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Value Added Products from Agriculture: Extraction of Pectin from Agro Waste Product *Musa Acuminata* and *Citrus* Fruit

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Abstract

Background: Pectin is a chemical substance composed of polymers of D- galacturonic acid which esterifies with methanol. Pectin normally occurs in the primary cell wall of plants and has the function of cell to cell adhesion. Pectin is commercially used for gelling purpose in many industries thus is of great economic importance. Purpose: India despite of having abundant natural resources has failed in its agricultural business globally, this is because the farmers are into vicious cycle. By using agro – waste raw products thus minimizing the product loss and achieving high quality products, could be a solution to the problem. Our study is putting forward a new innovative way for isolation of pectin from Musa acuminata and citrus fruit. Result: Results obtained suggest that agro waste of banana can be used as the potential source of pectin.

Keywords: Pectin, *Musa acuminata* and *citrus* fruit.

Introduction

Banana being one of the most important fruit crops in the world belongs to the genus Musa and family Musaceae. In country like India it is used in religious ceremonies. Banana and its plant have made its significant hold in the old medicine forms of the country. The whole body of the plant is rich in carbohydrates, dietary fibers; minerals like manganese, potassium and Vitamins such as vitamin C and vitamin B [1]. Plant finds its importance in industries like food, pharmaceutical, packing and feed. Pectin being the major component in the plant and is of more economic importance. Most of the pectin materials these days are seeking importance in the industrial field as it has properties of forming gels. Gels formed with high and low methoxy content both are being worked on in food industries as pectin has role to play in human's diet[2]. Pectin is used extensively in pharmaceutical industries. Its effectiveness in drug delivery system is been studied as it is degradable in the body[3]. So aim of our study was to extract pectin from agro waste product like Musa acuminata and citrus fruit peel, samples by Alcohol precipitation method and characterisation of pectin.

Material and Methods

Raw materials of the banana plant i.e. stem, leaf and peel and citrus peel were collected from the local market. Ethanol (MERCK), Hydrochloric acid (MERCK).

Methodology: Extraction of pectin by alcohol precipitation method, Different parameters were used to calculate the percentage yield of pectin. The parameters used were pH, temperature and time.

The dried pectin samples obtained from parts of banana plant (stem, leaf, peel) and orange fruit peel were subjected to qualitative and quantitative tests and then were characterized.

Qualitative tests performed: Colour, solubility in hot and cold water, solubility in hot and cold alkali, sugar and organic acids.

Pectin colour: Dried pectin samples were observed visually and the colours of samples were noted down.

Solubility in hot and cold water (dry pectin): 0.03g of the pectin samples were taken in different conical flasks with 10 ml of 95% ethanol added followed by 50 ml distilled water. The mixture obtained was shaken vigorously and a suspension was formed which was then heated at 85-95°C for 15 min using magnetic stirrer[3].

Solubility in hot and cold alkali (NaOH): To 10ml of 0.1N NaOH taken in a conical flask, 0.1g of dry pectin was added and was heated at 85-90 °C for 10- 15 minutes using magnetic stirrer[4].

Sugar and organic acids: 0.1g of pectin samples were taken in 250ml flask each and 5 ml ethanol was added to moisten it, which was then followed by 100ml water which was poured rapidly, shaken and allowed to stand for 10 min to this solution 100ml ethanol containing 0.3ml hydrochloric acid was added, mixed and filtered using muslin cloth, filtrate was collected and 2.5 ml of filtrate was measured and then transferred to a conical flask, the liquid was then evaporated on direct flame and the residue was collected which was then dried in an oven at 50°C for 2 h.

