

SKIN CARE FORMULATION INCORPORATING SODIUM LACTATES, SODIUM PCA AND LAURYL PCA: COMPARATIVE MOISTURISING EFFICACY ON ASIAN SKIN

Rosnah Ismail* and Salmiah Ahmad*

*Malaysian Palm Oil Board (MPOB) - Malaysia

Sodium lactates, sodium PCA and lauryl PCA are known Natural Moisturizing Factor (NMF) commonly used in skin care formulations. In this paper, moisturizing efficacy of oil-in-water (O/W) based emulsion containing 3% glycerin use as placebo and with additional NMF @1%, 3% and 5% active were conducted *in-vivo* on 36 Asian subjects consisting of a mixture of one Indian, two Chinese and the rest Malays including 21 females and 15 males, age between 23 to 45 years old (average 32 years). The subjects were divided into 3 groups of 12 subjects and each group was assigned to a set of formulae containing the NMF @1%, 3% and 5% active respectively.

The moisturizing efficacy was measured using Corneometer 820 CM (Courage & Khazaka) in a conditioned room ($22 \pm 2^{\circ}\text{C}$, $50 \pm 5\%$ relative humidity). Subjects were required to stay for half an hour in the conditioned room before measurement was made. The product (0.25g) was applied randomly on designated area of 6 cm^2 on the subject's forearm, after which, several hydration measurements were made at fixed intervals (30, 60, 90, 120 and 180 minutes). One area was left untreated as control.

The results indicated that @1% active, the moisturising efficacy of all three NMF increased significantly compared to untreated area as well the placebo to more than 25% but no significant different between them. At 3%, sodium lactates performed slightly better than either sodium PCA or lauryl PCA, while @5%, sodium lactates reached maximum skin hydration immediately after 30 minutes application, while sodium PCA and lauryl PCA, reached maximum hydration after 60 minutes application, there after maintained the skin hydration throughout the test duration, unlike @1% active, which showed decreasing in trend after 90 minutes application. Overall sodium lactates performed best in all tested concentrations. There was no significant difference between sodium PCA and lauryl PCA at all tested concentrations. These results show that 1) in PCA structures, the hydrophilic-lipophilic balance does not influence skin moisturisation performances 2) the free OH group in lactate is important in determining its activity 3) the importance of selecting the right concentration in order to increase the driving force for skin penetration in ionic species and 4) moisturizing actives require adequate investigation on their use concentration for getting the required efficacy. Long-term moisturisation studies are also being investigated.

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INTRODUCTION

The skin has the property to retain water in order to maintain its proper barrier function. In situations of environmental stress, age or intrinsic physiological disturbances, this function is maintained only in part. The water storage capacity of the skin decreases with an increased water loss by evaporation (transepidermal water loss, TEWL), resulting in a dry, deep-wrinkled or even squamous skin. The reconstitution of skin moisture is thus one of the main targets for skin care formulations.

Principally skin moisture can be improved either by hydrophilic substances binding water on the skin surface (humectants) [1], or by enriching the natural moisturizing factor (NMF) of the skin [2,3,4,5]. Typical examples of humectants are glycerol, sorbitol and propylene glycol. On the other hand, NMF is a complex mixture of low molecular weight, water-soluble compounds such as amino-acids (mainly serine, alanine and citroline), pyrrolidone carboxylic acid (PCA), lactic acid, or their respective salts, and urea, which are naturally present in the stratum corneum [6].

This paper highlighted a comparative moisturizing efficacy of skin care formulation based on an O/W emulsion incorporating various NMF i.e. sodium lactates, sodium PCA and lauryl PCA at various concentrations @1%, 3% and 5% active against a placebo containing a humectant, glycerin @3%. The study was conducted at the Efficacy Laboratory, AOTD (Advanced Oleochemical Technology Division), MPOB (Malaysian Palm Oil Board), Malaysia on Asian skin namely Malaysian.

MATERIALS AND METHODS

Test substances

The NFM used in the O/W emulsion are sodium lactates (PURASAL S/HQ 60), Sodium PCA (Nalidone) and Lauryl PCA (Dermidrol L) and the concentrations used

are @1%, 3% and 5% actives. The placebo O/W emulsion also contained glycerin @3%.

