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Effectiveness of Topical Grape Seed Oil (Vitis Vinifera) 100% on the Skin Barrier in Elderly: a Comparative Study of Tewl, Skin pH, and Overall Dry Skin Score Between Grape Seed Oil and Petrolatum

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KEYWORDS
xerosis cutis, elderly, grape seed oil, petrolatum

ABSTRACT
Xerosis cutis is a dermatosis with the highest prevalence among the elderly. The recommended treatment involves the use of moisturizers with anti-inflammatory, antibacterial, and antioxidant properties. This study aims to investigate the effectiveness of topical grape seed oil in reducing transepidermal water loss (TEWL), skin pH, and the Overall Dry Skin (ODS) score in elderly individuals with *xerosis cutis*. A randomized, single-blind clinical trial was conducted in elderly participants diagnosed with *xerosis cutis*, who received a moisturizer containing grape seed oil or petrolatum for four weeks. TEWL, skin pH, and ODS scores were assessed at baseline and at week four. Results indicated that 30 subjects were included, with 15 assigned to the grape seed oil group and 15 to the petrolatum group. The grape seed oil group showed a greater and statistically significant improvement in TEWL and ODS scores compared to the petrolatum group. However, the reduction in skin pH in the grape seed oil group was smaller than that in the petrolatum group, and this difference was not statistically significant. No serious adverse effects were observed in either treatment group. In conclusion, topical grape seed oil is effective in reducing TEWL, skin pH, and ODS scores in elderly individuals with *xerosis cutis*, with no adverse effects reported.

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INTRODUCTION

Xerosis cutis in the elderly is associated with alterations in skin structure and function, such as changes in lipid levels, natural moisturizing factor (*NMF*), the keratinization process, and skin pH (Anggraini et al., 2020; Boediardja, 2015; Lueangarun et al., 2020; Görög et al., 2022). These changes result in increased transepidermal water loss (*TEWL*), causing the water content in the *stratum corneum* to fall below 10%, which leads to *xerosis cutis (Görög et al., 2022; Tjekyan, 2015; Choi, 2019)*. In the elderly, the skin appears thin and is easily damaged, while slow cell turnover contributes to a more severe clinical appearance and prolonged skin barrier repair time (Boediardja, 2015; Görög et al., 2022; Choi, 2019; Tončić et al., 2017). *Xerosis cutis* is most often found on the anterolateral side of the lower limbs, arms, and trunk, but can also occur throughout the body (Görög et al., 2022; Augustin et al., 2019; Lacy & Ziemer, 2020). Although xerosis is not life-threatening, it can cause sleep disturbances and depression, thereby reducing quality of life (Anggraini et al., 2020).

Treatment of *xerosis cutis* includes the application of moisturizers (occlusive, emollient, or humectant), environmental and lifestyle modifications, and management of systemic diseases that may trigger xerosis (Anggraini et al., 2020; Görög et al., 2022). At present, no therapy is completely satisfactory (Sethi et al., 2016). Moisturizers as monotherapy are often insufficient, especially in cases accompanied by inflammation and pruritus (Lueangarun et al., 2020). Therefore, the use of moisturizers

containing anti-inflammatory, antibacterial, and antioxidant agents is recommended for elderly patients with *xerosis cutis (Augustin et al., 2019; Saeki et al., 2022)*. Topical corticosteroids and antihistamines are also used as adjunct therapies, but long-term use of topical corticosteroids can cause side effects in elderly patients, such as skin atrophy, telangiectasis, and purpura (Lueangarun et al., 2020; Saeki et al., 2022). Several plant oils—including sunflower seed oil, coconut oil, jojoba oil, oat oil, argan oil, and grape seed oil—are used as therapeutic options to repair skin barrier damage because they are easily available, relatively inexpensive, and have minimal side effects. Grape seed oil is notable for its high linoleic acid content, which helps repair the skin barrier (Vaughn et al., 2018). Additionally, it contains vitamin E isomers, phytosterols, and polyphenols, which provide anti-inflammatory, antibacterial, and antioxidant effects, making it a promising alternative for elderly patients with *xerosis cutis (Wijayadi & Kelvin, 2022; Sharafan et al., 2023; Dhifi & Mnif, 2018; Gitea et al., 2023)*.

