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A Review of Pectin from Muskmelon Peel and Addition of Pectin to Jam

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ABSTRACT: Pectin is a widely used ingredient in the food industry as well as the pharma industry. Pectin exhibits exceptional characteristics of gelling and texture maintaining agent in several food products. Pectin is found widely in several agricultural products such as banana, orange, muskmelon, okra pods and several other fruits and vegetables. Though several extraction techniques exist, the growing demand in the food industry calls for much more efficient techniques and source materials. The study attempts to review the extraction process of pectin from muskmelon peel and the use of pectin and its characteristics as an ingredient in jam. The studies reveal that pH, temperature, and time based on the extraction technique and solvent have a great impact on the yield. Pectin also exhibits good colour and texture retention properties as an additive in the food industry. Finally, this study attempts to reduce, reuse and recycle the fruit wastes and incorporate it in the food industry (Jam, Jelly, Squash).

KEYWORDS: Pectin, Extraction, Muskmelon peels, microwave assisted extraction

I. INTRODUCTION

One of the major issues that plagues the food industry is the humongous quantity of food wastes produced as a by-product of food processing. Reuse and recycling of such food industry wastes is gaining prominence in this decade. Pectin extraction is one such widely known reuse of food wastes such as fruit and vegetable peels. Pectin is a complex heteropolysaccharide present in the peels and skins of the higher plants. It is being used in the food processing industry as a texturiser, stabiliser, gelling agent, and fat substitute in many food products. The recent advancements in the food industry has spiked the demand for pectin as a food additive and calls for more efficient extraction techniques and identification of better sources of pectin. Factors such as pH, temperature, solvents used, Salting out temperature coupled with the heating technique such as microwave or conventional methods influence the yield of pectin.

II. LITERATURE REVIEW

Kumar et al [1] in 2020 discussed the trends in pectin extraction and application of pectin in food packaging. Much emphasis is given to functionalization of pectin for enhancement of microbial properties. A combination of innovative methods for extraction would yield pectin with distinct features and bioactivity.

Daniel Casas [2] et al in 2016 presented the process for extraction of pectin from orange peels. The author presented the size and schedule of a plant for 348 ton/year production of pectin. Optimal conditions used were a temperature of 90°C for 75 minutes and a pH of 1.5. The process included acid hydrolysis of orange peels, filtration system for hydrolysed suspension, alcoholic precipitation of pectin, gel pressing, drying and size reduction. Out of phase hydrolysis stages were used to eliminate characteristic dead times in precipitation process. Rheological analysis also was used which helped in realistic estimation of energy demands and cycle time.

Yi Chen [3] et al in 2014 studied the pectin extraction optimization using statistical analysis. The researcher used RSM (Response surface methodology) for optimizing extraction of pectin from Okra pods. Steady shear and oscillatory rheological measurements were used to investigate the extracted pectin. The pectin yield is based on the extraction parameters. The research team suggested the optimal conditions of pH of 3.9, 64 min extraction time and a 60°C temperature. A liquid solid ration of 42:1 was maintained. The extracted pectin displayed non-Newtonian shear thinning and could be well defined by Cross model.



Seyed Saeid Hosseini et al [4] in 2016 presented a microwave extraction technique for pectin from sour orange peel. The author employed Box-Behnken design to study various parameters. pH of 1.50, Microwave power of 700W and 3 minutes irradiation time produced a 29.1% optimal yield of pectin. At low concentrations, the extracted pectin showed Newtonian flow like behaviour but changed to pseudoplastic flow as concentration increased. The pectin obtained was low on methoxyl with DE values from 1.7% to 37.5%.

Joye DD et al [5] in 2014 studied the selective extraction of pectin from sources of plant materials. Calcium sensitive pectin (CSP) and non-calcium sensitive pectin (NCSP) have been accepted commercially. The author describes the process for selective extraction of NCSP and CSP using solutions of different pH. A pH of 3.0 and 3.3 was sufficient for NCSP extraction while CSP required a stronger acid with a pH of 2.0.

Minjares-Fuentes et al [6] in 2014 studied a RSM approach to extract pectin using ultrasound assistance. The research team used grape pomace as the source material. Box-Behnken design was used by the researchers for the study. An optimal temperature of 35°C to 75°C with 20 to 60 minutes of extraction time and a pH of 1.0 to 2.0 produced high yield with high average molecular weight and DE. Quadratic model had an impact on MW while the linear model was influential on DE of pectin. The experimental results and analytical studies produced similar results suggesting that ultrasound assisted extraction is an optimal process for pectin extraction from grape pomace.