Methods

Subjects were instructed not to wash or use any other product on their forearms for at least 5 hours before the test. The evaluation was conducted on volar forearms, two areas of 6 cm² were marked on each forearm and treated with the products, while one area on the upper arm was left untreated and used as control. The product (0.25gm) was applied uniformly and randomly in the defined area and let to dry for 30 minutes, after which several hydration measurements were made at fixed intervals (30, 60, 90, 120 and 180 minutes).

For the long-term efficacy, the subjects continued to apply the products twice daily for 2 weeks on the designated areas. Skin moisture was measured on Day 7 and 14, 12 hours after the last application.

The moisturising efficacy was conducted on 36 subjects consisting of a mixture of one Indian, two Chinese and the rest Malays including 21 females and 15 males, age between 23 to 45 years old (average 32 years). The subjects were divided into 3 groups of 12 subjects and each group was assigned to a set of formulae containing the NMF @1%, 3% and 5% actives respectively, together with the placebo as a control.

Statistics

Data obtained was analyzed using Analysis of Variance (ANOVA), to determine if there was any significant difference in a set of data, and Tukey HSD test to detect any significant difference in multiple comparisons between the data. All statistical analyses are conducted at 95% confidence limit or at significance level, $\alpha = 0.05$.

Moisture Measurement

The skin moisture was measured using a Corneometer CM 820 (Courage & Kazaka, Germany). Prior to measurement, subjects were conditioned for 30 minutes in a

conditioned atmosphere ($22\pm 2^{\circ}\text{C}$, $50\pm 5\%$ relative humidity) with their forearms uncovered to let the skin adapt to the temperature and humidity of the room.

RESULTS

The short-term moisturising efficacy are shown in Figures 1-3, a) indicates skin moisture in corneometric unit (c.u.) while b) skin moisture in percentage. All three natural moisturizers performed equally @1% active, @3% sodium lactates performed slightly better than either sodium PCA or lauryl PCA, while @5%, sodium lactates reached maximum skin hydration immediately after 30 minutes application, while sodium PCA and lauryl PCA, reached maximum hydration after 60 minutes application and there after maintained it throughout the test duration. Generally the moisturising effect of all NMF at all concentrations are significant compared to the non-treated skin area and also enhanced the moisturizing efficacy of the placebo containing 3% glycerin significantly ($p < 0.001$)

For the long-term efficacy, increase in skin moisture with time was also observed. At 1% and 3%, sodium lactates seemed to perform better than either lauryl PCA or sodium PCA. However, @5%, all three NMF performed equally. In all cases, the skin moisture of the placebo was enhanced with incorporation of the NMF at all concentrations after 2 weeks application. Statistically there was no significant difference between the three natural NMF at all tested concentrations. The results were as indicated in Figures 4-6.

DISCUSSION

The design of the moisturising efficacy studies was based on EEMCO (European Group for Efficacy Measurement on Cosmetics and other Topical Products) guidance [7]. It was conducted in a controlled environment ($22 \pm 2^{\circ}\text{C}$, $50 \pm 5\%$ relative humidity) and controlled procedures such as one operator and allowing the subjects to acclimatize at least 20-30 minutes to the room conditions before measurements are observed accordingly [7,8]. The results were reported in terms of corneometric units (arbitrary units) as recommended [9] and also in term of percentage increase to see the different effects of the actives.

For long-term moisturizing efficacy, the measurement was obtained at least 8-12 hours after the last product application as recommended [7]. Normally, in use test requires at least 2 applications per day for example once in the morning and once at night. In this study, besides the placebo as comparison, an area of the upper arm was also used as a control (untreated) throughout the duration of the study. It was observed, the basal skin moisture of the upper arm was slightly higher than the lower arm. However, statistically it was no significant difference. The same was observed in the previous study to find an alternative site for long-term efficacy [10].

CONCLUSION

The moisturising efficacy results of the NMF showed that 1) in PCA structures, the hydrophilic-lipophilic balance does not influence skin moisturisation performances 2) the free OH group in lactate is important in determining its activity 3) the importance of selecting the right concentration in order to increase the driving force for skin penetration in ionic species and 4) moisturizing actives require adequate investigation on their use concentration for getting the required efficacy.

