



Benefits of Topical Avocado Oil in Improving Skin Moisture: A Study in Atopic Dermatitis Patients

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Abstract

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Background : Atopic dermatitis is a chronic skin condition characterized by recurrent flare-ups that impair skin barrier function and significantly affect patients' quality of life. One of the key strategies in managing atopic dermatitis is to strengthen and maintain the skin's barrier function while reducing inflammation commonly achieved through the use of moisturizers such as petrolatum. However, petrolatum has several drawbacks, including a thick consistency that makes it difficult to apply, a greasy and shiny appearance, and the potential to cause follicular occlusion. As an alternative, avocado oil offers promising benefits due to its non-comedogenic properties and non-greasy finish.

Aim : To determine the difference in effectiveness between avocado oil and petrolatum in improving skin moisture.

Methods : This study is a single-blind randomized clinical trial using a two-parallel group pre- and post-test design. Samples were selected using consecutive sampling. The treatment was applied to the right and left forearms of patients with non flare-ups atopic dermatitis.

Results : The variable of user complaints was statistically significant in the general characteristics, with a *p*-value of <0.05. The TEWL (Transepidermal Water Loss) score for topical avocado oil showed a significant difference compared to petrolatum, with a *p*-value of <0.001.

Conclusion : A greater reduction in TEWL (indicating improved skin moisture) was observed with the application of 100% topical avocado oil in patients with non flare-ups atopic dermatitis, compared to the use of 100% topical petrolatum.

Keywords: atopic dermatitis, avocado oil, transepidermal water loss

INTRODUCTION

Atopic dermatitis (AD) is a recurrent skin disease found in patients with a family history of atopy, characterized by intense itching. The highest incidence of AD occurs in infancy, but significant incidences have also been reported in adolescence and adulthood.² Data from the Indonesian Pediatric Dermatology Study Group indicates that the prevalence of AD in Indonesia has reached 23.7%.³ The number of new cases of AD diagnosed between January 2012 to December 2013 at Kariadi Hospital was 121.⁴ The large number of AD cases, coupled with recurrent attacks, means that AD does not only impact skin health but also triggers psychological distress, lowers patients' quality of life, and impose an economic burden.^{1,2}

Atopic dermatitis is a complex skin disease that can occur due to the interaction of genetics, immune risk factors, impaired epithelial barrier function, and microbial imbalance. Interindividual variation adds to the heterogeneity of the causative mechanisms of AD.⁵ Decreased skin barrier function is caused by mutations in the gene encoding filaggrin. This contributes to increased transepidermal water loss (TEWL), allergen absorption into the skin, and microbial colonization.^{1,6} The TEWL score is an objective measure of skin integrity, measured as the amount of water lost in the stratum corneum. Transepidermal water loss can be measured using the Tewameter TM 300 (Courage & Khazaka, Cologne, Germany).⁷

Comprehensive AD management consists of five main pillars: patient and family education, modifying triggering factors such as irritants and allergens, strengthening and maintaining skin barrier function, reducing inflammation, and eliminating the itch-scratch cycle.⁹ Skin barrier dysfunction occurs in all AD patients, whether experiencing a relapse or not, making the use of moisturizers a fundamental therapy in AD management. Clinical studies have shown that the use of moisturizers will repair the skin barrier, thereby reducing the risk of relapse through its primary effect of reducing TEWL. Moisturizers can be classified as occlusives, emollients, and humectants.^{10,11}

Petrolatum is a classic occlusive moisturizer that effectively reduces TEWL by more than 98% and inhibits water vapor loss 170 times better than olive oil.^{12,13} The main drawback of petrolatum is its very thick texture, making it difficult to apply to the skin and can cause follicular occlusion. Its texture also leaves a greasy, shiny residue, often causing discomfort and decreasing user compliance. Therefore, it is necessary to consider alternative moisturizers that are more comfortable and preferred by patients, thereby increasing patient compliance.¹²⁻¹⁵

