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Synthesis of Pectin from Waste Lemon Peels

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ABSTRACT

Citrus peels contain cellulose, hemicellulose, lignin, pectin (galacturonic acid), chlorophyll pigments and other low-molecular weight compounds. Lemon peels contains 25-30 % of pectin on dry basis. Both fruit peels have germicidal, antioxidant and anticarcinogenic properties and thus may be effective against breast and colon cancers, skin inflammation, muscle pain, stomach upset and ringworm. Extraction of pectin from citrus fruit peels like Orange peels, sweet orange and lemon gives higher yield of pectin. % Yield and rate of extraction for pectin from lemon peels depends on parameters such as pH, temperature, solvent, time of extraction. Extraction carried out at pH 1.5, 2 and 2.5 at 60 min with 60,70 & 80 ^{O}C temperature. The higher yield of pectin at pH value 1.5 and contact time 60 min. The yield of pectin at various pH with HCL with extraction time 60 min and temperature 80 ^{O}C. Extraction carried out at pH 1.5, 2 & 2.5 at 60 min with 80 ^{O}C temperature. Experimental analysis shows higher yield of pectin extraction time 60 min and 1.5 pH. At optimum value of all parameters the % yield 28, 25 and 22 for pH 1.5, 2 and 2.5 resp. by using HCL and Acetic acid as an extraction solvent resp. By experimental analysis using the yield of pectin at various pH with HCL with extraction time 60 min and temperature 80 ^{O}C. Extraction carried out at pH 1.5, 2 & 2.5 at 60 min with 80 ^{O}C temperature. Experimental analysis shows higher yield of pectin extraction time 60 min and 1.5 pH. At optimum value of all parameters the % yield of pectin 28 % by HCL.

Keywords – Extarcion Pectin, Lemon Peels, Hydrochloric Acid and Nitric Acid, Ethanol, Extraction-Precipitation and Drying.

INTRODUCTION

Pectin is a family of complex polysaccharides that contains 1, 4-linked x and β galactosyluronic acid residues was extracted using alcohol precipitation method from peels of oranges. The results showed that the color of pectin from orange peel was pale yellow. Pectin is soluble in hot and cold alkaline water. Pectin can be used to improve the mouth feel and the pulp stability in juice-based drinks and as a stabilizer in acidic protein beverages. Pectin also reduces syneresis in jams and marmalades and increases the gel strength of low-calorie jams. Pectin is used in confectionery jellies to give a good gel structure and a clean bite. Pectin is a natural, biocompatible, biodegradable and renewable polysaccharide use as an emulsifier, gelling agent, glazing agent, stabilizer and thickener. Orange peels are a major commercial source of pectin. India is one of the large production countries of orange is about 2.64 millions/year. In Maharashtra Nagpur region is well known in central Asia to produce and market hub for orange. It is also known as the California of India

producing excellent quality oranges in large number. [1]

Classification of Pectin

1.High Methoxyl Pectin (HMP)

HMP need the presence of a high concentration of solids (> 55%) before they can gel, with sucrose used mainly for commercial pectin. HM pectin to sweetened products.

2. Low Methoxyl Pectin (LMP)

LMP can gel in the existence of divalent cations usually calcium. Gelation is due to the arrangement of intermolecular junction zones between homogalacturonic smooth regions of different chains. The arrangement of junction zone is normally attributed to the so called 'egg box' binding process. LMP with a blockwide distribution of free carboxyl groups are very sensitive to low calcium levels. They do not require a low pH, but gel at a pH range of 2-6.

Objective of Study

1. To Study the various Methods of Pectin.

2. Synthesis of pectin from lemon Peels.

3. Find out effect pH and temperature on yield of Pectin by experimental analysis.

4. Find out effect of different parameters on yield of Pectin.

2. LITERATURE REVIEWS

The sweet orange peels are good source of orange oil and pectin and does have the potential to become important raw material for food processing industries. The maximum pectin yield is 52.90%. pH is considered as one of the more crucial parameters affecting the amount and properties of extracted pectin. Pectin yield decreased with increasing pH, highest being 52.90% at pH 1 and 60-mesh size. [1] **Lemon peels converted into the powdered form utilized** for extraction of pectin. Pectin extracted with different combinations of Ultrasound Power 60, 80 and 100 %, citric acid concentrations (pH: 1, 1.5 and 2) and extraction time 10, 20 and 30 minutes. Highest pectin yield of 20.92% attained at Ultrasound power of 100 %, [3] **Experimental study on extract pectin from peel waste of variety of citrus fruit namely lemon (Citrus lemon) and the effect of processing conditions on the process of extraction.** Pectin was extracted using nitric acid at three different temperatures (40 °C, 60 °C and 80 °C) and PH (1.0, 2.5 and 4.0). Experiments carried out in water bath for two hours. The variety at various extraction conditions from the analysis the interaction effects were studied and the optimal process conditions, maximizing the percentage yield were found. Using nitric acid, the yield of pectin for the variety varies from 4.69 % -20.36 %. As decrease in PH the pectin yield increased and with an increase in extraction temperature the pectin yield also increased. Maximum yield of 20.36% obtained at PH 1.0 and temperature of 60 °C for the variety. The best condition for extraction using nitric acid was at 60 °C for 2 hours at pH 1.0. % yield minimum (5.1%) in sweet lime peel at treatment combination of pH 3.0 at 85 °C for 60 min but in case extraction temperature of 40 °C and pH of 4.0 has minimum yields of 5.69 %. [6] **The extraction of pectin from pumpkin peels Extraction using Soxhlet with two different acids.** The influence of time on pectin yield and to characterize the output determinations of methoxyl content, acetyl content, equivalent weight and degree of esterification in a laboratory on a small scale. The

