

# Moisturizing Kinetics of Maxrich, a Novel Moisturizing Formula Comprising of Xylitol and Xylitol-based Sugars such as Xylitylglucoside and Anhydroxylitol

Gaurav A Deshmukh<sup>1</sup>, Dhiraj S Dhoot<sup>2</sup>, Hanmant Barkate<sup>3</sup>

<sup>1</sup>Medical Advisor, Medical Services, Glenmark Pharmaceuticals Ltd., Mumbai, Maharashtra, India, <sup>2</sup>Senior Manager, Medical Services, Glenmark Pharmaceuticals Ltd., Mumbai, Maharashtra, India, <sup>3</sup>Vice-president, Medical Services, Glenmark Pharmaceuticals Ltd., Mumbai, Maharashtra, India

## Abstract

**Introduction:** Polyols such as glycerol and xylitol are commonly implicated as moisturizers of the skin and other epithelial tissues. Xylitol was found to augment collagen formation, markedly suppress sodium lauryl sulfate-induced transepidermal water loss (TEWL), exert anti-irritant actions, and increase filaggrin expression and skin hydration.

**Materials and Methods:** This was open-label, comparative, single-arm, pilot study involving 15 healthy volunteers who were prone to develop dry skin. Two test preparations were used in this study, one preparation was with ordinary cream base (control), while the other preparation was novel moisturizing formulation (MaxRich<sup>®</sup>) containing a complex of xylitol, xylitylglucoside, and anhydroxylitol. Primary objective of the study was to evaluate the hydration of skin, after application, of Maxrich<sup>®</sup> versus control over the duration of 24 h, while the secondary objective was to evaluate TEWL over the duration of 24 hours. MoistureMeter-SC (MMSC) and VapoMeter were used to measure skin hydration and TEWL, respectively.

**Results:** MaxRich<sup>®</sup> was associated with a significant increase in skin hydration from baseline after 4 hours as shown by increase in mean MMSC reading (22.86 vs. 9.36;  $P < 0.05$ ). The skin hydration was maintained above baseline throughout 24 hours which was statistically significant ( $P < 0.05$ ) as shown by higher mean MMSC reading at 8, 12, and 24 h. Compared to control, MaxRich<sup>®</sup> was associated with a significant increase in skin hydration (10.12 vs. 22.86,  $P < 0.05$ ). Similarly, MaxRich<sup>®</sup> was associated with a significant decrease in transepidermal water loss compared to baseline after 4 h as shown by decrease in mean VapoMeter readings (9.22 vs. 5.99,  $P < 0.05$ ). TEWL was maintained below baseline value as shown by lower mean VapoMeter readings at 8, 12, and 24 h. Compared to control, MaxRich<sup>®</sup> was associated with a significant decrease in TEWL (6.93 vs. 5.99,  $P < 0.05$ ).

**Conclusion:** Results of our study indicate that MaxRich<sup>®</sup>, a novel moisturizer containing xylitol, xylitylglucoside, and anhydroxylitol, is associated with intense, fast, and long-lasting moisturizing effect.

**Key words:** MaxRich, Skin hydration, Transepidermal water loss, Xylitol

## INTRODUCTION

It is well known that water content of the stratum corneum is very important factor in the appearance and

function of the skin.<sup>[1]</sup> Natural moisturizing factor (NMF) along with intercellular lipids is responsible for the water holding capacity and barrier function, respectively, thus is fundamental element in maintaining skin hydration.<sup>[1,2]</sup> Impairment in epidermal barrier, decrease in synthesis of intercellular lipids, and NMF with resultant increase in transepidermal water loss lead to decrease in water content of stratum corneum, leading to dry skin.<sup>[1-4]</sup>

Dry skin or xeroderma is a very frequent condition which occurs at any age. The incidence of dryness related dermatoses is on the rise due to urbanization, adulteration,

