*Int.J.Curr.Microbiol.App.Sci* (2020) *9*(5): 143-148

EXCELLENT PUBLISHERS

*International Journal of Current Microbiology and Applied Sciences*
***ISSN: 2319-7706*** **Volume 9 Number 5 (2020)**
Journal homepage: http://www.ijcmas.com

**Original Research Article** https://doi.org/10.20546/ijcmas.2020.905.015

# Pectin from Pineapple Wastes: Isolation and Process Optimization

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## A B S T R A C T

**Keywords**

agro-industrial, pineapple waste,pectin, pharmaceutical, therapeutic

**Article Info**

***Accepted:***
05 April 2020
***Available Online:***
10 May 2020

Work has been carried out to investigate the isolation of pectin from various pineapple waste biomass such as peel, core and pomace and its process optimization. About 60% of total pineapple fruit is regarded as waste in form of peel, core, pomace and crown. A valuable byproduct that can be obtained from pineapple peel is pectin. The wide use of pectin as an ingredient imparts rheological and textural properties to various food products. Acid extraction followed by ethanol precipitation was used to extract pectin. Results revealed that yield of pectin were found to be 14.21%, 12.75% and 11.24% from pineapple pomace, core and peel respectively. Initial and final moisture content for all sources were also studied for pectin extraction. The pineapple wastes were treated separately with different pH (1, 1.5, 2.0, 2.5 and 3.0), extraction temperature (60, 65, 70, 75, 80, 85 and 90$^o$ C) and extraction time (20, 30, 40, 50, 60, 70, 80, 90 and 100 minutes).Maximum yield of pectin was optimized at 1.5, 85$^o$ C and 70 min for pH, extraction temperature and extraction time respectively.

## Introduction

Huge quantities of by-products are produced from the fruit processing industry which can be used for animal feed and wastes causing environmental pollution (Min *et al.*, 2011).These by-products are a cheap source of raw material for value addition into various biochemicals for wide array of industries. Many of these fruit waste contains high amounts of pectin. Pectin is an important by-product that can be obtained from these fruits and vegetable wastes (Begum *et al.*, 2014). About 18% of the fruit and vegetables production value Rs. 13,300 crores are expected waste annually in India. Fruit and vegetables comprise of carbohydrates like sugars, dietary fibres, vitamins and minerals (Rudra *et al.*, 2015).

Pectin is a heteropolysaccharide present in the primary cell walls of terrestrial plants. Pectin is also present in primary cell walls as well as in the middle lamella between plant cells

(McCann and Roberts 1991). It is a highly valued food ingredient used as a gelling agent and stabilizer (Willats *et al.*, 2006). Various fruits can be utilized for extraction of pectin by chemical or enzymatic methods (Munarin *et al.,* 2012). It is most complex macromolecule composed of up to 17 different monosaccharides containing more than 20 different linkages (Voragen *et al.*, 2009).

Pectin communicates strength and flexibility to the cell wall with other functions such as signaling, cell proliferation and maintaining turgor pressure of cell (Ciriminna and Chavarria, 2015).In the food sector, pectin is used as a gelling agent and stabilizer along with a health-promoting functional ingredient (Ciriminna *et al.*, 2016; Min *et al.*, 2010;Peng *et al.*, 2014).

Another property of pectin is that it influences the texture of fruit and vegetables (Jarvis, 1984). Considering may properties and applications, pectin has gained immense potential in biopolymer market around the globe having greatest opportunities for future developments.

The pineapple (*Ananas comosus*) is the most important horticultural produce of the family *Bromeliaceae*. About more than 40% of the total pineapple production of the country was made from the NE region and 90 to 95% of the produce is organic. 'Giant Kew' and 'Queen' are the common cultivars grown this region. Manipur contributes about 7.37% of the total pineapple production of India (Sarangi *et al.*, 2019).

During pineapple processing, the crown and stem are cut off before peeling. The core is then removed for further processing. These wastes (peel, core, stem, crown and leaves) generally account for 60% (w/w) of total pineapple weight (Singh *et al.*, 2018).

The increasing production of pineapple processed items, results in massive waste generations mainly due to the elimination of components unsuitable for human consumption. These wastes are usually prone to microbial spoilage thus limiting further exploitation.

Further, the drying, storage and shipment of these wastes is cost effective and hence efficient, inexpensive and eco-friendly utilization is becoming more and more necessary. The utilization of waste would be an innovation to handle the great deal of waste from processing.

Worldwide research revealed that agricultural wastes and by-products are used as sources for pectin extraction (MoralesContreras *et al.*, 2018; Sabater *et al.*, 2018; Xu *et al.*, 2018), Owing to the above facts, the biotechnological approaches for efficient use of lignocellulosic materials like pineapple by-products having enormous availability in NE region may be focused as cheap sources of pectin.

In this paper, the isolation of pectin from various pineapple waste biomass such as peel, core and pomace along with their process optimization are detected.