Saritha G et al [7] in 2015 studied the pectic principles from mango processing waste. Preparation of mango puree in fruit processing industries generates huge quantities of mango peel, stone, and fibre. The research team studied the effects of different energy levels of microwave on yield, methoxyl content, galacturonic acid and viscosity of the extracted pectin. A 1000W microwave energy for 20 minutes produced maximum yield of pectin. Extended duration of heating led to a reduction in methoxyl content and galacturonic acid. Microwave extraction was found to be beneficial under controlled conditions.

Fernanda L et al [8] in 2013 presented the extraction process of pectin from passion fruit peel. Pectin is an extremely important raw material in the pharma and food products. The author used three acids namely tartaric acid, acetic acid, and nitric acid as extracting agents. The researcher has used response surface methodology to study the effect of microwave and extraction time on pectin yield. Under different conditions, 628W and 9 min of microwave produced the highest yield. Tartaric acid was found to be the most effective extracting agent with a yield of 18.2% but the pectin displayed lower purity and DE.

Jittra Singthong et al [9] in 2004 studied the gelling properties of Cissampelos pareira pectin. Galacturonic acid was a main component with traces of neutral sugar. The Krueo Ma Noy pectin had a degree of esterification of 41.7 with a molecular weight of 55kDa and viscosity of 2.3dl/g. The author states that the pectin exhibited good gelling properties in a 0.5% (w/v) aqueous solution at 5°C. The properties of pectin such as gel strength increased with polysaccharide concentration.

Banerjee et al [10] in 2017 in his study suggested that fruit by-products are sustainable sources of polysaccharides and antioxidants. Melon peels were extracted through hypothermal processing. The effect of temperature on the composition of extracted components was studied. matrix assisted laser desorption/ionization-time of flight mass spectroscopy (MALDI-TOF MS), Fourier transform infrared spectroscopy (FTIR) and high-performance anion exchange chromatography with pulsed amperometry detection (HPAEC-PAD) were used to characterise the extracted liquor.

Raji Z et al [11] in 2017 studied the physiochemical properties of pectin extracted from melon peel. The author has used acidic extraction using citric acid for pectin extraction. The study involves a central composite design (CCD) to study the impact of temperature, time and pH on yield and DE. Rheological experiments were used to evaluate pectin dispersions. The results showed that the dispersions had a weak gel behaviour at 1%w/v concentration. Emulsion stability increased at 4°C than at 23°C.

Muthukumar et al [12] in 2017 discussed the extraction of pectin from muskmelon. The author suggests that plant derived pectin is an economical and eco-friendly extract. The research team uses response surface methodology (RSM) and Box-Behnken Design (BBD) to identify optimal conditions for extraction. Multiple regression analysis produced a second order model equation with the correlation coefficient (R²) value of 0.92 for pectin extraction. ANOVA results revealed that the temperature and pH had a great impact on the efficiency of extraction.



Naqash F et al [13] in 2017 reviewed the Emerging concepts in the nutraceutical and functional properties of pectin. Pectin can be applied in the food industry as a gelling agent, stabilizer, and fat replacer. On the pharma side, pectin is capable of decreasing blood fat and fighting cancer. The study provides insight into the growth of pectin into progressive applications and the advancements in its productions. Pectin plays the role of a nutraceutical and medium for delivery of probiotics. Its applications in food industry are widely known. Pectin is also used as a biopolymer in packaging.

Adetunji L.R et al [14] in 2017 discusses the advancements in pectin extraction techniques. The heteropolysaccharide pectin has several functional and nutritional applications in the food industry. Though the available extraction techniques are well established they are not sufficient to provide to the growing demand. Several studies indicate that microwave and ultrasound energy are able to provide considerable yields. Enzymatic-augmentation and use of subcritical water instead of acidified water as a solvent are other known processes. The study reviews the parameters involves in the use of non-conventional extraction techniques.

Babbar Net al [15] in 2015, has reviewed the different facets of pectic oligosaccharides (POS). Pectin containing agricultural products will produce oligo-galacturonides (GalPOS), galacto-oligosaccharides (GalOS), rhamnogalacturonan-oligosaccharides (RGOS), etc. under controlled hydrolysis by chemical enzymatic and hydrothermal. The chemical structure of POS is also discussed in the paper.

Korish M et al [16] in 2015, discussed the effect of changes in extraction parameters such as pH, temperature, and time on pectin yield. The supply material used in the study was *Colocynthoides* waste. The structure of the extracted pectin was also studied revealing the presence of galactose, arabinose and rhamnose. Traces of Glucose, xylose and mannose were also found.

Kratchanova M et al [17] in 2004 studied the effect of microwave heating on pectin extraction from orange peels. Electron microscope scanning revealed that microwave heating destroyed the parenchymal cells. Also, water absorption capacity and endogenous enzymes were inactivated due to microwave. This development makes pectin extraction feasible. Use of microwave pre-treatment also improved the quality of pectin.