Various plant oils have long been used on the skin for cosmetic and medical purposes due to their proven

positive benefits. Avocado oil (*Persea americana*) is a plant oil obtained from avocados through various extraction methods, including cold pressing.¹⁰ Avocado oil fills the gaps between corneocytes, resulting in more moisturized and smoother skin.¹⁶ In addition, avocado oil can act as a skin protectant through its semi-occlusive effect, allowing the skin to retain moisture and resulting in a reduction in TEWL scores.¹⁷ Avocado oil contains various fatty acids, squalene, lecithin, carotenoids, vitamins C and E (tocopherols), phytosterols, alkaloids, saponins, and quinones. These compounds demonstrate avocado oil's role in moisturizing and repairing the skin barrier, in addition to providing anti-inflammatory, antioxidant, and antimicrobial effects.¹⁸⁻²⁰ Due to the various components and benefits of avocado oil, it is suspected that avocado oil may play a role in treating skin diseases with barrier-disrupting pathogenesis, such as atopic dermatitis (AD). However, research on the effects of topical avocado oil on patients with AD has not been conducted.¹⁸⁻²⁰

Although many studies on plant oil's role in improving skin moisture have been conducted, this research is the first to analyze the benefit of topical avocado in the context of lowering transepidermal water loss in atopic dermatitis patients in Indonesia. Compared to other plant oils, avocado oil is superior to olive oil in terms of its ability to repair the skin barrier. Avocado oil also has a role in wound healing by increasing collagen and reducing inflammatory cells, which is better than sunflower seed oil, safflower seed oil, soybean oil, peanut oil, sesame oil, oat oil, pomegranate seed oil, almond oil, apricot oil, rosehip oil, chamomile oil, and shea butter. Although both oil-based, avocado oil is also less comedogenic than other vegetable oils such as coconut oil or olive oil.¹⁰

METHODS

The study was conducted at the Dermatology and Venereology Clinic of Kariadi Hospital after obtaining ethical approval until the sample size was sufficient. This was a single-blind, randomized clinical trial with two-parallel groups pre- and post-test design.

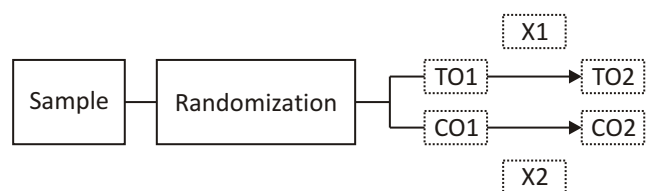


Figure 1. Research design

Description:

T : Treatment

C : Control

TO1 : Skin TEWL score before therapy in the treatment group

TO2 : Skin TEWL score after therapy in the treatment group

CO1 : Skin TEWL score before therapy in the control group

CO2 : Skin TEWL score after therapy in the control group

X1 : Topical 100% avocado oil for 4 weeks

X2 : Topical 100% petrolatum for 4 weeks

The target population was patients with non-flare-ups atopic dermatitis. Inclusion criteria included patients with AD, as defined by the Hanifin-Rajka criteria and no acute exacerbation in the body area to be treated with the test agent. Patients must be aged 18–45 years, willing to participate in the study and agree to receive therapy according to the agent used in the study.¹ Exclusion criteria include patients with a history of hypersensitivity to avocado extract and active skin infection or inflammation (such as AD exacerbation, psoriasis, scabies infestation, seborrheic dermatitis, or contact dermatitis) in the body area to be treated with the test agent, as determined by physical examination, taking medications that cause skin dryness such as antiandrogens, diuretics, chemotherapy, statins, cimetidine, or oral retinoids, and refusing to participate in the study or failing to attend the evaluation visit.^{1,18,32,35}

The study sample was selected using consecutive sampling, based on patient attendance at the Dermatology and Venereology Clinic, Kariadi Hospital. The sample size was calculated using the sample size formula for two-parallel groups pre- and post-test design.

$$n_1 = n_2 = 2 \left[\frac{(Z\alpha + Z\beta)SD}{X_1 - X_2} \right]^2$$

Annotation:

n1 = sample size in the treatment group

n2 = sample size in the control group

Za = level of significance (the value is set at 1,96)

Zb = power (the value is set at 0,842)

SD = standard deviation

X1-X2 = clinical difference (*clinical judgement*).

