

## 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

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### Abstract

This study was conducted to evaluate the efficacy of Aloe Vera as skin moisturizer as measured by Trans Epidermal Water Loss (TEWL) and hydration value. The Dermalab<sup>®</sup>Combo was used to determine the efficacy of skin cosmetic products. Fifteen subjects were divided into three groups where each group was tested with one type of moisturizer product available in the local market. The TEWL and Hydration level of the subjects were measured before they were treated with the products as the baseline reading and after 3 weeks applying the products twice daily on the left forearm. The TEWL and Hydration levels were increased after 3 weeks for both side but the percentage increment of TEWL on the test side was lower than control side. Meanwhile, the percentage increment of Hydration level was higher on the test side compare to the control side. From the results, it is clear that Aloe Vera is effective for skin care treatment. In conclusion, it can be used as ingredient to improve skin barrier function for different skin care products formulations.

**Keywords:** Transepidermal Water Loss, Dermalab, Hydration, Moisture, Aloe Vera.

## Introduction

There are many natural extracts like plant extract, herbal extract, animal extract and yeast extract [1-4] that can be used as the active ingredients in cosmetic products [5-7]. Natural phytochemicals have been reported to possess a wide range of biological activities [8-9]. Dry skin, or Xerosis, is a common condition experienced by most people and it becomes more prevalent with increasing age [10]. There are lots of moisturizers available to treat and improve symptom of xerosis and it can be categorized into emollients, occlusive and humectant. Emollients will soften and smooth the skin; occlusive provides a barrier that sits on the surface of the skin and prevents transepidermal water loss; and humectants, which bind and hold water in the stratum corneum. [11]

Aloe vera has a good moisturizing effect and can be used as a complement in the treatment of dry skin. Aloe vera based products has been using widely nowadays especially in cosmetic products. The constituents of aloevera especially mucopolysaccharides make it beneficial to be used especially in dermatological aspects[12]. The inner parenchymal cell which is a colorless aloe gel, is important as it consist more than 75 active ingredients including vitamins, minerals, enzymes, lipid, anthraquinones or phenolic compounds, sterols, lignin, amino acids, and salicylic acid. The main feature of Aloe leaf is their high water content. There is approximately  $97.42 \pm 0.13\%$  moisture contents in the aloe leaf.

Aloe Vera can improve skin moisture and hydration through humectant mechanism [13]. It can increase the water content of the stratum corneum by attracting water from the dermis below and keeping this water bounding the stratum corneum. In addition, the presence of mucopolysaccharide also helps to bind moisture which will make the skin moist [14]. This mechanism can increase the water content of the stratum corneum to improve skin hydration. There are many instrument available to analyse skin condition in vivo such as Laser Doppler imager, Chromameter, Corneometer, Skicon, Nova, and DermaLab [15]. These instruments are important to study the skin condition and to prove the efficacy of the skin cosmetic products before they were being marketed. Dermalab Combo instrument were used in this study. It was used to measure the Total Epidermal Water Loss (TEWL) value and also the skin hydration level to show the efficacy of the products in producing moisturising effect. TEWL is the rate at which water vapour is lost from the body across the skin and is based on

the measurement of the vapour pressure gradient between two points close to the skin. If the barrier is impaired, there is a corresponding increase in TEWL that directly relates to the degree of impairment and equally, there is a corresponding decrease in TEWL when the barrier is restored (12). The TEWL DermaLab consists of a probe connected to a data processing unit. The probe contains humidity 3(%) and temperature ( $^{\circ}\text{C}$ ) sensors. The probe was placed parallel onto the skin surface with the open chamber pointing towards the skin covering a measuring area of 10mm in diameter. The mean TEWL value was displayed after a sampling time of 60 seconds. The TEWL reading is expressed as the difference in  $\text{g}/\text{m}^2/\text{hr}$  within a range 0-250.

