

**Research Article****Use of mineral oil as skin moisturizer and evaluated by using Dermalab<sup>®</sup> Combo****Abul Kalam Azad<sup>1</sup>, Wan Mohd Azizi Wan Sulaiman<sup>2</sup>, Ismail N. Z<sup>3</sup>, Shyam Sundor Shaha<sup>4</sup>, Nushrat Khan Sunzida<sup>5</sup>**<sup>1-3</sup>Department of Basic Medical Sciences, Faculty of Pharmacy, International Islamic University Malaysia (IIUM), Jalan Sultan Ahmad Shah, 25200 InderaMahkota, Kuantan, Pahang, Malaysia.<sup>4-5</sup>Department of Biochemistry, Gonoshasthaya Samaj Vittik Medical College, Gono University, Dhaka-1344, Bangladesh.

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**Abstract**

**Objective:** This particular study aims to investigate the effect of mineral oil in different products on the barrier function of normal skin, as measured by transepidermal water loss (TEWL) and hydration. **Methods:** In this study, 15 female volunteers were divided into three groups, which corresponded with three different brands of moisturizers. The volunteers were treated with one test preparation on one volar forearm twice daily for 3 weeks, while leaving the other forearm untreated to serve as the control. After 3 weeks, both volar forearms, treated and control, were assessed for the measurement of TEWL and hydration by using DermaLab<sup>®</sup> Combo, and the readings were compared to the baseline. **Results:** Changes were observed after 3 weeks treatment of mineral oil-based moisturizers, in which both TEWL and hydration increased for both control and test sides, but the percentage of increment was lower than that observed with test side. Moisturizers influence the skin barrier function of normal skin, as measured by TEWL and hydration. TEWL readings of all subjects for all the three types of products increased significantly from the baseline. **Conclusions:** This results shows that the side treated with mineral-oil based moisturizers were able to promote greater degree of skin hydration compared to the untreated side.

**Keywords:** DermaLab<sup>®</sup>, Dehydration, Moisturizer, Trans Epidermal Water Loss.

**Introduction**

Medicinal plant is the main source of crude medicine (Azad et al., 2016, Azad et al., 2012a, 2012b). However, there are not enough scientific evidence for natural crude drug and its toxicity study (Azad et al., 2015). There are many organisms responsible for skin diseases like bacteria and fungi (Azad et al., 2013). Now a day's many cosmetic products are came from natural sources and its being using widely. The prevalence of dry skin, or scientifically known as xerosis, is quite common, especially among geriatric people, due to intrinsic and extrinsic aging processes that can influence the skin barrier function (Azad et

al., 2016a, 2016b). It is believed that several intrinsic, genetic and environmental factors are responsible of causing dry skin problem (Azad et al., 2016c), even though the real, exact etiology is not precisely explained. Usually, the state of skin dryness originates from the abnormalities in the layer of stratum corneum. Even though this kind of skin condition is not too severe that it can fatal or what, still it is a major concern as it is considered as cosmetic nuisance which can affect the skin appearance (White and Reddy, 2011). Even so, dry skin, if untreated, can lead to medical problems (Kraft and Lynde, 2005). For instance, dry skin can cause pruritus and skin irritation. Skin moisturizing agents, or simply known as moisturizers are the dermatological products introduced to treat the problem of dry skin (Lipizencic et al., 2006). Since many years, people around the world use moisturizers widely as skin therapies. The incorporation of occlusive materials in skin moisturizers is not something new in cosmetic world (Buraezewska et al., 2007). In general, the primary mode of action of occlusive agent is through their ability to

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physically block the trans-epidermal water loss (TEWL) Due to its great ability to retain moisture of the skin, mineral oil is often incorporated in various skincare products with combination of other active ingredients. Thus, this particular study aims to investigate the effect of mineral oil in different products on the barrier function of normal skin, as measured by transepidermal water loss (TEWL).

