
ADDITION OF 5% SACCHARIDE ISOMERATES IN MOISTURIZING FORMULATION INCREASES SKIN HYDRATION HIGHER THAN REGULAR MOISTURIZERS

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ABSTRACT

Dry skin is a problem for millions of people and often causes discomfort and even psychological stress. Increasing the water content in the stratum corneum can be done by applying moisturizer regularly and regularly because it will improve lipid levels and hydrate the epidermis. Saccharide isomers (SI) are one of the answers for the development of Glycobiology. The hypothesis of this study is that the addition of 5% SI in the moisturizing formulation further increases skin hydration and can maintain higher skin hydration even after discontinuation of use compared to ordinary moisturizers. The research subjects were 30 women aged 30-45 years who were not menopausal. Randomly divided into control group (15 people) and treatment group (15 people) by double blind. Moisturizer used for 2 weeks in a row, then discontinued use. Measurement of skin hydration was carried out 3 times a week during the use of moisturizer and after discontinuation. The non-invasive measuring instrument used is the Multi Skin Test Center® MC 750 made in Germany. Giving moisturizer in both groups resulted in an increase in skin hydration after 2 weeks of use ($p < 0.05$). After discontinuation of the moisturizer, the four locations showed significant differences in skin hydration ($p < 0.05$). From the results of this study, it can be concluded that the addition of 5% SI in the moisturizing formulation can increase skin hydration higher and can maintain higher skin

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hydration even after discontinuation of administration compared to ordinary moisturizers.

KEYWORDS

Dry skin, Skin hydration, Moisturizer, Saccharide isomerates, Hyaluronic Acid, Glycobiology



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INTRODUCTION

Everyone does not want to grow old because aging is a decline in condition and disability. However, aging is one phase that must be experienced by everyone (Estebasari et al., 2020). With increasing age, living things will also be followed by a process of loss of function of various body tissues. Aging is the accumulation of changes in organisms over time (Atwood & Bowen, 2011). This shows that with the passage of time, humans will experience a decline in function that is difficult to repair (Kyriazis, 2020). This will reduce health and survive various diseases (Fuellen et al., 2019). There are two kinds of aging, chronological aging and biological aging (Hamilton, 1994). Chronological aging is seen with reference to the effect of time on cells, while biological age refers to the number of daughter cells produced by certain cells (Cordero et al., 2011). Biological aging is more associated with decreased function (Ntaios, 2020). If chronological aging is determined by time of birth, then biological aging is more about changes that occur at the cellular level and are highly correlated with morbidity, mortality, and age (Bahour et al., 2022).

Various theories explain the process of aging, including the free radical theory, and the wear and tear theory. According to the free radical theory, an organism gets old due to the accumulation of damage by free radicals in cells over time. Free radicals will damage molecules whose electrons are attracted by these free radicals, causing cell damage, impaired cell function, and even cell death. It is stated in the free radical theory that aging is caused by the accumulation of damage caused by reactive oxygen species (Gladyshev, 2014). This theory also has implications for the gradual accumulation of oxidative cell damage as a fundamental driver of cell aging. The main molecules in the body that can be damaged by free radicals are deoxynucleic acid (DNA), fats and proteins. Oxidative stress occurs when the natural production of Reactive Oxygen Species (ROS) cannot be matched by the anti-oxidative capacity of tissues, leading to mitochondrial DNA damage and dysfunction and higher rates of cell apoptosis (Schöttker et al., 2015)

According to the “Wear and Tear” theory, which was first introduced by Dr. August Weismann, a biologist from Germany in 1882 stated that the body and cells become damaged due to overuse and abuse. Organs such as the liver, stomach, kidneys, skin and others decline due to toxins in food and the environment, excessive consumption of fat, sugar, caffeine, alcohol, nicotine, ultraviolet radiation, physical and emotional stress. Damage is not limited to organs, but also occurs at the cellular level. This theory believes that giving the right supplements and treatment that is not too late can restore the aging process. The mechanism is by stimulating the body's ability to repair and maintain body organs and cells (Pangkahila, 2007)

The aging process results in thinning of the epidermis, dermis and subcutaneous fat. The skin becomes dry, thin and its elasticity is reduced so it is easily damaged. Dry skin is a problem for millions of people and often causes discomfort and even psychological stress. In addition, dry skin is also one of the most common skin problems in the elderly (Hahnel et al., 2019). It is a very common dermatological disorder especially in the elderly and in patients with underlying health conditions (Amin et al., 2021). Clinical symptoms of dry

skin include the skin surface feeling tight and stiff, rough, dull, scaly, itching, redness and even pain. Dry skin mainly describes abnormalities in the stratum corneum of the epidermis. Actually there is no internationally accepted definition of dry skin. Because dry skin is simply a lack of water only on the 2-3 layers of the stratum corneum surface, but on the bottom it remains normal (Kligman, 2000) and this is a common or common condition (Proksch et al., 2020) that It often occurs in 75% of people 65 years of age and older (Guenther et al., 2012).

