

## The Comparison of Shampoos for Skin Hydration by Measurement of Epidermal Capacitance in Normal Canine Skin

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**Abstract :** Various commercial shampoos were frequently prescribed for dermatologic therapy in small animal practice. Skin hydration affected by the shampoos, however, was not evaluated routinely. In order to evaluate the skin hydration for the exact prescription of shampoos method to measure skin hydration of shampoos are needed. This study was undertaken to evaluate the skin hydration effect of shampoo on canine skin using Corneometer. Five healthy dogs were applied with 7 commercial shampoos: Humilac, Sebocalm, Sebolytics, Etiderm, Benzoyl peroxide, HyLyt and Zn-7 Derm. Skin hydrations were evaluated by measurement of electrical capacitance by Corneometer. A statistically significant increase in skin hydration was found 17(p<0.05) and 77 minutes(p<0.01) after application of Humilac indicating a humidifying effect of this product. A statistically significant decrease in skin hydration was found for the Benzoyl peroxide after 77 minutes(p<0.05). No statistically significant differences between the other shampoos were found. None of the products tested had any negative effect on the skin barrier function. The Corneometer was found useful for detecting skin hydration to shampoos and considered as a simple and useful tool for prescription of various shampoos routine practice.

**Key words :** Corneometer, skin hydration, shampoos, dog

### Introduction

The source of skin water were sweating, licking of the coat, and water from exposure to rain or when swimming or bathing in dog. The sweat glands are found associated with hair follicles in the hairy skin of the dog. The presence of an adequate amount of water in the stratum corneum is important for general appearance of a soft, smooth, well-moisturized skin, of a flexible skin, and of an intact barrier function allowing a slow rate of transepidermal water loss under dry conditions<sup>1-3</sup>.

Water plays a fundamental role in the biology of skin microorganisms. It was suggested that the numbers of streptococci on the gluteal skin of cattle has a significant positive correlation with transepidermal water loss and concluded that the temperature requirements of the majority of skin bacteria are less critical than their need for moisture and the other factors, which are altered by active sweat production<sup>9</sup>.

The measurement of skin surface water is considered important because the water content of stratum corneum has affect to the skin physiological characteristics such as barrier function, drug absorption, mechanical function. Currently used techniques were applied in the dog, which were based on principles similar to those employed by Tagami *et al*<sup>13</sup>. Commercial equipments for skin water were simple due to development of technology.

The Corneometer has been widely used to measure the water in skin. It makes to measure the water change in stratum corneum by various physiological, pathological,

experimental states and has multiple advantages such as high reproducibility, simple management, short measurement time and low price<sup>12</sup>.

In routine dermatological practice various type of shampoos were prescribed for topical therapy. However most prescription is empirical based on gross finding and it is difficult to evaluate the topical therapeutic hydration effect of shampoo. Therefore this study was performed for the effect of topical agents to the skin hydration using measurement of epidermal capacitance in normal canine skin, also whether the Corneometer CM 825 could be used in practice routinely for dermatologic application to enhance the effect of topical therapy.

### Materials and Methods

#### Experimental animals

Five clinically normal mixed breed dogs, aged between 2 to 4 years, 1 male and 4 female were included in this study. We performed the general physical and dermatological examination, and the absence of frank disease was established. The dogs were kept in the room in which measurements were made for at least an hour before readings were taken. No particular precautions were taken to prevent sweating, although frank sweating was not observed in any of the dogs.

#### Equipment

A Corneometer (CM 825, CK electronic Germany) was used to measure the capacitance of the skin (Fig. 1). The meter is attached to a probe, being composed of ceramic tiles with numerous, closely spaced gold lines located in par-

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allel, and functioning similar to capacitor plates. The measuring process is activated by placing and pressing the probe onto the skin.

**Moisture measurement**

Seven shampoos were tested, Humilac, Sebocalm, Etiderm, Sebolytic (Virbac, France), Peroxyderm (Chasoot, Swiss), HyLyt (DVM Pharmaceuticals, Inc., USA) Zn-7 Derm (Fayette, USA) diluted as a 1:10 aqueous solution with distilled water. One negative control site consisted of saline only and one positive control site consisted of a detergent (antibacterial hand soap, Kirkland signature TM, USA).

