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**Original Article**

# The beneficial effect of Aloe vera in skin barrier function improvement: A double-blind randomized trial of Madurese batik craftswomen

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## Abstract

***Background*** Exposure to chemicals in batik process increases the risk of skin barrier disruption in batik craftswomen.

***Methods*** In the control group, the stratum corneum hydration was significantly increased at the evaluation of the 2nd week (P=0.045; CI 95%) and the 4th week (P=0.010; CI 95%). In the experimental group there was a significant decrease in TEWL value at the 2nd week evaluation (P=0.004; CI 95%), a significant increase in stratum corneum hydration at the 2nd week (P <0.001; CI 95%) and 4th week evaluation (P<0.001; CI 95%), and significant skin pH at 4th week (P=0.014; CI 95%).

***Results*** In the control group, the stratum corneum hydration was significantly increased at the evaluation of the 2nd week and the 4th week. In the experimental group there was a significant decrease in TEWL value at the 2nd week evaluation, a significant increase in stratum corneum hydration at the 2nd week and 4th week evaluation, and significant skin pH at 4th week.

***Conclusion*** Aloe vera benefits in improving the physiological function of the skin in Madurese batik craftswomen.

***Key words***
Aloe vera, batik worker, ceramide, healthy lifestyle, skin hydration.

## Introduction

Batik, is a visual art, part of traditional cloth from Indonesia. It has been recognized by UNESCO as masterpiece of the oral and intangible heritage of humanity from Indonesia in 2009. Since then, the development of the batik industry has been very promising as public interest on it escalated. There are many centres of batik in various regions all over Indonesia with their own unique characteristics. One that also shows rapid development is the Madurese batik craft on the Madura Island, which is typical with its exotic, bold, and dynamic colours. Paseseh Village in Bangkalan district is a well-known regional center for Madurese batik crafts.[1-3]

The process of hand writing batik creation goes through three phases, which are repeated based on the details of the batik design. Hand writing batik is created in three phases, These stages are writing the patterns using canting, batik wax, and dyes, continue with coloring or dyeing

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process, then drying.[4,5] This process involved both natural and synthetic dyes, which can be irritants or allergens.[4] Synthetic dyes in the batik process contain harmful pollutants such as heavy metals, suspended solids, or organic substances. The skin is the first exposed organ, so it is susceptible to the harmful effect of the dyes. Impairment of skin barrier function or even worse skin inflammation is likely to be experienced by batik workers, especially on the hand. According to one study, contact dermatitis is the most frequent occupational complaint among Jogja batik workers. Exposure to dyes disrupt the physiological barrier of the skin, which makes the skin vulnerable to irritants exposure.[6,7]

Moisturizers have been shown to increase the skin's barrier properties and protect it from exposure to chemicals. Aloe vera is an Indonesian native plant that is considered to have a hydrating function that strengthens the skin barrier and reduces the risk of dermatitis due to contact with irritant or allergen substances. Aloe vera contains mucopolysaccharides and other substances that help bind the moisture into the skin. The use of Aloe vera as a moisturizer to prevent occupational contact dermatitis has not much published to date.[8] This study aims to explore the effect of Aloe vera in improving skin barrier function and prevent contact dermatitis among batik workers in Madura Island, Indonesia.

## Methods

This study was a double-blind randomized trial, comparing the experiment group and the control group. This research involved 30 batik craftswomen of Paseseh center for batik crafts, in Bangkalan Regency of Madura Island, 2 hours away from East java capital city Surabaya. This study's inclusion criteria were batik craftswoman aged 15 to 50 years and willing to participate in the study. Craftswoman with current dermatitis and systemic illness were not allowed to participate in this study. Subjects who met the criteria were then randomly divided into 2 groups, 15 people in the control groups received ceramide cream, and 15 people in the experiment groups received ceramide +2% Aloe vera formula. The formulation and labeling process of the control and experiment creams were carried out by Paragon manufactory. Both the subject and the researcher did not know the contents of the experimental cream received by each group. Each subject was given the cream and asked to apply it to the hands and arms twice daily. Evaluation of skin physiological function was performed using a Courage Khazaka® Cutometer MP-580 that consist of Tewameter to assess transepidermal water loss (TEWL), Corneometer to assess stratum corneum hydration levels, and pHmeter to assess skin acidity (pH). The evaluation was performed thrice during the study. The first evaluation was before experiment as the baseline value, the second evaluation was after 2 weeks of experiment, and the last evaluation was at the end of 4 weeks of experiment. The ethical committee of Dr. Soetomo General Academic Hospital Surabaya assessed and approved this study.

