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SUSTAINABLE UTILIZATION OF FRUIT WASTE: PECTIN

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ABSTRACT: Fruits and vegetables are highly used food products. With rising population of India, the production as well as processing of horticultural crops has exponentially improved to meet its increasing demand. Processing of fruits and vegetables generate a large amount of peel waste, which has led to big nutritional and economic loss and create environmental issues. Value added products can be generated through horticultural waste leading to its sustainable utilization. In the recent years isolation and characterization of natural pectin has gained attention of the consumers, as interest in natural food has grown enormously over the last decades. Pectin was isolated from oranges, mango, jackfruit and raw papaya waste. Pectin was extracted from these peels by acidified water having pH 1.5 containing Calgon. The precipitated pectin was purified with absolute alcohol and percent yield was found to be 16.3, 19, 6 and 8 for orange, mango, jackfruit and raw papaya respectively. The extracted pectin was characterized mainly for degree of esterification, methoxyl content and anhydrouronic acid content. Pectin can be used as a natural emulsifier, gelling agent and stabilizer. Extracted pectin from peel waste is a natural and vegan alternative to synthetic emulsifier and gelling agent.

Key words: - Pectin, anhydrouronic acid, gelling agent, Calgon, vegan

INTRODUCTION :

India is known for its high tropical fruit production. Part of fruit produce is consumed fresh, a part is exported while a major portion of fruit produce goes to the food processing industry, where fruit waste, which are highly perishable and seasoned, is a problem to the processing industry and pollution monitoring. Now-a-days food processing industries have been mushrooming at a rapid pace in India due to increasing consumption of convenience food which leads to linear increase in biodegradable waste. These wastes are prone to microbiological spoilage thus limiting further exploitation. Drying, storing and utilizing such fruit waste for production of convenient products becomes inexpensive, eco-friendly & sustainable. Rise in health consciousness and multifunctionality of pectin has led to the growth of the pectin industry. The numerous functional groups present in the structure of pectin can stimulate different functionalities and certain modifications can enable pectin for countless applications in food, agriculture, drugs, cosmetics and biomedicine. Pectin, a natural polysaccharide belongs to a group of polyuronates undergoing chain-chain association and forming hydrogels upon addition of divalent cation or pH.[1] It is composed of D-galacturonic acids linked with β-1,4 glyosidic bonds, galacturonate units are esterified as methyl galacturonate, whose extent is reported as degree of esterification.[2] There are two types of pectins, high methoxyl pectin & low methoxyl pectins. The best known property is that it forms gel with sugar and acid. The chemical characteristics of pectin that influence the gel strength are the degree of esterification. equivalent weight and methoxyl content.

Commercially available pectin is usually extracted from citrus fruit and apple pomace. The pectin market size is estimated to account for a value of USD1.0 billion in 2019 and is projected to grow at a CAGR of 6.5% from 2019

to reach a value of USD 1.5 billion by 2025.[3] With Increasing Demand of pectin the other raw materials can be considered for their potential for extraction of pectin. An attempt was made to extract pectin from raw papaya and jack fruit, orange and mango and characterize the extracted pectin and assess its jelly forming quality.

MATERIALS AND METHODS:

Materials: Orange and Mango peels were procured from NOGA (Nagpur Orange Growers Association) Motibagh, Nagpur, whereas Papaya and Jackfruit peel waste was procured from local fruit & vegetable vendors from Khamla Market, Nagpur. All the other chemicals were procured from HI -media.

Method: Fruit peels were segregated and pre-treated separately. The peels were cut into small sizes and washed with warm water to remove impurities. After washing peels were blanched in boiling water for 2 min. to inactivate the pectic enzymes. These treated peels were dried in a drier at 65^{o} C. Peels were ground to 8 mesh size and stored in a desiccator/polythene bag at room temperature for further use.