Under normal conditions, the stratum corneum contains about 30% water. Dry skin is characterized by decreased water retention capacity in the stratum corneum with a water content of less than 10%, in this condition the function of the skin will be disturbed and the skin will become dehydrated. Dry skin is not a single diagnosis because it is often associated with endogenous and exogenous conditions. Endogenous conditions that influence include ichthyosis, psoriasis, atopic dermatitis or chronic endogenous dermatosis, increasing age and hormonal changes (Hashizume, 2004). Meanwhile, exogenous conditions that influence include weather, dermatitis triggered by environmental factors such as exposure to chemicals, low humidity and ultraviolet radiation, chronic irritation, allergic contact dermatitis, photoaged skin aging and others. Modern life like the use of Air Conditioned (AC), traveling by plane can also cause dehydrated skin.

Dry skin conditions increase with age. Based on research conducted by Augustin (2018), at the age of 16-19 years the prevalence of dry skin was 16.7% which increased to 38.4% at the age of 60-70 years. Skin hydration decreases due to decreased stratum corneum barrier function and increased water loss by diffusion through the epidermis or transepidermal water loss (TEWL) (Alexander et al., 2018). In the elderly there is a decrease in the main lipid barrier so that the barrier function also decreases (Choi, 2019). Anti-aging medicine considers and treats aging as a disease that can be prevented, avoided and treated, so that it can return to its original state. This successful aging is also characterized by high physical, psychological, and social functions in old age without any disease (Annele et al., 2019). There are three factors that contribute to extending human life, namely clean drinking water, developed medicines, and better nutrition (Lee, 2019) Thus, humans no longer have to let themselves grow old with all the complaints and if necessary get treatment or treatment that is not necessarily successful (Pangkahila, 2007). However, prevention of aging-related diseases or ARDs is very important in the current era of aging population (Wu et al., 2021)

Various studies have been conducted to obtain optimal management of dry skin. Appropriate skin care products should be selected with the aim of increasing skin hydration and restoring its function (Augustin et al., 2019) One of them is by producing an effective moisturizer to increase the water content in the stratum corneum and hydrate it.

Moisturizers work with compositions that are occlusive and/or humectant as well as components of the Natural Moisturizing Factor (NMF). An occlusive composition physically blocks water loss from the skin's surface while a humectant composition works by drawing water into the skin. Moisturizers provide functional skin benefits, such as making the skin smooth and soft, increasing skin hydration, and improving the optical characteristics of the skin. Skin that is kept moist can defend itself against damage caused by the aging process (Draelos, 2018)

With the development of the role of carbohydrates/Glycosaminoglycans in inter and intercellular communication, a branch of Glycobiology has developed which studies the

structure, biosynthesis, biology and evolution of saccharides (chain sugars or glycans) (Varki et al., 2015). Meanwhile, in 2008, the pharmaceutical industry of Pentapharm in Switzerland produced the active ingredient Saccharide isomerates (SI) which is a complex carbohydrate mucopolysaccharide (glycan) similar to that found in the stratum corneum of human skin. So that in the epidermis it will form hyaluronan or hyaluronic acid. SI is one of the answers for the development of Glycobiology (Pentapharm, 2009). In accordance with the function of hyaluronan in the epidermis, SI can function to maintain moisture by increasing the water content in the stratum corneum even in low humidity. SI can also bind to the skin even under very low pH conditions (Pentapharm, 2009). There have been no published studies on the effects of using SI on moisturizing formulations. Research that has been done is research from SI product manufacturers which shows SI has a much higher skin moisture retention capacity than glycerin (Pentapharm, 2009). With the addition of SI to the moisturizing formulation, it is hoped that a moisturizing formulation that is effective in overcoming the problem of skin dryness can be obtained. So that it can be an ideal moisturizer that is able to rejuvenate dry skin due to aging without causing an irritating effect.

