J Vet Clin 18(4) : 363-367(2001)

The Comparison of Various Shampoos on Skin pH in Normal Dogs

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Abstract : Shampoos are used routinely by a large number of veterinarians to treat skin diseases. Skin pH is affected by shampoos, however, known to occur. In order to evaluate the effect of shampoos on skin surface pH, we performed the measurement of skin pH using skin pH meter PH900 in five healthy mixed breed dogs. The seven commercial shampoos: Humilac, Sebocalm, Sebolytics, Etiderm, Peroxyderm, HyLyt and Zn-7 Derm were included in this study. The anatomical sites, right thorax was the highest pH (7.66±0.10), and the lowest pH (6.20 ±0.23) was left pinna. A statiscally significant decrease in skin pH was found 7 minutes after application of Humilac, Sebocalm, Etiderm, Peroxyderm ($p<0.01$) and Sebolytics ($p<0.05$). After 17 minutes of application skin surface pH was inclined to increase in every shampoos but the degree of increase was slight at 77 minutes. No statiscally significant differences were found in HyLy-T and Zn-7 Derm, but skin pH was normal range (6.2-7.8) after application. Thoroughout the experiment skin surface pH was maintained above pH 7.0 in detergent. The commercial shampoos, Humilac, Sebocalm, Etiderm, had the decreasing effect on skin surface pH in dogs. The other four shampoos maintain the skin pH normal range. The skin pH meter PH 900 was found simple and useful for skin pH measurement.

Key words **:** skin pH, shampoo, PH 900 PC, dog

Introduction

In spite of number of reports related to veterinary skin diseases multiplies, the amount of research concerned with the normal biology of canine and feline skin is remarkably small. In the human dermatology there is now a large body of research, which demonstrates that the skin pH is affected by the various dermal structures, e.g. sweat gland, sebaceous gland, and environments.

Skin surface pH is an important factor in human dermatology, relating to microfloral environment and skin irritation. Normal skin pH distribution in humans ranges from pH 5.4 to 5.9, but can vary from more acidic to neutral and alkaline pH depending on the anatomical sites at which it is measured[2]. It is already known that a relationship exists between the acidity of the skin surface and its antimicrobial activity. In the case of acute exzema with erosion, the skin surface pH shifts to alkaline (pH 7.3-7.4) caused by extracellular fluid as a natural result in human. A complete body pH elevated in seborrheic dermatitis, atopic dermatitis, and xeroderma and the increased skin surface pH in sites predisposed to seborrheic dermatitis[3]. In present there has been no report on the relationship between skin pH and skin diseases in veterinary literature. Skin pH variations are important in the etiology and management of dermatological disorders.

There are two major techniques for measuring skin surface pH. The colorimetric approach and the glass electrode potentiometric technique. The glass electrode technique is more precise and sensitive than the colorimetric technique[11].

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The skin surfaces of haired mammals are generally acidic[10]. The pH of normal feline and canine skin has been reported to range form about 5.5-7.5[7-10]. The skin surface pH appears to vary with site, day, coat color, sex, gonadal status, and breed[8]. In addition, it has been reported that the skin surface pH of an excited dog can increase by greater than 1 unit within 1 minute[7].

However, there is no skin pH data in known for various shampoos on canine skin, despite widespread interest in small animal dermatology. This study describes the measurement of skin pH after application of shampoos in dogs and documents skin pH distributions for dogs of different shampoos, demonstrating the difference effect of shampoos on skin.

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. The general physical and dermatological examination was performed, and the absence of skin 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 Skin pH meter PH 900 (Courage and Khazaka, Germany) was used to measure the skin surface pH. The pH meter was calibrated prior to measurements using standard buffer solutions with pH 4.0 and 7.0. The combined elec-

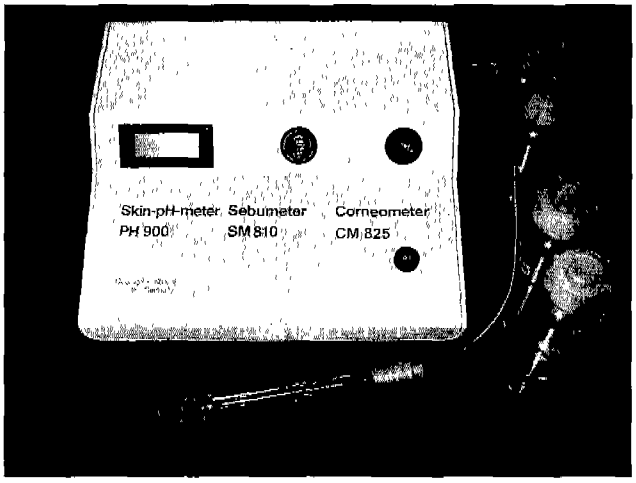

Fig 1. A skin pH meter PH 900PC.

trodes is connected to a pH meter which presents the voltage differences as digital pH values within seconds (Fig 1).

