FORMULATION AND PHYSICO-CHEMICAL CHARACTERISATION OF AN AFTER SHAVE OIL/WATER EMULSION CONTAINING TEA TREE OIL

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INTRODUCTION

The objective of this study was to formulate a stable after shave oil/water emulsion based on Ceralution H® as emulsifier and tea tree oil as an active ingredient, for application on sensitive, infection prone skin.
Ceralution H® (Sasol, INCI: Di Sodium Ethylene Dicocoamide PEG-15 Disulfate and Behenyl Alcohol and Glyceryl Stearate and Glyceryl Stearate Citrate) is a Gemini Surfactant based emulsifier (Di Sodium Ethylene Dicocoamide PEG-15 Disulfate). Its main features are creation of liquid crystalline lamellar gel network, easy incorporation of oils and actives, stability in a wide pH range (4.0-12.0) as well as good dispersant properties [1] [4].
Tea tree oil is an essential oil derived from the leaves of the Melaleuca Alternifolia species and is well known for its antimicrobial activity [3]. 1% w/w concentration in cosmetics is regarded as save according to opinion of the American Federal Institute for Risk Assessment [2].

EXPERIMENTAL METHODS

Materials

Gemini surfactant based emulsifier, Ceralution H® (was kindly provided by Sasol, Germany), Cyclomethicone (Cyclomethicone DC 345, Dow Corning Corp., Midland, USA), Caprylic/Capric Triglyceride (Mygliol 812®, Croda, UK), Sodium Lactate (and) Sodium Pyrolydin Carbon Acid (and) Glycine (and) Fructose (and) Urea (and) Niacinamide (and) Inositol (and) Sodium Benzoate (and) Lactic Acid (Lactil®, Degussa, Goldschmidt, Germany), Tea tree oil (Thursday plantation, Australia), Allantoin (Ph.Eur.), Cetostearyl alcohol (Ph.Eur.), Hydroxyethylcellulose (Ph.Eur.), Glycerin (Ph.Eur.), Xanthan Gum (Ph.Eur.), Disodium EDTA (Ph.Eur.), Panthenol (Ph.Eur.), Methylparaben and Propylparaben (2:1), d α-Tocopheryl acetate (Ph.Eur.), Purified water (Ph.Jug.IV).

Methods

Samples of oil/water emulsion were prepared using Ceralution H® as emulsifier (5% w/w concentration) and tea tree oil as active antiseptic ingredient (1% w/w concentration). Model formulation was developed using as few ingredients as possible (Table 1). After positive stability assessment, other samples were prepared using additional viscosity modifiers, emollients, humectants and vitamins until a stable emulsion with adequate sensory properties was obtained (Table 2).

	%
Phase A	
Ceralution H®	5,0
Mygliol 812®	20,0
Phase B	
Methylparaben	0,067
Propylparaben	0,033
Purified water	73,9
Phase D	
Tea tree oil	1,0

Table 1. Composition of model formulation – Sample F1

	%
Phase A	
Ceralution H®	5,0
Mygliol 812®	15,0
Cyclomethicone	2,0
Cetostearyl alcohol	2,0
d α-Tocopheryl acetate	1,0
Phase B	
Panthenol	3,0
Allantoin	0,2
Glycerin	2,0
Xanthan Gum	0,3
Hydroxyethylcellulose	0,5
Disodium EDTA	0,1
Methylparaben	0,067
Propylparaben	0,033
Purified water	65,8
Phase C	
Lactil®	2,0
Phase D	
Tea tree oil	1,0

Table 2. Composition of model formulation with adequate sensory properties – Sample F5

Preparation

The ingredients of phase B (without polymers) were dissolved at 75ºC. When the temperature of phase B was below 60ºC Xanthan Gum and Hydroxyethylcellulose were added and dispersed respectively (mixing speed 400 rpm). When the lump-free dispersion was attained, phase B was once again shortly heated at 75ºC and than phase A, heated on 70ºC, was slowly added (mixing speed 650 rpm). After the temperature of the emulsion dropped down below 40ºC phases C and D were added. Emulsification and homogenization were continued at the same speed for another 10 minutes until the emulsion cooled down. All mixing operations were carried on a laboratory mixer RZR 2020 “Heidolph”, Germany. After preparation the samples were allowed to equilibrate for 48 hours period at room temperature.