RESEARCH METHOD

The research method used in this study is a True experimental method using the "Pretest-posttest Control Group Design" Campbell & Stanley, 1963 (Hammersley, 1991)

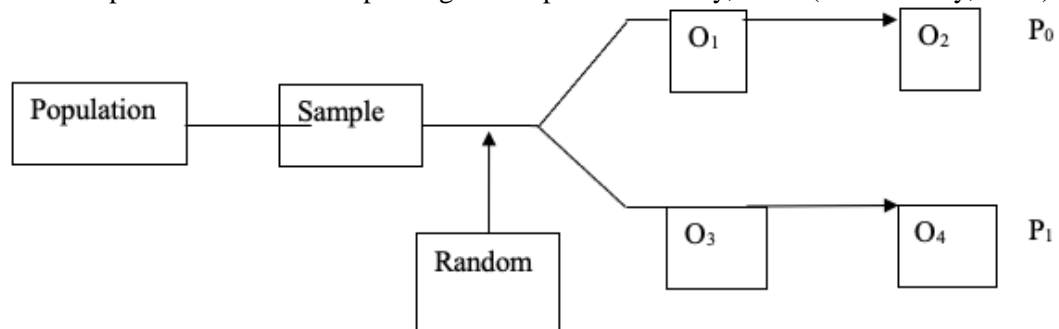


Figure 1 Research design

In the research subjects, the samples were randomly divided into the control group and the double-blind treatment group.

O1: Observation of the control group after being released from any lotion for 1 week

O2 : Observation of the control group after using regular moisturizing lotion for 2 weeks and after being free for 1 week

O3 : Observation of the treatment group after being released from any lotion for 1 week

O4 : Observation of the treatment group after using moisturizing lotion with 5% SI for 2 weeks and after being free for 1 week

P0 : Control group (ordinary moisturizing lotion)

P1 : Treatment group (moisturizing lotion with SI 5%)

This research was conducted at Tk Hospital. II Moh. Ridwan Meuraksa, Jln. Kramat Raya 174, Jakarta, which started in August-October 2010. The study population was female employees of Moh. Ridwan Meuraksa (MRM) Jakarta with an age range of 30-45 years while the sample was taken from those who met the criteria for acceptance of research subjects. In addition, the data obtained were analyzed with the following steps: (1) descriptive analysis for the data on the basic characteristics of the research subjects which

included age, weight, and height; (2) Chi-Square test was conducted (2x2 cross tabulation) in order to know the difference in distribution in each group; (3) Shapiro-Wilk normality test was performed on the data from skin hydration measurement results and the data obtained were normally distributed ($p > 0.05$); (4) carried out a comparative test with paired-sample t test; (5) a comparative test was conducted with an independent-sample t test on the percentage of skin hydration in the control group and the treatment group; (6) One Way Anova test was conducted to compare the percentage of skin hydration at the four measurement locations; and (7) the data was processed with the SPSS 13.0 for Windows Statistical Base Program.

RESULT AND DISCUSSION

In this study, 30 people were used as samples, 15 of them as a control group (using regular moisturizer) and 15 people as a treatment group (using a moisturizer containing Saccharide Isomerate 5% (SI 5%). In this discussion, the normality test will be described. data, data homogeneity test and comparability test.

Data Normality Test

The data from the measurement of skin hydration were tested for normality using the Shapiro-Wilk test. The result shows that the data is normally distributed ($p > 0.05$).

Homogeneity Test

The data from the measurement of skin hydration in the control group and the treatment group were tested for homogeneity using the Levene's test. The results show homogeneous data ($p > 0.05$).

Subject Characteristics

This section describes the basic characteristics, which include age, height, and weight. The above data is presented in Table 1 below.

Table 1 Basic Characteristics That Include Age, Height, and Weight

Characteristics	Regular Moisturizer (Control)	SI 5% (Treatment)
Age (year)	37,60 ± 5,51	39,27 ± 5,75
height(cm)	154,87 ± 4,09	156,67 ± 4,42
weight (kg)	61,40 ± 9,65	61,67 ± 10,49

Table 1 above shows the average age of study subjects in the control group and 5% SI, the average height and average weight.

Factors Affecting Skin Hydration in Research Subjects

From the anamnesis results obtained several factors that affect skin hydration. Presented in Figure 1.

