

Studies in extraction of pectin from agro-industrial waste

Dissertation-1 Report

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CERTIFICATE

This is to certify that Nikita has personally completed M.Sc. dissertation-1 report entitled, - *Studies in extraction of pectin from agro-industrial waste* under my guidance and supervision. To the best of my knowledge, the present work is the result of his original investigation and study. No part of pre-dissertation has ever been submitted for any other purpose at any University. The project report is appropriate for the submission and the partial fulfilment of the conditions for the evaluation leading to the award of Master of Food Technology.

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Signature of Supervisor

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DECLARATION

I hereby declare that the work presented in the dissertation I report entitled-“Studies in extraction of pectin from agro-industrial waste”. The work has been carried out by me at School of Agriculture, Lovely Professional University, Phagwara, Punjab, India under the guidance of Dr.Yogesh Gat, Assistant Professor (Food Technology) of School of Agriculture, Lovely Professional University, Phagwara, Punjab, India, for the award of the degree of Master of Science in Food Technology.

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I certified that the above statement made by the student is correct to the best of my knowledge and belief.

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Pectin is a naturally occurring substance and one of the prime plant cell wall element. It is a structural heteropolysaccharide because there are 17 different monosaccharide containing which have more than 20 different linkages (Sriamornsak et al., 2003). It is highly present in walls that are surrounded by dividing and growing cells. It is the presence in the cell walls in the soft region of plant, in plant lamella and cell corners. Pectin has significant role in both walls primary and secondary cell wall structures.

The properties of pectin such as physical properties are dependent upon chain length, type of branched chain and amount of esterified groups. Viscosity is the one of the most significant parameter which is required before using pectin. Pectin has a homogenous chemical structure and its based upon origin, the method by which pectin is extracted and the location also.

Pectin can be divided into two groups depending upon their degree of methylation. One is high methoxy pectin (DM >50) and low methoxy pectin (DM <50). High methoxy pectin has ability to form gel in acidic conditions, ph is 2.0-3.5, only if sucrose is present at concentration more than 55 weight % and the low methoxy pectin can form gels in presence of divalent ions (calcium) at large ph range 2.0-6.9 (Tanaka *et al.*,2010).

Recovery of pectin is difficult in food industry because of high demand in order to provide adequate amount. Generally the pectin is extracted is at high temperature by hydrolyzing proto pectin in to pectin but now another novel methods for extraction of pectin (Tripodo MM *et al.*,2015).

A good quantity of galacturonic acid are characterised in pectin of commerce. Moreover, legal definition has made a part for pectin that it can be used as food additives or for pharmaceutical purposes. Minimum of 65% of galacturonic acid on the ash and moisture-free substances are the main of the requirements. With this particular requirements in itself limits the potential sources of food and pharmaceutical pectin.

Pectin have following certain good points in terms of food additives and pharmaceutical products like the stability of pectin to withstand under acidic conditions even at high temperature makes it suitable to be used in drugs(Mesbahi *et al.*,2005).

Pectin is ideal carriers of bioactive agents because of its unique gelling properties presence of divalent ions. Pectin have long standing reputation of being non-toxic, high availability and low production cost. Pectin can be used for delivering drugs orally, nasally, and vaginally.

Pectin has shown some effect in lowering levels of cholesterol, glucose, antioxidant activity and in prevention of tumour growth and metastases. Pectin lowers cholesterol, by its water solubility property. Pectin can bind cholesterol indigestive tract, it will not absorb into blood stream and promotes its elimination. Pectin has body detoxifying properties and also helps in regulating the level of sugar. It is also studied that pectin also lessens the extent of lipid digestion. Moreover, pectin also used in treating diabetes because pectin is also have the property to diminish the activity of enzymes which break down starches and sugar and that helps in preventing blood sugar spikes. The ingestion of pectin reduces the gastric emptying rate and helps in improving glucose tolerance. Pectin and its combinations also used in treating diarrheal diseases especially in cases of infants and children.

It was first isolated by Henri Braconnot in 1825. The word ‘pectin’ taken from Greek word “pektos” which means firm and hard and shows the gelling ability of pectin. The isolation of commercial pectin only started at the starting of 20 era. The term “pectin” most commonly relates to those pectic substances soluble in water and capable of forming gels under suitable conditions. Pectin is a very important linear polysaccharide. Likewise others, it is both polydisperse and polymolecular. Pectin composition varies with type of sources and place of origin.

3.1. Sources-

The main commercial sources of pectin are citrus peels and apple pomace.

Table 1 : Different level of pectin in plants (fresh weight)

Citrus peels	>20.0%
Oranges	0.5 – 3.5%
Apples	1.0-1.5%
Carrots	1.40%
Apricots	1.00%
Banana	0.7-0.12%
Papaya	0.66-1.0%
Passion fruit	0.50%
Pineapple	0.04-0.13%
Tomato	0.2-0.6%
Mango	0.26-0.42%

However, the other sources of pectin are wastes such as passion fruit peel, soy hull, pumpkin, peppers, kiwi fruit, banana peel, pineapple peel.