Physico-chemical characterization

The samples were tested for their:
-macroscopic behavior
-physical stability (the centrifuge test, 2x 2500 rpm for 15 minutes using laboratory centrifuge LC 320 Tehtnica, Slovenia)
-electrical conductivity (directly in prepared samples using conductometer CMD 230 Radiometer, Copenhagen)
-pH value (carried out directly in prepared samples with pH meter HI 9321 “Hanna Instruments”, Portugal)
-rheological properties (rheological measurements were performed using rotational rheometer Rheolab MC 120, Paar Physica, Stuttgart, Germany, coupled with the cone and plate measuring device MK 22 (radius 25 mm, 1° angle, temperature 20 ± 0.1 °C). For flow curve evaluation the controlled shear rate procedure was used.)
All testing methods were performed on 48 hour-old samples and after 7 weeks of storage at room temperature (20 ± 2 °C).

Results and discussion

All prepared emulsions have passed physical stability testing with no phase separation. Conductometry testing confirmed that oil/water emulsions were created (results within the range 1,184-1,730 mS/cm) while pH values were slightly beneath 5,50 (5,10-5,40). However, all of them lacked adequate viscosity or sensory properties until sample F5 was formulated (Table 2).

Sample F5 was white, smooth, glossy, homogenous, thick lotion, with consistency suitable for after shave application (testing results are shown in Table 3, Table 4 and Table 5). It performed easy spreading on skin, quick absorption and light after feel with faint characteristic tea tree oil odor. Rheological measurements have shown expected pseudo plastic flow behavior with slight thixotropy (Figure 1 and Figure 2).

pH value	
after 48 hours	**after 7 weeks**
5,19	5,34

Table 3. Sample F5 - pH values after 48 hours and 7 weeks

σ value (mS/cm)	
after 48 hours	**after 7 weeks**
1,730	1,544

Table 4. Sample F5 - σ values after 48 hours and 7 weeks

η' max (Pas)/4,1 s-1		η' min (Pas)/200,0 s-1	
after 48 hours	**after 7 weeks**	**after 48 hours**	**after 7 weeks**
6,540	8,580	0,424	0,721

Table 5. Sample F5 – Values of apparent viscosities (η') after 48 hours and 7 weeks

