THE LIPID MARKERS OF DRY SKIN IN AFRICAN WOMEN

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1 INTRODUCTION

Although dry skin is often associated with dry winter conditions in the Northern Hemisphere, women in Sub-Saharan Africa often complain of dry body skin even in warm and humid climate conditions. Moisturizers are often used on the body more than once a day but the reason for this habit remains unclear, as there are few research studies on skin in Africa. It has been postulated that xerosis in richly pigmented skin can lead to a grey appearance known as "ashy skin" that can be culturally stigmatizing [1]. Some studies suggest that terminal epidermal differentiation may be different in heavily pigmented skin which might be linked to body skin dryness in these skins [2]. The lipids of the *Stratum Corneum* (ceramides, fatty acids and cholesterol) constitute one of the key elements for a healthy skin barrier. Although decreased ceramide levels are known to occur in seasonally dry, diseased (e.g. atopic dermatitis, psoriasis) and aged skin [3], there is a lack of robust studies to understand the interactions between skin lipid composition and dry body skin in populations of African descent. Our aim was to determine if ceramides, which are known to play a role in dry skin of other ethnic groups, are also associated with dry body skin in South-African women.

2 MATERIALS & METHODS

1- Clinical scoring:

Healthy female subjects of African descent, phototype V or VI were included in 2 groups based on the dryness of their skin on the outer side of the calf. Dryness was scored by a trained dermatologist using a grazing light dermatoscope (Dermascore®) with an 8-grade dry skin atlas. Water capacitance was also measured on the outer side of the calf with the Corneometer®. The groups were defined as follows: Dry group: dry skin score ≥ 3 + Corneometer® value < 40 a.u. Normal group: dry skin score ≤1 and Corneometer® value ≥40 a.u. N=29 samples analyzed for each group

2- Lipid Extraction:

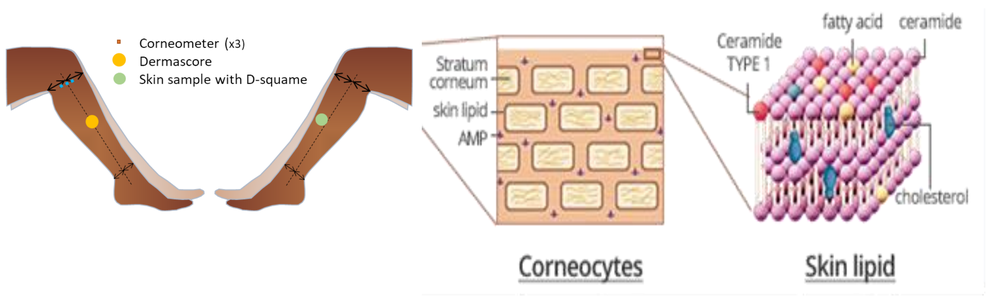
Stratum corneum samples were collected on the exterior side of the calf using D-squame® disks applied until saturation. Lipids were then extracted with methanol (90 min shaking after brief sonication).

3- Lipid analysis:

The profile of the 12 ceramide classes were determined by RP8 UPLC/Orbitrap ID-X Tribrid MS (Thermofischer) detector analysis.

4- Data generation:

150 ceramides were analyzed and all chain lengths within each class were summed, Results from the two groups were compared using Wilcoxon t-tests (p-value) and effect size (ES).



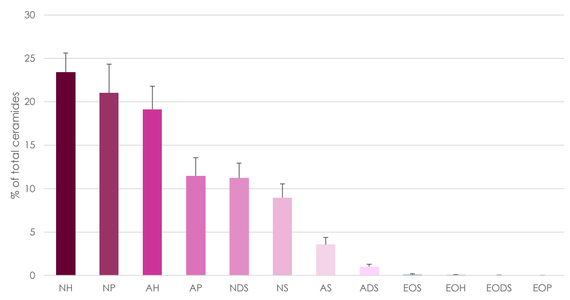
Lipid extraction with D-squame® allows to obtain all free ceramides forming the intercellular lipidic matrix

FATTY ACIDS / SPHINGOID BASES	Non-hydroxyl fatty acid [N]	α-hydroxyl fatty acid [A]	Esterified ω-hydroxy fatty acid [EO]
Dihydrosphingosine [dS]	NdS / CER 10	AdS / CER 11	EOdS / CER 12
Sphingosine [S]	NS / CER 2	AS / CER 5	EOS / CER 1
Phytosphingosine [P]	NP / CER 3	AP / CER 6	EOP / CER 9
6-hydroxy-sphingosine [H]	NH / CER 8	AH / CER 7	EOH / CER 4

