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## Crustaceans vs. Mushroom: A comparison of chitin isolation using green chemistry methods

**Abstract:**

Due to abundance and renewability, much of the research is based on polysaccharide materials prepared from renewable semi-crystalline biopolymers, such as chitin. Chitin is a linear natural polysaccharide found in the exoskeletons of crustaceans, the protective tissues of invertebrates, and mushrooms. Fungi and mushroom sources have recently increased in importance for the extraction of 'vegan' chitin because they can be derived from non-animal sources and are free from potential allergenic proteins. In addition, mushrooms can be cultured specifically for chitin production and provide a year-round supply. Fungal chitin is not limited by seasonal and regional variation, contrarily to crustacean chitin. In addition, biowastes can be considered inexpensive as they can be reused to cultivate the fungi. Their growth is conducted under controlled conditions with no need for sunlight. Mushrooms can be cultured by stacking on a minimal land area and growing in 2 – 3 weeks, whereas crustaceans require ~12 months (growth model of Litopenaeus vannamei). This fast growth rate can balance out low chitin yield per wet weight of fruit body compared with that for crustaceans. Harnessing fungal chitin is not without some challenges. The chitin yield per wet weight of mycelium or fruit body is relatively low compared with the animal-based counterpart. The major perceived obstacle discouraging researchers from working with fungal chitin has been the presence of glucans, and the isolation of chitin-glucan complex (CGC), where glucans are covalently attached to the polymer. This presentation will discuss the isolation of chitin from mushroom biomass. A special emphasis will be given to the characterization of chitin with a discussion of the challenges still to be met in the characterization of chitin from fungal sources. We advocate in this presentation that the accurate determination of properties of fungal chitin is essential and should be presented in every paper, as these properties influence the polymer properties and determine the polymer's biological activity. While the literature demonstrates few methods for the separation of chitin and glucans there is often inadequate characterization of its purity and properties making it unclear to understand whether the native properties of the material in the course of chitin isolation are preserved. Specifically, the presentation will show the chitin extraction from three different mushrooms – white (Agaricus bisporus), shitake (Lentinus edodes), and oyster (Pleurotus ostreatus) using four different methods: 1. traditional pulping (using NaOH), 2. extraction with 1-ethyl-3-methylimidazolium acetate ionic liquid (IL), 3. pulping with 1-butyl-3-methylimidazolium hydrogen sulfate, and isolation using deep eutectic solvent system (DES, [Cho]Cl – Lactic acid). A further focus is on the characterization of this polymer to identify different properties and purity. Finally, we will conclude whether it is required to separate the chitin and glucans, or CGC can be used directly for materials' preparation.

## Biography

**Julia Shamshina,** After gaining relevant experience during her PhD (2008, Organic Synthesis) and postdoctoral studies (2010, Analytical Chemistry) at The University of Alabama, She joined a small business company Streamline Automation, LLC (Huntsville, AL), where She was working on development and commercialization of advanced technologies for the aerospace and defense markets. The research was supported by the US Air Force, Army, and NASA. She is a recipient of a NASA Tech Brief Award for my work on replacement of hydrazine fuel with energetic ionic liquids (2011). In 2012, She joined the start-up company 525 Solutions, Inc., as a Chief Scientific Officer (CSO). She developed the company's technological backbone 'from the ground up', provided technical leadership, and ensured the implementation & commercialization of many technological solutions based on ionic liquids and applicable in biotechnology, pharmaceutical, and materials fields. At 525 Solutions, Inc. She was heavily involved in fundraising efforts from federal, foundation, and corporate sources (ca. ~70 proposals, ~$5M in funding). In 2016 — 2017, She went to Canada (McGill University, Department of Chemistry), as an Academic Associate in Green Chemistry where She was responsible for the projects related to the design and development of new products from renewable polymers. The nature of my assignment at McGill was to bridge the academic and industry environments, to bring academic innovation to commercialization. She worked with federal and industrial sponsors (US Air Force, Monsanto USA, Novartis USA). In 2017, She joined Mari Signum Mid-Atlantic, LLC where She was in charge of the development of marketable, patentable concepts involving chitin polymer. She is recipient of the American Chemical Society Green Chemistry Challenge Award Focus Area 2, Greener Reaction Conditions for "A Practical Way to Mass Production of Chitin: The Only Facility in the U. S. to Use Ionic Liquid-Based Isolation Process". Mari Signum was sold to Ross Group PLC in 2019. In 2021, She joined Fiber and Biopolymer Research Institute (FBRI) at Texas Tech University as a Research Assistant Professor, and just recently (November 2022) transitioned to the Assistant Professor position. Her current research interests focus on all aspects of biopolymer processing, from fundamental properties to overall material preparation to industrial applications. She particularly interested in potential industrial uses of biopolymers in high-value materials, with the ultimate goal of finding alternatives to synthetic plastics in multiple applications.

**STATISTICS:** Refereed Publications: 94 Book Chapters: 13; books edited: 1 Citations; h-Index; i10-index: > 5300; 40; 80 Patents and applications: 20 Presentations (including collaborators) before National, International and Regional Meetings: 95