Application of Multiple-light Scatterer to Evaluate the Effect of Different Emulsification Technology on Emulsion Stability

048

Yu Yu[2]; Sun Xi[1]; Yang Ying[2]; Tan Pei[1]; Ding Song[1]; Liu, Chenguang[2];*
[1] Qingdao Youdu Bioengineering Co., Ltd., Qingdao, Shandong, China;
[2] College of Marine Life Science, Ocean University of China, Qingdao, Shandong, China

Introduction:

Emulsification of immiscible two-phase fluids, i.e., one condensed phase dispersed homogeneously as tiny droplets in an outer continuous medium [1], represents a large part of the products of the cosmetics industry. The traditional process of cosmetic emulsion is to first heat and melt or dissolve the raw materials of the inner phase and the outer phase in two containers, and then mix the two phases to combine them to form an emulsion. However, low-energy emulsification method is an energy-saving emulsification process, which can improve the efficiency of emulsified products and shorten the batching time, and because the use of LEE can greatly reduce cooling water, effectively reduce the burden of processing and cooling, and greatly reduce production costs [2]. Meanwhile, the previous research results in our laboratory showed that the cream prepared by the low-energy emulsification process was easier to be absorbed with a smaller particle size and a better skin feeling, and it was more popular with consumers, compared with samples from the traditional method.

Stability evaluation is an important aspect of cosmetic quality assurance. Recently, multiple light scattering technique has received increasing attention from the research and industrial communities thanks to its ability to detect physical aggregation phenomena based on the scattering and transmission of light through a sample [3]. Many active ingredients used in cosmetics are sensitive to temperature or high-speed shearing, so when using traditional methods to prepare emulsions, we often add these active ingredients after homogenization at low temperature, but how these additions affect emulsions, stability is worth exploring.

Materials & Methods:

The materials used in this study were at least cosmetic grade, and deionized water was used for all experiments. In this study, two processes of traditional emulsification technology and low-energy emulsification(optimized LEE technology) were used to prepare the same cream. Then we prepared creams with the same formula above by changing the adding method of different active ingredients (α-bisabolol and sodium sodium hyaluronate) using low-energy emulsification technology. The stability of all the creams prepared by different processes was investigated by multiple-light scatterer. Then we used Agilent liquid chromatograph (LC-1260) to determine the content of α-bisabolol in the emulsions.

Results & Discussion:

1. Change in intensity of backscattered light (ΔBS) over time

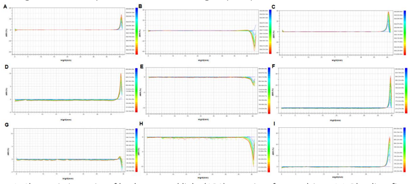

Figure 1. Change in intensity of backscattered light (ΔBS) over time for emulsions A-I. Blue line-first measurement, red line-last measurement. A-C: samples by traditional emulsification process; D-F: samples by low-energy emulsification process with active ingredients added before homogenization; G-I: samples by low-energy emulsification process with active ingredients added after homogenization and cooling. A/D/G are samples' 25 °C scan patterns, B/E/H are samples' 50 °C scan patterns, C/F/I are freeze-thaw samples' scan patterns.

2. Dispersion uniformity index evaluation.

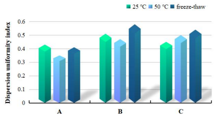

Figure 2. Dispersion uniformity index from samples by different emulsification methods. A: samples by traditional emulsification process; B: samples by low-energy emulsification process with active ingredients added after homogenization and cooling; C: samples by low-energy emulsification process with active ingredients added before homogenization.

3. Determination of α-bisabolol content in the emulsions.

Chromatography was used for detection, and the external standard method was used for quantitative calculation. The content of α-bisabolol in sample by traditional emulsification process was 0.30%, the content of α-bisabolol in sample by low-energy emulsification process with active ingredients added after homogenization and cooling was 0.30%, and the content of α-bisabolol in sample by low-energy emulsification process with active ingredients added before homogenization was 0.23%. High temperature treatment during homogenization period caused 23% loss of α-bisabolol activity

Conclusions:

In this study, the stability analysis of products with different emulsification processes was carried out using multiple light scattering instrument. The results show that, compared with the traditional emulsification process, the emulsified particles obtained by the low-energy process were smaller and tightly arranged. The emulsions had fine feelings to the skin and the products were more stable. The low-energy process could increase the stability of the formulation, but it would damage the structure of the thickener and reduce the uniformity of the system. The oil-soluble active substance α-bisabolol which is not resistant to high temperature, could improve the stability of the product when added to the system before homogenization with 23% lossing of the activity. Therefore, oil-soluble active substance that is resistant to high temperature should be selected as far as possible in the oil-in-water emulsions. Otherwise, we should increase the amount of active substances according to the needs of efficacy.

Acknowledgements:

This work was supported by the R&D team of Qingdao Youdo Bioengineering Co., Ltd.

References:

1. Deng H, Peljo P, Huang X, Smirnov E, Sarkar S, Maye S, Girault HH, Mandler D. Ionosomes(2021) Observation of Ionic Bilayer Water Clusters. J Am Chem Soc 143(20):7671-7680.
2. Lin,T.J., Low Energy Emulsification: Beyond Energy Conservation(2001). C&T 116(5):61-66.
3. Ramezani M, Ferrentino G, Morozova K, Scampicchio M(2021). Multiple Light Scattering Measurements for Online Monitoring of Milk Fermentation. Foods 10(7):1582.