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Isolation of Pectin from Kesar Mango Peel Using Cation Exchange Resin

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Abstract. Extraction of pectin from Kesar mango peel, a waste from mango canning and food processing industries, was carried out using cation exchange resin as an extracting medium. The effect of peel to extracting medium ratio and extraction temperature on yield and recovery of pectin was studied. Cation exchange resin was found to be the best extracting medium for extraction of pectin from mango peels. Maximum yield of pectin was obtained by taking two extractions each for one-hour duration employing a peel to extracting medium ratio of 1:4 (w:w), extraction temperature of 80 °C and at pH of 2.56. Using the optimum extracting conditions, about 14.78% (DWB) of purified pectin was obtained from mango peels which gave the recovery of 96.32%. The jelly grade of the pectin was found to be 170 at the optimized condition.

Keywords: Mango peel, pectin, extraction, cation exchange resin, yield

1 Introduction

Pectin is an important constituent present in the middle lamella of cell walls of various plant parts. Pectin plays a significant role in the manufacturing of fruit products like jams, jellies, marmalades, preserves, etc. and thus it is indispensable to the fruit processing industry. Pectin is also used as a thickening agent in the preparation of sauces, ketchups, flavored syrups and as a texturing agent in fruit flavored milk desserts. Besides, it has found numerous applications in pharmaceutical preparations, pastes, cosmetics, etc. [15].

Waste generated from citrus fruits and apple is the most important sources of pectin in the technologically advanced countries of the world. However, the availability of these raw materials in India is not enough to manufacture pectin sufficient to meet the local demand and hence a significant quantity of it is being imported from other countries every year [23]. In India, mango is the most preferred fruit to be processed into a variety of products right from immature to the ripe fruit stage. The waste generated from mango industry is in the form of peel, stones and pulper waste which is either gifted away for cattle feed or it is allowed to be decomposed in the field as manure [14]. Mango peel which contributes 12-15% of total weight of fruit is a very good source of some nutrients such as sugars, pectin, proteins and fibers. The free and plentiful availability of mango peels from mango processing units and the ease in their handling could make it a valuable source of raw material for pectin production [5].

Many methods are there for the extraction of pectin from fruit and vegetables wastes [21]. Pectin is generally extracted by suspending the fruit and vegetable wastes in different mineral acids and salt solutions [4], [22], [13]. But, still the pectin industry requires the standard method for extraction of pectin. From the available literature, it has been found that the extraction by cation exchange resin is the best for pectin extraction [16]. Double extractions at 85-88 °C for one hour using a cationic resin for the extraction of pectin from apple pomace have been reported to give higher yield and better gel strength of the product [11].

Looking into the importance of this process, it is highly essential to standardize the process of pectin extraction from mango peel by using cation exchange resin. In the present investigation, a method for extraction of pectin from Kesar mango peel under different processing conditions, viz. peel to extracting

medium ratio, temperature and time were evaluated to obtain the good quality pectin with better yield and recovery and hence to get potential economic value of pectin.

2 Material and Methods

2.1 Raw Material

Mango peel of Kesar variety, which is extensively used by fruit processing industries in Gujarat state of India, were procured from the Mango Canning Plant of Junagadh Agricultural University, Junagadh, Gujarat (India). The peels were thoroughly washed with tap water to remove the adhered pulp and to leach out other soluble solids followed by blanching to inactivate the enzyme capable of degrading pectins and to remove pigments. The peel was then dried in the cabinet dryer at 60 °C till moisture content is reduced to 4-6%(wb).

