



Effectiveness of Topical *Centella Asiatica* Extract on Xerosis Cutis in Geriatrics (a Transepidermal Water Loss (TEWL), Skin pH, and Overall Dry Skin Score (ODS) Study)

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KEYWORDS

Centella asiatica, xerosis cutis, TEWL, skin pH, ODS Score

ABSTRACT

Xerosis cutis in geriatrics is characterized by dry skin and impaired barrier function due to decreased water and lipid content in the *stratum corneum*. Effective management focuses on restoring the skin barrier and maintaining hydration. *Centella asiatica*, a medicinal plant, has been shown in dermatology to serve as a moisturizer for xerosis cutis. This study evaluated the efficacy of topical *Centella asiatica* extract in reducing Transepidermal Water Loss (TEWL), normalizing skin pH, and improving Overall Dry Skin (ODS) scores in elderly patients with xerosis cutis. Thirty geriatric residents at Rindang Asih II nursing home participated in a single-blind, randomized, placebo-controlled trial over four weeks. Subjects received either topical *Centella asiatica* extract or petrolatum as a placebo. Assessments included TEWL, skin pH, and ODS score measurements. All 30 participants completed the study. Application of topical *Centella asiatica* extract resulted in significantly greater reductions in TEWL, skin pH, and ODS scores on both lower legs compared to petrolatum ($p < 0.05$). Furthermore, all subjects in the *Centella asiatica* group reported no adverse sensations such as stickiness or greasiness. Topical *Centella asiatica* extract is thus more effective than petrolatum in improving skin hydration and barrier function in geriatric xerosis cutis, with excellent user tolerability.

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INTRODUCTION

Xerosis cutis in geriatrics is a condition characterized by dry skin and impaired skin barrier function, resulting from the loss or reduction of water and lipid content in the *stratum corneum* in elderly individuals (Siswati et al., 2021). Geriatrics, or the elderly, according to the World Health Organization (WHO), are defined as individuals aged 60 years and over (Anggraini et al., 2020). Although *xerosis cutis* in geriatrics does not cause death, it can lead to serious complications such as pruritus, secondary infections, ulceration, chronic wounds, sleep disturbances, and depression, thereby reducing quality of life (Anggraini et al., 2020; Lueangarun et al., 2020). Several studies report the prevalence of *xerosis cutis* in geriatrics ranges from 30% to 85%. It is the fifth most common skin disease, with an incidence of 6.27% among 2,343 patients at Dr. Cipto Mangunkusumo Hospital from 2008 to 2013 (Anggraini et al., 2020; Wijayadi & Wardoyo, 2022).

The principle of managing *xerosis cutis* in geriatrics is to improve skin barrier function and maintain skin hydration (Hasanah, 2016). Management includes the use of moisturizers (occlusives, emollients, or humectants), regulating fluid intake, lifestyle and environmental modifications, preventing direct sunlight exposure, and treating systemic diseases that may trigger *xerosis cutis* (Anggraini et al., 2020; Lueangarun et al., 2020; Yulisa & Menaldi, 2023).

Traditional herbal plants have gained renewed interest in recent years. *Centella asiatica*, a member of the Apiaceae family, has many scientifically proven benefits (Buranasudja et al., 2021). Several studies have shown that *Centella asiatica* can clinically improve *xerosis cutis*. Topical *Centella asiatica* improves skin hydration by acting as a humectant, increasing the expression of aquaporin-3 (AQP-3), filaggrin (FLG), loricrin (LOR), and involucrin (IVL), raising hyaluronic acid levels, and providing anti-inflammatory and antioxidant effects (Legiawati, 2021; Damayanti et al., 2021; Legiawati et al., 2020).

Topical *Centella asiatica* extract is one of the latest alternative therapies for *xerosis cutis* from herbal sources, considered safe with few side effects, prompting further research into its effectiveness for geriatric *xerosis cutis*. Previous studies offer valuable insights into the condition and its management. The study by Chen et al. (2019) explored the effectiveness of various topical moisturizers in managing *xerosis cutis*, focusing on skin barrier function and moisture retention, and concluded that emollients and humectants significantly alleviate symptoms. However, this study did not specifically examine herbal treatments such as *Centella asiatica*, which has recently gained attention for its hydrating and anti-inflammatory properties (Ordonez-Toro et al., 2022; Ratz-Lyko & Arct K., 2016; Venesia et al., 2020). Another study by Gupta et al. (2020) examined herbal plants in managing *xerosis cutis* and highlighted *Centella asiatica* as a promising natural remedy due to its effects on skin hydration and barrier function. However, Gupta's study primarily focused on clinical symptoms, without addressing objective skin parameters such as Transepidermal Water Loss (TEWL), pH, and Overall Dry Skin (ODS) scores, which are essential for evaluating the effectiveness of topical treatments in geriatrics.

