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Extraction of Pectin from Orange Peels and Optimization of Process Parameters

Lakshmana Naik R[1*], J. Mamatha[2], J. Bhargavi[3], T. Nayomi[4], B. Hema[5]

[1,2,3,4,5]Department of Chemical Engineering, AP IIIT, RGUKT, RK Valley, India

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***Abstract*:** The aim of the study was to extract pectin from orange peels. Orange peels are a major commercial source of pectin. Pectin is one of the major important product used in various applications such as food processing industries, pharmaceuticals and its traditional jelling agent for jam and jellies. In the past many researches working on the development of the part of the process technology needed for the extraction of value added products i.e. Pectin from orange peels. Many operating parameters are affecting on the extraction of pectin. It is necessary to understand the effect of various operating parameters on extraction of pectin, in present study effect of Temperature, Solvent used for extraction and time used for extraction where discussed. The effects of pH on extraction of pectin were also discussed; pH is one of the most important crucial parameter which effects on extraction of pectin. When the process conditions were varied, a maximum yield of 52% was obtained, when the temperature at 90°C, pH=1 by using citric acid as a solvent. This study extends the effect of operating parameters an extraction of pectin from orange peels.

***Keywords*—**Pectin, Extraction, Operating parameters, Orange peels.

I. INTRODUCTION

Pectin has been recognised for at least 127 years back and was originally identified in 1790 in apples by the French Chemist Nicholas Vauqlin. It was not until 1824 that further work on pectin was under taken by Braconnot who named the acid, gelling substance pectin acid after the Greek word for gelling or congealing. Later, in the 1920s and 1930s, factories were built that commercially extracted pectin from dried apple pomace. In 1924 Smolenski identified the gelling substance as a polymer of galacturonic acid and later on in the 1937 Schneider and Bock established the basic formula of pectin. Now a day pectin recognised as a complex polymer that is present in many plants as a component of the middle lamella. Pectin is used extensively in the food industry as a gelling agent and is the key gelling agent in jam manufacture which is still one of the biggest markets for pectin. In the past Pectin sold as a liquid extract, but is now most often used as dried powder, which is easier than a liquid to store and handle. Pectin is a naturally occurring biopolymer that is finding increasing applications in the pharmaceutical and biotechnology industry. It is also used in the food and beverage industry as a thickening agent, a gelling agent and a colloidal stabiliser. Pectin occurs commonly in most of the plant tissues, the number of sources of pectin include citrus peels, sugar beets, residues of mango, guava, coffee, dried apple pomaco, sunflower heads, papaya, and cocoa processing. Currently half of the commercial pectin's used in the food industry are extracted from citrus peels. New application opportunities have emerged and pectin is no longer just a gelling agent but also used in wide applications.

II. MATERIALS AND METHODS

Material: All the chemicals and solvents are used for this study are citric acid and nitric acid Ethanol, Orange peels, Distilled water. The following material was used during laboratory work. Knife, Digital pH meter, Filter paper.

