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## ***“Long lasting performance in lipstick formulations: a comparison between synthetic and natural oil-based polymers”***

**Joyce Wada <sup>1</sup>, Fernanda Piva <sup>1</sup>, Paulo Dalcin <sup>1</sup>, Marilia Esteves <sup>1</sup>, Michele Mathias<sup>1</sup>**

<sup>1</sup>Research and Development of Formulations, Natura &Co, São Paulo, Brazil.

### **1. Introduction**

The demand for new technologies and true innovation in lipstick products is increasing significantly. Therefore, in-depth research and studies of natural polymers applied in cosmetic formulations have also increased as an important alternative to synthetic formulations. Every year, new cosmetics products of the latest trend are introduced to consumers. The quality of lipstick is directly linked to the basic material used in the formulation. Varying the type and ratio of the ingredients determines the final product characteristic. Nowadays, the development of modern lipsticks seems not focus primarily on the pigments, but other applicators related to high performance as long lasting and transfer proof properties [1].

As consciousness rises regarding health among the consumers and awareness about all the benefits of sustainable cosmetics, so does the significant increase on the demand for natural lip color products with high performance. Over the past 2 years, covid-18 has dramatically impacted the color cosmetic landscape. The ongoing use of protective facemasks has created new challenges and will prolong the market recovery of lip segment. Thus, when venturing outside and wearing a protective facemask, consumers are seeking products with transfer-proof and long-lasting benefits to avoid disrupting their makeup while keeping their mask clean. Therefore, high performance and sustainability must evolve together to ensure consumer needs.

Polymers are an important class of raw materials of cosmetic formulations, being essential in the production of high-performance products. Using polymers, cosmetic chemists can create high performance products. These ingredients are macromolecules composed of many repeating units (monomers) usually arranged in the form of a chain. In cosmetics formulations, its structural diversity is used to promote a variety of functions as rheology modifiers, thickeners, foam stabilizers and destabilizers, emulsifiers, fixatives, conditioning,

and film formers. Natural polymers are biocompatible, eco-friendly and highly marketable to consumers [2,3,4].

This research developed a complex technology containing natural oil-based polymers to be applied in lipstick formulation to achieve a high long-lasting performance and sustainable formulation through the combination of renewable sourced ingredients. Furthermore, this new technology was compared to typical synthetic polymers.

## **2. Materials and Methods**

### **2.1. Materials**

All the materials and ingredients used to develop the oil-based complex have been chosen from Natura's Suppliers. Natural and synthetic polymers were prospected from leading wax manufacturers in the world.

The lipstick formulations were developed using mainly natural origin ingredients, also from Natura's Suppliers. The polymer complex concentration was determined considering quantities required for lipstick applications.

### **2.2. Method**

**Assessment of makeup durability:** The methodology consisted of photographic faces images acquisition of the research participants at the initial of the study, after application, and 8 hours after the application of the investigational product. 5 participants completed the study per sample (age:  $31 \pm 6$  years; 100% phototype III). The images were obtained with the subject in the sitting position, using the head support with luminosity controlled. The software to get measurements and data analysis was Microsoft® Office Excel 2010 (Microsoft Corp., EUA, 2010). Statistical analysis software program was GraphPad™ Prism® 8.0 (GraphPad Software, San Diego California USA). The evaluation of the durability of the makeup was calculated based on the calculation of the color intensity and the fixation of the product on the skin.

The obtained images were analyzed using image analysis, from the image conversion for 8-bits gray scale and calculation of the values of color intensity, C. The higher the value of C, the greater color and the fixation of the product on the skin. The evaluation of the durability of the makeup, D, was calculated based on the calculation of the color intensity and the fixation of the product on the skin, C using Equation 1. The obtained images were analyzed using image analysis, from the image conversion for 8-bits gray scale and calculation of the values of color intensity, C. The higher the value of C, the greater color and the fixation of the product on the skin. The evaluation of the durability of the makeup, D, was calculated based on the calculation of the color intensity and the fixation of the product on the skin, C using Equation 1:

$$D = 100 * \left( \frac{C_x - C_B}{C_i - C_B} \right)$$

**Equation 1:** Durability, D, calculated based on values of C. B = initial condition; i = after product application; x= immediately after and 8 hours the application.

