International Conference for Dispersion Analysis & Materials Testing 2024
Berlin, Germany, www.dispersion-letters.com
Abstract

# The long-term stability and properties of a skin cream with addition of liposomes

Kristyna Mullerova, Vojtech Enev

Brno University of Technology, Faculty of Chemistry, Institute of Physical Chemistry,
Purkynova 464/118, 612 00 Brno, Czech Republic
Kristyna.Mullerova@vut.cz

**KEYWORDS:** skin cream, emulsion, liposomes, stability, rheology

**BACKGROUND**: Quality control is important to ensure the efficacy and safety of a cosmetic product. Stability tests of a cosmetic product can be performed in real-time or under accelerated conditions. For stability testing under accelerated conditions, it is suitable to use, for example, the LUMiSizer analytical centrifuge with STEP-Technology. Quality tests should monitor stability and physical integrity under the specified conditions of storage, transport, and use, and should study chemical stability, microbiological stability, and compatibility between the cosmetic product and the container in which the product will be stored [1].

**OBJECTIVE:** This work aimed to study the stability and properties of the prepared skin creams with the addition of liposomal particles and then compare them with the native skin cream.

**METHODS**: Samples were subjected to sedimentation analysis using a LUMiSizer analytical centrifuge. In all cases, the analysis was run at 4000 RPM for 5 hours and the measurements were performed in 4 cycles at a wavelength of 865 nm. All samples were run a total of four times to obtain more reliable data and measurements were performed at a laboratory temperature of 25 °C and subsequently at 37 °C, a temperature approximately equivalent to human body temperature. The stability study of prepared samples was carried out at a longer time interval: 1 day after the preparation of the lotions, then at the age of 1 week, 4 weeks, and 12 weeks. Between each measurement interval, the samples were stored in a plastic container and kept in an air-conditioned room at a constant temperature of 25 °C.
The rheological properties of prepared skin creams were measured on the AR-G2 magnetic bearing rheometer from TA Instruments company. These properties were studied using flow tests and thixotropic tests. The geometry plate-plate was used for measuring skin creams as the fittest setup, whereas the upper plate was smooth, steel, with a diameter of 40 mm, and the lower plate was a stationary plate of the instrument. The calibration was accomplished at the beginning of every measure. The temperature was set at 25 °C, but in dependence on experiments was changed for particular methods. The normal force was set at 5 N, the gap between geometry was set at 45 mm and the time of relaxing was set at 180 s at 25 °C for all measurements. Samples were put on the middle of the lower plate by a stainless spatula in height approx. 2 mm. Each sample was measured twice, using a new sample for each measurement.

**RESULTS:** The results showed that the highest stability during the entire measurement interval at 25 °C was exhibited by the native skin cream sample without the addition of liposomal particles. The sample of skin cream with 20 wt.% addition of liposomes was the least stable. In general, a steady slow decrease in the instability index values was observed for all samples during the analysis at laboratory temperature, i.e. all samples showed an increase in stability over 2 weeks. This phenomenon was likely due to the slight evaporation of water from the samples during handling experiments. This trend was bucked only by the sample containing 10 wt.% liposomes when measured at 1 week and 12 weeks after preparation. This change could be due to the coalescence of air bubbles that entered the system during homogenization during sample preparation.
Experiments conducted at an elevated temperature of 37 °C showed that the stability of skin creams decreases at higher temperatures. From the average values of the instability indices, it was found that the stability of the sample of the native skin cream changed the least, on the contrary, the largest changes were recorded in the sample with 20 wt.% addition of liposomes. The sample of the native skin cream and the cream with the addition of 30 wt.% of liposomes showed the smallest stability changes over time, although this sample showed the least stability at the beginning of the experiment. In these two samples, the values of the instability indices changed in leaps and bounds, in the other two samples they gradually increased, i.e. their stability

decreased over time and a more pronounced separation of phases occurred more easily in them when a distinct layer of an oily phase formed above the sediment. The decrease in stability in the samples with liposomes could in all cases be caused by the disintegration of the liposomal particles, a larger amount of air bubbles that could have formed when the liposome solution was added to skin creams. The overall decrease in the stability of all samples during the experiment could also be caused by contamination with microorganisms, during which activity changes in consistency may occur due to microbial metabolic processes that cause the decomposition of the components of the oily phase. A comparison of the sedimentation profiles at the beginning and end of the experiment for the native cream and the cream with the largest addition of liposomes is shown in Figure 1.

