APPLICATION REPORT

SCALABLE PRODUCTION OF NATURAL MUSHROOM EXTRACTS

Ultrasound-Assisted Extraction (UAE) From Mushrooms

Producing mushroom extracts is notoriously difficult due to the remarkable strength of the hyphae cell structures that must be disrupted to access the bioactive compounds contained therein [1, 2]. This difficulty is especially pronounced when attempting to use mild and green solvents, frequently resulting in low extraction yields and low productivity rates [3, 4].

Background

Mushrooms are a subject of extensive research within the nutraceutical and pharmaceutical sectors due to their significant therapeutic potential [5, 6]. They are rich in myriad valuable bioactive components, such as alkaloids, vitamins, lactones, polysaccharides, polyphenolic compounds, sesquiterpenes, sterols, and terpenoids, which can be extracted and incorporated into health-promoting supplements [5, 7]. In particular, psychedelic mushrooms have gathered significant attention in clinical research due to their potentially important therapeutic effects [8]. Psilocybin is a psychoactive alkaloid and one of the active ingredients found in psychedelic mushrooms [9]. Among various psychedelic substances, psilocybin is noted to possess the most favorable safety profile [8]. However, due to its chemical properties and sensitivity to traditional extraction methods, psilocybin extraction is known to be particularly challenging [8].

Traditionally, the extraction of bioactive compounds from mushrooms is carried out using methods such as Soxhlet and reflux, supercritical carbon dioxide (sCO2), and agitated organic solvent techniques [13]. However, these approaches are time-consuming, energy-intensive, expensive, have volume limitations, require large production spaces, and frequently utilize harsh organic solvents associated with safety, environmental, and target compound degradation risks [10, 11]. .

Ultrasonic Production of Natural Mushroom Extracts

Ultrasound-assisted extraction (UAE) has emerged as an alternative technique with a promise to overcome the limitations associated with traditional mushroom extraction methods [13]. As an effective physical method for disrupting hyphae cells, it exposes the bioactive compounds contained therein and maximizes the efficiency and rate of their removal, even when mild and green solvents are used [12, 13]. In addition, ultrasound-assisted extraction has been found to enhance the antioxidant and enzyme inhibitory activities of mushrooms compared to conventional extraction methods, indicating its potential to improve the overall quality of the extracted compounds [13]. Furthermore, ultrasound has been successfully applied in the extraction of polysaccharides from mushrooms like Volvariella volvacea and β-glucans from chaga mushrooms, demonstrating its versatility and effectiveness in extracting specific bioactive compounds efficiently [14, 15]. In the psychedelic space, ultrasound has been used to effectively extract hallucinogenic compounds from mushrooms [16].

