The Role of *Aloe vera* and *Centella asiatica* to the Improvement of Skin Barrier Function in Indonesian Batik Workers

Damayanti[1,2], Menul Ayu Umborowati[2], Sylvia Anggraeni[2], Cita Rosita Sigit Prakoeswa[3]

[1]Doctor, [2]Researcher, [3]Professor, Department of Dermatology and Venereology, Faculty of Medicine Universitas Airlangga/ Dr. Soetomo General Academic Hospital, Surabaya, Indonesia

Abstract

Background: The batik industry uses dyes and candles, that can disrupt the skin barrier function and may precipitate skin disease.

Objective: To determine the role of *Aloe vera* and *Centella asiatica* to the improvement of the skin barrier function in Indonesian batik workers

Methods: This was a double blind clinical trial of 30 Indonesian batik workers were divided into 2 group and given *Aloe vera* or *Centella asiatica* topical randomly was applied twice a day. Transepidermal water loss (TEWL) level, stratum corneum hydration level, and pH level, were examined using Cutometer dual MP-580.

Result: Sensitivity (Sn) of new local compared with imported allergen extracts in this study was between 15.38%-84.61%, the highest point was house dust mite extract. Specificity (Sp) was ranged from 81.48%-93.75%, the highest rank was shrimp extract. Compared with IgE results, the Sn of new local and imported house dust mite extracts was good (85.7%; 92.9%). The Sp was good for egg white and cow's milk new local extracts (86.4%; 84.4%).

Conclusion: *Aloe vera* topical gave significant improvement on palm area of TEWL level (P=0.033; CI 95%), stratum corneum hydration (P=0.000; CI 95%), and pH level (P=0.004; CI 95%); while on dorsal hand area of stratum corneum hydration (P=0.002; CI 95%). *Centella asiatica* topical gave significant improvement on palm area of stratum corneum hydration (P=0.007; CI 95%); while on dorsal hand area of stratum corneum hydration (P=0.001; CI 95%) and pH level (P=0.17; CI 95%). No significant differences of *Aloe vera* compared to *Centella asiatica* in the improvement of skin barrier function.

Keyword: *Aloe vera, Centella asiatica, skin barrier function, Indonesian batik worker.*

Introduction

Batik was declared as Masterpieces of the Oral and Intangible Heritage of Humanity by UNESCO on October 2, 2009. Madura located adjacent to Java, is an area known for hosting quite a lot of home batik centers. One of them is in Bangkalan Regency, to be precise the Paseseh Village in Tanjung Bumi District. Tanjung Bumi batik is one of the most famous batik, not only in Indonesia but also in abroad. Tanjung Bumi batik has many beautiful colours, from natural colours until synthetic colours batik design. They still apply the traditional way in batik coluring steps, that increase the possibility of skin contact with batik candles, dyes and other batik industry agents.[1]

Nowadays, the use of natural dyes has decreased. The synthetic dyes is more easier to get, so that the use of it has increased. The increasing use of synthetic dyes increases exposure to harmful pollutants or allergens, such as heavy metals, suspended solids, or organic substances. The batik workers' skin are exposed to these agents almost everyday, especially for those who work in batik colouring steps. Textile and skin may direct contact can causes reactions, even damage or disease. Skin exposure to these agents may cause contact dermatitis,

and also disrupt the physiological condition of the skin, which in turn makes the skin more susceptible to skin disease. All of these condition may affect in quality of life of the batik workers.[1–4]

The prevalence of occupational contact dermatitis is vary among countries. In the developed countries, there were 50 – 190 cases per 100.000 workers per year; contact dermatitis was 90 to 95% among all occupational diseases. There were 97% of 389 cases of occupational disease is contact dermatitis in Indonesia; consist of farmers, hair dresser, construction workers, textile workers, and also batik industry workers. The report from batik industry in Lawean, Central Java, there were 58.6% of 70 batik industry workers who suffered from occupational contact dermatitis.[3,5]