III. SAMPLE PREPARATION

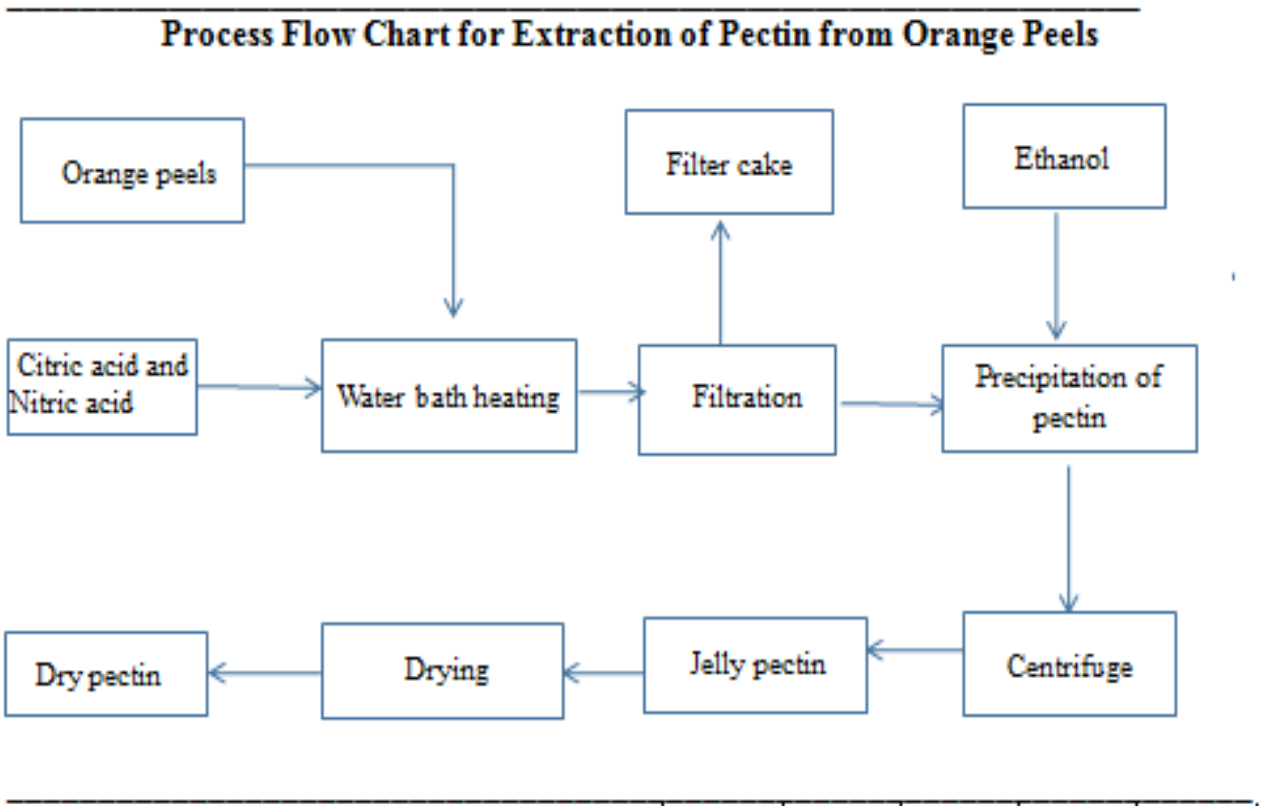
The orange fruits cut into four parts and peel removed, then peels were further cut into smaller pieces for easy drying and washed with large quantity of water to remove the glycosides the bitter taste of the peels and then weighed with a digital weighing balance and a dried.

IV. EXTRACTION OF PECTIN FROM ORANGE PEELS

Orange peels are dried for four days. After drying crush the dry peels and convert it into powder form. For the extraction of pectin orange powder is used for further experimentation. The solution having concentration of Citric acid and Nitric acid was prepared i.e.0.1M, 0.5 M and 1M of PH 1.0, 1.7 and 2.0 respectively. Orange powder is mixed with this solution and heated for each different pH medium of extraction while stirred at different temperature 70°C, 80°C and 90°C for 15 minutes time period. The hot

acid extract was filtered and each filtrate is added different ml of ethanol. After that, Jelly like pectin is precipitated and separated by filtration and dried it. The dried product is grind into fine powder. The pectin powder is then collected and weighed. The percentage pectin yield is calculated by the ration of dry pectin collected to initial weight orange peels. The pectin yield can be calculated by following way,

$$\%\text{Yield}=\frac{Weight\ of\ dry\ pectin}{Initial\ amount\ of\ orange\ peels}\times 100$$



V. RESULTS AND DISCUSSION

Present work is under taken to study the extraction of pectin by using orange peels. In this study citric acid is used for the extraction of pectin. The extraction yield is analysed by using different pH (1-2) values with temperature of system is (70°C-90°C) with the extraction time is constant i.e. 15min. According to the results obtained by experimentation at 70°C the yield of pectin obtained is very low due to low temperature insufficient to permit the hydrolysis of proto pectin by acids, thus obtaining lower yield of pectin. The experimental runs are shown in below tables with different operating parameters such as pH, Temperature etc.

