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Foundation products have a measureable impact on moisturization

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Synopsis

Multifunctional products are becoming more prevalent in the color cosmetics market. We evaluated four foundation products for *in vivo* moisturizing benefits using the mini-regression test method. We found that statistically significant long-lasting moisturization was provided by the foundations tested, but only if hygroscopic moisturizing ingredients were present.

INTRODUCTION

Today's consumers are increasingly looking for products that offer multifunctionality, and cosmetics are no exception. Women prefer product formulations that offer benefits beyond basic makeup. One such benefit that is appealing to a broad base of consumers is moisturization (1). Dermatologists and makeup artists alike recommend keeping the facial skin moisturized to ensure optimal skin health and appearance. This advice extends across all facial skin types.

Although much work has been done to assess the efficacy of moisturizers, less is known about the ability of a color cosmetic product to have lasting, measurable effects on skin. In particular, this study examined the ability of a foundation to have a measureable impact on skin hydration when applied under real wear conditions—once per day, remaining on the skin for approximately 8 h before being washed off. To assess a cosmetic's impact on skin hydration, we made skin impedance measurements. The measurement of skin impedance (the total electrical resistance of the skin to an applied alternating current) provides a simple and well-established technique to assess the hydration of the skin surface (2). Skin surface hydration changes are a contributor to skin dryness and can be used to evaluate moisturization of the skin (3).

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The accepted way of comparing the moisturizing performance of skin care products is to determine how long the moisturizing effect on the skin is sustained after treatment is stopped, which is known as the regression method. This method was first developed by Kligman (4), who assessed skin dryness at various time points after discontinuation of daily treatment with a moisturizer for a number of weeks. In the original method, dryness measurements continued until the skin regressed to its original condition before treatment. A faster method is the mini-regression test suggested by Grove (3), which indicates 4 weekdays of treatment, followed by skin dryness evaluations the following week for up to a week of regression.

To understand the effect that product formulation has on moisturization, a foundation formulation and two variations were compared. The first variation built upon the base formulation with the inclusion of an emollient commonly used as an aesthetic modifier. The second variation continued to build upon the base formulation by including the same emollient from the first variation as well as a moisturizing active material. Finally, a marketed moisturizing foundation was included as a benchmark formula with similar-colored pigments, but a different emulsion composition. This benchmark foundation was claimed to provide moisturizing benefits.

MATERIALS AND METHODS

PRODUCT FORMULATIONS

The product formulations applied are listed in Tables I–III. The base foundation formulation was a silicone in water formula with moderate viscosity and a pH of about 6. Two variations of the base formulation were tested, one with propylheptyl caprylate as an aesthetic modifier, and a second with three moisturizing active materials added:

- Moisture blend #1 is a blend of hygroscopic molecules and hydrating agents.
- Moisture blend #2 consists of dehydrated hyaluronic acid microspheres.
- *Moringa oleifera* seed oil is an organic oil with moisturizing properties.

CLINICAL STUDY DESIGN

The double-blinded study was conducted with a total of 24 healthy Caucasian female subjects between the ages of 18 and 65. The study started on February 20, 2013 and concluded on March 1, 2013. All subjects executed an Informed Consent Form prior to the start of study procedures.

The principles of Good Clinical Practice, as defined by the International Conference on Harmonisation of Technical Requirements for Registration of Pharmaceuticals for Human Use, were followed except for the requirement that investigational products should be manufactured, handled, and stored in accordance with applicable Good Manufacturing Practice, which is not a requirement for cosmetic products. The study protocol was reviewed and approved by our Internal Review Board on February 19, 2013. There were no adverse events encountered, and no protocol amendments or deviations took place.

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Table I
Overview of Product Formulations Tested with Key Moisturizing Ingredients Highlighted

INCI Name	A Base foundation	B Base foundation with propylheptyl caprylate	C Base foundation with moisture blend #1, moisture blend #2, *Moringa oleifera* seed oil, and propylheptyl caprylate	D Marketed benchmark
Water	53%	50%	42%	√
Moisture blend #1	-	-	4%	
Glycerin				√
Water				√
Urea				
Sodium PCA				√
Trehalose				√
Polyquaternium-51				√
Triacetin				
Sodium hyaluronate				√
Moisture Blend #2	-	-	2%	
Ethlyhexyl palmitate				
Silica dimethyl silylate				
Butylene glycol				√
Sodium hyaluronate				
Moringa oleifera seed oil	-	-	2%	
Propylheptyl caprylate	-	3%	3%	

