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Extraction & Characterization of Pectin from Mixed Fruit Peels Waste

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Abstract – *Fruit and vegetable peels are considered agro waste and are thrown into the environment instead of being used as a source of nutrient, supplement or antimicrobial agent. Various studies conducted on peels revealed the presence of these useful constituents, which can be used for various purposes. Present work addresses to this issue partially & attempts in separation of pectin from combined fruits peels mixture like apple, pineapple, orange, sweet lime, and pomegranate. Experimental studies are conducted for combinations of fruit peels waste & the FTIR of the samples A-1, OLP-1, APO-1 have been carried out. From the comparison of the spectrogram, it can be observed that the wavenumbers are in agreement with each other and with that reported in literature for pectin. The percentage of pectin isolated is observed to be in A-1 (0.05%), APO-1(14%), OLP-1 (12%). Thus, it can be concluded of various combination of fruit peels tried in the present work that a good amount of pectin can be isolated effectively.*

Key Words: mixed fruit peels waste, pectin extraction, orange peel, apple peel, pineapple peel, pomegranate peel, lime peel

1. INTRODUCTION

India is the second largest fruit producer in the world after China as per the report of the ministry of horticulture and produced 82.631 million tons of fruits in 2014-15, while China tops the list with 154.364 million tons. The current apple production in India is around 20 lakh tons per year and is predominantly grown in Jammu and Kashmir, Himachal Pradesh and Uttarakhand. India produces 29 lakh tons of excellent quality oranges per year mostly in the central part of India. Around 1415 thousand ton per year of Pineapple is grown in almost entire north east region whereas production of Citrus limetta, also known as mousambi, is around 3251.68 tons per year. Production of Pomegranate is around 743 thousand tons per year & Maharashtra is leading producer of it followed by Karnataka, Andhra Pradesh ,Gujrat and Tamil Nadu.

Fruit and vegetable peels are considered agro waste and are thrown into the environment instead of being used as a source of nutrient, supplement or antimicrobial agent. Various studies conducted on peels revealed the presence of these useful constituents, which can be used for various purposes. By-products and waste materials if discarded without processing have detrimental impact on environment & affects economic, and social sectors. The fruit waste is one of the major concerns contributing to global environmental burden. While some of the agricultural wastes can be used as animal feed or fertilizer; waste such as pulp & peel can be treated for value added products such as pectin, essential oils, lignin & cellulosic constituents.

Presently many cities have adopted segregation of dried and green waste material, however these may not lead to value addition to the waste. The Present work addresses to this issue partially & attempts in separation of pectin from combined fruits peels mixture like apple, pineapple, orange, sweet lime, and pomegranate.

2. LITERATURE SURVEY

An outline of the summary of published papers on related theme is given below:

The paper titled [1] "Separation of oil and pectin from orange peel and study of effect of pH of extracting medium on the yield of pectin" discusses about an orange specifically, the sweet orange (citrus sinensis (L.)) which is the most commonly grown tree fruit in the world. Orange trees are widely cultivated in tropical and subtropical climates for the sweet fruit, which is peeled or cut and eaten whole, or processed to extract orange juice and also fragrant peel. The orange processing industry can get a complete makeover if due importance is given for separation of useful ingredient from orange peel. The outcome of this work highlighted that 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. Two methods namely simple distillation and leaching have been explored for separation of oil from peels. It is found from the experimental observation that the orange peel source gives higher yield than leaching residue when orange oil is extracted using simple distillation

In the paper titled [2] "Extraction of pectin from an orange peel"; that describes about pectin, which belongs to a family of complex polysaccharide containing 1,4-linked alpha and beta galactosyluronic acid residues that was extracted using alcohol precipitation method from peels of oranges. The overall results showed that the pectin from this source has potential for industrial use.