The use of moisturizers is known to improve the physiological condition of the skin. Good skin barrier function will be able to prevent and improve the skin conditions that are affected by many agents in batik industry. *Aloe vera* and *Centella asiatica* are known as active substances that can be used in moisturizing products. *Aloe vera* is also used as an active substances, contains mucopolysaccharides which help bind the moisture to the skin. Amino acids can also soften the hardened skin cells and zinc, which acts as an astringent to tighten pores. *Aloe vera* has a moisturizing effect that is widely used in the treatment of dry skin associated with work-related exposures. *Aloe vera* provides a cooling effect and also acts as a moisturizing agent[6]. *Centella asiatica* is one of the active substances used for intervention in batik, has been shown to have an antioxidant effect through its active components. *Centella asiatica* contains oleanane-type pentacycloc triterpenoid saponins which can be called centelloids. These active components can act as antioxidants that are relevant to protect the skin from the effects of free radical.[7,8]

There were still minimal data about using *Aloe vera* and *Centella asiatica* in Indonesian batik workers, especially in Tanjung Bumi, Bangkalan. *Aloe vera* and *Centella asiatica* extracts are known as active substances that can be used in moisturizing products. The aim of this study was to determine the role of *Aloe vera* and *Centella asiatica* to the improvement of the skin barrier function in Indonesian batik workers.

Methods

This was a double blind clinical trial of 30 Indonesian batik workers who suffered from skin dryness, but had no clinical manifestation of contact dermatitis. The study was held at Paseseh Village, Tanjung Bumi Subdistrict, Bangkalan Madura Regency, Indonesia. The inclusion criteria of the study were batik workers aged 15 to 50 years old, work specialty in batik colouring steps, suffered from skin dryness and willing to join the study. Subjects who suffered from contact dermatitis and other skin disease or systemic disease were excluded. Diagnosis of skin dryness and contact dermatitis were established by dermatologists through anamnesis and clinical examination. Subjects were divided into 2 group and given cream contained *Aloe vera* or *Centella asiatica* randomly. Both subjects and researchers were blinded to the type of cream. The cream was applied to the hands and arms twice a day. Transepidermal water loss (TEWL) level, stratum corneum hydration level, and skin acidity level that were expressed the skin barrier function, were examined using Cutometer dual MP-580.

Tewameter is used to assess evaluation in skin barrier function by TEWL. A microprocessor measures the values. The flux density of water is expressed in grams according to gram per square meter per an hour (g/m2/h). Transepidermal water loss (TEWL) level, stratum corneum hydration level, and skin acidity level were performed in 20 to 22°C room temperature and 40 to 60% room moisture. These evaluation were performed by placed the probe perpendicularly without skin pressure, in horizontal position. The evaluation of each variable was performed 3 times. The time needed in each evaluation was 30 seconds. The probe was moved by lifted up and placed the prove vertically to minimize the condensation.[9]

The baseline data was recorded in the first examination, followed by second and third examinations at 2 and 4 weeks of treatment. The data was collected and analyzed by repeated measure Annova. This study was approved by ethical committee of Dr. Soetomo General Academic Hospital, Surabaya, Indonesia No 1678/KEPK/XI/2019.

Results

The study included 30 participants of batik industry

workers with work specialty in batik colouring steps (dipping). All subjects were female, aged 15 to 50 years old, suffered from skin dryness but has no clinical manifestation of contact dermatitis, other skin disease or systemic disease. The baseline data of skin barrier function was recorded in the first examination, in both dorsal hand area and palm area. The mean of TEWL level after *Aloe vera* cream and *Centella asiatia* cream on palm area were 60.52 and 60.91; while on dorsal hand area were 28.41 and 28.80. The stratum corneum hydration after *Aloe vera* cream and *Centella asiatia* cream on palm area were 43.73 and 41.79; while on dorsal hand area were 47.44 and 47.12. The pH level after *Aloe vera* cream and *Centella asiatia* cream on palm area were 5.44 and 5.46; while on dorsal hand area were 5.13 and 5.35.

Table 1. Evaluation of skin barrier function after the application of *Aloe vera* cream.