Table1 Experimental results for Citric Acid Used as a solvent @ T=70^{O}C, Amount of peels taken=10 gm, Volume of solution taken=100ml.

pH	Quantity of Acid (gm)	Volume of ethanol added (ml)	Amount of Pectin Obtained (gm)	% Yield of pectin Obtained
1.0	1.75	28	0.5	5
1.7	2.5	35	0.4	4
2.0	1	40	-	-

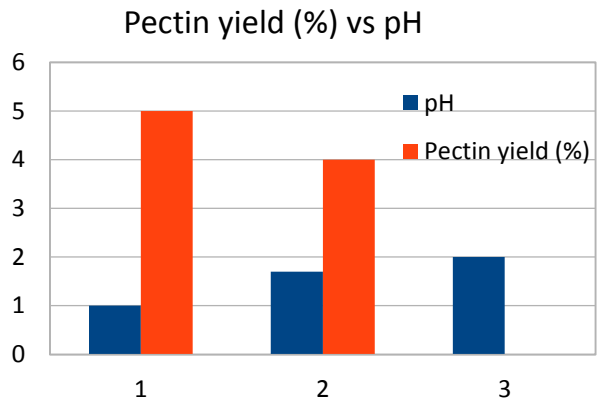


Fig1a: Pectin yield at different pH of extracting medium by using Citric Acid

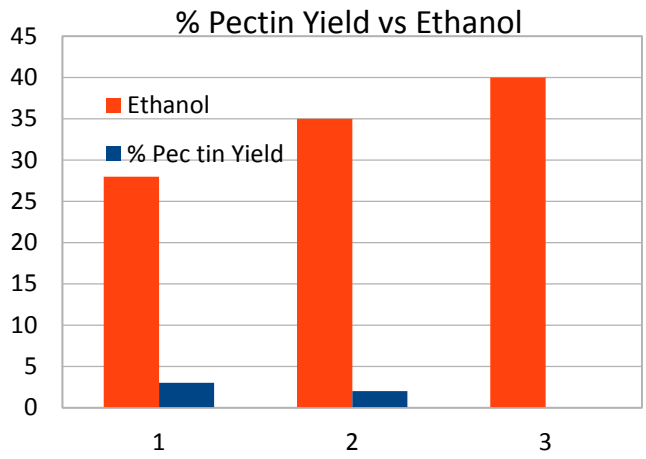


Fig1b: Pectin yield at different ml of Ethanol by using Citric Acid

Table2 Experimental results for Citric Acid Used as a solvent @ T=80^{O}C, Amount of peels taken=10 gm, Volume of solution taken=100ml.

pH	Quantity of Acid (gm)	Volume of ethanol added (ml)	Amount of Pectin Obtained (gm)	% Yield of pectin Obtained
1.0	1.75	44.5	4.55	45.5
1.7	2.5	25	2.21	22.1
2.0	1.0	35	1.15	11.5

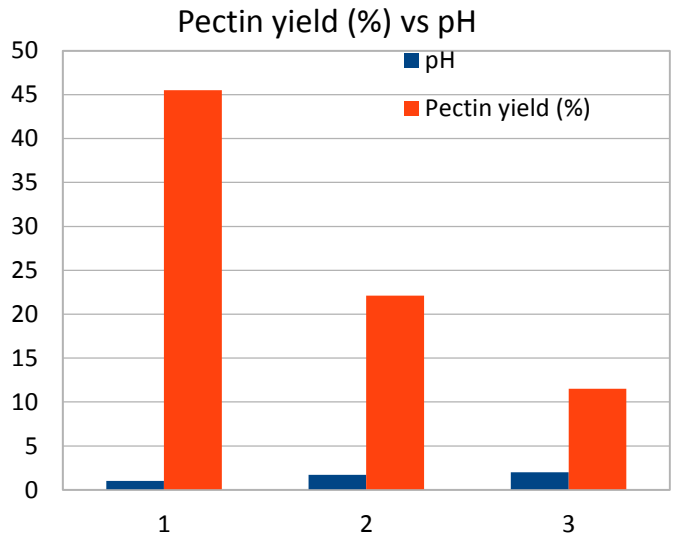


Fig2a: Pectin yield at different pH of extracting medium by using Citric acid

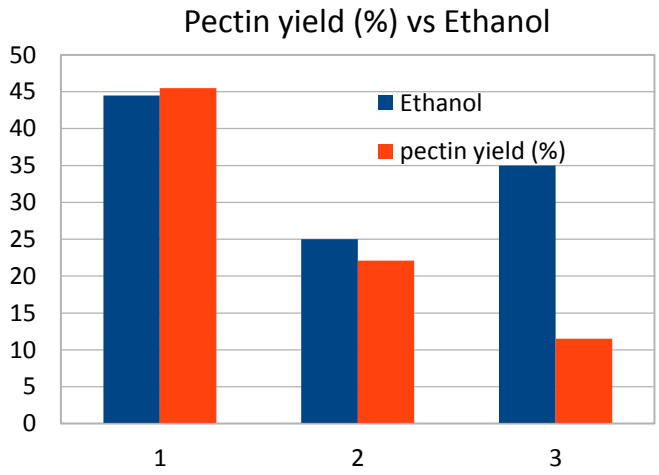


Fig2b: Pectin yield at different ml of Ethanol by using Citric Acid

Table3 Experimental results for Citric Acid Used as a solvent @ T=80^{O}C, Amount of peels taken=10 gm, Volume of solution taken=100ml.