Extraction of pectin - Peels were extracted at 90 ^{o}C for 30 min. with acidified water which was made acidic to a pH of 1.5 with HCl in presence of Calgon. The contents were strained through muslin cloth. The procedure was repeated twice with acidified water (pH 1.8) in presence of calgon. All the extracts were filtered through muslin cloth and combined. For precipitation of pectin, 1% HCl was added to the combined extracts & pectin was precipitated by addition of absolute alcohol which was twice the quantity of extract. The precipitates were washed successively with 60, 80 and 95% alcohol with retention time of 30 min. in each washing for purification. This purified pectin was fridge dried, ground and packed in an airtight container.[4]

Analysis of Pectin

Proximate Analysis of pectin - Proximate composition of pectin was determined by the standard AOAC procedures.[5]

Analytical Methods[6] - The quality & characteristics of pectin was judged by determining methoxyl content, degree of esterification, Anhydrouronic acid content and jelly grade.

Equivalent Weight- Accurately 0.5 grams of pectin sample was moistened with 5 ml. ethanol. NaCl was added to sharpen the end point and titrated with NaOH to determine equivalent weight. This neutral analyte was used for determination of methoxyl content.

Methoxyl content- 25 ml of 0.25 N NaOH was added to the neutral solution containing 0.5 grams of sample. It was then properly shaken and kept for 30 min. at room temperature. To this solution again 25 ml of 0.25 N HCl was added an titrated with 0.1 N NaOH and methoxyl content was calculated.

Anhydrouronic Acid (AUA)- Alkalinity of ash was determined and anhydrouronic acid was calculated.

Degree of esterification - The degree of esterification was calculated using the methoxyl content & AUA values.

Jelly grade Determination – It was measured by Test jelly method under standard conditions (TSS 68^{0} B, PH 3.2). The sugar, water and citric acid was kept constant, while pectin content was varied. The quality of the gel was judged and jelly grade was calculated for the well set and firm gel.[7]

Viscosity determination of Jelly - Viscosity determination was done at 27^{0}C using the Ford cup (No. 4) method.[8] Viscosity of pectin from orange, mango, raw papaya & jackfruit peels was compared with Standard pectin. Pectin jelly was prepared at different concentrations (1,2,3%) using sugar. Citric acid was added to adjust the pH to 3.0 ± 0.5.

The relative viscosity of pectin at different concentrations have been reported in Table 3.

RESULT & DISCUSSION:

Percent Yield: Pectin yield for orange, mango, jackfruit & Papaya was found to be significant. Acid extraction yield for orange was found to be 16.3, for mango 19%, for jackfruit 6% and for papaya 8%. Mango showed an exceptional high yield. jackfruit & papaya pectin yield was substantial but it was less as compared to mango & orange.

Characterization of pectin: Characterization of powdered pectin obtained from orange, mango, jackfruit & papaya was carried out for various parameters to evaluate its suitability in food systems. The moisture content, ash content, anhydrouronic acid, degree of esterification, methoxyl content & equivalent weight are given in Table No.2

Pectin

The presence of methyl group is a very important feature of pectin which affects their functionality. The pectin is divided into high and low methoxyl pectin and this was measured by degree of esterification. The degree of esterification is an important factor in evaluating the setting time of pectins & AUA contents on the higher side indicates a better quality of pectin. Orange and mango showed more than 72% of degree of esterification which forms fast setting jelly with no sugar. Jackfruit and papaya have DE values between 45 -65% and thus forms slow setting jelly.[9] Orange and mango peels showed a high methoxyl content of 6.07 & 7.6 respectively, this also reflects in their higher degree of esterification values. Anhydrouronic acid content suggests purity of pectin according to the Food Chemical Codex of 1996. The AUA of pectin should not be more than 65% to be classified as pure.[10] As all the values of AUA are below 65%, it shows that extracted pectin are not contaminated.