Skin barrier function after the application of Aloe vera cream	Week I		Week II		Week IV		P
	Mean	±SD	Mean	±SD	Mean	±SD	
TEWL level on palm	60.52	12.26	54.15	11.82	55.29	13.79	0.102
Stratum corneum hydration on palm	43.73	18.44	69.46	26.04	65.88	21.49	0.000
pH level on palm	5.44	0.23	5.45	0.17	5.67	0.35	0.004
TEWL level on dorsal hand	28.41	13.01	36.55	13.10	26.32	9.71	0.033
Stratum corneum hydration on dorsal hand	47.44	9.11	74.65	22.51	58.98	19.10	0.002
pH level on dorsal hand	5.13	0.63	5.18	0.67	5.31	0.74	0.058

TEWL= transepidermal water loss

pH= acidity level

Table 2. Evaluation of skin barrier function after the application of *Centella asiatica* cream.

Skin barrier function after the application of Centella asiatica cream	Week I		Week II		Week IV		P
	Mean	±SD	Mean	±SD	Mean	±SD	
TEWL level on palm	60.91	10.82	55.75	10.00	56.42	8.48	0.260
Stratum corneum hydration on palm	51.79	19.52	66.51	24.13	62.88	29.70	0.007
pH level on palm	5.46	0.18	5.39	0.15	5.47	0.21	0.385
TEWL level on dorsal hand	28.80	14.00	35.40	11.63	29.73	9.80	0.056
Stratum corneum hydration on dorsal hand	47.12	21.18	76.63	32.77	58.90	25.61	0.001
pH level on dorsal hand	5.35	0.21	5.21	0.19	5.45	0.22	0.017

TEWL= transepidermal water loss

pH= acidity level

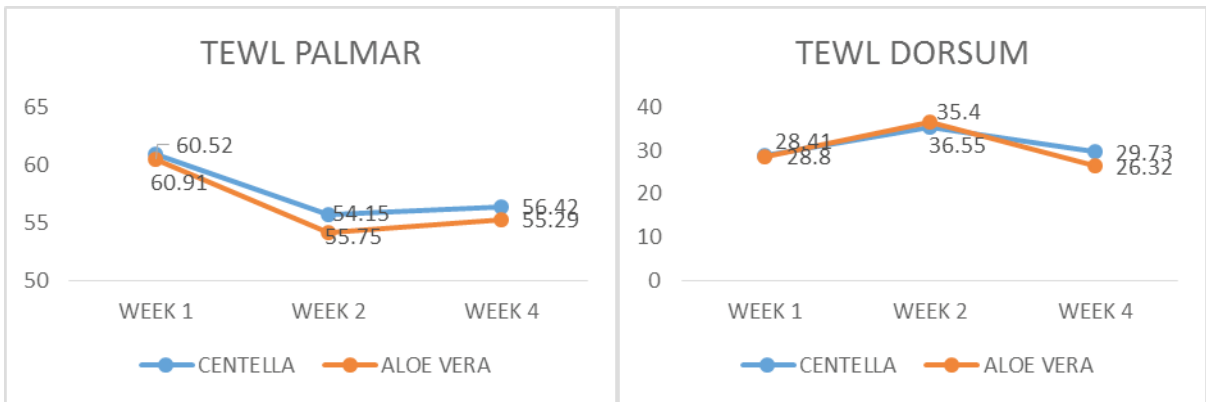
After 4 weeks of treatment, *Aloe vera* topical application gave significant improvement of TEWL level on palm area (*P*=0.033; CI 95%), stratum corneum hydration on palm area (*P*=0.000; CI 95%), stratum corneum hydration on dorsal hand area (*P*=0.002; CI 95%), and pH level on palm area (*P*=0.004; CI 95%) (Table 1). There were also significant improvement of *Centella asiatica* topical application in stratum corneum hydration on palm area (*P*=0.007; CI 95%), stratum corneum hydration on dorsal hand area (*P*=0.001; CI 95%), and pH level on dorsal hand area (*P*=0.17; CI 95%) (Table 2). There were no significant differences of *Aloe vera* effectiveness compared to *Centella asiatica* in the improvement of skin barrier function (*P*> 0.05; 95% CI) (Table 3). Graph 1, 2, and 3 showed TEWL level, stratum corneum hydration, and pH level after the application of *Aloe vera* and *Centella asiatica* cream in the first week, second week, and fourth week.