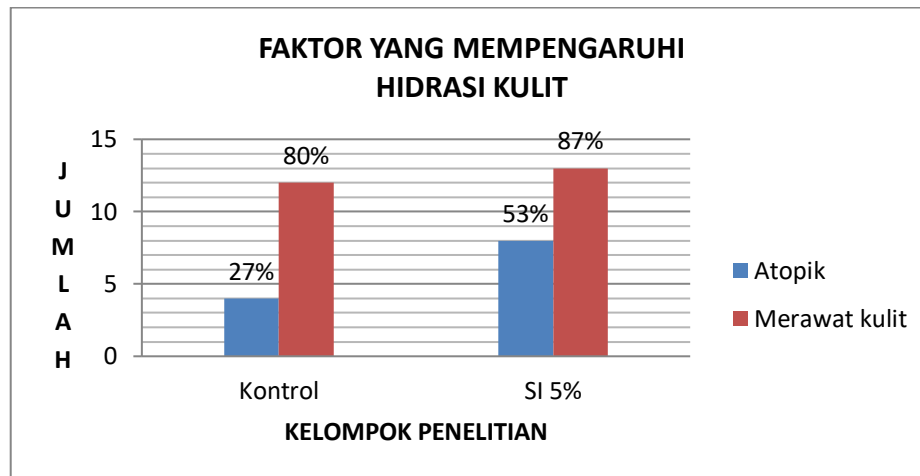


Figure 2 Factors Affecting Skin Hydration in Research Subjects

To determine the role of these influencing factors on skin moisture, the Chi-Square test (2x2 cross tabulation) was used in order to determine the difference in distribution in each group. The results of the analysis are presented in Table 2.

Table 2 Distribution of Factors Affecting Skin Hydration in each group

Influential factors		Group		χ^2	P
		Control	SI 5%		
Skin Care	Yes	12	13	0,240	0,624
	No	3	2		
Atopic	Yes	4	8	2,22	0,136
	No	11	7		

Based on the results in Table 2 above, it was found that the skin care habits and atopic conditions were not different in each group ($p > 0.05$). The p-value for skin care habits is 0.624, the p-value for atopic conditions is 0.136. This means that these factors have no effect on changes in skin hydration in this study.

Effects of Using Moisturizer on Skin Hydration

This section describes the percentage of skin hydration before and after using a moisturizer for 2 weeks. To find out whether there is a moisturizing effect on skin hydration in each group, a paired-sample t test was performed. The results of the analysis are presented in Table 3 and Table 4.

1. Regular moisturizing group (Control)

Table 3 Average Skin Hydration Before and After Using Regular Moisturizers For 2 weeks

Location	Average skin hydration (%)	t	p
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	Week 0	Week 2		
Upper arm	26,20±3,21	62,80±6,56	23,557	0,000
Forearm	25,63±2,27	54,67±5,49	19,443	0,000
Upper limbs	23,73±3,27	49,07±6,36	14,681	0,000
Lower limbs	22,00±2,12	49,77±10,21	10,417	0,000

Table 3 above shows the mean skin hydration of the control group at the four measurement locations before and after using regular moisturizer for 2 weeks. The results of the significance test with the paired-sample t test showed a p value <0.05. This means that the mean skin hydration after using regular moisturizer for 2 weeks showed a significant difference.

2. SI group 5%

Table 4 Average Skin Hydration Before and After Using SI 5% Moisturizer For 2 weeks

Location	Average skin hydration (%)		t	p
	Week 0	Week 2		
Upper arm	28,47±4,80	71,30±10,79	19,835	0,000
Forearm	26,63±2,68	63,93±9,24	18,503	0,000
Upper limbs	24,20±5,72	60,60±14,71	10,099	0,000
Lower limbs	22,00±2,13	41,57±6,95	11,144	0,000

Table 4 above shows the mean skin hydration of the 5% SI group (treatment) at the four measurement sites before and after using a moisturizer containing 5% SI for 2 weeks. The results of the significance test with the paired-sample t test showed a p value <0.05. This means that the mean skin hydration after using a moisturizer with an SI 5% for 2 weeks showed a significant difference.

