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Ph. D. dissertation "The influence of selected cosmetic materials on the internal structure and stability of stick lipsticks"

ABSTRACT

The changes taking place in the lipstick matrix may lead to the appearance of oil drops on the surface of stick (syneresis) or lipid blooming. These changes are perceived by customers as a defect and are a reason for complaints from the market. The aim of the thesis carried out part of the implementation doctorate was to examine the impact of selected cosmetic raw materials on the internal structure and stability of lipsticks.

The literature on crystallization and recrystallization processes in wax-oil products was reviewed. Structural ingredients in lipsticks were selected: paraffin, vegetal and synthetic waxes. They create the matrix of the product where the liquid oil, pigments and micro-fillers are closed. Crystallization of waxes and the related changes inside the stick are the most intense during the production process, but they also last with different intensity throughout the 'life' of the product. The structure of the lipstick is rebuilt thanks to recrystallization processes, caused by temperature changes and the thermodynamic balance.

A lipstick (reference sample) was selected from the Bell's products portfolio. It was withdrawn from the offer due to the appearance of oil droplets and lipid blooming on the stick surface over time. The influence of temperature of the melting bulk and of the mold on the stability of the lipstick was investigated. It was found that the temperature of the mold and the use of appropriate structural additives have the greatest influence on the stability of the stick. Components that may have an impact on the stabilization of the stick and reducing the effect of oil sweating and the formation of lipid blooms on the surface were selected. The research was carried out with the use of techniques such as: differentia scanning calorimetry, computed microtomography, X-ray diffraction, scanning electron microscopy, digital microscopy and measuring the contact angle.

The best results were obtained with the use ingredients with amphiphilic properties, commonly used in the cosmetics industry as emulsifying raw materials. Out of 26 tested components with different HLB values, six stopped the effect of oil sweating and fat blooming. Sorbitan Stearate, Sorbitan Trioleate, Sorbitan Tristearate, Sucrose Distearate, Sucrose Tristearate, Lecithin have been shown to have a positive effect on the stability of the stick. The surface of the lipsticks with their 2% addition remained smooth and shiny. It was confirmed that the function of the additive is not influenced by the HLB value, the structure of the emulsifier is more important.

The common feature of all these ingredients is the length of the hydrophobic tail (C_{18}), but the structure of the emulsifier head is crucial. It should be the right size, with donors and acceptors of hydrogen bonds. These additives participate in the formation of the crystal matrix and interact with free oils due to the hydrogen bonds formed. As a result, the oil sweating and lipid blooming is stopped.

A mechanism of crystallization of amphiphilic molecules has been proposed. It was found that their arrangement in the system was influenced by their size relations between the head and the lipophilic tail. Three systems for the co-crystallization of amphiphilic components with a lipstick matrix have been proposed:

1) Single Chain Length, SCL, specific to Sorbitan Stearate.
2) Double Chain Length, DCL (Double Chain Length), suitable for Sorbitan Tristearate and Lecithin.
3) Reversible Double Chain Length (RDCL), for Sucrose Distearate and Sucros Tristearate.

16 micro-fillers of various shapes, sizes and physicochemical parameters were tested. These additives did not affect the crystal structure of the stick. The best results were obtained by combining (synergy) various shapes of fillers (e.g. sponge with fibers). Sweating of oil was reduced due to the oil-absorbing properties and physical obstacles that prevented the oil from migrating as much as in non-micro-filler lipsticks. The syneresis effect in products with micro-fillers has not been completly eliminated.

The use of stearin derivatives of polysaccharides and bentonites has led to unusual observations. These derivatives most probably build into the crystal structure of the stick, have an impact on its recrystallization and organization of the wax structure. The additives improved the stability of the stick over time but did not eliminate completly the syneresis effect and the fat blooming.

Two new products with the addition of lecithin were launched into production: face concealer and eye liner.

Key words: lipstick, syneresis, lipid blooming, lecithin, sorbitan stearate, sucrose stearate, micro-filler, stability

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