The calculation results are as follows:

Variable	Za	Zb	X1	X2	SD	n	Annotation
TEWL	1.96	0.842	11.70	9.93	1.61	9.01	Patzelt A, et al ¹⁹

When the research conducted by Patzelt is be added into the sample size formula calculation, the result is

9.01(rounded to 9). If it is estimated that there is a possibility of 10% dropout, then the sample size calculation with dropout correction is as follows:

$$ndo = \frac{n}{1 - do} = \frac{9}{1 - 0.1} = 10$$

From the calculation above, at least 10 patients were selected for the treatment group (100% topical avocado oil) and the control group (100% topical petrolatum), resulting in total number of samples not less than 20 patients. In this study, the researcher added 3 patients to both the treatment and control groups to anticipate any patients being excluded during the research process. Therefore, in this study the total number of samples was 26 people.

The moisturizer was coded A for 100% topical avocado oil and B for 100% topical petrolatum. The medication order was arranged using simple random sampling. The administration was determined by a staff who were not directly involved in the study sample observation. The order was stored in a sealed envelope and opened after the study was completed. A study sample was considered a dropout if an allergic reaction, such as itching, pain, a red rash, hives, or swelling, was observed after the therapy was administered.

Before data collection began, the assessing physician (resident doctor in the Dermatology, Venereology, and Aesthetics Program) received training on how to utilize a tewameter (Courage & Khazaka, Cologne, Germany) to examine the volar area of the left and right forearm. The volar area was chosen due to its ease for application, easily examined by researchers, has a quality level comparable to facial skin but is more ethically feasible for research in the event of adverse effects, and has the least bias compared to other skin areas. The average reading was then taken from the three evaluators.

Patients with a history of AD who visited to the Dermatology and Venereology Clinic of Kariadi Hospital were recorded and then interviewed using a screening questionnaire. Sampling was carried out sequentially until the sample size was reached. Each study sample underwent a one-week preconditioning period before participating in the study. During the week, the study subjects were advised against bathing with warm water, recommended to bathe twice daily and use the provided baby soap. They should not use any other soap or topical agent other than the one provided for the study. Each subject received a moisturizer consisting of 100% topical avocado oil or 100% topical petrolatum, according to randomization order, for a period of 4 weeks. The study subjects were randomly allocated to two groups: a control group and a treatment group.

Before participating in the study, each subject was

informed of the purpose of the study, its benefits, and potential risks. Those who understood and agreed to participate were asked to sign a consent form. The examining physician took a history of dry skin complaints in patients with AD, current medications, and history of skin care product used.

The physician explained how to use the topical agent. Patients in each test group applied the topical agent twice daily immediately after bathing. The topical agent was applied evenly to the volar aspect of the left and right forearm. During the first visit, the physician explained how to apply the topical agent, then patients applied the agent themselves at home. The physician then measured the skin moisture using a tewameter. This measurement was taken before any treatment was administered (day 0) and week 4 (day 28) after the start of test material administration. Upon arrival for a follow-up examination on the last measurement day, the subjects

were asked not to use the topical agent on that day because the presence of topical materials on the skin surface would reduce the accuracy of TEWL measurements. Patient's compliance was assessed through a daily logbook and communication via WhatsApp. Objective parameters were evaluated by measuring TEWL. Prior to the study, the study protocol was submitted to the Health Research Ethics Committee of Kariadi Hospital with the registration number 16308/EC/KEPK-RSDK/2024 on December 16, 2024.

RESULTS

The characteristics of the research subjects in the avocado oil group and the petrolatum group are shown in [Table 1](#).