It is a common practice to include humectants such as glycerol in the skin care formulation as it helps to moisturize the skin. Depending on the cost of the NMF, formulators have the choice to choose which NMF to enhance and optimize the moisturizing efficacy of a skin care formulation containing glycerol. As observed from the long-term efficacy, @1% active NMF can enhance 3 times the moisturizing efficacy of a formulation containing 3% glycerol.

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Results of short-term moisturizing efficacy

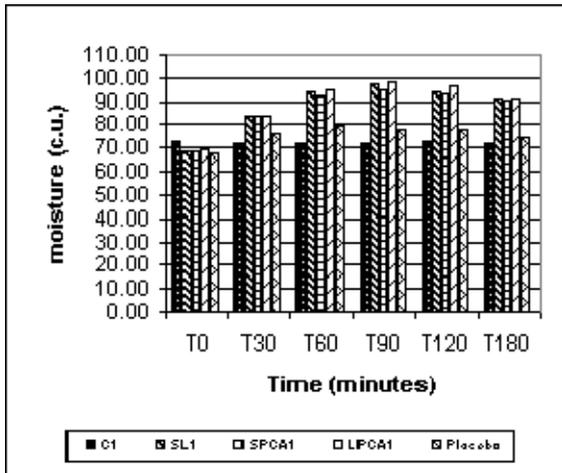


Figure 1a - Skin moisture (c.u.) @1% active

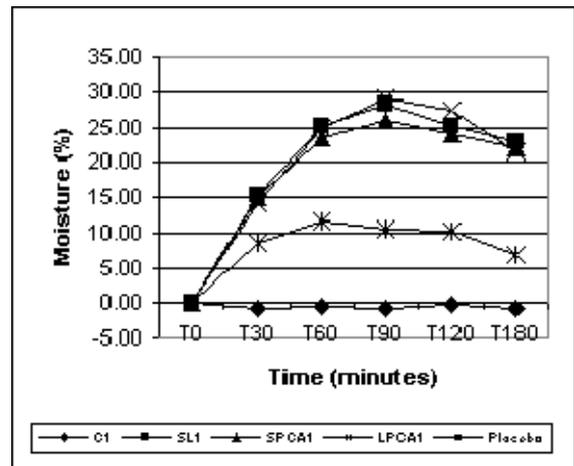


Figure 1b - Skin moisture (%) @1% active

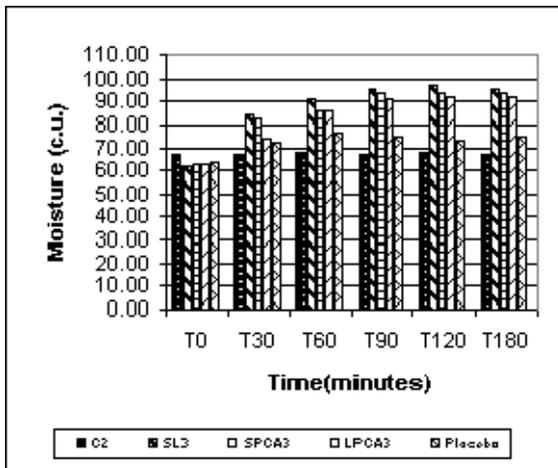


Figure 2a - Skin moisture (c.u.) @3% active

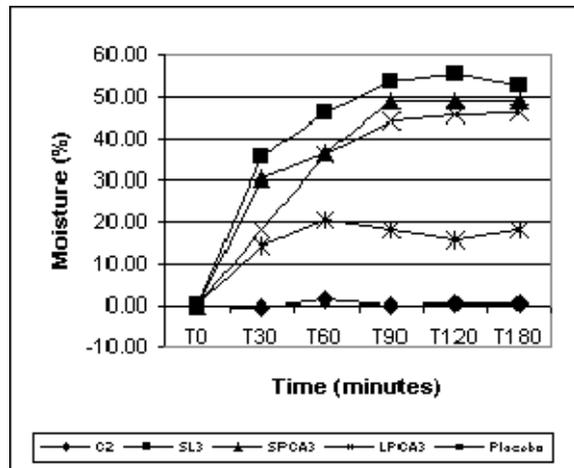


Figure 2b - Skin moisture (%) @3% active

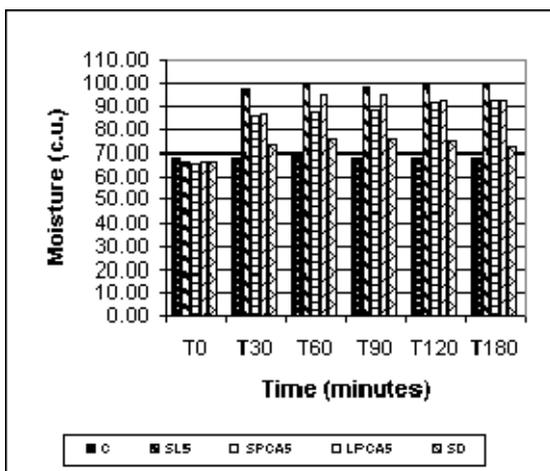


Figure 3a - Skin moisture (c.u.) @5% active

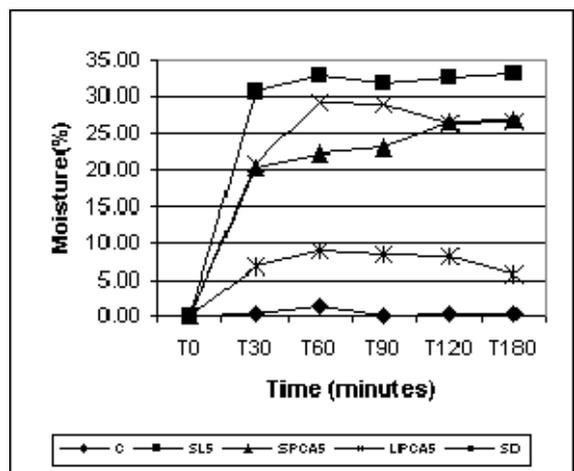


Figure 3b - Skin moisture (%) @5% active