In the present investigation, cation exchange resin was used as an extractin medium for pectin extraction. An ion-exchange resin is an insoluble matrix (or support structure) normally in the form of small (0.5-1 mm diameter) beads, usually white or yellowish, fabricated from an organic polymer substrate. The beads are typically porous, providing a high surface area. The use of ion exchange agents containing a -SO3H (sulphonic acid) exchange group are preferable in the pectin extraction. Resins other than the -SO3H type give comparable yields but gel grades are lower [10]. Looking to this, cation exchange resin named Indion 225H was used to check the feasibility of the resin in the extraction of pectin from mango peel. Indion 225H is a strong acid cation exchange resin containing sulphonic acid groups. This resin has high capacity and excellent kinetics. The ion-exchange capacity of Indion 225H resin is about 1.8 mol/kg of dry resin [9]. The required quantity of resin was obtained from the Ion Exchange (India) Ltd., Mumbai (India).

2.2 Extraction of Pectin Using Cation Exchange Resin

Extraction of pectin using cation exchange resin was carried out under the following extraction conditions.

Quantity of dried peels	= 50 g
Extracting medium	= Cation exchange resin (Indion 225H)
pH of extracting medium	= 2.56
Peel to extracting medium ratio	= 1:2 (M1), 1:3 (M2), 1:4 (M3)
Extraction temperature	= 80 °C (T1), 100 °C (T2)
Extraction time	= 60 min
Number of extractions	= 2
Precipitation method	= Alcohol precipitation (0.05N, 95% acidified ethanol)

In background of the conclusions given by some of the scientists [16], [11] and [18] for better yield and quality of pectin, pH of 2.56 was selected for the extraction of pectin. While the extraction time (60 min) was kept constant for all the treatments in context to the recommendation given by [23], [3] and [8]. [23] indicated that all the pectin from mango peels could not be recovered in a single extraction and a second extraction was found necessary to recover most (94.6%) of it, hence, the number of extractions was kept limited up to two. [19] and [2] also found that two extractions each for one hour were necessary to recover 92.5% and 96.0% of total pectin from guava fruits and orange peel, respectively.

2.3 Procedure for Extraction of Pectin

The extraction of pectin was done in accordance with the procedure suggested by [16]. The cation exchange resin was mixed with coarse grinded dried mango peel and distilled water was added to form the aqueous slurry of mango peel and resin. The amount of added water was decided on the basis of preliminary trials and kept 10 times the amount of mango peel. The mixture was continuously stirred and maintained at selected temperatures (80 °C and 100 °C) for 60 min. Concentrated HCl was added dropwise to maintain the pH of 2.56. The extract was separated using refrigerated centrifuge

(Model:MP800, Electrocraft (India) Pvt. Ltd., Mumbai, India) at 7000 rpm for 15 min, strained through cheesecloth and the pectin was precipitated by the addition of three volumes of 95% ethanol containing 0.05 N HCl. The precipitated pectin was separated by simple filtration using muslin cloth and then washed at least twice with 95% ethanol containing 0.05 N HCl. Finally, the precipitate was washed with 95% ethanol without any added HCl and dried at 40 °C in a hot air oven and powdered. The dried pectin powder was filled in airtight polyethylene bag to avoid moisture absorption and stored at ambient temperature (30-35 °C). The major steps involved in the extraction of pectin from mango peels are given in Fig. 1 in the form of process flow chart.