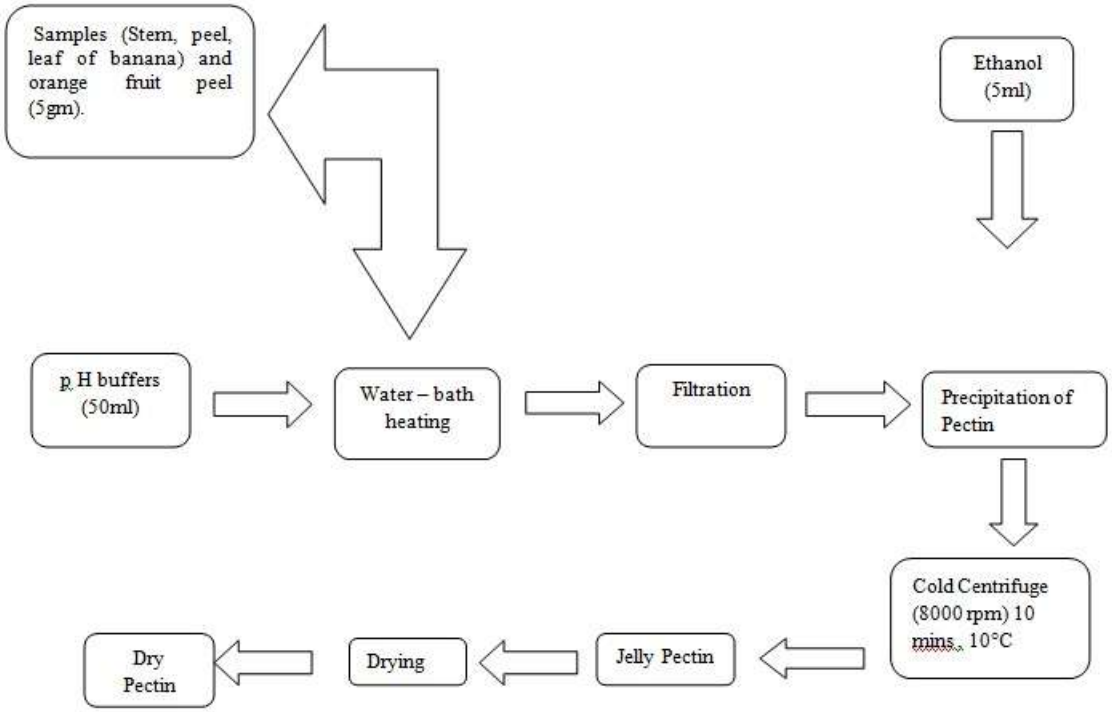

Figure-1

Quantitative tests performed: Determinations of equivalent weight, methoxyl content, ash content and moisture content.

Determination of Equivalent weight (E.W): In a 250ml conical flask 0.1g of pectin sample was taken and to it 5ml of ethanol was added. To the flask Sodium chloride (1.0g) was added and 100ml distilled water was poured into the flask. Phenol red (1-2 drops) is used as indicator. It was ensured that the pectin sample was dissolved without clumping and it was titrated against 0.1M NaOH till pink colour appeared in the end point[8].

Calculation: E.W= (weight of pectin sample/ Volume of Alkali (cm^3) X Molarity of Alkali X100

Determination of Methoxyl content: Neutralized solution obtained after equivalent weight determination was used. 25mL of NaOH (0.25M) was added to the neutralized solution. This mixture was stirred and allowed to stand for 25- 30mins at room temperature[8].

Calculation: % Methoxyl content = Volume of Alkali (cm^3) X Alkali X weight / Weight of Pectin (mg) X100

Determination of Ash content: To a weighed empty crucible 0.1 g of each sample was taken. The crucible was placed in the furnace for 2 hours and the temperature was set to 100°C so that all the organic matter was burnt off leaving behind ash. Once the whole organic matter is charred the crucible was placed in the desiccators to cool down and then the crucible was reweighed[8].

Calculation: % Ash content = (Weight of residue/ Weight of pectin) X100

Determination of Moisture content: An empty Petri dish was taken dried in oven and cooled in dessicator and the empty weight was noted. To the Petri dish 0.1 g of pectin was transferred and placed in oven set at 130°C for an hour. Then the Petri dish was removed, cooled (in dessicator) and reweighed[8].

Calculation: % moisture content = (weighed of residue/ weight of pectin) X 100

Results and Discussion

In our study we have worked on effect of pH, temperature and time on isolation of pectin. By doing this we could find out the Optimum parameters (pH, temperature and time) for different isolated pectin samples. The samples used were the banana stem, leaf, peel and orange fruit peel. Citrus being one of the most commercially used agro-waste for isolation of pectin. Optimum pH for samples was at pH 3, Optimum temperature for stem, leaf and peel were 100°C, 80°C and 60°C respectively. Optimum time for stem sample was 10 minutes, leaf sample it was 10mins, and peel sample it was 30 minutes. Optimum pH for orange peel was at pH 1, optimum temperature was 70°C and optimum time was 30 minutes. The equivalent weight was found to be 250,166.6, 181.1 and 200 mg/mol respectively; while the methoxyl content (%) for the 4 samples were 31.86%, 25.04%, 29.76% and 33.108%. The % moisture content obtained was 18%, 10%, 24% and 28% respectively. The percentage ash content obtained was 12%, 6%, 8% and 2%

respectively.

