Acute Moisturizing Effect of Palm-based Lotions

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ABSTRACT

An acute moisturizing efficacy study was conducted by using MPOB's palm-based cosmetic products namely Palmianis lotion with vitamin E, goat's milk lotion and Whitening Lotion 1. A total of 13 volunteers were involved in the study. The skin hydration was measured several times at different intervals (30, 60, 90, 120 and 180 min) after a single application of the product. Full statistical analysis using ANOVA and Tukey Honestly Significantly Different (HSD) tests were carried out on the data using statistical software, SPSS®,. The results showed that all the three cosmetic products significantly increased skin hydration compared to the control. The products elevated the skin hydration level up to 34%-50% after 90 min of a single application and were able to maintain it for 90 min.

ABSTRAK

Satu kajian efikasi kelembapan kulit telah dijalankan ke atas produk kosmetik MPOB yang berasaskan minyak sawit iaitu losyen Palmianis dengan vitamin E, losyen susu kambing dan Losyen Pemutih 1. Seramai 13 sukarelawan telah mengambil bahagian dalam kajian ini. Selepas sekali penggunaan losyen tersebut, kelembapan kulit telah dicerapkan pada selang masa tertentu (30, 60, 90 120 dan 180 min). Analisis statistik iaitu ANOVA dan ujian Tukey Honestly Significantly Different (HSD) *telah dijalankan menggunakan perisian statistik, SPSS®,. Hasil kajian penggunaan ketiga-tiga produk kosmetik menunjukkan peningkatan kelembapan kulit yang signifikan berbanding kawalan. Produk-produk tersebut boleh meningkatkan tahap kelembapan kulit sebanyak 34%-50% selepas 90 min dengan sekali penggunaannya dan ia mampu mengekalkan tahap kelembapan tersebut pada 90 min berikutnya.*

INTRODUCTION

Efficacy tests are essentially designed to show that a product performs the function for which it is intended. For example, a moisturizer 'moisturizes' and a deodorant reduces or masks detectable body malodour. It is also a fundamental requirement that the cosmetic and toiletry manufacturers making claims about their products demonstrate that their claims are true. In order to fulfill this requirement without resorting to the use of animals, non-invasive skin bioengineering techniques are now being employed with human volunteers.

Most skin care products are aimed at replenishing moisture levels in the skin, or at least at preserving the existing level. One of the signs of firm and healthy skin is that it is well hydrated. Sufficiently hydrated skin is less prone to wrinkle formation and premature ageing. Thus, the appropriate moisturizing product for the consumer must be very effective to support the claims made by the manufacturers (Radez, 1997).

MOISTURIZATION

Water vapour is always lost at a slow rate from the skin surface. This is not the same as sweating which is a much more pronounced form of water loss and may appear as water droplets in relevant body areas. Any product, which reduces water loss enables the water to be retained within the skin and more particularly within the stratum corneum. This will enhance moisturization of the skin. Moisturization (Baker, 1987) is hence the ability of a preparation to increase the water content of the stratum corneum. Moisturizing creams, lotions and gels are applied for the relief of the signs and symptoms of dry skin, leaving it soft, smooth and supple. Many methods have been utilized to increase the moisture content of the stratum corneum:

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1. Retarding transepidermal water loss (TEWL) through the use of occlusive oils;

2. Use of strong humectants such as glycerin to draw water to the skin;

3. Use of hydrophilic matrices such as colloidal oatmeal and hyaluronic acid to act as a type of water blanket, providing protection as well as moisture to the skin; and

4. Use of UV light absorbing chemicals to prevent damage of cells which would otherwise dehydrate.

The most popular and common methods of achieving moisturization are use of emollients and humectants.

FACTORS AFFECTING SKIN HYDRATION

There are many factors affecting skin hydration measurements. Regional differences or site-to-site differences between the body areas can give variable readings (Rogiers *et al.*, 1990; Moseley *et al.*, 1985; Loden *et al.*, 1992). However, hydration of symmetrical parts of the body is generally identical except on the dorsum of the hands (Rogiers *et al.*, 1990). Therefore comparative left-right studies in the same selected skin sites should be preferable to avoid skin site difference. Other factors such as temperature, relative humidity (Clar *et al.*, 1975; Barel and Clarys, 1995) and seasonal variation (Leveque *et al.*, 1987) are known to significantly influence stratum corneum hydration.

