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Introduction

The skin barrier provides protection from the damaging effects of the environment, not only to the skin, but also to the internal organs. When the barrier is damaged, either from ultraviolet radiation, chemicals, or physical insult, water immediately escapes. A compromised barrier can lead to skin irritation and skin pathologies such as atopic dermatitis and skin infections. Naturally occurring lipids such as ceramides have been shown to be necessary for normal barrier function and have beneficial effects when added exogenously to the skin.^A Other lipids, such as hydrolyzed jojoba esters, have also been shown to benefit the skin.^B

Floratech has created the hydrolyzed jojoba esters by hydrolyzing the wax ester found in the native jojoba seed oil. The resultant esters are used in various cosmetic and personal care formulations. The following studies were designed to determine if hydrolyzed jojoba esters incorporated into hydro-alcoholic and non-alcoholic, nonwoven wipes could increase skin hydration, and reduce TEWL and erythema.

In order to explore additional benefits of hydrolyzed jojoba esters, three small, vehicle controlled, studies were carried out using nonwoven wipes to deliver the hydrolyzed jojoba esters to the skin. In the first study skin irritation was created by dry shaving the forearm of normal subjects. 1% HJE20* (20% hydrolyzed jojoba esters in water) or 0.2% HJE80** (80% hydrolyzed jojoba esters + 10% jojoba esters in water) was incorporated into *baby* wipes and compared with a vehicle wipe as well as a wipe containing 0.5% bisabolol. Multiple wipe applications were made over 4 days with erythema and transepidermal water loss (TEWL) measurements taken after each wipe application. The baby wipes which contained HJE20* or HJE80** increased barrier recovery (as measured by TEWL) better than bisabolol and were as effective as bisabolol in reducing skin erythema. In a second study, 1% of HJE20* or 0.2% HJE80** was incorporated into *hydro-alcoholic* wipe solutions. After one application of the wipes to the designated skin test sites, the wipes containing HJE20* or HJE80** produced statistically greater skin hydration (as measured by capacitance) than the vehicle wipe, with peak hydration increases of 34% and 36%, respectively. In the third study, 0.5% HJE20* or 0.1% HJE80** was incorporated in *non-alcohol* based antimicrobial wipes. These wipes were compared to a vehicle wipe as well as to currently marketed antibacterial wipes. After one application of the wipes to the skin test sites, the wipes containing HJE20* or HJE80** produced statistically greater skin hydration than all other wipes, with peak hydration increases of 40% and 47%, respectively. These studies indicate that hydrolyzed jojoba esters can be delivered to the skin from various formulas of nonwoven wipes and produce significant benefits to the skin barrier.



Figure 1. Jojoba Seed



Figure 2. Jojoba Seed

Clinical Design

Three small, randomized, vehicle controlled, clinical studies were conducted under controlled environmental conditions (72±2°C and <50% RH) at Floratech in Chandler, Arizona, to ascertain the ability of nonwoven wipes incorporated with various hydrolyzed jojoba esters to increase skin moisturization, decrease transepidermal water loss (TEWL), and decrease skin erythema. The studies were approved by an independent IRB and the subjects signed an informed consent form before enrolling into the studies. Each study had a three day wash out period in which subjects did not use any creams, lotions, or gels on the test sites. TEWL measurements were carried out in duplicate using a Tewameter TM300.^C Erythema was measured in triplicate using a Mexameter MX 18.^D Skin hydration was measured in triplicate using a Corneometer[®] CM 825^E. The non-alcoholic wipes were made by soaking 45g/m² of spunlace in 5g of test solution for 24 hours. The hydro-alcoholic wipes (60% ethanol) and baby wipes were made by soaking 45g/m² of spunlace in 2.5 g of test solution for 72 hours (hydro-alcoholic wipes) or 24 hours (baby wipes).

Study # 1 - Barrier Function and Anti-Irritation: Baby Wipes

The objective of the first study was to determine if HJE20* and HJE80**, incorporated into a baby wipe, can increase barrier recovery from "dry shaving" and reduce erythema. The forearms of fourteen healthy subjects were "dry shaved" to produce skin irritation and disrupt the skin barrier. TEWL measurements were made pre and post "dry shaving", and 4, 24, 48, and 72 hours post initial test article application. Test article applications were made following post-shave, 4, 24, and 48 hour measurements.

Figure 3. Increased Barrier Recovery

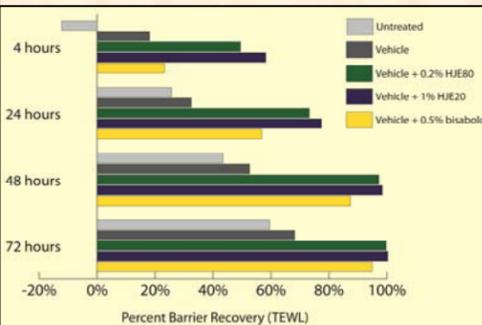


Figure 3. The addition of 1% HJE20* or 0.2% HJE80** produced statistically significant increases ($p < 0.01$) in barrier recovery over the vehicle and untreated skin at all time points. The HJE20* products also performed statistically significantly ($p < 0.05$) better than 0.5% bisabolol at the 4 and 24 hour time points.

