

Measurement of UV Protection in Hair Care

a report by

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Hair care is important as hair appearance contributes largely to the overall facial image of a person. However, there are many reasons why hair condition can deteriorate. The sources of possible degradation can be grouped into three broad categories:

- mechanical (for example brushing, friction);
- chemical (for example perms, oxidative colouring, lipid-depleting surfactants); and
- environmental (e.g. solar radiation, heat from hot-blow drying, chlorine from swimming pools).

Solar exposure alone can lead to undesired results such as colour fading (natural and artificial colours) and loss in hair manageability. The loss in manageability can be attributed directly to an alteration of the hair surface. The hair encounters more damage as it becomes more hydrophilic, the cuticles of the hair surface are lifted and the hair shows more split ends. In fact, ultraviolet (UV) radiation is considered to be the most damaging of all environmental factors.

Measuring UV Protection in Hair Care

Measuring UV protection in hair is for evident reasons not as straightforward as assessing redness of UV erythema on skin. Hair, contrary to skin, will not send a message of pain due to over-exposure. UV-induced damage is likely to be perceived by the consumer only after cumulative exposure. UV-induced erythema is a sole property of the skin and the derived skin protection factor (SPF) calculations for protective formulations can by no means be used in hair care. There is relative freedom in defining a UV protection factor for hair care. Factors such as keratin protection factor (KPF) and hair protection factor (HPF) have been defined and used by some cosmetic companies to position UV protective formulations for hair care. *Table I* lists a few of the most widely used endpoints to measure UV protection in hair care. Meaningful attributes to the consumer such as hair strength, ease of combing and colour changes are particularly popular.

Most of the time, it is possible to express a protection factor (in %) by comparing the change of

the chosen endpoint (Δ Endpoint) due to weathering obtained with a placebo formulation to the change obtained with a test formulation as expressed in the formula below:

$$\text{Protection (\%)} = \frac{(\Delta \text{Endpoint}_{\text{placebo}} - \Delta \text{Endpoint}_{\text{Test}}) / \Delta \text{Endpoint}_{\text{placebo}}}{1} \times 100$$

Using this formula, a protection of 100% is obtained for the test formulation relative to the placebo formulation if $\Delta \text{Endpoint}_{\text{Test}}$ is equal to zero, which means that weathering imparted to hair resulted in no change of the chosen endpoint. A protection of 0% is obtained for the test formulation relative to the placebo formulation if

$$\Delta \text{Endpoint}_{\text{placebo}} = \Delta \text{Endpoint}_{\text{Test}}$$

which means that the weathering imparted to the hair resulted in the same change of the chosen endpoint for both placebo and test-treated hair. If hair damage imparted to hair is greater with the test formulation than the placebo formula, the above protection number using this formula will be negative.

Achieving UV Protection of Hair

Hair can be best protected from UV damage by treating it with a leave-on formulation containing a UV filter, prior to exposure. Most products on the market today that contain a UV filter for hair care are formulated with ethylhexyl methoxycinnamate (EHMC). The amount of EHMC typically found in such products ranges from 0.1% to 2%, although specific 'suncare leave-on gels' were found to contain as much as 8% EHMC. It is therefore a good idea to evaluate any sunscreen for hair protection by comparing its efficacy to a widely used benchmark such as EHMC. The additional protection obtained with UVA filters such as butyl methoxydibenz-oylethane (BM-DBM) may also be investigated.

The use of rinse-off products will usually give less protection, although a certain deposition of the filter on the hair fibre can be achieved. The level of deposition depends on the formulation and the

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