## Results

A total of 30 batik workers included in this study were female between 15 to 50 years old. The mean age of the subjects in the two groups was not significantly different. Mean age in control group was 34,8 years old, and 34,13 years old in experiment group. All included subjects worked on the hand writing process using canting, batik wax, and dye. They did the batik work for three to four hours almost every day. The baseline physiological condition of the skin as seen from the TEWL levels, hydration of stratum corneum, and acidity of the skin showed no significant difference among two groups **(Table 1)**.

**Table 1** Baseline value of control and experimental group.

| | *Control group Mean±SD* | *Experimental group Mean±SD* | *P value* |
|---|---|---|---|
| Age (years old) | 34,8±9,70 | 34,13±10,56 | 0, 858 |
| Baseline TEWL palmar | 58,20±13,25 | 60,50±12,27 | 0, 625 |
| Baseline Corneometer palmar | 48,39±20,02 | 46,91±18,03 | 0,833 |
| Baseline pH palmar | 5,44±0,15 | 5,43±0,24 | 0,868 |

TEWL= *trans epidermal water loss,* SD=Standard Deviation, CI= 95%.

**Table 2** The comparison of skin function after the application of control and experimental group.

| | *Control group Mean±SD* | *P value* | *Experimental group Mean±SD* | *P value* |
|---|---|---|---|---|
| TEWL palmar week 2 | 51.27±12.16 | 0.069 | 54.48±12.02 | 0.004 |
| TEWL palmar week 4 | 52.84±9.34 | 0.091 | 56.24±15.03 | 0.196 |
| Corneometer palmar week 2 | 60.10±25.36 | 0.045 | 72.23±23.83 | 0.000 |
| Corneometer palmar week 4 | 61.63±18.49 | 0.010 | 68.43±20.68 | 0.000 |
| Ph palmar week 2 | 5.39±0.12 | 0.170 | 5.44±0.17 | 0.853 |
| Ph palmar week 4 | 9.86±16.99 | 0.331 | 5.68±0.23 | 0.014 |

TEWL= *trans epidermal water loss,* SD=Standard Deviation, CI=95%.

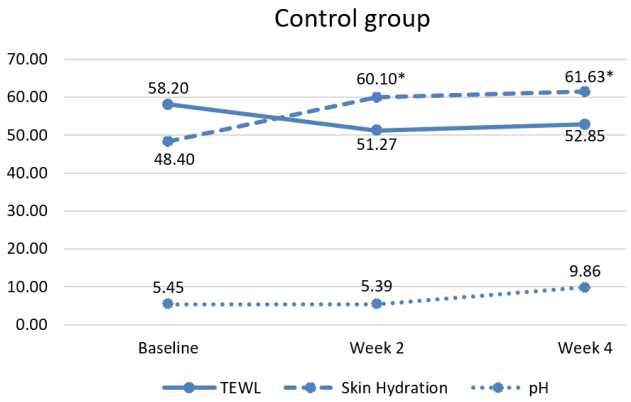


**Figure 1** Skin function evaluation in control group. TEWL: trans epidermal water loss, pH: acidity, *: statistically significant.

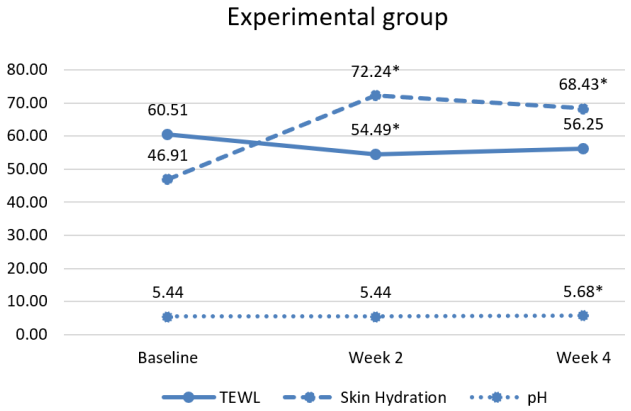


**Figure 2.** Skin function evaluation in experimental group. TEWL: trans epidermal water loss, pH: acidity, *: statistically significant.

