

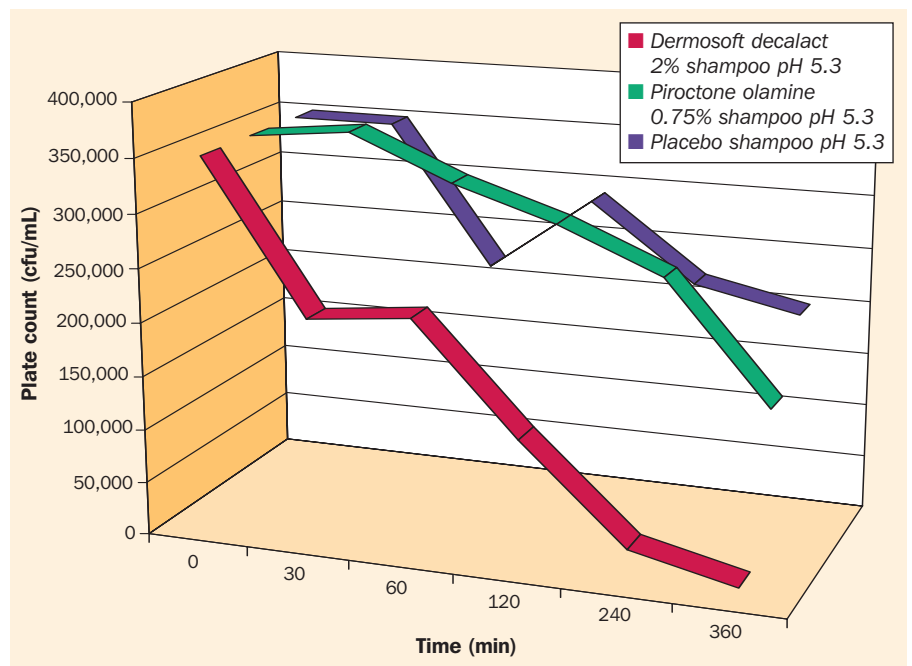
# A modern, multifunctional anti-dandruff agent

The demand for natural ingredients remains on the increase. Being a challenge for raw material suppliers it is a consequence of the market trends in major cosmetic markets worldwide. Consumers are confronted with information triggering scepticism and fears regarding the impact of chemicals on human health as well as on the environment. Recent years have shown an impressive growth of natural cosmetics and natural ingredients too. More and more, natural actives are used in cosmetics turning consumer products greener.

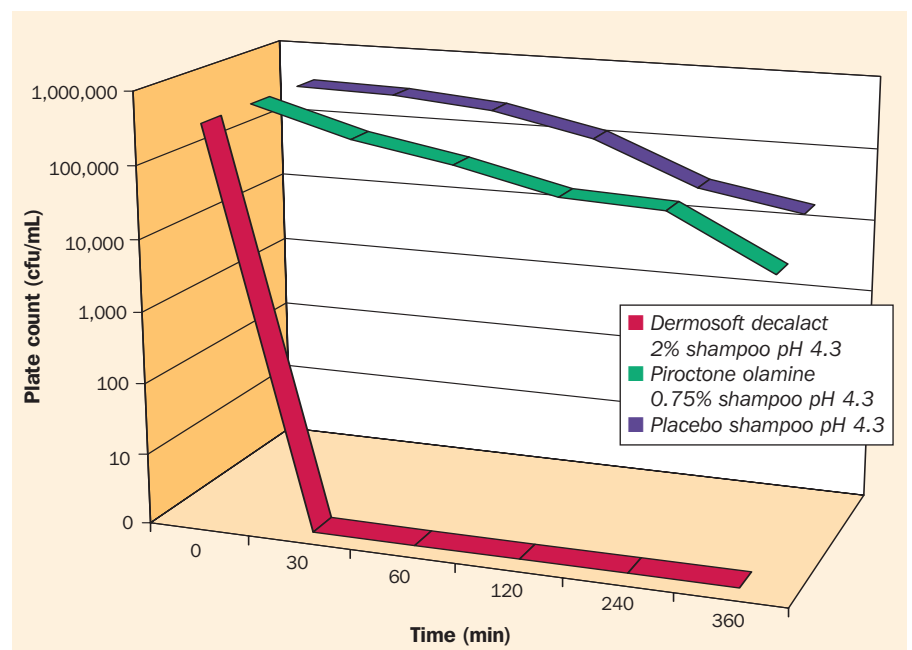
A segment still relatively untouched by this development is the hair care market. While in skin care products, consumers nowadays do not have to sacrifice quality when using natural cosmetics, in hair care it is still difficult to find natural products that meet the consumers' expectations. What makes it so difficult to formulate high performing natural hair care products is obviously the self-imposed limitation in the choice of ingredients that is dictated by most natural cosmetics labels.

