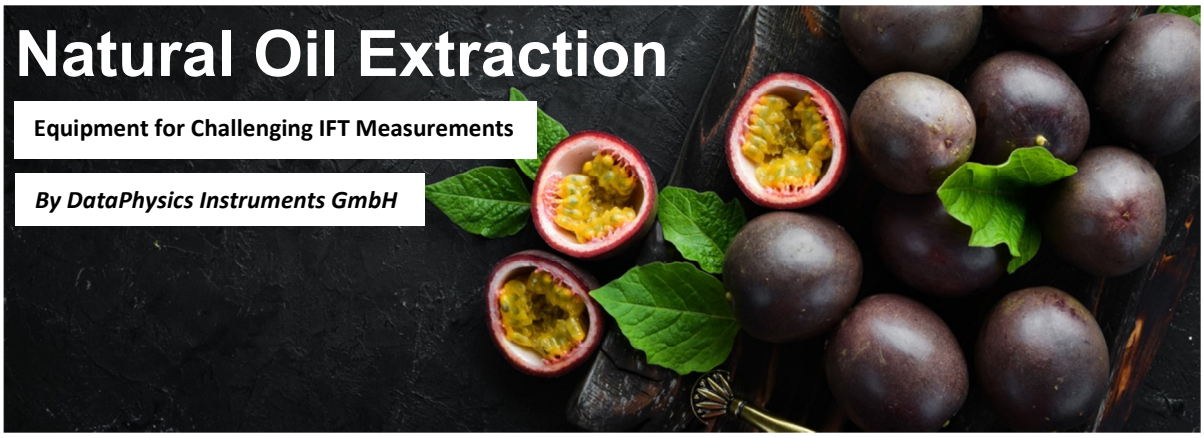
Interfacial Tension Measurements Can Help to Extract Passionfruit Oil Efficiently



Passion fruit is one of the most popular and well known fruits, not only because of its distinctive flavour, but also its valuable seeds. Passion fruit seeds contain a high amounts of oil which has a growing utilization in food, pharmaceuticals, especially in cosmetic industry, due to its high content of unsaturated fatty acids, active antioxidant, phenolic compounds, piceatannol *etc*., that help against oxidative stress, aging skin cells and allergy. However, currently the major amount of seeds are wasted in the juice production process. Although there already exist many oil extraction techniques for example the typical industrial extraction methods with hexane, cold-pressing or ultrasound-assisted extraction supercritical fluid extraction, they are not easily and widely applicable, due to the toxicity and flammability of the solvents or time consuming procedures and high cost. Besides, the oil extraction methods have huge effects on oil quality especially for cosmetics and beauty products that require a low oil extraction temperature, so that more bio-active compounds can be kept intact. This leads to the conclusion that exploring a non-toxic method that can extract passion fruit seed oil efficiently at low temperature will be of high interest.

Picture 1: *Passion fruit oil has a high content of unsaturated fatty acids, active antioxidant, phenolic compounds and piceatannol making valuable for food, pharmaceutic and cosmetics industry*

What are the critical factors for effective extraction of passion fruit seed oil? Previous studies have shown that the interfacial tension (IFT) value between the oils and the extracting medium is crucial in improving the oil removal efficiency. Several works also reported that some industrial surfactants could obtain ultra-low IFT values, which leads to a high efficiency of oil extraction. Unfortunately, this kind of surfactant can only be applied to extract non-food purpose oil, due to its non-food grade and toxicity.

Recently, Surlehan *et al.* applied the surfactant-assisted aqueous extraction process (SAAEP) for oil extraction from passion fruit seeds, which is not only efficient, but also environmentally friendly and safe. In this study, Tween 20 and Span 20 were used as surfactants because they are food grade surfactants and commonly employed in food and cosmetic production. On the other hand, Tween 20 is a non-ionic surfactant and has good solubility in water with 16.7 Hydrophilic-lipophilic balance (HLB) value, while Span 20 is easily soluble in oil with 8.7 HLB value. It has been reported that combining a high HLB surfactant with low HLB surfactant can achieve much lower IFT values than a single surfactant. As shown, in Figure 1 (a), the IFT between passion fruit oil and surfactants was obviously reduced when increasing the HLB from 13 to 14, while the IFT kept almost the same from HLB 14 to 16. Therefore, adjusting the HLB of the Tween 20 and Span 20 mixture between 15 and 16 was found to result in the lowest IFT value.

