysis indicated that both treatment conditions (paraffin-loess and paraffin-only) resulted in significantly higher moisture levels compared to the pre-application condition (Table 2). In other words, the combination of paraffin and loess yielded the highest skin moisture, followed by paraffin alone, both surpassing the baseline. This enhancement in hydration is consistent with the fundamental understanding that improved skin hydration leads to better stratum corneum function and suppleness [12].

Table 2.
Changes in skin moisture after application of paraffin wax alone vs. paraffin wax with loess.

Condition	Moisture (% Mean ± SD)	Mean Rank	U	p	Post hoc
Pre-application (A)	17.95 ± 10.41	16.90	20.73	.000	A < B, C
Paraffin-loess mixture (B)	35.40 ± 7.93	41.48	-	-	-
Paraffin wax alone (C)	30.55 ± 11.09	33.13	-	-	-

Note: A = before application; B = after paraffin-loess treatment; C = after paraffin-only treatment. P-value is from Kruskal-Wallis test for overall group differences. Post hoc indicates that both treatment groups (B, C) are significantly greater than the pre-treatment condition (A).

4.3. Changes in Perceived Skin Moisture

In addition to objective measurements, participants' perceived skin moisture was assessed by self-rating their skin moisture as very bad, bad, moderate, good, or very good. Prior to treatment, the majority of participants (90%) described their skin moisture level as "very bad." After treatments, the distribution of self-assessments shifted, especially in the paraffin-loess group. In the paraffin-loess group, 40% of participants rated their skin moisture as "very bad" post-treatment (improved from 90% at baseline), 30% as "bad," and 30% as "moderate" or better (with 5% "good" and 5% "very good"). In the paraffin wax group, 70% still reported "very bad" moisture, 25% reported "bad," and only 5% rated their skin moisture as "moderate," with none reporting "good" or "very good." Statistical analysis of the perceived moisture ratings showed a significant overall difference among the three conditions (pre vs. paraffin-loess vs. paraffin-only, $p < 0.01$). Post hoc comparisons confirmed a significant improvement in perceived skin moisture in the paraffin-loess group compared to the pre-application group, whereas the paraffin-only group's improvement was smaller and not statistically significant relative to baseline (Table 3). These subjective results align with the objective measurements, indicating that participants also felt a greater improvement with the loess mixture.

Table 3.
Changes in perceived skin moisture levels (self-assessed) after treatments.

Group	Very bad	Bad	Moderate	Good	Very Good	Mean Rank	U	p	Post hoc
Pre-application (a)	18 (90.0%)	0 (0.0%)	2 (10.0%)	0 (0.0%)	0 (0.0%)	23.4	10.017	.007	a, c < b
Paraffin-loess mixture (b)	8 (40.0%)	6 (30.0%)	4 (20.0%)	1 (5.0%)	1 (5.0%)	38.17	-	-	-
Paraffin wax alone (c)	13 (65.0%)	5 (25.0%)	1 (5.0%)	0 (0.0%)	1 (5.0%)	29.93	-	-	-

Note: Values denote number of participants (% of group). p-value is from Kruskal-Wallis test for overall differences in distributions. Post hoc indicates perceived moisture in group (b) was significantly better than in groups (a) and (c).

4.4. Changes in Oil Content

Before application, 90% of participants rated their skin oil level as "very bad," reflecting a feeling of excessive dryness or lack of oil. After the treatments, there were notable differences between the two groups. In the paraffin-loess group, only 50% of participants still rated their skin oil content as "very bad," while 20% rated it "bad," and 30% reported their oil level as "moderate" or better (with 10% "good" and 20% "very good"). In contrast, in the paraffin wax group, 70% continued to report "very bad" oil levels, 20% reported "bad," and only 10% experienced any improvement (5% "good" and 5% "very good"). Thus, the paraffin-loess treatment led to a greater retention or restoration of skin oils compared to paraffin alone. The paraffin-loess group's ability to maintain skin oil was significantly higher than both the baseline and the paraffin-only group ($p < 0.05$ overall; see Table 4). This suggests that adding loess helped the skin retain oils more effectively. Such oil retention is an important aspect of maintaining the skin's barrier function, since skin lipids play a key role in preventing moisture loss [13]. Post hoc analysis indicated that the loess mixture group differed significantly from the other conditions, whereas the paraffin-only group's oil levels, while slightly improved, were closer to the baseline condition.