Access this article online



www.ijss-sn.com

Month of Submission : 10-2018  
Month of Peer Review : 11-2018  
Month of Acceptance : 12-2018  
Month of Publishing : 12-2018

**Corresponding Author:** Dr. Gaurav A Deshmukh, Medical Advisor, Medical Services, Glenmark Pharmaceuticals Ltd., Mumbai, Maharashtra, India. E-mail: Dr.Gaurav.Deshmukh@glenmarkpharma.com

pollution, increased life span, and abandonment of traditional oil massages and baths.<sup>[5]</sup>

Moisturizing products constitute one of the largest and most important skin care product categories.<sup>[5]</sup> The function of moisturizers is to maintain the stratum corneum hydrated. There is plethora of moisturizers available in the market with different constituents and different claims. Despite their widespread use and applications, the scientific literature on moisturizers lacks strong evidence.<sup>[5-7]</sup> Early studies conducted on individuals with both healthy and diseased skin showed that some moisturizers tend to weaken the skin barrier function, whereas others may strengthen it, and these discrepant results were assumed to be caused by the varied compositions of moisturizers.<sup>[8]</sup>

Polyols such as glycerol and xylitol are commonly implicated as moisturizers of the skin and other epithelial tissues.<sup>[9]</sup> While the moisturizing effects of glycerol are very well documented, very limited data are available on the cutaneous effects of a closely related polyol, namely xylitol and xylitol-based sugars.<sup>[9]</sup> Despite their similar chemical structures, these polyols induce different gene expression changes in the keratinocytes.<sup>[10]</sup> In few *in vitro* and *in vivo* studies, xylitol was found to augment collagen formation, markedly suppress sodium lauryl sulfate-induced transepidermal water loss (TEWL), exert anti-irritant actions, and increase filaggrin expression and skin hydration.<sup>[9-14]</sup>

We conducted this pilot study with the purpose to evaluate *in vivo* the stratum corneum hydration and TEWL by the electrical measurements of skin, after treatment with novel moisturizing formula, MaxRich<sup>®</sup> comprising xylitol and xylitol-based sugars such as xylitylglucoside and anhydroxylitol.

## MATERIALS AND METHODS

Primary objective of the study was to evaluate the hydration of skin, after application, of Maxrich<sup>®</sup> versus control over the duration of 24 h, while the secondary objective was to evaluate TEWL over the duration of 24 h. MoistureMeter-SC (MMSC) and VapoMeter were used to measure skin hydration and TEWL, respectively.

Two test preparations were used in this study, one preparation was with ordinary cream base (control), while the other preparation was novel moisturizing formulation (MaxRich<sup>®</sup>) containing a complex of xylitol, xylitylglucoside, and anhydroxylitol. The study was conducted according to the ICH-GCP guidelines.

This study involved 15 healthy human volunteers who were prone to dry skin: Seven women and eight men aged 20–30 years. Inclusion criteria were low hydration values ( $\leq 10$ ) on the volar forearms, measured with MoistureMeter-SC. Exclusion criteria were - major skin diseases, pregnancy or breastfeeding, systemic corticosteroid or cytostatic therapy within 30 days, any use of local drugs within 30 days that might influence the skin texture, and any skin condition on that could interfere with a clear-cut assessment of the skin. The volunteers were tested for any allergy to tested products, and 3 days before the study, they were advised not to use any moisturizer.

The volar forearms were selected as the test site for conducting this study. Forearms of each volunteer were cleaned, and the volunteers were acclimatized under controlled conditions for the duration of 1 h at the beginning of the study. The humidity was maintained between 40% and 60% and temperature at 20–22°C for the entire study duration. Two 3 cm<sup>2</sup> × 3 cm<sup>2</sup> areas were marked on volar forearm of each participant. Area 1 received control product while Maxrich<sup>®</sup> was applied on area 2. Approximately 30 mg of study product was applied on the test sites by massaging for 30 s using a fingerstall. Two treatments were applied on test sites for 4 times over the total duration of 24 h at 4, 8, 12, and 24 h.