Skin baseline pH measurement

Skin pH was measured using a flat membrane skin-pH-meter. Anatomical sites measured were: left and right inner surface of pinna, left and right axilla, left and right thorax, rump and neck.

Skin pH measurement

Seven shampoos were tested, Humilac, Sebocalm, Etiderm, Sebolytic (Virbac, France), Peroxyderm (Chasoot, Swiss), HyLyt (DVM Pharmaceuticals, Inc., USA) and 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. 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_0, T_0 + 7, T_0 + 17, and T_0 + 77.

Statistical analysis

The significant difference between the mean values for each group was evaluated using *t*-test. A probability of 95 per cent or more was regarded as significant.

Results

The mean skin pH for all dogs for left and right pinna, left and right axilla, and left and right thorax were: mean±SE, 6.20±0.23, 6.63±0.06, 6.53±0.20, 6.83±0.14, 7.33±0.08, 7.66±0.10, respectively. The mean skin pH of rump and neck were 7.05±0.22, 6.90±0.13, respectively (Fig 2). Both sides of thorax showed the highest level of pH. The pH of left pinna was the lowest of 6.2.

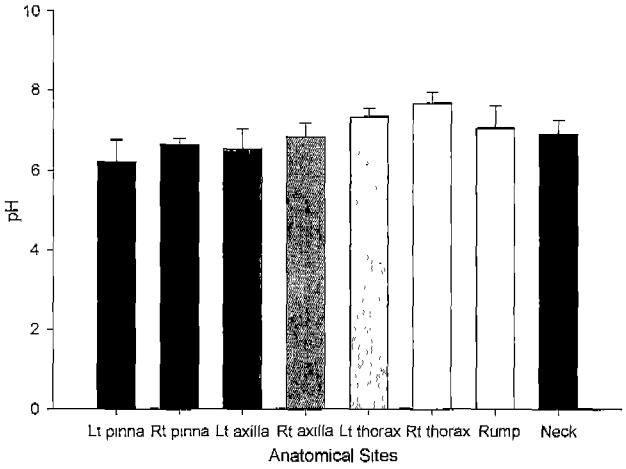

Fig 2. Skin pH values for particular sites on the canine skin. These data are the mean values taken from 5 dogs of the mixed breed.

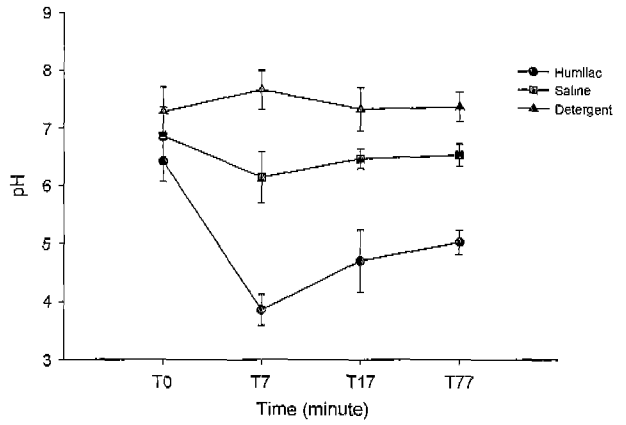

Fig 3. Canine skin pH change versus time after application for Humilac, saline and detergent. Significant differences at the 95% and 99% level denoted by * and **, respectively.

Fig 3 compares the mean results of the skin pH of the Humilac, saline and detergent. The significant decrease was shown at 7, 17 and 77 minutes after application than the saline and the detergent ($p<0.01$). The skin surface pH after application of Humilac were: (mean±SE) 6.42±0.34, 3.86±0.26, 4.70±0.5320 and 5.02±0.20, at T_0, T_7, T_{17} and T_{77}, respectively.