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Table II
Other Ingredients in Formulations A, B, and C That Are Not Listed in Table I, Listed Alphabetically by INCI Name

Caprylic/Capric triglyceride, Caprylyl glycol, Caprylyl glycol (and) Phenoxyethanol (and) Hexylene glycol, Dimethicone (and) Polysilicone-11 (and) Nylon-12 (and) Silica (and) PEG-10 Dimethicone (and) Polysorbate 40 (and) Isohexadecane (and) Ammonium polyacryloyldimethyl taurate, DMDM Hydantion (and) Iodoproynyl butylcarbamate, Hexyl laurate, Iron oxide (Black), Iron oxide (Red), Iron oxide (Yellow), Isostearic acid, Magnesium aluminum silicate, Mica (and) Titanium dioxide (Orange), Mica (and) Titanium dioxide (Violet), Oleyl erucate, Pentaerythrityl tetra-di-t-butyl hydroxyhydrocinnamate, Silica (and) Hyaluronic acid, Sodium polyacrylate, Synthetic fluorphlogopite (and) Lauroyl lysine, Titanium dioxide, Vegetable oil (and) Glycerin (and) Lauryl glucoside (and) Polyglycerl-2-dipolyhydroxystearate

Enrolled panelists were instructed to wash their inner forearms with PURPOSE® Gentle Cleansing Wash (Valeant Consumer Products, Montreal, Canada) once daily for 3 days prior to the study date. Panelists were told to shower 12 h prior to the first and last visit. Additionally, they refrained from using any non-assigned products on their inner forearms for the duration of the study. They were required to go to the test facility for 5 consecutive days.

MEASUREMENT OF SKIN IMPEDANCE

Moisture content in the skin was assessed using a NOVA® DPM 9003 skin impedance meter (NOVA Technology Corporation, Portsmouth, NH). This instrument provides a non-invasive, objective, reproducible method of measurement to quantify biophysical characteristics and relative hydration of the skin. It reports skin impedance in arbitrary units (2).

Prior to all measurements, panelists acclimated to controlled environmental conditions with a constant temperature of 19°–22°C and 40–50% relative humidity, for at least 15 min. Five 3 × 3 cm test sites were marked on the forearms using a surgical pen. Within each site, baseline skin impedance measurements were taken on day 1 prior to the first application and again on day 5, 12 h after the last application was washed off. Moisturization measurements were taken in triplicate at each site. We did not monitor regression of the skin following product application beyond 12 h, as the skin impedance measurement at that time showed sufficient differentiation among the test products. Also, consumers would generally reapply the product at 12 h after washoff.

Table III
Other Ingredients in Formulation D That Are Not Listed in Table I, Listed Alphabetically by INCI Name

1,2-Hexanediol, Aloe barbadensis leaf extract, *Argania spinosa* kernel oil, Boron nitride, C12-15 Alkyl benzoate, Caprylic/Capric triglyceride, Caprylyl glycol, Cellulose gum, Ceteth-25, Cetyl alcohol, Cetyl ethylhexanoate, Disodium EDTA, Ethylhexyl methoxycinnamate, Glyceryl stearate, *Helianthus annuus* (Sunflower) seed oil, Hexapeptide-3, Iron oxide (Black), Iron oxide (Red), Iron oxide (Yellow), Isopropyl lanolate, Linoleic acid, Linolenic acid, Magnesium aluminum silicate, Oleth-25, PEG-26-PPG-30 Phosphate, *Persea gratissima* (Avocodo) oil, Polyhydroxystearic acid, Proplyene glycol isostearate, Propylene glycol, Propylene glycol stearate, Sodium dehydroacetate, Squalane, Titanium dioxide, Tocopherol, Triethanolamine, Tripeptide-3

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After baseline measurements, 25 mg (equal to 2.8 mg/cm^2) of each test product was applied daily to the panelists' forearms. Each test product was applied to the designated test site according to the pre-determined randomization and was massaged into the skin for approximately 10 s using a finger cot. Subjects remained onsite in an acclimation room until all the products were dry to the touch. To simulate real wear conditions, panelists were told to leave the products on the skin all day until they showered at night. The above product application process repeated on days 2, 3, and 4.