Table 4.
Changes in skin oil levels (self-assessed) after application of paraffin wax vs. paraffin-loess.

Group	Very bad	Bad	Moderate	Good	Very Good	Mean Rank	U	p	Post hoc
Pre-application (a)	18 (90.0%)	0 (0.0%)	0 (0.0%)	2 (10.0%)	0 (0.0%)	24.65	7.643	.022	a, c < b
Paraffin-loess mixture (b)	10 (50.0%)	4 (20.0%)	0 (0.0%)	2 (10.0%)	4 (20.0%)	36.95	-	-	-
Paraffin wax alone (c)	14 (70.0%)	4 (20.0%)	0 (0.0%)	1 (5.0%)	1 (5.0%)	29.90	-	-	-

Note: Values denote number of participants (% of group). The paraffin-loess group (b) achieved significantly better oil-level outcomes than both the pre-treatment (a) and paraffin-only (c) conditions ($p = 0.022$ for overall comparison).

4.5. Changes in Skin Softness

Skin softness (or pliability) showed notable improvement after both treatments, with the paraffin-loess mixture again yielding a greater effect. Before application, 90% of participants rated the softness of the skin on their hands as "very bad," indicating their skin felt very coarse or stiff. Following treatment, in the paraffin-loess group only 50% continued to rate their skin softness as "very bad," whereas 20% rated it "bad," 25% reported "good," and 5% reported "very good." In the paraffin wax group, 70% still rated their skin as "very bad" in softness, 20% as "bad," and only 5% noted an improvement to "good" (with 5% "very good"). Thus, a quarter of participants experienced a marked improvement to good or very good softness with the loess mixture, compared to only 10% in the wax-only group. By objective measurement with the skin analyzer, skin elasticity/softness values also improved in both groups (not shown quantitatively here), which agrees with the subjective reports. Statistically, the paraffin-loess group exhibited significantly greater improvements in skin softness compared to the paraffin-only group ($p < 0.05$ for between-group difference, Table 5). Post hoc analysis suggested that the loess mixture led to a softness increase that was significantly higher than baseline and higher than that achieved by paraffin alone. In practical terms, participants' skin felt softer and suppler after treatment, especially when loess was included. This outcome is in line with the expectation that improved hydration and oil balance will enhance the mechanical softness of the skin's outer layer [12].

Table 5.
Changes in skin softness levels (self-assessed) after application of paraffin wax vs. paraffin-loess.

Group	Very bad	Bad	Moderate	Good	Very Good	Mean Rank	U	p	Post hoc
Pre-application (a)	18 (90.0%)	0 (0.0%)	0 (0.0%)	2 (10.0%)	0 (0.0%)	24.8	7.088	.029	a, c < b
Paraffin-loess mixture (b)	10 (50.0%)	4 (20.0%)	0 (0.0%)	5 (25.0%)	1 (5.0%)	36.65	-	-	-
Paraffin wax alone (c)	14 (70.0%)	4 (20.0%)	0 (0.0%)	1 (5.0%)	1 (5.0%)	30.05	-	-	-

Note: Values denote number of participants (% of group). The increase in softness in group (b) was statistically greater than in group (c) ($p = 0.029$ overall).