In Sebocalm mean skin pH reached 4.74±0.35 at 7 minute after application, and gradually increased to 5.50±0.40 and 5.86±0.33 at 17, and 77 minutes, respectively (Fig 4). The significant decrease was found at 7 minutes ($p<0.01$) and at 17, 77 minutes ($p<0.05$) than those of detergent.

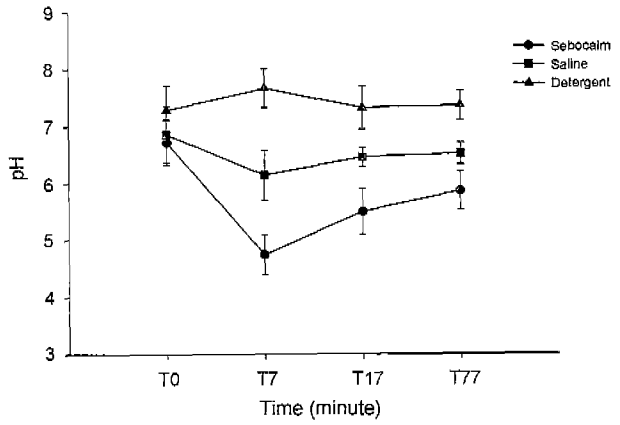

Fig 4. Canine skin pH change versus time after application for Sebocalm, saline and detergent. Significant differences at the 95% and 99% level denoted by * and **, respectively.

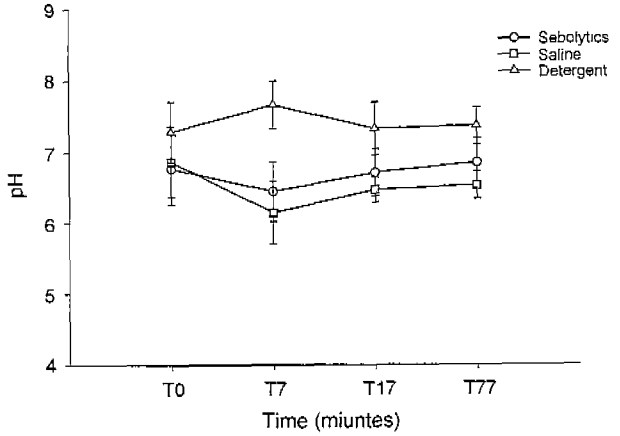

Fig 6. Canine skin pH change versus time after application for Sebolytics, saline and detergent. Significant differences at the 95% and 99% level denoted by * and **, respectively.

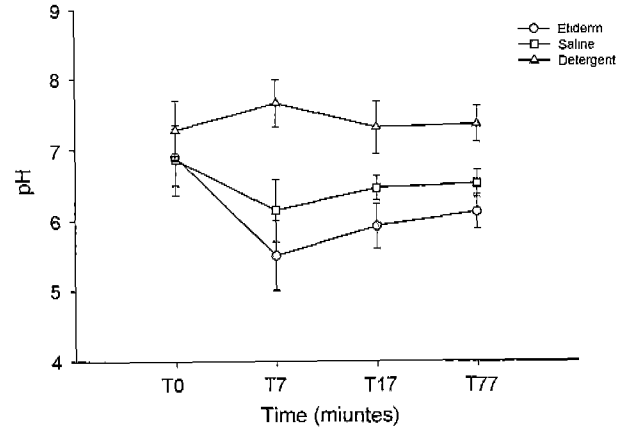

Fig 5. Canine skin pH change versus time after application for Ediderm, saline and detergent. Significant differences at the 95% and 99% level denoted by * and **, respectively.

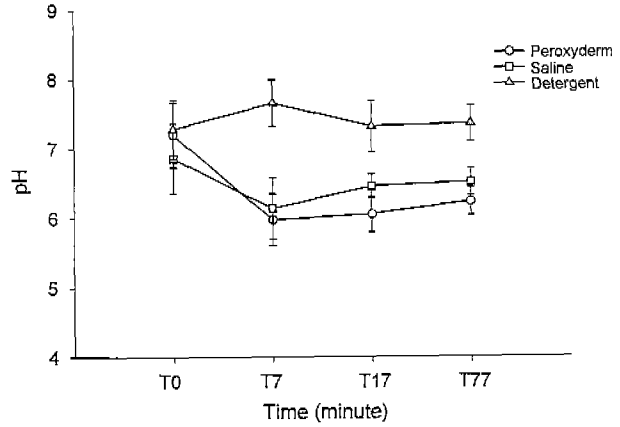

Fig 6. Canine skin pH change versus time after application for Peroxyderm, saline and detergent. Significant differences at the 95% and 99% level denoted by * and **, respectively.

