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Research Article

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Extraction and Characterization of Pectin from Orange Peels

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Abstract Pectin was extracted by varying temperature and time to determine their effects on the percentage yield. Pectin is a family of complex polysaccharides with applications that cut across mainly food and medicine/ pharmaceuticals, it was extracted from sweet orange (Citrus *sinensis)* using alcohol precipitation method. 10g of orange peels produced 3.5g percentage yield of pectin at 40˚C in 5 mins and 4.2g at 80˚C in 7 mins. FTIR analysis was used to show the presence of carboxylic acid and ester which was used to calculate the degree of esterification (DE) of pectin as 58.86% which makes it a high methoxyl pectin. The result shows that, the higher the extraction time and temperature, the higher the pectin yield.

Keywords Pectin extraction, Alcohol precipitation method, FTIR analysis.

Introduction

Pectin for use in food is defined as a polymer containing galacturonic acid units (at least 65%). The acid groups may either be free, combined as a methyl ester, or as sodium, potassium, calcium or ammonium salts, and in some pectins amide groups may also be present. Pectin is produced commercially as a white to light brown powder, mainly extracted from citrus fruits, and is used in food as a gelling agent, particularly in jams and jellies. It is also used in fillings, medicines, sweets, as a stabilizer in fruit juices and milk drinks, and as a source of dietary fiber [1-3].

Pectin is a structural heteropolysaccharide contained in the primary cell walls of terrestrial plants. It was first isolated and described in 1825 by Henri Braconnot. In plant biology, pectin consists of a complex set of polysaccharides that are present in most primary cell walls and are particularly abundant in the non-woody parts of terrestrial plants [2]. Pectin is a major component of the middle lamella, where it helps to bind cells together, but is also found in primary cell walls.

The amount, structure and chemical composition of pectin differs among plants, within a plant over time, and in various parts of a plant. Pectin is an important cell wall polysaccharide that allows primary cell wall extension and plant growth. During fruit ripening, pectin is broken down by the enzymes pectinase and pectinesterase, in which process the fruit becomes softer as the middle lamellae break down and cells become separated from each other [4]. A similar process of cell separation caused by the breakdown of pectin occurs in the abscission zone of the petioles of deciduous plants at leaf fall. Pectin is a natural part of the human diet, but does not contribute significantly to nutrition. The daily intake of pectin from fruits and vegetables can be estimated to be around 5 g (assuming consumption of approximately 500 g fruits and vegetables per day).In human digestion, pectin binds to cholesterol in the gastrointestinal tract and slows glucose absorption by trapping carbohydrates. Pectin is thus a soluble dietary fibre. Consumption of pectin has been shown to reduce blood cholesterol levels. The mechanism appears to be an increase of viscosity in the intestinal tract, leading to a reduced absorption of cholesterol from bile or food [5].

Materials and Methods

Extraction and Characterization of Pectin from orange peels

Fresh sweet oranges were collected and prepared for juice extraction. After extracting the juice, the peels were processed for the separation of albedo (pectin rich) from the flaverdo (oil + pigment) portion. The albedo was minced, air dried and two samples of 10g each where prepared and mixed with cold water at different pH values of 1.0 and 2.0 respectively. The desired pH of the mixture was adjusted with 15ml of citric acid and then

incubated at temperature values for various time intervals with continuous mixing. The mixtures were first incubated in the incubator for 15min to remove soluble sugar and pigment, and then sieved with 80µ mesh stainless screen, after which the 15ml of citric acid was added to both mixtures. The mixture with pH of 1.0 (sample 1) was placed into the incubator at 40˚C for 5minutes, after which the mixture was passed through the rotary evaporator for solvent removal. The mixture was then oven dried at 40˚C. The sample with pH of 2.0 (sample 2) was also inserted into the incubator at 80˚C for 7minutes and was passed through the rotary evaporator and then oven dried at 40˚C.

Determination of the effect of extraction time and extraction temperature on Yield

To determine the effect of extraction time and temperature on the pectin yield, the extracted pectin under different time intervals and extraction temperature were both measured on a weighing balance to see if extraction time and extraction temperature will lead to difference in the yield.

The Yield (%) of pectin is based on the amount of peel sample taken, and is calculated as:

Ypec%= 100× (P/Bi).....Equation 1

Where:

Ypec (%) = extracted pectin yield (%),

P = amount of dry pectin (g) and

Bi = initial amount of orange peel (g).

