J. Soc. Cosmet. Chem., **27**, 235-239 (May 1976)

Recoating of Human Hair by Sebum

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Synopsis—The results of two model experiments show that SEBUM does not creep along the HAIR. Accordingly, the sebum which coats the hair does not originate from its FOLLICLE. It is assumed that the terminal hair picks up sebum mechanically from surrounding follicles.

The hair and the SEBACEOUS GLAND together form the pilosebaceous apparatus in both man and hairy animals. The hair protects the body from loss of warmth, while the sebaceous glands protect the hair by covering it with lipid. Therefore, we can assume that the sebum, which is present in the hair follicle, is coating the whole hair. Greasing of the hair, which takes place during its growth out of the sebum-filled follicle, is of minor importance, since the rate of hair growth is only 0.35 mm a day. Moreover, recoating of hair by sebum occurs within a few days. Therefore, creeping of the sebum along the hair, as has been assumed by some authors (1), (2), seems to provide a natural explanation for the process of hair greasing.

Introduction

The Creeping of Sebum Along the Hair

The passive creeping of the sebum along the hair was examined in two experiments: the capillary experiment and the spreading experiment. These experiments will be discussed in the following two sections of this paper.

Experimental and Results

The Capillary Experiment

A glass capillary was filled with freshly sampled, human sebum, and a human terminal hair was threaded into the capillary. The temperature was held

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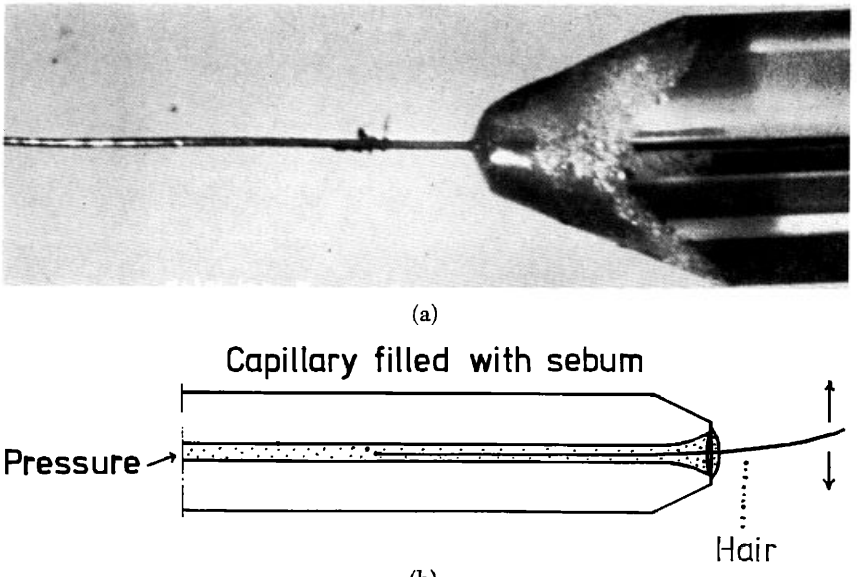

Figure 1. (a) + (b) Capillary experiment

constant at 35°C. Crystals of lipid soluble Sudan black were placed on the hair near the opening of the capillary to indicate whether or not any movement of sebum along the hair occurred. If sebum had crept along the hair, the Sudan black would have dissolved and colored the hair. This is shown in Figs. 1 (a) and (b).

Actually, the hairs remained unstained even after several days. In a modified experiment, the pressure on the sebum in the capillary was raised to enlarge the surface of the sebum in the funnel-shaped opening. Moreover, the hair was moved mechanically to imitate its natural movement. But again, the crystals did not dissolve. No creeping of sebum could be detected, and the hair did not function as a wick in the follicle.

The Spreading Experiment

To determine whether or not sebum spreads on human hair, a second experiment was conducted as follows.

A droplet of freshly sampled human sebum was placed on a human terminal hair, and the temperature was kept constant at 35°C, as is shown in Fig. 2. The droplet of sebum did not spread over the hair even after several days, and the size of the droplet did not change. This is identical with the behavior of lipids on textile fibers (7). Therefore, one may conclude that sebum

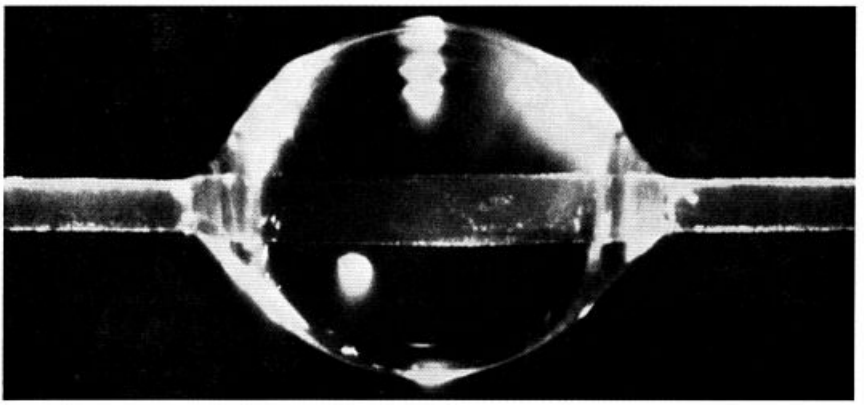

Figure 2. Spreading experiment

cannot spread along the hair and that greased hair is not greased by sebum from its own follicle. In other words, one can conclude that the sebaceous gland is not able to secrete sebum actively on the hair. A wick effect between parallel hairs may occur, but this is not the normal situation, because the distance between the hairs on the scalp is too large.

