

# Flexabrasion hair strength - a comparison of two commercial actives

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## Key words

Flexabrasion, hair breakage and fracture, hair strength, relative humidity, hair strengthening actives, tensile extension, bending modulus, friction, Keravis, D-Panthenol, conditioner, shampoo

## Introduction

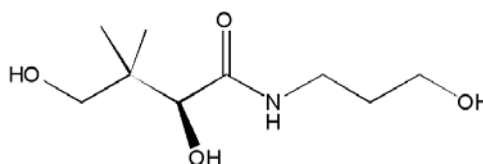
There is an ever increasing consumer demand for cosmetic products that provide perceivable benefits. Manufacturers are responding by incorporating functional ingredients, with appropriate claims, into their formulations. By doing so, manufacturers are also required to provide claims justification, either by carrying out their own evaluation or by relying on data provided by the ingredient suppliers.

In hair care cosmetics there are many claims associated with the use of functional ingredients; claims such as increased hair strength, reduced hair breakage, improved moisturisation, enhanced gloss, better conditioning, detangling, UV protecting etc. are common and manufacturers use these claims as bold statements both on the packaging and with the associated product advertising.

In recent years, many claims and advertising campaigns promoting hair care products, have been based upon improving hair strength and reducing hair breakage. These claims have arisen out of keen consumer interest in strong and healthy hair. One of the most popular ingredients, by far, that has been used to support these hair 'strengthening' claims has been D-Panthenol, or as it is more commonly known 'Pro Vitamin B5'.

Panthenol is used in a wide range of hair care products and is claimed to provide strengthening and moisturisation benefits. It is added to almost all new hair care formulae and

Figure 1: Structure of D-Panthenol.



has gained a massive following within the industry.

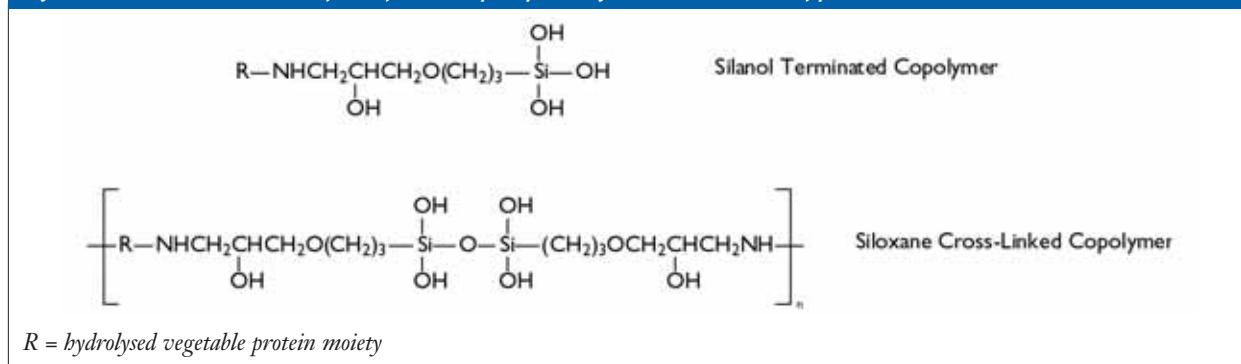
In this article we compare the flexabrasion hair strength performance of D-Panthenol with a new hair strengthening complex called Keravis (INCI: Aqua (and) Hydrolysed Vegetable Protein PG-Propyl Silanetriol).

Keravis has an average molecular weight in the region of 1800 Daltons, low enough for a significant portion of it to be able to penetrate into the hair cortex. Once there, its hydrophilic nature provides excellent moisture binding capacity. It also has the ability to cross-link on drying giving rise to a polymeric structure and film-forming ability. The structure of this new material for formulators is illustrated in Figure 2.

## Flexabrasion

The instrumental technique of 'Flexabrasion' was used to measure hair strength in this study (1,2,3). This technique measures a number of parameters that are considered to be most relevant during normal grooming practises. It is not the intention of this article fully to describe the methodology of flexabrasion, however, a full description and validation of the methodology is available elsewhere (Flexabrasion: A Method for Evaluating Hair Strength; J A Swift, S P Chahal, D L

Figure 2: Structure of Keravis (Aqua (Aqua) and Hydrolysed Vegetable Protein PG-Propyl Silanetriol).



Coulson and N I Challoner; *Cosmetics and Toiletries* Vol. 116, No. 12, p. 53-60, December 2001). One difference between the methodology previously described and that used in this study is that three adjacent hair segments were used (see below) as opposed to only two segments previously described.

**Methods and materials**

**Hair samples**

Virgin European brown hair was used for all the studies, obtained from De Meo Bros. (New York City).

