Designing emulsions suitable for lipsticks application

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Lipsticks form an intrinsic part of most cosmetic companies' product range[1]. Currently they consist of three main ingredients; waxes, pigments and perfumes, each of which have important roles. Waxes provide the lipstick with its desired melting properties (for example the lipstick needs to be solid at room temperature but spreadable at skin temperature). The pigments are used to provide the lipstick with different shades depending on the consumers needs and it adds to the solid content which alters the melting properties. And finally the perfume needs to be controlled in a way to deliver sensory properties.

There is a desire to modify lipstick to deliver new sensory properties and to overcome a number of problems. If lipsticks are used over a prolonged period, unwanted changes in skin biology can occur[2]. For example excess wax on the lips can prevent the natural lubrication, resulting in drying. In addition the wax gives the product its material properties which if new sensory properties are to be delivered need to be modified.

The aim of this research project is to 1) develop a mechanistic understanding of emulsions and stabilisation in lipstick type formulation and 2) to add water into an emulsion to deliver moisture to the lips. By doing this, the previously highlighted limitations can be overcome. The scientific challenge is to overcome the difficulties that an emulsion brings, such as a) stability, b) material property changes that occur with the introduction of water, c) certain emulsifiers can cause irritation and d) large crystals can be formed, which will affect the physical and sensory properties of the lipstick.

Emulsions are thermodynamically unstable resulting in phase separation[3]. Therefore preliminary research was performed to create an emulsion which was stable, in which the water is not perceived at the bulk level and the emulsion was then tested to compare material and physical properties to a currently available lipstick.

Initially, Polyglycerol polyricinoleate (PGPR) was investigated as an emulsifier for use in a lipstick emulsion formulation made via a Silverson high shear mixer. The stability of the emulsions was monitored by measuring the droplet size via Bruker Minispec Nuclear Magnetic Resonance (NMR) over a period of time. Results (**Figure 1a**) show that as PGPR concentration increases the droplet size decreases. It also shows that there is no decrease in droplet size after ~1% PGPR is used. This could be due to the water phase interface being fully saturated. **Figure 1b** shows how that once the emulsion is formed the droplet size does not vary with time. This can be attributed to a wax crystal network stabilising the emulsion and preventing coalescence.

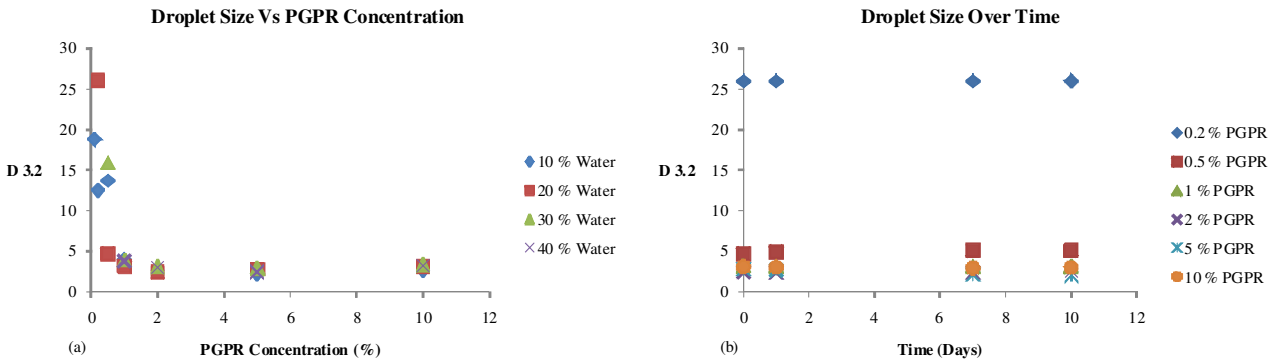

Figure 1 - (a) shows the effect of PGPR concentration on D3.2 and (b) shows the stability of 20 % W/O emulsions over time with varying PGPR concentrations.

Secondly, different wax ratios were investigated to check both the melting profiles and the hardness of the formulations to investigate whether they are suitable for lipstick application. The hardness was evaluated by calculating the penetration depth (**Figure 2**) of a given formulation. **Figure 2** shows that as water content increases the penetration depth increases meaning the samples are becoming softer.

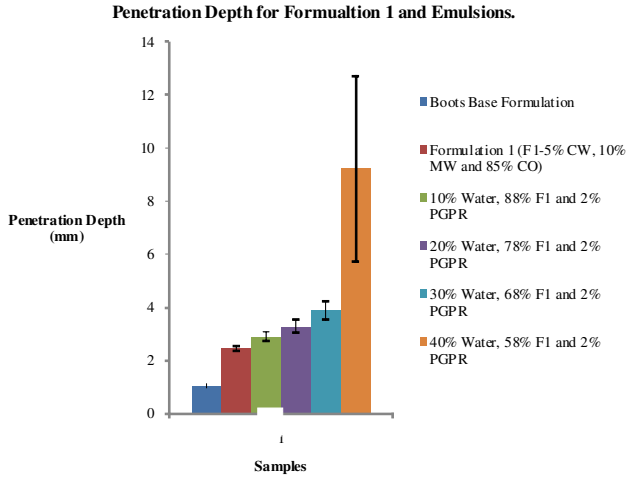

Figure 2 - Shows the penetration depth of boots base formulation, formulation 1 and emulsions where CW - Carnauba wax, MW - Microcrystalline Wax, CO - Castor Oil and PGPR - Polyglycerol Polyricinoleate.

References

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[3] Hodge. S. M., Rousseau. D., *"Flocculation and coalescence in water-in-oil emulsions stabilized by paraffin wax crystals"*, Food Research International, August **2003**.