5. Discussion

This study examined the effects of combined paraffin wax and loess treatments on skin hydration, oil retention, and softness. The results indicate that the combined application enhances moisture retention and skin softness more effectively than paraffin wax alone. Both objective measurements and subjective evaluations showed significant improvements after treatment, with the paraffin-loess mixture yielding superior outcomes. The improvements in skin hydration observed here are important, as enhanced moisture content is known to improve the mechanical properties and flexibility of the stratum corneum, thereby leading to a softer and healthier skin texture [12]. To ensure consistency and minimize biases, all participants maintained a stable skincare routine for one week prior to the study, and each participant effectively served as their own control by treating opposite hands with different interventions. Paraffin wax is widely recognized for its moisturizing properties and its ability to reinforce the skin barrier [4]. By creating an occlusive layer, paraffin wax prevents moisture loss and helps maintain hydration levels in the skin for an extended period. It also provides thermal therapy benefits; the heat from melted paraffin can improve blood circulation and relax the underlying muscles, contributing to improved skin pliability and comfort. These properties have made paraffin wax a common treatment for dry skin and minor aches; for instance, paraffin hand baths are often used in spa and clinical settings to soften skin and relieve stiff joints. Our findings of increased skin moisture and softness with paraffin are in line with previous research demonstrating that paraffin treatments significantly improve skin hydration and elasticity [14]. In contrast, loess is known to improve circulation, promote an even skin tone, and emit far-infrared radiation, which can enhance microcirculation and overall skin health [15]. A recent study by Fukui et al. showed that far-infrared light exposure led to beneficial effects in biological tissues [15] supporting the idea that loess's infrared emission could stimulate blood flow in the skin. In the context of our study, incorporating loess into the paraffin treatment likely amplified the warming and circulation-boosting effects, delivering more nutrients and oxygen to skin cells during the treatment period. Loess also has inherent mineral content (such as silicon, aluminum, magnesium, and others) that may be absorbed in trace amounts into the skin, potentially aiding in skin regeneration processes [8, 9]. The combination of these factors—occlusion and hydration from paraffin, plus thermal and mineral benefits from loess—appears to produce a synergistic effect on skin quality. The findings of this study align with prior observations in the skincare literature. Yi and Lee [14] reported that a paraffin wax mask pack improved skin moisture and texture, which is consistent with the improvements seen in our paraffin-only group [14]. By extending this concept, our study showed that adding loess to paraffin can lead to even greater enhancement. The synergistic interaction between paraffin wax and loess appears to amplify the beneficial effects, making their combination a promising candidate for advanced skincare formulations. Notably, loess brings additional antibacterial and anti-inflammatory properties to the treatment, which may help reduce skin irritation and stress during the treatment process. Participants in the paraffin-loess group not only had better hydration and softness outcomes, but some also reported that their skin felt more "calm" or less itchy (though we did not formally quantify this). This anecdotal feedback could be related to loess's ability to absorb impurities and possibly soothe inflammation. While specific literature on loess's dermatological effects is limited, its use in traditional remedies and some studies (e.g., in acne treatment soaps) suggest it can help reduce bacterial growth on the skin, contributing to a cleaner, less irritated skin surface. Beyond improvements in hydration and softness, the paraffin-loess mixture presents a promising skincare formulation for individuals with dry, rough, or environmentally stressed skin. The treatment could be particularly beneficial for people suffering from xerosis (chronically dry skin) or those who experience skin dryness as a side effect of other conditions. The deep hydration provided by paraffin, coupled with loess's potential to deliver far-infrared warmth and minerals, means this combined treatment can both infuse moisture and improve circulation in the skin. Our results showed a noticeable increase in skin oil content retention with the loess mixture, which suggests it may help in restoring the lipid balance of the skin. Maintaining an optimal oil-moisture balance is critical for skin barrier function; loess's fine particles might help the skin hold onto oils by providing additional surface for oil binding or by mildly occluding pores to prevent excessive sebum loss. This characteristic can make the paraffin-loess treatment useful for individuals who have dry skin that also loses oils quickly, as well as for those with combination skin looking for a boost in certain areas without greasiness. From a practical perspective, the treatment we studied could be easily translated into spa therapy or home-use products. Warm paraffin baths are already popular in beauty and rehabilitation settings, and introducing loess into these treatments could enhance their efficacy. Loess is an inexpensive and natural material, which adds to the appeal of this formulation for wider use. The mixture could be applied as a hand or foot mask in salons, or potentially be developed into a peel-off mask or body wrap for therapeutic purposes. With further refinement, paraffin-loess products might serve as effective remedies for rough skin on elbows, knees, or heels, as well as hydrating facial

