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# Effect of extraction conditions on the quality characteristics of pectin from passion fruit peel (*Passiflora edulis f. flavicarpa L.*)

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ABSTRACT

Passion fruit (*Passiflora edulis f. flavicarpa L.*) yellow variety is composed of 50–55 g peel per 100 g of fresh fruit which is discarded as waste during processing. Utilization of passion fruit peel for pectin extraction was studied. Passion fruit peel obtained after juice extraction was blanched in boiling water for 5 min, dehydrated in a cross flow hot air drier at 60 ± 1 °C to a moisture content of 4 g/100 g of dried peel. The dehydrated passion fruit peel was used for extraction experiments of pectin. The effect of pH, peel to extractant ratio, and number of extractions, extraction time and temperature on the yield and quality characteristics of pectin were investigated. The optimized conditions for extraction of pectin from passion fruit peel yielded 14.8 g/100 g of dried peel. Pectin extracted from the dried peels had a methoxyl content of 9.6 g/100 g, galacturonic acid content of 88.2 g/100 g and jelly grade of 200. Extraction of pectin from dried peels of passion fruit may be considered for effective utilization of passion fruit processing waste.



## 1. Introduction

India produces a wide variety of fruits and vegetables in tropical, subtropical, temperate and arid regions. The production of fruits in India has been steadily increasing every year and is now estimated at 49.8 million tonnes. Processing of fruits into various products by food industries generate significant quantity of biodegradable material. The waste material from the fruits is in the form of peels, core, seed and trimmings of over ripe and defective materials. At present the fruit processing industries dispose the waste generated without any treatment in the near by low lying areas resulting in pollution of the environment. Most of the commercial pectin is extracted from citrus peels and apple pomace in which pectin content ranges from 20 to 40 g/100 g on dry weight basis. Wastes generated from citrus (Cerezal, Larrauri, & Pinera, 1995; Cho, Lee, & Kim, 2003; Contreras-Esquivel, Hours, Voget, & Mignone, 1999) and apple (Harsimart & Dhwan, 2001; Kong, Liu, & Chen, 2000; Lee, Yuk, Hwang, Choi, & Cho, 1999) processing industries are reported to be rich source of pectin. Passion fruit (*Passiflora edulis f. flavicarpa L.*) which belongs to the family *passifloraceae is* an exotic fruit with a characteristic flavour. It is a commercially important fruit successfully grown in most of the tropical and subtropical regions of the world notably in America, Australia, New Zealand, India and South Africa. Passion fruit is also widely cultivated in north eastern region of India. Physico-chemical properties of yellow passion fruit with different harvest times with respect to fruit size, peel, peel colour, yield, pH, total soluble solids, total acidity, ascorbic acid were reported by Marchi, Monteiro, Benato, and Silva (2000). Passion fruit juice and juice concentrate are popular processed fruit products in the world market. Passion fruit is also processed into juice and blended fruit drinks with other tropical fruit pulps (Borges, Reis, Jorge, Pinto, & Oliveiera, 2002; Vercelino-Alves, Sarantopoulos, Segantini-Saron, & Bordin, 2001). In India, passion fruits are processed into juice, ready to serve beverages, squash and syrups in the states of Mizoram, Manipur and Nagaland. The waste generated during processing of passion fruit mainly consists of peel and seed. Passion fruit peel was reported to contain significant amount of pectin (Corona et al., 1996; Prasad, 1980). Dietary fiber from yellow passion fruit (*Passiflora edulis*) peel was reported to prepare as alcohol insoluble material which may be suitable to protect against diverticular diseases (Yapo & Koffi, 2008). Passion fruit peel has also been reported to be used for the preparation of preserve (Freiman-de-Oliveira, Figueiredo-Nascimento, Borges, Nascimento-Ribeiro, & Ruback, 2002). However, the conversion of passion fruit peel into a valuable by product such as pectin offers great scope for utilization. Therefore, the main objectives of the present investigation are to study the effect of extraction conditions on the composition and physico-chemical characteristics of pectin from passion fruit peel.

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## 2. Materials and methods

### 2.1. Raw materials

Passion fruits were purchased from local fruit market, sorted, washed and cut into halves, pulp and seeds were scooped out and passed through a pulper extractor fitted with a stainless steel sieve having a pore diameter of 0.7931 mm to extract juice and separate the seeds. The peels obtained after juice extraction were washed thoroughly in tap water to remove the adhering pulp and soluble sugars.

### 2.2. Dehydration of passion fruit peel

Passion fruit peels were passed through a fruit mill to crush the material into pieces of 3–5 mm, washed in tap water and blanched for 5 min in boiling water. Blanched material was loaded on stainless steel trays with a tray load of 9.375 kg $m^{-2}$ and dehydrated in a cross flow hot air drier at 60 ± 1 °C to a final moisture content of 4–4.5 g/100 g . Subsequently, the dehydrated peels were packed in low density polyethylene bags having thickness of 75 μm, sealed in tin containers and stored at 10 °C. These dried peels were used for pectin extraction studies. The flow chart for the preparation of dried passion fruit peels is shown in Fig. 1.