Limitations of Conventional Ultrasonic Technology

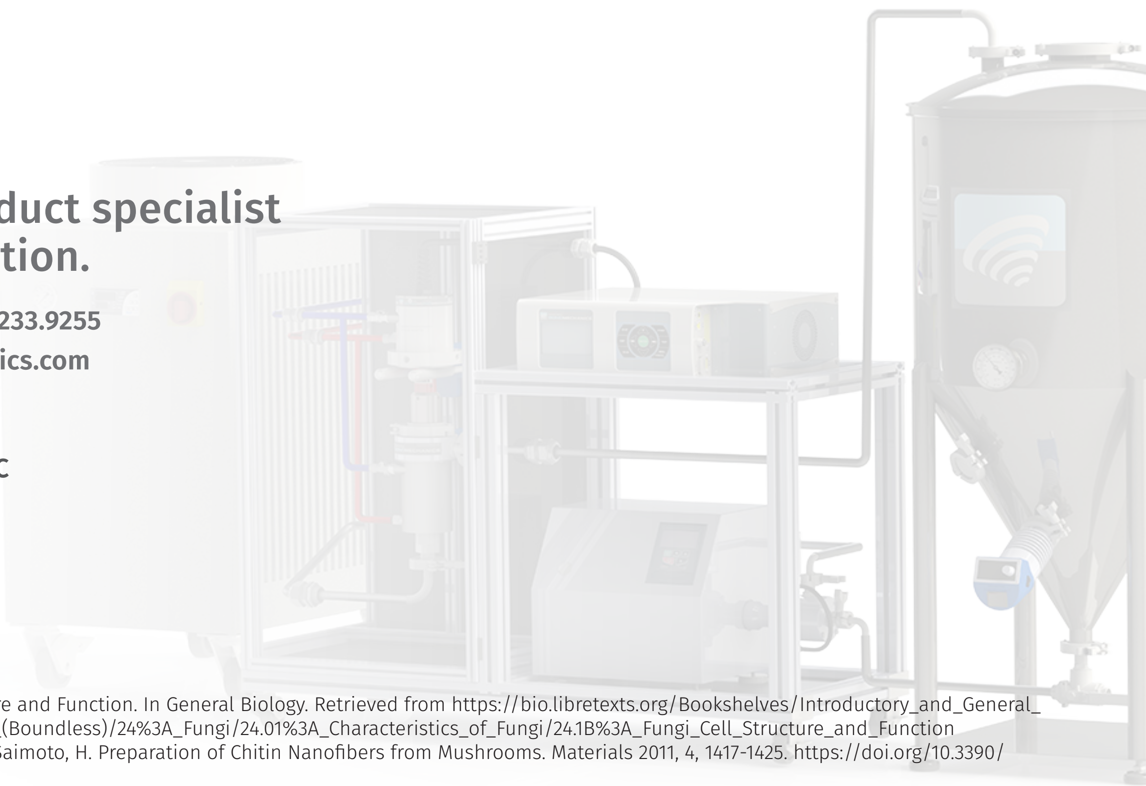
Until recently, ultrasonic processors faced a significant limitation - they were confined to laboratory settings due to their reliance on conventional ultrasonic horns. Studies show that high ultrasonic amplitudes are required in order to obtain adequate extraction productivity rates and yields [17, 18]. The main limitation of conventional ultrasonic horns, however, is their inability to generate the necessary high ultrasonic amplitudes and cavitation intensities on a large scale, rendering them unsuitable for commercial-scale extraction processes [19].

Why ISM's Ultrasonic Technology?

Barbell Horn® Ultrasonic Technology (BHUT) introduced by Industrial Sonomechanics® (ISM) in 2006 has resolved this issue by making it possible to increase the sizes of ultrasonic processors without losing the required high amplitudes [19]. ISM has been at the forefront of ultrasound-assisted extraction process and equipment development, offering commercial-scale, high-intensity ultrasonic extraction systems utilizing Barbell Horns®. Developed and patented [19] by ISM, Barbell Horns® enable the scaling up of the ultrasonic mushroom extraction process, providing a safer, more effective and economical approach compared to traditional methods. Barbell Horns® allow for the use of high-amplitude ultrasound to disrupt hyphae cell structures, thereby significantly enhancing the extraction efficiency and enabling the replacement of harsh organic solvents with milder, greener, and more economical food-grade alternatives, such as ethanol or water, while still achieving superior results.

ISM processors can be configured in both batch and flow-through modes, are able to operate continuously (24/7), and handle anywhere from a few milliliters to many hundreds of liters of material at a time. ISM flow-through systems' reactor chambers (flow cells) are designed without narrow gaps or capillaries, eliminating common clogging issues associated with alternative mushroom extraction equipment. The incorporated cooling jackets enable precise temperature control, making it possible to extract heat-sensitive substances. Water-cooled transducers are another essential part of ISM's IP portfolio and ultrasonic extractors [20]. Integrated into the BSP-1200 and ISP-3600 systems, they are fully sealed to the outside environment, making them immune to high-humidity conditions and suitable for working with flammable materials, such as organic solvents.

ISM ultrasonic processors are "plug-and-play" and are shipped mostly pre-assembled for quick and easy installation. ISM provides turn-key, automated equipment for a wide range of applications, and offers manuals, video guides, SOPs, remote installation assistance, as well as post-purchase technical and warranty support.



Consult with a product specialist or request a quotation.

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