The Coating of Hair by Sebum

It is assumed that the hair picks up sebum mechanically from the surrounding follicles. Because this process occurs separately for each hair after each shampooing and is easily disturbed by external influences like combing, it is very difficult to establish the unformity of this process. Two observations are reported, as follows, which support our assumption concerning the mechanism of the sebum coating of hair.

Lack of Lipid on the Hair

Terminal hairs from a normally oily scalp are extracted and pressed on a glass plate. After removing the hair from the plate, the lipid prints of the hair are visible on the plate. This is illustrated in Fig. 3.

Some, but not all, of this head's oily hairs show a reduction or even a lack of lipids for about 1 to 2 cm from the root of the hair. Obviously, the hair is able to pick up sebum from follicles at a distance of 1 cm or more from its own follicle.

This observation can be readily explained because hair does not grow parallel to the skin surface. There is always an angle between the hair and the surface. This angle depends on the length and, most probably, on the thickness of the hair. The hair may touch the skin surface again after a distance of 1 cm or more, where it can pick up serbum from neighboring follicles.

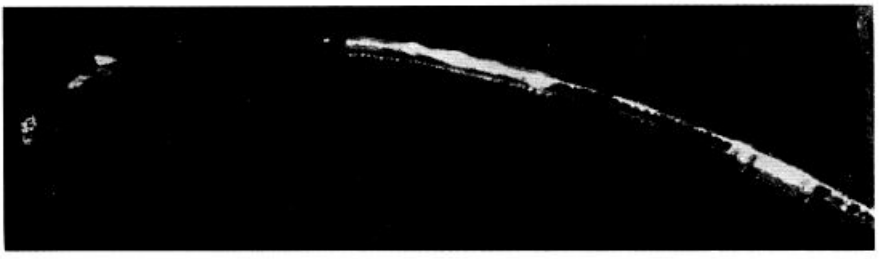

Figure 3. Lack of lipid on hair

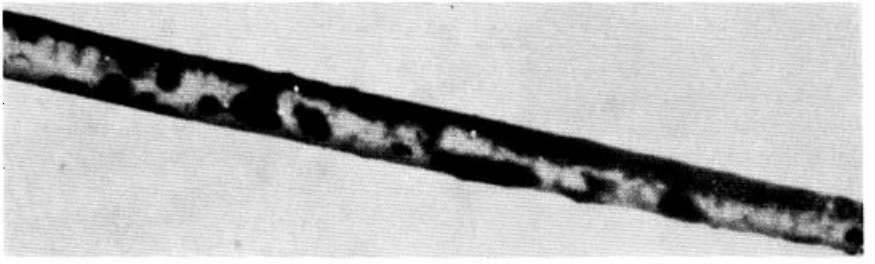

Figure 4. Lipid pattern on oily hair

Lipid Pattern on Oily Hair

White or blond hairs, which were extracted from human scalps, were exposed to an atmosphere of osmium tetroxide. After a few minutes, the lipids on the hair were stained black as is indicated in Fig. 4.

When examined under a stereoscopic microscope, these oily hairs showed a droplet-shaped pattern of lipids on the greasy areas as a result of the adsorption of sebum from the follicles. No coherent film was visible which would be evidence of the spreading of sebum over the hair.

Conclusions

Hair is oilier, if it is pressed against the head, e.g., by a hat. Persons with upright hairs exhibit only greasy scalps not greasy hairs. Short hair is recoated by sebum more slowly than long hair.

The time for the regeneration of lipid on the forehead is very different from the time needed for the greasing of hair. We were able to demonstrate that the greasing of hair occurs within a few days (3). Measurements with the same method revealed that the regeneration of lipid on the forehead is completed within a few hours and that it is stopped by a regulatory mechanism (4). We were also able to demonstrate that the lipid regeneration time of skin

on the forehead is the same as that of skin on the scalp (5). Hair can then pick up sebum from the oily skin until it is saturated with the lipid (3). This level is reached after a few days.

The greasing mechanism of hair after shampooing may then be described as follows: after it is degreased by shampooing, the follicle is filled with sebum until regulation by surface tension occurs. The hair in the follicle has no effect on this regulation because it does not change the surface area of the sebum in the follicle. It was shown by Kligman and Shelly (6) that follicles filled with sebum look like oily pools. The pools of strong excretors contain more sebum than those of weak excretors (4). The hairs pick up the sebum from these pools mechanically, i.e., by simple contact with the scalp, until the hairs are saturated with lipids. During greasing and in the steady state, sebum transfer from hair-to-hair, hair-to-skin, and skin-to-skin is also possible. When the hair cannot pick up any more sebum, the excretion of sebum is stopped by surface tension.

Therefore, we conclude that the lipid pick up by hair is not regulated active by a special mechanism. The hair looses its sebum naturally, and continually picks up small quantities of sebum from the follicle and causes a weak but steady excretion of sebum on the hairy skin. This is the natural function of the sebaceous glands.

(Received July 14, 1975)

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