Effects of Using Moisturizer on Week 0 to Week 3

In this section, the percentage of skin hydration after using moisturizer is presented. Presentation of results based on location. Based on the results of the normality test and homogeneity test, the data obtained were normally distributed and the data between groups was also homogeneous, so a parametric test was used, namely the independent-sample t test to analyze the differences between the control group and the treatment group. The results of the analysis are presented in Table 5 to Table 12.

1. Upper Arm

Table 5 Differences in the mean skin hydration of the upper arm of the control and treatment groups

Research time	Control (%)	SI 5% (%)	t	p
Week 0	26,20 ± 3,21	28,47 ± 4,80	1,520	0,140

Week 1	39,77 ± 5,28	43,13 ± 7,06	1,479	0,150
Week 2	61,80 ± 6,56	71,30 ± 10,79	2,913	0,007
Week 3	42,07 ± 6,22	57,43 ± 9,39	5,280	0,000

From Table 5 above, it was found that, at the location of the upper arm there was a significant difference in mean skin hydration in the 2 groups with independent-sample t test after 2 weeks of using moisturizer (week 2) and after a week of stopping it (week 3) ($p < 0,05$).

2. Forearm

Table 6 Differences in Forearm Skin Hydration Rates in Control and Treatment Groups

Research time	Control (%)	SI 5% (%)	t	p
Week 0	25,63 ± 2,27	26,63 ± 2,68	1,102	0,280
Week 1	37,33 ± 4,52	41,87 ± 8,24	1,868	0,072
Week 2	54,66 ± 5,49	63,93 ± 9,23	3,340	0,002
Week 3	37,93 ± 6,01	53,13 ± 7,88	5,937	0,000

Table 6 above, shows that:

At the location of the forearm there was a significant difference in the mean percentage of skin hydration in the 2 groups with independent-t test after 2 weeks of using moisturizer (week 2) and after a week of stopping it (week 3) ($p < 0.05$).

3. Upper Limb

Table 7 Differences in Limb Skin Hydration over Control and Treatment Groups

Research time	Control (%)	SI 5% (%)	t	P
Week 0	23,73 ± 3,27	24,20 ± 2,72	0,424	0,674
Week 1	33,40 ± 5,68	40,37 ± 14,71	2,864	0,008
Week 2	49,07 ± 6,36	60,60 ± 9,23	2,787	0,009
Week 3	34,87 ± 4,22	47,63 ± 8,45	5,234	0,000

Table 7 above, shows that at the location of the upper limbs there is a significant difference in mean skin hydration in 2 groups with independent-t test after 1 week of using moisturizer (week 1), 2 weeks of using moisturizer (week 2) and after a week of stopping it (week 3) ($p < 0.05$).

4. Lower Limb

Table 8 Differences in the mean skin hydration of the lower limbs in the control and treatment groups

Research time	Control (%)	SI 5% (%)	t	P
Week 0	22,00±2,13	22,60±3,23	0,600	0,553
Week 1	31,43±3,90	34,10±5,91	1,460	0,156
Week 2	41,57±6,95	49,77±10,21	2,570	0,016
Week 3	30,53±4,30	42,33±7,69	5,190	0,000

Table 8 above, shows that at the location of the lower limbs there is a significant difference in mean skin hydration in the 2 groups with the t-independent test after 2 weeks of using moisturizer (week 2) and after a week of stopping it (week 3) ($p < 0.05$).

Differences in Skin Hydration between Locations on Week 0 – Week 3

1. Upper Arm

Based on the measurement data, the mean skin hydration of the upper arm at week 0 – week 3 in the control group and the 5% SI group is presented in Figure 2 below:

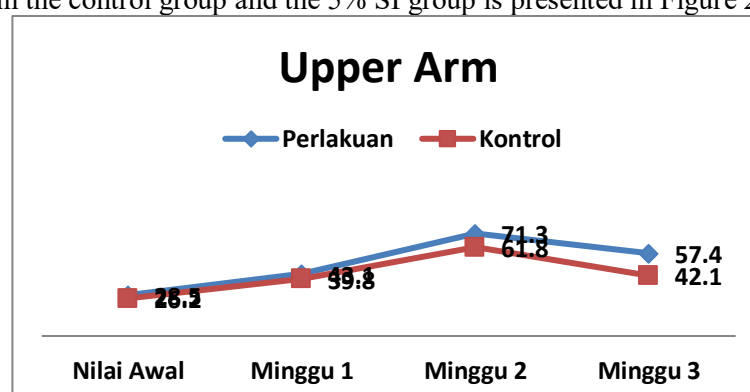


Figure 3 Average Skin Hydration of the Upper Arm Week 0 – Week 3

2. Forearm

The mean forearm skin hydration at week 0 – week 3 in the control group and the 5% SI group is presented in Figure 3 below.