higher average yield of pectin obtained by using Soxhlet acid extraction (7.72% for nitric acid and 6.80% for citric acid) while the lower yield was obtained with acid extraction without using Soxhlet (6.24% for nitric acid and 5.36% for citric acid). Equivalent weight and acetyl contain of extracted pectin with both nitric and citric acids were (1250 g/mol and 0.43) respectively while methoxyl content was (6.20% and 7.23 %) degree of esterification was (66.53% and 66.57%) for nitric and citric acid respectively. Pumpkin peels are a promising commercial source of pectin. [8] **The potential of citrus peel as a source of pectin. Pectin was extracted from lemon peel powder using nitric acid and at three different temperatures, time and pH viz (60, 70 & 80 ^{0}C), (30, 45 & 60 min), (1.5,2 &2.5 pH) respectively.** Pectin yield extracted by using citric and nitric acid as reagents medium varied from 15.8% to 67.8% and 13.8% to44.2% respectively. The best extraction condition by both the extraction reagents showed higher in yield by using citric acid at 800C, 60 min, 1.5 pH. Degree of esterification of extracted pectin showed low methoxyl pectin. The ash and moisture content of isolated pectin were also determined. [12]

Manufacturing Process

Raw Materials

1. Lemon Peels

2. 0.1 N HCL

3. Distilled Water

4. 95% Ethanol

Apparatus Requires

1. Filter Papers

2. Digital Thermometers

3. Heating Element/Mental

4. Measuring Cylinders

5. Glass Rod

6. Beaker

Experimental Process

Extraction Pectin Using Hydrochloric Acid

Pectin extraction from lemon peels done in two stages. First extracted from lemon peels samples which pectin isolated with hydrochloric acid hydrolysis technique and second stage of precipitation with ethanol to from gel and then dry in oven or sunlight to form powdered form pectin.

1.100 gm Lemon peels are oven/sun dried to remove moisture.

2. Then crushed citrus waste peels powder form.

3 400 ml distilled water mix with 10-15 ml of 0.1 N HCL (pH-1.5-2.5).

5. Powdered peels heated with solution for 60 minutes at 75-80 ^{O}C at continuous stirring.

6. After cooling the solution it was filtered with muslin cloth.

7. The filtrate put in beaker and add double amount of ethanol and allowed to precipitate.

8. The jelly-like precipitate formed is nothing but pectin wash with ethanol or Acetone.

9. Pectin was then dried in a hot air oven at 40 ^{0}C for 20 minutes or in oven.

Results and Discussion

Yield of Pectin Extracted from Powdered Peels

Extraction of pectin from orange and sweet lemon (Mosambi) peels carried out in the acidic water at different pH, contact time, at different temperatures and various acids like Conc. HCL, Acetic acid etc. After extraction precipitation of pectin carried out by ethanol to form gel form and to maintain pH. Then drying carried out to removal of moisture from pectin gel in sunlight or an oven. Then yield of pectin powdered extracted from the powdered peels to be calculated. The optimum value of pH, Temperature, Contact time, amount of acid and amount of ethanol is important for higher yield of pectin. After Experimental analysis and literature study we can find the optimum values of parameters.

Yield (%) = (Amount of dry Pectin obtain/Amount of Powder Peels) ∗ 100

The maximum yield of pectin from lemon peels will be 30 % due to lemon peels contains 25-30 % pectin on dry basis.

% Yield of Pectin Open Flask Cooking

1. Extraction with HCL

1. At pH 1.5, Contact (Extraction) time 60 Min, Temperature 80 ^{O}C

% Yield = (28/100) * 100 = 28

2. At pH 2, Contact (Extraction) time 60 Min, Temperature 80 ^{O}C

% Yield = (25/100) * 100 = 25

3. At pH 2.5, Contact (Extraction) time 60 Min, Temperature 80 ^{O}C

% Yield = (22/100) * 100 = 22

% Yield of Pectin Using HCL

Sr. No.	pH	Yield with HCL
01	1.5	28
02	2	25
03	2.5	22

Table % Yield of Pectin using HCL

Observation table shows the yield of pectin at various pH with HCL with extraction time 60 min and temperature 80 ^{O}C. Extraction carried out at pH 1.5, 2 & 2.5 at 60 min with 80 ^{O}C temperature. Experimental analysis shows higher yield of pectin extraction time 60 min and 1.5 pH. At optimum value of all parameters the % yield 28, 25 and 22 for pH 1.5, 2 and 2.5 resp. by using HCL and Acetic acid as an extraction solvent resp.