The TEWL scores of the right and left legs of the study subjects at baseline (week 0) and week 4, as well as the difference in TEWL scores between the avocado oil

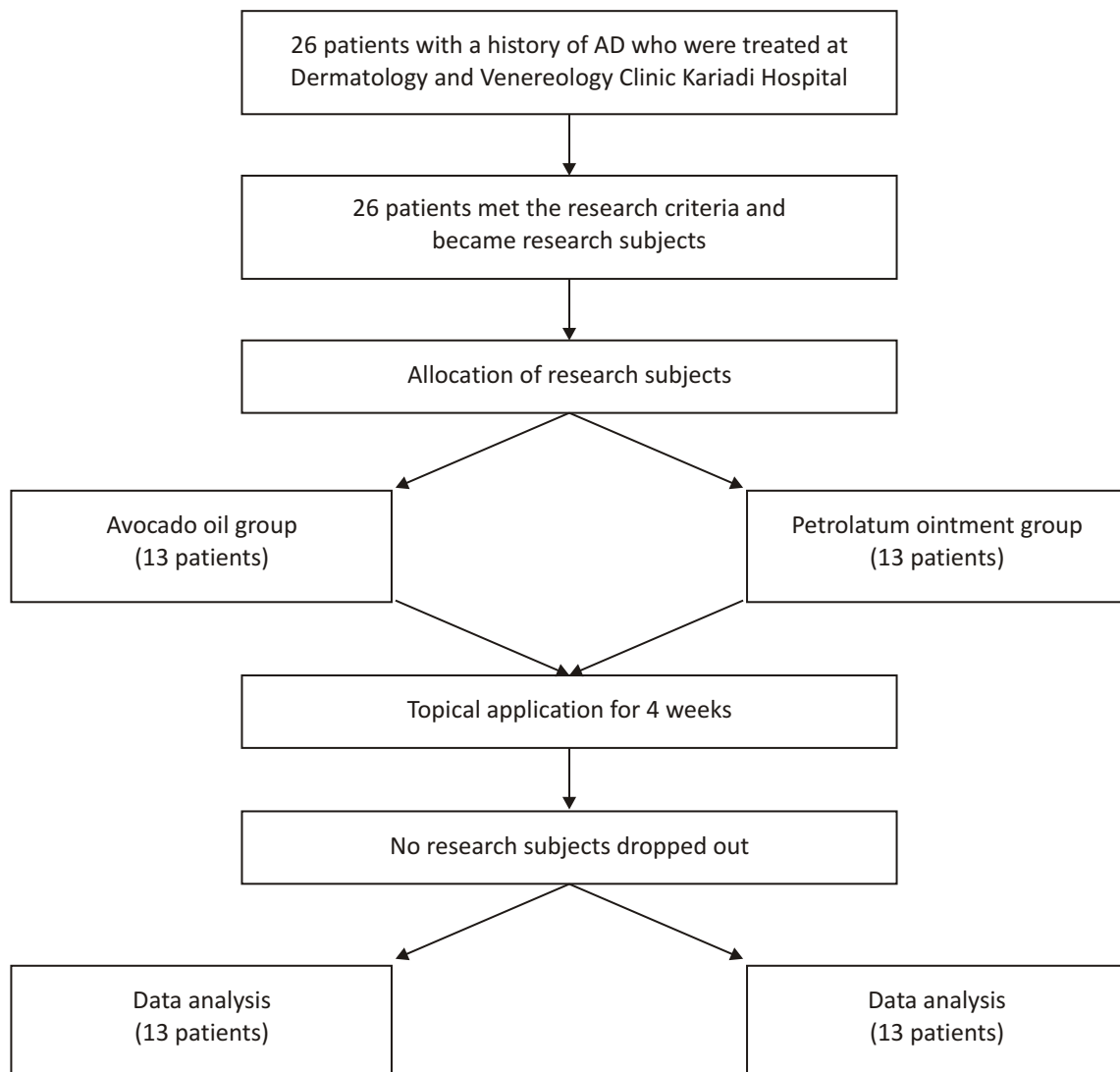


Figure 2.