Md Zohurul Islam et al [18] in 2012 studied the Effect of Pectin on the processing and preservation of Strawberry jam and jelly. Different concentrations of pectin in strawberry jam and jelly were studied for dissipation from processing to storage. Jam and Jelly were prepared with 0.5%, 1.0% and 1.5% pectin. Potassium metabisulphite was used as preservative. It was observed that no significant change was deducted up to 6 months. Products containing 1.5% pectin were voted best by a panel of 10 members.

Mirela Kopjar et al [19] in 2009 studied the influence of pectin on jam colours. Any preserved food products need to maintain a good colour and texture. The anthocyanin content and phenol content were found to be high in jams prepared with methoxy amidated pectin which decreased after storage of 4 to 6 weeks. Free radical scavenging activity also decreased during storage. As far as the texture parameters are concerned, namely firmness, consistency, and cohesiveness, high methoxyl pectin was found to provide better textures.

Mariana-Atena Poiana et al [20] in 2013 studied the antioxidant property and colour quality of blackberry jam added with different pectin. Traditionally prepared blackberry jam was used for the study and mixed with different commercial pectin such as HMP, LMP and LMAP at three different concentrations of 0.3%, 0.7% and 1.0%. The type of pectin and its level of dosage greatly influenced the properties of the jam having a direct impact on processing and storage. Best colour retention and TMA was achieved by LMAP addition. The retention of bioactive compounds and jam colour stability were strongly dependent on the pectin type and dosage. By a proper selection of pectin type and dose could be limited the losses recorded in response to processing and storage.

Wang W et al [21] in 2016 compared ultrasound assisted extraction and conventional heating methods for extraction of pectin. Ultrasound assisted extraction exhibited a lower molecular weight but higher concentrations. Also, methoxylation degree was lesser with higher acetylation. FT-IR and NMR spectra analysis revealed that the chemical structure of pectin extracted using ultrasound or conventional methods were same. Antioxidant property and lipase inhibitory capability of UP significantly improved compared with CP.



Wikiera A et al [22] in 2016, made a comparative study of Endo-xylanase and endo-cellulase-assisted extraction of pectin from apple pomace. The researcher commented that it was necessary to degrade xylans for higher efficiency of pectin extraction. Use of 50 U endo-xylanase per gram apple pomace provided a considerable efficiency of 19.8% pectin extraction. Use of 50 U endo-cellulase per gram apple pomace yielded 15% extraction. It was also found that an interlink between cellulase and xylanase decreases pectin extraction efficiency. Also, the characteristics of pectin differed based on use of cellulase or xylanase.

Yeoh S et al [23] in 2008, compared different water-based extraction techniques for pectin. The researchers studied different solvent systems at different pH levels and time using both microwave and conventional methods. The source material used was orange peels which yielded high amounts of pectin at a pH of 1.5. A solvent system with mixture of ethanol and EDTA for an extraction period of 15 minutes and a pH of 1.5 yielded double the amount of pectin extracted using distilled water.

Zhang W et al [24] in 2015 reviewed the impact of pectin as a cancer therapy dietary supplement. Pectin has been used in the food industry for a long period for its gelling properties and texture characteristics. It is also important to understand the application of pectin as an anti-cancer dietary mechanism. The author discussed the structural properties of modified pectin. It was found that pectin was effective as an Anti-cancer mechanism and a drug vehicle.

Qui L et al [25] in 2010, investigated the combined effect of several key factors such as pH, temperature, time, and solvents on the extraction of pectin from banana peel. Response surface methodology was used by the researcher. The research results suggest that temperature and period had the greatest impact on extraction rate. The author suggests optimum extraction conditions such as pH of 1.5, temperature of 85.5 °C with a time of 2 hours and a 70°C salting out temperature.

III. CONCLUSIONS

The reviews exhibit that similar to several other plant sources, Muskmelon is also an effective source of pectin and can yield pectin with good structural properties. A few of the factors to be noted in pectin extraction are listed below.

- More efficient pectin sources from food processing wastes must be studied and extraction processes must be documented.
- Factors such as pH, temperature, time and salting out time have a great impact on the yield of pectin.
- Heating techniques such as ultrasound assistance and microwave heating were found to be more beneficial than conventional techniques.
- The gelling properties of pectin is well documented and can be used effectively with Jam as it is known to retain the colour and texture of the product up to a shelf period of six months.
- It has been observed that response surface methodology (RSM) and Box–Behnken Design (BBD) are more widely used by researchers to study pectin extraction.

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