Paper titled [3] "Optimization of method for extraction of pectin from apple pomace" discusses about apple which is an important fruit crop of the world. A substantial quantity of the apple produce is processed into juice, pulp, concentrate and other processed products. The apple pomace is left after extraction of apple juice. Since apple pomace is highly biodegradable, it's disposal near the processing units leads to environmental pollution besides causing a huge economic loss to the processing industry. Apple pomace is a rich source of sugars, pectin and crude fibre & it is reported to contain about 18-19% pectin on moisture free basis. The present study was therefore, conducted to investigate the effect of various extraction variables, viz. pre-treatment of raw material, extraction precipitation methods on the yield and quality of pectin in order to develop a method for commercial extraction of pectin from apple pomace.

The paper titled [4] "Extraction and characterization of pectin from fruit waste" highlights how India is the third major producer of fruits and vegetables and ranks next to Brazil and China respectively, in the world. The paper highlights also about the effect of fruit waste which is one of the major concerns, contributing to global environmental burden. Fruit waste such as citrus peel, mango peel, apple pomace and banana peel were collected from fruit juice manufacturing industries and were subjected to pectin extraction the results revealed that citrus peel content of about 24.5%. Characterization of different fruit waste was also done.

Paper titled [5] "Fruit peel waste: characterization and its potential uses" investigates commonly available large volume of fruit peels waste such as banana, orange, citrus, lemon and jackfruit for surface, physical & chemical characteristics with a view to purpose their valorization in detail.

3. PRESENT WORK

3.1 Objective:

The objective of the present work is separation of pectin from combined fruits peels waste of apple, pineapple, pomegranate, orange and sweet lime.

3.2 Methodology:

The methodology adopted in present work is depicted in fig no.: 1.

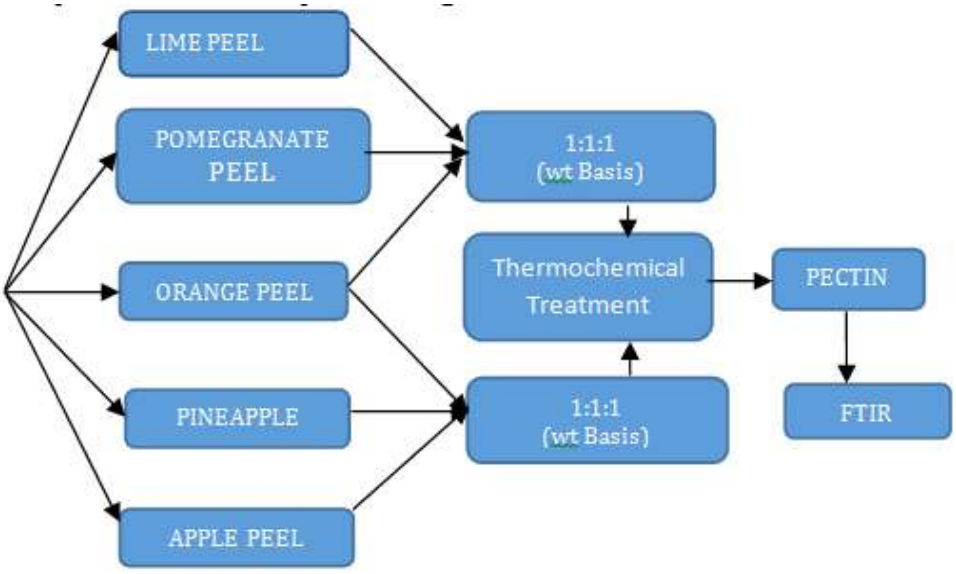

Fig no.1: Methodology of present work

3.3 Materials and method:

3.3.1 Materials:

Fruit waste such as orange peel, apple peel, pomegranate peel, pineapple and sweet lime peel were collected from fruit juice centre, HCl, Ethanol etc.