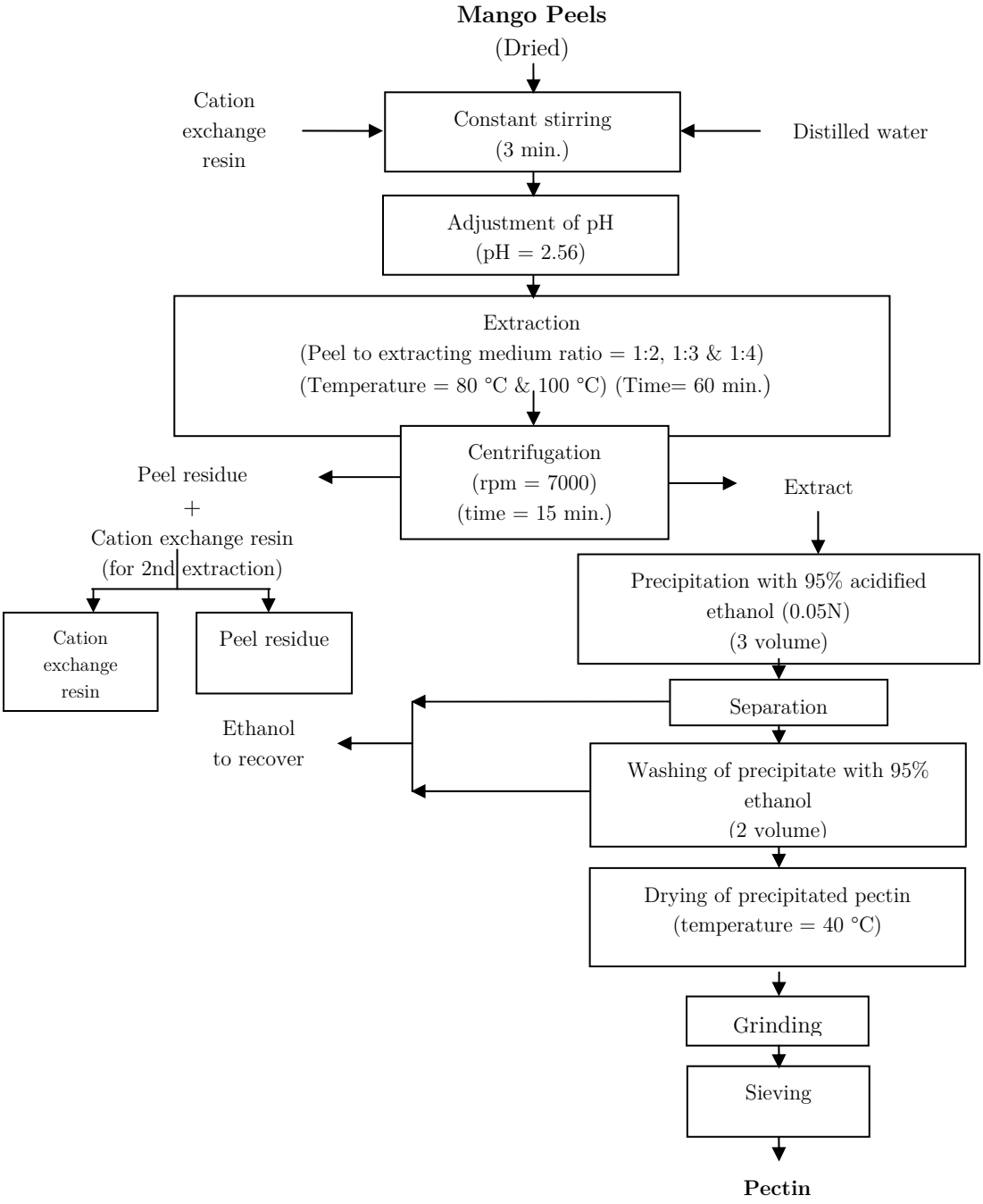

Figure 1. Experimental flow chart for extraction of pectin by cation exchange resin [16], [10], [18].

2.4 Estimation of Pectin Content in Mango Peel

To estimate the pectin content in the Kesar mango peel, the dried mango peels were coarsely grinded and 50 g of it was mixed with 300 ml of 0.01 N HCl in 1 L beaker and the mixture was boiled for 30 min. The residues and solution after boiling of mango peel were separated by cooling centrifuge. This procedure was repeated twice by boiling the separated residues first in 100 ml of 0.05 N HCl for 20 min and then in 100 ml of 0.3 N HCl for 10 min. The separated solutions were cooled, pooled and volume was made up to 500 ml by addition of water. 100 to 200 ml of pooled solution with 250 ml water was taken into 1 L beaker and neutralized with 1 N NaOH. Excess 10 ml of 1 N NaOH was added with constant stirring and allowed it to stand for 16 h. To the neutralized solution, 50 ml of 1 N acetic acid and after 5 min, 25 ml of 1 N calcium chloride were added with stirring. The solution was allowed to stand for 1 h and boiled for 1 to 2 min. After boiling, the solution was filtered through a pre-weighed Whatman No.1 filter paper. The precipitated calcium pectate was washed with boiling (75 to 80 °C) water till the filtrate was free from chlorine. The filter paper with chlorine free calcium pectate was dried in a hot air oven at 100 °C till it gets constant weight (4 to 5 h). The filter paper along with dried calcium pectate was cooled in desiccator and weight was measured. Percent calcium pectate was calculated by the formula as given below [20].

