OPEN ACCESS Freely available online

ISSN: 2157-7110
Journal of Food Processing & Technology

Opinion Article

# Enhancing Pectin Yield and Quality through Modern Extraction Techniques in Food Industry

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## DESCRIPTION

Pectin a natural polysaccharide primarily found in plant cell walls, particularly in fruits, possesses unique crystallizing properties that make it indispensable in the food industry. Apart from its culinary applications, pectin is also utilized in pharmaceuticals and cosmetics due to its biocompatibility and versatility. Traditionally sourced from citrus peels and apple pomace by-products of the juice and cider industries pectin extraction is now evolving. There is growing interest in extracting pectin from other food processing wastes and by-products to enhance cost-effectiveness and environmental sustainability in production methods.

### Innovations in extraction techniques

**Enzymatic extraction:** Enzymatic extraction is increasingly favoured as an eco-friendly approach to extracting pectin. Using enzymes like pectinase, cellulase, and hemicellulase, this method effectively breaks down plant cell walls to release pectin. It operates gently, maintaining the functional qualities of pectin while minimizing by-product formation. Its environmental advantages and potential for increased yields make enzymatic extraction a compelling choice for sustainable pectin manufacturing.

**Microwave assisted extraction:** Microwave Assisted Extraction (MAE) uses microwave energy to heat plant materials, causing cell wall disruption and facilitating pectin release. MAE significantly reduces extraction time and solvent usage, making it an efficient method. Recent studies have optimized MAE parameters, such as microwave power, extraction time, and solvent concentration, to maximize pectin yield and quality from various food processing wastes.

**Ultrasonic assisted extraction:** Ultrasonic Assisted Extraction (UAE) employs ultrasonic waves to create cavitation in the solvent, enhancing mass transfer and cell wall disruption. UAE has proven effective in increasing pectin yield and reducing extraction time. Combining UAE with other techniques, such as enzymatic treatment or MAE, has shown synergistic effects, further improving the efficiency of pectin extraction processes.

**Utilization of green solvents:** The shift towards sustainable processing methods has led to the exploration of green solvents for pectin extraction. Ionic liquids, deep eutectic solvents, and supercritical fluids have been investigated for their efficacy in extracting pectin from food wastes. These solvents offer advantages such as low toxicity, biodegradability, and recyclability, aligning with the principles of green chemistry and providing a sustainable alternative to traditional solvents.

### Applications of extracted pectin

**Food industry applications:** In the food industry, pectin serves multiple roles: it acts as a gelling agent in jams and jellies, a thickener in dairy products, and a stabilizer in beverages. With growing demand for natural and clean-label ingredients, there is increasing interest in pectin sourced from unconventional sources. Pectin derived from food processing waste can effectively meet this demand, promoting sustainability through waste reduction and the use of renewable resources.

**Pharmaceutical applications:** Pectin's biocompatibility and biodegradability make it suitable for pharmaceutical applications. It is used in drug delivery systems, wound dressings, and as an excipient in tablets. Pectin from food waste offers a cost-effective alternative for these applications, with the added benefit of being derived from renewable resources, thus promoting sustainable practices in the pharmaceutical industry.

**Cosmetic industry applications:** In the cosmetics industry, pectin is used as a thickener, emulsifier, and stabilizer in products such as lotions, creams, and shampoos. The trend towards natural and organic cosmetics has spurred interest in pectin from sustainable sources. Valorizing food processing waste for pectin extraction aligns with this trend, providing an eco-friendly ingredient for cosmetic formulations and enhancing the sustainability profile of cosmetic products.

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**Received:** 28-May-2024, Manuscript No. JFPT-24-26360; **Editor assigned:** 31-May-2024, PreQC No. JFPT-24-26360 (PQ); **Reviewed:** 14-Jun-2024, QC No. JFPT-24-26360; **Revised:** 21-Jun-2024, Manuscript No. JFPT-24-26360 (R); **Published:** 28-Jun-2024, DOI: 10.35248/2157-7110.24.15.1111

**Citation:** Rai S (2024) Enhancing Pectin Yield and Quality through Modern Extraction Techniques in Food Industry. J Food Process Technol. 15:1111.

The valorization of food processing waste and by-products for pectin extraction represents a potential approach for sustainable production. Advances in extraction techniques, such as enzymatic, microwave-assisted, and ultrasonic-assisted methods, have improved the efficiency and environmental impact of pectin extraction processes. Utilizing green solvents further enhances the sustainability of the extraction methods. The extracted pectin finds applications in various industries, contributing to the circular economy and reducing waste. However, challenges related to standardization, economic feasibility, and regulatory approval need to be addressed to fully realize the potential of this approach. With continued investigation and innovation, the valorization of food processing waste for pectin extraction can play a significant role in promoting sustainable industrial practices and contributing to a more sustainable prospect.