**Table 2** and **Figure 1** showed the control group evaluation after experiment. There was no significant decrease in the mean TEWL at the 2nd week evaluation (P=0.069; CI 95%) and at the end of 4th week (P=0.091; CI 95%). The value of stratum corneum hydration level increased significantly both at the 2nd week evaluation (P=0.045; CI 95%) and 4th week (P=0.010; CI 95%), while the level of skin acidity (pH) appeared not significantly increased at the 2nd week evaluation (P=0.170; CI 95%) and 4th week (P=0.331; CI 95%).

Evaluation of experimental group was showed in **Table 2** and **Figure 2**. The mean TEWL at the 2nd week evaluation were significantly decreased (P=0.004; CI 95%), while at the 4th week evaluation it decreased insignificantly compared to the baseline (P=0.196; CI 95%). Compared to the baseline, the mean stratum corneum hydration level was significantly increase at the both 2nd week (P<0.001; CI 95%) and 4th week evaluation (P<0.001; CI 95%). Result of 2nd week evaluation showed no significant escalation of the skin acidity (P=0.853; CI 95%), while at the 4th week evaluation it increased significantly (P=0.014; CI 95%). while at the 4th week evaluation it increased significantly

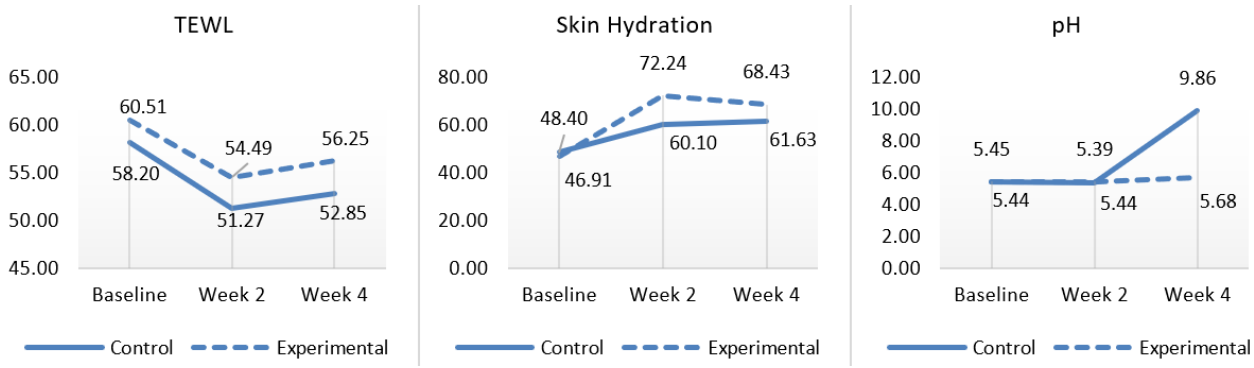


**Figure 3** The comparison of transepidermal waterloss (TEWL), skin hydration, and skin acidity (pH) after treatment of control and experimental group.

(P=0.014; CI 95%).

The comparison between control and experimental groups was seen in the **Figure 3**. The TEWL on both groups were decreased with not significant difference between the groups at 2nd week (P=0.473; CI 95%) and 4th week evaluation (P=0.464; CI 95%). The stratum corneum hydration increased on both groups at 2nd week and 4th week evaluation, with higher value on experimental group. The means difference between groups were not statistically significant (P=0.188; CI 95%), and (P=0.351; CI 95%). Changes in skin pH observed in the two groups were not significantly different at the 2nd week (P=0.322; CI 95%) and 4th week evaluation (P=0.357; CI 95%).

## Discussion

Madura island is famous with its *kasaran* (rough) batik. Farming and fishing society of Madurese inspiring its batik design.[1] Its bright colour and special pattern has high philosophy and reflects Madurese character itself.[3] Majority of batik worker in Madura Island are women, especially they who work on the hand drawing process. In this coastal village of Madura, batik drawing is a skill that is traditionally passed from mother to daughter. This is done to spend time while the men sail to fish. Since the development of the batik industry in Indonesia, this activity can also contribute to family income.[9]