Previous studies have examined *xerosis cutis* in the elderly, particularly its pathophysiology and treatment strategies. For instance, Smith et al. (2018) conducted a study on the relationship between aging and skin structure alterations, highlighting the decline in lipid levels and *NMF*, which leads to xerosis. Their study suggests the need for moisturizing treatments but also emphasizes the limitations of using moisturizers alone in treating this condition (Smith et al., 2018). Another study by Johnson et al. (2019) focused on the use of plant-based oils, such as sunflower seed oil and coconut oil, as alternatives to traditional corticosteroid treatments, finding them effective in restoring the skin barrier and reducing inflammation (Johnson et al., 2019). However, both studies did not investigate the specific molecular mechanisms underlying the efficacy of these treatments or their long-term benefits in elderly patients.

This study aims to investigate the effectiveness of topical grape seed oil in reducing *transepidermal water loss* (*TEWL*), skin pH, and Overall Dry Skin (*ODS*) score in elderly individuals with *xerosis cutis*. The findings of this research will benefit clinicians by providing evidence for a natural treatment alternative for *xerosis cutis* in the elderly, reducing dependency on corticosteroids, and improving patient outcomes. Additionally, it will contribute to the broader field of dermatology by shedding light on the molecular interactions between plant oils and skin cells, which could lead to the development of more targeted skincare therapies for the aging population.

METHOD

This single-blind randomized clinical trial with a two-group pre- and post-test control group design was conducted between May and June 2024 at a nursing home in Semarang, Central Java, Indonesia. Elderly individuals aged 60 years or older who were diagnosed with *xerosis cutis* and had an Overall Dry Skin (*ODS*) score of ≥1 at the moisturizer application site were enrolled in the study. Exclusion criteria included sensitivity to the test agents, current skin diseases at the application site (such as dermatitis, psoriasis, or other skin infections), communication disturbances that could interfere with the study (including delirium or dementia), and the use of other topical agents, oral or topical steroids, oral isotretinoin, diuretics, statins, chemotherapy agents, antiandrogens, or other immunosuppressant agents within four weeks prior to the study. All participants were required to sign informed consent before participation and were instructed to refrain from using any other topical treatments or moisturizers during the study period.

Subjects were assigned to receive either a 100% grape seed oil moisturizer or a control treatment with 100% petrolatum, applied twice daily for four weeks to the anterolateral side of the lower legs. Assessments of transepidermal water loss (*TEWL*), skin pH, and *ODS* scores were performed at baseline

and after four weeks by a blinded examiner. *TEWL* and skin pH were measured using a tewameter and a pH meter, respectively. The *ODS* score ranged from 0 to 4, with clinical features defined as follows: 0, absent; 1, faint scaling, faint roughness, and dull appearance; 2, small scales in combination with a few larger scales, slight roughness, and whitish appearance; 3, small and larger scales uniformly distributed, definite roughness, possibly slight redness, and possibly a few superficial cracks; 4, dominated by large scales, advanced roughness, redness, eczematous changes, and cracks. Any side effects were recorded throughout the treatment period and during follow-up. Data were analyzed using the SPSS software package, version 25.

RESULT AND DISCUSSION

There were 30 elderly subjects who completed the study. The majority of them were female (60%) with an average age of 74.3 ± 8.07 years. Seventy percent of the subjects usually take a bath with antiseptic soap and warm water (60%). The characteristic subject of this study is presented in Table 1.