Concentrated hydrochloric acid (Analytical Reagent) was procured from Qualigens fine chemicals, India, and was used for the extraction of pectin.

### 2.3. Preparation of extractant

One part of unbuffered concentrated hydrochloric acid (HCl) was mixed with one part of distilled water by weight and used as a stock solution, for preparing extractants of different pH. The pH of the extractant was measured using a digital pH meter, Model No. CD 4 PX 175 E/C, CD instruments, India. The different extractants with pH of 1.0, 1.5, 2.0, 2.5 and 3.0 were prepared by diluting the stock solution of hydrochloric acid solution. These extractants were used for the extraction of pectin from the dried passion fruit peel.

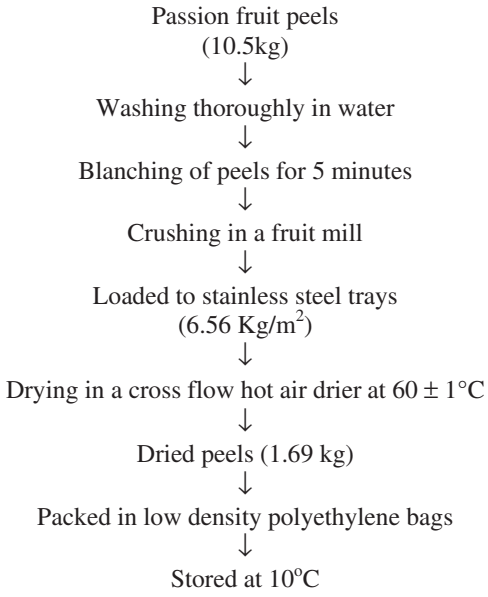


**Fig. 1.** Flow chart for preparation of passion fruit peel for pectin extraction.

### 2.4. Peel to extractant ratio

The dried peel to extractant ratios were maintained at 1:10, 1:15, 1:20, 1:30 and 1:40 (w/v), during extraction.

### 2.5. Extraction time

Extraction time of pectin was varied for 30, 45, 60 and 90 min to determine the time of extraction required for maximum yield of pectin from the dried peels.

### 2.6. Extraction temperature

Peel and extractants were weighed and taken in a 1 L Borosil glass beaker. The beakers were kept in a thermostatically controlled stainless steel water bath at the required temperature. The temperature of the water bath during extraction were maintained at 70, 80, 90 and 98.7 °C and heating was done in open conditions.

### 2.7. Extraction of pectin

The pectin was extracted from coarsely ground, dehydrated peels of passion fruits. The peels were heated in diluted hydrochloric acid solution for a specific time, filtered through a nylon cloth (0.25 mm pore diameter) and pressed to recover the extract. The extract was further filtered through whatman No. 3 filter paper using buchner funnel. The pectin was precipitated by adding absolute ethanol (98% purity) in the ratio of 1:2 (1 part of pectin extract and 2 parts of ethanol) and keeping at room temperature for 2 h. The precipitated pectin was filtered and the pectin residue was separately washed with aqueous ethanol of 75% (v/v) and 85% (v/v) and finally with absolute ethanol to remove the soluble impurities. The pectin was finally washed with absolute alcohol and dried at 50 ± 1 °C in a vacuum oven under vacuum of 24″Hg to constant weight. The yield of pectin was calculated as follows:

$$\text{Pectin (g/100g)} = \frac{\text{Weight(g) of dried pectin} \times 100}{\text{Weight(g)of dried peel taken for extraction}}$$

The pectin was milled, sieved (0.25 mm) and packed in metallized polyester pouches. The packs were kept in air tight tin containers and stored at 10 °C for analysis.

### 2.8. Composition

Moisture content of dried peels was determined by drying known weight of sample in a vacuum oven for 6 and 7 h at 60 °C to a constant weight. The moisture content of the samples was calculated from weight loss and expressed as percent (AOAC, 2000). Total soluble solids of pectin extract were determined by hand refractometer (Erma, Japan), pH of the pectin extract was measured at room temperature using digital pH meter. Total sugars, titratable acidity, total carotenoids, starch, ascorbic acid were estimated by methods as per AOAC (2000). Analysis was carried out in three replicates and the results were expressed as the mean ± standard deviation (Steel & Torrie, 1980). Calcium pectate content in the dried peels of passion fruit was determined according to the method described by Ranganna (1995).

15 g of coarsely ground, dehydrated peels of passion were weighed in a 1000 mL glass beaker. 400 mL Hydrochloric acid of 0.05 molar equivalent/L was added to the peel and boiled gently for 2 h. The water lost by evaporation was replaced. The contents were cooled and transferred to a 500 mL volumetric flask and the volume made up with distilled water. The extract was filtered through No. 4 Whatman paper. 200 mL aliquot of the filtrate was taken in