The DermaLab USB with hydration probe and module makes use of the conductance measurement principle, which is known to measure the water binding capacity of the stratum corneum. Two probe designs are available - a flat faced probe and a pin probe with eight pin electrodes. The flat faced probe is used for normal skin measurements, whereas the pin probe electrode design is for dry skin and scalp applications. Both probes have springloaded design in order to trigger the measurement at a present skin load. The hydration screen allows for performing up to eight sequential measurements, which can be named for ease of operation [16].

## Methods

Participants: 15 female volunteers or subjects within age range 20-23 years old were chosen to avoid the effect of age and gender on skin barrier function. Each subject would get one type of product to be applied on the left forearm.

Inclusion and Exclusion Criteria: About the idea of inclusion and exclusion criteria for participants or respondents was developed and followed by Azad, et al., (2012). The exclusion criteria were the presence of dermatitis or other skin or allergic diseases and a smoking habit. Volunteers were instructed not to apply any topical products such as sunscreens, moisturizers, and anti-aging formulations on the test sites for two weeks before and during the study. During the test period the subjects were allowed to wash normally, but did not use any other skin care products on their arms.

Name and ingredients of the products: Nivea Pure & Natural Moisturising Day Cream with Bio Argan Oil & Aloe Vera: Ingredients : Argania Spinosa Kernel Oil, Aloe Barbadensis Leaf Juice Tocopherol, Aqua, Glycerin, Alcohol Denat, Caprylic/ Capric Triglyceride, Cetearyl Alcohol, Hydrogenated Vegetable oil, Octyldodecanol, Glyceryl Stearate Citrate, Methyldiphenylmethane, Dicaprylyl Ether, Glyceryl Stearate Citrate, Propylene Glycol, Sodium Carbomer, Xanthan Gum, Methylisothiazolinone.

The Body Shop Aloe Soothing Day Cream:  
Ingredients : Aloe Barbadosis Gel,  
Isononylisononanoate, Glycerin, Water,  
Cyclomethicone, Pentylene Glycol, Butylene Glycol,  
Cetearyl Glucoside, Myristyl Myristate,  
Sesamum Indicum (Sesame) Seed Oil, Cetyl Alcohol,  
Myristyl Alcohol, Palmitic Acid, Stearic Acid,  
Cetearyl Alcohol, Myristyl Glucoside, Acrylates/C10-  
30 Alkyl Acrylate Crosspolymer, Bisabolol, Xanthan  
Gum, Avena Sativa (Oat) Kernel Flour  
Instrument: DermaLab® Combo Series by Cortex  
Technology

Study design: Three different products of aloe vera based cosmetic products available in the market were used and each product was tested on five participants. Informed consent were obtained from all subjects. During the test period nor in the three preceding days, they were not allowed to use any skin care products on their forearms.

The baseline reading of the TEWL and skin hydration level on control side (right forearm) and test side (left forearm) were taken on 11th April 2015 by using the Dermalab® Combo instrument. The measurements were taken in a sitting position with the forearm lying on a table. The shoulder should be adducted and the hand is kept in a position with the palm of the hand facing the table. Since touching the probe or moving the cables could influence the results, care should be taken of avoiding body movement during the measurements. The probes were attached to the main unit with two tubes in two different channel input connectors. The products were applied to the test site which is the left forearm of the volunteers. They needed to apply the moisturiser product to the test side twice daily, in the morning and in the evening. The right forearm would be the control site. The TEWL value and Hydration value after three weeks of product application which was on 4<sup>th</sup> May 2015 were measured and the results were recorded and analysed.

## Results

The purpose of the research project was to study the efficacy of aloe vera in different types of moisturising products available in the market. The results were categorised into two parameters which are TEWL value and skin hydration level.