TABLE 1

General characteristics of the study subjects in the groups receiving 100% avocado oil and 100% topical petrolatum

Variables	Group		<i>p</i>	Statistical test
	Avocado oil	Petrolatum		
Age	30.85 ± 3.81	30.15 ± 2.97	0.610	Levene
Gender			1.000	Chi-Square
Man	4 (30.8%)	4 (30.8%)	20 (52.6%)	
Woman	9 (69.2%)	9 (69.2%)		
Level of education			1.000	Chi-Square
Vocational school	1 (7.7%)	2 (15.4%)		
Bachelor	12 (92.3%)	11 (84.6%)		
Bathing frequency			1.000	Chi-Square
2x	10 (76.9%)	11 (84.6%)		
>2x	3 (23.1%)	2 (15.4%)		
Types of soap			1.000	Chi-Square
Antiseptic	11 (84.6%)	10 (76.9%)		
Non-Antiseptic	2 (15.4%)	3 (23.1%)		
Warm bath			0.673	Chi-Square
Yes	5 (38.5%)	3 (23.1%)		
No	8 (61.5%)	10 (76.9%)		
How to dry the body			1,000	Chi-Square
Wiped/patted	6 (46.2%)	5 (38.5%)		
Rubbed	7 (53.8%)	8 (61.5%)		
History of moisturizer use			0.378	Chi-Square
Always	5 (38.5%)	2 (15.4%)		
Seldom	6 (46.2%)	10 (76.9%)		
Never	2 (15.4%)	1 (7.7%)		
History of therapy			0.673	Chi-Square
Topical	8 (61.5%)	10 (76.9%)		
Topical + oral	5 (38.5%)	3 (23.1%)		
Initial complaint			1.000	Chi-Square
Dry skin	11 (84.6%)	10 (76.9%)		
Dry skin + Itchy	2 (15.4%)	3 (23.1%)		
Usage complaint			0.030	Chi-Square
Sticky	0 (0%)	7 (53.8%)		
Greasy	1 (7.7%)	0 (0%)		
No complaint	12 (92.3%)	6 (46.2%)		

TABLE 2
TEWL scores before and after topical application of 100% avocado oil and 100% petrolatum

Variables	Group		<i>p</i>	Statistical test
	Avocado oil	Petrolatum		
Right side TEWL				
<i>Baseline</i>	16.40 (15.01 – 20.06)	16.06 (15.22 – 21.62)	0.412	Mann-Whitney
Week 4	6.55 ± 0.73	9.40 ± 1.61	<0.001*	<i>Independent t-test</i>
<i>p</i>	<0.001*	<0.001*		
Statistical test	<i>Paired t-test</i>	<i>Paired t-test</i>		
Right side TEWL difference	-10.31 ± 1.38	-7.23 ± 1.59	<0.001*	<i>Independent t-test</i>
Left side TEWL				
<i>Baseline</i>	16.93 (16.34 – 22.60)	16.81 (15.25 – 20.65)	0.124	Mann-Whitney
Week 4	6.55 ± 1.04	9.24 ± 1.51	<0.001*	<i>Independent t-test</i>
<i>p</i>	<0.001*	<0.001*		
Statistical test	<i>Paired t-test</i>	<i>Paired t-test</i>		
Left side TEWL difference	-10.95 ± 1.55	-7.56 ± 1.27	<0.001*	<i>Independent t-test</i>

Notes : *Significant (*p* < 0.05)