This study aims to prove the effectiveness of topical *Centella asiatica* extract in reducing TEWL values, normalizing skin pH, and improving ODS scores in geriatric *xerosis cutis*. The significance of this research lies in providing scientific evidence supporting *Centella asiatica* as a safe and effective alternative treatment for *xerosis cutis*, potentially improving the quality of life for elderly individuals affected by this condition.

METHOD

This was a single-blind randomized placebo-controlled trial compared *Centella asiatica* extract and petrolatum as placebo. All research subjects bathed using normal temperature water and baby soap. Ethical clearance was from the Ethics Committee for Health Research, Faculty of Medicine, Diponegoro University, Semarang (No.299/EC/KEPK/FK-UNDIP/VI/2024).

Inclusion criteria: patients aged \geq 60 years with *xerosis cutis*, ODS score \geq 1, were willing to follow research procedures and receive therapy according to research procedure and were willing to sign an agreement or informed consent form.

Exclusion criteria: Patients with history of hypersensitivity to *Centella asiatica* extract, there were lesions with active infection on the part of the body where the treatment materials will be applied, were currently using topical medications such as: other types of moisturizers, topical corticosteroids, or topical antibiotics in the last 7-14 days, had history of taking medications to moisturize the skin and oral medications such as retinoids and hormonal drugs in the last 7-14 days, suffering from other skin diseases (erythroderma, psoriasis, ichthyosis), dementia and delirium patients who cannot give informed consent.

Baseline evaluation such as demographic data, frequency of bathing, type of bath soap, whether using warm water bath, how to dry the body, history of using moisturizers, initial complaints, and comorbid diseases was collected.

Physical examination was carried out by 3 dermatology, venereology, and aesthetic residents, using tewameter TM 300 (Courage & Khazaka Cologne, German) and pehameter 905 (Courage & Khazaka, Cologne, German). The average of TEWL and skin pH values was taken from 3 people who examined and ODS score was also assessed clinically.

The selection of research subjects was carried out by randomization based on purposive sampling, based on inclusion and exclusion criteria at the Rindang Asih II Nursing Home, Semarang. The research sample size was calculated using the sample size formula for two parallel group pre and post test design. Based on the calculations, the number of samples in each treatment (topical centella asiatica extract) and control (petrolatum) groups were 15, so that the total number of research samples were 30 patients.

Moisturizers were given codename A for topical Centella asiatica extract, codename B for topical petrolatum. Research allocation would be carried out using a 2 block randomization method, for example AB, AB, BA, BA. The order of the blocks would be arranged by officers who were not directly involved in observing research subjects. The block sequence would be stored in a sealed envelope and only opened after the study was completed.

Topical 1% Centella asiatica extract ointment was applied to the right and left anterolateral lower legs (shin bone below the knee) at 1 finger tip unit (FTU) per administration, 2 times a day after bathing in the morning and evening for 4 weeks. Topical Centella asiatica extract was administered within a maximum period of 24 hours before measurements were taken. Topical 100% petrolatum as placebo was applied in the same manner as topical 1% Centella asiatica extract.

Objective parameters were evaluated by measuring TEWL and skin pH while subjective parameter was evaluated by assessing the ODS score. Measurements were carried out at the beginning before treatment was given (day 0) and after the 4th week (day 28) after the start of administering the treatment material. Subjects' compliance in participating in the research were seen through the their daily log sheet and communication were carried out via telephone or by the caregiver of the Rindang Asih II Semarang Nursing Home.

The primary efficacy variable was the decrease in TEWL and skin pH value. TEWL measurement results could be interpreted as follows: (i) 0-10, very healthy; (ii) 10-15, healthy; (iii) 15-25, normal; (iv) 25-30, disturbed; (v) > 30, critical condition. The range of skin pH value was 1-14. Transepidermal Water Loss (TEWL) was measured using a tewameter while skin pH was measured using a pehameter.

The secondary efficacy variable was the decrease in ODS score. ODS score was determined with a subjective assessment of 5-point scale that ranges from 0 (no dry skin) to 4 (severe scale, roughness, inflammation and crusting). The ODS score can be seen in Table 1.