Table 1. Subject Characteristics

Characteristic	Group		p
	Grape Seed Oil	Petrolatum	
Age	73,13 ± 8,08;72 (60 – 89)	75,47 ± 8,18;76 (60-91)	0,438
Gender			
Man	7 (46.7%)	5 (33.3%)	0,709
Woman	8 (53.3%)	10 (66.7%)	
Soap			
Antiseptic	11 (73.3%)	10 (66.7%)	0,067
non antiseptic	4 (26.7%)	5 (33.3%)	
Warm bath			
Yes	13 (86.7%)	5 (33.3%)	0,009
No	2 (13.3%)	10 (66.7%)	

Source: author

Transepidermal Water Loss (TEWL) before applying moisturizer on the right and left anterolateral lower limbs in both grape seed oil and petrolatum groups averaged 21.25 ± 5.40 g/m2/h and 20.82 ± 5.63 g/m2/h, which are classified as disturbed skin barrier. The measurement result of TEWL. The results of tewl measurements in both group at baseline and week 4 can be seen in Figure 1 (A-B). The difference in the average of TEWL of the right lower limb before and after the administration of moisturizer in the 4th week was greater in the grape seed oil group (-8.92 ± 3.46) than petrolatum group (-4.98 ± 3.14) (p = 0.003). Meanwhile, the difference in the average of TEWL of the left lower limb before and after the administration of moisturizer in the 4th week was also greater in the grape seed oil group (-8.90 ± 2.96) than petrolatum group (-6.04 ± 5.15) (p = 0.014). It can be concluded that there is significant difference between the average of TEWL of the right and left lower limb at baseline compared with TEWL after 4th week application of moisturizer in both group.

This study showed that the pH value of the skin before applying moisturizer on the right and left anterolateral lower limbs in both grape seed oil and petrolatum groups averaged 5.81 ± 0.38 and 5.74 ± 0.51, which are classified as normal skin pH. The results of skin pH measurements in both group at baseline and week 4 can be seen in Figure 1 (C-D). The difference in the average of skin pH of the right anterolateral lower limb before and after the administration of moisturizer in the 4th week was smaller in the grape seed oil group (-0.37 ± 0.27) than petrolatum group (-0.53 ± 0.39) (p = 0.208). The difference in the average of skin pH of the left anterolateral lower limb before and after the

administration of moisturizer in the 4th week was smaller in the grape seed oil group (-0.37 ± 0.29) than petrolatum group (-0.48 ± 0.48) (p = 0.678). It can be concluded that there is no significant difference between the average of skin pH of the right and left lower limb at baseline compared with skin pH after 4th week application of moisturizer in both group.

The ODS score before applying moisturizer to the right and left legs in both grapeseed oil and petrolatum groups averaged 2.63 ± 0.56 and 2.73 ± 0.69. The results of ODS score measurements in both group at baseline and week 4 can be seen in Figure 1 (E-F). The difference in the average of ODS score of the right lower limb before and after the administration of moisturizer in the 4th week was greater in the grape seed oil group (-1,53 ± 0,52) than petrolatum group (-1,00 ± 0,54.) (p = 0.013). Meanwhile, the difference in the average of ODS score of the left lower limb before and after the administration of moisturizer in the 4th week was also greater in the grape seed oil group (-1,60 ± 0,91) than petrolatum group (-1,00 ± 0,54) (p = 0.032). It can be concluded that there is significant difference between the average of ODS score of the right and left lower limb at baseline compared with TEWL after 4th week application of moisturizer in both group.

There were 26.7% subjects in the grape seed oil group had complaints after using moisturizers such as stickiness (13.3%) and greasiness (13.3%). In the petrolatum group, there were 73.3% subjects had complaints such as stickiness (60%) and also stickiness and grasiness (13.3%). The difference in value according to the statistical test has a significant difference (p = 0.008).