## Materials and Methods

### Raw materials

Above investigation was conducted in AICRP on Post-Harvest Engineering and Technology laboratories at Department of Agriculture Engineering, College of Agriculture, Central Agricultural University, Imphal, Manipur, India. Pineapple fresh fruits were collected nearby Imphal Market. Moisture level at different stages was recorded by the help of UV based moisture meter present in the laboratory.

## Sample preparation

Fresh pineapples were properly washed with water and peeled by the help of pineapple slicer cum cutter developed by AICRP-PHET Imphal centre. By this method, other waste products like stem, core was also removed. Small pieces of all products were obtained by the help of knife so that these can be easily dried. The pulp part is used for making juice leaving the pomace which was used for pectin formation. Then all these Pineapple wastes (PE) were kept inside the drier at 65$^{o}$C for 4 days. At this stage, the moisture level of PE became 5-6% so that these could be grounded into fine powder by the help of pulverize in our laboratory.

## Pectin extraction and process optimization

A known quantity of pineapple sample was taken in a beaker and certain quantity of distilled water was added based on amount of sample taken at a proportion of 5 gm of sample to 100 ml of distilled water. Then pH was lowered by addition of $H_2SO_4$. After that, whole samples were heated at wide range of temperatures along with continuous stirring followed by filtration. Equal volume of 95% ethanol was added for coagulation of filtrate. After separation through filtration, the product was washed at different concentrations of ethanol.

After that the pectin was dried at 40°C for 24 h., stored in container for further uses. Three different waste products were tested by above methods. Various process parameters were taken for optimization of pectin yield. Different pineapple wastes were treated separately with different pH (1, 1.5, 2.0, 2.5 and 3.0), temperature (60, 65, 70, 75, 80, 85 and 90$^{o}$ C) and time period (20, 30, 40, 50, 60, 70, 80, 90 and 100 minutes). Yield of pectin (%) was calculated from three wastes products based on the following Equation.

$$\text{Percentage of Pectin} = \frac{\text{Weight of Pectin produced (Dried form)}}{\text{Weight of the sample taken}} \times 100$$

## Results and Discussion

During the processing of pineapple, different waste parts such as crown, peel, core and pomace were released. Results revealed that percentage of peel, core, stem and crown were found to be 44.15, 4.26, 1.06 and 14.36 respectively. During juice formation, percentage of juice with pomace was 14.89 and 21.28 respectively. It is obvious that the waste generated through the processing pineapple is more that 60% which needs to be explored for value added products having importance in various industries (Fig.1.).

Standardization of Process parameters for optimization of pectin yield is very crucial as far the final recovery and economical points are concerned. Different pineapple wastes were treated separately with different pH (1, 1.5, 2.0, 2.5 and 3.0), temperature (60, 65, 70, 75, 80, 85 and 90$^{o}$ C) and time period (20, 30, 40, 50, 60, 70, 80, 90 and 100 minutes). Maximum yield of pectin was optimized at 1.5, 85$^{o}$ C and 70 min for pH, extraction temperature and extraction time respectively (Fig.2).

As far pectin yield is concerned, highest yield is detected in pomace (14.21%) which is descending order of Pomace> core> Peel (Fig.3). It is supposed as pomace is generated during juice formation through pineapple processing; it may be the possibility for its maximum yield having varied carbohydrate content and structurally favorable for pectin formation other than peel and core. More researchable issues are to be solved for further investigation. Also, different fruit wastes are to be explored for pectin production in future study.