3.3.2 Method:

- **Pre-treatment:**
  - Collected fruits peels waste are separately dried in an oven at 70°C for 5 hr to eliminate moisture
  - The dried samples were powdered
  - Following combinations of peels powder mixture was used for experimentation
    - Combination1: orange, sweet lime & pomegranate peels
    - Combination 2: orange, apple & pineapple peels

Treatment procedure is same for both the combinations:

- 8gm each of fruit peel powder (total 24 gm) is taken in a beaker
- 3ml HCl in 200ml of water is added with a pH value of around 1
- The entire solution was heated for 1hr at 65°C
- After extraction, the extract was separated from the solid residue by filtration
- The pectin extract obtained was cooled to room temperature & further treated with pure ethanol for precipitation of pectin
- Precipitate was then separated & jelly pectin obtained is washed with water followed by drying in an vacuum oven at 50°C

Block diagram & actual photographic representation of the process steps are shown in the fig. no.2 & 3 respectively.

Similarly the details of process parameters are given in table no 1.

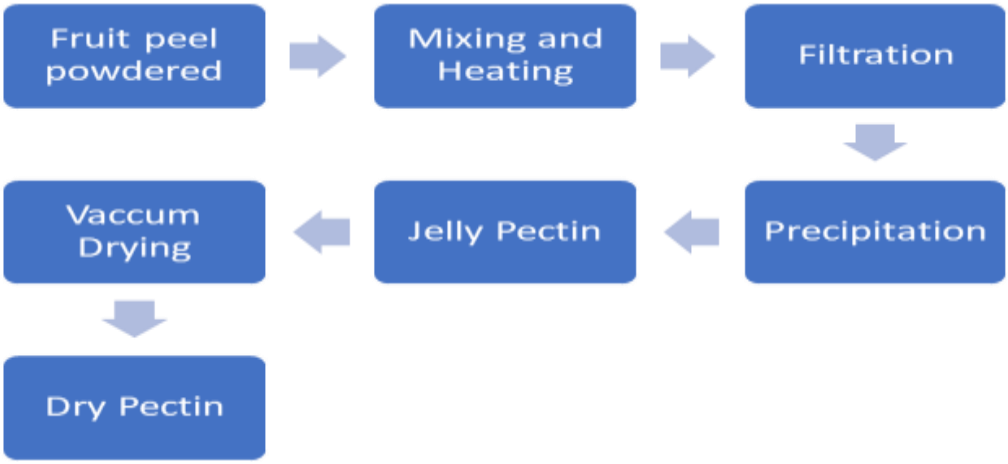

Fig. no. 2 : Block diagram of the process

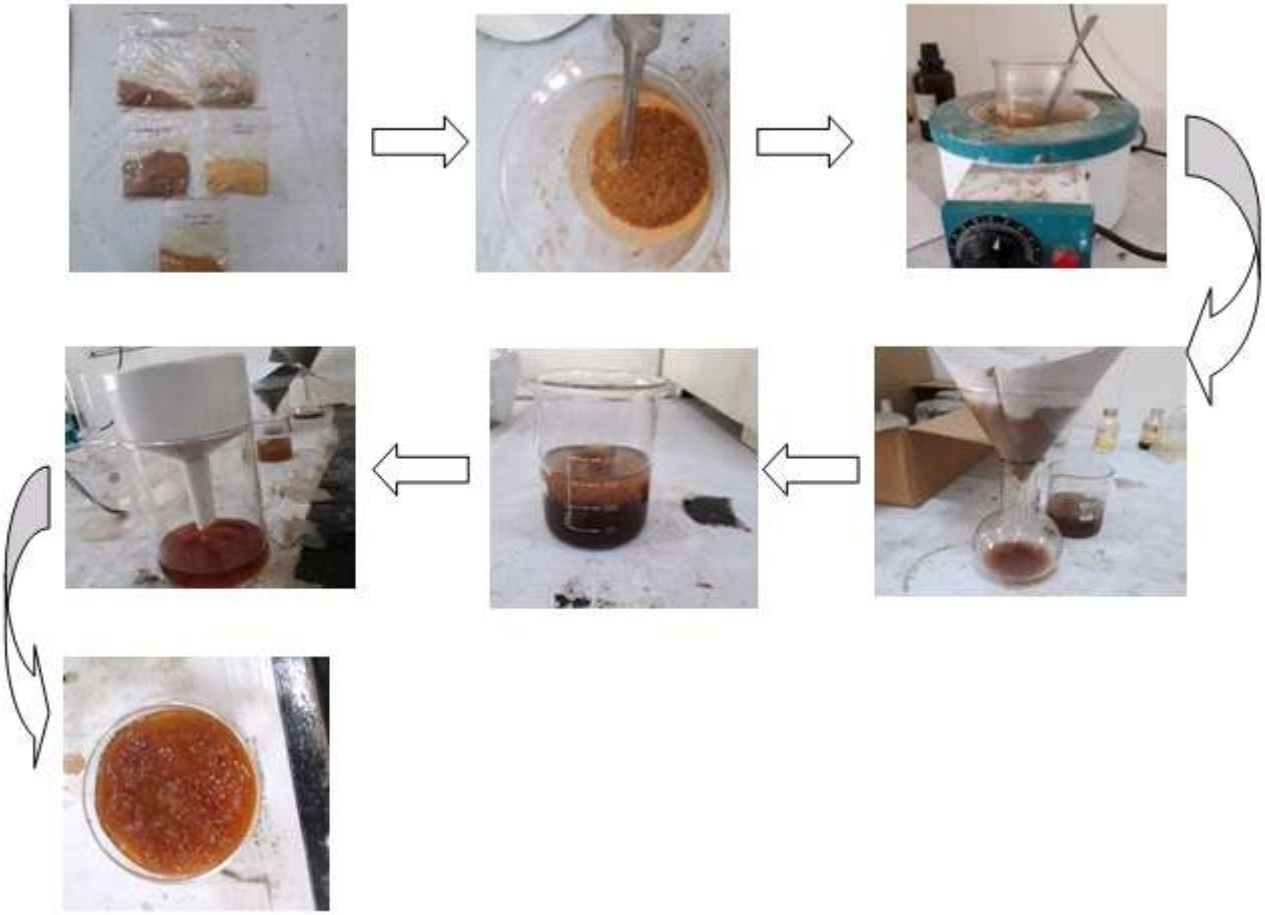

Fig no.3: Photographic representation of process

3.4. Observation Table:

Experimental run	Sr. No.	Sample Name	Raw Material	Qty of raw material (gm)	Qty of HCl (ml)	Temp °c	Time (Hr)	pH	Pectin yield (gm)
RUN-1	1.	A-1	Apple pulp Water	48	0.5	90	1	1	0.21
	2.	OLP-1	Orange peel Lime peel Pomegranate peel	8 8 8	3	70	1	1	3.51
	3.	APO-1	Apple peel Pineapple peel Orange peel	8 8 8	3	70	1	1	3.04
RUN-2	4.	APO-2	Apple peel Pineapple peel Orange peel	8 8 8	3	70	1	1	1.27
	5.	OLP-2	Orange peel Lime peel Pomegranate peel	8 8 8	3	70	1	1	0.68
RUN-3	6.	APO-3	Apple peel Pineapple peel Orange peel	8 8 8	3	70	1	1	2.95
	7.	OLP-3	Orange peel Lime peel Pomegranate peel	8 8 8	3	70	1	1	5.59

Table 1: Details of Process parameters

3.5 Results and discussions

FTIR analysis of the samples A-1,APO-1, and OLP-1 have been carried out. The spectogram of these samples is compared with that of pectin extracted from apple pulp and other fruit pulp reported in literature[6]. The details of wavenumber and comparison with interpretations are mentioned in the Table 2. Similarly, the spectograms are given in figure 4,5,6 respectively.

From the comparison , it can be observed that the wavenumber are in agreement with each other and with that reported in literature.

Thus it can be said that pectin has been successfully extracted from combination of fruit peels.Howeever, based on overall interpretations it can be said that pectin extraction from combination of fruit peel is greater than apple pulp and it gives higher yield.