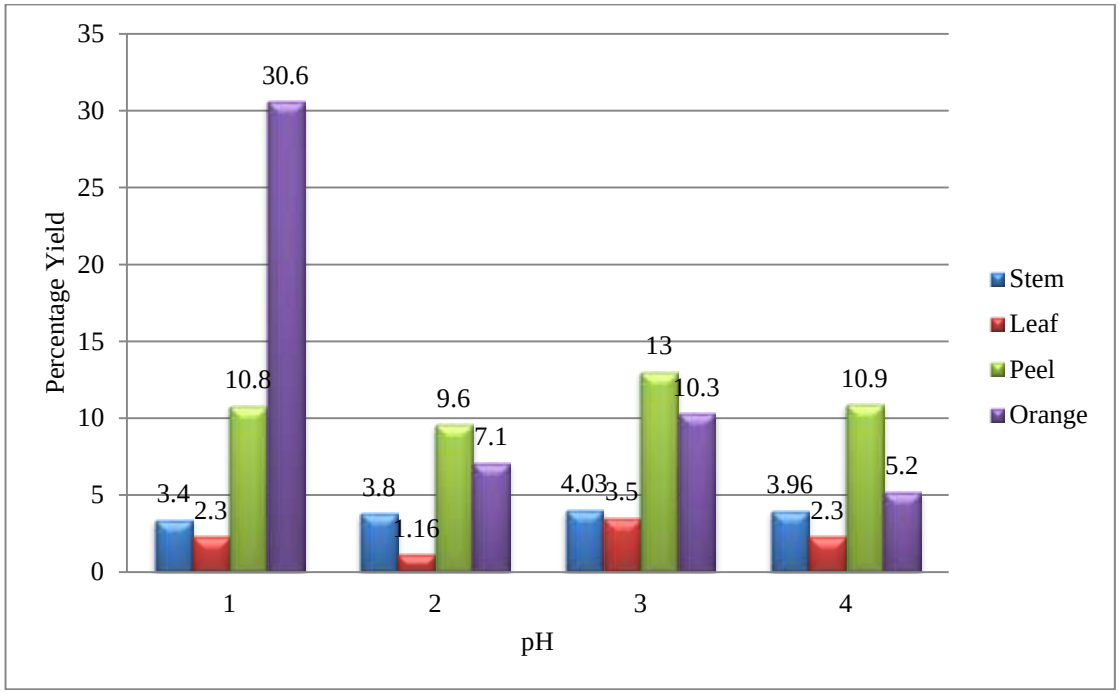

Figure-2
Effect of pH on yield of pectin

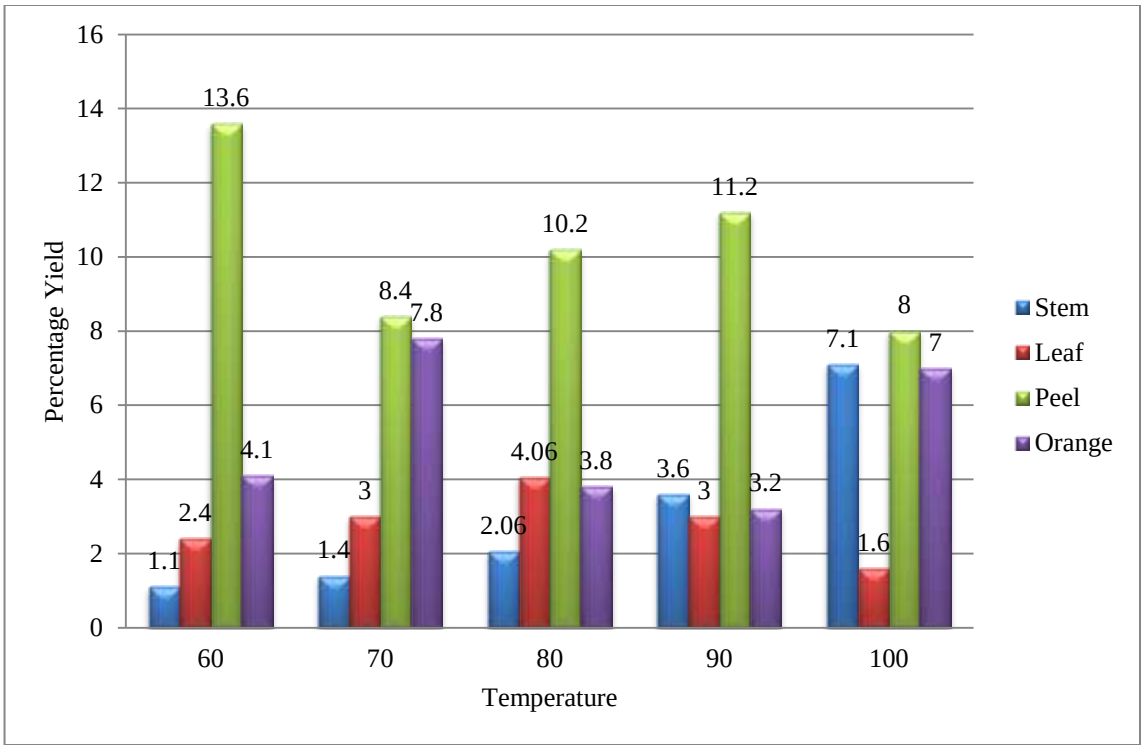

Figure-3
Effect of temperature on yield of pectin

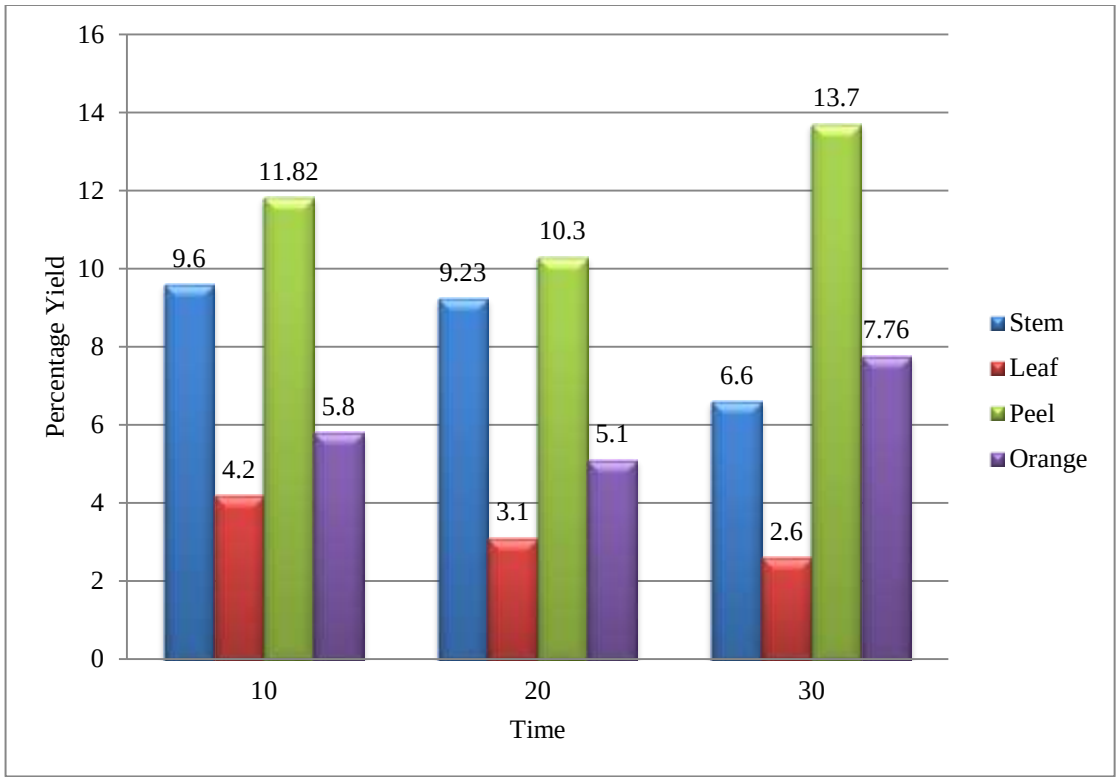

Figure-4
Effect of time on yield of Pectin

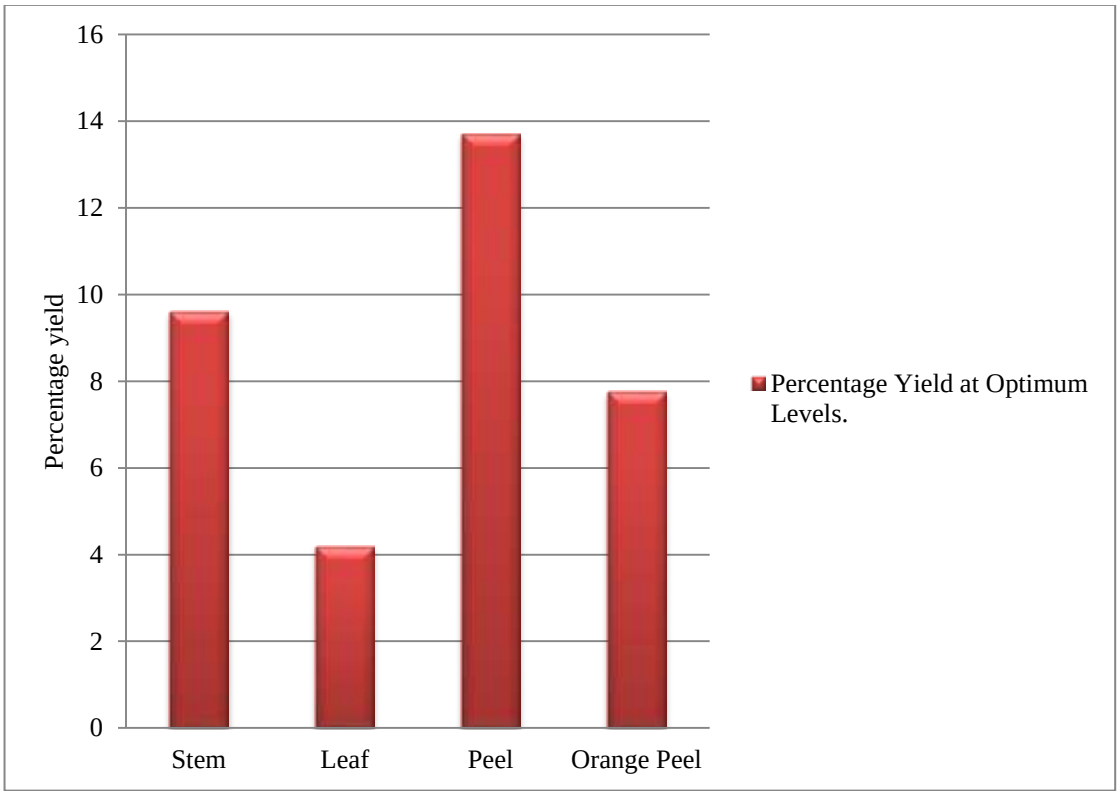

Figure-4
Highest yield of pectin at Optimum conditions

We in our studies are putting forward a new innovative way for isolation of pectin from banana samples. The result obtained showed significant percentage yield of about 13.7% in peel of banana. Thus we can consider peel as a fruitful source of pectin which can be utilized in commercial production of pectin.

Conclusion

Pectin has been successfully extracted from the four samples with different extraction parameters. The results from the present study indicated that peel