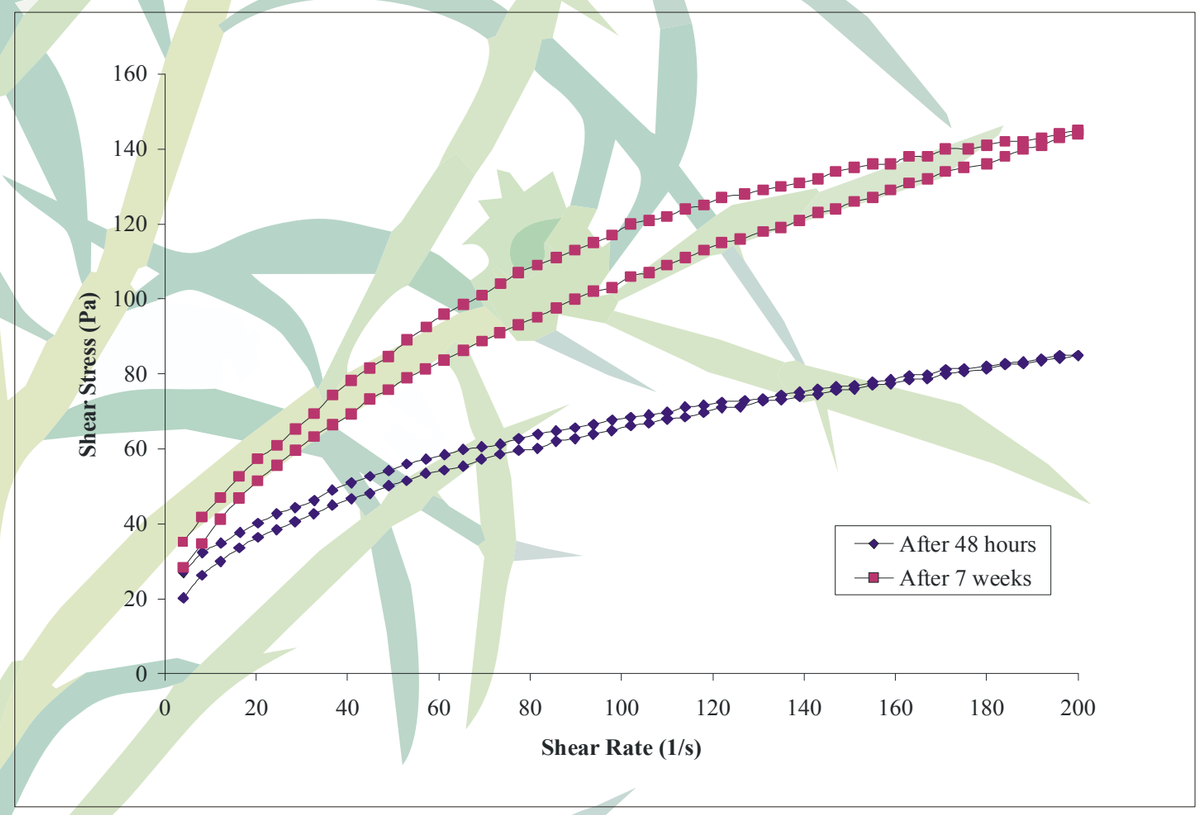

Figure 1. Sample F5 – Flow curves after 48 hours and 7 weeks

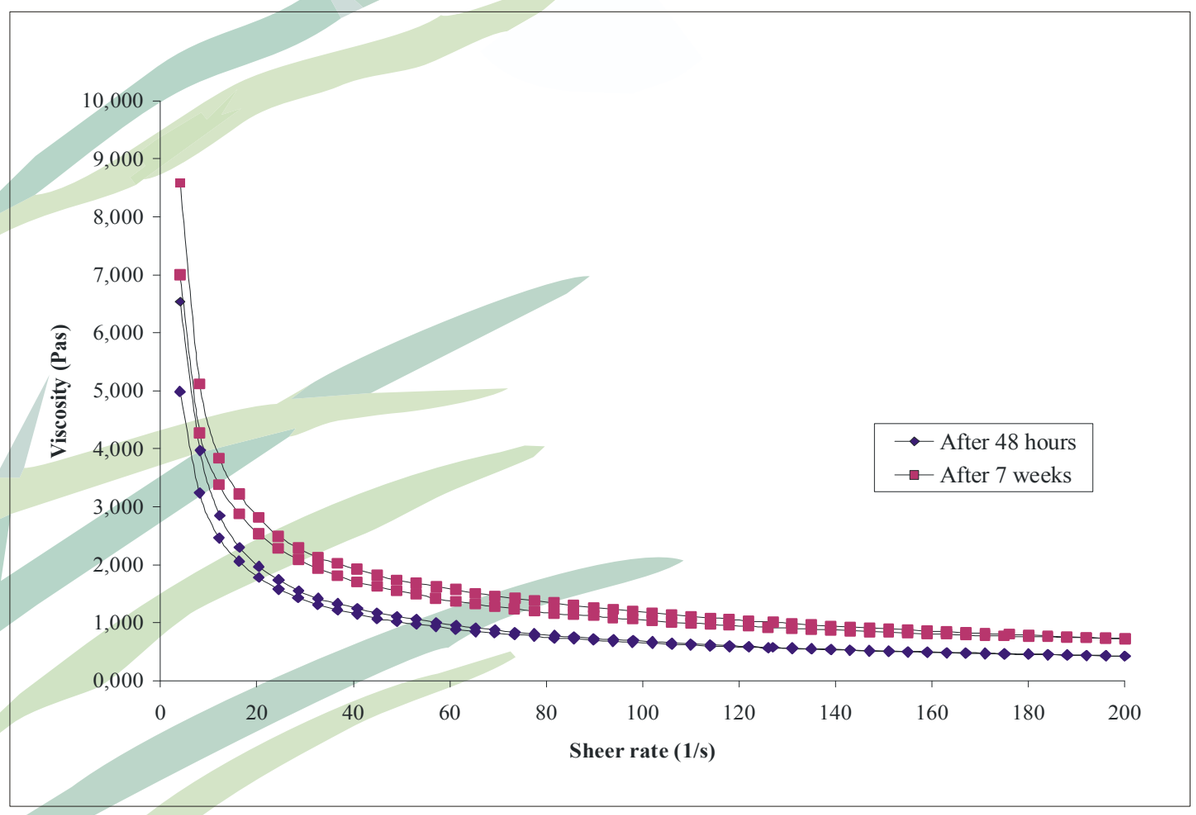

Figure 2. Sample F5 – Viscosity curves after 48 hours and 7 weeks

CONCLUSION

These preliminary results show that developed oil/water emulsions, using Ceralution H® as emulsifier, could be suitable vehicles for tea tree oil.
Using different concentration of viscosity modifiers and active ingredients, a model after shave emulsion with adequate sensory properties has been developed.

REFERENCES

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