The mean pH for Etiderm was 6.9±0.40, 5.30±0.49, 5.92 ±0.32 and 6.12±0.23 for T_0, T_7, T_{17} and T_{77}, respectively (Fig 5). The skin implicated with Etiderm was significantly lower than that of the detergent at 7 minutes ($p<0.01$) and 17 minutes ($p<0.05$).

The mean skin surface pH for Sebolytics was 6.76±0.50, 6.44±0.42, 6.70±0.33, 6.84±0.34 at T_0, T_7, T_{17} and T_{77}, respectively (Fig 6). The significance was observed at 7 minutes ($p<0.05$) comparing with the detergent.

The skin pH after Peroxyderm shampoo was 7.20±0.46, 5.98±0.36, 6.06±0.25, 6.24±0.19 at T_0, T_7, T_{17} and T_{77}, respectively (Fig 7). The significance was observed at 7 minutes ($p<0.01$) and 17 minutes ($p<0.05$), comparing with the detergent.

The skin pH were 6.92±0.39, 6.40±0.47, 6.42±0.22 and 6.72±0.16 at at T_0, T_7, T_{17} and T_{77}, respectively, in HyLy-T (Fig 8). There was found no statistical significance. The mean skin pH levels of Zn-7 Derm were shown Fig 9. The pH were 6.88±0.47, 6.68±0.46, 6.60±0.34, 6.58±0.41 at T_0, T_7, T_{17} and T_{77}, respectively. There was found no statistical significance.

Discussion

In general the skin surfaces pH of mammals is acidic. The normal pH of canine skin has been reported to range from about 6.2-7.8[7,10]. In a study[7] of skin surface pH in dogs, pH values varied at different sites on the skin and varied from day to day, ranging from 6.11 to 8.10. Males had significantly higher pH values than females. Spayed females had significantly higher pH values at all sites than intact females on all sites. In breed difference black Labrador retrievers had significantly higher pH values than yellow Labrador retrievers, and Labrador retrievers and miniature schnauzers were significantly different from English springer spaniels and

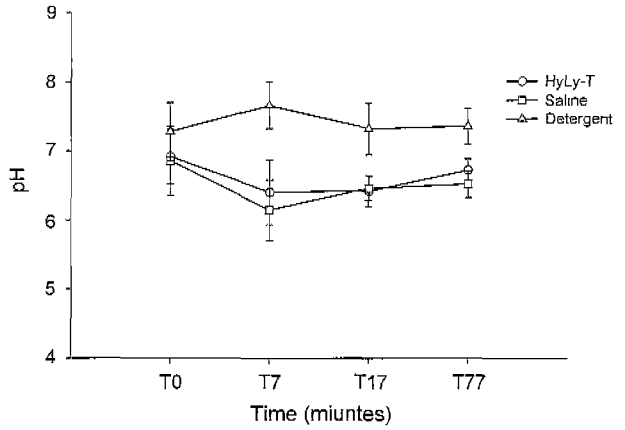

Fig 8. Canine skin pH change versus time after application for HyLy-T, saline and detergent. Significant differences at the 95% and 99% level denoted by * and **, respectively.

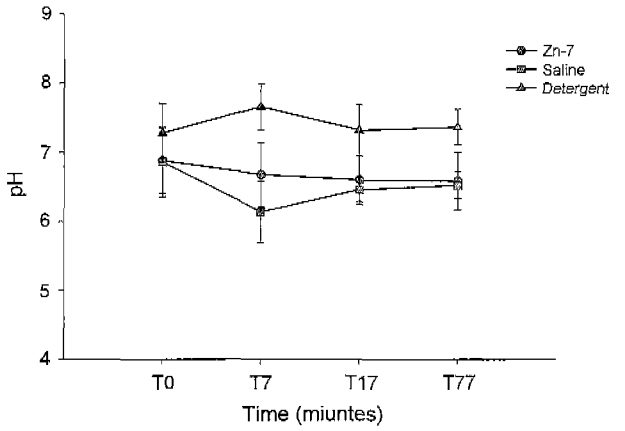

Fig 9. Canine skin pH change versus time after application for Zn-7, saline and detergent. Significant differences at the 95% and 99% level denoted by * and **, respectively.

