



APPLICATION
REPORT

BEVERAGE STERILIZATION/ PASTEURIZATION



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Industrial Sonomechanics, LLC ([ISM](#)), offers high-amplitude ultrasonic processors for the sterilization/pasteurization of beverages. The processors are based on our [patented](#) Barbell Horn® Ultrasonic Technology ([BHUT](#)), which makes it possible to tremendously intensify ultrasound-assisted treatment of liquids and guarantees reproducible and predictable results at any scale of operation.



Background

Thermal treatment is currently the most common method for the inactivation of microorganisms in beverages, such as milk and juices. This procedure, however, is known to cause deterioration of beverage flavor and nutritional quality. Thermo-sonication is an alternative “minimal processing” sterilization/pasteurization technique that has been successfully implemented on a laboratory scale for a number of food products, demonstrating efficient microbial inactivation and shelf life improvement. The use of high-amplitude ultrasound permits significantly lowering the processing temperature, compared with

thermal-only treatment. The required level of microbial deactivation is obtained without affecting the product’s physicochemical properties, freshness, and bioactive compounds’ integrity. The process can be further improved by combining high-amplitude ultrasound with short-wave ultraviolet radiation (UV-C).

Very high ultrasonic amplitudes (90 – 120 microns) are required for ultrasonic sterilization/pasteurization. High-amplitude ultrasound-promoted microbial deactivation is attributed to intense ultrasonic cavitation, which generates violently imploding vacuum bubbles and causes micro-jets, hot spots and localized pressures that break up microorganism cell walls.

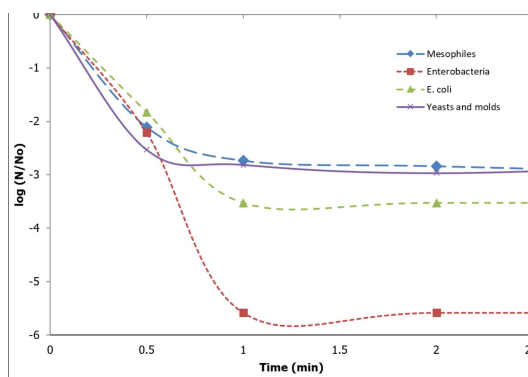
Application Example: Sterilization Of Carrot Juice



The data presented below was collected in cooperation with Washington State University, Center for Nonthermal Processing of Foods (WSU) and Allied Innovative Systems, LLC (ALLIS). Similar results have previously been obtained by WSU on the laboratory scale (500 ml batch size) using a conventional high-amplitude ultrasonic processor. ISM’s Barbell Horn® Ultrasonic Technology made it possible to scale up the process without lowering the ultrasonic amplitude, making it feasible for commercial application.

Raw carrot juice was provided by WSU and processed at ISM’s facility using the ISP-3000 industrial ultrasonic processor. An HBHB-type ultrasonic horn capable of providing amplitudes up to 110 microns

and having the output diameter of 45 mm was utilized in combination with a 300 ml reactor chamber (flow-cell). The chamber had a transparent polycarbonate section, which allowed visual monitoring of the cavitation process. 5 L of the raw carrot juice were pre-heated to 54 °C and inoculated with a strain of Escherichia coli ATCC 11775 in the main storage tank, as the juice recirculated at the rate of 10 L/min through the reactor chamber with ultrasound deactivated. About 30 seconds after the inoculation, ultrasound was activated. The processing conditions were: ultrasonic amplitude - 110 microns, output system power - 2.6 kW, recirculation rate - 10 L/min. Samples were taken during processing at 30 sec, 1 min, 2 min and every 2 min thereafter until reaching 12 min. The samples were analyzed for mesophiles, enterobacteria, E. coli and yeasts and molds. The results are presented below. No significant changes occurred after 2 min of exposure, which is why the data for samples taken beyond 2 min is not shown.



The figure on the left shows microbial inactivation of mesophiles, enterobacteria, E. coli and yeasts and molds in carrot juice using the ISP-3000 ultrasonic processor (initial counts: Mesophiles - 105 cfu/ml, Enterobacteria - 105 cfu/ml, E. coli - 104 cfu/ml, Yeasts and molds - 105 cfu/ml). Very significant levels of sterilization were obtained for all microorganisms after 1 min of treatment, corresponding to the processing rate of 5 L/min. The depth and rate of processing can be further improved by combining the high-amplitude ultrasound with short-wave ultraviolet radiation.

Why ISM's Ultrasonic Technology?

Prior to the introduction of ISM's Barbell Horn® Ultrasonic Technology, none of the existing industrial-scale ultrasonic processors could generate the high amplitudes required for efficient sterilization/pasteurization. ISM offers BHUT-based bench and industrial ultrasonic processors able to operate at extremely high amplitudes, making it possible to directly implement laboratory accomplishments in a production environment and guarantee reproducible and predictable results. Our equipment is compact and low-cost, needs little technical support and includes very few wetted parts.

Conclusions

High-amplitude ultrasound in combination with mild heat is a simple and effective technique for beverage sterilization/pasteurization, which does not suffer from side-effects of the traditional thermal treatment method. With the use of Industrial Sonomechanics' Barbell Horn® Ultrasonic Technology, the process is directly scalable and can be implemented in an industrial production environment using the ISP-3000 ultrasonic processor.

Consult with a product specialist or request a quotation.

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