Experimental Analysis of Factors Affecting on Rate Extraction - Parameters affected on % Yield and rate of extraction for pectin from lemon peels such as pH, temperature, solvent, time of extraction. All these parameters are very important for higher yield of pectin. Selection of acid (Solvent) for pectin extraction also important factor.

1. pH

pH is considered as one of the more crucial parameters affecting the amount and properties of extracted pectin. In literature shows that the pectin yield decreased with increasing the pH value and vice-versa. Extraction carried out at pH 1.5, 2 & 2.5. Experimental analysis shows higher yield of pectin at pH value 1.5 with time 60 min.

2. Temperature

At the lower temperature the yield of pectin is low while at high temperature it Combustible. As compared to low and high temperature range the pectin yield is high at moderate temperature. Extraction carried out at pH 1.5 at 60 min and 60-80 ^{O}C. Experimental analysis shows higher yield of pectin at pH value 1.5 and temperature 80 ^{O}C.

3. Solvent for Extraction

In the literature many solvents are used for the extraction of pectin such as Citric Acid, Hydrochloric Acid, Sulphuric Acid, Nitric Acid and oxalic acid ($C_2H_2O_4$). The high yield is obtained by using HCL as a solvent. The yield of pectin extraction is up to 25-28 % by using HCL.

4. Time of Extraction

The time of extraction increased increase yield of pectin reported and but decreased from maximum level due to thermal degradation of the extracted pectin. Extraction carried out at pH 1.5, 2 & at 60 min with 60-80 ^{O}C temperature. Experimental analysis shows the higher yield of pectin extraction time 60 min.

Economics and Future Scope

The pectin has wide applications in the pharmaceutical, food industry, medical, Dairy, Nutritional, Health and cosmetic products. Pectin is known for being the traditional gelling agent in jams and jellies. The chemistry and gel-forming characteristics of pectin have enabled this naturally occurring biopolymer to be used in pharmaceutical industry, health promotion and treatment. Pectin use potentially in pharmaceutical preparation and drug formulation as a carrier of a wide variety of biologically active agents not only for sustained release applications but also as a carrier for targeting drugs to the colon for either local treatment or systemic action. By selection of the appropriate type of pectin, gelation conditions, added excipients and coating agents, the dosage forms of various morphology and characteristics can be fabricated. Development continues with delivery system using pectin expect to see many innovative and exciting applications in the future. Pectin is a versatile compound that can be used to develop different materials in many food applications such as thickening and gelling agent, colloidal stabilizer, texturizer and emulsifier. These important applications are not limited to food processing but also to packaging, coatings on fresh and cut fruits or vegetables and as microencapsulating agents. Pectin are widely used in the food industry as emulsifier and gelling agents. The ability of pectin to form gels under specific conditions has been used to obtain aerogels, hydrogels. Hydrogels are the most popular gel compositions used in food packaging since they are able to absorb large amounts of water or other biological fluids inside their structure.

CONCLUSION

Extraction of pectin from citrus fruit peels like Orange peels, sweet orange and lemon gives higher yield of pectin. % Yield and rate of extraction for pectin lemon peels depends on parameters such as pH, temperature, solvent, time of extraction. As compared to low and high temperature range the pectin yield is high at moderate temperature. Citrus peels contain cellulose, hemicellulose, lignin, pectin, chlorophyll pigments and other low-molecular weight compounds. Lemon peels contains 25-30 % of pectin on dry basis. Both

fruit peels germicidal, antioxidant and anticarcinogenic properties. The yield of pectin at various pH with HCL with extraction time 60 min and temperature 80 ^{O}C. Extraction carried out at pH 1.5, 2 & 2.5 at 60 min with 80 ^{O}C temperature. Experimental analysis shows higher yield of pectin extraction time 60 min and 1.5 pH. At optimum value of all parameters the % yield 28, 25 and 22 for pH 1.5, 2 and 2.5 resp. by using HCL and Acetic acid as an extraction solvent resp. By experimental analysis using the yield of pectin at various pH with HCL with extraction time 60 min and temperature 80 ^{O}C. Extraction carried out at pH 1.5, 2 & 2.5 at 60 min with 80 ^{O}C temperature. Experimental analysis shows higher yield of pectin extraction time 60 min and 1.5 pH. At optimum value of all parameters the % yield of pectin 28 % by HCL.

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