The TEWL results of all the products as shown in Table 1, 2 and 3 stated that all the TEWL values were increased in both test and control side after three weeks of applying the moisturising cream. TEWL is defined as the measurement of the quantity of water loss from inside of the body

through the epidermal layer to the surrounding atmosphere via diffusion and evaporation processes. The lower the TEWL value means the higher the moisture contents in the skin. However, the TEWL result obtained in this study are unreliable because TEWL value should be decreased after moisturiser were applied [17]. This happened due to systemic error during the test. The error might occur because of the Instrumental and Environmental error during the test. The error might occur because of the Instrumental and Environmental error. The TEWL probe might be poorly calibrated. Besides, it might also due to the environmental factor such as temperature and humidity which would affect the moisture level in the environment and affect the TEWL reading [18]. For instance, in a study conducted by Flavio et al (2011) [19], prior to all measurements the subjects stayed in the testing room for at least 30 min in order to allow temperature ( $20^{\circ} \pm 2^{\circ}\text{C}$ ) and humidity (45-60%) adaptation [20]. During a study conducted by Steven S et al in 2005, the forearms were rested on a desk covered in a black cloth to avoid light reflection from surfaces, which could interfere with instrument readings [21]. Besides, during measurements the probe should be placed parallel onto the skin surface with the open chamber pointing towards the skin covering a measuring area of 10mm in diameter.

However, as can be seen in Figure 4, the results showed that the percentage increment of the TEWL value after applying the moisturiser on the test side is lower than the percentage increment of the TEWL value on the control side which make it still can prove the effectiveness of the moisturiser despite the results is not really reliable. On the other hand, hydration results of the subjects for all three moisturiser brands show increment as shown in Table 4, 5 and 6 as well as in Figure 1, 2 and 3. The percentage increments on the test side are much higher than the control side. This showed that aloe vera is effective to be used as the ingredient in moisturising cream to increase the hydration in the skin. Hence, the results of the study were interpreted and analysed based on the skin hydration level. The control side showed little increment of hydration level or reduction in the skin hydration.

When comparing results of the three moisturiser brands, it showed that Brand A (Nivea) has the lowest percentage increment in TEWL value and has the highest percentage increment of hydration value followed by Brand C (Body Shop) and Brand B (Safi); where the hydration level increased by 37.82%, 13.39% and 3.21% respectively.

These results showed that different aloe vera based

products had different efficacy in giving moisturising effect to the skin. This might be due to several factors. Some of the factors that might produce this different efficacy are their different formulation and the presence of other ingredients which also act as moisturiser.

### Discussion

All the products tested have aloe vera as the main ingredients for producing moisturising effects. However, they have different formulation and ingredients. Different formulation of moisturiser might produce different efficacy of the product. Furthermore, different ingredients and formulation also had different cost of production. Thus, it will make the price of the products different. In this study, the most costly product used is Brand C (Body Shop) with the price approximately RM70 followed by Brand A (Nivea) with price RM40 and the last one Brand B (Safi), RM9. Even though Body Shop is more expensive than Nivea, but the study result showed that Nivea is more effective as it has the highest percentage in increment of hydration level. It can be concluded that efficacy of moisturiser product does not directly proportional with the cost or price of the product. In addition, there are also other factors which cause different efficacy of the product. There are other ingredients in the formulation which were believed to enhance the moisturising effect. For instance, in Brand A (Nivea), there was Argania Spinosa Kernel Oil (Argan Oil) which also has moisturising effect [22-23]. This will enhance the efficacy of aloe vera which acts as humectant.

There are several limitations in this study. Firstly, the subjects might not comply with the product. Some of the subjects did not apply the moisturiser product on the test side twice daily. Besides, some of the subjects had sensitive skin and allergy with the moisturiser products. Moreover, the amount of the moisturiser applied might be varied between the subjects which might affect the test reading. The condition of the subjects before testing also might affect the test reading. For example, the subjects might sweat which might affect the TEWL value. [24-26]. As a conclusion, aloe vera is effective to improve skin barrier function as can be seen from the increment in the skin hydration level by using the Dermalab instrument. The increase in TEWL value is unreliable due to the environmental and instrumental errors and it is contradicted with the previous studies where it supposedly should be lowered. Besides that, all the products produce moisturising effect as

all of them increase the hydration level but their efficacies are different which might be caused by the different formulation and ingredients.