Two types of moisturization tests can be conducted: long term and short term studies. Long term studies will show the product's moisturization power. However, environmental factors will be the major drawback as they also influence skin hydration. Short term moisturization evaluation is less sensitive to environmental influence and more reliable in determining the product's moisturization efficacy (Serup, 1992; Krostanje *et al.*, 1992). In this case, the skin hydration can be easily measured for a few hours after a single application of the product.

CAPACITANCE

Capacitance is a parameter that is closely related to electrical characteristics of any medium that conducts electricity. Since the skin and more particularly the stratum corneum is hydrated to a greater or lesser extent, it demonstrates electrical properties. A dry horny layer is a dielectrical medium with a dielectric constant below 7, as with most substances. Water on the other hand has a dielectric constant of 81 (Radez, 1997). When the layer is hydrated, a significant change in the dielectric properties of this medium is observed. So, the total capacitance is changed as a function of the degree of hydration of the skin. This method is very sensitive for measurements at low hydration and less sensitive at very high hydration values (> 110) (Blichman and Serup, 1988). It detects variation in dielectric constant of the skin to a depth of 60-100 mm. The presence of salts or ions on skin surface will increase the capacitance and level of reading.

In practice, an electric field is generated in the skin via the electrodes located in the hand-held probes of the instrument, and the resistance of the skin is measured using capacitance. Resistance to current flow is reduced in hydrated skin and higher capacitance values are registered in the presence of an effective moisturizer (Loden and Lindberg, 1991).

LOTIONS

Lotions are cosmetic products applied topically on the skin to obtain one or all of the following desired effects: moisturizing, moisture-retaining, softening, whitening and sun protecting. They are either oil in water (O/W) or water in oil (W/O) types of emulsion. The O/W type is the most predominantly available in the market. Lotions can be formulated using palm-based oleochemicals. Oleochemicals such as glycerine, fatty acids (lauric, myristic, palmitic, stearic acids), fatty alcohols and their esters are widely used in lotion formulations for various purposes such as emollients, emulsifying agents, humectants and stabilizers. Since palm-based oleochemicals are plant derived, products formulated from them are natural and are expected to be mild, environmentally friendly and acceptable to all religions.

Palmianis lotion for example is formulated with 98% palm-based materials with the other 2% comprising preservatives and perfume. The oleochemicals used are of highest grade (99% purity) and typical examples are listed below. Lotions with different feel and characteristics can be formulated by varying the percentages of the raw materials used. For specific function or nichness, other active ingredients can be included in the formulation, such as vitamin E for anti-ageing, arbutin and kojic acid for whitening and sunscreen agents for sun protection.

PRINCIPLE OF METHODS

Selection of Subjects

Criteria for recruitment. All subjects were well informed of the aims of the test and any risks or consequences involved. Each subject was required to countersign the consent form before admission to the protocol.

A total of 13 subjects, three males and 10 females, aged between 22 and 54 (average age 31 years), in good health and free from skin infections, were included in the study. The selection was made according to the inclusion and exclusion criteria listed below.

Inclusion Criteria

- Race: Caucasian (11 subjects) and Malay (2 subjects).
- Age: adult from 22 to 54 years old.
- State of health: absence of disease during and immediately preceeding the study.
- Knowledge of the English language.
- Easily contactable.

Exclusion Criteria

- Subjects who do not conform to the inclusion criteria.
- Pregnant and breast-feeding women.
- Subjects affected by temporary or chronic skin diseases.
- Subjects with a history of intolerance to drugs, cosmetic products and nickel.

Restrictions

For the whole duration of study that is four hours, the following restrictions were imposed on the subjects: avoid washing their hands with water or covering the test areas with cloth.

INSTRUMENT

Corneometer

The corneometer (corneometer CM 820 PC Courage & Khazaka) consists of a square-shaped sensor with a special glass covering the front, on a mobile axis (area: 49 mm^2), connected to the base unit by a spiral cable. When the front surface of the sensor is pressed against the skin, a number (maximum three figures) appears on the liquid crystal display. The measurement must be made on a flat area, taking care to use constant pressure, to avoid provoking occlusion phenomena with the probe. The corneometer CM 820 is based on the capacitance method.