Table 3. Skin barrier function after the application of *Aloe vera* and *Centella asiatica* cream.

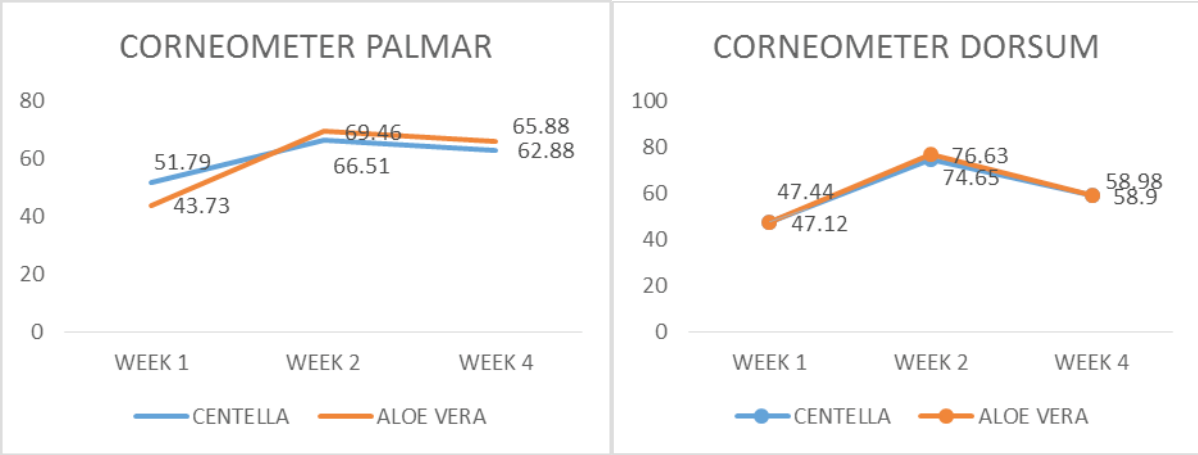
Skin barrier function	Centella asiatica		Aloe vera		P
	Mean	±SD	Mean	±SD	
TEWL level on palm	-4.48	13.14	-5.22	10.40	0.967
Stratum corneum hydration on palm	11.09	17.03	22.15	19.78	0.112
pH level on palm	0.01	0.27	0.23	0.33	0.054
TEWL level on dorsal hand	0.92	12.56	-2.09	11.40	0.496
Stratum corneum hydration on dorsal hand	11.78	18.75	11.54	17.96	0.868
pH level on dorsal hand	0.01	0.27	0.23	0.33	0.054

TEWL= transepidermal water loss

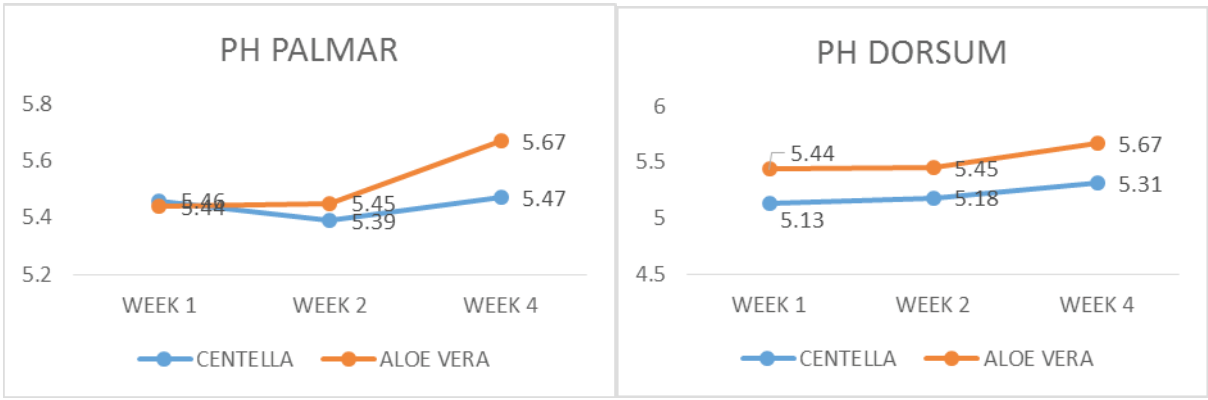
pH= acidity level



Graph 1: Graph of the first week, second week, and fourth week of TEWL level after application of *Aloe vera* and *Centella asiatica* cream.