**Specimen preparation and flexabrasion equipment**

Three segments from along the fibre length are used. The advantage of this technique is that it provides a third internal data point and thus allows not only the performance of a test material against its corresponding control, but also provides for performance benchmarking against other raw materials with reported hair strengthening activity. Additionally, the

Formulation for a basic hair conditioner.	
Ingredient	% by weight
Conditioner Base CB0967 (Proprietary Blend)	2.00
Light Mineral Oil 25cS at 25°C	0.25
Lactic Acid to pH	4.0-4.5
Keravis or D-Panthenol	As required
Deionised water	to 100

Formulation for a basic hair shampoo.	
Ingredient	% by weight
Empicol ESB3	35.00
Incronam 30	15.0
Crovol A70	6.0
Lactic Acid	to pH 6.5
Keravis or D-Panthenol	As required
Deionised Water	to 100

technique has been used for the comparison of control and test treatment regimes with untreated ‘blank’ hair fibres to allow the extent of any damage repair/control to be determined.

The mounting of the hair fibres is illustrated in Figure 3.

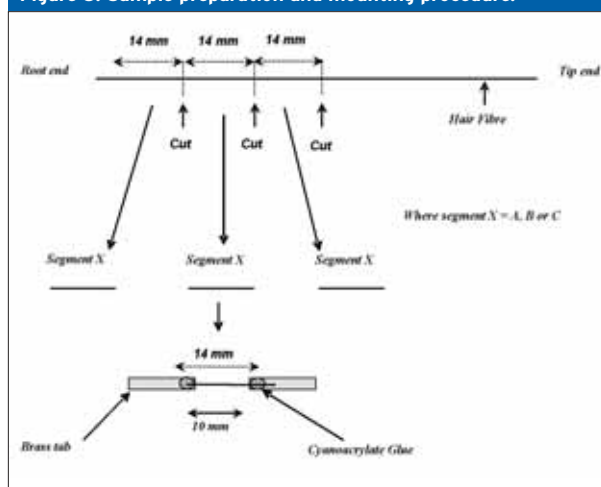
**Sample treatment protocol**

Unless indicated otherwise, all testing was carried out on bleached hair from a conditioner (1:5 dilution in water) or from a shampoo (1:10 dilution in water) using the following protocol.

The A segments were mounted according to Figure 3, then soaked in water for 6 mins and subsequently dried under ambient conditions for 1 day. The B & C segments were bleached with a solution of hydrogen peroxide (6%) and ammonium persulphate (5%) at pH 9.5 for 30 mins and rinsed. The B & C segments were subsequently allowed to dry and then mounted according to Figure 3.

The B segments were soaked in the basic conditioner (or

Figure 3: Sample preparation and mounting procedure.



conditioner containing test active D-Panthenol or Keravis) at 35°C for 2 mins and rinsed in water. This was repeated twice, giving a total of three treatments. The C segments were soaked in the conditioner containing test active D-Panthenol or Keravis at 35°C for 2 mins and rinsed in water. This was also repeated twice, giving a total of three treatments. Both segments were then allowed to dry under ambient conditions for 1 day.

Immediately prior to the flexabrasion test, the segments were conditioned at 60% RH for standard testing, or other test RH when appropriate, for 1 hour.

## Results and discussion

All results are expressed as a percentage change in the mean fatigue lifetime of the hair fibre in comparison to the untreated control virgin hair fibre. The formula used is detailed below:

$$\text{Percentage Difference} = \left[ \frac{(X-Y)}{Y} \times 100 \right]$$

where:-

Y = Mean fatigue lifetime of the unbleached virgin blank hair segment

X = Mean fatigue lifetime of test/control hair segment

All results have been analysed statistically using the students t-test and unless otherwise quoted found to be significant.

### Comparison of Keravis and D-Panthenol (see Figures 4 - 8)

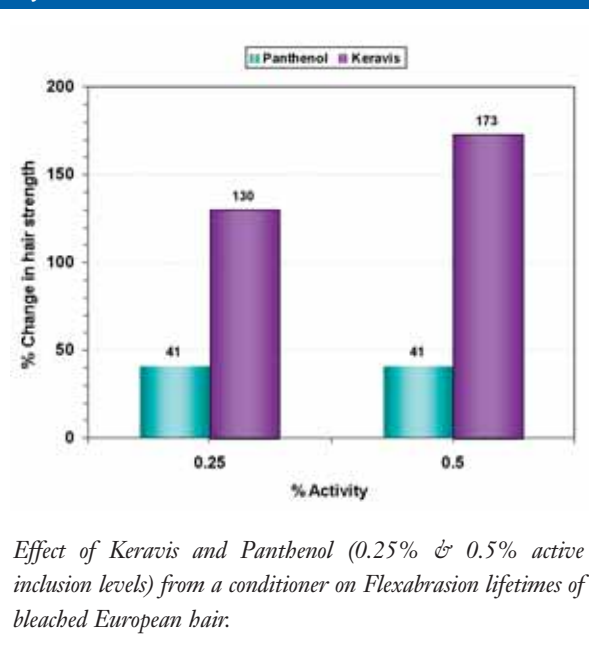
The first study (Figure 4) compares Keravis and D-Panthenol when delivered from an undiluted conditioner at 0.25% and 0.5% inclusion levels, on the flexabrasion fatigue lifetime of bleached hair. The results demonstrate that at both inclusion levels, Keravis and D-Panthenol provide an increase in hair strength compared to the virgin control hair fibres, however, Keravis has a much greater strengthening effect than D-Panthenol. Increasing the active inclusion from 0.25% to 0.5% generates no additional strength benefit for D-Panthenol, but Keravis provides a further increase in strength.