### Acknowledgments

This study was supported by the IIUM endowment (EDW B13-065-0950) fund. The authors acknowledged the assistance of Basic Medical Science department of Kulliyah Pharmacy, International Islamic University of Malaysia.

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**Table 1.** TEWL value of the control and test side before and after 3weeks for Brand A (Nivea)

Subject/ Side	Control side (g/m <sup>2</sup> /h)			Test side (g/m <sup>2</sup> /h)		
	Baseline	After 3weeks	Percentage increment (%)	Baseline	After 3weeks	Percentage increment (%)
Subject 1	24.7	27.3	10.52	24.1	26.0	7.88
Subject 2	18.4	26.5	44.02	17.6	27.9	58.52
Subject 3	24.7	26.2	6.07	34.6	23.9	-30.92
Subject 4	14.7	27.5	87.07	17.7	24.3	37.29
Subject 5	20.6	30.2	46.6	25.5	29.9	17.25
	Average		38.86	Average		18.004

**Table 2.** TEWL value of the control and test side before and after 3weeks for Brand B (Safi)

Subjects/ Sides	Control side(g/m <sup>2</sup> /h)			Test side(g/m <sup>2</sup> /h)		
	Baseline	After 3weeks	Percentage increment (%)	Baseline	After 3weeks	Percentage increment (%)
Subject 1	361	138	-61.77	250	234	-6.4
Subject 2	199	183	-8.04	145	150	3.45
Subject 3	366	280	-23.50	298	290	-2.68
Subject 4	234	235	0.43	189	213	12.70
Subject 5	184	176	-4.35	167	182	8.98
	Average		-19.45	Average		3.21

**Table 3.** TEWL value of the control and test side before and after 3weeks for Brand C (Body Shop)

Subjects / Sides	Control side(g/m <sup>2</sup> /h )			Test side(g/m <sup>2</sup> /h )		
	Baseline	After 3weeks	Percentage increment (%)	Baseline	After 3weeks	Percentage increment (%)
Subject 1	293	253	-13.65	269	290	7.81
Subject 2	271	231	-14.76	245	297	21.22
Subject 3	242	250	3.31	271	315	16.24
Subject 4	266	249	-6.39	284	304	7.04
Subject 5	250	265	6	239	274	14.64
	Average		-5.098	Average		13.39

**Table 4.** Skin Hydration level of the control and test side before and after 3weeks for Brand A(Nivea)

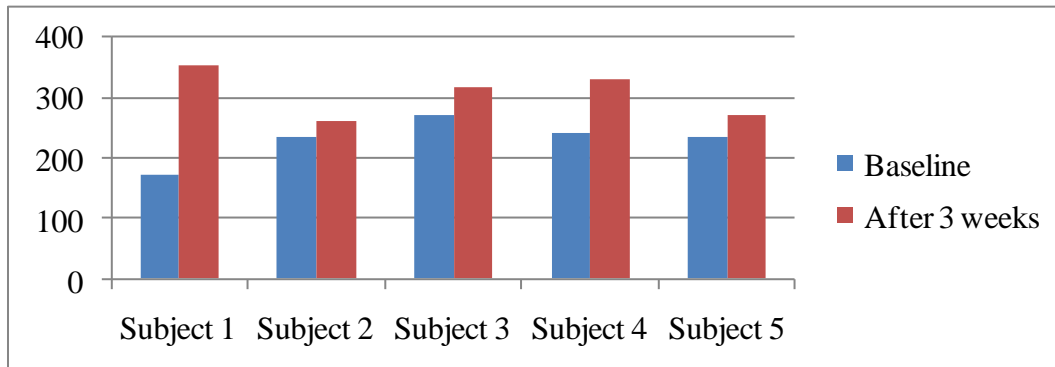
Subjects / Sides	Control side			Test side		
	Baseline	After 3weeks	Percentage Increment (%)	Baseline	After 3weeks	Percentage increment (%)
Subject 1	161	241	49.69	171	354	107.02
Subject 2	233	193	-17.17	234	261	11.54
Subject 3	248	260	4.84	271	317	16.97
Subject 4	226	197	-12.83	241	331	37.34
Subject 5	240	241	0.42	234	272	16.24
	Average		4.99	Average		37.82