Table 1. Overall Dry Skin Score (ODS)

Scale	Clinical features
0	No abnormalities are found
1	The scale is fine, slightly rough, and looks dull
2	Small scales and several large scales are found together, a little rough, the skin looked white
3	Small and large scales are found scattered irregularly; clearly rough, slight erythema can be found and cracked skin (superficial fissures) can be found
4	Dominated by large, very rough scales, erythema is found, accompanied by eczematous changes and fissures

There was no side effects until the end of the research. This research data showed that all research subjects (100%) in the Centella asiatica extract group had no complaints whether sticky or oily, while 9 (60.0%) research subjects complained about stickiness and 2 (13.3%) research subjects complained of stickiness and oiliness after application of topical petrolatum. There was no dropouts in this study.

Data analysis included descriptive analysis and hypothesis testing. The normality test used the Shapiro-Wilk test. Hypothesis testing of differences in mean TEWL values, skin pH values, and ODS scores before and after therapy would be tested using the paired t-test if the data distribution was normal. The Wilcoxon test would be used if the data distribution was not normal. Differences in TEWL values, skin pH values, and ODS scores between the treatment and control groups along with their deltas (the value after subtracting the value before) would be analyzed using the unpaired t-test if the distribution was normal or using the Mann-Whitney test if the distribution was not normal. Differences are considered significant if $p \leq 0.05$. SPSS version was used for data analysis.

RESULT AND DISCUSSION

Research Population

The demographics of the subjects were 30 patients aged 60-92 years. There were no significant differences in the baseline characteristics between the two treatment groups (Table 2).

Table 2. Characteristics of research subjects in the Centella Asiatica extract and petrolatum groups

Variable	Groups		p	Statistical test
	<i>Centella asiatica</i>	Petrolatum		
Age	72,67 ± 9,36	75,47 ± 8,18	0,597	Levene
Gender				
Male	10 (66,7%)	5 (33,3%)	0,068	Chi-Square
Female	5 (33,3%)	10 (66,7%)		
Education				
Elementary school	3 (20)	3 (20)	0,223	Chi-Square
Junior High School	2 (13,3)	6 (40)		
Senior High School	10 (66,7)	6 (40)		
Frequency of bathing				
Once a day	3 (20)	4 (26,7)	0,666	Chi-Square
Twice a day	12 (80)	11 (73,3)		
Type of bathsoap				
Baby soap	1 (6,7)	5 (33,3)	0,068	Chi-Square
Antiseptic soap	14 (93,3)	10 (66,7)		
Using warm water bath				
Yes	1 (6,7)	5 (33,3)	0,068	Chi-Square
No	14 (93,3)	10 (66,7)		
How to dry the body				
Wiping	2 (13,3)	6 (40)	0,099	Chi-Square
Rubbing	13 (86,7)	9 (60)		
History of using moisturizer				
Yes	2 (13,3)	6 (40)	0,099	Chi-Square
Occasionally	13 (86,7)	9 (60)		
Initial complaints				
Dry	9 (60)	7 (46,7)	0,484	Chi-Square
Dry, itchy	3 (20)	6 (40)		

Variable	Groups		p	Statistical test
	<i>Centella asiatica</i>	Petrolatum		
Dry, itchy, redness	3 (20)	2 (13,3)		
Comorbid disease				
Hypertension	1 (6,7)	4 (26,7)	0,142	Chi-Square
None	14 (93,3)	11 (73,3)		

Source: processed data

Efficacy analysis

TEWL

Table 3 showed that the decrease in TEWL value of the right and left lower leg in the Centella asiatica extract group and petrolatum group from baseline to week 4 was significant. This study results showed that the decrease in TEWL value of the right and left lower leg in the Centella asiatica extract group was significantly greater than the petrolatum group ($p=0.002$; $p=0,007$).

Table 3. TEWL value of the lower leg of research subjects in the Centella asiatica and petrolatum extract groups

TEWL (lower leg)	Groups		p	Statistical Test
	<i>Centella asiatica</i>	Petrolatum		
Right lower leg				
Baseline	25,59 ± 9,43	18,05 ± 3,21		
Week 4	14,12 ± 4,34	13,07 ± 1,82		
p	<0,001	<0,001		
Statistical test	Paired t	Paired t		
Delta TEWL	-11,48 ± 6,57	-4,98 ± 3,14	0,002	Independent t
Left lower leg				
Baseline	23,51 ± 7,71	18,24 ± 5,55		
Week 4	11,74 ± 3,43	12,20 ± 1,34		
p	<0,001	0,001		
Statistical test	Paired t	Wilcoxon		
Delta TEWL	-11,77 ± 6,18	-6,04 ± 5,15	0,007	Mann-Whitney

Source: processed data

Skin pH

Table 4 showed that the decrease in skin pH values of the right and left lower leg in the Centella asiatica extract group and petrolatum group from baseline to week 4 was significant. This study results showed the decrease in skin pH value of the right and left lower leg in the Centella asiatica extract group was significantly greater than the petrolatum group ($p=0.019$; $p=0,038$).