Figure 4. Decreased Erythema

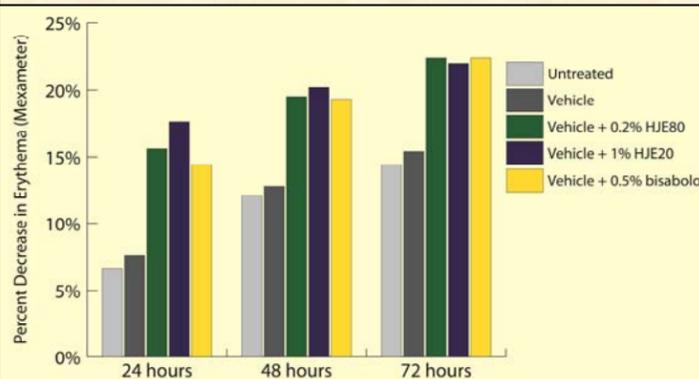


Figure 4. The addition of 1% HJE20*, 0.2% HJE80**, or 0.5% bisabolol produced statistically significant decreases ($p < 0.01$) in erythema over the vehicle, untreated skin, and baseline at all time points. The HJE20* and HJE80** products performed statistically equivalent to 0.5% bisabolol.

Study # 2 - Skin Hydration: Hydro-Alcoholic Wipes

The objective of the second study was to determine the potential of HJE20* and HJE80** in combination with glycerin (1%) to increase skin hydration when added to a hydro-alcoholic wipe. Twelve healthy females with dry, lower legs participated in the study. One application of the experimental wipe was applied to the appropriate test site followed by Corneometer measurements every 30 minutes for two hours.

Figure 5. Increased Skin Hydration

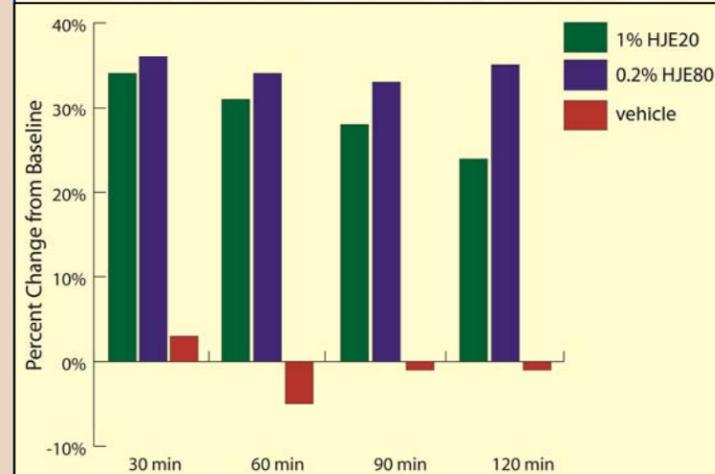


Figure 5. The addition of 1% HJE20* or 0.2% HJE80** produced statistically significant ($p < 0.05$) increases in skin hydration over the vehicle at all time points.

Study # 3 - Skin Hydration: Non-Alcoholic Wipes

The objective of the third study was to determine the potential of HJE20* and HJE80** in combination with glycerin (1%) to increase skin hydration when incorporated into a non-alcoholic wipe. Twelve healthy females with dry lower legs were enrolled into the study. One application of each experimental wipe was applied to the appropriate site on the lower leg of each subject. Skin hydration was measured every 30 minutes up to four hours.

Figure 6. Increased Skin Hydration

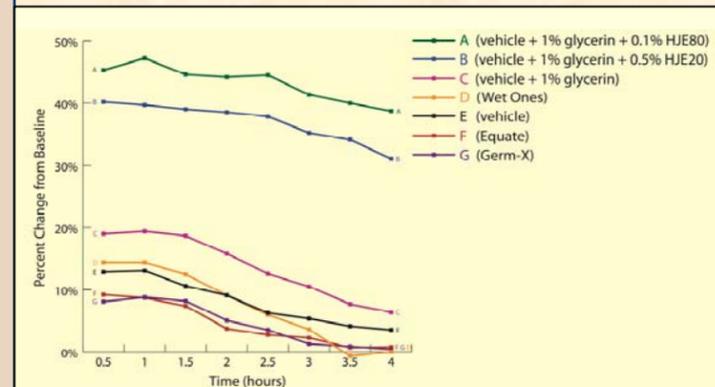


Figure 6. The addition of 0.5% HJE20* or 0.1% HJE80** produced statistically significant increases ($p < 0.001$) in skin hydration over the vehicle + 1% glycerin and over baseline at all time points. The HJE20* and HJE80** products also performed statistically significantly ($p < 0.05$) better than Wet Ones[®], Germ-X[®], and Equate[®].