Following the philosophy that only 100% naturally sourced ingredients are allowed and many chemical modifications prohibited, there are many classical hair care ingredients, like polyethoxylated surfactants and quaternised conditioning agents, as well as petrochemically-derived active ingredients that are not allowed for natural cosmetics. However, it is not only the market for natural cosmetics that is in need of natural innovations. Also an increasing number of conventional brands are using the natural claims that transport a positive image. Thus, the replacement of many classical and powerful ingredients like parabens, triclosane, silicones or polyethoxylated surfactants is no longer the preserve of niche products. Big brands and multinational companies are looking for more natural ingredients for their marketing but without compromising product quality and safety.

One such ingredient has been developed in our laboratories in recent years. Analysing the market for anti-dandruff products, it becomes obvious that the field is dominated by a few chemical actives like Zn-pyrithione, piroctone olamine or selenium disulfide. All



**Figure 1:** Reduction of *Malassezia furfur* in vitro at a pH of 5.3: Dermosoft decalact shows a reduction of 97% of the population after 6 hours (40% reduction after 30 minutes) while piroctone olamine eliminates only 60% after 6 hours (no reduction after 30 minutes).



**Figure 2:** Reduction of *Malassezia furfur* in vitro at a pH of 4.3: Dermosoft decalact shows a total elimination of the population after 30 minutes while piroctone olamine eliminates only 60% after the same time (98% reduction after 6 hours).

these ingredients have a long record of use in cosmetics – and they are perceived as ‘chemical’ by consumers and cannot be used in natural concepts. This gap triggered research in our labs several years ago, starting the search for a naturally-derived anti-dandruff active that should not be inferior in efficacy. Intensive studies have led to the optimisation of a class of ingredients well known for certain antimicrobial activity with good detergent properties. This dual activity distinguishes the acyl lactylates presented in this paper from commonly found chemical anti-dandruff agents. The newly-launched Dermosoft decalact (INCI: Sodium Caproyl/Lauryl Lactyl Lactate) shows excellent antimicrobial properties and at the same time outstanding foaming and foam stabilising properties. This, together with a high degree of substantivity as shown in a clinical study presented in this paper, makes Dermosoft decalact a very interesting and cost-effective natural anti-dandruff active.

### Anti-microbial activity against *Malassezia furfur*

It is well known among experts that the yeast, *Malassezia furfur*, is among the main factors for the development of dandruff.

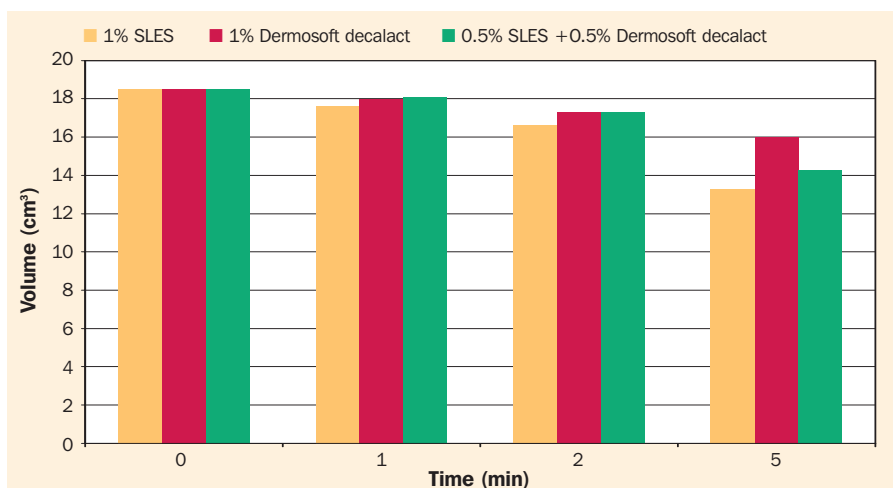
Therefore, besides removal of loose corneocytes and sebum control, the primary target for anti-dandruff products is the control of *Malassezia furfur*. There are a number of petrochemically derived antimicrobials that are used in anti-dandruff shampoos. During recent years, following a general tendency for milder ingredients, there has been an increased use of a newer ingredient, piroctone olamine, first used in 1979. Nevertheless, with piroctone olamine being of petrochemical origin and relatively expensive, there is a continuing demand for a natural active, as effective and if possible more economic than piroctone olamine. Further benefits of the alternative material should be ease of use, better solubility and the possibility of formulating transparent anti-dandruff shampoos.