**Table 5.** Skin Hydration level of the control and test side before and after 3weeks for Brand B (Safi)

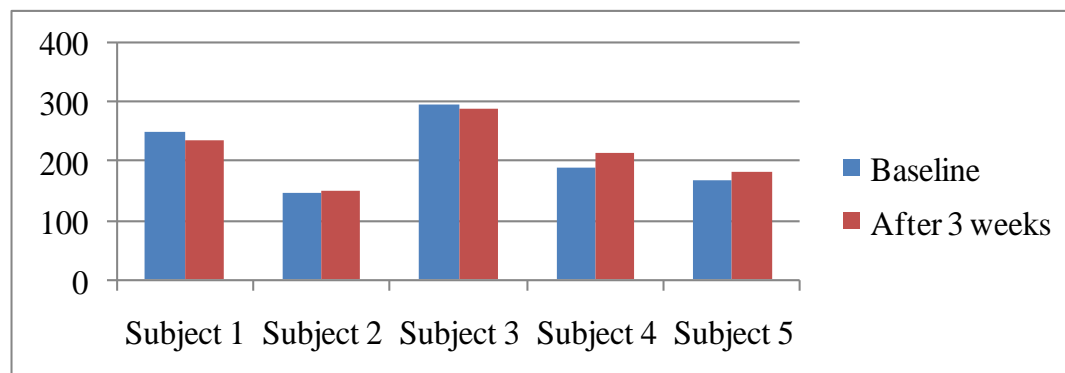
Subjects / Sides	Control side			Test side		
	Baseline	After 3weeks	Percentage increment (%)	Baseline	After 3weeks	Percentage increment (%)
Subject 1	361	138	-61.77	250	234	-6.4
Subject 2	199	183	-8.04	145	150	3.45
Subject 3	366	280	-23.50	298	290	-2.68
Subject 4	234	235	0.43	189	213	12.70
Subject 5	184	176	-4.35	167	182	8.98
	Average		-19.45	Average		3.21

**Table 6 .** Skin Hydration level of the control and test side before and after 3weeks for Brand C (Body Shop).

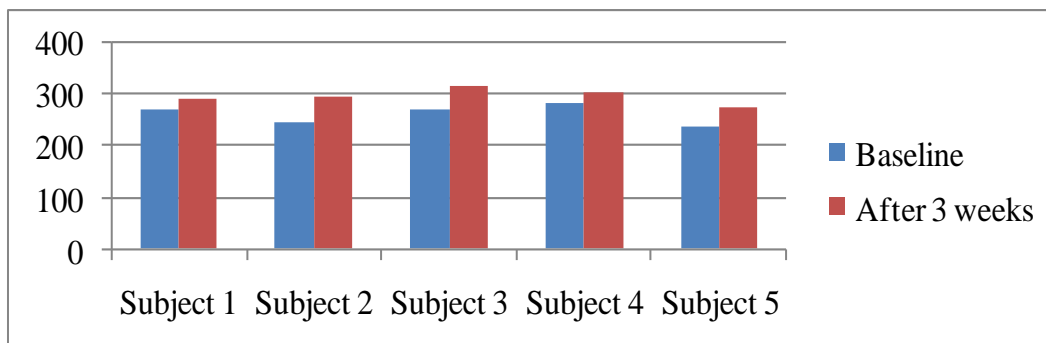
Subjects / Sides	Control side			Test side		
	Baseline	After 3weeks	Percentage increment (%)	Baseline	After 3weeks	Percentage increment (%)
Subject 1	293	253	-13.65	269	290	7.81
Subject 2	271	231	-14.76	245	297	21.22
Subject 3	242	250	3.31	271	315	16.24
Subject 4	266	249	-6.39	284	304	7.04
Subject 5	250	265	6	239	274	14.64
	Average		-5.098	Average		13.39