Table 4. pH value of the lower leg of research subjects in the Centella asiatica and petrolatum extract groups

Skin pH (lower leg)	Groups		p	Statistical Test
	<i>Centella asiatica</i>	Petrolatum		
Right lower leg				
Baseline	5,94 ± 0,22	5,85 ± 0,43		
Week 4	5,17 ± 0,13	5,32 ± 0,24		
p	0,001	<0,001		
Statistical test	Paired t	Paired t		
Delta skin pH	-0,77 ± 0,24	-0,53 ± 0,39	0,019	Mann-Whitney
Left lower leg				
Baseline	5,95 ± 0,22	5,83 ± 0,56		
Week 4	5,13 (5,01-5,83)	5,35 ± 0,32		

p	<0,001	0,001		
Statistical test	Wilcoxon	Paired t		
Delta skin pH	-0,67 ± 0,29	-0,42(-1,86-(-0,01))	0,038	Mann-Whitney

Source: processed data

ODS

Table 5 showed that the decrease in ODS score of the right and left lower leg in the Centella asiatica extract group and petrolatum group from baseline to week 4 was significant. This study results showed the decrease in ODS score of the right and left lower leg in the Centella asiatica extract group was significantly greater than the petrolatum group (p=0.026).

Table 5. ODS score of the lower leg of research subjects in the Centella asiatica and petrolatum extract groups

ODS score (lower leg)	Groups		p	Statistical Test
	<i>Centella asiatica</i>	Petrolatum		
Right lower leg				
Baseline	3 (2-3)	2 (2-3)		
Week 4	1 (1-2)	1 (1-3)		
p	<0,001	<0,001		
Statistical test	Wilcoxon	Wilcoxon		
Delta ODS score	-1 (-2-(-1))	-1 (-2-0)	0,026	Mann-Whitney
Left lower leg				
Baseline	3 (2-3)	2 (2-3)		
Week 4	1 (1-2)	1 (1-2)		
p	<0,001	<0,001		
Statistical test	Wilcoxon	Wilcoxon		
Delta ODS score	-1 (-2-(-1))	-1 (-2-0)	0,026	Mann-Whitney

Source: processed data

Based on the results of the characteristics of the subject, there was no significant difference between the Centella asiatica extract group and petrolatum group, which means it can be said that these characteristics are homogenous and their potential as confounding variables can be controlled.

Skin changes in geriatrics occur due to intrinsic and extrinsic factors. Intrinsic skin changes in geriatrics include decreased skin barrier function, increased skin pH, decreased desquamation stratum corneum, decreased hydration of the stratum corneum, decreased vascularity in the skin layers, decreased activity of sebaceous and sweat glands, and increased TEWL (Wijayadi & Wardoyo, 2022; Damayanti et al., 2023). Several extrinsic factors can also trigger xerosis cutis, including low air humidity, excessive bathing habits, use of irritating soap, wearing irritating clothing, and use of alcohol and acetone on the skin. These factors can increase TEWL and cause disruption of NMF and intracellular lipids, so that the skin becomes dry and scaly (Zahrudin & Damayanti, 2018; Tanely et al., 2021).

Kulthanan et al. shows that the use of antiseptic soap causes changes in the pH of the skin, resulting in irritation and dryness of the skin. The use of soap with a pH close to 5.5 is recommended to minimize skin damage. Soap should contain a little surfactant, not contain fragrance and alcohol because they can irritate the skin (Yulisa & Menaldi, 2023; Ordonez-Toro et al., 2022). The recommended bathing habit is to use a shower with a maximum temperature of 35°C. Bathing in lukewarm water is better than bathing in warm water (Damayanti et al., 2023). Drying the skin by rubbing can damage the skin barrier, disrupt epidermal lipids, increase TEWL, and cause itching by

triggering the itch-scratch cycle (Czarnowicki et al., 2016; Kamrani et al., 2024; Sari et al., 2023; Shen et al., 2019; Sun et al., 2022).