Relative viscosity Determination: Relative viscosities of extracted pectins were compared with standard pectin. 2% concentration of orange & mango found to be comparable with standard pectin. (Table No.3)

Jelly grade is the weight of sugar with which one part of weight of pectin under suitable condition form a satisfactory gel.[11] As the methoxyl content increases the spreading quality and sugar binding capacity of pectin increases. Mango pectin was found to form firm jelly as compared to jellies by orange and papaya whereas jackfruit jelly was watery.

CONCLUSION:

Present study aims on extracting and characterizing pectin from jack fruit, raw papaya, mango and orange peel to observe whether they have the potential to become an important raw material for pectin production. Pectin quality was found to vary with fruit peel waste used as raw material. The pectin yield was significantly low in Jackfruit and papaya. The degree of esterification for extracted pectin was higher than 50% for orange, mango and papaya except jackfruit which classifies them as high methoxyl pectin. Pectin extracted from all the four types of peel waste showed better grade of purity. Pectins are soluble fibres and often replace gelatin in plant based recipes so can be used as vegan alternative in food product. Various other sources can be exploited for pectin extraction and can be used to make new useful products and create a sustainable circular economy that is better for the environment, thus harnessing wealth from food waste.

REFERENCES:

C. Agnieszka, L. Andrzej et.al.,2013. Effect of Quantity of low methoxyl Pectin on physical properties of freeze dried strawberry jellies, Journal of Food Nutrition Science, Vol. 65 (4), pp233-241.

H.D.W.G Belitz and P. Schieberle, 2004. Chemistry of Pectin, Food Chem., 4th Revised extended edition Springer, Berlin.

Pectin market -Growth Trends and Forecast (2019-2025), 2019. (Available via http://www market sandmarkets.com/Market Report. Report code FB 7357 Sep 2019.)

D. V Sudhakar, and S.B Maini,1995. Pectins from fruit processing waste- A review, Indian Food Packer,60, pp39-56

AOAC official methods of analysis, 1970. 11th ed, Washington,D.C., pp 214

S. Ranganna, 1986. Handbook of Quality control of fruits and vegetable products, Tata McGraw Hill publishing Co. Ltd; New Delhi

H.S. Owens et al, Chemistry and Technology of Pectin. edited by Reginald H., Academic Press Inc. 1991

Georgina Sosa, 2005. Standard Test Method for Viscosity by Ford Viscosity Cup, Designation D 1200-94 (Reapproved 2005) American Society for Testing & Materials, International Standard Organization

R. K. Shaha, Y.Nayagi et.al, 2013. Optmized extraction condition & characterization of pectin from Kaffir lime (Citrus hystrix), Malaysia: Research Journal of Agriculture & Forestry Sciences, 1(2): pp1-11)

A.T. Katherine et.al, 2019. A comparative study of characteristics of pectins from various fruit peel waste extracted using acid and microbial enzymes, Journal of Microbiology, Biotechnology & Food Science, Vol.9 (2), pp 1-7

E. A. McComb and R. M. McCready, 1952. Extraction & Determination of Total Pectic materials in Fruits, Analytical Chemistry, 29, pp819

Table No.1-Pectin Yield in % at pH 1.5

Pectin	% Yield
Orange	16.3
Mango	19
Jackfruit	6
Papaya	8

Table No.2- Chemical Properties of Extracted Pectin

Parameter(in%)	Orange	Mango	Papaya	Jackfruit
moisture	3.7	2.7	7.32	9.20
ash	2.8	0.9	4.3	8.34
AUA	62.4	60.6	57.2	50.2
D.E	76	77.5	54.5	44
MeO	6.07	7.6	5	3.6

(AUA- Anhydrouronic acid, D.E- Degree of Esterification, Meo- Methoxyl Content)

Table No.3- Relative viscosity of pectin extracted from orange, mango,papaya and jackfruit peels

Concentration	Relative viscosities				
	standard	Orange	Mango	Papaya	Jackfruit
1%	2	2.7	2.5	1.8	1.2
2%	4.5	4.8	4.9	2.9	1.9
3%	12	8.0	8.4	4.1	2.4