pH	Quantity of Acid (gm)	Volume of ethanol added (ml)	Amount of Pectin Obtained (gm)	% Yield of pectin Obtained
1.0	1.75	50	5.2	52
1.7	2.5	38	2.3	23
2.0	1.0	42	1.28	12.8

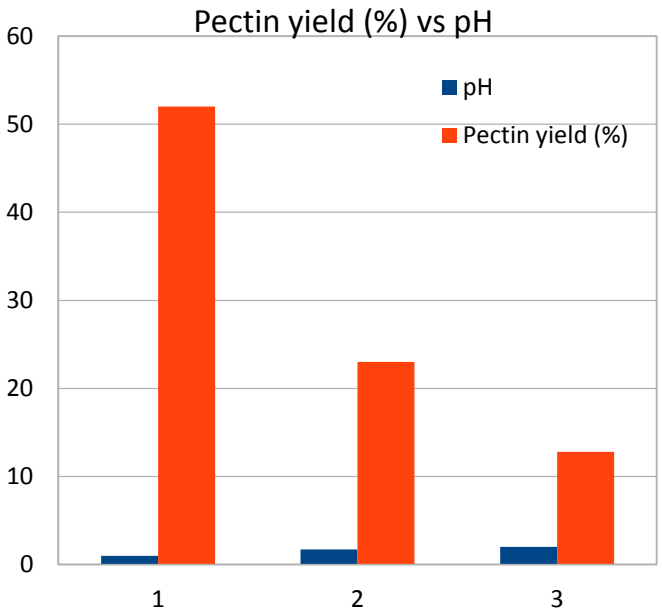


Fig3a: Pectin yield at different pH of extracting medium by using Citric acid

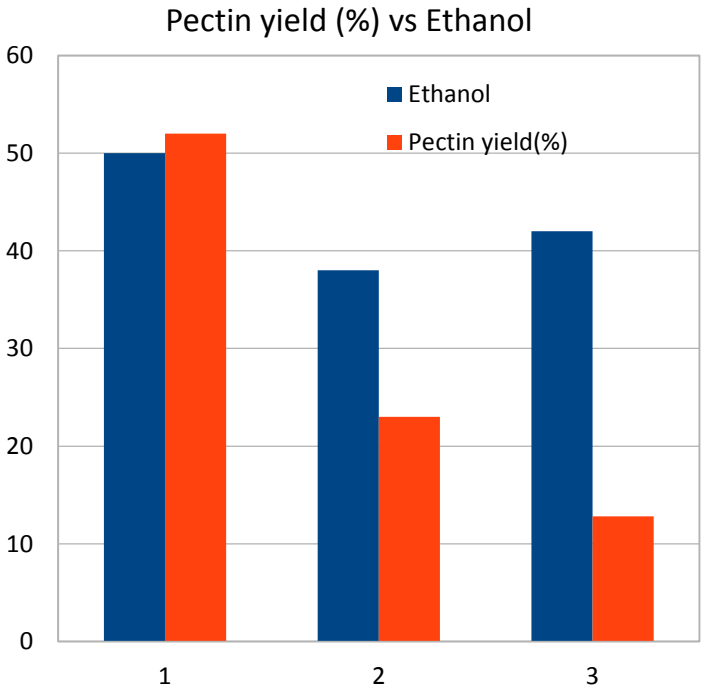


Fig3b: Pectin yield at different ml of Ethanol by using Citric Acid

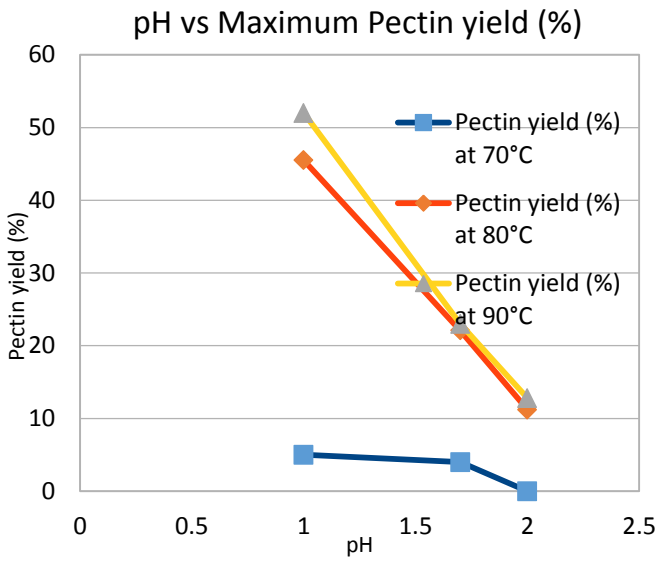


Table4 Experimental results for Nitric Acid Used as a solvent @ T=70^{O}C, Amount of peels taken=10 gm, Volume of solution taken=100ml

pH	Quantity of Acid (gm)	Volume of ethanol added (ml)	Amount of Pectin Obtained (gm)	% Yield of pectin Obtained