Yorkshire terriers. Therefore, skin surface pH appears to vary with anatomical sites, day, coat color, sex, gonadal status, and breed[8,10]. In present study pH values varied at different sites of the skin, ranging from 6.2 for left pinna to 7.66 for right thorax. These pH data was consistent with those of normal pH range, in spite of small size of samples.

A relationship exists between the acidity of the skin surface ("acid mantle" of the skin surface) and its antimicrobial activity[4]. The buffer capacity of the skin surface against external and internal acidifying and alkalinizing effects depends on several buffering systems, including lactic acid in sweat, ammonia in sweat, and amino acids in human[6]. In general, inflammation causes the skin surface pH to switch from acid or neutral to alkaline[12]. The optimal pH range supporting growth of *S. aureus* is 7.0 to 7.5, although the bacteria can reproduce at pH 4.5 to 9.0[6]. Normal canine skin surface pH range is 6.2-7.8. Campbell *et al.*[3] reported that skin surface pH was highest in summer. Therefore canine skin is more susceptible to bacterial infection, especially in summer season. In our study after application of shampoos skin surface pH was maintained normal range except Humilac, Sebocalm and Etiderm, so it was thought that the other shampoos has no bactericidal effect by skin pH change. Also low skin pH of Humilac, Sebolytics and Etiderm may have bactericidal effect. However, lowered skin pH could irritate the skin surface. Further research is needed to identify the relationship between the bacterial infection and skin pH.

Measurement of skin surface pH is a simple procedure and can be performed easily by an inexperienced examiner. For buffer capacity measurements sodium hydroxide was applied directly to the skin. Then the time needed for neutralization of skin pH was measured using an indicator. The interpretation of the results was very subjective, and the accuracy was low[2]. The colorimetric procedure was increasingly replaced by the potentiometric pH measurement[11]. For this method different electrodes were used. The construction of a glass electrode with a selective hydrogen sensitivity led to highest sensitivity and reliability. In this study we used single glass rod measuring circuit that is connected to a pH meter, which presents the voltage differences as digital pH values within seconds. The flat electrode top is placed onto the skin with a slight pressure during the measurement. A glass electrode technique pH meter typically measures the skin surface pH. This skin pH meter didn't cause any harmful problems in dogs and approved to be the practical noninvasive method.

Shampoo therapy has moved to the forefront as a component in the treatment of all but the rarest skin disorders. The use of cleansing, moisturizing, lipolytic, anti-seborrheic, degreasing, anti-parasitic, anti-bacterial, anti-fungal and antipruritic shampoos are involved in it. Specific products and protocols usually are selected on the basis of the presenting morphologic characteristics such as dryness, oiliness, scaling, inflammation and associated pyoderma. The selection of shampoo products must consider reducing the risk of side effects such as irritation. In our study all prescription shampoos did not induce the side effects, however, Humilac, Sebolytics, and Etiderm has lowering effect of skin pH due to their ingredients, which are lactic acid, salicylic acid, and ethyl lectate, respectively.

In present study the application times and amounts were short and small, and frequency of application was once. Therefore the further study is needed to effect of shampoo on skin pH after the repeated application, also long-term effect of specific shampoo on canine skin pH in various anatomical sites.

Conclusion

Skin pH were evaluated by measurement of the measurement of skin pH using skin pH meter PH900 in five healthy

mixed breed dogs. The dogs were applied with 7 commercial shampoos: Humilac, Sebocalm, Sebolytics, Etiderm, Benzoyl peroxide, HyLyt and Zn-7 Derm. The anatomical sites, right thorax were the highest pH (7.66±0.10), and the lowest pH (6.20±0.23) was left pinna. A statiscally significant decrease in skin pH was found 7 minutes after application of Humilac, Sebocalm, Etiderm, Peroxyderm ($p<0.01$) and Sebolytics ($p<0.05$). After 17 minutes of application skin surface pH was inclined to increase in every shampoos but the degree of increase was slight at 77 minutes. No statiscally significant differences were found in HyLy-T and Zn-7 Derm, but skin pH was normal range (6.2-7.8) after application. The Humilac, Sebocalm, and Etiderm had the decreasing effect on skin surface pH in dogs. The other four shampoos maintain the skin pH normal range. The skin pH meter PH 900 was found simple and useful for skin pH measurement. None of the products tested had any negative effect on the skin.