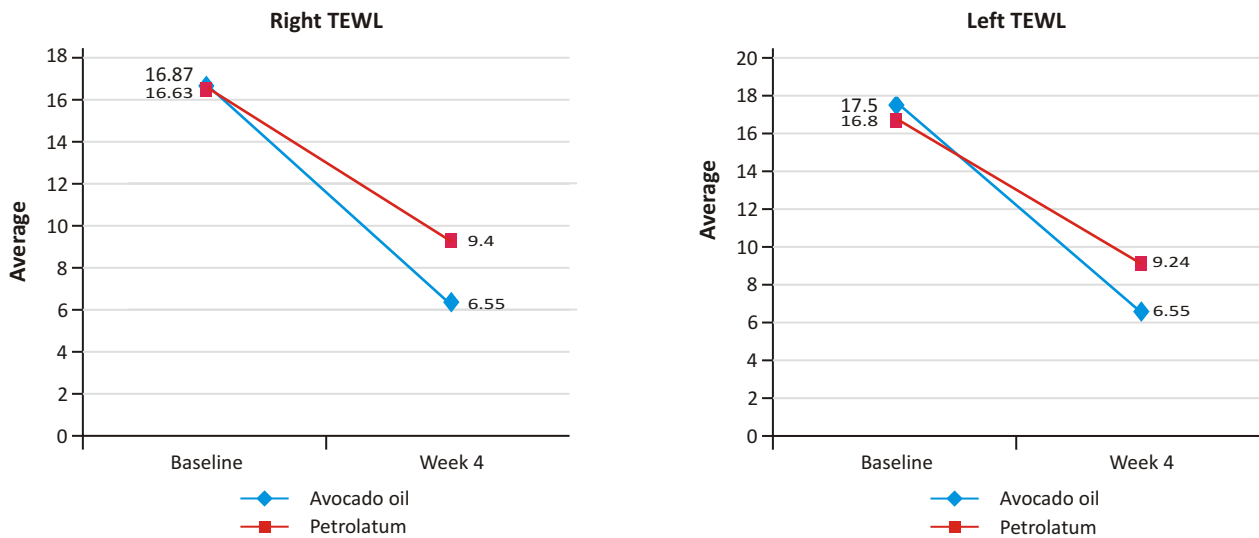


Figure 3. A. Right-sided TEWL scores at baseline and week 4 in the avocado oil and petrolatum group. **B.** Left-sided TEWL scores at baseline and week 4 in the avocado oil and petrolatum group.

and petrolatum groups, are shown in [Table 2](#).

TEWL Scores Before and After Avocado Oil Use

The TEWL scores of the right and left legs of the study subjects at baseline (week 0) and week 4, as well as the difference in TEWL scores between the avocado oil and petrolatum groups, are shown in [Table 2](#).

DISCUSSION

The research was a single-blind, randomized clinical trial with a two-group pre- and post-test control design. It assessed the effect of topical 100% avocado oil compared to topical 100% petrolatum on skin barrier repair (TEWL score) in patients with a history of atopic dermatitis (AD). This study was the first of its kind. The mean age in both

groups was 30.50 ± 3.36 , with an age range of 24–36 years. Consistent with the literature, adult-onset AD itself occurs most often in individuals aged 20–40 years.³⁵ Research conducted by Wahnadian *et al.* at the Dermatology & Venereology Clinic, Waled Regional Hospital, Cirebon Regency, from November 2019 to December 2021 revealed that atopic dermatitis sufferers in the 26–45 year age range were the highest among all adult-onset AD patients.³⁶

Gender in this study showed that the majority of subjects were female, representing 69.2% in each group, both the avocado oil and petrolatum groups. A study at the Dermatology & Venereology Clinic Dr. H. Abdul Moeloek Hospital found that of 96 AD patients, 41 (42.7%) were male and 55 (57.3%) were female. The Chi-Square statistical test results showed $p=0.012$ ($p<0.05$), indicating a significant association between gender and the incidence of AD. Emotional stress plays a significant role in the development of AD because sensory nerves release neuromediators that regulate inflammation, thus increasing inflammation in the skin. Stress itself is closely related to the hormone progesterone, which women experience as part of their biological functions. This results in women being more sensitive and susceptible to stress, especially during hormonal fluctuations, such as during the menstrual cycle and pregnancy, compared to men.³⁷