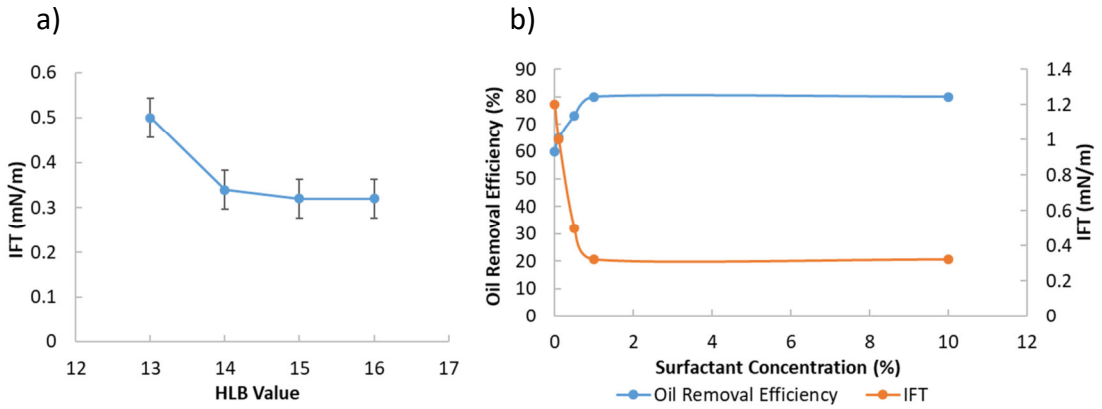


Figure 1: *a) The effect of the HLB value on the IFT measured by spinning drop Tensiometry (SVT 20N). The test was carried out under 1% surfactant concentration, 25±2°C. b) The effect of the surfactant concentration on oil removal efficiency and IFT.*

Moreover, the effects of surfactant concentration on oil removal efficiency and IFT were investigated in this research. As Figure 1(b) shows, increasing the surfactant concentration from 0% to 1%, the IFT value reduced dramatically from 1.2 mN/m to 0.32 mN/m. Nevertheless, the IFT value retained the same during increasing the surfactant concentration to 10% since the critical micelle concentration (CMC) was already reached at concentration >1% leading to the formation of micelles and no further decrease of the IFT value. Besides, Figure 1(b) illustrates that the oil removal efficiency is remarkably enhanced with increasing surfactant concentration up to the CMC. From the findings, it can be clearly concluded that the efficiency of extraction has a strong correlation with the IFT. In addition, the authors also studied the effects of solid to liquid ratio (SLR) and extraction time on the

extraction efficiency and found that 79.82% efficiency was achieved with 4:75 SLR and 15 mins contact time.

Overall, this work presented a deep study on the correlation between oil removal efficiency and IFT at different surfactant mixtures/concentration and provides an environmentally friendly and safe technique to extract passion fruit seed oil with high efficiency at low surfactant concentrations (only 1%) and low extraction temperature (25˚C) in a short extraction time, which will have a bright prospect in the food and cosmetic industry.

The Spinning Drop Video Tensiometer 20N (SVT 20N) (DataPhysics Instruments GmbH, Germany) was used for the interfacial tension measurement in this research.

For more information, please refer to the following article:

Extraction of oil from passion fruit seeds using surfactant-assisted aqueous extraction; H.F. Surlehan, N.A. Noor Azman, R. Zakaria and N.A. Mohd Amin; *Food Research* **2019** *3(4)*, 348-356; DOI: 10.26656/fr.2017.3(4).146