METHOD

Each volunteer was instructed not to wash or use any other product on his/her forearm for at least five hours before the test. The evaluation was carried out on the forearm, in an area of 6 cm^2. Two areas of 6 cm^2 were marked on each forearm, three areas were treated with the products, while one area was left untreated as control. The products were randomly applied on the four marked areas of the forearms of the volunteers. Before applying the product and recording the parameter, the subjects stayed for 30 min in a conditioned room (24°C, 50% relative humidity) with their forearms exposed to allow the skin to adapt to the temperature and humidity of the room. After the basal corneometric evaluation, the product was applied (0.25 g) in the area defined before. The product was uniformly placed by means of a rubber finger-stall and left to dry for 30 min, after which several hydration measurements were made at fixed intervals (30, 60, 90, 120 and 180 min).

Mathematical Elaboration

To evaluate the data, the means and standard deviations were calculated for the groups of values (different times of readings).

The differences between the final and the basal data were then calculated:

T_f - T_o = variation of the parameter

Where,

T_f = data recorded at times T_{30m}, T_{60m}, T_{90m}, T_{120m} and $T_{180m.}$
T_o = data recorded at $T_{o.}$
The variation % is also reported.

Data were compared using ANOVA and Tukey HSD tests. ANOVA was carried out to determine if there was any significant difference in a set of data while Tukey test was used to detect any significant differences in multiple comparisons between the data. All statistical analyses were conducted at 95% confidence limit or at significance level, $\alpha = 0.05$. A statistical analysis is considered significant if the probability value is lower than or equals the significance level, α. All statistical analyses were carried out using a statistical software, SPSS®, V9.0.

RESULTS AND DISCUSSION

Control

Results of hydration measurements of each of the 13 subjects on the untreated area are listed in *Table 1*. *Table 1* shows that for untreated areas, the cormeometer recorded a slight increase in hydration between 10% to 16%. It is attributed to normal slow water vapour loss from the skin surface. ANOVA was carried out on control data and the results showed no significant difference was detected among the different measurement times with probability value, $p = 0.819$. Tukey HSD test was not carried out as ANOVA did not detect any significant difference in the control data.

TABLE 1. HYDRATION VALUES AT DIFFERENT TIMES ON UNTREATED AREA

Subject	T0	T30	T60	T90	T120	T180	T30-T0	T60-T0	T90-T0	T120-T0	T180-T0
1	43	50	51	46	50	46	7	8	3	7	3
2	33	28	35	37	34	33	-5	2	4	1	0
3	30	35	36	32	31	32	5	6	2	1	2
4	27	28	30	33	29	28	1	3	6	2	1
5	30	38	33	36	35	34	8	3	6	5	4
6	39	50	47	46	41	47	11	8	7	2	8
7	31	29	30	29	30	31	-2	-1	-2	-1	0
8	23	24	27	25	26	26	1	4	2	3	3
9	43	62	59	55	59	49	19	16	12	16	6
10	27	34	32	31	33	30	7	5	4	6	3
11	33	42	45	41	42	44	9	12	8	9	11
12	51	55	52	53	52	54	4	1	2	1	3
13	35	34	31	53	34	36	-1	-4	18	-1	1
Ave ± s.d	34 ± 8	39 ± 12	39 ± 10	38 ± 9	38 ± 10	38 ± 9	5 ± 6	5 ± 5	4 ± 4	4 ± 5	3 ± 3
						% Variation	14	14	16	11	10

Notes:
Ave: average; s.d = standard deviation.

Palmianis Lotion with Vitamin E

Results of hydration measurements on each of the 13 subjects treated with Palmianis lotion with vitamin E are listed in *Table 2*.

Data in *Table 2* indicates that the difference in hydration values increased 30, 60, 90 and 120 min after application of Palmianis lotion with vitamin E. The value reduced after two hours of product application. ANOVA was carried out and significant differences were detected among the different times with a probability value, $p < 0.001$. A single application of Palmianis lotion with vitamin E significantly increased skin hydration by 47% within 90 min and maintained it for the next 90 min.