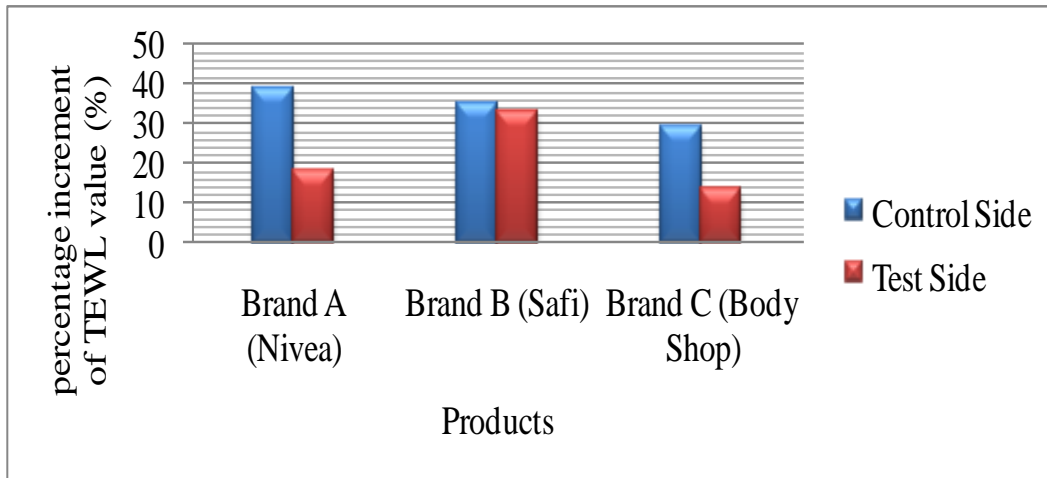
**Figure 1.** Skin Hydration level on test side before and after 3weeks using Brand A(Nivea)



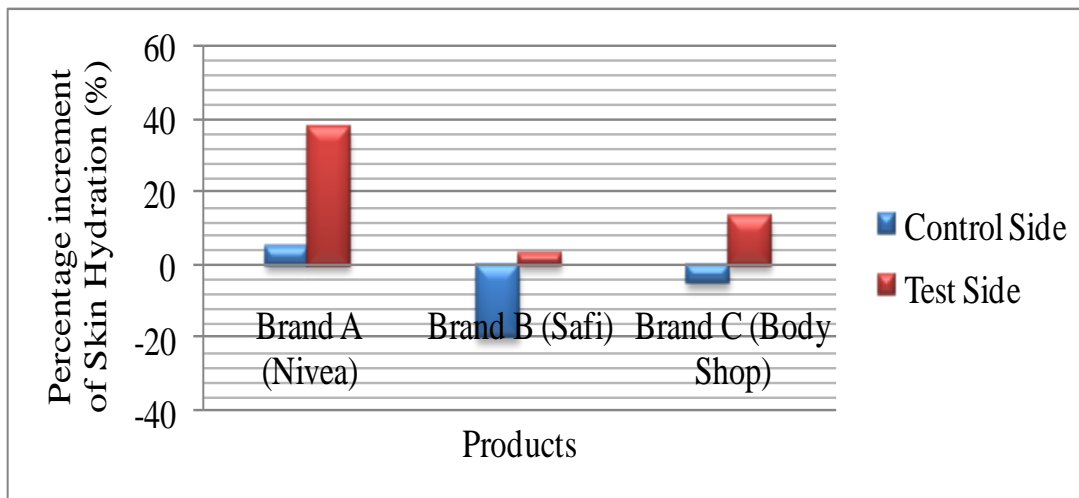
**Figure 2.** Skin Hydration level on the test side before and after 3weeks using Brand B (Safi)



**Figure 3.** Skin Hydration level on test side before and after 3weeks using Brand C (Body Shop)



**Figure 4.** Graph of Percentage increment of TEWL value 3weeks after applying the products on test and control sides



**Figure 5.** Graph of Percentage increment of Skin Hydration value 3weeks after applying the products on test and control sides.