1.0	0.9	28	0.3	3
1.7	0.27	35	0.2	2
2.0	0.09	40	-	-

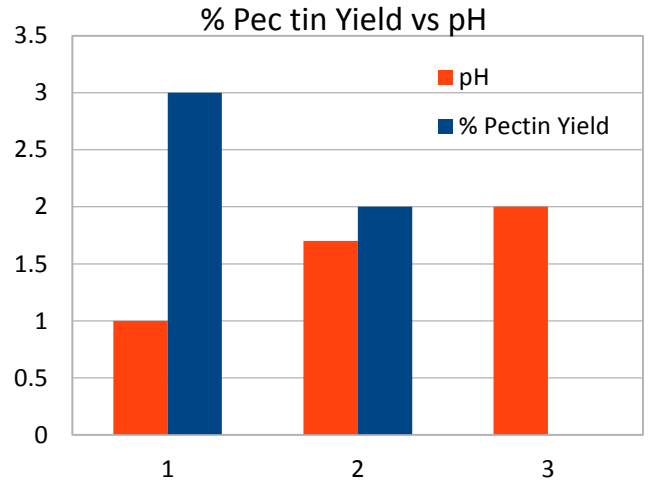


Fig4a: Pectin yield at different pH of extracting medium by using Nitric Acid

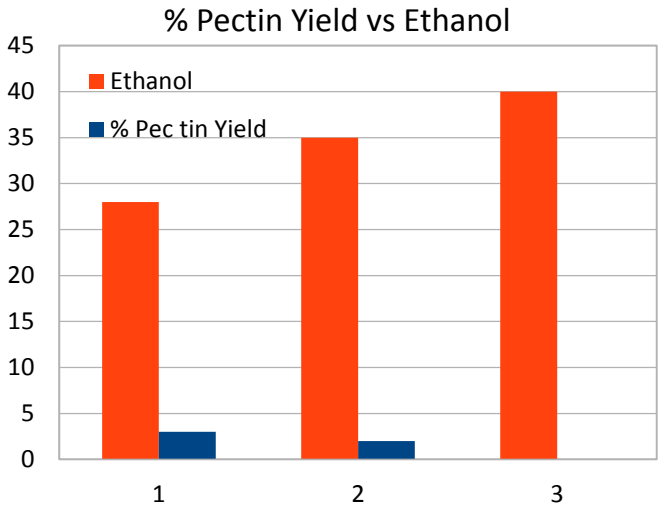


Fig4b: Pectin yield at different ml of Ethanol by using Nitric Acid

Table5 Experimental results for Nitric Acid Used as a solvent @ T=80^{O}C, Amount of peels taken=10 gm, Volume of solution taken=100ml

pH	Quantity of Acid (gm)	Volume of ethanol added (ml)	Amount of Pectin Obtained (gm)	% Yield of pectin Obtained
1.0	0.9	50	0.5	5
1.7	0.27	39	0.4	4
2.0	0.09	44	-	-