The MoistureMeter SC measures the hydration of stratum corneum indirectly by measuring the electrical capacitance. The skin is electrically a layered structure. The electrical properties of these layers are related to their water content. The probe, the skin surface, and the deeper skin layers form a structure, similar to an electrical capacitor. The measured capacitance is proportional to the water content of the surface layer of the skin. The higher the reading, the higher the moisture content.

VapoMeter measures the transepidermal water loss indirectly by measuring the relative humidity (RH) and temperature. The VapoMeter is equipped with a closed cylindrical chamber that contains sensors for RH and temperature. There is a linear increase of RH% in the chamber shortly after placing the device in contact with the skin. The TEWL is calculated from the increase in RH%. Values of ambient RH (%) and temperature (°C) are recorded before skin contact. The chamber is passively ventilated between measurements. Reduction in the VapoMeter readings indicates improvement in the skin barrier properties.

Skin hydration and TEWL measurements were carried at baseline and were repeated at 4 h, 8 h, 12 h, and 24 h after product application. Short-term testing, in which the effects are usually determined within a few hours after the initial

application of a defined dose of Maxrich® is extremely useful for the evaluation of the efficacy of product. The interpretation of the results was done by unpaired *t*-test using Microsoft Excel version 2016. *P* < 0.05 was considered as significant statistically difference.

## RESULTS

### Skin Hydration Measurements Using MoistureMeter SC

The mean MoistureMeter-SC readings are shown in Table 1. At baseline, there was no statistical difference between MMSC readings for MaxRich® and control product.

After application of MaxRich®, there was significant increase in skin hydration from baseline after 4 h as shown by increase in mean MMSC reading (22.86 vs. 9.36; *P* < 0.05). The skin hydration was maintained above baseline throughout 24 h which was statistically significant (*P* < 0.05) as shown by higher mean MMSC reading at 8, 12, and 24 h. When compared to control product, there was statistically significant increase in skin hydration with MaxRich® at 4 h as shown by significantly higher mean MMSC readings (10.12 vs. 22.86, *P* < 0.05). Similar trend was seen at 8 h, 12 h, and 24 h [Figure 1].

### TEWL Measurements Using VapoMeter

The mean VapoMeter readings are shown in Table 2. At baseline, there was no statistical difference between VapoMeter for MaxRich® and control product.

Similar to skin hydration, there was a significant decrease in TEWL compared to baseline seen 4 hours after application of MaxRich® as shown by decrease in mean VapoMeter readings (9.22 vs. 5.99, *P* < 0.05). TEWL was maintained below baseline value as shown by lower mean VapoMeter readings at 8, 12, and 24 h. When compared to control product, MaxRich® was associated with statistically significant decrease in transepidermal water loss after 4 h

as shown by lower mean VapoMeter readings (6.93 vs. 5.99, *P* < 0.05). Similar trend of lower mean VapoMeter readings was seen with MaxRich® compared to control at 8, 12, and 24 h; however, the difference was not statistically significant [Figure 2].

## DISCUSSION

Moisturizing products constitute one of the largest and most important skin care product categories.<sup>[5]</sup> The function of moisturizers is to maintain the stratum corneum hydrated. Despite their widespread use and applications, the scientific literature on moisturizers lacks strong evidence.<sup>[5-7]</sup> Various studies with moisturizers showed that not every moisturizer is beneficial to skin and some moisturizers may weaken the skin barrier function which is assumed to be caused by varied composition of moisturizers.<sup>[15-18]</sup>

Polyols like glycerol are most commonly used ingredient in moisturizing products. A structurally similar polyol, xylitol, is also used as humectant and moisturizer. In few *in vitro* and *in vivo* studies, xylitol was found to augment collagen formation, markedly suppress sodium lauryl sulfate-induced TEWL, exert anti-irritant actions, and increase filaggrin expression and skin hydration.<sup>[9-14]</sup>