At the storage temperature, the sample with 10 wt.% and 30 wt.% liposome addition showed the smallest changes over time in the zero-viscosity measurement. In contrast, at increased temperature, the sample with 10 wt.% liposome addition and the native sample showed the highest changes in zero viscosity. When the infinite viscosity was analyzed at laboratory temperature, it was found that the viscosity changed the least over time for the lotion without adding liposomes. In contrast, the most significant changes were observed for the sample with 10 wt.% addition of liposomal particles. When analyzed at increased temperature, it was found that the sample with 10 wt.% addition immediately after preparation should be the most spreadable in practice. In contrast, the sample with 30 wt.% liposomes at 12 weeks of age was found to be the least spreadable. When thixotropic properties were studied, it was found that the native lotion sample showed the highest recovery rate at both laboratory and increased temperature. For all samples, a general decrease in regenerative ability with aging time was observed.

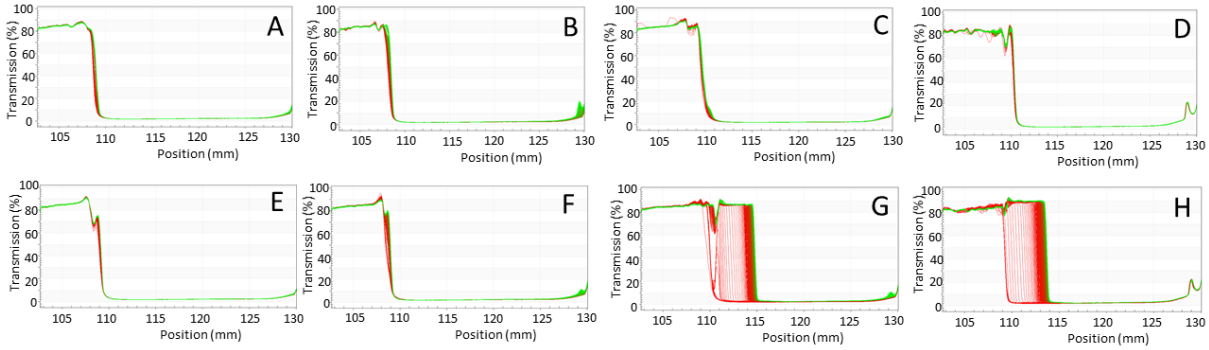


Figure 1: *Sedimentation profiles:* **(A)** *– Sample of native skin cream aged 1 day after preparation at 25 °C;* **(B)** *– Sample of native skin cream aged 12 weeks from preparation at 25 °C;* **(C)** *– Sample of skin cream with the addition of 30 wt.% of liposomes aged 1 day after preparation at 25 °C;* **(D)** *– Sample with an addition of 30 wt.% of liposomes at the age of 12 weeks from preparation at 25 °C;* **(E)** *– Sample of native facial cream aged 1 day after preparation at 37 °C;* **(F)** *– Sample of native skin cream aged 12 weeks from preparation 37 °C;* **(G)** *– Sample of skin cream with the addition of 30 wt.% of liposomes aged 1 day after preparation at 37 °C;* **(H)** *– Sample with an addition of 30 wt.% of liposomes at the age of 12 weeks from preparation at 37°C.*

**CONCLUSIONS:** The LUMiSizer analytical centrifuge with STEP-Technology was used for the stability test stage of the prepared skin cream samples. The skin creams contained different weight percentages of liposomal particles with encapsulated vitamin E, and their stability and rheological properties were compared with the native skin cream sample. The results show that the stability of the lotions generally decreases at elevated temperatures; however, it was found that the native lotion sample exhibited the highest long-term stability at both storage and elevated temperatures.

**REFERENCES:**

[1] GUIDELINES ON STABILITY TESTING OF COSMETIC PRODUCTS [online]. B.m.: COSMETICS EUROPE – THE PERSONAL CARE ASSOCIATION. April 2004. from: https://www.cosmeticseurope.eu/files/5914/6407/8121/Guidelines_on_Stability_Testi ng_of_Cosmetics_CE-CTFA_-_2004.pdf