The study was planned and conducted per determinations of Resolution 466/12 of the National Health Council for Regulatory Guidelines and Standards for Research Involving Humans. The images of the subjects are confidential, non-publishable and nontransferable. They are used solely as an instrument to determine the efficacy of the cosmetic treatment according to the study methodology. Protection of personal image meets the provisions set forth in Law 10.406/2002, Article 20 and in 1988 the Brazilian Federal Constitution, 5th Article, line X and line XXVIII, paragraph a.

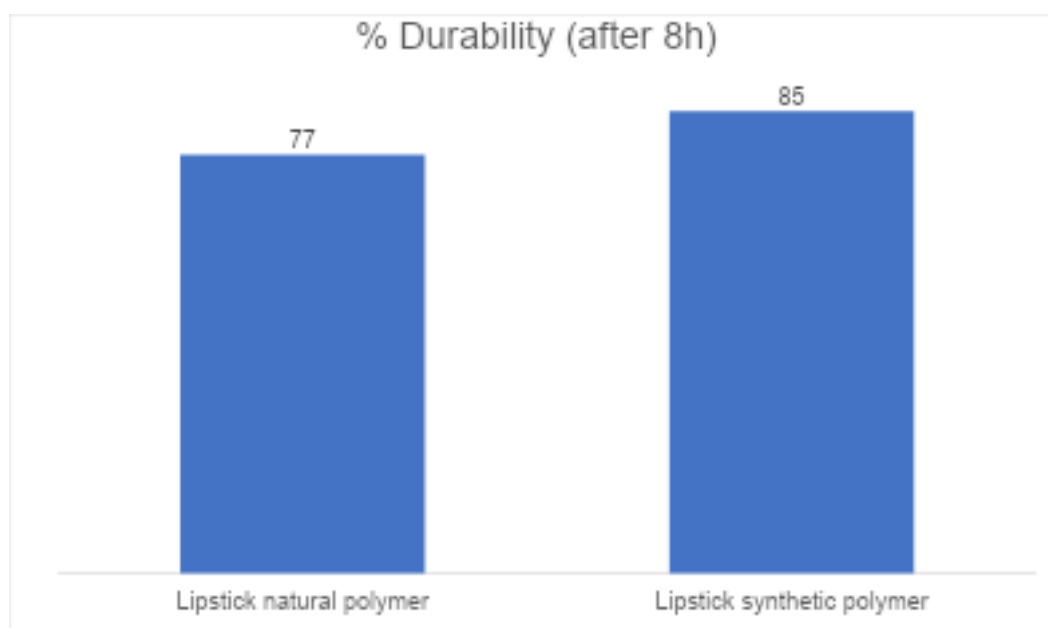
### 3. Results and Discussion

Both natural and synthetic polymer complex were developed considering quantities required for lipstick formulations. All the formulations were built maintaining the same rate of polymers in order to evaluate and compare the long-lasting performance. Although polymers are strongly responsible for these characteristics and benefits for lipstick formulations, their performance is directly related to compatibility of each polymer to be used with each ingredient in the formulation.

The proposed technology presented 100% of natural origin ingredients based on sebacic and behenate acid copolymer derivatives and natural emollients. Therefore, the formulation containing this technology showed more than 70% of natural origin ingredients without any silicone and its derivatives, microplastics and animal origin ingredients. Triacetyl PVP was the synthetic polymer chosen to be compared with the new polymer technology in the same formulation.

To develop this natural formulation, it was crucial to evaluate the compatibility of the new technology to avoid the occurrence of phenomena related to formulation instability, such as exsudation and fat bloom.

The assessment of makeup durability was performed with 2 formulations containing natural or synthetic polymers. The proposed formulation containing the new natural polymer complex showed an average durability of 77%. The similar formulation using synthetic polymer presented 10% higher durability, showed in graph 01. Although the natural version has shown lower result, it's important to emphasize that all the values are good results for long lasting property.



**Graph 01.** Lipsticks durability after 8h

Then, the durability test demonstrated comparable good results for natural and synthetic polymer complex applied in the lipstick. Therefore, it was possible to confirm these polymers promoted the formation of a hydrophobic film on the lip surface. Long-lasting lipsticks containing these polymers allowed the product to remain for a higher number of hours affixed to the lip skin.

#### 4. Conclusion

The development of natural oil-based polymer complex containing a combination of 100% renewable sourced ingredients was achieved and proved to have long lasting properties up to 8h. Working with natural alternatives remains a challenging task for researchers around the world. However, natural origin ingredients with good performance are increasingly available in the industry. Thus, this oil-based natural complex allows the development of innovative lipstick formulations connecting long lasting performance, innovative texture and sustainable aspects.

#### Acknowledgments

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