The pectin degree of esterification (D.E) was evaluated from the FTIR data as:

$$DE = \frac{\text{Area of esterified carboxyl group}}{\text{area of non esterified carboxyl group + area of esterified carboxyl groups}} \times 100 \text{.....equation (2)}$$

$$DE = \frac{1729.4}{1208.44+1729.4} \times 100 = 58.86\%$$

Results and Discussion

The extracted citrus pectin appears to be a white yellowish powder. The FTIR spectrum of citrus pectin extract is shown in Figure 1. The spectrum is characterized by prominent band for carboxylic acid ranging between 1750 cm to 1500 cm.

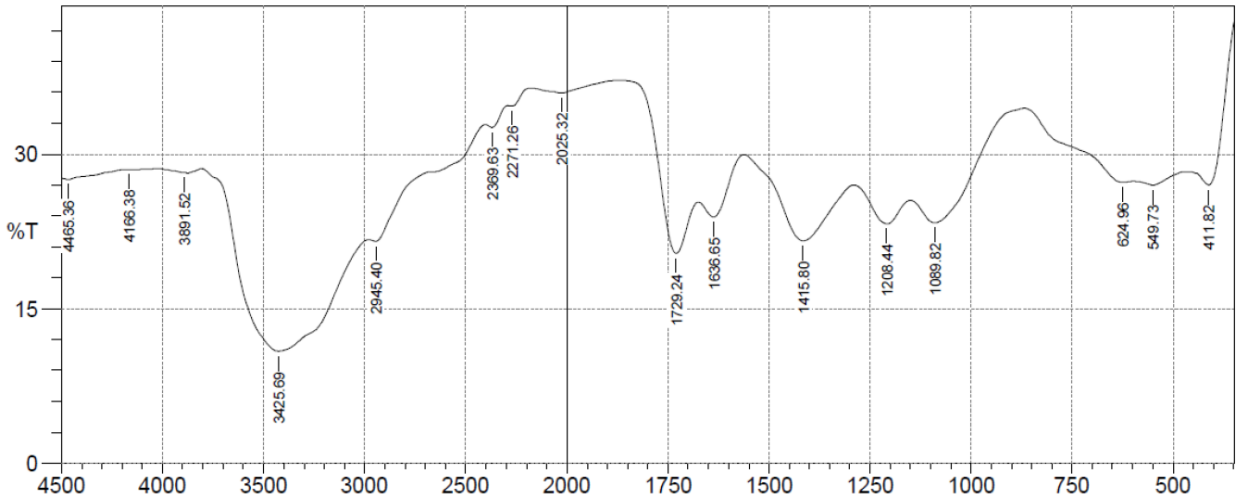

Figure 1: FTIR spectrum of citrus pectin extract.

The results of the experimental yield are summarized in Table 1. The results shows that the higher the extraction temperature the higher the pectin yield as high temperature lead to more effective burning and evaporation of oil pigment, and the higher the extraction time the higher the yield as long time in the oven drier means a more dried sample. It was also observed that the water sample with pH 2.0 is slightly purer than pH 1.0 and that also lead to more yield of pectin. Pectin was extracted by water based extraction technique and 3.5g was obtained for pH 1.0 and extraction temperature of 40˚C and extraction time of 5mins from 10g of orange peel, and 4.2g was

obtained for the pH 2.0 and extraction temperature 80˚C and extraction time 7mins from same 10g of orange peel [6]. The percentage yield was calculated to be 35% and 42% for pH 1.0 and pH 2.0 respectively. The FTIR analysis in figure 1 shows the present of esters and carboxylic acid which is always present in standard pectin extract. The FTIR result was used to determine the degree of esterification by checking the wavelengths of C-O and C=O bonds and the DE was found to be 58.86%. Pectin extracted normally and has DE of more than 50% is classified as "High Methoxyl ester (HM) pectin" [6].

Table 1: Experimental results

Parameters	Sample 1	Sample 2
Amount of peel sample (g)	10	10
Extraction temperature (˚C)	40	80
Extraction time (mins)	5	7
Volume of ethanol (ml)	100	100
Weight of dried pectin (g)	3.5	4.2
pH	1.0	2.0
%Yield of pectin	35	42

Conclusion

Pectin was successfully extracted from orange peels with a percentage yield of 35% and 42% for sample 1 and 2 respectively. Extraction temperature affects pectin yield from orange peel, the higher the temperature, the higher the percentage yield. As the extraction time increases, the percentage yield also increases. The optimum extraction temperature was determined to be 80˚C with the yield 42%. The FTIR analysis shows that the extracted pectin contained the carboxylic acid functional group and the DE was calculated as 58.86% and is regarded as High Methoxyl ester (HM) pectin.

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