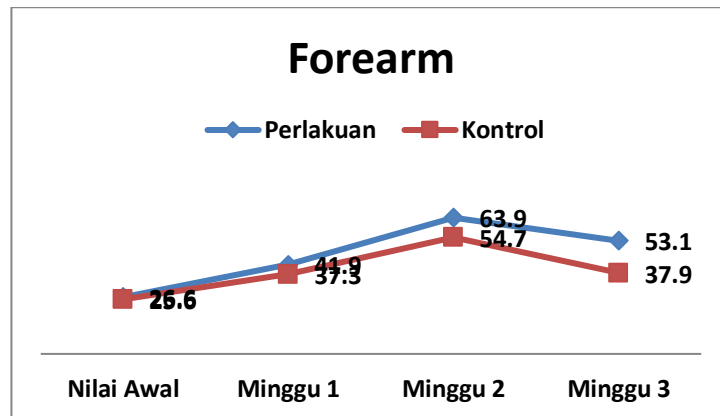


Figure 4 Average forearm Skin Hydration Week 0 – Week 3

3. Upper Limb

The mean skin hydration of the upper limbs at week 0 – week 3 in the control group and the 5% SI group is presented in Figure 4 below.

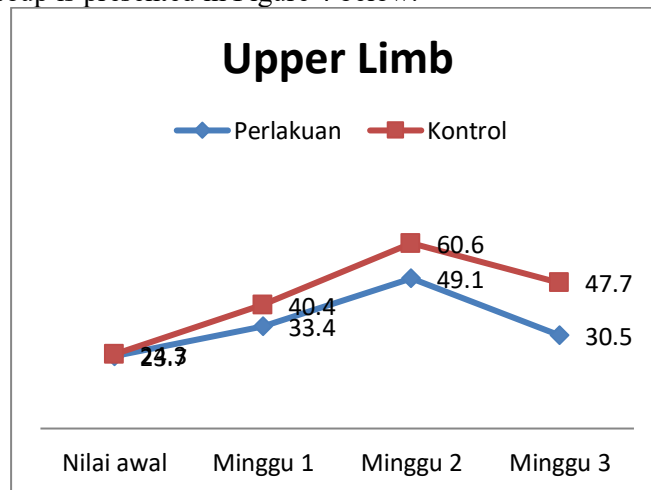


Figure 5 Average Skin Hydration of the Upper Limb Week 0 – Week 3

4. Lower Limb

The mean skin hydration of the lower limbs at week 0 – week 3 in the control group and the 5% SI group is presented in Figure 5 below.

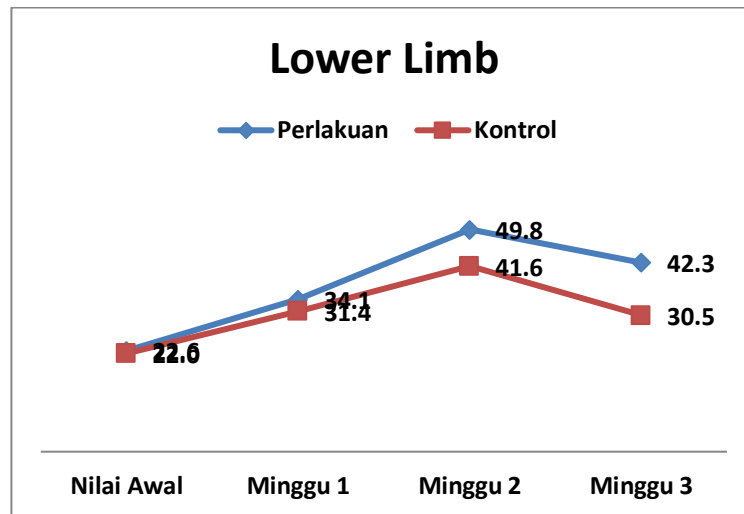


Figure 6 Average Skin Hydration of the Lower Limb Week 0 – Week 3

From the data above, the percentage increase in skin hydration in the SI group is 5% compared to the control group every week of measurement at each location, as follows (Figure 6):

