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The effect of red palm oil (*Elaeis guineensis* Jacq.) on skin hydration in streptozotocin-induced diabetic white rat models

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Abstract

Diabetes mellitus (DM) is frequently associated with cutaneous complications, including xerosis cutis, due to impaired skin barrier function. Red palm oil (RPO; *Elaeis guineensis* Jacq.) contains bioactive compounds with antioxidant, anti-inflammatory, and barrier-repair properties that may improve skin hydration. The objective of this study was to evaluate the effect of topical RPO on skin hydration in streptozotocin (STZ)-induced diabetic rat models. Thirty-two male Sprague-Dawley rats were randomly assigned to four groups (n=8 each): normal control (G1), untreated diabetic (G2), diabetic treated with 10% urea cream (G3), and diabetic treated with RPO (G4). Diabetes was induced using STZ and confirmed by blood glucose measurement. Treatments were applied once daily for 28 days to a standardized dorsal skin area. Skin hydration was assessed using a Corneometer®. Data were analyzed using the Shapiro-Wilk test and one-way analysis of variance (ANOVA) followed by the Tukey *post hoc* test. Skin hydration differed significantly among groups ($p < 0.001$). The highest mean hydration was observed in the normal group (34.13 arbitrary units [AU]), while the lowest was in untreated diabetic rats (14.38 AU). RPO treatment significantly increased skin hydration (29.00 AU) compared to untreated diabetic rats ($p < 0.001$) and urea-treated rats ($p < 0.001$). No significant difference was found between the RPO-treated and normal groups ($p = 0.082$). To conclude, topical RPO significantly improves skin hydration in diabetic rats, with effects comparable to normal skin and superior to 10% urea cream. RPO shows potential as a therapeutic agent for diabetes-associated xerosis.

Introduction

Diabetes mellitus (DM) is a metabolic condition defined by hyperglycemia. It affects 9.5% of the global population, with an estimated prevalence of more than 50% by 2030. High medical, social, and economic burdens are expected to arise as the prevalence of DM increases. In diabetic patients, serious complications often occur and can interfere with the patients' quality of life and cause long-term disability. These complications include skin complications, which are relatively common and often the first clinical sign observed in diabetes.¹ The overall prevalence of skin disorders in type 1 DM and type 2 DM varies widely, ranging from 51.1 to 97% in different regions of the world. This high prevalence indicates the importance of skin complications of DM.²

Skin disorders in the form of xerosis cutis are often found in diabetic patients, especially those with type 2 DM. Xerosis cutis is the second most common skin complication in diabetic patients after infections. One study even found that 81.3% of type 2 DM patients experience dry skin. The exact mechanism of

xerosis in DM is also not fully understood. Research indicates that in diabetic skin, there is a decrease in sebum and triglyceride production in the sebaceous glands due to impaired insulin signalling. Xerosis often goes undiagnosed and untreated, even though it can lead to further skin complications in diabetic patients such as fissures and superinfections, which can ultimately lead to other, more serious disorders.^{3,4} Numerous diabetes treatments are still being developed today.¹ Understanding how common skin conditions are in diabetic patients will help people realize the importance of preventing and managing skin disorders in diabetes. Dermocosmetic strategies are one of the options to manage biophysical changes in the skin of diabetic patients, particularly to improve skin hydration and other contributing factors.² Regarding the possible pathogenesis of skin disorders in diabetes, the use of topical products containing antioxidants in combination with antiglycation agents can be used as a safe and simple treatment of some skin complications of diabetes.⁵ Currently, alternative treatment options involving various natural products are highly sought after for the management of various diseases and conditions.⁶ Specifically, in the case of vegetable oils, it is now well established that, when applied topically, their constituents can act synergistically through various mechanisms, including skin barrier protection, antioxidant, anti-inflammatory, and wound-healing activities. This potential makes vegetable oils increasingly attractive for development as medicinal ingredients and skincare products.⁷

Palm oil (*Elaeis guineensis* Jacq.) is one of the most significant vegetable oils today. Red palm oil (RPO) contains high levels of bioactive compounds, including carotenoids, vitamin E, co-enzyme Q10, and sterols, which have antioxidant, anticancer, anti-inflammatory, antidiabetic, and anti-obesity activities.⁸⁻

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Based on the above explanation, the author hypothesizes that RPO, with its various active ingredients, can improve skin conditions in diabetic patients, especially in terms of skin hydration. To test this hypothesis, the author will conduct a study on the impact of RPO on skin hydration in white rats (*Rattus norvegicus*) as a model of streptozotocin (STZ)-induced DM.