References

1. Anderson DS. The acid-base balance of the skin. Br J Dermatol 1951; 63: 283-296.
2. Braun-Falco O, Korting HC. Der normale pH-Wert der menschlichen Haut. Hautarzt 1986; 37: 126-.
3. Campbell KL, laflamme DP, Harrison J. Seasonal variations in skin surface pH, skin surface hydration, and ahir epilation of normal dogs in Midwestern United States climate. Vet Dermatol 2000; 11 (suppl.): 19.
4. Chikakane K, Takahashi H. Measurement of skin pH and its significance in cutaneous diseases. Clin Dermatol 1995; 13: 299-306.
5. Dahl MV. *Staphylococcus aureus* and atopic dermatitis. Arch Dermatol 1983; 119: 840-846.
6. Korting HC, Kober M, Mueller M, Braun-Falco O. Influence of repeated washings with soap and synthetic detergents on pH and resident flora of the skin of forehead and forearm. Acta Derm Venereol, Stochkh 1987; 67: 41-47
7. Meyer W, Neurand K. Comparison of skin pH in domesticated and laboratory mammals. Arch Dermatol Res 1991; 283: 16-18.
8. Rucdisueli FL, Eastwood NJ, Gunn NK,Watson TDG. The measurement of skin pH in normal dogs of different breeds. In: Kwochka KW, *et al.* : Advances in Veterinary Dermatology III. Butterworth-Heinemann, Boston, 1998; 521-522.
9. Scott DW: Feline dermatology 1900-1978: A monograph. J Am Anim Hosp Assoc 1980; 16: 331-352.
10. Scott DW, Miller WH, Griffin CE. Miller and Kirks Small Animal Dermatology 6th ed. W.B. Saunders Philadelphia 2001: 3.
11. Welzel J. pH and ion. In: Bioengineering of the skin: Methods and Instrumentation. CRC press, Boca Raton 1995: 91-93.
12. Zlotogorski A. distribution of skin surface pH on the forehead and cheek of adults. Arch Dermatol Res 1987; 279: 398-401

상용샴푸가 정상견의 피부 pH에 미치는 영향

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요 약 : 개의 피부질환은 발생이 매우 높은 질환으로 다양한 원인에 의해 발생하나 대부분 장기간의 치료가 요구되거나 완치가 되지 않고 평생 치료를 받아야 하는 경우가 많다. 샴푸는 원발성 원인 치료에 보조적으로 사용되고 있으나 처방샴푸 치료의 중요성이 강조되고 있다. 본 연구는 피부표면 pH에 대한 다양한 샴푸의 영향을 알아보기 위해 샴푸를 정상견의 피부에 적용한 후 피부 pH 측정기를 통해 pH를 측정하였으며 적용된 샴푸는 Humilac, Sebocalm, Sebolytics, Etiderm, Peroxyderm, HyLy-T, Zn-7를 이용하였다. 해부학적 위치에 대한 피부 pH는 우측 흉부가 7.66±0.10으로 가장 높았고 좌측 이개는 6.20±0.23으로 가장 낮았으나 모두 정상 범위 (6.2-7.8)이었다. 샴푸 적용후 7분에 Humilac ($p<0.01$), Sebocalm($p<0.01$), Etiderm($p<0.01$), Peroxyderm($p<0.01$), 과 Sebolytics ($p<0.05$)가 detergent에 비해 유의하게 낮았으며 Humilac과 Sebocalm은 정상범위 보다 낮게 나타났다. HyLy-T와 Zn-7 Derm은 적용후 17분에는 샴푸를 적용한 모든 피부의 pH는 증가하였으며 77분에 다소 증가하였다. 본 실험을 통해 처방 샴푸는 피부의 pH를 낮추었고 그 효과는 즉시 나타났으며 피부 pH 측정기는 피부의 pH 측정에 실제적이며 간단한 방법으로 생각된다.