Szél *et al.* in their experiment have shown the skin hydrating and anti-irritant effects of xylitol in murine model of

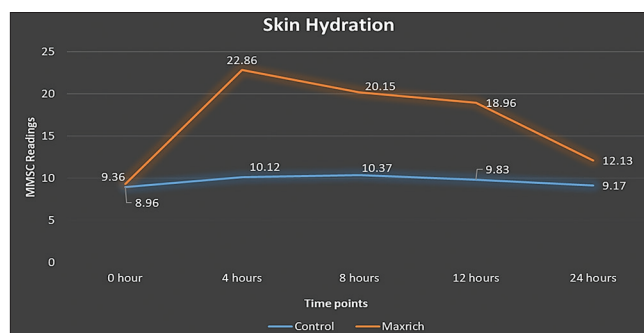
**Table 1: Mean of MMSC readings at different time points**

	0 h	4 h	8 h	12 h	24 h
Control	8.96	10.12	10.37	9.83	9.17
Maxrich®	9.36	22.86	20.15	18.96	12.13

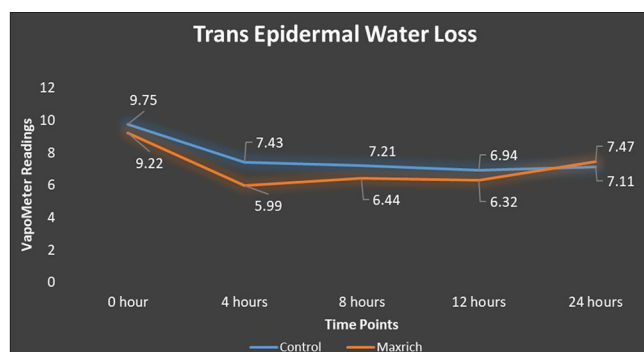
MMSC: MoistureMeter-SC

**Table 2: Mean of VapoMeter readings at different time points**

	0 h	4 h	8 h	12 h	24 h
Control	9.75	7.43	7.21	6.94	7.11
Maxrich®	9.22	5.99	6.44	6.32	7.47



**Figure 1: Mean of MoistureMeter-SC readings at different time points**



**Figure 2: Mean of VapoMeter readings at different time points**

irritant contact dermatitis.<sup>[19]</sup> Katsuyama *et al.* in their study showed the beneficial effect of xylitol-containing cream on atopic dry skin.<sup>[20]</sup> Erős *et al.*, their study revealed that the combined application of glycerol and xylitol significantly elevated the hydration of the SC in healthy probands within 2 h.<sup>[21]</sup> Leite e Silva *et al.* in their clinical trial concluded that moisturizer containing xylitol, xylitylglucoside, and anhydroxylitol produced most intense hydration level of the skin surface compared with the gel containing herbal extract and gel containing NMF components.<sup>[1]</sup> Results of these studies clearly demonstrate the skin hydrating benefits of xylitol.

One of the possible explanations of this skin hydrating effect of xylitol is water-binding capacity originating in their chemical structure. However, this is not the only possible explanation as xylitol and xylitol-based sugars reported to exert profound effects on the expression of certain genes and signaling pathways in keratinocytes. Páyer *et al.* in their experiment reported that both glycerol and xylitol upregulated the expression of proteins associated with barrier repair and skin hydration such as filaggrin, loricrin, involucrin, and occludin, but xylitol exerted somewhat more profound effects.<sup>[9]</sup> Authors concluded that the cutaneous barrier-repairing, differentiation-promoting, and anti-inflammatory effects of xylitol might be superior to those of glycerol.<sup>[9]</sup>

Szabó-Papp *et al.* in their study reported that xylitol was associated with a marked upregulation of filaggrin, a key molecule of epithelial regeneration and barrier repair.<sup>[10]</sup> Authors concluded that “since filaggrin levels were shown to be suppressed in dry skin, our intriguing data suggest that xylitol treatment may induce accelerated regeneration and premature differentiation of the keratinocytes resulting in a faster barrier recovery.”<sup>[10]</sup>

