The Effect of a Moisturizing Cream with Saccharide Isomerate and Ceramide on Increasing Skin Hydration

Vlorensia[1], Helen Hartini[1], Hairus Abdullah[2], Ahmad Raif Martinus[1], Refi Ikhtiari[1,2*]
[1]*Laboratory of Biomolecular Chemistry, Graduate School of Biomedical Science*
Universitas Prima Indonesia
[2]*Laboratory of Materials Chemistry, Faculty of Industrial Engineering,*
Universitas Prima Indonesia

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Abstract: Normal skin profile and function show that the water content in the stratum corneum must be greater than 10%. If the fluid balance in the skin is disrupted, it can cause the skin to become dry and sensitive to various physical and chemical influences. The study aimed to determine the effectiveness of saccharide isomerate and ceramide moisturizing creams in improving skin hydration. The subjects of the study were intervention group 1 who received treatment using saccharide isomerate moisturizer and intervention group 2 who received treatment using ceramide moisturizer. The moisturizing creams have been applied in the forearms and lower legs of the subjects. The number of subjects is 15 people for each group. Data analysis used the Friedman test. The results showed that moisturizing creams containing saccharide isomerate and ceramide were effective in improving skin hydration. The average of skin hydration after treatment is 24.46% with a standard deviation of 3.83. The average of skin hydration after treatment is 24.62% with a standard deviation of 2.81.

1 INTRODUCTION

Skin has a very important role. The main function of the skin is to ensure survival, besides that the skin has other meanings in aesthetics, race, and systemic indicators (Wasiatmadja, 2010). There are three layers of skin structure, namely: epidermis, dermis and subcutaneous. The epidermis is mostly composed of keratinocytes, a small portion of melanocytes and dendritic cells like langer hans cells. The skin in the nucleated epidermal layer contains nerve fibers that supply impulses. There are three layers, namely basal stratum (stem cells and postmitotics), intermediate cells (called transiently amplifying cells), stratum spinosum (sweat layer), stratum granulosum, and stratum corneum (Menon, 2015).

Skin is said to be healthy and normal when the outer layer of skin contains more than 10% water. This is due to the regulation of fluid balance in the skin (Baumann, 2009). Normal skin profile and function show that the water content in the stratum corneum must be greater than 10%. Water content can be reduced through the process of evaporation to the environment with conditions of low air humidity and must be replaced again by water from the layer below (Draelos, 2011). "As we age, the skin is less capable of maintaining moisture, and age-related loss of moisture can cause more dryness over time," explains Dr. Hellman, who suggests moisturizing more frequently as you get older to help offset the damage. There are a variety of factors that play into one's skin type, so the precise cause of one person's dry skin may be different from someone else's. "Some people have blue eyes and some people have brown eyes. Different people [have different] skin," Dr. Hellman says, noting how some of the factors that come into play for parched skin are hereditary and due largely to genetics.

Voegeli et.al (2019) has reported that remarkable gradients of skin hydration, TEWL, skin surface pH and sebum exist within short distances across the face and the gradients are distinctive among different ethnic groups. In addition, these studies have demonstrated that darkly- pigmented individuals do not necessarily have a better skin barrier function than their less- pigmented counterparts and that Caucasians have a lower facial skin surface pH compared with more pigmented subjects. Overall, there are no correlations between capacitance, TEWL and skin surface pH including individual topology (Voegeli et. Al 2019).

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If the fluid balance in the skin is disrupted, it can cause dry skin to be sensitive to various physical and chemical influences (Partogi, 2008). Dry skin is a disorder on the surface of the skin due to reduced fluid or oil content in the skin so that the moisture on the surface of the skin layer decreases (Nuzantry, 2015). Skin hydration decreases due to decreased stratum corneum barrier function and increased water loss through diffusion through the epidermis or TEWL (Black et al., 2005). According to the US Census Bureau estimated in the United States in 2004, there were 3.1% or 8.4 million people suffering from skin dryness. It is estimated that the Indonesian population who suffered skin dryness amounted to 7,392,041 in 2004. This data was obtained by statistical extrapolation based on data in the United States, the United Kingdom, and Australia (Health Grade, 2009).Dry skin is a problem that is often faced by almost all people in all parts of the world. Dry skin will look dull, feel rough, scaly, wrinkled, and less elastic than normal skin (Draelos, 2018).