More representative of consumer use is the application of the conditioner and shampoo formulations in diluted form. All proceeding studies are representative of formulations applied in a diluted form.

### Comparison of the conditioner with and without actives inclusion (Figure 5)

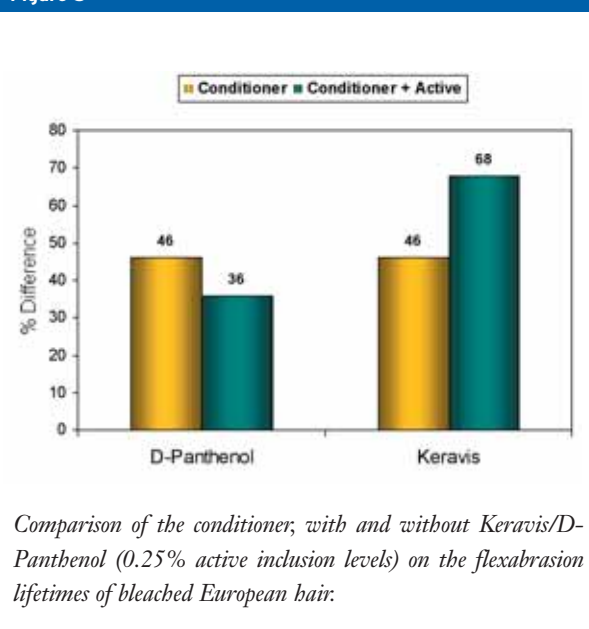
This result clearly indicates that the conditioner alone offers some improvement in hair strength, lubricating the surface thus reducing the frictional component of

Figure 4



flexabrasion. The result also demonstrates that there is no additional improvement to hair strength, beyond that of the original performance of the conditioner, upon the addition of D-Panthenol to the formulation. In the case of Keravis, the addition of this active contributed significantly to the performance of the conditioner.

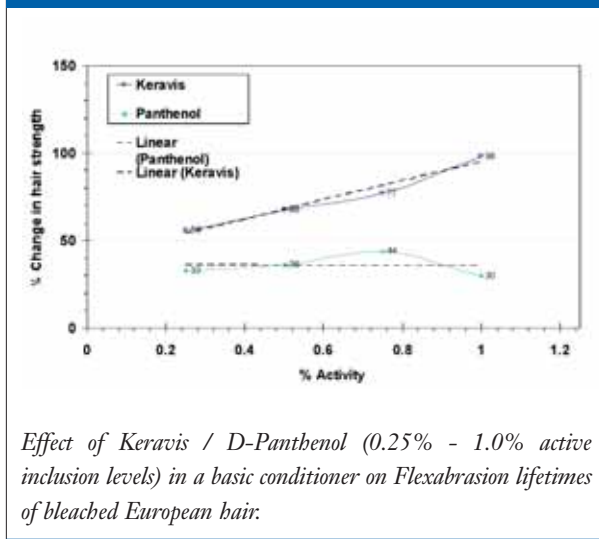
Figure 5



**Influence of active concentration (Figure 6)**

The level of active added to a formulation should, up to a point, be related to the degree of functionality imparted by the active. In this study the inclusion levels of both Keravis and D-Panthenol were increased from 0.25% active to 1.0% active to determine the impact on strength performance. The results demonstrate that as the level of Keravis is increased in the conditioner formulation, the influence on

Figure 6



hair strength is also increased, i.e., there is a dose dependant linear response. This cannot be said of D-Panthenol and the results obtained show a dose independent response and again at a level that would be seen for the conditioner alone.