## Materials and methods

### Design and Methods of Study

Every study with the pharmaceutical products should maintain few parameters very carefully like patient base or survey study or in vivo, in vitro & ex vivo study (Azad et al., 2013, Fahim et al., 2015). In the study, the volunteers were treated with one test preparation on one volar forearm twice daily for 3 weeks, while leaving the other forearm untreated to serve as the control. A long term study of moisturizer effect on skin conducted by Buraczewska et al was performed for 7 weeks, which is longer than the application time in the majority of similar studies performed to date. Due to the time constraint, the duration of this present study is chosen to be 3 weeks. After 3 weeks, both volar forearms, treated and control, were assessed for the measurement of TEWL and hydration by using DermaLab® Combo. The TEWL value after treatment with the moisturizer containing mineral oil were compared to the baseline reading (before treatment). All measurements on the forearm were taken in a sitting position with the forearm lying on a table. The shoulder were adducted and the hand was 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.

### Inclusion and Exclusion Criteria for Subject Selection

The inclusion and exclusion criteria were followed by Azad et al., (2012). Fifteen volunteers were chosen (age = 20-25 years) and all them were female volunteers in order to avoid the effect of gender and age from interfering the skin barrier function. Furthermore, children and elderly subjects are prone to dry skin problem due undeveloped and diminished skin barrier function. Those who has any skin diseases or under skin therapy were excluded from this study. There were altogether three products, and each product was tested on five participants. Informed consent was obtained from all participants. During the test period nor in the three preceding days, they were not allowed to use any skin care products on their forearms.

### Name and details of products

#### *Vaseline nourishing hand lotion*

Water, mineral oil, stearic acid, dimethicone, glycerin, glycol stearate, cyclopentasiloxane, triethanolamine, glyceril stearate, helianthus annuus (sunflower) seed oil, perfume, cetyl alcohol, magnesium aluminium silicate, DMDM hydantoin, olea

Europea (olive) fruit oil, carbomer, methylparaben, tocopheryl acetate, stearamide AMP, glycine soja (soybean) sterols, disodium EDTA, dihydroxypropyltrimonium chloride, hydroxyethyl urea, lecithin, hydrolyzed keratin, propylene glucol, phenoxyethanol, pentasodium pantetate, CI 14700, CI 47005

#### *Johnson's 24 Hour Lasting Moisture Body Lotion*

Water, mineral oil, glycerin, cetareth-6, carbomer, phenoxyethanol, stearyl alcohol, sodium citrate, fragrance, sodium hydroxide, methylparaben, butyrospermum parkii (shea butter), propylparaben, citric acid, ethylparaben, squalene, glyceryl oleate, tocopheryl acetate, simmondsia chinensis (jojoba) seed oil.

#### *Nivea Body Lotion*

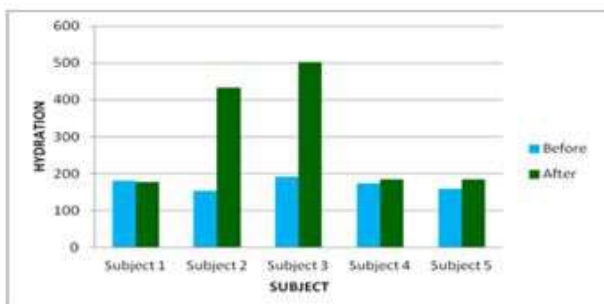
Aqua, paraffinum liquidum (mineral oil), isopropyl palmitate, glycerin, cetaryl alcohol, glyceryl stearate citrate, dimethicone, Maris Sal, glyceryl glucoside, sodium carbomer, methylparaben, propylparaben, phenoxy ethanol, Parfum.

## Results

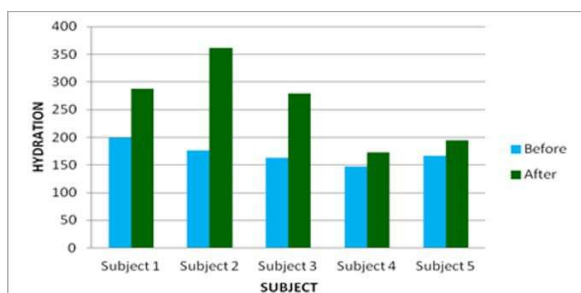
Application of different brands of moisturizers resulted in increase in TEWL value in all subjects. However, in fact, mineral oil-based moisturizers are expected to reduce TEWL of the skin, thus resulting in enhanced skin moisture. Some studies claimed that mineral oil-based products were able to reduce the TEWL value after product application for certain period of time. Basically, the skin moisturizing effect demonstrated by mineral oil is due to its occlusive property. Occlusive materials provide hydration to the skin, mainly by reducing the trans-epidermal water loss (TEWL) from the stratum corneum.

