

THE ROLE OF HYDROLYZED JOJOBA ESTERS COMPLEX IN AN ALCOHOL GEL SANITIZER ON THE SKIN CONDITION OF HEALTH CARE WORKERS (HCW) WITH CHRONIC HAND DERMATITIS

Lawrence A. Rheins, Ph.D., Mary F. Fredenberg, MD, Brooke Marshall, Grace Hastings, John Hill and David Ashley

Floritech International

Introduction

The repeated use of ethanol sanitizer products sometimes as high as 50 or more times during the work day essentially strips the stratum corneum of essential lipids leading to loss of normal homeostatic barrier function. The loss of a competent barrier begins the cascade towards inflammation and in some cases the eventual harboring of transient pathogenic organisms.

Jojoba (*Simmondsia chinensis*) is a perennial arid shrub grown in Mexico, Brazil, Argentina, Israel, Australia, and the Sonora deserts of Northwest Mexico, and Arizona. Jojoba oil, a straight chain wax ester of 36 to 46 carbons in length, is uniformly composed of a long chain fatty acid, and fatty alcohol joined by an ester bond. The fatty acid mixture of eicosenoic, docosenoic and oleic of jojoba is chemically similar to human sebum. Jojoba's unique chemistry also possesses robust oxidative stability thereby diminishing free radical activity and providing extensive emollient properties when used in commercial skin, hair and nail care products. In addition to jojoba's reported moisturizing effect on the stratum corneum, studies have demonstrated multiple anti-inflammatory functions including down regulation of nitric oxide (NO), and tumor necrosis factor- α .

The purpose of this study was to further elucidate whether an alcohol gel hand sanitizer supplemented with a natural botanical could reduce the symptoms in dermatologist diagnosed chronic hand irritant dermatitis in HCW's, and in doing so provide a topical formulation that would assist with hand-hygiene compliance in multiple health care settings.

Methods:

We enrolled 14 HCW's (10 hospital nurses, 3 group practice pediatric nurses, 1 physician assistant) ranging in age from 23-65 years old, with physician diagnosed chronic hand dermatitis of moderate involvement (average 13 years of disease duration). The study was conducted under Good Clinical Practices (GCP), including the study protocol being reviewed by an outside institutional review board. In addition to signing an Informed Consent and completing a brief dermatologic history, the subjects underwent a Physician Assessment (PA) of their hands prior to commencement of the study. The study subjects were required to demonstrate at least a score of 2 (0-4 scale) in 4 out of 7 criteria: erythema, scaling, fissuring, xerosis, edema, vesiculation, and lichenification. Three days prior to the study and for duration of the 14 day study, subjects were prohibited from using any other topical treatment to their hands (e.g. moisturizers, corticosteroids, topical NSAIDS, topical retinoids, and calcineurin inhibitors). During the three day 'wash-out' the study subjects used only Cetaphil Cleanser Bar (Galderma Laboratories, L.P., Fort Worth, TX) to provide general acclimation of the subjects' skin condition, prior to use of the gel sanitizer.

At baseline, following the physician examination, close-up digital images were obtained of the palmar, and dorsal surface of the hands with a Nikon D70S digital SLR camera fitted with a Nikon AF 105mm close-up lens with synchronized flash.

A 61% ethanol gel formulation was prepared consistent with the required CDC hand-hygiene guidelines, supplemented with jojoba esters. In vitro anti-bacterial efficacy tests revealed that the jojoba derivatives did not interfere with TFM requisite ethanol disinfectant effect.

In addition to the clinical and photographic evaluation, additional objective quantification of the skin barrier, evaporative water loss was evaluated by transepidermal water loss TEWL (TM 300 Tewameter, Courage-Khazaka, Koln, Germany). TEWL measurements were obtained at baseline, day 7, and 14 in a temperature and humidity controlled room (i.e. 20-22°C, relative humidity 30-40%). Subjects were requested to sit quietly for approximately 15 minutes in the environmentally controlled room prior to any TEWL measurements being recorded.

Statistical analysis was performed using a student's t test to evaluate significance of differences between categorical variables. Alpha was set at 0.05, and all tests performed were two-tailed.

