The Use of 1,2-Alkanediols in Personal Care Formulations

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Objective: 1,2-Alkanediols are good moisturizers and skin/hair conditioners. Besides, they are increasingly being used in cosmetic formulations because of their anti-microbial properties to help reduce preservatives. The anti-microbial activity of a material in a formulation, especially an emulsion, depends to a great extent on whether the material is present in the water phase. This paper investigates the influence of solubility and distribution of 1,2-Alkanediols and their mixtures in cosmetic formulations on preservative efficacy.

Methods: It has been reported that the minimum inhibitory concentrations (MICs) of a 1:1 mixture of 1,2-Hexanediol/1,2-Octanediol against microbes like *E. coli, P. aeruginosa, S. aureus, C. albicans* and *A. niger* are equal to or even better than that of 1,2-Octanediol, though the MICs of 1,2-Hexanediol are much lower than that of 1,2-Octanediol. In our first study we evaluated the distribution ratio of 1,2-Hexanediol, 1,2-Octanediol and their 1:1 mixture between water and oil phases. For that purpose we made 1:1 mixtures of paraffin oil-water and added 1% each of the individual diols or their mixture. The water and oil phases were mixed, then separated and the concentration of the diols in the water phase was analyzed by reverse phase HPLC and refractive index detection.

In the second study we investigated if having the 1,2-Alkanediols in the water phase of an emulsion has an effect on the anti-microbial efficacy of the diols. Three oil-in-water emulsions were prepared by using the same formulation containing 0.3% of a 1:1 mixture of the two 1,2-Alkanediols and with no preservatives; the only difference between the emulsions was the order of addition of the diol mixture – one was made by adding the diol mixture to the water phase, the other was made by adding it to the oil phase and the third was made by adding it after the emulsion was formed. All the three emulsions were then tested as per standard preservative challenge protocol. The test was repeated with emulsions containing 0.5% of the diol mixture.

Results and Discussion: The results of our first study indicated that using a 1:1 mixture of the 1,2-Alkanediols results in a higher concentration of the diols in the water phase of an emulsion compared to using 1,2-Octanediol alone. The preservative challenge tests with three different emulsions showed that the formulation in which the diol mixture was added after the emulsion was formed, has a faster rate of kill. We believe that the addition of the diols to an oil-in-water emulsion after the emulsion was formed helped keep the diols in the external water phase, thereby providing more anti-microbial efficacy. Adding the diols in the water phase did not help as some of the material would have got emulsified during the subsequent emulsification step.

Conclusion: The antimicrobial efficacy of 1,2-Alkanediols in formulations is greatly determined by their availability in the water phase. We have showed that it is advisable to have the diols in the water phase of formulations for getting better anti-microbial efficacy from the diols. While making oil-in-water emulsions this is achieved this by adding the diols after the emulsion is formed. These observations greatly help cosmetic chemists to make formulations with better stability against microbial contaminations.