Results of long-term moisturizing efficacy

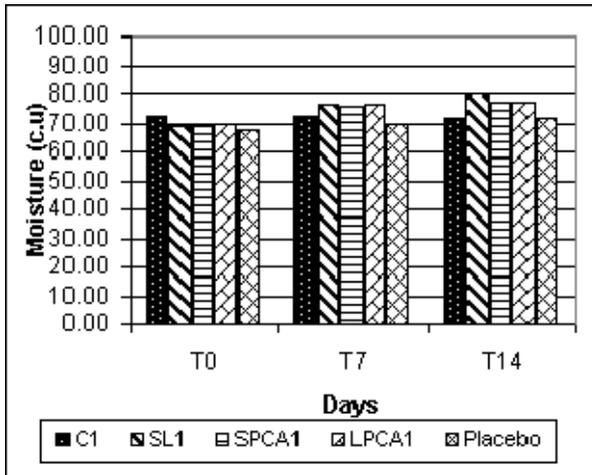


Figure 4a - Skin moisture (c.u.) @1% active

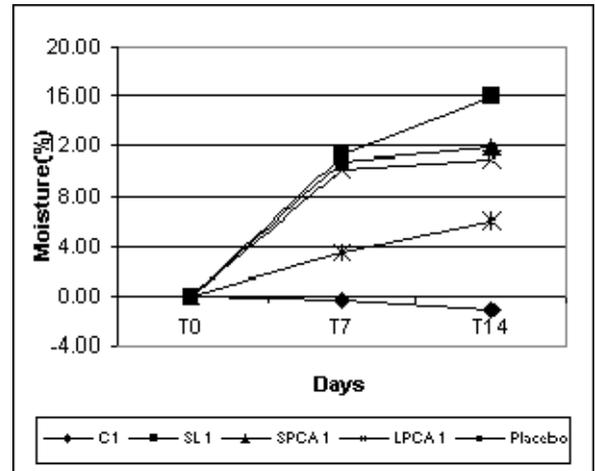


Figure 4b - Skin moisture (%) @1% active

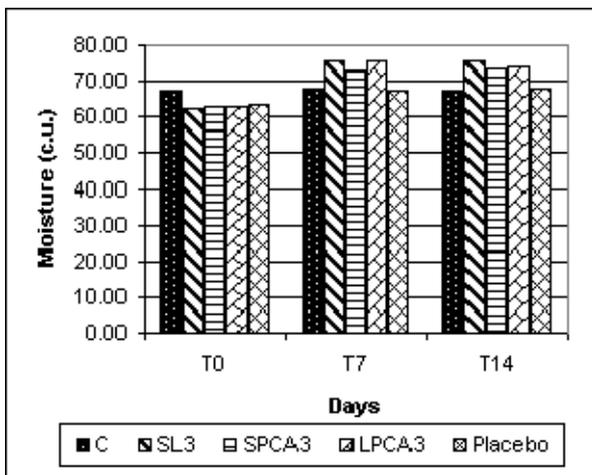


Figure 5a - Skin moisture (c.u.) @3% active

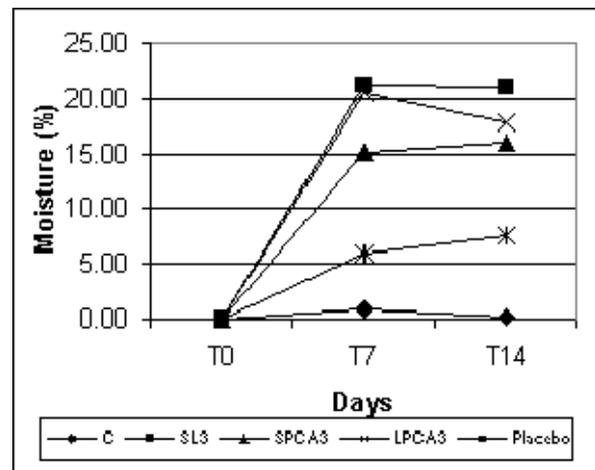


Figure 5b - Skin moisture (%) @3% active

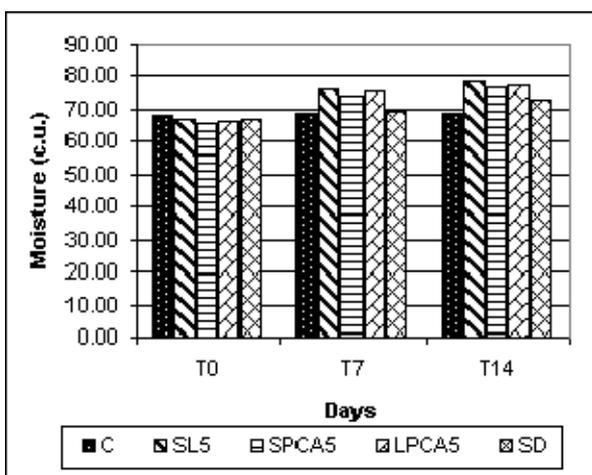


Figure 6a - Skin moisture (c.u.) @5% active

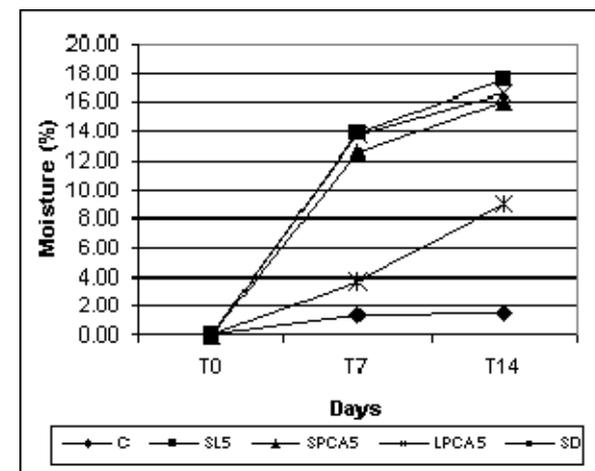


Figure 6b - Skin moisture (%) @5% active