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Microwave influence on solid-liquid equilibrium

Ana ÁLVAREZ MARTÍN[1], Héctor TRIGUEROS FERNÁNDEZ[1], María José COCERO[1], Rafael B. MATO[1]

[1] *University of Valladolid, Spain*

The advantages of adding microwaves to chemical processes have been widely proved. However, there is not a clear understanding of the microwaves' role in these processes. For instance, the enhancement produced in natural products extraction is broadly recognised, but only oil extraction improvement from trichomes has been rigorously described. In order to shed light on microwave intensification, some authors have reported changes in vapour-liquid equilibrium when microwave heating is applied to the interface [1]. This work analyses if microwaves may also contribute to ameliorate the solubility of certain compounds under radiation, and so, find an explanation for the extraction enhancement in microwave assisted processes.

Gallic acid and quercetin were chosen as key compounds in order to analyse their solubility in water, ethanol and ethyl acetate. These solvents have been selected in accordance to their dielectric properties, ranging from efficient absorbents to almost transparent to radiation (loss tangents between 0.659 and 0.059).

An isothermal system subjected to radiation was achieved in a CEM Discover microwave, providing a constant power of 30, 50, 70 and 90 W (corresponding, respectively, to absorbed energies from 2.4 to 11.5 W/g) and refrigeration with cooled air to keep a constant temperature. Homogeneity was attained by a vigorous mechanical stirring.

Results suggest that no further improvement takes place in solubility when microwaves are applied. None of the solvents tested provide any enhancement so, the hypothesis that equilibrium is only affected by radiation in the interphase is not fulfilled in the case of solid-liquid equilibrium.

In light of these results, the effect of the microwaves on solid-liquid equilibrium is void. Thus, a microwave boost able to explain a presumed athermal effect has not been demonstrated.

[1] Altman, E., et al., *Process Intensification of Reactive Distillation for the Synthesis of n-Propyl Propionate: The Effects of Microwave Radiation on Molecular Separation and Esterification Reaction.* Industrial & Engineering Chemistry Research, 2010. 49 (21): p. 10287-10296.

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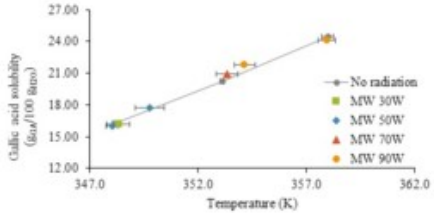

Figure 1. Water solubility of gallic acid with and without microwave radiation