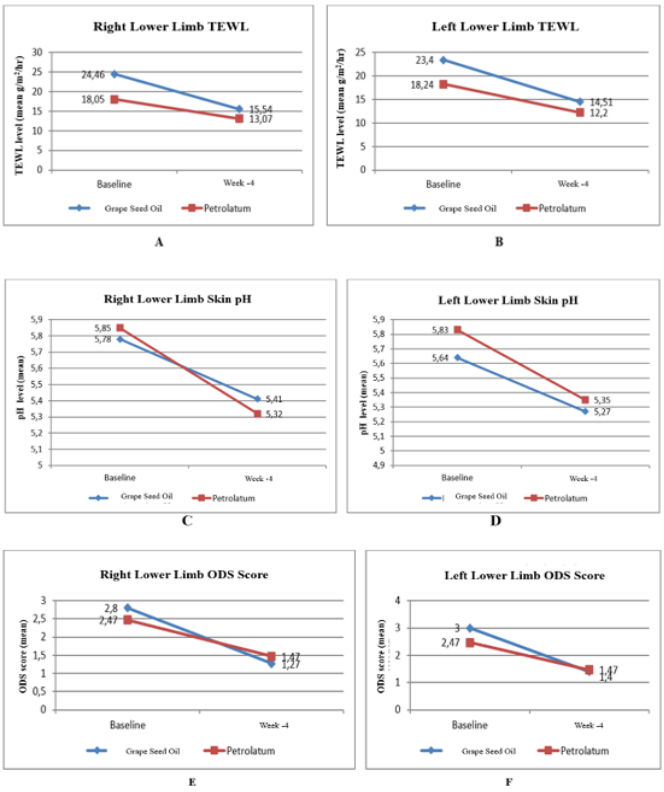

Figure 1. The measurement result of TEWL, skin pH, and ODS score at baseline and week-4
Source: author

Xerosis in the elderly caused by multifactorial factor. The use of antiseptic soap and warm water instead of hot water and when bathing can cause dry skin. Antiseptic soap has alkaline pH. The use of alkaline soap will increase the skin pH which is usually acidic. This alkalinity chemically damages the

lipids in the skin. Alkalinity causes the bonds between lipid components to be broken down into water-soluble components that are easily washed away, and reduces the production of NMF. This condition causes an increase in TEWL which causes xerosis cutis (Chang et al., 2013; Proksch et al., 2020; Khosrowpour et al., 2022).

The skin barrier can also be disrupted by exposure to water, especially hot water. Prolonged exposure to water can also cause disruption of the intercellular lamellar lipids in the stratum corneum, inducing swelling of corneocytes and the formation of large water pools in the intercellular space. In addition, it has been explained that water exposure causes changes in the morphology of the stratum corneum, facilitating the penetration of extrinsic irritants or allergens and creating a suitable environment for excessive bacterial growth. Hot temperatures also cause an increase in TEWL. Hot water can also cause damage to skin lipids and increase skin permeability. In addition to causing an increase in TEWL, it can also cause an increase in skin pH (Herrero-Fernandez et al., 2022).

This study showed the application of moisturizer containing 100% grape seed oil twice daily for 4 weeks can decrease TEWL greater than 100% petrolatum. This is in accordance with research conducted by Lueangarun et al. (2020) which showed that the results of using moisturizer containing grape seed oil showed improvements in TEWL in elderly with xerosis cutis which were much better than the side given hydrophilic cream with a significant difference of 45.55% vs 7.68%, ($p < 0.001$) on the 28th day. Grapeseed oil has a high linoleic acid content compared to other plant oils, which is around 74.2% (Martin et al., 2020). Linoleic acid is one of the free fatty acid components in the skin that cannot be synthesized by the body itself (Lin et al., 2018). Linoleic acid improves the function of the skin barrier, thereby protecting against transepidermal water loss. Linoleic acid is also a natural component of sebum. So giving a moisturizer with grapeseed oil content can improve skin moisture (Martin et al., 2020; Blaak et al., 2015).

Oil-based moisturizers work as occlusive moisturizers that can increase moisture by coating the skin surface, limiting the release of water so that more water is trapped in the stratum corneum (Vaughn et al., 2018). Emollient moisturizers are more effective in repairing the skin barrier and reducing TEWL when used in combination with occlusives or humectants. The combination of emollient and occlusive moisturizers such as grapeseed oil is more effective in reducing TEWL values compared to the use of emollient, occlusive or humectant moisturizers that are not combined (Damayanti et al., 2023; Rajkumar & Lio, 2023).