Skin hydration decreases due to decreased barrier function of the stratum corneum and increased diffusion of water loss through the epidermis or TEWL (Black et al., 2005). Skin hydration has a major effect on maintaining homeostasis on the surface of the skin and maintaining its elasticity. Low-hydration skin elasticity will be reduced, the skin will become dry and the surface is easily damaged. However, changes in the epidermal fat component of the skin can also cause xerosis. Some experts believe that the incidence of dry skin has increased in recent years because people often take a shower using hot water, foaming cleansers, bubble baths, and bath salts, which damage the skin barrier by stripping the lipid component on the surface of the skin. Soap, detergent, and hard water can eliminate a healthy and normal skin barrier (Baumann, 2009).

Various studies have been carried out to obtain optimal dry skin management. One of them is by producing moisturizers that effectively increase the water content in the stratum corneum and hydrate it. Nuzantry et al., (2015) investigated aloe vera extract and olive oil as a basic ingredient in moisturizing base formulations and reported that the mixture of aloe vera extract and olive oil in moisturizing formulations is effective in skin dryness. Moisturizers are complex formulations designed to improve the hydration mechanism of the skin and maintain the structure and function of the skin from various influences such as dry air, sunlight, old age, temperature, various skin diseases and diseases that can accelerate water evaporation (Nuzantry, 2015).

Moisturizers has been generally used to relieve dry skin by increasing barrier repair, creating temporary artificial barriers, and restoring skin softness. Scientifically, moisturizing treatment involves four processes, namely repairing the skin barrier, increasing water content, reducing trans epidermal water loss (TEWL), and restoring lipid's water barrier function (Klein, 2005). The basic components of a moisturizer consist of an occlusive, humectant and emollient. Occlusive is a substance to coat the stratum corneum and reduce TEWL. Humectants are useful for the skin hydration process. While emollients are substances that are added to cosmetics to make skin soft and smooth. Other components are antioxidants, vitamins, essential fatty acids, lipoic acid, linoleic acid and herbal extracts (Lodén, 2011).

Previously have been reported that four commercial moisturizer products of different brands were tested on volar forearm region of healthy human female volunteers. This study was conducted for a period of 30 days with 0, 7, and 30 days as time points of analysis. The results of this study clearly indicate that not all the moisturizer products hydrate the skin to the expected levels, and this extent of skin hydration varies with duration of application of these products (Tippavajhala et. al. 2018). Another studies by Engebretsen 2018 reported that Epidermal deficiency of filaggrin, and the derived natural moisturizing factors (NMFs), is associated with increased risk of atopic dermatitis (AD). While filaggrin gene mutations cause filaggrin deficiency, there is limited insight into the causative environmental factors. NMFs levels are decreased along with increased secretion of various skin cytokines in healthy individuals. Our data highlight environmental factors that might play a role in AD pathophysiology (Engebretsen et.al.2018).

Saccharide isomerate (SI) is a muco-polysaccharide carbohydrate complexes that are similar as those found in the human skin's stratum corneum. The active ingredient saccharide isomerate in the epidermis will form hyaluronic or hyaluronic acid. Saccharide isomerate is one of the answers to the development of glycobiology. Saccharide isomerate can retain moisture by increasing the water content in the stratum corneum even in low air humidity. Saccharide isomerates can also bind to the skin even in very low pH conditions (Pentapharm, 2009).

The phenomenon of peeling skin manifests itself as one of the conditions such as dehydrated skin, loss of moisture retention and natural protective film possibly due to the use of strong cleansing products or harmful effects of the environment, i.e. chemicals. When this corneocyte layer is damaged, they will lose their ability to bind, losing NMF leading to the phenomenon of peeling in each section and an opportunity for more harmful thing to enter into our bodies possibly causing different types of atopic dermatitis. Extending the time of injury due to

dehydration, our skin will become a desert, even if you drink a lot of water it will be too late at this point as it will quickly evaporate. This is where Saccharide Isomerate (SI) will became our saving grace SI is a carbohydrate complex that is similar in structure to natural carbohydrates found in NMF, acting as a magnet for water-retention. When the SI is inserted into the skin, it will replace the lost natural carbohydrates, and now when the water is added to the skin to be absorbed into these carbohydrates, we can help prevent the water from evaporating so quickly. SI acts as an emollient, water retention agent, and also has the ability to bind to skin proteins closely, capable of remaining on the skin longer than conventional softeners. Simultaneously, SI use for a long time also helps to develop filaggrin proteins, loricrin, and develop the skins increase hyaluronic acid production.