12 ceramide classes

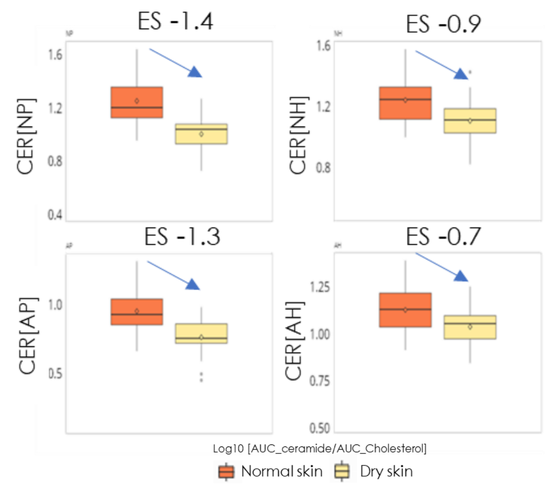
3 RESULTS & DISCUSSION

→ Ceramide profile comparison: Impact of dry skin on ceramides



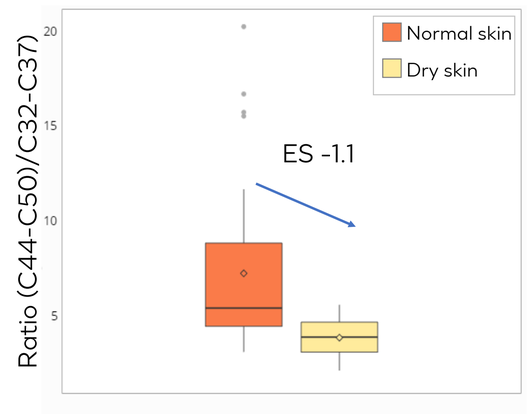
A complete profile of the prevalence of each ceramide class (in % of the total) in all study participants (dry and normal skin groups) shows that the most represented ceramides are the families NH, NP, AH and AP which contain 3 hydroxyl groups (phytosphingosine base or 6-hydroxy sphingosine base).

Statistical comparison between dry and normal skin groups (on the right) shows a significant reduction of these 4 most abundant ceramide families ($p<0.05$, moderate effect size) in the dry skin group. Consequently, a significant decrease in ceramides containing 3 hydroxyl groups is observed.

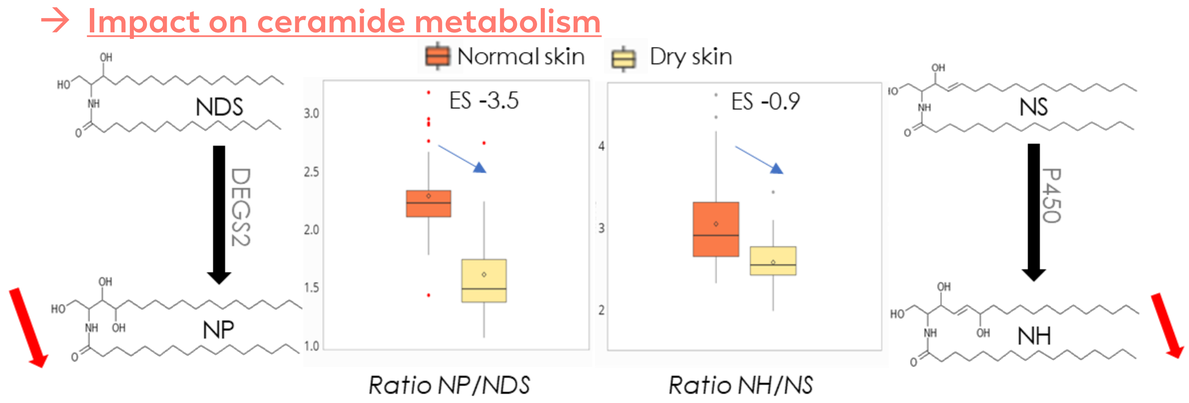


→ Chain length and skin dryness

Ceramides are mainly composed of sphingoid bases with 18, 20 or 22 carbon atoms (C) linked to a 24C to 28C fatty acid.
All free ceramides analyzed were separated into 3 groups based on the length of their chain: (C32-C37) (C38-C43) and (C44-C50). Esterified ceramides were excluded from this categorization.
The ratio of C44-C50 to C32-C37 ceramides is significantly reduced ($p<0.05$, moderate effect size 1.1) in the dry skin group. This result indicates that differences in the presence of long chains could be involved in dry skin.



→ Impact on ceramide metabolism



Information on lipid metabolism can be inferred using the ratios of substrate/product. The ceramide NDS is the substrate of ceramide NP and the ceramide NS is the substrate of ceramide NH. Both ratios of substrate/product are significantly reduced ($p<0.05$) in the dry skin group with respectively very good (-3.5) and moderate (-0.9) effect size. This suggests that the ceramide metabolic pathway is altered in dry skin. The alteration could possibly be due to under-activity of the enzyme DEGS2 leading to a decrease in NP and under-activity of the yet-unidentified Cyp450 enzyme that results in reduced NH.

4 CONCLUSIONS

Total ceramide content has been previously associated with dry skin. We have characterized the phenotype of dry body skin in women of African descent in terms of ceramide families. This demonstrates the strong association between dry skin and a reduction in the two most abundant ceramide families of the stratum corneum, NP and NH. A higher number of hydroxyl groups in the sphingoid base of ceramides is essential for the orthorhombic configuration that forms via hydrogen bonds. This configuration is important for optimal skin barrier function and water retention [4]. Our results show that in women of African descent with dry skin, there is a reduction of the ceramide families built from bases with 3 hydroxyl groups, namely phytosphingosine and 6-hydroxy-phingosine
A reduced amount of long chain (C44-C50) ceramides was also found to be associated with skin dryness in our study.
Because of deficiencies in ceramides containing 3 hydroxyl group sphingoid bases in dry skin, we could hypothesize that a cosmetic formula containing ceramides with tri-hydroxylated bases such as phytosphingosine and 6-hydroxy-sphingosine could alleviate skin dryness.

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