Graph 2: Graph of the first week, second week, and fourth week of stratum corneum hydration after application of *Aloe vera* and *Centella asiatica* cream.



Graph 3: Graph of the first week, second week, and fourth week of pH level after application of *Aloe vera* and *Centella asiatica* cream.

Discussion

The exposure to chemical agents used in batik industry, especially in traditional batik production, gives potential risk to the incidence of skin barrier disturbance and contact dermatitis. The ingredient of batik candles such as coconut oil, bee hive, animal fat, paraffin; and the dyes used in batik industry, may increased the risk of contact dermatitis. This agents may increase TEWL level, decrease stratum corneum hydration, and decrease the acidity of the skin.[2,10,11]

Contact dermatitis may affect the quality of life of the patients. It may disturb the daily or working activity. Especially among the batik workers, contact dermatitis might affect the individual productivity. The use of moisturizers is known to improve the physiological condition of the skin and prevent contact dermatitis. [12] *Aloe vera* and *Centella asiatica* are commonly used as the ingredient in moisturizers.

After 4 weeks of treatment, *Aloe vera* topical application gave significant improvement of TEWL level, stratum corneum hydration, and pH level. Some literature mentioned the efficacy of moisturizer containing *Aloe vera* to improve the skin barrier function. Azizi et al showed that moisturizer containing *Aloe vera* increase the skin hydration.[13] Saraf et al showed that herbal moisturizers consist of germ oil, *Aloe vera* and olive oil, gave synergistic effect in producing skin hydration. It had been reported that *Aloe vera* extract improves skin hydration by humectant mechanism, and the addition of oil could form an occlusive layer on the skin and prevent loss of moisturizer.[14] The humectant increase the water content of stratum corneum, because the stratum corneum layer attract the water from the deeper skin layer and from the atmosphere. The humectant keep the water bound on the stratum corneum

layer. This mechanism cause the increasing of skin hydration level.[12, 13]

There were significant improvement of *Centella asiatica* topical application in stratum corneum hydration and pH level in this study. The TEWL level decreased after *Centella asiatica* topical application, but the improvement was not significant statistically. The amount of moisturizer applied on the skin by the subjects might be varied, that may affect the result of the test reading. Study of Lyko et al about formulation containing *Centella asiatica* twice daily showed uts efficacy in improving skin moisture by increasing the skin surface hydration and decreasing TEWL level in 25 healthy volunteers significantly (P<0.05). It also has anti-inflammatory properties, that was useful in dry and sensitive skin management.[7]

Centella asiatica has been used for hundreds years in Asian medicine, especially in dermatological condition. It exhibit a broad spectrum of therapeutic effect. The most important therapeutic effect are anti-inflammatory, anti-oxidant, anti-microbial and anti-carcinogenic activity. *Centella asiatica* has active compounds, including pentacyclic triterpenes, mainly asiaticoside, madecassoside, asiatic and madecassic acids. The important ingredient in *Centella asiatica* is triterpenoid saponins, known as centelloids. *Centella asiatica* promotes fibroblast proliferation, collagen synthesis, intracelullar fibronectin content synthesis, and improve the tensile strength of newly formed skin. The anti-inflammatory effect of *Centella asiatica* are related to saponins ability to inhibit cyclooxygenase, phospholipase, and lipooxygenase activity; and saponins ability to inhibit pro-inflammatory cytokine.[8, 15, 16, 17]

Conclusion

This study showed that *Aloe vera* and *Centella asiatica*, as moisturizers improve the skin barrier function by decreasing TEWL level, increasing stratum corneum hydration, and increasing skin acidity, on daily use in batik workers. The skin barrier improvement after *Aloe vera* and *Centella asiatica* topical application may decrease the incidence of contact dermatitis in batik workers.

