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Sebum flow dynamics and antidandruff shampoos

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Synopsis

The clinical efficacy of antidandruff shampoos is correlated with both their anti-*Malassezia* and their squamolytic activities. The sebum flow nourishing the lipophilic yeasts is another actor on the scene, fueling the skin disorder.

This study was conducted in 120 men in order to quantify the effect of eight proprietary antidandruff shampoos on sebum flow dynamics. Evaluations were made using the Lipometer®. Two shampoos exhibited a significant effect upon the sebum follicular reservoir, steadily increasing the sebum excretion rate in time. One other product induced a significant decrease in sebum output.

Present data give insight into the distinct effects of shampoos on the follicular reservoir function in androgenic alopecia. The resulting sebum flow dynamics may be significantly increased or decreased by proprietary products.

INTRODUCTION

Dandruff and seborrheic dermatitis are the result of excessive growth of *Malassezia ovalis* releasing pro-inflammatory mediators and activating an immune response (1–3). The lipophilic character of *M. ovalis* makes sebum a likely actor on the scene, fueling the abnormal skin condition. It has been previously shown that excessive oiliness is a disturbing side effect following regular use of selenium sulfide shampoo to control dandruff (4,5). Little is known about the variations in sebum output during other antidandruff treatments. The aim of the study was to compare the effect of proprietary shampoos on sebum flow dynamics.

MATERIALS AND METHODS

Eight proprietary antidandruff shampoos were used (Table I). A total of 120 men, aged 21–44 years, who suffered from androgenic alopecia of the vertex with mild dandruff, were enrolled. The study was conducted during the winter season. A three-week period of wash-out was observed during which panelists shampooed their scalps thrice weekly with a nonmedicated shampoo (mild shampoo Galenco®). At completion of this run-in period they were randomly allocated to one of eight groups receiving a test antifungal

Table I
Test Shampoos

Brand name	Antifungal
Anatel®	Piroctone olamine 1%
Cystelle®	Piroctone olamine 1%
Dercos®	Piroctone olamine 0.5%
Head and Shoulders®	Zinc pyrithione 1%
Nizoral®	Ketoconazole 2%
Pevaryl®	Econazole nitrate 1%
Selsun®	Selenium sulfide 2.5%
Zinkan®	Zinc pyrithione 1%

shampoo. Both the investigators and volunteers were unaware which shampoo was used. No other cosmetic product was allowed on the scalp during the three weeks prior to and during the study.

The sebum output on the scalp was evaluated weekly for five weeks on the alopecic vertex using the L'Oréal Lipometer®, equipped with a specially designed 6-mm probe (6,7). The close contact of the glass plate with the skin was rendered possible after the hair had been cut flush with the scalp surface. The amount of sebum was measured in the morning, three to four hours after shampooing. Eight successive measures at the same site were added. The sebum excretion rate (SER, $\mu g/cm^2/h$) was calculated by dividing the value of the amount of sebum by the time interval between the shampoo and the measures. For each shampoo, the mean of the weekly SER values was compared to that obtained at the end of the run-in period to yield the variation in SER (V-SER) expressed in percent. Such calculation was made including data from the five-week treatment and from the last two weeks of treatment.

The distribution of the numerical variable V-SER was characterized by the mean, median, and 95% confidence interval. Variations from baseline values were evaluated using the Wilcoxon test. Differences between products were tested with the Kruskal-Wallis and Dunnet tests. Regression analysis was applied to determine the V-SER changes in time. The linear, logarithmic, exponential, and power models were tested with calculation of the coefficient of correlation. All results were considered to be significant at the 5% critical level ($p < 0.05$).

RESULTS

At the clinical inspection, all shampoos showed a good antidandruff activity without revealing signs of irritation.

Data collected in the lipometry test are illustrated in Figure 1. Subjects using the selenium sulfide shampoo (S) showed a significant logarithmic ($r = 0.70$, $p < 0.05$) SER increase in time. SER in subjects using piroctone olamine shampoos (A, D) was unmodified except for one product (C) yielding increased values from the fourth week until completion of the study. No significant change in SER was disclosed for one of the azole shampoos (P) and the zinc pyrithione-containing shampoos (H, Z). The other azole shampoo (N) induced a significant ($p < 0.05$) SER decrease for the last two weeks of the study.