Batik craftswomen draw the batik pattern on a piece of cloth by hand using melted wax, dyes, and a tool called canting. This process allows their bare hands to be exposed to the chemical substances contained in the wax and dye.[9] It has the potential to trigger contact dermatitis reactions or disrupt the skin barrier. The materials used in batik process, including batik wax which made from coconut oil, honeycomb, animal fat, and paraffin, are said to have the potential to be a triggering factor for contact dermatitis.[10,11] Wijayanti, et al showed that there was a significant relationship between exposure to batik dyes and the incidence of irritant contact dermatitis in batik workers in Surakarta.[12] Febriana et al. found that 7 out of 9 batik workers in Yogyakarta who were patch tested had positive reaction to at least one allergen used in batik process.[13] Batik workers in Indonesia are likely to be exposed to some sensitizing materials that can cause disruption of the skin barrier as indicated by increased TEWL, decreased of stratum corneum hydration level, and decreased skin acidity.[13-15]

One of the efforts to prevent occupational contact dermatitis is the use of moisturizers. When the skin barrier is disrupted, the water content in the stratum corneum will decrease.[16,17]

Moisturizers improve the skin barrier, increase skin hydration, and increase the water content of the stratum corneum. Improving skin barrier means protecting the skin from exposure to irritants and allergens from the environment. In addition, moisturizers also increase the smoothness and softness of the skin and improve the appearance of the skin. Based on its mechanism of action, moisturizers are divided into humectants, occlusives, and emollients.[14,18,19]

In this study, each intervention showed the effect of improving the physiological condition of the skin. All skin function parameters in the ceramide group improved, but only the stratum corneum hydration level was statistically significant. Ceramide is one of the ingredients of the lipid bilayer structure that makes up the skin barrier, in addition of cholesterol and fatty acid. Moisturizers that work by filling the structure are known as emollients.[20,21] TEWL and stratum corneum hydration, as well as skin acidity, were significantly improved in the Aloe vera group. Mustifah et al. showed that the use of moisturizer containing Aloe vera or ceramide for 2 weeks can reduce TEWL and improve skin hydration.[17]

Aloe vera belongs to the Asphodelaceae family. This plant has been widely used traditionally in indigenous systems of medicine such as Ayurveda, Siddha, Unani, and Homeopathy. Various studies have revealed that Aloe vera leaves have various therapeutic effects.[11] Many of the health benefits of aloe vera is associated with a polysaccharide contained in its leaf gel.[8] Aloe vera gel can be used as a moisturizer because the water content is more than 90%. In addition to its water content, Aloe vera also contains mucopolysaccharides, amino acids, lipids, sterols, and vitamins.[22] Aloe vera improve skin moisture with a humectant mechanism, which absorbs water from the environment to skin and from dermis to epidermis.[23]

The improvement in skin function after therapy in the Aloe vera group, compared to the ceramide group, appeared to be better but not statistically significant. As standard therapy, of course, it is easily accepted that ceramides will improve the stratum corneum hydration level.[20] The addition of Aloe vera to a moisturizing cream formulation enhances the repair effect on the skin function. Azizi et al. stated that Aloe vera is effective for increasing skin hydration and improving skin barrier function. The humectant mechanism of Aloe vera complements the mechanism of the ceramide emollient as a moisturizer. This mechanism can shield batik craftswomen from batik dye exposure and preventing contact dermatitis.[8,20,24]

## Conclusion

The use of Aloe vera as a moisturizer in batik worker is beneficial for improving the physiological function of the skin. Study with a larger sample size can be done to show more of these effects.

## References

1. Tresnadi C, Sachari A. Identification of Values of Ornaments in Indonesian Batik in Visual Content of Nitiki Game. J Arts Humanit. 2015;4(8):25–39.
2. Iswara H, Yahya LR., Moeis X. Batik pesisir pusaka Indonesia koleksi Hartono Sumarsono. Jakarta: Kepustakaan Populer Gramedia; 2011.
3. Umam K, Barakbah AR, Basuki A. Semantic Madurese Batik Search with Cultural Computing of Symbolic Impression Extraction and Analytical Aggregation of Color,Shape and Area Features. Emit Int J Eng Technol. 2017;5(1):72–90.
4. Soebaryo R. Batik Manufacturing Workers. In: Rusmeyer T, Elsner P, John S, Maibach H, editors. Kanerva's Occupational Dermatology. 2nd ed. Springer; 2012. p. 1289–95.

