

Effects of High Hydrostatic Pressure on Fungal Spores and Plant Bioactive Compounds

Subjects: Microbiology

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Fungi, and their spores, are responsible for the spoilage of several foods and plants and are susceptible to contamination with mycotoxins, which have associated health hazards. In this context, proper methodologies for inactivating such fungi and controlling mycotoxin production are critical. High-pressure processing (HPP) has recently become popular as a nonthermal alternative to conventional thermal pasteurization processes. Even though HPP can effectively eliminate some fungal spores, some species, such as those from the genera *Byssoschlamys*, *Talaromyces*, and *Aspergillus*, are quite resistant to this treatment. Additionally, high pressure can also be used as a cold extraction technique for bioactive compounds from medicinal plants and other matrices (termed high pressure-assisted extraction, HPE). With this method, safe use for food, cosmetic, and pharmaceutical applications is guaranteed. This method simultaneously works (depending on the applied pressure level) as an extraction technique and induces the pasteurization effect on the extracts. This encyclopedia entry aims to highlight the effects of nonthermal HPP on fungal spores, the prevalence of mycotoxins in plant materials and how high pressure can be used as an extraction technique to produce high-value cold pasteurized extracts with biological activity.

Keywords: fungi ; spores ; high-pressure processing ; mycotoxins

The consumption of natural products, especially those derived from medicinal plants and herbs, is increasing worldwide, as plants have been used since ancient times to prevent or treat maladies in both humans and other animals. These medicinal plants are rich in several compounds with biological activities that are beneficial for consumers, such as anti-inflammatory, analgesic, antioxidant, and antimicrobial activities ^{[1][2]}. These biologically active chemicals are derived from the secondary metabolism of plants or those produced when the plant is subjected to a stress source that triggers different metabolic pathways that will counteract the stress source with different compounds.

As these plants are usually grown in open fields, they are susceptible to several sources of contamination, such as insects, rodents, birds, and others, which can transmit plant diseases and damage crop health and development ^[3].

Spores from heat-resistant fungi (HRF) cause food spoilage and food-borne illness in pasteurized fruit juices, pulps, and concentrates, representing considerable economic losses for the food industry and a threat to food safety. In this sense, several strategies have been developed to ensure fungal spore destruction by means of chemical additives or by improving the traceability of the raw materials.

In addition to the animal and plant kingdoms, fungi include a broad range of eukaryotic microorganisms. The fungus kingdom includes yeasts, molds, mushrooms etc., with some having applications in the food, cosmetic and pharmaceutical industries ^[4]. Interestingly, fungi and human health regulation are concurrently linked, as high-fat diets are associated with changes in gut fungi, which can play a key role on the development of obesity and gut inflammation, even though fungi involved in this process represent less than 1% of the human gastrointestinal tract ^[5].

However, certain fungi present a risk to the industry since they can be a source of contamination for meals and value-added products, such as bioactive-rich plants ^[6]. For example, dried tea leaves and medicinal plants may contain different types of microorganisms and their toxins, especially those from fungi, and contaminate food products and extracts originated from contaminated plants, consequently raising, food safety issues ^[7]. Even though the presence of mycotoxins (in very low concentrations) in dried plants is normal, the presence of several mycotoxins in the same plant materials is considered a major concern, as it is reported to have a synergistic effect in toxicity between mycotoxins when compared to the individual mycotoxins, i.e., the toxicity effect of two mycotoxins in plant materials is higher than the sum of the individual toxicity levels of each individual mycotoxin ^[8]. In legal terms, Europe and Malaysia typically have the most restrictive limitations on the maximum concentration of mycotoxins in foods and products, followed by the United States, which requires extremely stringent agricultural practices to ensure such low levels ^[9].

This encyclopedia article aims to provide a concise summary of fungal spores in plants and how they can impact the quality and availability of bioactive compounds extracted from such plant materials. This points to the methodological application of high-pressure processing (HPP) simultaneously as a nonthermal pasteurization methodology to destroy vegetative fungi and some fungal spores, as well as an extraction methodology of bioactives from medicinal plants.

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