Multiple comparisons between the times were carried out with Tukey HSD to determine whether the differences between them were statistically significant. *Table 3* shows that the increases were statistically significant at 30, 60, 90, 120 and 180 min. There was no significant difference with other comparisons.

Goat's Milk Lotion

Results of hydration measurements on each of the 13 subjects treated with goat's milk lotion are listed in *Table 4*.

The data indicates that the hydration values increased 30, 60, 90 and 120 min after application of goat's milk lotion and reduced after two hours of product application. ANOVA on the data detected significant differences among the different times with a probability value, $p = 0.001$. A single application of goat's milk lotion significantly increased skin hydration by 43% within 120 min.

TABLE 2. HYDRATION VALUES AT DIFFERENT TIMES ON SUBJECTS TREATED WITH PALMIANIS LOTION

Subject	T0	T30	T60	T90	T120	T180	T30-T0	T60-T0	T90-T0	T120-T0	T180-T0
1	40	43	45	63	63	62	3	5	23	23	22
2	29	33	43	47	44	47	4	14	18	15	18
3	31	42	41	40	48	45	11	10	9	17	14
4	30	38	42	46	45	43	8	12	16	15	13
5	31	44	44	50	49	51	13	13	19	18	20
6	40	39	56	61	59	58	-1	16	21	19	18
7	31	49	47	52	49	51	18	16	21	18	20
8	28	41	37	37	41	43	13	9	9	13	15
9	43	62	63	53	59	47	19	20	10	16	4
10	25	39	44	44	50	43	14	19	19	25	18
11	40	55	61	60	62	62	15	21	20	22	22
12	55	56	67	67	67	62	1	12	12	12	7
13	39	49	51	56	49	56	10	12	17	10	17
Ave ± s.d	36 ± 8	45 ± 7	49 ± 9	52 ± 9	53 ± 9	52 ± 8	10 ± 6	14 ± 5	16 ± 5	17 ± 4	16 ± 5
						% Variation	27	39	47	49	45

Notes:
Ave: average; s.d = standard deviation.

TABLE 3. PROBABILITY VALUES (P) AFTER MULTIPLE COMPARISONS WITH TUKEY HSD TEST

Time	T0	T30	T60	T90	T120	T180
T0	-	**0.048**	**0.001**	**< 0.001**	**< 0.001**	**< 0.001**
T30	-	-	0.848	0.366	0.258	0.448
T60	-	-	-	0.966	0.913	0.985
T90	-	-	-	-	1.000	1.000
T120	-	-	-	-	-	0.999
T180	-	-	-	-	-	-

Note: * Bold numbers indicate significant differences with probability value, $p < 0.05$.

TABLE 4. HYDRATION VALUES AT DIFFERENT TIMES ON SUBJECTS TREATED WITH GOAT'S MILK LOTION

Subject	T0	T30	T60	T90	T120	T180	T30-T0	T60-T0	T90-T0	T120-T0	T180-T0
1	43	50	58	58	59	56	7	15	15	16	13
2	35	36	39	40	54	49	1	4	5	19	14
3	32	36	32	31	40	49	4	0	-1	8	17
4	28	48	50	48	47	43	20	22	20	19	15
5	33	31	44	45	49	43	-2	11	12	16	10
6	36	44	57	57	55	49	8	21	21	19	13
7	39	48	49	55	54	54	9	10	16	15	15
8	23	36	28	36	34	34	13	5	13	11	11
9	40	49	46	43	44	39	9	6	3	4	-1
10	23	41	43	41	46	42	18	20	18	23	19
11	40	57	57	54	55	52	17	17	14	15	12
12	54	47	58	58	67	61	-7	4	4	13	7
13	33	57	49	53	51	49	24	16	20	18	16
Ave ± s.d	35±8	45±8	47±10	48±9	50±8	48±7	9±9	12±7	12±7	15±5	12±5
						% Variation	26	33	35	43	35

Notes:
Ave: average; s.d = standard deviation.