The finding of this study, however, corresponds with a study conducted which also justified the efficacy of mineral oil as skin moisturizers. The aim of that previous study was to investigate the impact of long-term treatment with moisturizers on the barrier function of normal skin, as measured by TEWL. The pure hydrophobic hydrocarbons derived from mineral oil (paraffin and isohexadecane) were incorporated in the cream. It was a long-term treatment study in which the duration was chosen to be 7 weeks. From the results obtained, it is found that there was an increase in TEWL measured after the cream application on the forearm. Skin capacitance, which also one of the parameters measured, was decreased after usage of hydrocarbon cream. This reduced skin capacitance indicates the impairment of the skin barrier, which can possibly explain the increased TEWL caused by the hydrocarbon cream derived from mineral oil.

Due to the contradictory and undesirable findings of increased TEWL value after moisturizers application in this study, TEWL results is not going to be discussed further and cannot be used as a parameter or a tool to compare the efficacy of different brands of moisturizers used. However, another skin parameter evaluated in this study, which is skin hydration has provided better reliability and reproducibility. Based on Figure 1, 2 and 3, basically in overall, treatment with three different types of moisturizers for 3 weeks resulted in increase of skin hydration. The baseline readings of both parameters were much lower than the readings measured after moisturizer application. The exceptions to this overall increase in skin hydration can be seen in the use of Vaseline nourishing hand lotion (Subject 1) and Nivea Body Lotion (Subject 2), in which the reading of hydration slightly decreased after treatment with moisturizer on the test sides. Hydration value on the untreated control side (left forearm) also increased, but the percentage of increment was lower than that observed with test side (right forearm), the one treated with moisturizer. Based on Figure 4, there was negative change of hydration on the control side of Nivea product, which indicates that the hydration value decreases after 3 weeks. Therefore, this shows that the side treated with mineral-oil based moisturizers were able to promote greater degree of skin hydration compared to the untreated side.



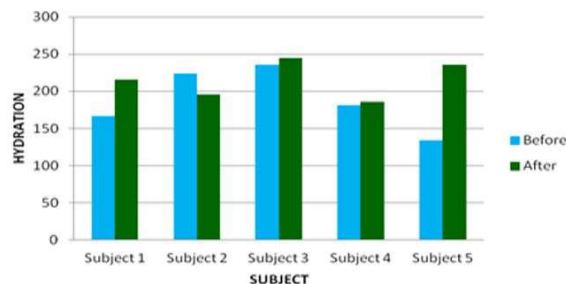
**Figure 1.** Hydration value before and after application of Vaseline nourishing hand lotion



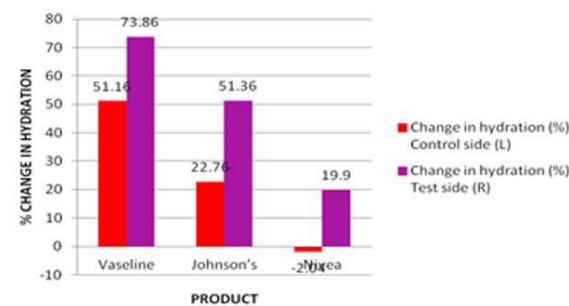
**Figure 2.** Hydration value before and after application of Johnson's 24 Hour Lasting Moisture Body Lotion

Different moisturizers have different level of efficacy in improving the skin barrier function. In this study, the efficacy of different brands of moisturizers can be made by comparing the average increase in hydration value after 3 weeks treatment with moisturizers. Based on Figure 4, Vaseline nourishing hand lotion resulted in the highest increment of skin hydration value

(73.86%) from the baseline measurement, followed by Johnson's 24 Hour Lasting Moisture Body Lotion, while the lowest percentage of hydration increase can be observed after application of Nivea Body Lotion (19.9%). However, it cannot be concluded that the hydration effect is contributed by mineral oil content alone, because the products used in this study did not comprise only of mineral oil. Instead, there are several other ingredients that may contribute to the overall increased hydration.