Materials and Methods

Animals and experimental design

Thirty-two male Sprague-Dawley rats (12 weeks old; 150-200 g) were acclimatized for 1 week under controlled conditions (22±3°C; 50-60% humidity; 12-hour light/dark cycle). Rats were randomly divided into four groups (n=8 each): G1: normal control; G2: diabetic control; G3: diabetic + 10% urea; G4: diabetic + RPO.

Procedures

Diabetes was induced using STZ, and hyperglycemia was confirmed by measuring blood glucose levels. A 3-cm dorsal area was shaved, and treatments were applied once daily for 28 days. Skin hydration was measured using a Corneometer[®] and expressed in arbitrary units (AU). Normality was assessed using the Shapiro-Wilk test. One-way analysis of variance (ANOVA) followed by Tukey's *post hoc* test was performed for statistical analysis. Statistical significance was set at $p < 0.05$.

Results

Skin hydration

Mean skin hydration varied across groups (Table 1). The highest hydration level was observed in the normal control group (34.13 ± 5.17 AU), whereas the lowest was found in the untreated diabetic group (14.38 ± 3.54 AU). The group treated with 10% urea cream showed a moderate increase in hydration (19.63 ± 1.85 AU). In contrast, the RPO-treated group demonstrated a marked improvement (29.00 ± 4.96 AU), approaching values observed in the normal group.

Normality testing

Shapiro-Wilk testing confirmed that all groups were normally distributed ($p > 0.05$), indicating that parametric analysis was appropriate.

Comparative analysis

One-way ANOVA revealed a statistically significant difference in skin hydration among the groups ($F = 37.915$, $p < 0.001$).

Post hoc Tukey analysis (Table 2) showed that skin hydration in the untreated diabetic group was significantly lower than in the normal control group ($p < 0.001$). Treatment with 10% urea cream resulted in an increase in hydration; however, this improvement was not statistically significant compared to the untreated diabetic group ($p = 0.072$). The RPO-treated group demonstrated a significantly higher hydration level compared to both the untreated diabetic group ($p < 0.001$) and the urea-treated group ($p < 0.001$). No statistically significant difference was observed between the RPO-treated group and the normal control group ($p = 0.082$).

Discussion

This study demonstrates that topical RPO significantly enhances skin hydration in diabetic rats, surpassing the clinically established efficacy of 10% urea cream. Diabetic rats exhibited severe skin dryness, consistent with the known increase in advanced glycation end products and matrix metalloproteinase-9 levels, which led to a decrease in collagen IV levels and an increased release of histamine and hyaluronidase by mast cells, resulting in decreased hyaluronic acid levels and, consequently, dry skin.¹¹

The use of vegetable oils as skin moisturizers has been practiced for a very long time. These oils have been used to moisturize and smooth the skin at all ages, but they are still most commonly used in newborns and infants because their skin is far more sensitive and vulnerable to injury and infection than that of adults. Vegetable oils are used in dermatology for a number of purposes, some of which are crucial: oil massage for newborn and baby skin care, treatment of atopic dermatitis, xerosis, other eczematous conditions, psoriasis, and others. Importantly, vegetable oils nourish and hydrate the delicate skin by acting as an efficient emollient.¹²