The outstanding properties of Saccharide Isomerate:

- Instant water supply, deeply moisturizing lasting up to 72 hours.
- Reduces irritation, reduces AHA's side effects by 22% because the skin is making its own exogenous AHA's.
- In 3 minutes SI has 38% higher moisturizing ability than glycerin.
- Stimulate gene expression to a create skin protection barrier keeping inflammatory skin issues at bay.
- Improve the effectiveness of peeling and bring soft and moisturized skin.

There are several studies on the effects of using SI on moisturizing formulations that have been published both by the producers of SI products and by academic researchers. Research from the manufacturer of SI products shows that SI has a much higher skin moisture retention capacity compared to glycerin (Pentapharm, 2009). Dewi in 2010 examined the addition of 5% Saccharide Isomerate in a moisturizing formulation to improve skin hydration compared to ordinary moisturizers. His research found that the addition of 5% saccharide isomerate in moisturizing formulations can improve skin hydration higher and can maintain higher skin hydration after the administration is stopped compared to ordinary moisturizers.

Another moisturizer that is thought to help skin hydration is ceramide. Ceramide helps skin retain water and soften dry skin. Ceramide is synthetic which can mimic natural substances in the outer layers of the skin to help maintain moisture (Octavia, 2017). Another study reported by Spada et.al. 2018 that topical application of the Ceramide cream moisturizer leads to increased skin hydration and decreased TEWL making it suitable to help restore xerotic skin. Maintenance of skin barrier function is vital to mitigate the skin's susceptibility to irritants, allergens, and microbes (Spada et.al. 2018).

Ceramide naturally found in the skin will decrease with aging and other factors that have an impact on dry skin. Giving ceramide synthesis can overcome skin dryness through improved skin barrier function (Wertz et al., 2000). Ceramide is a compound of phytosphingosine that is naturally present in the skin around the stratum corneum which has the effect of maintaining skin moisture. Ceramides found in the skin will naturally decrease with aging and other factors that cause the skin to become dry (Jafar, 2015). Ceramide is a component that plays an important role in the function of the skin barrier. Currently, commercially available products containing ceramide and filaggrin break down products have been specifically designed for patients with sensitive skin (Eric et al., 2012).

Ceramides are the main component of SC (stratum corneum) intercellular lipids and contain a lot of linoleic acids. The bond between ceramide and water will form a smooth emulsion so that it appears smooth and soft. The administration of ceramide-containing emollients has been carried out in cases of atopic dermatitis, which is caused by impaired skin barrier function. Research shows that ceramide does not only improve TEWL and erythema severity, but also increases levels of endogenous ceramide in the stratum corneum (Partogi, 2008).

With a complexion short on ceramides, things like seasons and environmental factors will zap your already diminishing supply of these good fats because you don't have the (fatty) defenses you need to keep that stuff at bay. One small Dutch study found a particularly steep drop in ceramide levels among participants between summer and winter. You've be warned. The weather, dry central heating and general low-humidity environments, air pollution, UV rays and sun damage, it sort of feels like simply being alive depletes ceramides in the skin, and that's not even considering hormonal and genetic issues or diseases that affect skin integrity, like diabetes

Ishikawa and his colleagues conducted a study whose results showed that indicators of dry (dry, rough and scaly) skin were closely related to ceramide levels in 2013. Associated with this study, formulization of seramite in moisturizing creams studied was a solid lipid nanoparticle formulation (SLN) . According to Ekambaran and friends, SLN has many advantages such as good biocompatibility, low toxicity, good physical stability of the system and incorporation of hydrophilic and lipophilic drugs (Ekambaram et al., 2012). SLN is a nano-sized particle with a solid lipid matrix. SLN consists of oil droplets (lipids) which are at room temperature and stabilized by surfactants. SLN has an occlusive nature

so it is good to be used as a daily cosmetic skin cream product (Puri et al., 2010).