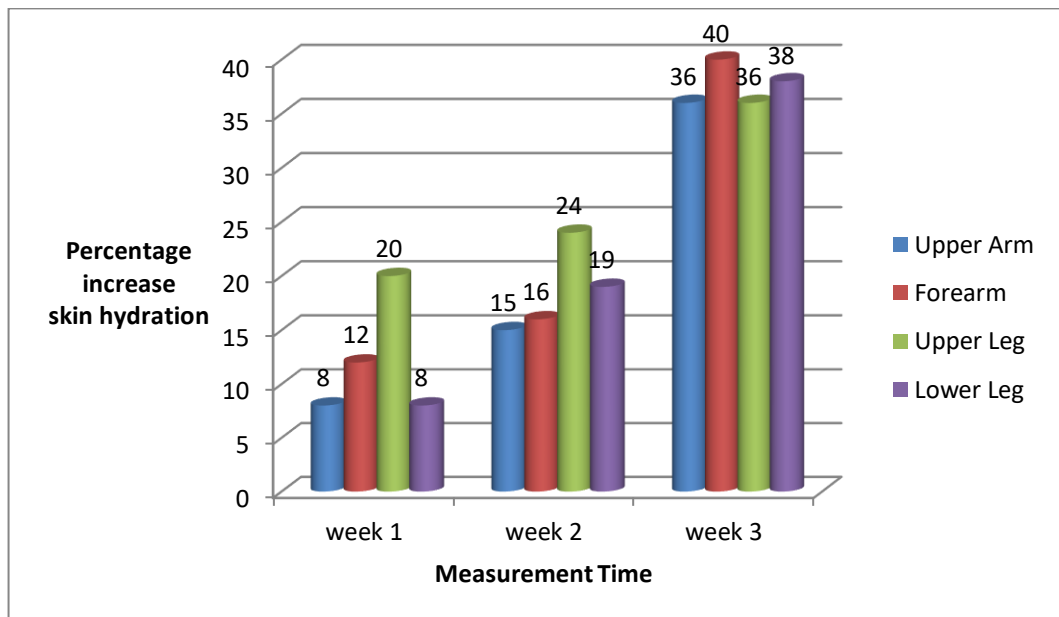


Figure 7. The Average Percentage of Increased Skin Hydration in the SI Group 5% Compared to the Control Group

Since the beginning of the measurement (before the use of moisturizer) there are differences in skin hydration at each measurement location. Presented in Figures 7 and 8.