**Figure 3.** Hydration value before and after application of Nivea Body Lotion



**Figure 4.** Percentage change in hydration on control and test sides for different products

## Discussion

However, the findings of this study contradicted with other previous studies, in which the application of mineral oil-based moisturizers did not produce any significant reduction in TEWL value after 3 weeks. Instead, TEWL readings of all subjects for all the three types of products increased significantly from the baseline (before treatment). Trans-epidermal water loss is a measure of the amount of water that passes from inside a body to the outside via the epidermis, the skin's topmost layer. The water loss occurs via diffusion and evaporation and is continual and beyond our control. Increased TEWL value indicates that the skin barrier function is disrupted, and the skin is losing higher amount of water. However, the contradiction of this study with other previous studies can be explained by the fact that, TEWL value can actually vary due to many external factors, such as temperature, humidity and UV light (Agero et al., 2004).

Furthermore, the measurement was done in the open chamber, in which air currents in the vicinity of the TEWL

probe disturb the diffusion zone within it and caused measurement errors. TEWL can be measured accurately if a homogeneous diffusion zone is maintained within the cylinder throughout the measurement period and if the ambient humidity is low. Therefore, to achieve those conditions, closed measurement chamber should be used, in order to protect both the diffusion zone from external perturbations and to make the measurements independent of ambient humidity. On top of that, different working conditions can also lead to great variability in the measured skin parameters, such as TEWL.

Clarifying the relationship between TEWL and the environmental parameters of ambient temperature ( $T_a$ ) and relative humidity (RH), with the help of a climatic chamber to make the environment reliable. The results showed a significant correlation between TEWL and  $T_a$ , while the RH had a weaker effect on TEWL in the temperature range under investigation C (Cravello and Ferri, 2007). Finally, skin surface hydration was found to be strongly affected by both environmental parameters (Rawlings et al., 2012). In addition, the measurement of TEWL should actually be done in controlled environment, in which several related factors must be fixed. For instance, maintaining the relative humidity in the room where the measurements took place varied between 26% and 40%, the ambient room temperature was 19-22°C, while the air convection was kept minimum (Wiechers et al., 2000). Other than that, in that study, participants also rested for 30 min with their forearms exposed before measurements were taken, but this condition is not achieved in this study, which contribute to another cause of inaccuracy of TEWL values measured. Besides, the main source of fluctuations in these measurements was also associated with the contact between the measurement head and the skin. If the contact is too light or at an angle, then the seal with the skin may be impaired. If the contact is too heavy, then the skin surface may become distorted and the mean distance between the skin surface and the sensor may change Bob et al., 1998).

The increased hydration level of the moisturizer-treated skin in this study is in accordance with the previous study which also showed mineral oil efficacy through significant improvement in skin hydration and increase in skin surface lipid levels (Cravello and Ferri, 2007). The hydration effect showed by mineral oil is indirect and is due to its occlusive property, (Rawlings et al., 2004) which generally minimize water loss to the external environment. The complementary occlusive activity then contributes to skin hydration as well (Agero et al., 2004).

In conclusion, from this study, application of mineral-oil based moisturizers increases both hydration and TEWL. Even though increased value of TEWL is undesirable and contradictory to many previous study, Dermalab can actually has high reliability to measure the degree of skin hydration and TEWL if the readings are measured in a controlled environment

and related factors are maintained in proper way. In fact, mineral oil is an efficacious skin moisturizer providing occlusivity and emolliency. Its occlusive effects lead to increases in stratum corneum water content by reducing transepidermal water loss. If any other studies regarding this are about to be done in the future, for better reproducibility and reliability of the results, the study should be conducted in properly controlled room, the participants should be strictly monitored to ensure constant amount of fluid intake and not to apply any other products during study period, and last but not least, products that only consist of mineral oil without interference of other ingredients, should be used.

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#### Conflict of interest

All authors have no conflict of interest.

