AGGREGATIVE STABILITY OF EMULSIONS CONTAINING WALNUT OIL

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Abstract. Phase diagrams of the state of a three-component emulsion – *Walnut oil / Aqua / Ethanol* were developed. It is shown that walnut oil is more prone to form A/O emulsion than O/A ones, that is possibly explains by the presence of surfactants in it. The aggregate stability of emulsions is also affected by the composition of a water-ethanol phase. The most stable emulsions were those that included practically equal volume fractions of ethanol and water. This fact could be explained by an approximate densities equality of polar (aqua + ethanol) and nonpolar (oil) phases.

Keywords: walnut oil, ethanol, emulsions, phase state diagrams, aggregative stability

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Introduction

Walnut oil obtained by a cold pressing represents a complex composition, that includes, besides various fatty acids, phospholipids. These substances contain hydrophilic groups and therefore have a surface activity [1]. Thus, cold pressed walnut oil, unlike refined oils, should have its own surface activity [2]. From this point of view, it is interesting to investigate the aggregative stability of emulsions based on walnut oil.

Experimental

Systems containing nonpolar phase – a cold pressed walnut oil as, and polar phase – water and ethanol obtained by rectification, were investigated. Walnut oil was obtained from freshly picked and manually peeled nuts, aged for 24 h over anhydrous sodium sulfate to uniquely remove the aqueous phase with its attendant substances.

Results and discussion

"Three-component" emulsions were obtained, and diagrams of the type "***property = f (composition)"*** in the form of Gibbs-Roseboom Triangle were developed.

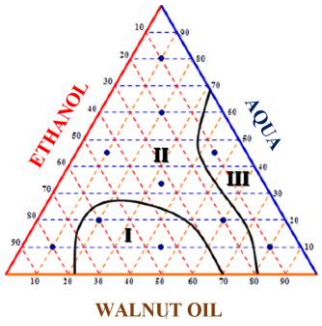

Fig.1. *Phasic state regions of Walnut oil/ Aqua / Ethanol system*

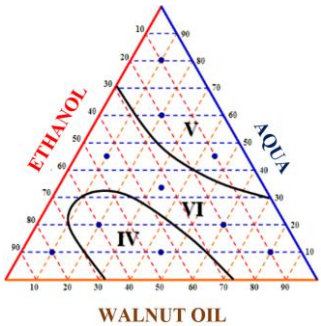

Fig.2. *Kinetic stability regions of Walnut oil/ Aqua / Ethanol system*

Region I (Figure 1) comprises: 25-65% Walnut oil, 0-25% Aqua, 30-75% Ethanol, where the A/O emulsion is formed. The formation of A/O emulsion on the left side of this region is quite unexpected, because the apolar phase (in other words, dispersion medium for A/O emulsions) is less than 50%.

Region II (Figure 1) is much more complicated by its shape and occupies a bigger space. The largest area in this Region is: 0...30% Walnut oil, 30...100% Aqua, 0...70% Ethanol. A very small field is attached to this area: 0...15% Walnut oil, 0...30% Aqua, 60...100% Ethanol. The formation of O/A emulsions in this area is natural, because the nonpolar phase volume doesn`t exceed 10%. The third area is very interesting, ranging from 40...80% Walnut oil, 0...30% Aqua, and a very narrow range of Ethanol, 20 ... 30%.

In Region III (Figure 1), the O/A/O three-phase emulsion is formed. Region borders are: 40...100% Walnut oil, 0...60% Aqua, 0...12% Ethanol. Thus, the "top" phase of the emulsion represents an oil, i.e. walnut oil tends to absorb the droplets of polar phase and it this area, too.

Region IV (Figure 2) shows a low aggregate stability, which doesn`t exceed 2 minutes, after which visible signs of coalescence appear in the system.

Region V (Figure 2) also represents a low stability, approximately 2 minutes. But this area has been separated from Region IV, because both regions are antipodes by water content (0...30% Aqua in IV and 30...100% Aqua in V) and does not overlap.

Region VI (Figure 2) disparates the areas of low stability. It has the largest field on the discussed diagram and shows a high stability, which reaches up to 5...10 minutes. It is interesting that the most part of Region VI is located almost symmetrically along the bisector, which starts from 100% Walnut oil and corresponds to the equation of straight *Aqua = Ethanol*. It is easy to show, that exactly this Aqua/Ethanol ratio contributes to the fact that the density of a polar phase is equal to the density of a nonpolar phase, that significantly reduces the coalescence rate. Region VI is also supplemented by a small area, located at 0...30% Walnut oil, 0...30% Aqua and 70...100% Ethanol.

Conclusion

Walnut oil is more prone to form A/O emulsion, than O/A one. Perhaps, this fact is due to the presence of phospholipids in it, which have surfactants properties. The composition of water-ethanol phase also influences on the aggregate stability of obtained emulsions. The most kinetically stable emulsions are those, in which the volume fractions of ethanol and water are approximately equal.

References

1. Birdi K.S., *Handbook of Surface and Colloid Chemistry*. Taylor & Francis Group, 2016.

2. Baerle A., Popovici C., Radu O., Tatarov P., *Effect of Synthetic Antioxidants on the Oxidative Stability of Cold Pressed Walnut Oil*. Journal of Food and Packaging Science, Technique and Technologies, 2016, №9. – p. 19-24.