Hanzola et al., (2015) studied the effect of the use of aloe vera masks on dry facial skincare on the skin moisture indicator showed the highest score in the fourth and fifth treatments with an average score of 4.0 categorized as very moist. Prima's research (2017) which found that dry face skincare without using watermelon white skin masks in the control group did not show a better change in results, for the 1x3 day experimental group there were significant changes as well as the 1x7 day treatment group showed significant results on the indicator of moisture and brightness of facial skin. Based on research results prove the watermelon white skin mask as a dry facial skincare mask with the best use frequency of 1 x 3 days. Previous research was conducted using various natural ingredients to treat dry skin or improve skin hydration, such as Eucalyptus extract, aloe vera masks, and watermelon white skin masks. This research is different from the two studies above, which is trying to use isomerate saccharide which is a complex compound of carbohydrate mucopolysaccharide and ceramide synthesis formulated in the form of solid lipid nanoparticles.

Skin hydration and TEWL are important of non-invasive measurements in dermatology and cosmetology because the measurement values of TEWL and the water level of the stratum corneum can be used to assess and compare the efficacy of various products applied to the skin, especially moisturizers (Pedersen and Jemec, 2006). TEWL reflects the evaporation of the skin surface. One characteristic of healthy skin is a proportional comparison between TEWL and skin hydration (Primavera et al., 2005). TEWL measurements are only valid within the boundary layer that has diffused in the human body whose depth is around 10-30 μm under normal conditions. Instrument sensitivity can also interfere with TEWL measurement results. TEWL measurement uses an evaporimeter. This tool has a probe that measures the pressure of partial evaporation of water at two locations above the surface of the skin, 3 mm and 9 mm with the help of two pairs of humidity transducers and thermistors. The difference in partial evaporation water pressure at the two locations is then calculated and expressed as gr/m2 per hour. Normal TEWL values are between 2-5 gr/m2 per hour. The value can reach 90-100 gr/m2/hour after stripping the skin or in the presence of atopic dermatitis lesions (Black et al., 2005).

The age parameter does not affect TEWL very much, but in certain life periods there can be significant changes, for example in premature infants who are less than 30 weeks pregnant will experience epidermal barrier disorders but within a few days after birth, there will be skin barrier maturation (Primavera et al., 2005).

Based on research background, this study aimed to determine the effect of saccharide isomerate and ceramide moisturizing creams in improving skin hydration.

2 METHOD

The research subjects in this study were divided randomly into intervention group 1 who were treated by using saccharide isomerate moisturizer and intervention group 2 who were treated using ceramide moisturizers. The number of samples is 15 people for each group (intervention groups 1 and 2). The research material consisted of a moisturizing cream containing saccharide isomerate namely Pentavitin which contained >50% saccharide isomerate produced by DSM Nutritional Products Ltd and moisturizing cream containing ceramide in a solid lipid nanoparticle formulation namely CeraVe Moisturizing Cream. The moisturizing creams have been applied in the forearms and lower legs of the subjects. The research instrument used to measure skin hydration was Digital Moisture Monitor for Skin (SK-IV). The data of skin hydration measurements were processed using Statistical Package for the Social Sciences (SPSS) version 17.0. Data analysis used the Friedman test.

3 RESULTS AND DISCUSSION

3.1 Analysis of Subjects Characteristics

The characteristics of subjects from intervention group 1 (saccharide isomerate moisturizer) according to age, the majority are 30-35 years old 73.3%, according to ethnicity, the majority are Chinese ethnic 46.7%, according to marital status, the majority have not married 80.0%, according to the type of work, all private employees are 100% and according to location work, all work indoors 100%.

Subject characteristics of intervention group 2 (ceramide moisturizer), according to the age of the majority of 30-35 years old 66.7%, according to ethnicity, the majority of Javanese are 60.0%, according to marital status, all are not married 100%, according to the type of work all employees are 100% and according to location works, all work indoors 100%. Furthermore, based on the literature studies, the age parameter does not affect TEWL very much, but in certain life periods there can be significant changes, for example in premature infants who are

less than 30 weeks pregnant will experience epidermal barrier disorders but within a few days after birth, there will be skin barrier maturation (Primavera et al., 2005). The details of group intervention are presented in the Table 1.

Table 1: Subjects characteristics based on ages, ethnics, marital status, occupation and working location.