The hairs in abdomen were clipped with No. 10 clipper (Oyster, USA) prior to baseline data collection. Each test area was divided into 15 × 15 mm test zones separated by Medical Bandage tape, to avoid lateral spread of the material (Fig. 2). Fifty microliters of each test substance was applied in the center of each area. The material was spread on the area studied to produce a uniform film. The emulsion was allowed to stay for 7 minutes. Measurement were made in T<sub>0</sub>, T<sub>0</sub>+7, T<sub>0</sub>+17, and T<sub>0</sub>+77.



Fig 1. The Corneometer CM 825.

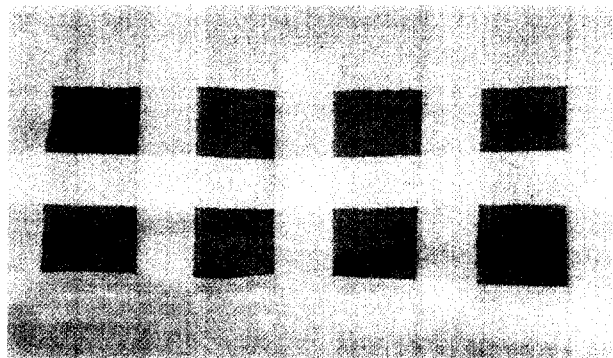


Fig 2. The skin preparation for the measurement of skin hydration.

**Statistical analysis**

The significant difference between the mean values for each group was evaluated using Student's *t* test. A probability of 95 per cent or more was regarded as significant.

**Results**

Comparing the various skin sites for baseline levels of skin hydration, the highest level was found in right thorax. Skin hydration level of rump was the lowest among the sites. Orderly the hydration level of neck was third level (Fig. 3).

Fig. 4 compares the mean results of the arbitrary capacitance units of the Humilac, saline and detergent. The significant increase was shown at 17 and 77 minutes after application than saline and detergent ( $p < 0.05$ ,  $p < 0.01$ , respectively). The humilac maintained the hydration state until 77 minutes. The hydration of saline and detergent were more rapidly return to baseline levels than humilac.

In Sebocalm mean hydration state reached the 108 a.u. at 7 minute and gradually increased to 121.4 a.u. at 17 minutes after application, and then decreased to 80.8 a.u. at 77 minutes (Fig. 5). The significant increase was found at 77 minutes ( $p < 0.01$ ).

In Etiderm there was found no statistical significance but hydration state was more maintained long until 17 minutes than saline and detergent.

Fig. 7 showed the mean results of Sebolytics, and 19.6, 103.8, 119.6 and 77 a.u. at 0, 7, 17, 77 minutes, respectively. There was found no statistical significance.

In Benzoyl peroxide the hydration state were 21.0, 106.6, 109.0 and 18.8 a.u. at 0, 7, 17, 77 minutes, respectively (Fig 8). At 77 minutes the hydration state was rapidly decreased to baseline level, and the mean results at 77 minutes was significantly decreased than saline and detergent ( $p < 0.05$ ).