Petrolatum does not change the pH of the skin and works by forming a protective layer and helping to maintain healthy skin acidity (Farage et al., 2018; Ordoñez-Toro et al., 2022). Meanwhile, grapeseed oil is a moisturizer containing linoleic acid, oleic acid, stearic acid, and palmitic acid, as well as tocopherol, phenolic compounds, and phytosterols. These ingredients have anti-inflammatory and antioxidant effects, so they can reduce the levels of pro-inflammatory cytokines. This anti-inflammatory effect can prevent damage to skin integrity and maintain normal skin pH levels. Grapeseed oil indirectly repairs damaged lipid structures by regulating ROS production and reducing pro-inflammatory cytokines (Widyastuti & Widhiati, 2022). Therefore, the decrease in skin pH after using grapeseed oil moisturizer in this study is not as large and as fast as petrolatum.

According to research conducted by Blaak et al. (2017) moisturizers containing plant oils in 23 subjects with dry skin in a 3-week study (mean age: 73.5 ± 3.4 years) had decreased TEWL results, increased skin hydration, while skin pH remained compared to untreated controls. A significant increase was found in lipid levels in the stratum corneum after application of the product.29,30 Application for 3 weeks is too short to reduce the pH of the skin surface, but a study conducted over a longer period of

time by Blaak et al. (2017) conducted for 7 weeks showed a decrease in the pH value of the skin surface after application of the moisturizer (Lukić et al., 2021; Mekić et al., 2019).

This study showed the application of moisturizer containing 100% grape seed oil can also decrease ODS score greater than 100% petrolatum. According to the literature, linoleic acid can improve skin barrier function by activating the peroxisome proliferator-activated receptor-alpha (PPAR-α) receptor which functions to regulate keratinocyte proliferation and accelerate skin barrier repair. PPAR-α receptor agonists in linoleic acid trigger keratinocyte differentiation, improve skin barrier function, and improve skin lipid metabolism. PPAR-α activation is expressed by keratinocytes, responsible for regulating keratinocyte proliferation, inflammation, and skin barrier homeostasis by increasing epidermal lipid metabolism and synthesis (Vaughn et al., 2018; Dabetic et al., 2020).

Grape seed oil also has high resveratrol, linoleic acid, vitamin E, phytosterols and phenolic compounds that can modulate anti-inflammatory cytokine mediators. Research by Lueangarun et al. (2020) also showed a significant decrease in erythema due to skin inflammation on the 28th day on the side treated with lotion containing grape seed oil compared to the side treated with hydrophilic lotion.3,22 Proanthocyanidin in grape seeds also triggers the release of vascular endothelial growth factor and its topical application causes contraction and closure of wounds on the skin (Enaad, 2015; Hemmati et al., 2015). All of these contents make the application ofmoisturizer containing grape seed oil able to provide significant improvements in ODS scores due to increased keratinocyte differentiation, decreased erythema and wound healing time.

No subjects complained of itching, rash or redness or significant side effects after use in either the grapeseed oil or petrolatum groups. This is in accordance with research by Lueangarun et al. (2020) which stated that the group given grapeseed oil moisturizer and the group with hydrophilic cream were well tolerated without serious side effects during the study.

The limitation in this study is duration of the study was only 30 days so that it was not possible to observe the effectiveness and risk of long-term side effects.

CONCLUSION

The use of moisturizers containing grape seed oil has been shown to effectively improve the skin barrier in elderly individuals with *xerosis cutis* by significantly reducing transepidermal water loss (*TEWL*), skin pH, and Overall Dry Skin (*ODS*) scores, owing to its anti-inflammatory, antibacterial, and antioxidant properties, with no reported adverse effects. This evidence supports the clinical application of grape seed oil as a safe, affordable, and accessible intervention to enhance the quality of life for elderly patients suffering from dry skin conditions. For future research, it is recommended to explore the long-term effects and molecular mechanisms of grape seed oil on skin health, as well as to compare its efficacy with other plant-based oils in diverse elderly populations.

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