The oil palm (*Elaeis guineensis*) is a tropical tree crop that grows in Asia, Africa, and along tropical belts in Latin America. It is the source of palm oil, a widely marketed edible oil that is important for human nutrition. Phytonutrients with numerous potential health benefits can be derived from palm fruit oil. Due to its high productivity and superior functional properties, oil palm is one of the most important crops in the world. In dermatology, palm oil is frequently used in the treatment of various dermatological conditions, for oil massage, and in skin care.¹²⁻¹⁴

RPO's potent hydrating effect may be explained by several mechanisms. RPO provides strong antioxidant protection and is one of the richest natural sources of carotenoids and tocotrienols. These antioxidants help improve skin hydration and strengthen the barrier function, while tocotrienols specifically promote ceramide synthesis.¹⁵⁻¹⁸ RPO also exhibits lipid-replenishing properties. It contains a physiologically relevant blend of saturated and unsaturated fatty acids – mainly palmitic, stearic, oleic, and linoleic acids – which mirror the free fatty acids naturally present in the stratum corneum.¹⁹ Likewise, Tan *et al.* described RPO as rich in balanced fatty acids, sterols, carotenoids, and tocotrienols that support its biological activity.²⁰ RPO exhibits notable anti-inflammatory activity, helping to prevent oxidative inflammatory disorders associated with tissue damage by suppressing reactive oxygen species-driven inflammatory signaling pathways. It also reduces the production of key pro-inflammatory mediators, including nitric oxide, prostaglandin E₂, tumor necrosis factor-alpha, and interleukin-1 beta, ultimately inhibiting nuclear factor kappa B activation.¹⁰ In addition, RPO provides substantial amounts of

triglycerides that form an occlusive, hydrophobic film on the skin surface, thereby reducing transepidermal water loss. Research indicates that triglyceride-dominant lipophilic excipients can significantly limit water vapor loss *in vivo*, while other studies show that triglycerides, particularly linoleic acid-rich types, can both reduce transepidermal water loss and integrate into epidermal lipid structures, thereby facilitating direct barrier restoration.^{21,22} These results correspond with the improved hydration outcomes documented in the animals that received RPO treatment in this study.

Urea 10% is a standard hydrating agent used for diabetic xerosis because it restores the natural moisturizing factor and increases water-binding capacity.²³ However, in this study, urea did not fully reverse DM-related hydration loss. RPO demonstrated significantly superior improvement, suggesting a barrier-repair advantage attributable to its lipid-rich and antioxidant composition.

Clinical implications

These results suggest that RPO may serve as a low-cost, natural therapeutic for managing xerosis in diabetic patients. Its rich phytochemical composition may position it as both a moisturizer and barrier-repair agent. Future research should investigate histological changes, transepidermal water loss, natural moisturizing factor levels, and molecular markers of skin barrier restoration.

Conclusions

Topical RPO significantly improves skin hydration in diabetic rats and demonstrates superior efficacy compared to 10% urea cream, suggesting its potential as a natural therapeutic option for xerosis cutis in DM.