5. Pramitasari R, Hartini E. Muskuloskeletal Pain of "Batik Tulis" (Writing) Women Worker in Berkah Lestari Batik, Bantul using Nordic Body Map and Physical Assesment. 6th Asian Acad Soc Int Conf [Internet]. 2018;(1):79–85. Available from: http://aasic.org/proc/aasic/article/view/342
6. Young E, Andersen KE, Bruze M, et al. Twenty-eight-day follow-up of patch test reactions to p-phenylenediamine and p-phenylenediamine dihydrochloride: A multicentre study on behalf of the European Environmental and Contact Dermatitis Research Group. Contact Dermatitis. 2019;81(1):1–8.
7. Pinheiro RR, Borges AS, Brasileiro A. Textile allergic contact dermatitis caused by occupational exposure—An overlooked condition. Contact Dermatitis. 2018;1–2.
8. Manvitha K, Bidya B. Aloe vera: a wonder plant its history, cultivation and medicinal uses Karkala. J Pharmacogn Phytochem. 2014;2(5):85–8.
9. Djojo RK. Batik Madura, uniquely crafted by women [Internet]. 2013 [cited 2021 Jul 1]. Available from: https://www.thejakartapost.com/news/2013/05/06/batik-madura-uniquely-crafted-women.html
10. Malinauskiene L, Bruze M, Ryberg K, et al. Contact allergy from disperse dyes in textiles: a review. Contact Dermatitis [Internet]. 2012 Feb;68(2):65–75. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23289879
11. Feily A, Namazi MR. Aloe vera in dermatology: a brief review. G Ital Dermatol Venereol [Internet]. 2009 Feb;144(1):85–91. Available from: http://www.ncbi.nlm.nih.gov/pubmed/19218914
12. Wijayanti R, Sumardiyono S. Pengaruh Paparan Zat Pewarna Batik Terhadap Kejadian Dermatitis Kontak Iritan Pada Pekerja Batik Di Surakarta. J Bakti Masy Indones. 2019;2(1):58–63.
13. Febriana SA, Ridora Y, Indrastuti N, et al. Occupationally relevant positive patch test reactions in Indonesian batik workers. Contact Dermatitis [Internet]. 2020 Jun;82(6):387–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/32112423
14. Agner T. Skin Barrier Function. In: Current problems in dermatology. Basel, Schweiz: Karger; 2016.
15. Damayanti, Umborowati MA, Anggraeni S, Prakoeswa CRS. The Role of Aloe vera and Centella asiatica to the Improvement of Skin Barrier Function in Indonesian Batik Workers. Indian J Forensic Med Toxicol. 2021;15(3):2805–11.
16. Papadatou Z, Cooper K, Klein S, et al. Effectiveness of interventions for preventing occupational irritant hand dermatitis: a quantitative systematic review protocol. JBI database Syst Rev Implement reports [Internet]. 2016 Jun;14(10):72–81. Available from: http://www.ncbi.nlm.nih.gov/pubmed/27846117
17. Mustifah EF, Dewi SR, Hastuti R, Kariosentono H. Perbandingan Fungsi Barrier Kulit Pasien Dermatitis Atopik antara Krim Aloe Vera dan Krim Seramid : Penelitian Awal. Cermin Dunia Kedokt. 2018;45(8):571–5.
18. Purnamawati S, Indrastuti N, Danarti R, Saefudin T. The role of moisturizers in addressing various kinds of dermatitis: A review. Clin Med Res. 2017;15(3–4):75–87.
19. Lee C, Bajor J, Moaddel T, et al. Principles of Moisturizer Product Design. J Drugs Dermatol [Internet]. 2019;18(1s):s89-95. Available from: http://www.ncbi.nlm.nih.gov/pubmed/30681817
20. Jungersted JM, Agner T. Eczema and ceramides: an update. Contact Dermatitis [Internet]. 2013 Aug;69(2):65–71. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23869725
21. Spada F, Barnes TM, Greive KA. Skin hydration is significantly increased by a cream formulated to mimic the skin's own natural moisturizing systems. Clin Cosmet Investig Dermatol. 2018;11:491–7.
22. Khoirini F. Peran Gel Lidah Buaya Dalam Mengurangi Xerosis. J Media Kesehat. 2016;9(1):72–7.
23. Fox LT, Plessis J du, Gerber M, Zyl S van, et al. In Vivo skin hydration and anti-erythema effects of Aloe vera, Aloe ferox and Aloe marlothii gel materials after single and multiple applications. Pharmacogn Mag. 2014;10(38):392–403.
24. Azizi W, Azad AK, Ahmad NA, Sunzida NK. Clinical Efficacy of Aloe Vera Based

Products Available in The Market As Skin Moisturiser Measured By TEWL Value and Skin Hydration Level By Using Dermalab Technology. PharmacologyOnLine. 2016;2:42–9.