Proposed Mechanisms of Action of HJE and Glycerin

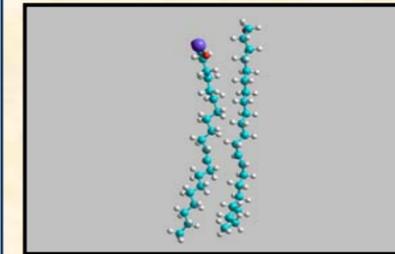


Figure 7. Hydrolyzed Jojoba Ester Molecules

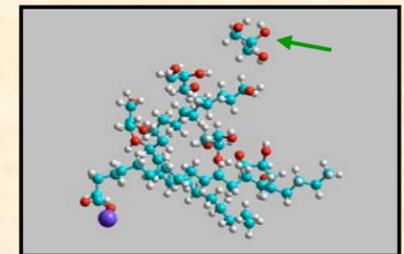


Figure 8. Hydrolyzed Jojoba Esters + Glycerin Molecules

At room temperature, the alcohols and salts of the fatty acids of hydrolyzed jojoba esters generally orient themselves in an anisotropic geometry (Figure 7); however, when glycerin (example indicated by the green arrow) is added to the system the hydrolyzed jojoba esters break free of the highly ordered geometry, thereby trapping glycerin (Figure 8). Accordingly, when hydrolyzed jojoba esters form a film on the skin, glycerin molecules are entrained, thereby increasing the bio-available hydration potential of glycerin. [Figures 7 and 8 produced using Hyperchem r.8 (Hypercube, Inc., Gainesville, FL, USA)]

Conclusions

- Hydrolyzed Jojoba Esters, when incorporated into a baby wipe, increased barrier recovery over the vehicle wipe at all time points ($p < 0.01$). (Figure 3)
- Hydrolyzed Jojoba Esters, when incorporated into a baby wipe, produced faster barrier recovery than the wipe containing 0.5% bisabolol at the 4 and 24 hour measurements ($p < 0.05$). (Figure 3)
- Hydrolyzed Jojoba Esters, when incorporated into a baby wipe, decreased skin erythema over the vehicle wipe ($p < 0.01$). (Figure 4)
- Hydrolyzed Jojoba Esters, when incorporated into a baby wipe, decreased skin erythema equal to that of the known anti-irritant, bisabolol ($p > 0.05$). (Figure 4)
- Hydrolyzed Jojoba Esters, when combined with glycerin in a nonwoven wipe, increased skin hydration over the vehicle wipe and other marketed non-alcoholic wipes ($p < 0.001$) and increased skin hydration over the vehicle wipe within hydro-alcoholic wipes ($p < 0.05$). (Figures 5 and 6)

*HJE20 trade name: Floraesters K-20W Jojoba; **HJE80 trade name: Floraesters K-100 Jojoba

References

- A. Mao-Qiang, M. Fengold, K.R., Wang, F., Thronfeldt, C.R., and Elias, P.M. A Natural Lipid Mixture Improves Barrier Function and hydration in Human and Murine Skin. *Journal of the Society of Cosmetic Chemists* 1996, 47, 157-166.
 B. Rhoads, L.A., Harper, R.A., Sondgenoth, J.B., Ashley, D.A., Oliphant, T.N., Marshall, R.D. The Role of Hydrolyzed Jojoba Esters as a Unique Botanical Technology for Long Acting Moisturization. *The 67th Annual Meeting of the American Academy of Dermatology*, American Academy of Dermatology, San Francisco, CA. 6-10 March 2009.
 C. Tewameter is a product of Courage + Khazaka Electronic GmbH, (Köln, Germany).
 D. Mexameter is a product of Courage + Khazaka Electronic GmbH, (Köln, Germany).
 E. Corneometer is a registered trademark of Courage + Khazaka Electronic GmbH (Köln, Germany).
 F. Fresh Scent Wet Ones[®] Antibacterial Hand and Face Wipes Pocket Size Singles were utilized. Wet Ones is a registered trademark of Playtex Products Inc. (Dover, DE).
 G. Germ-X[®] Antibacterial Soft Wipes Singles were utilized. Germ-X is a registered trademark of Vi-Jon Laboratories (St. Louis, MO).
 H. Wal-Mart[®] Equate[®] Antibacterial Wipes were utilized. Equate is a registered trademark of Wal-Mart Stores, Inc. (Rockline Industries, Sheboygan, WI).

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Delivery of Hydrolyzed Jojoba Esters to the Skin from Wipes: Beneficial Effects on Barrier Function and Skin Hydration

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