Furthermore, formulators should always attempt to adjust the pH of a product to the needs of the human skin – not to the active ingredient. The physiological pH of normal skin is just below pH 5.0. To maintain a healthy skin and scalp this pH should be stabilised and not altered by hair care products. While piroctone olamine needs a relatively high pH (around 7) for optimum performance, Dermosoft decalact has an excellent performance at the natural pH of the scalp and hair, between pH 4 and 5.

In a process of optimisation of existing concepts with known efficacy against yeast-type microorganisms we developed a unique combination of lactylates that showed best performance in reducing *Malassezia furfur*. The reduction of the dandruff-causing yeast

**Table 1: Solubility of anti-dandruff actives.**

Name of active	Dermosoft decalact	Piroctone olamine	Zn-pyrithione	Selenium disulfide
Solubility in water (pH 7, room temperature)	>2%	0.05%	8 ppm	Insoluble



**Figure 3:** Foam stability of SLES compared to Dermosoft decalact and mixture of both. The total foam volume was placed in a graduated cylinder and the decomposition of the foam measured after 1, 2 and 5 minutes. Note the improved foam stability of SLES in combination with Dermosoft decalact.

was tested *in vitro* comparing with a benchmark active (piroctone olamine) and placebo. While in pure water, the efficacy of piroctone olamine and Dermosoft decalact (now referred to as ‘the natural anti-dandruff active’) is the same (total reduction of *Malassezia furfur* after three minutes) the performance in a shampoo formulation is different. The influence of the shampoo formulation on the efficacy of the two anti-dandruff agents is reflected in Figures 1 and 2. All samples were prepared using the same basic shampoo formulation based on SLES/cocamidopropylbetaine and using recommended dosage of the actives, tested first at a pH level of 5.3. The result of the *in vitro* tests shows a better reduction of the germ after for the natural anti-dandruff active compared to piroctone olamine, but no significant reduction for the placebo shampoo without any anti-dandruff active. This same test performed with shampoos at a lower pH (4.3) shows a much better performance of the natural anti-dandruff active, resulting in a complete reduction of the germ after 30 minutes with the natural anti-dandruff active, while the same formulation with piroctone olamine failed to reduce the germ completely even after six hours.

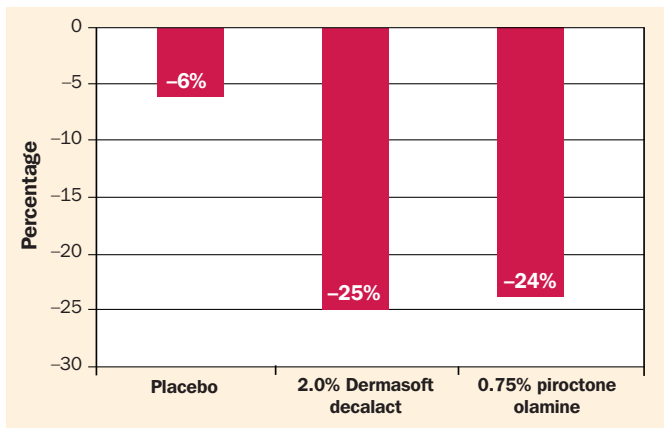
### Problems formulating with conventional anti-dandruff actives

Typical drawbacks of traditional anti-dandruff agents are the limited solubility and discolouration of the finished product.

The limited solubility of Zn-pyrithione or piroctone olamine makes it very difficult or impossible to obtain clear, transparent solutions. Being a lesser problem in hair treatments that are emulsion based, it is a major disadvantage for the formulation of shampoos or hair tonics. In such concepts it is often desired to offer a transparent product, since this opens more possibilities for the packaging and presentation of such a product to the consumer. However, even though piroctone olamine can yield transparent products in selected surfactant bases, it should not be displayed in transparent packaging due to its decomposition by exposure to daylight.

Discolouration is another annoying area for manufacturers of anti-dandruff shampoos, but for the consumer too. Piroctone olamine forms a yellow coloured complex with traces of iron (1 ppm of iron being enough according to the technical data sheet of the supplier) and it cannot be avoided by using complexing agents. For other agents it is more of a concern for the consumer, as it is known for example that selenium disulfide shows discolouration of hair dyes and the hair itself, thus strongly interfering with the whole concept of hair care.

