The Effect of Thickeners and Performance-Enhancing Powders on the Application Characteristics of Mascara

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Introduction
Mascara is a relatively simple cosmetic product, upon which consumers and formulators place a set of very complex requirements. Different formulation approaches are used in order to achieve a combination of ease of application, longevity, comfort, increased eyelash volume and perceivable eyelash curl, expected from a good product.[1,2]

Mascara formulae must be thixotropic with rapid recovery to prevent dripping down the lid and running off the brush. In addition to providing suitable rheology, thickeners improve product homogeneity, enabling the deposition of a uniform film onto the lashes.

Performance enhancing powders are added to the classic mascara formulation to help product deposition, increase lash diameter and prevent “sticking”[3]. They may also aid the application of second and subsequent layers of product.

There are very few publications on mascara analysis[4,5], indicating that cosmetic houses have their own testing methods. It was of interest to establish suitable protocols for the testing of a range of mascara properties, including deposition, tack, curl and compression. Image analysis was also used in this study in order to evaluate the effects of mascara products on the length, diameter and volume of the eyelashes.

Aim
The aim of this study was twofold: to establish a set of relevant application tests and to systematically assess the changes in the application of mascara due to the variations in formulation parameters.

Materials and Methods
Materials
Mascara formulation chosen for this study, based on in vitro formulated thickeners-cellulose-starchate, is shown in Table I. Thickeners and powders were added at the expense of water. A commercial product from the French market was used as a benchmark.

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<tbody>
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Table I. Composition of the basic formulation

Six different hydrophilic thickeners were used: xanthan gum, microcrystalline cellulose (and) cellulose gum, pectin, hydroxypropyl guar, gelatin and acrylates/C10-30 alkyl acrylate crosspolymer. In addition, this study has looked into the performance-enhancing effects of the following powders: polyamide-5, nylon-12, methyl methacrylate crosspolymer, talc and dimethicone/vinyl dimethicone crosspolymer and silica.

Methods

Test 1: Deposition of product onto lashes

Identical eyelashes were laboratory-made, using human hair of the same type and length. The weight of every individual eyelash was recorded and, using tweezers, it was attached onto a rim of a small beaker with scotch tape, giving it a defined curvature. The test product was applied on the eyelashes in a reproducible manner. The eyelashes were weighed and left to dry. This was done in triplicate for each test sample.

Test 2: Tack test – Analysis of the drying time of the product

A small amount of product to be tested was placed on a glass plate and levelled using a 200μm draw down bar. The set area was tested every 10 seconds, using index finger. The point of tack was randomised and the finger cleaned between tack tests. Once there is no product removed by the finger, the product was considered dry and the time was recorded.

Test 3: Measurement of eyelash curl

Adhesive double-sided tape was applied to one edge of a glass plate. A small amount of the product was applied on the lashes. Once there is no product removed by the finger, the product was considered dry and the time was recorded. The eyelash was viewed under the microscope Leica DM E (Germany). The whole of the eyelash width and length was viewed, a representative photograph was taken and then it was possible to measure the difference between the eyelash diameter before and after product application.

Test 5: Microscopic image analysis

Each eyelash was viewed under the microscope Leica DM E (Germany). A standard eyelash with a known amount of product was mounted on a vertical holder in a way that it just touches a horizontal glass surface. The holder was set to move for 5min, applying a constant force, while the force of resistance exerted by the test sample was measured.

Test 6: Compression test - Analysis of the resistance to external pressure

This test was performed using the instrument Testometric M505-20CT (UK). A standard eyelash with a known amount of product was mounted on a vertical holder in a way that it just touches a horizontal glass surface. The holder was set to move for 5min, applying a constant force, while the force of resistance exerted by the test sample was measured.

Test 7: Microscopic image analysis

Each eyelash was viewed under microscope Leica DM E (Germany). The whole of the eyelash width and length was viewed, a representative photograph was taken and then it was possible to measure the difference between the eyelash diameter before and after product application.

Results and Discussion

The results for deposition, tack, curl and compression are presented in Table II. One-way ANOVA analysis has confirmed the existence of significant differences among samples in all tested categories. Detailed statistical analysis revealed that the thicker concentration played a major part in exerting the differences between samples. However, the highest concentration was almost never the optimum one. On the basis of similarities with the benchmark product, the formulation with 0.2% xanthan gum (shown in bold) was chosen for further study. In principle, the addition of a thickener to the basic mascara formulation aided in the application of the product and increased the amount of mascara deposited onto the lashes in a single application.

Table III presents the same set of application parameters as Table II, this time obtained from samples containing 0.2% xanthan gum and a range of powders known to enhance the performance of mascara products.

Materials and Methods

Table II. One-way ANOVA analysis has confirmed the existence of differences between the eyelash diameter before and after product application. In vitro microscopic image analysis, and applied to two sets of formulations The results obtained were mostly highly reproducible and of practical value in the formulation work.

Figure 2. Examples of microscopic images: a) basic formulation; b) formulation with 2% xanthan gum and 3% polyamide-5

It appears that the uniformity of shape and size of synthetic polymers offers a more superior performance. The difference in curling ability between polyamide-5 and nylon-12 could be due to different weight of particles, since it is known that nylon-12 is a denser product.

Generally, the addition of powder to the mascara formulation has resulted in easier initial application, as well as a more successful re-application of the product. Powders reduce the appearance of clumps and the sticking of eyelashes caused by mascara.

Figure 2 provides examples of images used for microscopic analysis (performed in triplicate for each sample), showing basic formulation and the one containing 3% polyamide.

Conclusion

Five in vitro testing protocols for the evaluation of mascara products have been developed, i.e. deposition, tack, curl and compression tests and microscopic image analysis, and applied to two sets of formulations. The results obtained were mostly highly reproducible and of practical value in the formulation work.

Out of the six rheological modifiers tested (five natural derivatives and one synthetic), xanthan gum in the concentration of 2% was shown to be the most suitable for the TEA-stearate based mascara product. It has produced the formulation that largely matched the properties of the commercial benchmark product. Out of the five powders tested (four synthetic polymers and talc), polyamide-5 has shown the best compatibility with the chosen thickener and the best overall performance, closely followed by nylon-12.

Further work in this area should involve in vivo evaluation, as an ultimate test of the validity of in vitro data.

References