#### References

- Abdul Kalam A, Sulaiman W, Azizi W M, Labu ZK, Zabin S. 2013. An overview on phytochemical, anti-inflammatory and anti-bacterial activity of *Basella alba* leaves extract. Middle-East Journal of Scientific Research, 14(5):650-655.
- Agero A L, Verallo-Rowell V M. 2004. A randomized double-blind controlled trial comparing extra virgin coconut oil with mineral oil as a moisturizer for mild to moderate xerosis. Europe PubMed Central 15(3):109-116.
- Azad A K, Sulaiman W M A W, Sunzida N K. 2016. Phytochemical and toxicity evaluation of *Phaleria macrocarpa* (Scheff.) Boerl by MCF-7 cell line and brine shrimp lethality bioassay. Journal of Coastal Life Medicine, 4(1):45-49.
- Azad A K, Awang M, Rahman M M, Akter F U. 2012. Biological and pre-clinical trial evaluation of a local medicinal plant *Bacopa monnieri* (L.) Penn. International Journal of Current Research and Review, 4(19):92.
- Azad A K, Awang M, Rahman M M. 2012. Phytochemical and Microbiological Evaluation of a Local Medicinal Plant *Bacopa monnieri* (L.) Penn. International Journal of Current Pharmaceutical Review and Research, 3(3):66-78.
- Azad A K, Islam M A, Azizi WW. 2013. Appraisalment of

- Ranitidine Hydrochloride Tablet (USP150mg) Preparations from Few Selected Companies in Bangladesh. *Pakistan Journal of Nutrition*, 12(11): 966.
- Azad A K, Rahman M K, Sunzida N K. 2015. Acute oral toxicity Study on Malaysian traditional herb: *Lagerstroemia speciosa* L.(Banaba). *Journal of Pharmacognosy and Phytochemistry*, 4(4): 228-232.
- Azad MAK, Ansary MRH, Akhter MA, Al-Mamun S M, Uddin M. 2012. Disposal Practice for Unused Medications among the Students of the International Islamic University Malaysia. *Journal of Applied Pharmaceutical Science*, 2(7): 11.
- Azad, A K, Wan Azizi W S, Sunzida N K. 2016. Efficacy of *Punica granatum* L. based cosmeceutical products in improving hydration and skin color. *Asian Journal of Pharmacy and Pharmacology*, 2(1):1-5.
- Azad, A K, Wan Azizi, W S, Adham S A, Yee B L. 2016. Maggot debridement therapy for diabetic foot ulcer: Experience from Maggot treatment Centers. *Asian Journal of Pharmacy and Pharmacology*, 2(1):23-25.
- Bob Imhof, Don O'Driscoll, Perry Xiao, Elliott Berg. New Method of Measuring Trans-epidermal Water Loss. *Internal Report based on a Poster Presentation at the SCII Conference, Cardiff 1998*; 1-8.
- Buraczewska I, Lindberg M, Loden M. 2007. Changes in skin barrier function following long-term. *British Journal of Dermatology*, 156:492-498.
- Cravello B, Ferri A. 2007. Relationships between skin properties and environmental parameters. *Skin Research and Technology*, 14(2):180-186.
- Karim FT, Kalam A, Anwar R, Miah MM, Rahman MS, Islam SA. 2015. Preparation and evaluation of SEDDS of simvastatin by in vivo, *in vitro* and *ex vivo* technique. *Drug Development and Industrial Pharmacy*, 41(8):1338-42.
- Kraft J N, Lynde C W. 2005. Moisturizers: What They Are and a Practical Approach to Product Selection. *Skin Therapy Letter*, 10(5): 1-12.
- Lipizencic J, Pastar Z, Marinovic-Kulisic S. 2006. Moisturizers. *Acta Dermatovenerologica Croatica* 14(2):104-108.
- Rawlings AV, Canestrari DA, Dobkowski B. 2004. Moisturizer technology versus clinical performance. *Dermatologic Therapy* 17(1):49-56.
- Rawlings AV, Lombard KJ. 2012. A review on the extensive skin benefits of mineral oil. *International Journal of Cosmetic Sciences*, 2012; 34:511-518.
- Wan Mohd W S, Sunzida N K, Azad A K. 2016. The screening of local herbs in treating non healing wounds and diabetic foot ulcers complications using nih 3T3 mouse fibroblast and raw 264.7 mouse macrophage cells. *Pharmacologyonline 1* (2016):139-145.
- White-Chu, E Foy, Reddy M. 2011. Dry skin in the elderly: Complexities of a common problem. *Clinics Dermatology*, 29 (1): 37-42.
- Wiechers JW, Taelman MC, Barlow A, Dederen J C. 2000. Relative performance testing of formulations: emulsifiers. *Cosmetic and Toiletries*, 115:37-42.