No	Subject Characteristics	SI Group 1 (n = 15)		S Group 2 (n = 15)	
		f	%	f	%
1.	Age				
	a. 30-35 years	11	73,3	10	66,7
	b. 36-40 years	4	26,7	5	33,3
2.	Etnic				
	Chinese	7	46,7	2	13,3
	Batak	6	40,0	4	26,7
	Java	2	13,3	9	60,0
3.	Marital Status				
	a. Single	12	80,0	15	100
	b. Married	3	20,0	-	-
4.	Occupation				
	Private employee	15	100	15	100
5.	Working location				
	Indoor work	15	100	15	100

To evaluate the application of SI and S on the forearm and lower limbs, the average value (%) of skin hydration has been monitored as of before, during and after treatment. The data presented statistically in order to obtain comprehensive understanding on the skin hydration at forearm and lower limbs. The data of skin hydrations (%) are presented in Table 2.

3.2 Analysis of Average Skin Hidration Effects of SI and S Applications on the Forearm and Lower Limbs as of before, During and after Treatments

Data from Table 2 shows the average of skin hydration in intervention group 1 (saccharide isomerate/SI) on the forearm before treatment, is 15.08% with a standard deviation of 4.80. The average of skin hydration during treatment for 1 week, in measurement I is 18.82% with standard deviation of 4.19 and in measurement II is 22.31% with standard deviation of 4.06. The average of skin hydration after treatment is 24.46% with a standard deviation of 3.83.

Table 2: Average of skin hydration as of before, during and after treatment with SI and S on the forearm and lower limbs.

Location	Average Skin Hydration (%) Before (%)	During Treatment Measurement I (%)	During Treatment Measurement II (%)	After (%)
SI				
Forearm	15,08 ± 4,80	19,82 ± 4,19	22,31 ± 4,06	24,46 ± 3,83
Lower limbs	18,68 ± 4,36	23,51 ± 4,15	26,84 ± 3,69	28,37 ± 3,54
S				
Forearm	14,46 ± 2,80	16,70 ± 3,18	18,94 ± 2,80	20,75 ± 2,70
Lower limbs	17,20 ± 3,48	20,10 ± 2,83	22,88 ± 2,73	24,62 ± 2,81

The average of skin hydration in intervention group 2 (ceramide moisturizer/S) on the forearm before treatment is 14.46% with a standard deviation of 2.80. The average of skin hydration during treatment for 1 week in measurement I is 16.70% with a standard deviation of 3.18 and in measurement II is 18.94% with a standard deviation of 2.80. The average of skin hydration after treatment is 24.62% with a standard deviation of 2.81. To evaluate the normality of data distribution, the data of skin hydration was evaluated as shown in the Table 3.

The normality test used the Shapiro-Wilk test on skin hydration of the subjects of the intervention group 1 before treatment using SI moisturizer at the forearm (LB0) and lower limb (TB0) the significance value was <0.05, meaning the data was assumed to be normally distributed. Subject skin hydration in the intervention group 2 before treatment using S moisturizer on the forearm (LB0) and lower limb (TB0) the significance value was >0.05, this means the data is assumed to be normally distributed.

To evaluate the normality of data distribution, the data of skin hydration on the wholebody, forearm and lower limbs, were evaluated as shown as in the the Table 4.

Skin hydration in both intervention groups SI and S at the time of treatment in the forearm (LB1 and LB2) and lower limbs (TB1 and TB2) both at the first measurement and the second measurement significance value >0.05, this contains the meaning of data assumed to be normal distribution. Skin hydration in the two intervention groups SI and S after treatment was measured in the forearm (LB3) and lower limb (TB3) the significance value was >0.05, this meant the data was assumed to be normally distributed.

Table 3: Normality test of skin hydration as of before, during and after treatment with SI and S on the wholebody, forearm and lower limbs.

Location	Groups	*Sig*	note.
Whole body			
ST0 (before)	SI	0,004	Not normal
	S	0,542	Normal
ST1 (during)	SI	0,363	Normal
	S	0,000	Not normal
ST2 (during)	SI	0,819	Normal
	S	0,109	Normal
ST3 (after)	SI	0,532	Normal
	S	0,178	Normal
Forearms			
LB0 (before)	SI	0,009	Not normal
	S	0,300	Normal
LB1 (during)	SI	0,463	Normal
	S	0,167	Normal
LB2 (during)	SI	0,219	Normal
	S	0,320	Normal
LB3 (after)	SI	0,263	Normal
	S	0,316	Normal
Lowerlimbs			
TB0 (before)	SI	0,015	Not normal
	S	0,993	Normal
TB1 (during)	SI	0,363	Normal
	S	0,167	Normal
TB2 (during)	SI	0,368	Normal
	S	0,320	Normal
TB3 (after)	SI	0,700	Normal
	S	0,143	Normal

Table 4. Homogeneity test of skin hydration as of before, during and after treatment with SI and S on the wholebody, forearm and lower limbs.