Results:

Throughout the duration of the study, subjects were instructed to use the jojoba supplemented sanitizer in place of their current sanitizer/alcohol rub product, as often as required during their work shift, but at least a minimum of eight times during the work shift. At 14 days a positive clinical response was noted during the Physician Assessment with all 14 subjects demonstrating an identifiable reduction in erythema, scaling, fissuring, and xerosis (Table 1), (Figure 1). Erythema, scaling, and xerosis went from a moderate score of 2 to only visibly perceivable (+) clinical symptoms. Those subjects experiencing fissuring at baseline presented with healed skin sites at two weeks following product use.

It's known that evaporative water loss from the stratum corneum correlates with the degree of barrier perturbation, including inflammatory dermatoses. There was a 25% reduction in TEWL values following baseline measurements at day 7, and a 53% reduction in TEWL measurements following 14 days of product application. ($p < 0.0001$ for 7 and 14 days following baseline measurements). A breakout of skin site differences revealed that the dorsum of the hands produced a 19% and 36% reduction in TEWL values respectively at the day 7 and 14 evaluation points. Measurement of TEWL values on the palmar surface demonstrated a 36% reduction in TEWL at day 7, with a 59% reduction in evaporative water loss denoted at day 14. Both site differences were significant ($p < 0.001$) at day 7 and 14 versus baseline values. (Figure 1).

Discussion:

During the last 10 years alcohol based (60-95% ethanol) hand sanitizers have become predominant for sanitizing hands in most health care facilities, providing time savings, faster microbial killing, and less dermatitis of the hands than with plain soap and water or antiseptic hand wash scrub products. Although the time savings achieved by use of these products is viewed positively by most HCW's, the attendant changes in epidermal barrier function observed with multiple 40-50 or more exposures per day of the alcohol preparations can lead to chronic inflammatory skin disease and loss of hygiene adherence. As the CDC and WHO hand-hygiene guidelines continue to establish alcohol gel sanitizers as the preferred approach for HCW hand disinfection, the incidence of acute and chronic contact hand dermatitis and the loss of hygiene compliance will increase, as chronic ethanol exposures of the skin in an increasing number of HCW's occurs.

Jojoba oil and its derivatives have chemistry closely resembling excreted human sebum. Further pre-clinical studies have demonstrated a variety of anti-inflammatory responses following exposure to jojoba, including a decrease in myeloperoxidase, nitric oxide (NO), and tumor necrosis factor- α activity.

It is well known that the epidermal lamellar membranes consist of stratum corneum lipids containing a preponderance of ceramides, cholesterol, and long chain essential and non-essential free fatty acids. These lipids are essential in maintaining permeability and barrier function. Jojoba based oil derivatives with their similar cutaneous sebaceous lipid composition may serve to reconstitute lipids stripped from the epidermis during repeated hand washings with alcohol based hand sanitizers. The direct restoration of key lipids along with antioxidant/anti-inflammatory activity following topical exposure with jojoba derivatives may provide down regulation of inflammatory mediators and up-regulation of signaling for epidermal lipid re-synthesis which occurs during any perturbation of the barrier.

References

1. Boyce J, Dziekan G, Girard R, et. al. *The WHO Guidelines on Hand Hygiene in Healthcare (Advanced Draft): Global Patient Safety Challenge 2005-2006. World Health Organization, Geneva, Switzerland, 1-217 (2006).*
2. Habashy RR, Abdel-Naim AB, Khalifa AE, Al-Azizi MM, Anti-inflammatory effects of jojoba liquid wax in experimental models, *Pharmacol. Res.*, **11**, 1-11 (2004).

Table I. Physician Assessment (PA) of Hand Condition at Baseline and 14 Days Post Treatment

	Baseline		14 Days Post Treatment	
	Dorsal	Palmar	Dorsal	Palmar
Erythema	2.0	2.0	+ Score<1	+ Score<1
Scaling	2.0	2.0	+ Score<1	+ Score<1
Fissuring	1.0	1.0	0 (healed)	0 (healed)
Xerosis	2.0	2.0	+ Score<1	+ Score<1
Edema	0	0	0	0
Vesiculation	0	0	0	0
Lichenification	0	0	0	0

0, no identifiable signs and symptoms; +, slight involvement; 1, mild; 2, moderate; 3, moderately severe; 4, very severe.

Figure 1. Transepidermal Water Loss (TEWL) values observed at day 7 and 14 for the dorsal and palmar surface sites alone.