and stem of *Musa acuminata* showed highest pectin yield. Peel has been the excellent source of pectin which was extracted by alcohol precipitation method. This study was intended to identify if *Musa acuminata* could be a potential source for pectin source and if there is any, the optimum conditions which could be determined. From the results obtained, *Musa acuminata* gives a significant amount of pectin whereby it can be considered in commercial production of pectin alongside with other citrus sources.

The optimum levels for each sample were as tabulated:

Table-1
Optimum conditions for samples

Sample	Optimum pH	Optimum Temperature (°C)	Optimum Time (Minutes)
Stem	3	100	10
Leaf	3	80	10
Peel	3	60	30
Orange peel	1	70	30

Acknowledgements

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Table-2
Qualitative tests and its result

	Stem	Leaf	Peel	Orange peel
Colour	Brown	Green	Dark brown	Orange
Solubility of dry pectin in cold water	Insoluble	Insoluble	Insoluble	Insoluble , imbibes water, swells after vigorous shaking
Solubility of dry pectin in hot water	Insoluble	Insoluble	Insoluble	Sparingly soluble
Solubility of dry pectin in cold alkali (NaOH)	Sparingly soluble	Sparingly soluble	Sparingly soluble	Sparingly soluble
Solubility of dry pectin in hot alkali (NaOH)	Partially soluble	Partially soluble	Partially soluble	Partially soluble
Sugar and organic acids	68%	36%	48%	30%

Table-3
Quantitative tests and its result

Sample	Stem	Leaf	Peel	Orange
Equivalent weight(mg/mol)	250	166.6	181.1	200
Methoxyl content	31.86%	25.04%	29.76%	33.108%
Ash content	12%	6%	8%	2%
Moisture content	18%	10%	24%	28%

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