Several comorbid factors are related to xerosis cutis, including hypertension, diabetes mellitus, renal dysfunction, liver disorders, thyroid disease, hepatitis B and C, HIV, hormonal changes (menopause, pregnancy), nutrition (dehydration, malnutrition). Hypertension is the most common comorbid factor found. Hypertension and hyperlipidemia can reduce blood circulation thereby increasing the risk of xerosis cutis, facilitating pathogens to enter through damaged skin, and increasing the risk of skin infections (Wijayadi & Wardoyo, 2022; Damayanti et al., 2023).

The decrease in TEWL values of the right and left lower legs in the *Centella asiatica* extract group was significantly greater than in the petrolatum group ($p < 0,05$). Topical *Centella asiatica* has a humectant ability that attracts moisture from the surrounding environment and deeper layers of the skin. The decrease in TEWL is mainly caused by the presence of substances in the *Centella asiatica* extract which can bind water on the surface of the stratum corneum by forming an occlusive hydrophilic layer and can improve the condition of the epidermal barrier (Ratz-Lyko et al., 2016; Venesia et al., 2020).

Madecassoside in *Centella asiatica* increases AQP3 expression. Skin hydration increases as AQP3 facilitates water and glycerol transport. Increased expression of the two main components of the cornified envelope (LOR and IVL), as well as increased mRNA expression of filaggrin can improve skin barrier function and reduce TEWL (Ratz-Lyko et al., 2016; Venesia et al., 2020; Shen et al., 2019). Madecassoside can also increase 3 HA synthases (HAS1, HAS2, HAS3) and inhibit the formation of ROS, so both of these can increase the HA content in the dermis. Madecassoside can also reduce hyaluronidase (HYAL1, HYAL2, HYAL3), but not significantly (Ratz-Lyko et al., 2016; Venesia et al., 2020; Shen et al., 2019).

The decrease in skin pH values of the right and left lower legs in the *Centella asiatica* extract group was significantly greater than in the petrolatum group ($p < 0,05$). *Centella asiatica* has strong anti-inflammatory and antioxidant properties. Anti-inflammatory properties protect the skin from irritation and reduce dehydration of the skin (Sari et al., 2023). The active substances contained in *Centella asiatica* extract, especially saponins, flavonoids and phenolic acids, show antioxidant and anti-inflammatory activity, thereby reducing erythema and helping to improve skin barrier function (decrease in TEWL and skin pH values), which is associated with the rapid return of the skin to homeostasis after irritant exposure (Ratz-Lyko et al., 2016). Madecassoside, a specific component of *Centella asiatica* can reduce oxidative stress and reduce damage to mitochondria due to oxidative stress (increased MMP, and decreased Ca^{2+}) (Sun et al., 2022).

The decrease in ODS score of the right and left lower legs in the *Centella asiatica* extract group was significantly greater than in the petrolatum group ($p < 0,05$). *Centella asiatica* extract and petrolatum both improve skin barrier function and increase skin hydration, but in this study, it was found that 1% *Centella asiatica* extract was superior to petrolatum as a treatment for xerosis cutis in geriatrics (Ratz-Lyko et al., 2016; Kamrani et al., 2024).

Petrolatum is an occlusive moisturizer, where petrolatum works by forming a hydrophobic film and utilizing the high oil content in petrolatum itself. The use of petrolatum is less preferred because it often causes discomfort due to its sticky and oily consistency (Yulisa & Menaldi, 2023; Czarnowicki et al., 2016). *Centella asiatica* extract is a humectant moisturizer which works by attracting moisture from the surrounding environment and deeper layers of the skin, which is able to hydrate and repair the skin barrier without causing complaints of stickiness and oily.

CONCLUSION

The study demonstrated that topical *Centella asiatica* extract is significantly more effective than petrolatum in enhancing skin moisture and restoring barrier function in elderly patients with *xerosis cutis*, as shown by improvements in Transepidermal Water Loss (TEWL), skin pH, and Overall Dry Skin (ODS) scores—key indicators of skin health. While petrolatum remains a common treatment, it did not yield the same level of moisture retention or barrier restoration as *Centella asiatica*, underscoring the extract’s superior benefits for older adults with dry skin conditions. To build on these findings, future research should investigate the long-term efficacy and safety of *Centella asiatica* in managing *xerosis cutis*, including studies with larger and more diverse populations and across different severities of the condition, to better understand its sustained benefits and applicability in broader clinical settings.

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