The educational level of the study subjects in both the avocado oil and petrolatum groups was predominantly bachelor's degree. Individuals with lower levels of education often experience significant health disparities due to limited health literacy, which hinders understanding of skin care practices, medication adherence, and recognition of environmental triggers that can exacerbate AD.^{38,39} A 2024 study by Nurapriyanti on the relationship between knowledge level and skin care behaviors in atopic dermatitis showed that patients with higher education demonstrated a better understanding of AD treatment, including AD-related skin care behaviors and needs.⁴⁰

Most study subjects showered twice daily. Regular bathing can help cleanse the skin of bacteria, allergens, and irritants. However, a study involving 28 children with AD found no significant difference in symptoms whether they bathed daily or only twice a week. To date, there are no standards for the optimal frequency and duration of bathing.⁴¹

In avocado oil group 11 study subjects (84.6%) bathed with antiseptic soap. Meanwhile, in petrolatum group, 10 study subjects (76.9%) bathed with antiseptic soap. Antiseptic soap is commonly used for its ability to eliminate pathogenic bacteria and prevent skin infections. On the other hand, this type of soap can strip natural oils of the skin, causing increased dryness and irritation, especially in individuals with sensitive skin conditions such as AD.⁴² However, this contradicts a

study conducted by Baihaqi *et al.* on medical students at Diponegoro University regarding the relationship between antiseptic soap use and dry skin. The study showed no significant association.⁴³

Five study subjects (38.5%) in the avocado oil group and three study subjects (23.1%) in the petrolatum group had a habit of bathing with warm water. Studies suggest that exposure to hot or warm water can remove the skin's natural oils, disrupting the skin's lipid matrix, leading to increased transepidermal water loss, worsening skin dryness and irritation.⁴⁴

The drying method among study subjects was divided into patting (6 subjects) and rubbing (7 subjects) in the avocado oil group, while in the petrolatum group was divided into patting (5 subjects) and rubbing (8 subjects). For treating AD patients, rubbing should not be used because the mechanical friction that occurs during rubbing can damage the skin barrier and trigger the release of pro-inflammatory cytokines.^{45,46}

The use of moisturizer in avocado oil group was detailed as follows: 5 study subjects (38.5%) regularly used moisturizer, 6 study subjects (46.2%) rarely used moisturizer, and 2 study subjects (15.4%) reported never used moisturizer. The history of moisturizer use in the petrolatum group was detailed as follows: 2 study subjects (15.4%) regularly used moisturizer, 10 study subjects (76.9%) rarely used moisturizer, and 1 study subject (7.7%) reported never used moisturizer. Regular use of moisturizer can prevent transepidermal water loss (TEWL) and maintain skin moisture.^{2,12,28} Patzelt's research supports this statement, where transepidermal water loss (TEWL) before and after application of avocado oil moisturizer decreased from 11.70 ± 1.61 to 9.93 ± 2.22 .¹⁹

Eight subjects in the avocado oil group (61.5%) had a history of topical treatment and five subjects (38.5%) had a history of topical treatment combined with oral treatment. Ten subjects in the petrolatum group (76.9%) had a history of topical treatment and three subjects (23.1%) had a history of topical treatment combined with oral treatment. The five main pillars of AD management are providing education about AD, avoiding and modifying trigger factors, strengthening and maintaining skin barrier function, reducing inflammation with anti-inflammatory medications, and controlling and eliminating the itch-scratch cycle.^{9,30} A retrospective study conducted by Ratnaningtyas *et al.* regarding topical treatment in AD patients at Dr. Soetomo General Hospital Surabaya during 2013–2015 showed that 272 patients (83.2%) of 327 new AD patients received topical therapy: topical corticosteroids for 187 patients (23.6%), emollients for 183 patients (23.6%), and gents (23.1%), and topical antibiotics in 40 patients (5.1%).⁴⁷