Multiple comparisons between the times and basal values with Tukey HSD showed statistically significant increase in skin hydration after 60, 90, 120 and 180 min of product application. The test also did not detect any significant differences in other comparisons as shown in *Table 5.*

Whitening Lotion 1

Results of skin hydration measurements on each of the 13 subjects treated with Whitening Lotion 1 are listed in *Table 6.*

TABLE 5. PROBABILITY VALUES (P) AFTER MULTIPLE COMPARISONS WITH TUKEY HSD TEST

Time	T0	T30	T60	T90	T120	T180
T0	-	0.074	**0.011**	**0.006**	**< 0.001**	**0.006**
T30	-	-	0.983	0.947	0.524	0.941
T60	-	-	-	1.000	0.906	1.000
T90	-	-	-	-	0.962	1.000
T120	-	-	-	-	-	0.966
T180	-	-	-	-	-	-

Note: * Bold numbers indicate significant differences with probability value, $p < 0.05$.

TABLE 6. HYDRATION VALUES AT DIFFERENT TIMES ON SUBJECTS TREATED WITH WHITENING LOTION

Subject	T0	T30	T60	T90	T120	T180	T30-T0	T60-T0	T90-T0	T120-T0	T180-T0
1	41	49	54	51	54	53	8	13	10	13	12
2	30	41	48	49	53	45	11	18	19	23	15
3	29	37	35	36	42	48	8	6	7	13	19
4	29	44	49	56	53	49	15	20	27	24	20
5	32	36	35	45	47	43	4	3	13	15	11
6	34	51	61	58	52	50	17	27	24	18	16
7	32	53	49	51	49	49	21	17	19	17	17
8	24	25	27	40	37	32	1	3	16	13	8
9	42	53	40	60	60	51	11	-2	18	18	9
10	27	34	38	43	47	38	7	11	16	20	11
11	40	57	63	62	57	54	17	23	22	17	14
12	44	44	49	60	58	53	0	5	16	14	9
13	35	42	53	50	55	45	7	18	15	20	10
Ave ± s.d	34±6	43±9	46±11	51±9	51±7	47±6	10±6	13±9	17±5	17±4	13±4
						% Variation	29	37	51	51	39

Notes:
Ave: average; s.d = standard deviation.

Whitening Lotion 1 was able to increase skin hydration by 51% after a single application of the product. The value reduce after two hours of product application. ANOVA on the data detected significant differences among the times with a probability value, $p < 0.001$.

Multiple comparisons between the times and basal values with Tukey HSD showed statistically significant increases in skin hydration after 30, 60, 90, 120 and 180 min of product application. The Tukey test did not detect any significant differences in other comparisons as shown in *Table 7.*

TABLE 7. PROBABILITY VALUES (P) AFTER MULTIPLE COMPARISONS WITH TUKEY HSD TEST

Time	T0	T30	T60	T90	T120	T180
T0	-	**0.031**	**0.002**	**< 0.001**	**< 0.001**	**0.001**
T30	-	-	0.956	0.198	0.171	0.889
T60	-	-	-	0.686	0.639	1.000
T90	-	-	-	-	1.000	0.812
T120	-	-	-	-	-	0.773
T180	-	-	-	-	-	-

Note: * Bold numbers indicate significant differences with probability value, $p < 0.05$.

Comparison between the Palm-based Lotions

ANOVA was carried out to determine if there are any significant differences between the test products. The results showed significant differences only after 90, 120 and 180 min of product application as shown in *Table 8*.

Multiple comparisons between the products at 90, 120 and 180 min were carried out using the Tukey HSD. *Tables 9, 10* and *11* show Tukey test results, which only detected significant differences in products when compared to control. There were no significant differences in other comparisons. Therefore, the palm-based lotions have similar ability in hydrating the skin.

The forearm area treated with each of the products, Palmianis lotion with vitamin E, goat's milk lotion and Whitening Lotion 1 showed statistically significant differences compared to the control sites. The products could elevate skin hydration up to 35%-51% after 90 min of single application and were able to maintain it for the next 90 min as shown in *Figure 1*.

TABLE 8. ANOVA BETWEEN PRODUCTS AT DIFFERENT TIMES

Time (min)	0	30	60	90	120	180
Probability value, p	0.925	0.348	0.071	**0.001**	**< 0.001**	**< 0.001**

Note: * Bold numbers indicate significant differences with probability value, $p < 0.05$.