Zappelli *et al.* in their review article commented that xylitylglucoside, a sugar derivative of two plant sugars, xylitol and glucose, stimulated the synthesis of proteins, enzymes (different types of keratin, loricrin, and transglutaminase), and ceramides essential to the function of the skin barrier. Authors also commented that these xylitylglucosides are associated with the increased synthesis of dermal macromolecules such as hyaluronic acid and chondroitin sulfate in fibroblast culture.<sup>[22]</sup> Korponyai *et al.* also reported similar results in their long-term clinical trial with xylitol, authors reported that xylitol leads to an elevated protein expression of filaggrin, a source of NMF.<sup>[14]</sup>

The results of the above studies clearly demonstrate that besides skin hydration xylitol effectively improves the barrier function of the skin.

In the present study, there was a significant increase in skin hydration compared to baseline as well as control within 4 h after application of MaxRich<sup>®</sup>, a novel moisturizing formula containing xylitol-based sugars. This is in accordance with previously discussed studies. Similarly, there was a significant decrease in transepidermal water loss associated with MaxRich<sup>®</sup> compared to both baseline and control product 4 h after application. Decrease in transepidermal water loss demonstrates that MaxRich<sup>®</sup> is associated with epidermal barrier repair. These results highlight the intense and fast acting moisturizing effect of MaxRich<sup>®</sup>.

Another important finding seen in this study is that the skin hydration was maintained above baseline value while transepidermal water loss was maintained below baseline throughout 24-h period after single application of with MaxRich<sup>®</sup>. This point toward the long-lasting effect of MaxRich<sup>®</sup>.

This being a pilot study, small sample size, and very short evaluation period are the main limitations of the study. However, these limitations do not undermine the results of the study. Long-term clinical trial with larger sample size is warranted in future.

## CONCLUSION

Results of our study indicate that MaxRich<sup>®</sup>, a novel moisturizer containing xylitol, xylitylglucoside, and anhydroxylitol, is associated with intense, fast, and long-lasting moisturizing effect.

## REFERENCES

1. Leite e Silva VR, Schulman MA, Ferelli C, Gimenez JM, Ruas GW, Baby AR, *et al.* Hydrating effects of moisturizer active compounds incorporated into hydrogels: *In vivo* assessment and comparison between devices. *J Cosmet Dermatol* 2009;8:32-9.
2. Sator PG, Schmidt JB, Hönigsmann H. Comparison of epidermal hydration and skin surface lipids in healthy individuals and in patients with atopic dermatitis. *J Am Acad Dermatol* 2003;48:352-8.
3. Loden M, Maibach H. *Dry Skin and Moisturizers: Chemistry and Function*. 1<sup>st</sup> ed. New York: CRC Press; 1999.
4. Lynde CW. Moisturizers: What they are and how they work. *Skin Therapy Lett* 2001;6:3-5.
5. Sethi A, Kaur T, Malhotra SK, Gambhir ML. Moisturizers: The slippery road. *Indian J Dermatol* 2016;61:279-87.
6. Del Rosso JQ. Cosmeceutical moisturizers. In: Draeos ZD, editor. *Procedures in Cosmetic Dermatology Series: Cosmeceuticals*. 1<sup>st</sup> ed. Philadelphia, PA: Elsevier; 2005. p. 97-102.
7. Lee D, Seo ES, Hong JT, Lee GT, You YK, Lee KK, *et al.* The efficacy and safety of a proposed herbal moisturising cream for dry skin and itch relief: A randomised, double-blind, placebo-controlled trial study protocol. *BMC Complement Altern Med* 2013;13:330.
8. Buraczewska I, Berne B, Lindberg M, Törmä H, Lodén M. Changes in skin barrier function following long-term treatment with moisturizers, a randomized controlled trial. *Br J Dermatol* 2007;156:492-8.



