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The role of volumetry, shape and primary packaging material in retinol stability

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Introduction:

Retinoids are fundamental to the organism and are involved in many biological processes: embryogenesis, reproduction, vision, anti-inflammation, growth, differentiation, proliferation and apoptosis. In the 1970s, the use of retinoids for the treatment of skin disorders was introduced and, since then, their use in cosmetic products has been gradually increasing. However, there are some difficulties in the development of cosmetic products containing retinoids, such as their stability in formulation. Due to its high degradation rate in the presence of oxygen, light and heat and its liposolubility, there are many restrictions regarding the formula and packaging, as well as specific care during the manufacturing and filling process. In order to reduce retinoid stability problems, several solutions have been developed over time: active delivery systems with application in cosmetic formulations such as nanoemulsions, liposomes, nanocapsules; packaging with air less system; factory production in a controlled environment, with lower incidence of light and exclusive reactor; modified atmosphere packaging. Since factory adaptations are more expensive and often do not compensate the production volume, evaluating the combination of retinoids in a delivery system associated with the most appropriate packaging can be a faster and cheaper solution to enable the manufacture of this kind of product. There are several studies demonstrating variations in the stability of retinoids in different formulations, but there are still few studies evaluating the impact of packaging on cosmetic products containing retinoids. Most articles address the stability of vitamin A (or retinol) in food products. Thus, the objective of the present study is to evaluate the stability of cosmetic formulations containing retinol in different types of packaging and to observe the impact of packaging alone in protecting retinol.

Materials & Methods:

In laboratory scale, a gel cream was produced containing 0.2% nanoencapsulated retinol. The same batch of formulation was packaged in five types of packaging: 1) plastic pump tube packaging 40g in green polyethylene; 2) plastic ophthalmic tube 40g in green polyethylene; 3) opaque glass pump bottle dispenser 30g using post consumption glass; 4) amber glass jar 40g using post consumption glass; 5) clear glass jar 100g.

The samples were stored at 5°C, 23°C and 40°C for 90 days. Retinol content was measured using high performance liquid chromatography at 0, 30, 60 and 90 days. The chromatographic analysis was carried out using HPLC Agilent 1260 integrated system equipped with an automated injector, pump and multiwavelength diode-array detector (Agilent, Santa Clara, CA, USA). The chromatographic separation of the compounds was achieved with a reversed phase column, ECLIPSE XDB-C18 (4.6 mm × 150 mm, 5 µm) operating at constant temperature (30°C). The chromatographic data were analyzed using Agilent OpenLab. The compounds under study were identified by their retention times and their UV spectral characteristics. Chromatographic separation was obtained using a mobile phase composed of isopropanol, metanol and 0,4% acetic acid pH 5,2 eluted in gradient mode.

Results & Discussion:

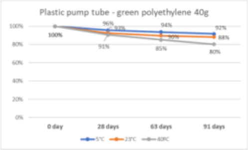

Figure 1 – Retinol recovery over 90 days under conditions of 5°C, 23°C and 40°C in plastic pump tube packaging.

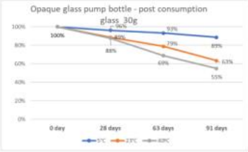

Figure 2 – Retinol recovery over 90 days under conditions of 5°C, 23°C and 40°C in opaque glass pump bottle packaging.

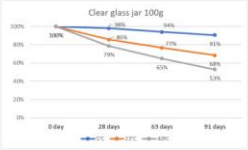

Figure 3 – Retinol recovery over 90 days under conditions of 5°C, 23°C and 40°C in clear glass jar packaging.

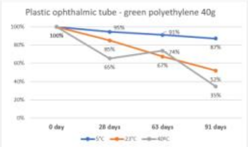

Figure 4 – Retinol recovery over 90 days under conditions of 5°C, 23°C and 40°C in plastic ophthalmic tube packaging.

Figure 5 – Retinol recovery over 90 days under conditions of 5°C, 23°C and 40°C in amber glass jar packaging.

More stable results were observed in the plastic pump tube packaging wtih above 80% retinol recovery in all conditions until the end of the 90 days. The lowest values were found for the amber glass jar packaging, which in 30 days at 40°C condition had only 41% of retinol recovery. This is mainly related to the greater exposure to oxygen in containers such as pot, which favors the degradation of retinol.

The study also addresses the interaction of bulk with different packaging materials such as glass, polyethylene, green polyethylene. We expected that glass could get better results, however the pot did not perform well in retinol measure. The other packages also proved to be an inert material. The results indicate the relevance of packaging in the development of products containing retinoids, demonstrating that the shape, opening and volumetry of the packaging can significantly influence the preservation of retinol in the formula.

Conclusions:

The results presented not only demonstrate the influence of packaging on the preservation of retinol in the formula, but also draw attention to the importance of combining technologies to achieve better stability results, as an active in a delivery system associated with appropriate packaging in shape and volumetry. The study intends to collaborate with the decision-making process in the development of cosmetic products containing retinoids, suggesting that adequate formula and packaging can bring better results in protecting retinoids over time, avoiding higher investments in specific manufacturing and packaging processes.

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