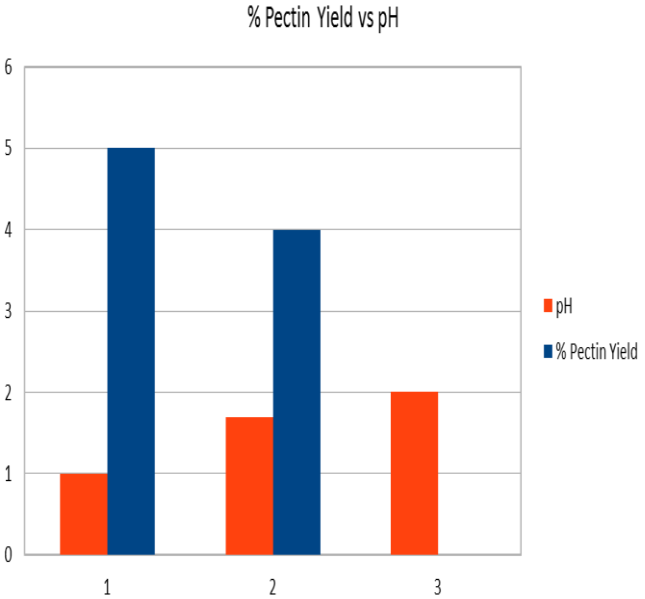


Fig5a: Pectin yield at different pH of extracting medium by using Nitric acid

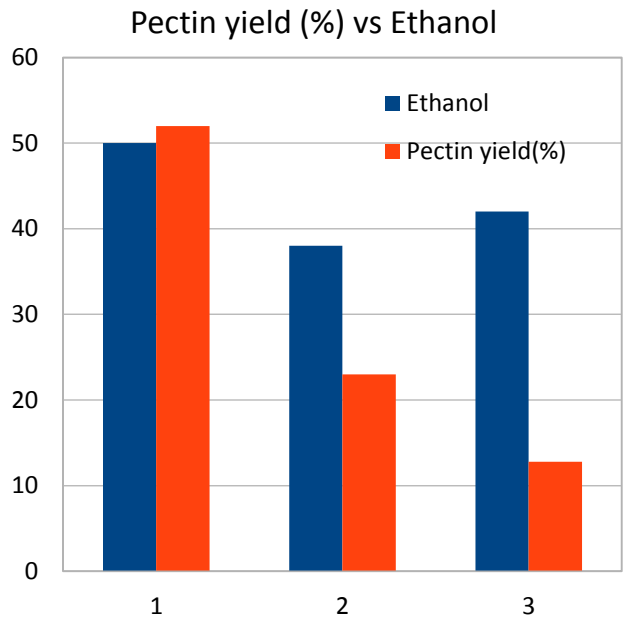


Fig5b: Pectin yield at different ml of Ethanol by using Nitric Acid

Table6 Experimental results for Citric Acid Used as a solvent @ T=90^{O}C, Amount of peels taken=10 gm, Volume of solution taken=100ml

pH	Quantity of Acid (gm)	Volume of ethanol added (ml)	Amount of Pectin Obtained (gm)	% Yield of pectin Obtained
1.0	0.9	28	0.5	5
1.7	0.27	35	0.4	4
2.0	0.09	40	-	-

