A STUDY OF SURFACTANT EFFECTS ON THE PHYSICAL CHEMISTRY OF VEGETABLE AND MINERAL OILS

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INTRODUCTION

The behaviour and operation of a stable dispersion within the pharmaceutical industry is indispensible, especially in methods involving particle size analysis. The performance of a stable dispersion ultimately depends on the properties of the individual constituent particles, which are often neglected. The objective of the study was to highlight the possible relationship between the physicochemical properties of the constituents, namely the density, surface tension and kinematic viscosity of six different types of oils from both vegetable and mineral sources, in conjunction to four different types of surfactants at different concentrations. The study also entailed comparing the results obtained to the ones conducted by Ellul (2012) to determine the influence of a change in oil brand.

METHOD

The six oils used as dispersing liquids were paraffin oil, vaseline oil, cornflower oil, sunflower oil, rapeseed oil and olive oil. The four dispersing agents used in this study were Brij 30, Span 20, Span 40 and lecithin, which were added in concentrations of 100, 50, 25, 10, 2.5, 0.5, 0.05, 0.005 and 0 g/L to the respective oils.

- The densities and surface tensions of the pure dispersing liquids and their respective surfactant solutions were determined by using a Sigma 701 tensiometer (KSV Instruments Ltd.).
- The kinematic viscosity measurements were conducted by using U-Tube Ostwald Viscometers operated in accordance with the ASTM methods D446-004 and D445-01.

RESULTS AND DISCUSSION

1. Physicochemical Properties of Pure Dispersing Media

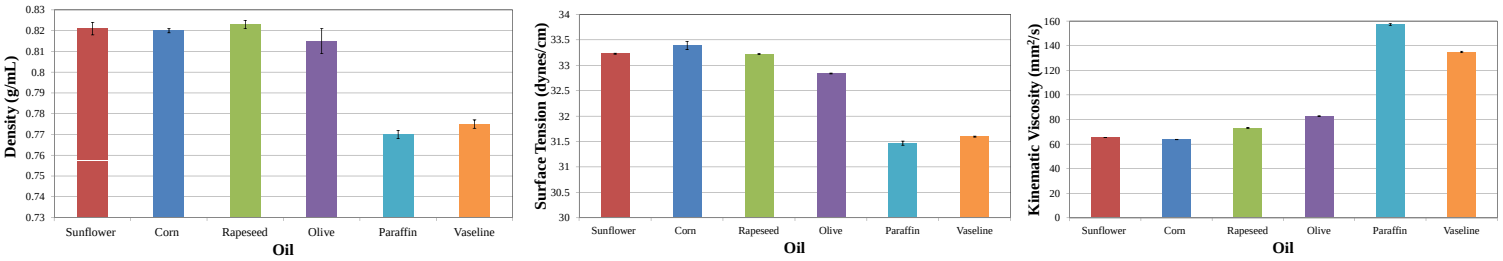

Fig. 1: Bar charts illustrating the variation of density, surface tension and kinematic viscosity with the type of pure oil being used.

2. Effect of Surfactant on the Dispersing Liquid

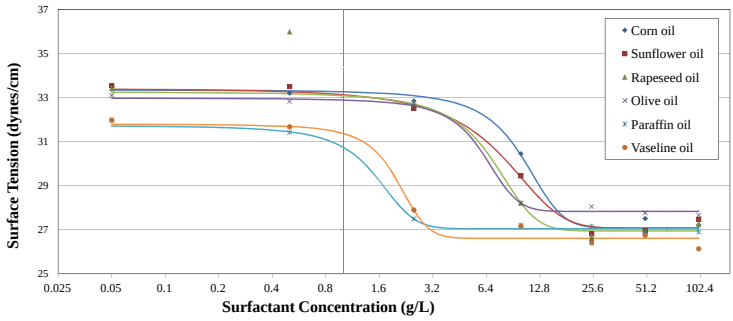

Fig. 2: Variation of surface tension with increasing concentration of Span 20 using different oils. The plot includes the result of a nonlinear regression analysis for a sigmoidal response with variable slope.

Table 1: Summary of General Linear Model data output showing *p*-values obtained for the three parameters. A 0.05 level of significance was considered.

Source	Density	Surface Tension	Kinematic Viscosity
Surfactant Concentration	0.000	0.000	0.968
Dispersing Liquid	0.000	0.037	0.000
Surfactant Type	0.001	0.000	0.000
Dispersing Liquid * Surfactant Type	0.053	1.000	0.008

3. Multi-Study Data Comparison

Table 2: Outcome of the paired *t*-test: Paired Two Sample for Means for Oil-Surfactant systems showing *t*-values and *p*-values obtained for each set of data from the respective studies. A 0.05 level of significance was considered.

Property	*t*-value	*p*-value
Density	5.348	1.512×10^{-6}
Surface Tension	-12.461	3.610×10^{-18}
Kinematic Viscosity	-1.984	0.0519

Table 3: Summary of the *t*-test between the two studies: Paired Two Sample for Means for Oil-Surfactant systems showing *t*-values and *p*-values obtained for density, surface tension and kinematic viscosity. A 0.05 level of significance was considered.

Oil	Value	Density	Surface Tension	Kinematic Viscosity
Corn oil	*t*-	2.350	-5.146	-5.463
	p-	0.0433	0.000606	0.000399
Sunflower oil	*t*-	2.223	-9.970	-3.784
	p-	0.0533	3.67×10^{-6}	0.00432
Rapeseed oil	*t*-	1.038	-5.178	5.518
	p-	0.326	0.000581	0.000371
Olive oil	*t*-	2.605	-5.981	-2.590
	p-	0.0285	0.000207	0.0292
Paraffin oil	*t*-	2.792	-4.142	-2.00785
	p-	0.0105	0.00126	0.0378
Vaseline oil	*t*-	2.644	-6.817	-1.102
	p-	0.0134	3.88×10^{-5}	0.150

CONCLUSIONS

1. Preliminary tests on pure oils showed a distinct difference between the two sources of oils; namely the **vegetable oils** (corn, sunflower, rapeseed and olive oil) and **mineral oils** (paraffin and vaseline oil).
2. Presence of **surfactant** was found to significantly affect the density, surface tension and viscosity of the oils, arising from the different interactions of the dissimilar surfactant structures.
3. Not only did the oil exert an influence on the physicochemical properties of the dispersing liquid, the *t*-test showed that there was a significant difference between the results obtained in this study to those conducted by Ellul (2012) since the two studies made use of **different oil suppliers**.

REFERENCES

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