The majority of patients' initial complaints were dry skin. The literature indicates that patients with AD

experience decreased expression of epidermal differentiation proteins due to mutations in the filaggrin (FLG) gene. As a result, the skin becomes dry so that irritants and allergens are more easily absorbed, resulting in inflammation and pruritus.²³⁻²⁵

After using avocado oil for 4 weeks, no significant side effects were generally observed. The literature indicates that the main disadvantage of petrolatum is its oily texture and high viscosity which makes the skin surface sticky upon application and reducing compliance.^{26,27} This is consistent with research conducted by Leo *et al.*⁴⁸

This study found a decrease in TEWL scores before and after avocado oil application of -10.31 ± 1.38 on the right side and -10.95 ± 1.55 on the left side. These results indicate a statistically significant decrease in TEWL scores, with $p < 0.001$ on the right side and $p < 0.001$ on the left side. This aligns with the hypothesis that TEWL scores after avocado oil application on AD patients are lower than TEWL scores before treatment. The linoleic acid content in avocado oil makes it a potent moisturizing agent compared to other plant oils, helping to increase skin hydration and improve xerosis and pruritus.^{30,33} The phospholipid lecithin component helps improve skin hydration and strengthens the skin barrier integrity. Meanwhile, squalene, a natural moisturizing component, can protect the skin by preventing environmental stressors and oxidative damage.^{18,34} The results of this study align with those of Patzelt *et al.*, who demonstrated a decrease in transepidermal water loss (TEWL) before and after avocado oil application in six healthy study samples.¹⁹

A statistically significant decrease was found in TEWL scores in the avocado oil group on the right side (-10.31 ± 1.38) and left side (-10.95 ± 1.55) compared to the decrease in TEWL scores in the petrolatum group on the right side (-7.23 ± 1.59) and left side (-7.56 ± 1.27). This finding aligns with the hypothesis that TEWL scores after avocado oil application are lower than those after petrolatum application in AD patients.

According to the literature, avocado oil and petrolatum effectively reduce TEWL. Both play a role in repairing the skin barrier and increasing skin moisture. The various essential fatty acids contained in avocado oil fill the intercorneocyte gaps in the skin, making avocado oil a good emollient.²⁶ Furthermore, avocado oil is said to have semi-occlusive properties due to its ability to form a hydrophobic layer to resist evaporation on the skin surface and the superficial interstitium of the stratum corneum.^{10,12,13} The phospholipid component lecithin helps improve skin hydration and strengthens the integrity of the skin barrier. Meanwhile, squalene, a natural moisturizing component, can protect the skin by preventing environmental stressors and oxidative damage.^{18,34} Vitamin E, vitamin C, carotenoids (lutein and beta-carotene), phenolics, and phytosterols are

antioxidant components contained in avocado oil that can help neutralize free radicals and prevent cellular damage due to oxidation, thereby increasing resistance to factors that can exacerbate water loss and irritation.^{30,34}

In addition to being a moisturizer and antioxidant, avocado oil can reduce skin inflammation by inhibiting the expression of inflammatory cytokines and the activation of NF- κ B/caspase-1.³¹ As an antibacterial, the alkaloids, saponins, and quinones in avocado oil can inhibit the growth of *Staphylococcus aureus* bacteria in AD patients, which occurs either primarily or secondary to epidermal barrier disruption and Th2-dominated immunity.^{20,22,25} This reason is thought to be behind a more significant effect of avocado oil on reducing TEWL than petrolatum.

Previous research on the effects of avocado on skin hydration was not conducted in atopic dermatitis population, even though atopic dermatitis patients often experience recurring itching and require long-term use of moisturizer.^{10,19}

CONCLUSION

This study that revealed topical 100% avocado oil is more effective in reducing TEWL scores in patients with AD compared to topical 100% petrolatum. Further research could use a larger sample size in a wider population to increase the generalizability of the results.

CONFLICT OF INTEREST

All authors certify that they have no affiliations with or involvement in any organization or entity with any financial or non-financial interest in the materials discussed in this manuscript.

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