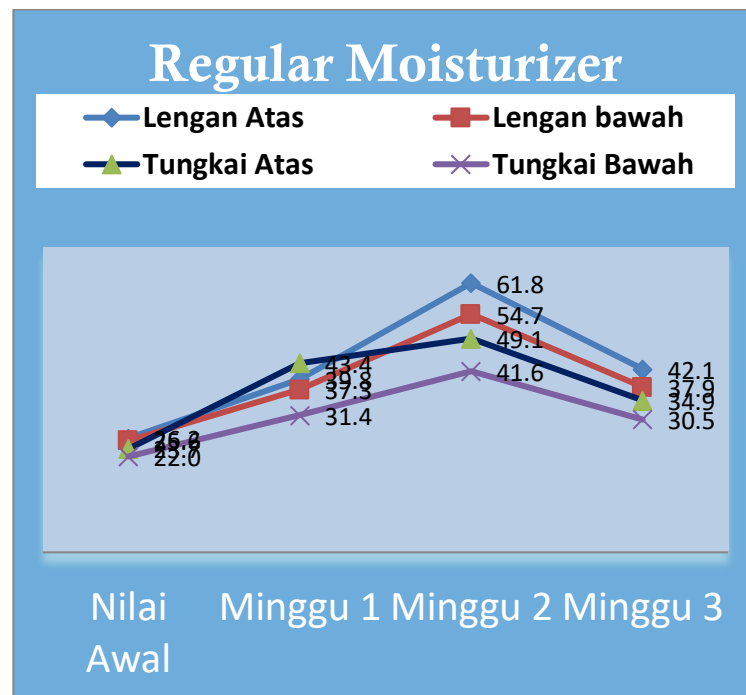


Figure 8 Skin Hydration at the Measurement Location of the Control Group

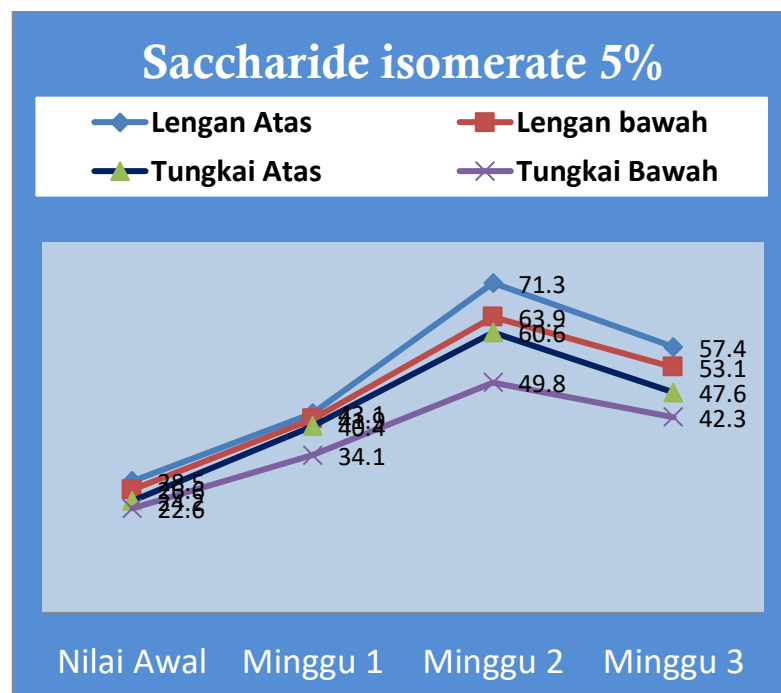


Figure 9 Skin Hydration at the SI Group Measurement Location 5%

Analysis of Significance with One Way Anova Test

From the results of skin hydration measurements at the four measurement locations, differences were found since the beginning of the study. For this reason, a significance analysis was carried out on the difference in the percentage of skin hydration at each measurement location using the One Way Anova test. Analyzes were carried out in both the control group and the 5% SI group from the start of the moisturizer use (0-week 3) until the week of stopping the moisturizer.

1. Regular moisturizer (Control)

Table 9 Average Skin Hydration for the Four Measurement Locations Every Week in the Control Group

Source of variation		SS	df	SB	F	P
week 0	Between Groups	164,479	3	54,826	7,139	0,000
	Within Groups	430,067	56	7,680		
	Total	594,546	59			
week 1	Between Groups	637,683	3	212,561	8,868	0,000
	Within Groups	1342,300	56	23,970		
	Total	1979,983	59			
week 2	Between Groups	3306,112	3	1102,037	27,216	0,000
	Within Groups	2267,600	56	40,493		
	Total	5573,712	59			
week 0	Between Groups	1068,317	3	356,106	12,809	0,000
	Within Groups	1556,833	56	27,801		
	Total	2625,150	59			

Table 9 above shows that: the mean skin hydration of the control group at each location and every week of measurement analyzed by One Way Anova test showed a significant difference ($p < 0.05$).

2. Moisturizer with SI 5%

Table 10 Average Skin Hydration of the Four Measurement Locations Every Week in the SI group 5%

Source of variation		SS	df	SB	F	P
week 0	Between Groups	302,746	3	100,915	8,385	0,000
	Within Groups	673,967	56	12,035		
	Total	976,712	59			
week 1	Between Groups	722,633	3	240,878	4,606	0,006
	Within Groups	2928,300	56	52,291		
	Total	3650,933	59			
week 2	Between Groups	3603,033	3	1202,011	9,204	0,000
	Within Groups	7313,367	56	130,596		
	Total	10919,400	59			

Groups					
Within Groups					
	1940.700	3	646,900	9,207	0,000
Total	3934,733	56	70,207		
	5875,433	59			

Table 10 above shows that: the mean skin hydration of the SI group was 5% at each location and every week the measurements were analyzed using the One Way Anova test showing a significant difference ($p < 0.05$).

CONCLUSION

Based on this study, it can be concluded that the addition of 5% saccharide isomerates in the formulation for moisturizers can increase skin hydration higher and can maintain higher skin hydration after discontinuation of administration compared to ordinary moisturizers. The results can be seen in this study that saccharide isomerates is one of the formulas that can be used in preventing skin aging. However, further research is needed to determine the mechanism of action of saccharide isomerates, especially in terms of signal transmission between cells in the skin moisturizing mechanism.

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