Regarding the ease of use, stability issues or discolouration, there are no drawbacks found for the natural anti-dandruff active. It shows good and sufficient solubility for allowing transparent products with an effective concentration. There is neither a colour change of the



**Figure 4:** Reduction of dandruff scales after 28 days treatment. Assessment by removal of corneocytes from hair by 1 minute combing. Both treatments with piroctone olamine and Dermasoft decalact show comparable, significant reduction of dandruff after 28 days.

finished product nor a decomposition of the active following exposure to daylight. But there is more than the mere lack of disadvantages to this product: the natural anti-dandruff active aids in foaming and stabilises the foam produced by other surfactants. Figure 3 shows the foaming of SLES at 1% in water compared to the natural anti-dandruff active at the same concentration. The natural anti-dandruff active alone as well as the mixture of the natural anti-dandruff active and SLES shows a better foam stability as shown after 1, 2 and 5 minutes.

Thus, regarding the additional benefits in common hair care formulations this natural ingredient truly deserves its classification as a multifunctional anti-dandruff agent.

### In vivo reduction of dandruff compared to piroctone olamine

Coming back to the primary function of the natural anti-dandruff active, it was also tested in a clinical study concerning its ability to reduce dandruff *in vivo*. Three formulations were prepared for this study,

one placebo as a control without any anti-dandruff active, one shampoo with 0.75% piroctone olamine and the last containing 2.0% of the natural anti-dandruff active (having approximately the same costs as piroctone olamine at 0.75%). For this study 60 individuals with dandruff were selected and divided into three groups of 20 each. The criteria for selecting the volunteers were an age between 18 and 60 years for both females and males, and a presence of dandruff with level 2-3 (moderate to severe dandruff according to the four-point dermatological scale).

These groups were treated with:

- A placebo shampoo (as control group).
- The same shampoo base with 0.75% piroctone olamine.
- The same shampoo base with 2% the natural anti-dandruff active.

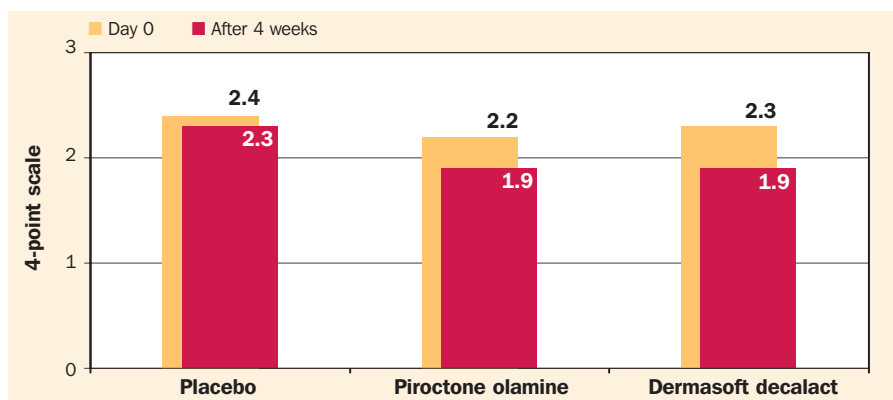
Two weeks prior to start the first evaluation, all subjects were asked to stop using any shampoo other than a neutral (placebo) shampoo provided by the test institute. All individuals presented themselves at the lab and a first evaluation of the

dandruff was made before starting treatment with the different products. The following parameters were tested:

- Total weight of dandruff scales removed after one minute of combing.
- Reduction of number of corneocyte clusters larger than 0.5 mm<sup>2</sup>.
- Optical assessment by dermatologist using the four-point scale for dandruff.

After the first evaluation before starting the treatment, all individuals had to use the provided shampoos during a period of 28 days at least three times a week. At the end of the 28-day study period all individuals presented themselves in the laboratory again to evaluate the result of the treatment by using the same methods as at the beginning of the treatment. The average change of dandruff for the three groups is shown in Figures 4 to 6.

Also the evaluation by a dermatologist shows a slightly better result for the natural anti-dandruff active (reduction by 0.4 points) compared to piroctone olamine (reduction by 0.3 points). All original study results are available upon request.



**Figure 6:** Reduction of dandruff score after 28 day treatment. Optical assessment by dermatologist, average reduction shown after evaluation according to 4-point dermatological scale (0 = absent/no dandruff scales; 1 = mild a few isolated scales of little/medium size; 2 = moderate/many isolated scales of little/medium size or some cluster of scales; 3 = severe/many clusters of scales).

### Conclusion

With the full set of *in vitro* data, results of clinical test and application data it is clearly demonstrated that Dermasoft decalact offers equal dandruff reducing efficacy compared to benchmark products of petrochemical origin, a fast and efficient reduction of dandruff causing *Malassezia furfur in vitro* and further technical benefits like transparency and foam boosting in shampoos. With a cost-effective and high performing natural active like Dermasoft decalact there is no need to accept the disadvantages of established actives that were innovations when originally launched more than 30 or even 80 years ago like piroctone olamine or Zn-pyrithione respectively.