Fig. no.4: Actual photographs of samples

Table 2: Comparison of FTIR spectogram

Sr.No.	Functional group	A-1	APO-1	OLP-1	Wave no from Literature
1.	OH Group	3299	3289	3271	3400-3600
2.	C-H Group	2924	2926	2930	2938-2900
3.	C=O Group	1739	1731	1714	1740-1750
4.	COO- Group	1635	1634	1621	1630-1636
5.	C-O-C Group	1021	1013	1011	1000-1300

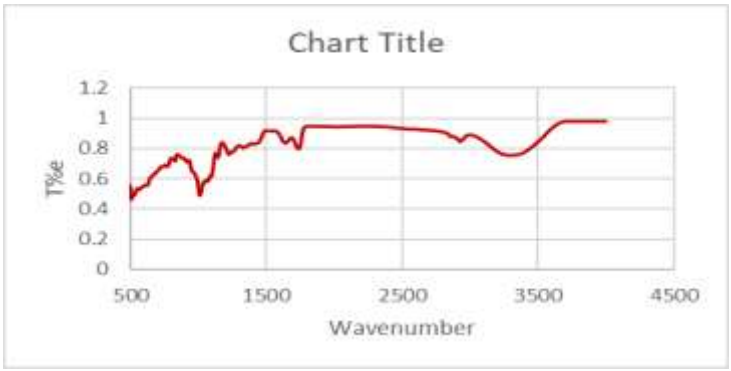

Fig 5: FTIR spectrogram of A-1

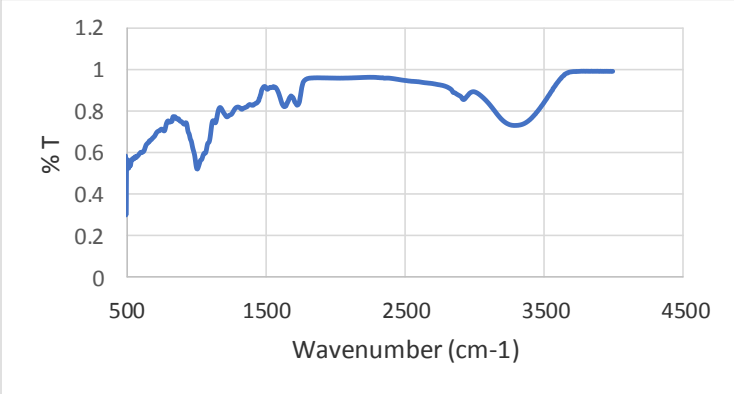

Fig 6: FTIR spectrogram of APO-1

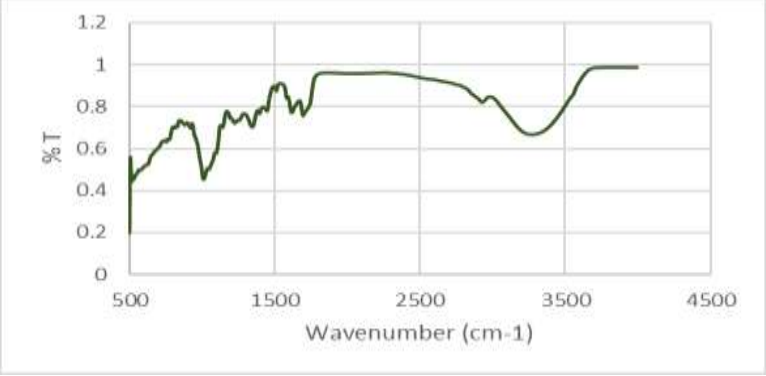

Fig 7: FTIR spectrogram of OLP-1

4. CONCLUSION

A large quantity of fruit and vegetable agro-waste is thrown without giving due consideration regarding valuable ingredients present in them. The present work addresses to the isolation of pectin, one such useful ingredient from combined fruits peels waste such as orange, apple, pineapple, pomegranate, and lime. Three combinations amongst these fruit peels waste having three types of peels each are treated in acidic medium and isolation is carried by aqueous ethanol solution. The characterization of product sample is done using FTIR technique. Based on the interpretation of spectrogram of these sample, it is observed that the present method has successfully isolated pectin from combined fruit waste. The yield varied between 12-14%. The work is demonstrative and can be applied to combined fruit peel waste collected from kitchen, hotels, fruit juice corners etc.

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