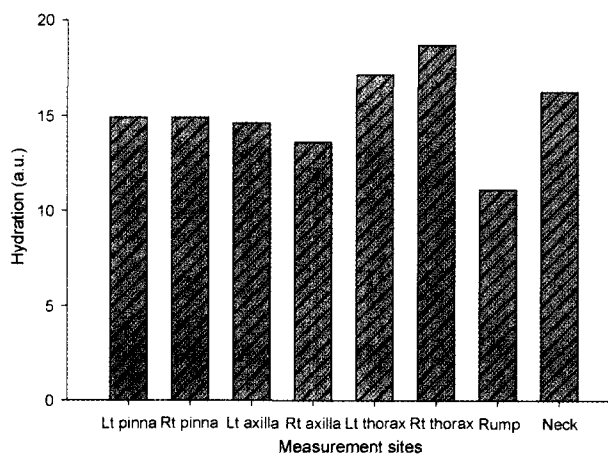
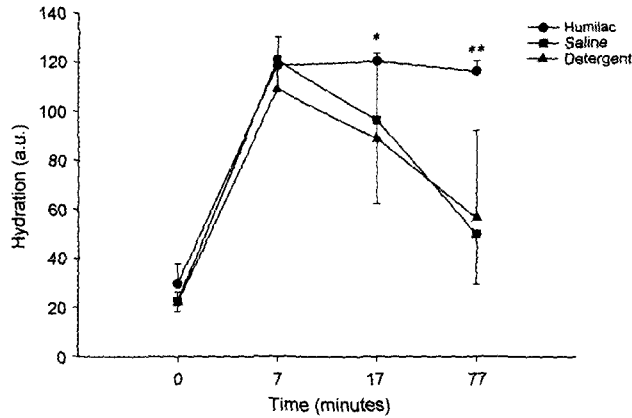
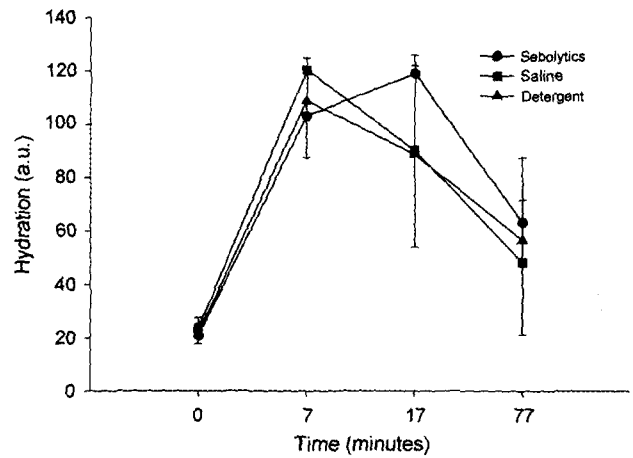


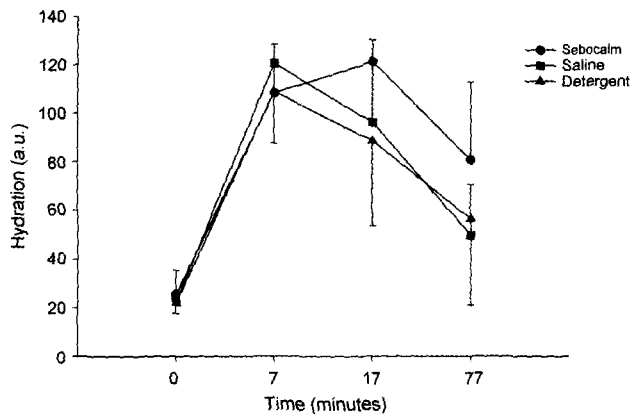
Fig 3. Moisture levels for particular sites on the canine skin. These data are the mean values taken from 5 dogs of the mixed breed.



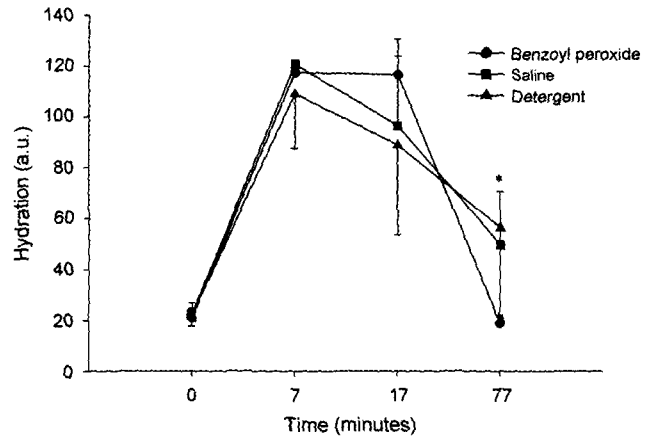
**Fig 4.** Changes in hydration (arbitrary capacitance units) of the abdomen skin after a single application of an Humilac in comparison with saline and detergent (\* $p < 0.05$ , \*\* $p < 0.01$ ).