Location	*Sig*	note
Whole body		
ST0	0,523	Homogen
ST1	0,088	Homogen
ST2	0,144	Homogen
ST3	0,383	Homogen
Forearms		
LB0	0,291	Homogen
LB1	0,648	Homogen
LB2	0,389	Homogen
LB3	0,615	Homogen
Lowerlimbs		
TB0	0,783	Homogen
TB1	0,144	Homogen
TB2	0,216	Homogen
TB3	0,203	Homogen

Based on the homogeneity test using Levene's test as shown in the Table 4, both intervention group SI (Saccharide Isomerate moisturizer) and intervention group S (Ceramide moisturizer) at the time before treatment using moisturizers, when treated with moisturizers and after treatment, the significance value is <0.05. This means that the data is assumed to be homogeneous.

3.3 Effectiveness of SI and S Applications on the Forearm and Lower Limbs as of before, During and after Treatments

To evaluate the effectiveness of SI and S on the forearm and lower limbs as of before, during and after treatment. The significance values have been statistically considered by the the mean value of skin hydration (%) (Table 5).

Our data showed the average of skin hydration in intervention group 1 on the forearm and lower limbs during treatment using SI moisturizer for 1 week and after treatment tended to increase. The results of the Friedman difference test to determine the differences in skin hydration at both locations before, during and after treatment showed a significance value of 0,000, which means that there was an effect of using SI moisturizer on skin hydration.

Table 5. Effectiveness of Moisturizing Cream Containing SI and S on Hydrating Skin in Subject's Forearms and Lower Legs Before, During and After Treatment.

	SI		S	
Location	***Mean Rank***	***Sign***	***Mean Rank***	***Sign***
Forearms:				
LB0 (before)	1,00		1,00	
LB1 (during)	2,00	0,000	2,00	0,000
LB2 (during)	3,00		3,00	
LB3 (after)	4,00		4,00	
Lower Legs:				
TB0 (before)	1,00		1,00	
TB1 (during)	2,00	0,000	2,07	0,000
TB2 (during)	3,00		3,07	
TB3 (after)	4,00		3,87	

Based on data from Table 5 above, the effect of using SI moisturizer on the forearm before, during and after treatment using SI and S moisturizers, with a significance value of 0,000. There is an effect of the use of SI moisturizers in the lower limbs before, during and after treatment with a significance value of 0,000. There is the effect of using S moisturizer on the forearm before, during and after treatment with a

significance value of 0,000. There is the effect of using SI on the lower limbs before, during and after treatment with a significance value of 0,000.

This study is in accordance with the results of previous study which together examined the effect of saccharide isomerate on skin hydration. Dewi's (2010) study also found that the addition of 5% saccharide isomerates in moisturizing formulations can improve skin hydration higher and can maintain higher skin hydration after the administration is stopped compared to ordinary moisturizers.

We also showed the average of skin hydration in intervention group 2 in the forearm and lower limbs, during treatment using ceramide moisturizer for 1 week and after treatment tended to increase. The results of the Friedman difference test to determine the differences in skin hydration at both locations before, during and after treatment showed a significance value of 0,000, which means that there was an effect of using sakarida isomerate moisturizer on skin hydration.

The results of this study are also supported by previous studies that also examined the effects of ceramide on skin hydration. Research conducted by Ishikawa and colleagues in 2013 showed that Indicators of dry (dry, rough and scaly) skin were closely related to ceramide levels. Partogi (2008) also supports the results of this study with his statement that ceramide administration not only improves transpidermal water loss (TEWL) and erythema severity, but also increases levels of endogenous ceramide in the stratum corneum.

4 CONCLUSION

Based on the data analysis, we conclude that there was an significant effect of moisturizing cream containing saccharide isomerate on skin hydration and there was the effect of moisturizing cream containing ceramide in solid lipid nanoparticles formulations on skin hydration

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