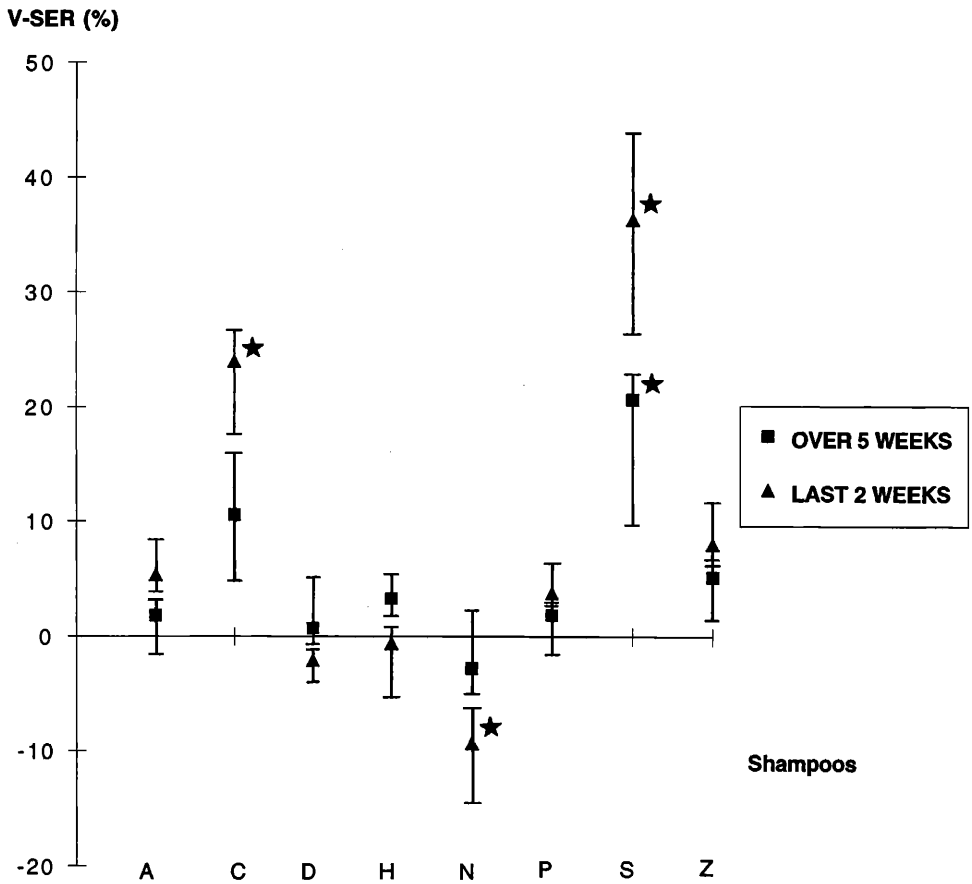

Figure 1. Photometric quantification of the median variation with 95% confidence interval in sebum excretion rate (V-SER) over the five-week use and last-two-week use of antidandruff shampoos (see Table I). Significant changes (*p < 0.05) take place versus baseline values.

At completion of the study, shampoos S and C significantly increased seborrhea compared to all other products and shampoo N alone, respectively.

DISCUSSION

The pivotal role of *M. ovalis* in the development of dandruff is generally acknowledged (1–3,8). For cosmetic reasons and pathogenic consideration, it is desirable that the sebum flow dynamics does not increase in response to the use of antidandruff shampoos.

Various methods have been used for measurement of the rate at which the sebum flows onto the skin surface. The optoelectronic method we used was specially designed for evaluations made on the scalp (6,7), affording direct reading of the collected amount of lipids (9). The sebum collected over a three- to four-hour period is directly related to the pool of sebum stored in the follicular reservoir (10–12) following its synthesis and secretion by the sebaceous glands. Many studies have shown that the early sebum flow after the skin is cleaned comes mainly from a reservoir in the pilosebaceous follicle, and

not from any feedback stimulation of the sebaceous gland (13–15). Hence, the present data, which are measures of sebum excretion, give insight into the activity of shampoos on the follicular reservoir function. In addition, since the size of the sebum pool lying within the pilosebaceous duct and the stratum corneum is in part related to the rate of sebum production, the method also provides an indirect measure of sebaceous gland activity.

In the present study, most of the antidandruff shampoos showed an absence of significant SER change over time. The discrete trend in SER increase might be related to the removal of dandruff, which allowed the sebum to spread freely at the skin surface. Such a finding confirms the unreality of the so-called reactive seborrhea, in which the sebaceous excretion increases with the frequency of most hair washes. However, this rule may have exceptions, illustrated by the fact that two shampoos of the present study induced a significant increase in SER. Such abundant sebum flow was already reported following the use of the selenium sulfide shampoo (4,5). Another study using the squamometry and corneosurfametry bioassays had shown that those shampoos promoting seborrhea were those yielding some irritancy potential on the stratum corneum (16). The direct relationship between alterations in sebum flow dynamics and subclinical irritation is suggested, although not proven, by these studies.

Only a few topical products are known to decrease the sebum output at the skin surface. Among them, the effect of progesterone (17), astringents (18), erythromycin–zinc complex (19), corticosteroids (20), and elubiol (21) have been documented. The 2%-ketoconazole shampoo formulation could be added to that list. It should be compared to the shampoos claiming a presumptive antiseborrheic activity.

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