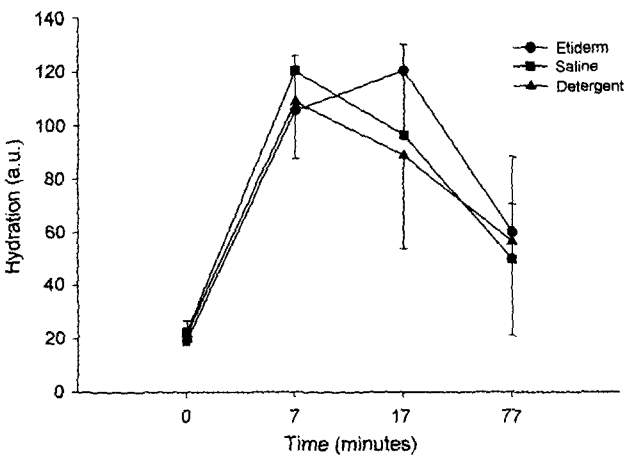
**Fig 7.** Changes in hydration (arbitrary capacitance units) of the abdomen skin after a single application of on Sebolytics in comparison with saline and detergent.



**Fig 5.** Changes in hydration (arbitrary capacitance units) of the abdomen skin after a single application of an Sebocalm in comparison with saline and detergent.



**Fig 8.** Changes in hydration (arbitrary capacitance units) of the abdomen skin after a single application of an Benzoyl peroxide in comparison with saline and detergent (\* $p < 0.05$ ).



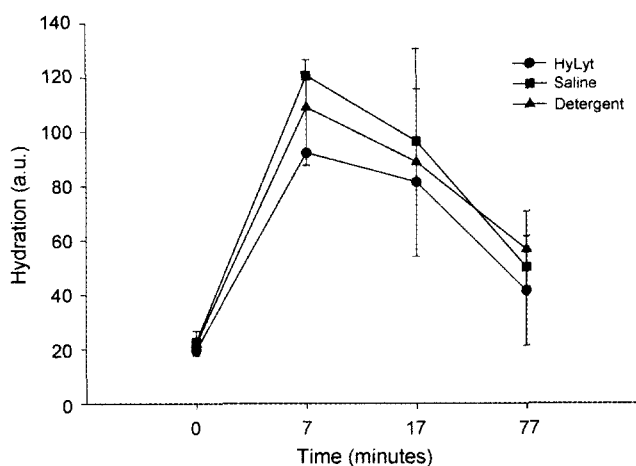
**Fig 6.** Changes in hydration (arbitrary capacitance units) of the abdomen skin after a single application of an Etiderm in comparison with saline and detergent.

In HyLyt baseline levels were 19.6 a.u., after 7 minutes, 92.2 a.u., 17 minutes, 81.4 a.u., 77 minutes 41.4, respectively (Fig. 9). Generally the hydration state of HyLyt was maintained below the mean of saline and detergent through experimental time.

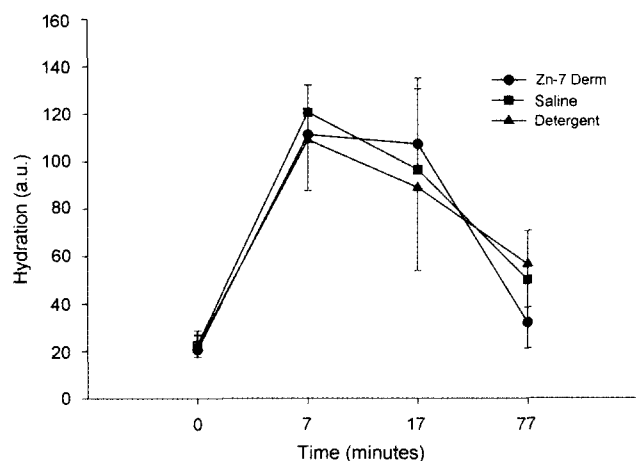
The mean hydration levels of Zn-7 Derm were shown Fig. 10. The peak value was lower than saline, and the return to baseline levels more rapid. At 77 minutes the mean hydration value of Zn-7 Derm was lower than that of saline and detergent.