9. Páyer E, Szabó-Papp J, Ambrus L, Szöllösi AG, András M, Dikstein S, *et al.* Beyond the physico-chemical barrier: Glycerol and xylitol markedly yet differentially alter gene expression profiles and modify signalling pathways in human epidermal keratinocytes. *Exp Dermatol* 2018;27:280-4.
10. Szabó-Papp JS, Oláh A, Szöllösi AG, Tóth BI, Czifra G, Bíró T. Differential effects of common moisturizer polyols on normal human epidermal keratinocytes. *J Invest Dermatol* 2012;132:S51-64.
11. Korponyai C, Szél E, Behány Z, Varga E, Mohos G, Dura Á, *et al.* Effects of locally applied glycerol and xylitol on the hydration, barrier function and morphological parameters of the skin. *Acta Derm Venereol* 2017;97:182-7.
12. Knuutila ML, Kuksa TH, Svanberg MJ, Mattila PT, Karjalainen KM, Kolehmainen E, *et al.* Effects of dietary xylitol on collagen content and glycosylation in healthy and diabetic rats. *Life Sci* 2000;67:283-90.
13. Mattila PT, Pelkonen P, Knuutila ML. Effects of a long-term dietary xylitol supplementation on collagen content and fluorescence of the skin in aged rats. *Gerontology* 2005;51:166-9.
14. Korponyai C, Kovács RK, Erös G, Dikstein S, Kemény L. Antiirritant properties of polyols and amino acids. *Dermatitis* 2011;22:141-6.
15. Lodén M, Bárány E, Mandahl P, Wessman C. The influence of urea treatment on skin susceptibility to surfactant-induced irritation: A placebo-controlled and randomized study. *Exog Dermatol* 2004;3:1-6.
16. Held E, Sveinsdottir S, Agner T. Effect of long-term use of moisturizer on skin hydration, barrier function and susceptibility to irritants. *Acta Derm Venereol* 1999;79:49-51.
17. Lodén M, Kuzmina N, Nyrén M, Edlund F, Emtestam L. Nickel susceptibility and skin barrier function to water after treatment with a urea-containing moisturizer. *Exog Dermatol* 2004;3:99-105.
18. Gånemo A, Virtanen M, Vahlquist A. Improved topical treatment of lamellar ichthyosis: A double-blind study of four different cream formulations. *Br J Dermatol* 1999;141:1027-32.
19. Szél E, Polyánka H, Szabó K, Hartmann P, Degovics D, Balázs B, *et al.* Anti-irritant and anti-inflammatory effects of glycerol and xylitol in sodium lauryl sulphate-induced acute irritation. *J Eur Acad Dermatol Venereol* 2015;29:2333-41.
20. Katsuyama M, Kobayashi Y, Ichikawa H, Mizuno A, Miyachi Y, Matsunaga K, *et al.* A novel method to control the balance of skin microflora Part 2. A study to assess the effect of a cream containing farnesol and xylitol on atopic dry skin. *J Dermatol Sci* 2005;38:207-13.
21. Erös G, Korponyai C, Szabó K, Behány Z, Szél E, Kemény L. Antibacterial and skin hydrating effects of Xylitop<sup>®</sup> gel containing glycerol and xylitol. *Borgyogy Venerol Sz* 2014;90:152-5.
22. Zappelli C, Barbulova A, Apone F, Colucci G. Effective active ingredients obtained through biotechnology. *Cosmetics* 2016;3:39.

**How to cite this article:** Deshmukh GA, Dhoot DS, Barkate H. Moisturizing Kinetics of Maxrich, a Novel Moisturizing Formula Comprising of Xylitol and Xylitol-based Sugars such as Xylitylglucoside and Anhydroxylitol. *Int J Sci Stud* 2018;6(9):91-95.

**Source of Support:** Nil, **Conflict of Interest:** None declared.