References

1. Zhang S, Ke Z, Yang C, et al. High glucose causes distinct expression patterns of primary human skin cells by RNA sequencing. *Front Endocrinol* 2021;12:603645.
2. De Macedo GMC, Nunes S, Barreto T. Skin disorders in diabetes mellitus: an epidemiology and physiopathology review. *Diabetol Metab Syndr* 2016;8:63.
3. Demirseren DD, Emre S, Akoglu G, et al. Relationship between skin diseases and extracutaneous complications of diabetes mellitus: clinical analysis of 750 patients. *Am J Clin Dermatol* 2013;15:65-70.
4. Stingeni L, Tramontana M, Cordera L, et al. Xerosis in patients with type 2 diabetes: an Italian multicentre study. *Acta Derm Venereol* 2021;101:adv00577.
5. Pierard G, Seite S, Hermanns-Lê T, et al. The skin landscape in diabetes mellitus: focus on dermocosmetic management. *Clin Cosmet Investig Dermatol* 2013;6:127-32.
6. Shahrim Z, Makpol S, Tan GC, et al. Topical application of palm tocotrienol-rich fraction enhances wound healing in type 2 diabetic mice. *J Oil Palm Res* 2022.
7. Lin TK, Zhong L, Santiago JL. Anti-inflammatory and skin barrier repair effects of topical application of some plant oils. *Int J Mol Sci* 2018;19:70.
8. Mancini A, Imperlini E, Nigro E, et al. Biological and nutritional properties of palm oil and palmitic acid: effects on health. *Molecules* 2015;20:17339-61.
9. Mba OI, Dumont MJ, Ngadi M. Palm oil: processing, characterization and utilization in the food industry – a review. *Food Biosci* 2015;10:26-41.
10. Khalil A, Tazeddinova D, Aljoumaa K, et al. Carotenoids: therapeutic strategy in the battle against viral emerging diseases. *Prev Nutr Food Sci* 2021;26:241-61.
11. Horikawa T, Hiramoto K, Goto K, et al. Differences in mechanisms of type 1 and type 2 diabetes-induced skin dryness. *Int J Med Sci* 2020;18:474-81.
12. Plyduang T, Atipairin A, Yoon AS, et al. Red palm extract-loaded lipid nanoparticles for anti-aging. *Cosmetics* 2021;9:3.
13. Purnama KO, Setyaningsih D, Hambali E, Taniwiryono D. Processing, characteristics, and applications of red palm oil. *Int J Oil Palm* 2020;3:40-55.
14. NOF N, Amarachukwu NEL, Ogheneochuko NTP. Wound healing effect of *Elaeis guineensis* oil. *World J Biol Pharm Health Sci* 2021;8:13-28.
15. Nagendran B, Unnithan UR, Choo YM, Sundram K. Characteristics of red palm oil. *Food Nutr Bull* 2000;21:189-94.

16. Kim JH, Kwack MH, Lee WJ. Effects of antioxidants on skin hydration and inflammation. *Int J Immunopathol Pharmacol* 2024;38:3946320241303860.
17. Kim DY, Kang YH, Kang MK. Umbelliferone preserves skin barrier in diabetes. *Nutr Diabetes* 2025;15:51.
18. How KN, Chang HW, Lai OM. Tocotrienol-rich moisturizer in atopic dermatitis. *J Cosmet Dermatol* 2023;22:2746-54.
19. Nainggolan M, Sinaga AGS. Fatty acid composition of red palm oil. *J Adv Pharm Technol Res* 2021;12:22-6.
20. Tan CH, Lee CJ, Tan SN, et al. Red palm oil: processing and health benefits. *J Oleo Sci* 2021;70:1201-10.
21. Fromder A, Lippold BC. Water vapour transmission and occlusivity in vivo. *Int J Cosmet Sci* 1993;15:113-24.
22. Hartop PJ, Prottey C. Changes in transepidermal water loss after triglyceride application. *Br J Dermatol* 1976;95:255-64.
23. Parker J, Scharfbillig R, Jones S. Moisturisers for foot xerosis: a systematic review. *J Foot Ankle Res* 2017;10:9.

Table 1. Mean skin hydration values (AU) by experimental group.

Group	Mean $\pm$ SD (AU)
G1	34.13 $\pm$ 5.17
G2	14.38 $\pm$ 3.54
G3	19.63 $\pm$ 1.85
G4	29.00 $\pm$ 4.96

SD, standard deviation; AU, arbitrary units; G1, normal control; G2, diabetic control; G3, diabetic treated with 10% urea cream; G4, diabetic treated with red palm oil.

Table 2. Tukey *post hoc* test results (p-values).

Group	Tukey <i>post hoc</i>			
	G1	G2	G3	G4
G1	-	0.000	0.000	0.082
G2	0.000	-	0.072	0.000
G3	0.000	0.072	-	0.000
G4	0.082	0.000	0.000	-

Values are presented as p-values from Tukey *post hoc* test; $p < 0.05$ indicates statistically significant difference; G1, normal control; G2, diabetic control; G3, diabetic treated with 10% urea cream; G4, diabetic treated with red palm oil.