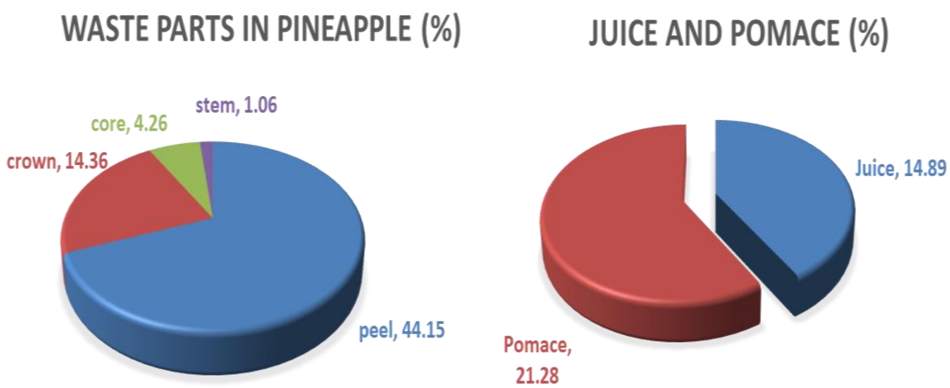


**Fig.1** Various parts of pineapple in percentage

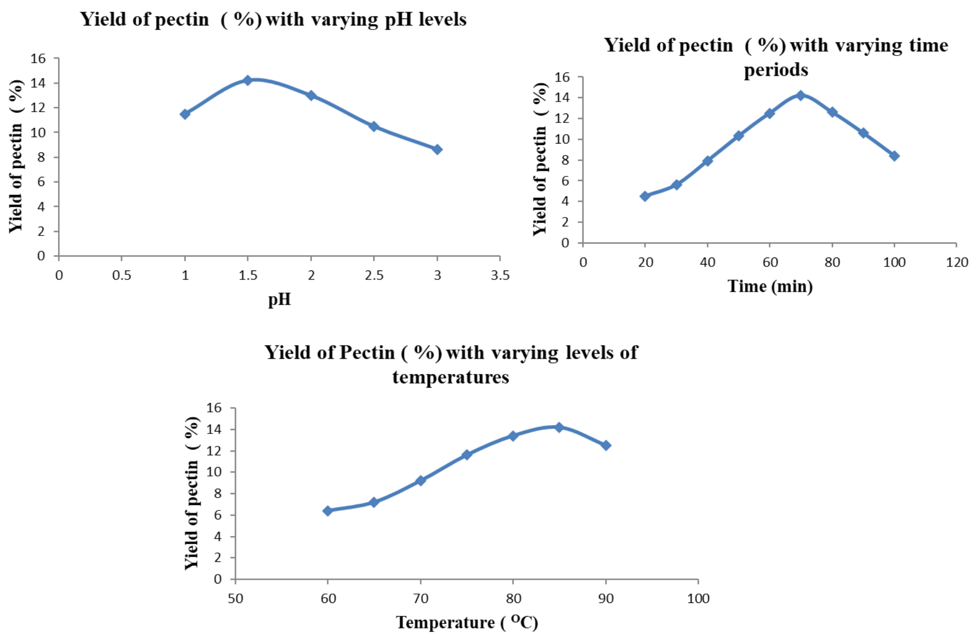


**Fig.2** Pectin yield from Peel at varying range of pH, temperature and time period

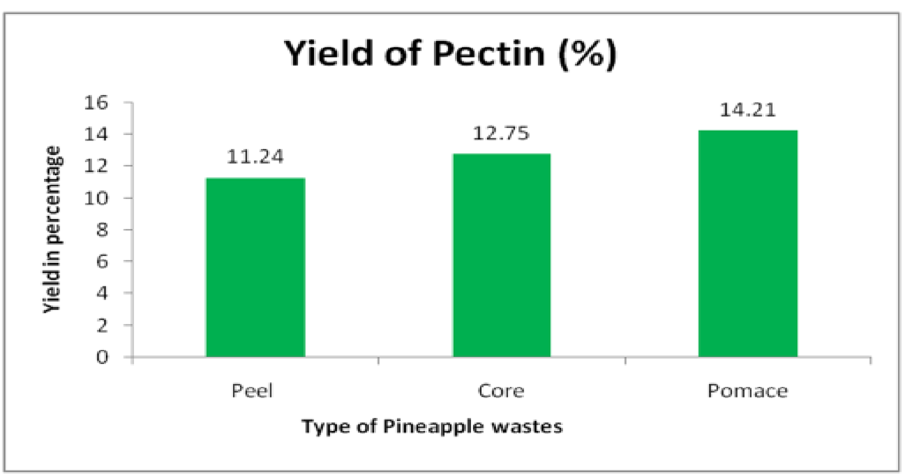


**Fig.3** Yield of Pectin (%) from different pineapple waste

Pectin is one of the most extensively studied natural biodegradable polymer. In spite of its availability in a large number of plant species, commercial sources of pectin are very limited. There is, therefore, a need to explore other sources of pectin or modify the existing sources to obtain pectin of desired quality attributes. In the present study, result reveled that the pineapple wastes were treated separately with pH (1, 1.5, 2.0, 2.5 and 3.0), Extraction temperature (60, 65, 70, 75, 80, 85 and 90$^{o}$ C) and Extraction time (20, 30, 40, 50, 60, 70, 80, 90 and 100 minutes).

Maximum yield of pectin was optimized at 1.5, 85$^{o}$ C and 70 min for pH, extraction temperature and extraction time respectively. Extensive studies are to be carried out to find out more about the conversion pathways to explore various efficient so that pectin extraction may be economically viable and subsequently can be commercialized. The large variety of applications as well as the increasing number of studies on pectin suggests that the potential of pectin as novel and versatile biomaterial will be even more significant in the future. As the research and development continues in pectin-based products, many innovative and exciting applications may be also explored.

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**How to cite this article:**

Prakash K. Sarangi, Ng. Joykumar Singh and Th. Anand Singh. 2020. Pectin from Pineapple Waste: Isolation and Process Optimization. *Int.J.Curr.Microbiol.App.Sci.* 9(05): 143-148.
doi: https://doi.org/10.20546/ijcmas.2020.905.015