RESULTS AND DISCUSSION

We analyzed and compared three different foundation formulas against the base foundation formula and the marketed benchmark formula. Skin impedance measurements were taken before application at baseline and then 12 h after the product was washed from the skin. This allowed us to measure the moisturization effect of the foundation formulas on the skin 12 h after the product was removed for a mini-regression test.

Each measurement was taken in triplicate at each site per subject. Product comparison p-value was based on an analysis of variance model. The *p* values within the products, change, and percent change from baseline were based on a paired *t*-test and found to be statistically significant.

Figure 1 shows the increase in skin impedance reading, indicating the increase in moisturization of the skin, from the baseline value. Both formulas B and C provided statistically significantly higher impedance levels than the base foundation A, indicating higher moisturization. The impedance measured with formula C was significantly higher than formula B as well, indicating the contribution of the additional moisturizing ingredients.

We also compared the highest scoring formulation to a marketed benchmark moisturizing foundation, formula D (Figure 2). Formula C was significantly higher in impedance than formula D, providing more moisturization to the skin.

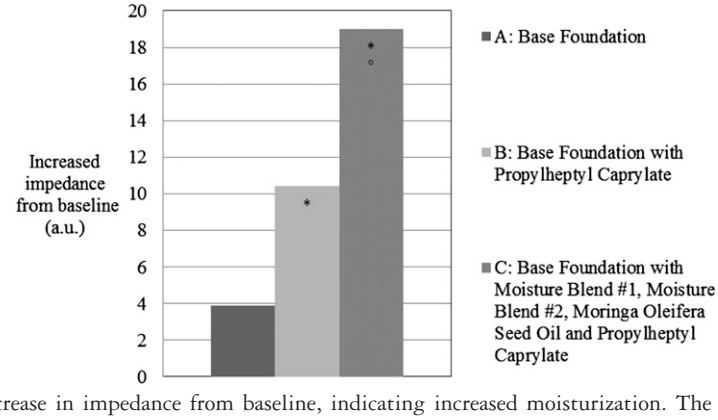

Figure 1. Increase in impedance from baseline, indicating increased moisturization. The values for both Formula B and C were statistically significant (* $p < 0.05$) versus Formula A. The value for Formula C was statistically significant (° $p < 0.05$) versus Formula B.

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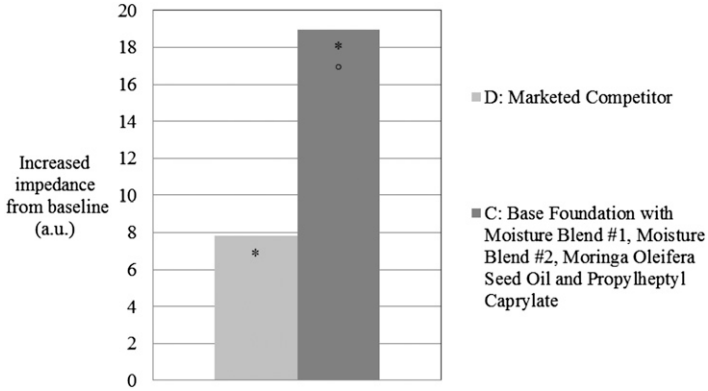

Figure 2. Increase in impedance from baseline, indicating increased moisturization. Even though the values for both products were statistically significant (* $p < 0.05$) versus baseline, the value for Formula C was statistically significant (° $p < 0.05$) versus Formula D.

CONCLUSION

The base foundation with moisture blend #1, moisture blend #2, *Moringa oleifera* seed oil, and propylheptyl caprylate (formula C) moisturized the skin significantly better than the base foundation (formula A) and the base foundation containing only propylheptyl caprylate (formula B). Furthermore, when compared to a marketed competitor product, the base foundation with moisture blend #1, moisture blend #2, *Moringa oleifera* seed oil, and propylheptyl caprylate (formula C) also provided superior moisturizing ability. These results indicate that adding moisture blend #1, moisture blend #2, *Moringa oleifera* seed oil, and propylheptyl caprylate to foundation formulas can promote long-lasting moisturizing ability within foundation products.

The improved moisturization efficacy we observed can be explained by the hygroscopic nature of the ingredients in moisture blend #1 and moisture blend #2, especially the hyaluronic acid microspheres in moisture blend #2.

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