Acknowledgement: We gratefully thank PT Paragon Technology and Innovation, Dr Soetomo General Academic Hospital, Batik Zulpah Tanjungbumi, and other parties that supported this research.

Ethical Clearance: Taken from Ethical Committee of Dr Soetomo Academic General Hospital Surabaya Indonesia (1678/KEPK/IX/2019).

Funding Sources: PT Paragon Technology and Innovation & Dr Soetomo General Academic

Conflict of Interest: There is no conflict of interest

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. doi:10.18533/journal.v4i8.797
2. 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. doi:10.1111/cod.13235
3. Ramos Pinheiro R, Borges AS, Brasileiro A. Textile allergic contact dermatitis caused by occupational exposure-An overlooked condition. *Contact Dermatitis*. 2018;79(5):323-324. doi:10.1111/cod.13080
4. Zhong W, Xing MMQ, Pan N, Maibach HI. Textiles and human skin, microclimate, cutaneous reactions: An overview. *Cutan Ocul Toxicol*. 2006;25(1):23-39. doi:10.1080/15569520500536600
5. Johansen JD, Aalto-Korte K, Agner T, et al. European Society of Contact Dermatitis guideline for diagnostic patch testing - Recommendations on best practice. *Contact Dermatitis*. 2015;73(4):195-221. doi:10.1111/cod.12432
6. Manvitha K, Bidya B. Aloe vera: a wonder plant its history, cultivation and medicinal uses. *undefined*. Published online 2014.
7. Ratz-Lyko A, Arct J, Pytkowska K. Moisturizing and antiinflammatory properties of cosmetic formulations containing Centella asiatica extract. *Indian J Pharm Sci*. 2016;78(1):27-33. doi:10.4103/0250-474X.180247
8. James JT, Dubery IA. Pentacyclic triterpenoids from the medicinal herb, Centella asiatica (L.) Urban. *Molecules*. 2009;14(10):3922-3941.

doi:10.3390/molecules14103922

9. Gardien KLM, Baas DC, de Vet HCW, Middelkoop E. Transepidermal water loss measured with the Tewameter TM300 in burn scars. *Burns*. 2016;42(7):1455-1462. doi:10.1016/j.burns.2016.04.018
10. Malinauskiene L, Bruze M, Ryberg K, Zimerson E, Isaksson M. Contact allergy from disperse dyes in textiles-a review. *Contact Dermatitis*. 2013;68(2):65-75. doi:10.1111/cod.12001
11. Feily A, Namazi MR. Aloe vera in dermatology: A brief review. *G Ital di Dermatologia e Venereol*. 2009;144(1):85-91. Accessed November 18, 2020. https://europepmc.org/article/med/19218914
12. Turrentine JE, Sheehan MP, Cruz PD. Allergic Contact Dermatitis. In: Kang S, Amagai M, Bruckner AL, et al., eds. *Fitzpatrick's Dermatology*. 9th ed. New York : McGraw-Hill Education; 2019:395-413.
13. (PDF) 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. Accessed November 18, 2020. https://www.researchgate.net/publication/308098195_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
14. Saraf S, Sahu S, Kaur CD, Saraf S. Comparative measurement of hydration effects of herbal moisturizers. *Pharmacognosy Res*. 2010;2(3):146-151. doi:10.4103/0974-8490.65508
15. George M, Joseph L, Ramaswamy. Anti-allergic, anti-pruritic, and anti-inflammatory activities of Centella asiatica extracts. *African J Tradit Complement Altern Med*. 2009;6(4):554-559. doi:10.4314/ajtcam.v6i4.57206
16. Bylka W, Znajdek-Awizeń P, Studzińska-Sroka E, Brzezińska M. Centella asiatica in cosmetology. *Postep Dermatologii i Alergol*. 2013;30(1):46-49. doi:10.5114/pdia.2013.33378
17. Bylka W, Znajdek-Awiżeń P, Studzińska-Sroka E, Dańczak-Pazdrowska A, Brzezińska M. *Centella asiatica* in Dermatology: An Overview. *Phyther Res*. 2014;28(8):1117-1124. doi:10.1002/ptr.5110