masks for people with dry skin types. This broad applicability underscores the value of integrating natural materials into modern skincare. While this study presents encouraging results, there are several limitations to consider. The sample size (N = 20) was relatively small and consisted mainly of young adults, which may limit the generalizability of the findings. Skin responses can vary with age, skin type, and ethnicity, and these factors were not diversified in our cohort. Additionally, our study focused on the short-term effects—measuring skin properties immediately after a single treatment session. The long-term benefits and potential cumulative effects of repeated paraffin-loess treatments remain unclear. It is possible that regular application of the loess mixture could lead to sustained improvements in skin hydration and texture, or conversely, diminishing returns if the skin becomes acclimated. Future studies should explore the long-term efficacy of paraffin-loess formulations across different skin types, including sensitive, aging, and acne-prone skin. It would be valuable to conduct trials with a larger and more diverse population to confirm the benefits observed in this preliminary study. Additionally, examining the impact of repeated applications (for example, daily or weekly treatments over several months) would help determine whether prolonged use leads to sustained or further improved skin hydration, elasticity, and barrier function. Understanding the long-term safety is also crucial; however, existing reviews on mineral oils and waxes suggest that they have minimal dermal penetration and a good safety profile when used in cosmetics [16]. This indicates that incorporating loess into paraffin treatments is unlikely to introduce toxicity, although patch testing for allergies to loess (which is essentially clay) would be prudent. Further research could also investigate the optimal ratio of paraffin wax to loess to maximize efficacy. In our study, we chose a 3:1 paraffin-to-loss ratio based on pilot testing for spread ability and adherence. Different ratios might yield different outcomes in terms of ease of use and effectiveness. Moreover, there is room to explore synergies with other skincare ingredients: for instance, combining the paraffin-loess mixture with botanical extracts known for soothing or moisturizing effects (such as aloe Vera or green tea) or with humectants like hyaluronic acid and ceramides could enhance moisturization and skin repair. Such combinations might amplify the benefits or target additional aspects of skin health, like pigmentation or antioxidation. Expanding the scope of investigation in these ways may establish the paraffin-loess formulation as a well-rounded dermatological solution applicable to both cosmetic skincare and therapeutic treatments. If further validated, this combined treatment could be commercialized for use in day spas, dermatology clinics, and home skincare routines, providing a natural and effective alternative to conventional hydrating treatments. It resonates with the current trend toward more natural and multi-functional skincare products. In summary, the paraffin wax and loess mixture demonstrated significantly improved outcomes for skin hydration and texture in the short term, and it holds promise as a novel treatment approach pending more extensive research.

6. Conclusion

In conclusion, this study confirms that a combined paraffin wax and loess treatment can significantly improve skin moisture levels and softness compared to paraffin wax alone. The synergistic properties of paraffin (providing occlusion and deep moisturization) and loess (providing far-infrared warmth, minerals, and purification) work together to enhance skin hydration, oil balance, and texture. Participants who received the paraffin-loess treatment experienced greater improvements in perceived skin condition, highlighting the mixture's potential as a superior skincare intervention. These findings support the paraffin-loess combination as a promising candidate for both cosmetic and therapeutic applications aimed at improving dry or rough skin. With further clinical validat and formulation refinement, paraffin-loess based products have strong potential for commercialization and widespread use in settings ranging from beauty salons and spas to dermatological therapy for dry skin conditions. This approach also fits well with consumer demand for natural ingredients in skincare, offering a treatment that is both traditional in inspiration and innovative in performance.

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