



## Power Ultrasound for the Improvement of Juices & Smoothies

**Researches from the Technical University Berlin found that ultrasonication is a very effective processing method to improve fruit and vegetable juices as well as smoothies. Being a non-thermal food process technique, ultrasound provides a mild but effective treatment that intensifies flavours, and stabilizes and preserves juices and purees. The results of ultrasonic juice treatments include improved flavours, stabilization and preservation.**

The application of ultrasound in food production processes is a field of growing interest for food manufacturers. In contrast to low intensity ultrasound (intensities  $< 1 \text{ W/cm}^2$ ), which can be used for non-destructive testing and imaging, power ultrasound (intensities  $> 5 \text{ W/cm}^2$ ) causes material alteration and can be used for the improvement of versatile processes in the food industry. Ultrasonic waves are compression waves that mechanically interact with the product under sonication. Cyclic compressions and rarefactions can influence cell structure. At high pressure amplitudes power ultrasound causes cavitation, the growth and implosion of gas bubbles, which is accompanied by pressure and temperature peaks and homogenizes and stabilizes disperse systems. Hielscher Ultrasonics and researchers from the Department of Food Biotechnology and Food Process Engineering from the Technical University of Berlin investigated the positive effects of ultrasound to improve quality, stability and taste of smoothies; blended and chilled beverages made of fruit and vegetable juices and purees.

Although there is no legal right limiting the ingredients of smoothies to pure fruit and vegetable products, producers intend to place them on the market as healthy and valuable products. Consequently, it is intended to produce them without the addition of stabilizers, flavor enhancers or colorants. However, the juices and purees often have high contents of pulp. Thus, they tend to phase separation resulting in a less appealing look of the product. For this reason, most of the smoothies currently available contain banana as a main ingredient, which is reducing the phase separation due to an increase in viscosity.

Ultrasound can be applied in order to disrupt the pulp particles and to affect the particle size distribution. A smaller particle size results in lower settling velocity leading to a reduction of sedimentation and improved storage stability. Furthermore, this disintegration of particles can lead to an increased release of flavor components, color pigments and cell constituents such as sugar or volatile aroma compounds into the juice. The result is an improvement in color intensity, sweetness and aroma impression. Additionally, reduced particle size influences the mouth feeling, leading to a smoother overall impression.

In order to assure a certain shelf life of smoothies, the mixtures have to be pasteurized. However, heat treatments always have an impact on product quality, color and the impression of freshness.

Consequently, the reduction of processing temperatures is one of the main focuses in the food industry. Ultrasound has a synergistic effect on the inactivation of microorganisms and enzymes when it is applied in combination with temperature, called thermosonication, or elevated pressure, called manosonication. Positive results are furthermore known for the combination of all three parameters under the term of manothermosonication. It is assumed that cells treated by ultrasound become more susceptible to other stress factors such as pressure and heat. Additionally, ultrasonic waves can disrupt boundary layers and induce mixing resulting in improved heat transfer. Therefore, another focus of the research project is the reduction of pasteurization temperatures by development of an ultrasound assisted preservation process. The improvement of product quality and the reduction of energy costs while maintaining or extending

product safety and shelf life are envisaged.

The comprehensive effects of ultrasound, which could allow the simultaneous improvement of sedimentation characteristics, taste, appearance, mouthfeel and microbiological as well as enzymatic stability of smoothies as high value products, could represent an important advantage for the food industry and the marketing of fresh fruit and vegetable beverages in the future. Furthermore, the percentage of banana or other high viscosity ingredients could be reduced, when product stability is improved by ultrasonic treatments and enable the creation of new smoothie varieties.

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