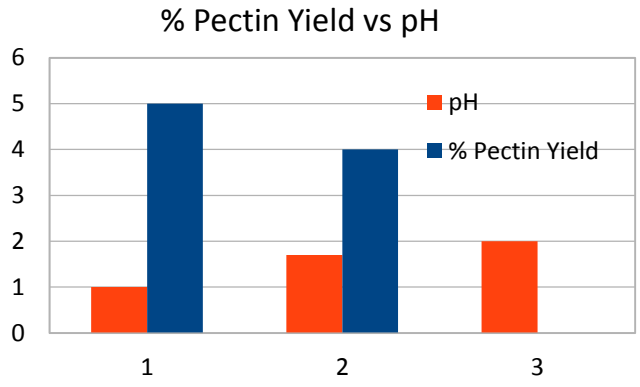


Fig6a: Pectin yield at different pH of extracting medium by using Nitric acid

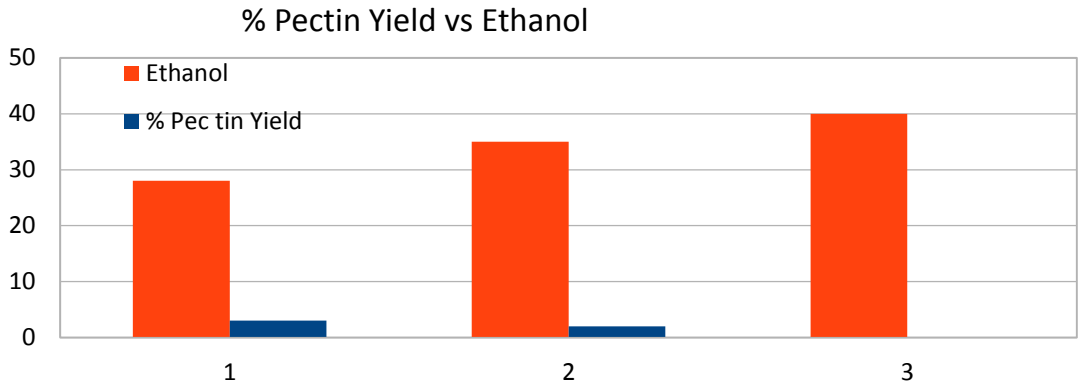
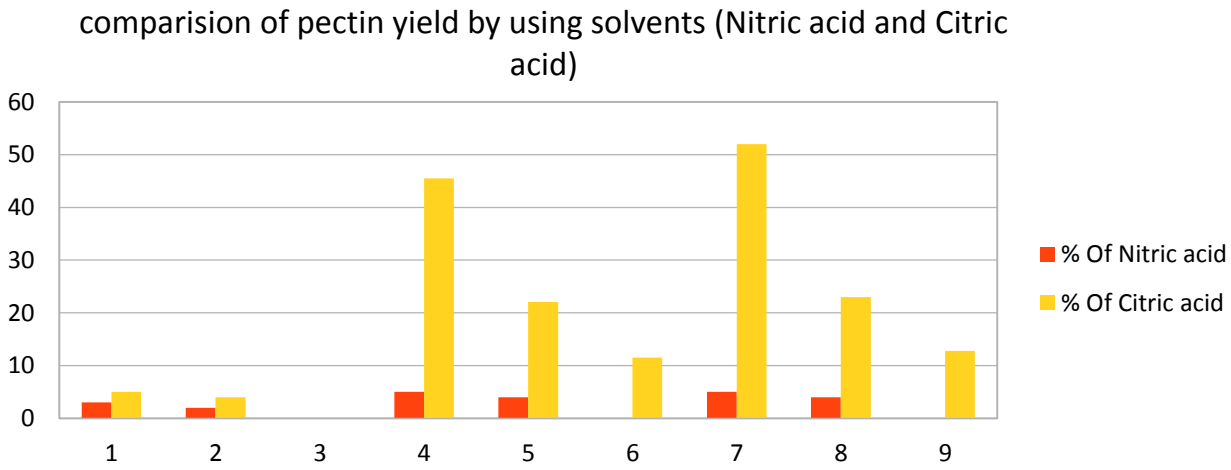


Fig6b: Pectin yield at different ml of Ethanol by using Nitric Acid



VI. FACTORS AFFECTING PECTIN PRODUCTION

From this study we observed from the table 1,2, 3,4,5,6. In extraction of pectin from orange peels affect the following parameters such as pH, temperature, solvent used for extraction. The detail parameters are discussed below.

1. P^H: It is observed that at low pH we observed maximum yield and at high pH low yield observed. This is due to when pH is lower ionization of carboxylate groups is suppressed, and this results in reduction in hydration of carboxylic acid groups. So this phenomena increases the yield of pectin. Finally we observed that the pectin yield decreased with increasing the pH values.

2. Temperature: At the lower Temperature the yield of pectin is low while at high Temperature the yield of pectin is high.

Solvent used for extraction: In this study we used solvents are Citric acid and Nitric acid. The high yield is obtained by using Citric acid as a solvent. The yield of pectin extraction is reported up to 40-55% by using Citric acid as a solvent.

VII. CONCLUSION

The review gives the idea about extraction of pectin from orange peels. The detail extraction process is described in the extraction of pectin section. The pectin has wide applications in the pharmaceutical, food industry, medical,

dairy, nutritional, health and cosmetic products. Pectin is known for being the traditional gelling agent in jams and jellies. World over, industrial waste of citrus processing industries is used as an input for pectin. Despite abundant resources, India doesn't produce sufficient pectin to cater to the domestic demand. Now a days India has better opportunity in the field of pectin production. As research and development (R&D) recently increasing to find more yield of pectin, in future we expect many innovative and exciting applications in the field of extraction of pectin.

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