### Discussion

Water supply to the skin is influenced by the fact that water arrives at the base of the epidermis from the dermis at least 50 to 100 times as fast as it is lost from the surface of



**Fig 9.** Changes in hydration (arbitrary capacitance units) of the abdomen skin after a single application of an HyLyt in comparison with saline and detergent.



**Fig 10.** Changes in hydration (arbitrary capacitance units) of the abdomen skin after a single application of an Zn-7 Derm in comparison with saline and detergent.

the epidermis<sup>1</sup>. This reflects the barrier function of the stratum corneum, which has a very low diffusibility for water<sup>1</sup>. However, when skin integrity is altered, as in human psoriasis, this barrier function is compromised<sup>12</sup>.

The current views of skin water accept that there is as yet no tool, which will measure the true water content of skin in vivo<sup>6</sup>. However, two aspects of skin water can be explored: the varying hydration of the skin surface, and the layer of water vapour close to the skin, lying within the coat.

The regional differences showed in this study are probably not related to variation in dermal hydration, but the rate of water loss from the epidermal surface may vary with the humidity of air close to the skin. This can be modified by varying densities of hair cover and the level of exposing densities of hair cover and the level of exposure of site; the

rump is exposed, as opposed to the groin or flexural fold which are relatively enclosed. It is also possible that varying levels of moisture above the skin could influence skin hygroscopicity<sup>4</sup>. This feature influenced the production of the principal hygroscopic compounds within the skin, uronic acid and pyrrolidone carboxylic acid<sup>10</sup>. In the present study of regional skin surfaces the baseline hydration was not significantly different from each other, however, the left and right thorax and neck region was higher than other regions. This suggests densities of hair coat and site exposure may modify the epidermal surface water.

In dermatological practice various specific shampoos were prescribed for adjunct therapy to treat the specific dermatoses, also general shampoos were used for cleaning of hair and skin regularly. However some veterinarians are followed by manufacturers instruction simply, some veterinarians are not. Generally for better shampoo effect the skin contact time is very important, usually 15-minutes contact time. In present study of various shampoos on abdomen skin hydration ability of shampoo was reached high at 7 minutes after application of shampoos and began to declined at 17 minutes, except Humilac and Sebolytics. At 77 minutes after application the skin hydration were markedly dropped. This suggests that skin hydration ability of shampoo was maintained within the 77 minutes.

The Humilac shampoo has skin moisturizing effect and skin hydration was significantly maintained for 77 minutes comparing saline and detergent. In contrast to Humilac Benzoyl peroxide was known to potent drying agent and skin hydration was significantly decreased at 77 minutes after application. These results indicated that the skin hydration measurement by Corneometer was useful for measurement of epidermal hydration to test the hydration effect of any other shampoo formula in dogs. The Corneometer a commercially available electrical instrument that measures skin capacitance is considered able to depict changes of hydration much deeper into the skin than the high-frequency method.<sup>11</sup> Thus, we have compared various shampoos with this instrument in canine skin.

In present study the application times was short and frequency of application was once. Therefore the further study was needed to evaluate the hydration effect of shampoos after the repeated application, also long term effect of specific shampoo on skin hydration in canine skin.

### Conclusion

Five healthy dogs were applied with 7 commercial shampoos: Humilac, Sebocalm, Sebolytics, Etiderm, Benzoyl peroxide, HyLyt and Zn-7 Derm. Skin hydrations were evaluated by measurement of electrical capacitance by Corneometer. A statistically significant increase in skin hydration was found 17 and 77 minutes after application of

Humilac indicating a humidifying effect of this product. A statistically significant decrease in skin hydration was found for the Benzoyl peroxide after 77 minutes. No statistically significant differences between the other shampoos were found. None of the products tested had any negative effect on the skin barrier function. The Corneometer was found useful for detecting skin hydration to shampoos and considered as a simple and useful tool for prescription of various shampoos routine practice.