TABLE 9. PROBABILITY VALUES (P) AFTER TUKEY HSD TEST AT 90 MIN

Lotion	Control	Palmianis	Goat's milk	Whitening
Control	-	**0.001**	**0.044**	**0.004**
Palmianis	-	-	0.600	0.988
Goat's milk	-	-	-	0.794
Whitening	-	-	-	-

Note: * Bold numbers indicate significant differences with probability value, $p < 0.05$.

TABLE 10. PROBABILITY VALUES (P) AFTER TUKEY HSD TEST AT 120 MIN

Lotion	Control	Palmianis	Goat's milk	Whitening
Control	-	**< 0.001**	**0.003**	**0.002**
Palmianis	-	-	0.897	0.961
Goat's milk	-	-	-	0.997
Whitening	-	-	-	-

Note: * Bold numbers indicate significant differences with probability value, $p < 0.05$.

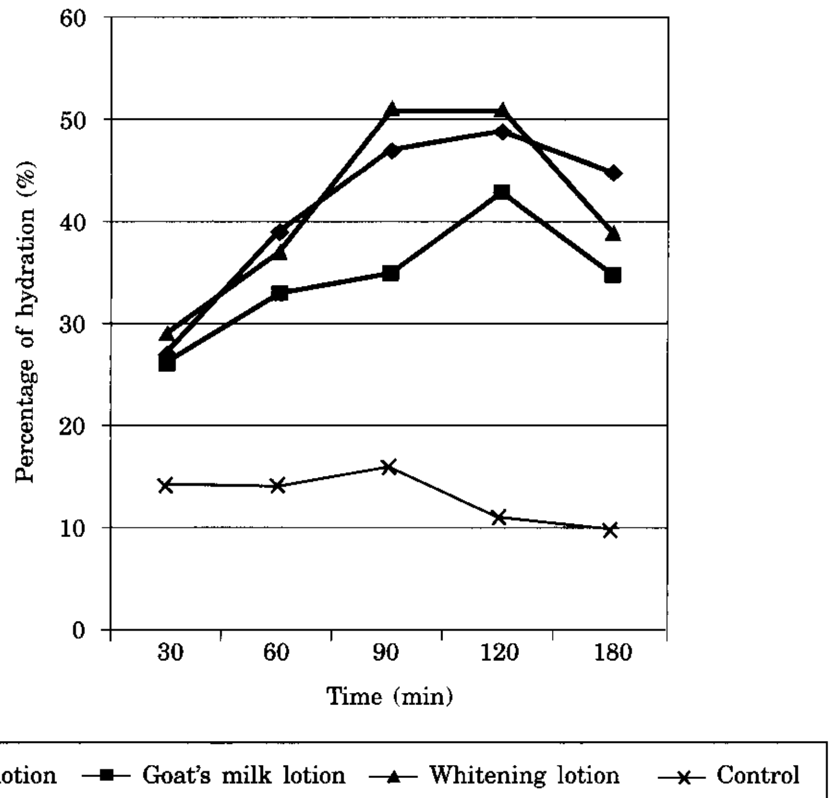

Figure 1. Acute moisturizing effect of Palmianis lotion with vitamin E, goat's milk lotion and Whitening Lotion 1 compared to control.

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TABLE 11. PROBABILITY VALUES (P) AFTER TUKEY HSD TEST AT 180 MIN

Lotion	Control	Palmianis	Goat's milk	Whitening
Control	-	**< 0.001**	**0.009**	**0.018**
Palmianis	-	-	0.581	0.426
Goat's milk	-	-	-	0.994
Whitening	-	-	-	-

Note: * Bold numbers indicate significant differences with probability value, $p < 0.05$.

CONCLUSION

Generally, all palm-based lotions showed a rapid increase in skin hydration within 30 min of product application. A single application of palm-based lotions was able to increase skin hydration by at least 35% within 180 min of product application. Palmianis lotion with vitamin E and goat's milk lotion increased skin hydration by 47% and 43%, respectively within 90 min of application and were able to maintain this for the next 90 min. Whitening Lotion 1 increased skin hydration by 51% within 90 min and was able to maintain it for the next 30 min. The palm-based lotions had similar performance in elevating skin hydration.

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