Title: Production characterization of pectin extracted from pomegranate and dragon fruit peel:A comparative study

Introduction

Pectin is a viscous and soluble fiber that is mainly composed of galacturonic acid units conjugated to other sugars . This natural polymer offers a wide range of benefits across numerous industries due to its unique mechanical properties. Pectin is essential in gelling, thickening, and stabilizing solutions, which are vital factors in the food, pharmaceuticals, and cosmetics industries . For example, in processing jams, jellies, and fruit preserves, pectin is used as a gelling agent to provide the added consistency and texture . In yogurts and excited dairy drinks, pectin is used to make a thick and smooth paste . Dairy products, beverages, salad dressings, and dressings benefit from the physiological buffering provided by pectin, which mitigates phase separation and extends the shelf life of the final product. Struggling with limited sustainability and accessibility, the conventional pectin sources, particularly citrus fruits and apple pomace, cannot meet the surging needs for the current output. Meanwhile, notable efforts have been made to identify alternative sources of pectin, with fruit peels commonly being overlooked as waste. Among the newly discovered sources, pomegranate and dragon fruit peels have become popular owing to their fundamental nutrients and substantial bioactive compounds that include pectin . Relying on the identified by-products secures the recovery of valuable items and alleviating the environmental issues related to discard. In conclusion, extraction and characterization of pectin from pomegranate and dragon fruit peels are feasible approaches to sustainable resource consumption and value addition. Innovative extraction methods such as enzymatic hydrolysis and microwave-assisted extraction allow pectin isolation from fruit peels with high energy efficiency and minimal process waste. Moreover, the results of characterization studies, such as chemical composition and molecular weight distribution and rheological properties, enable judgments on the quality and efficacy of the pectin recovered. Moreover, the knowledge of the structural and other differences in composition of pectin obtained from diverse fruit peels makes it possible to apply pectin more efficiently and with regard to the type of its origin. This can be exemplified by the gelling ability variations of pectin obtained from the peels of pomegranate and dragon fruit. Depending on the purposive use of pectin, such variation in gel-making property may make it more or less suitable for diverse types of certain food, fruit, or pharma-system protection, stabilization, isolation or a range of other uses. Therefore, based on

these findings and further refining pectin extraction technologies, scientists can realize the full potential of fruit-based pectin as a source of multifunctional, sustainable and cheap raw material for a multiplicity of applications.

Therefore, this research proposal seeks to bridge this gap through a comparative study on the production and characterization of pectin extracted from pomegranate's and dragon fruit's peel. This study will further offer critical details on the outcome of optimized extraction methods, characterization of the resulting extracted pectin, and the assessed activities through which functional properties of the pectin can be projected to the prospective applications.

Literature review

The extraction of pectin from pomegranate and dragon fruit peels has also attracted the researchers' attention. The most recent studies were concentrated on the optimization of the extraction procedure and further characterization of the obtained pectin. Abid et al. (2016) used the central composite design to assess the effect of the extraction conditions upon the yield and composition of pomegranate peels pectin. Tien et al. optimized the extraction of pectin from dragon fruit peels with the combination of microwave-ultrasound-assisted extraction with the natural deep eutectic solvents . Another similar research was conducted by Chua et al. (2020) and was associated with the optimization of the dragon fruit peels waste to pectin production. The stages of drying, extraction, and characterization were used. Additionally, Haque (2023) combined Box–Behnken design with response surface methodology to optimize pectin extraction from fruit peels, which includes pomegranate peels. Moreover, Listyarini et al. (2020) analyzed the pectin extraction from dragon fruit peel with HCl solution, which yielded 11% pectin. Thus, all of these studies contribute to the relevant extraction techniques and the potential of pomegranate and dragon fruit peels as alternative sources of pectin. Abid et al. (2017) also studied the chemical characteristics of pectins extracted from pomegranate peel, which allowed them to evaluate their gelling properties. In addition, Tien et al. analyzed the physicochemical characteristics of dragon fruit peel pectin extracted by natural deep eutectic solvent with a microwave-ultrasound approach.

In conclusion, research associated with the production characterization of pectin extracted from pomegranate and dragon fruit peels emphasize the efforts of optimizing methods of extracts, the chemical composition of the extracted pectin, and the production characterization of its properties. Conducted studies help in the accumulation of a solid scientific foundation in the directions related to the use of fruit-peels wastes as a promising source of pectin with the use of a significance of benefits for industrial purposes.

Methodology:

Sample collection and preparation: The fresh peels of pomegranate and dragon fruit will be obtained from the ripe fruits. The collected samples will be cleaned thoroughly, dried, and powdered finely. The powder serves as a good source of pectin as homogenization is aided and made easy for the optimal conditions.

Optimization of extraction parameters: Several extraction methods will be carried out for the optimum extraction of pectin from the fruit peels, such as hot acid, microwave assistance, and enzymatic extraction, and other parameters include temperature, pH, and scanning time, and solvent concentration The extracts obtained have variable properties with different structural reactions.

Characterization of extracted pectin: The extracted pectin will be characterized thoroughly to identify its elemental properties and functional activities. The chemical structure and the properties will be characterized by using Fourier-transform infrared spectroscopy , nuclear magnetic resonance spectroscopy , size exclusion chromatography , rheological analysis , etc. The molecular weight and function of the extracts will also be elucidated.

Evaluation of functional properties: The pectin isolated based on the pomegranate and dragon fruits will be worked on its functional properties specifically water insoluble capacity and destabilization in varying conditions drugs to evaluate its potentiality.

Statistical analysis: The results obtained are statistically calculated for the effective correlation between the isolated pectin based on fruits. Suitable tests performed will be ANOVA. Thus, the

two pectin's yield extracts from fruit peels is compared and studied with other fruit based pectin for work potential.

Objectives:

- Optimizing the extraction potential of pomegranate and dragon fruit peel pectin from various extraction methodology.
- Characterizing pectin sedimentation aspect like molecular weight, DE, viscosity, and gelling characteristics from each origin.
- Determination of functional behaviour like water holding capacity, emulsifying activity, and emulsion constancy of pectin extracted from pomegranate and dragon fruit peel .
- Study on potential utility in food such as imitative jams , jells, pharmaceutical and cosmetic application etc.

Expected outcomes:

- The optimal conditions for pectin extraction from pomegranate and dragon fruit peel will be identified
- Pectin from both sources could be yielded and compared in terms of their quality and quantity.
- It is possible to fully characterize pectins extracted, discover physicochemical and functional properties.
- Potential application for pectins of pomegranate and dragon fruit peel in various branches of industry.

Significance of the Study:

Thus, the impact of the current study on the utilization of fruit peels as sustainable sources of pectin is substantial. It will help to address the issue of waste reduction and enhance environmental sustainability. The extraction of pectin from pomegranate and dragon fruit peel and its comparison will offer knowledge on the difference between the sources . As a result, it will allow for targeted sources selection for various needs to ensure maximum utilization of resources. In addition to that, the study results can align innovation in the development of food,

pharmaceutical, and cosmetic production. It will secure the competitive advantage and sustainability of the industries from the business sector and help to additionally address economic and environmental goals.

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