3.2. Pectin interactions-

Pectin can also interact with some other hydrocolloids polysaccharides such as alginate. The interactions of pectin are-*Pectin with protein:* Generally give satisfactory result of food texture. *Pectin with gelation:* In all confectionary products to give tough gummy like structure. *Pectin with starch:* This combination gives one so called product “jelly beans”. *Pectin with agar agar.* This is also used in confectionary items such as marshmallows (Vandna Tyagi *et al.*,2015)

3.3. Nutritive Aspects of pectin-

Pectin have different nutritive aspects like it act as a source of dietary fibre, the hydration property of pectin, it can use as a structural component in food such as in bakery products. Pectin have a mineral binding property, because of negative charges and calcium binding ability, it can associate ions (Shamkova NT *et al.*,2006) . Fibres which are rich in pectin can behave as weak cation (Gibson *et al.*,2006). Pectin also shows prebiotic effect, cholesterol regulation by lowering down the absorption level of cholesterol in blood stream and the anti cancer properties.

3.4 Extraction of pectin-

The production of pectin is very crucial because of its high demand. Pectin content from apple pomace is about 10-15% on dry weight basis and it is extracted by convential method which is also called as acid extraction and precipitation. It gives brown hue color. Now days, apple pomace is significantly showing high gelling properties than citrus pectin. But because of its dark color it can't be incorporated into light food products. This color comes because of oxidation of phenolic compounds present in apple pomace (Kratchanova M *et al.*,2004; Thibault JF *et al.*,2003).

3.5. Use of pectin in food industry-

Pectin can be used in food by different ways, it can used as thickening agent, stabilizing agent, gelling agent as well as fat replacer in products as ketchup, jam, jellies, yoghurt, fruit based products and ice creams. The most common and the most used source of pectin are

citrus pectin apple pomace pectin. The accurate conditions of extraction of pectin are low pH and high temperature. The consumption or the usage of pectin is allowed in throughout the world. The functionality of pectin can be judged on the basis of degree of methoxylation and molecular size but these properties are mainly judged in case of industrial pectin. On commercial scale, pectin is usually judged on the basis of pectin grade which is based on number of sugar units. Pectin can be used for different different purposes.

3.5.1. Jam, Jellies, Preserve

Major of the pectin are used by these industries. For jam preparation, cooking of fruit and then juice extraction and pectin through conversion of protopectin to water soluble pectin. Pectin solution concentrations ranging from 4-8% can be added as dry powder in mixture with sugar as a dispersing medium.

3.5.2 Conserves

Conserves are the product which do not add any sweetener because of this the total soluble solid ratio of this product is less 55 to 62%. A rapid set HM pectin is added at upper soluble level and LM pectin is added to give desire taste.

3.5.3 Bakers' jellies

In this pectin is used in production of instant jelly which is further used in bakery products. high methoxyl pectin is more thermally stable and it is used to make jellies which are placed in dough or batter without making it fluidized. On another hand, LM pectin can be used in making bakery jams and jellies.

3.5.4 Barbecue Sauce

Low methoxyl pectin is used in some sauces' because of their flavour release attribute and texture.

3.5.5 In Pharmaceutical Industry

Pectin effects cholesterol levels in blood and also acts against poisoning with toxic cations. It is effective in removing lead and mercury from the gastrointestinal tract and respiratory organs. It is useful in controlling haemorrhage or local bleeding (Yamada H et al.,2003).

4.1 Extraction of pectin:

Acid extraction: Extraction of pectin is done by the method developed by (Emaga *et al.*, 2008)



4.2 Proximate analysis

4.2.1 Moisture, Ash and Protein contents

Moisture was determined by the vacuum oven drying method . Ash was determined by incinerating the sample overnight in a muffle furnace at 600°C and the protein by lowry method. Moisture, protein, and ash contents were measured using AACC methods 44-15A, 46-13, and 08-01.

4.3 Physiochemical analysis

4.3.1 Extraction yield

The pectin yield was calculated by Pectin extraction yield was calculated by the ratio between the weight of the end product and the weight of feedstock submitted to extraction

4.3.2. Degree of esterification

This follows the method given by Klinchongkon *et al.*,(2016)

4.3.3 Content of methoxyl groups

Degree of (methyl) was assessed by a direct titration method (Yapo *et al.*, (2009a)

4.3.4 Galacturonic acid content

The galacturonic acid (GalA) content was determined with a colorimetric method described by Filisetti-Cozzi & Carpita (1991)

4.3.5 Fat absorption capacity

Fat absorption capacity involves the method developed by (Moura *et al.*,2017).

4.3.6 Cation exchange capacity

It involves the titration method with 0.1 M potassium hydroxide and by conductimetry.

4.3.7 Water holding capacity

Water holding capacity is determined by the procedure of Moura *et al.*,(2017).

4.3.8Copper binding capacity

Copper binding capacity test will be done by method of (Warpechowski *et al.*,2006).

4.3.9 Total phenolic compound

The total phenolic content of the extract determined by the method of Folin–Ciocalteu method (Sharma *etal.*,2017).

4.3.10. Antioxidant content

The antioxidant content determined by AOAC 2000 (DPPH method).

4.4 Applications of produced pectin

The extracted pectin will be used in thickening agent in tomato ketchup, gelling agent in jelly, stabilising agents and fat replacer in salad cream.

1. Optimization of process parameters for the extraction of pectin from different agro-industrial waste sources.
2. Purification and characterization of extracted pectin for different physicochemical properties.
3. Application of extracted pectin as thickening, gelling, stabilising agents and fat replacer.

To the best of our knowledge very less literature is available on extraction of pectin from different agro-industrial waste. Most of the research reports have focused on extraction of pectin from the citrus fruits and used as gelling agent in jelly making process. An extensive study can be carried out on extraction of pectin from different sources and its application as thickening agent, fat replacer as well a stabilizing agent.

1. Isolation of pectin
2. Characterization of pectin
3. Application of pectin in different food products.

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