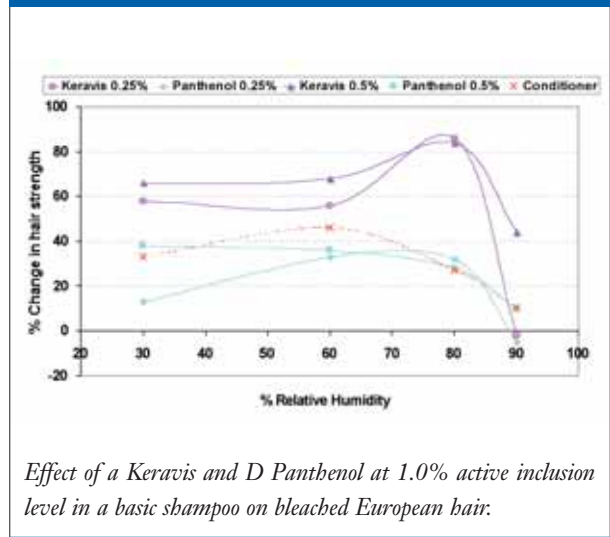
The final series of tests undertaken evaluated the effect of humidity on the hair strengthening performance of the conditioner alone and the conditioner containing the two actives.

**Influence of relative humidity (Figure 7)**

From previous work we have undertaken, it has been demonstrated that the hair achieves its maximum strength at 80% RH; above or below 80% RH hair strength reduces 4,5. The aim of this work was to discover if these two actives could offer improvements at lower humidities and help retain the strength at higher humidities. Studies were carried out at 30%, 60%, 80% and 90% RH.

In previous studies we have determined that the fatigue lifetimes of untreated hair vary according to the RH under which they are tested. At Low RH the fatigue lifetimes are

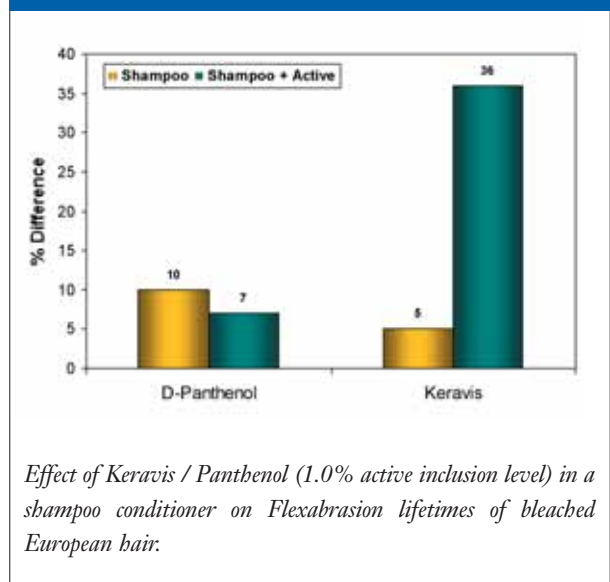
Figure 7



relatively short, at 80% RH they are at their maximum. In this case the evaluation demonstrated that Keravis offered improvements above and beyond those provided by the conditioner formulation alone, even at the extreme low and high humidities tested. D-Panthenol offers no improvements at any of the humidities tested above those supplied by the conditioner formulation.

Interestingly the conditioner base alone provided a limited improvement in hair strength at all humidities. The improvements observed were almost identical to

Figure 8



those observed with the conditioner containing D-Panthenol indicating that in terms of increasing hair strength, through improving flexibility, tensile strength and reducing abrasion, the addition of D-Panthenol to the conditioner offers no benefits, as the conditioner performed as well alone.

#### **Effect of a Keravis and D Panthenol at 1.0% active inclusion level (Figure 8)**

Up to this point all the work discussed has concentrated on assessing the effect of these two actives from a conditioner formulation. The next stages of the work shifted that assessment to a shampoo as the active carrier.

This study demonstrates that there is no improvement observed when D-Panthenol is added to a shampoo formulation. Whereas it clearly shows that the addition of Keravis to the shampoo can improve hair strength by 36%.

#### **Conclusions**

The use of flexabrasion fatigue lifetime testing of hair strength, as discussed in a previous C&T article, is considered to be a method very relevant to the impact of normal grooming influences on hair strength. This method was therefore used in this study to measure the influence of two actives on hair strength.

The perception of D-Panthenol as a hair strengthening active has been studied and surprisingly the data indicate that in terms of flexabrasion hair strength D-Panthenol offers no benefit when delivered from a conditioner or shampoo, at any of the inclusion levels and RH conditions.

In contrast, the performance of Keravis for increasing the flexabrasion strength of bleached hair has been clearly demonstrated from both a conditioner and shampoo. Keravis provides a significant increase in hair strength and

demonstrates a dose dependant response. It also provides significant strength improvements at all relative humidities tested, especially at humidities where hair would normally be very weak.

Keravis is a proven new active for hair strength and optimum use of this active can provide benefits for a variety of hair care formulations.

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