

Microwaves and ultrasound - a stunning combination - applications in the food industry

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Microwave radiation is nonionized and possess the potential to transport energy from one medium to another in a small duration of 10^{-9} s with every run of electromagnetic energy. The relaxation time of molecules receiving this energy is roughly 10^{-5} s. This suggests that the time required for the energy to advance is quicker than the time needed for the molecules to relax. This gives rise to non-equilibrium state and rapid increase in temperature that influence the reaction kinetics of the entire system¹. The effect produced by microwave radiations in the chemical synthesis is a combined effect of non-thermal and thermal phenomenon.

The thermal phenomenon consists in an action like overheating, hotspots and selective heating. The non-thermal phenomenon is noticeable for highly polarized radiations or as alteration of thermodynamic parameters².

Ultrasound can be used to improve the mass transfer. Power ultrasound, which is capable of influencing chemistry and processing, generates cavitation bubbles when passes through the liquid. There are many thousands of such bubbles in the liquid some of which are relatively stable, but others expand further to an unstable size and undergo violent collapse to generate temperatures of about 5000°K and pressures of the order of 2000 atm. If the bubble collapses close to or on a solid surface the collapse is not symmetrical and results in a microjet of liquid being directed towards the surface of the material at speeds of up to 200 m/s. These jets are of course the underlying reason why ultrasounds are so effective in increasing mass transfer.

Therefore, the application of hybrid processing method of microwave-assisted ultrasound food processing technique with concomitant synergistic effect based on theoretical and experimental knowledge should allow for eliminating the defects of each individual technique³.

The paper presents the possibilities of applying the combined treatment - microwave and ultrasound in several types of processes used in the food industry (literature review completed with experimental data):

- Extraction of natural compounds;
- Drying of food materials;
- Enhanced enzyme activity.

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