## References

- Blank IH. Factors which influence the water content of the stratum corneum. *J Invest Dermatol* 1952; 18: 433-440.
- Chesney CJ. Water: its form, function and importance in the skin of domestic animals. *Vet Rec* 1993; 34: 65-71.
- Chesney CJ. The intimate envelope: water and the skin. In: *Advances in Veterinary Dermatology*, Vol. III. Woburn, Butterworth-Heinemann, 1996: 47-56.
- Chesney CJ. Measurement of skin hydration in normal dogs and in dogs with atopy or a scaling dermatosis *J Small Anim Pract* 1995; 36: 305-309.
- Distante F, Beradesca E. Hydration In: *Bioengineering of the skin: Methods and Instrumentation*, Boca Raton: CRC press. 1995: 5-11.
- Edwards C. The electrical properties of skin. In: *the Physical Nature of Skin*, Lancaster, MTP Press, 209-214.
- Jenkinson D, McE E. Sweat and sebaceous glands and their function in domestic animals. In: *Advances in veterinary Dermatology*, Vol. I, London: Bailliere Tindall. 1990: 229-251.
- Leveque JL, de Rigal J. Impedance methods for studying skin moisturization. *J Soc Cosmet Chem* 1983; 34: 419.
- Lloyd DH. The effect of climate on the microbial ecology of the skin of cattle and sheep. Ph.D. thesis, University of Glasgow, 1978.
- Scott IR, Harding CR. Filaggrin breakdown to water binding compounds during development of the rat stratum corneum is controlled by the water activity of the environment. *Developmental Biology* 1986; 115: 84-92.
- Tagami H. Impedance measurements for evaluation of the hydrations state of the skin surface. In:
- Tagami H, Kanamuru Y, Inoue K, Suehisa S, Inoue F, Iwatsuki K, Yoshikuni K, Yamada M. Water sorption-desorption test of the skin in vivo for functional assessment of the stratum corneum. *J Invest Dermatol* 1982; 78: 425-428.
- Tagami H, Ohi M, Iwatsuki K, Kanamuru Y, Yamada M, Ichijo B. Evaluation of the skin surface hydration in vivo by electrical measurement. *J Invest Dermatol* 1980; 75: 500-507.

## Epidermal Capacitance를 이용한 시판되는 치료용 샴푸의 정상적인 개 피부에 대한 가수효과

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**요약** : 피부질환에는 보조 치료로 다양한 치료용 샴푸가 빈번하게 적용되고 있으나 이들 샴푸의 피부수분에 미치는 영향은 일반적으로 평가되지 않고 있는 실정이다. 따라서 치료용 샴푸의 정확한 처방을 위해서는 피부의 수분을 측정하기 위한 측정법이 필요하다. 본 연구는 여러 종류의 치료용 샴푸의 피부 수분에 대한 영향을 알아 보기 위해 Corneometer를 이용하여 피부에 샴푸를 적용후 수분을 측정하였다. 5두의 건강한 개를 대상으로 7가지 샴푸로 Humilac, Sebocalm, Seboldyics, Etiderm, Benzoyl peroxide, HyLyt, Zn-7 Derm를 선정하여 적용하였다. Humilac의 경우 통계학적으로 유의한 피부수분의 증가는 적용 후 17분( $p < 0.05$ ), 77분( $p < 0.01$ )에 나타났으며, Benzoyl peroxide의 경우 적용 후 77분( $p < 0.05$ )에 피부의 수분이 유의하게 감소되었다. 다른 샴푸의 경우 통계학적으로 유의하지 않았으나 전반적으로 감소하는 경향을 보였으며 적용 후 77분에 최초 적용 수치에 근접하게 감소하였다. 어떤 샴푸도 피부에 부작용을 유발하지 않았다. Corneometer는 실제 임상에서 피부의 수분을 평가하는데 간단하고 유용한 측정방법으로 사료된다.