$$\%\ calcium\ pectate\ =\ \frac{Weight\ of\ calcium\ pectate\ x\ 500\ x\ 100}{ml\ of\ solution\ taken\ for\ estimation\ x\ weight\ of\ sample} \tag{1}$$

2.5 Yield and Recovery of Pectin

The yield of pectin was calculated in percent dry weight basis (%DWB) by taking the ratio of weight of pectin obtained and quantity of dried peel used in the extraction. Similarly, the recovery of pectin was determined by dividing the yield of pectin with total estimated pectin content in the dried mango peel.

2.6 Ash Content

Ash content is the residue remaining after destruction of organic matter. 1 to 2 g of pectin sample and 2 to 3 drops of ethanol were taken into pre-weighed silica crucible. The pectin and ethanol mixture was ignited slowly. Crucible with completely ignited pectin sample was placed in the electrical muffle furnace for 4 h at 600 °C temperature. After completion of process, the crucible was cooled to room temperature in a desiccator and weight was taken. The difference between initial weight of empty crucible and final weight of crucible with ash was taken as weight of pectin ash [20]. Percent ash content was calculated by the formula given below:

$$Percentage\ of\ ash\ =\ \frac{Weight\ of\ ash}{Weight\ of\ pectin}\ x\ 100 \tag{2}$$

2.7 Alkalinity of Ash

The ash obtained from 2 g of pectin sample was taken in 250 ml conical flask and moistened with a little distilled water (1 to 2 ml). To the ash water solution, 25 ml of 0.1 N H2SO4 was added and heated for 15 min. During heating, the water loss by evaporation was avoided. After heating the solutions in the conical flask, the solutions were allowed to cool at room temperature and then titrated against 0.1 N NaOH using methyl red/methylene blue as an indicator [12]. The above process was repeated for blank preparation, i.e. without pectin ash for the preparation of solution. The percent alkalinity was estimated by the following equation:

mole Equivalent = 4(a - b) N NaOH per kg of pectin.

where,

a = Burette reading for blank
b= Burette reading for pectin ash solution

$$Percentage\ of\ alkalinity\ =\ \frac{Mole\ equivalent}{10000}\ x\ 40 \tag{3}$$

2.8 Equivalent Weight

Pectin sample of 0.5 g and 5 ml ethanol was taken into the 250 ml conical flask. 1 g of sodium chloride to sharpen the end point, 100 ml of carbon dioxide free distilled water and 6 drops of phenol red indicator was added to pectin ethanol solution. The solution was shaken thoroughly till all the pectin substances were dissolved and no lumps were retained on the side of the flask. The solution was titrated slowly with 0.1N NaOH until the color of the indicator changed; the color change should persist at least for 30 sec. [20]. The equivalent weight of pectin was calculated according to following formula:

$$Equivalent\ weight\ =\ \frac{Weight\ of\ sample}{ml.\ of\ alkali\ x\ normality\ of\ alkali}\ x\ 40 \tag{4}$$

2.9 Methoxyl Content

Methoxyl content was determined by saponification of the pectin and titration of the librated carboxyl group (COOH) with standard NaOH as per the procedure described by [20]. The neutral solution was titrated for equivalent weight; containing 0.5 g pectin. In the solution 25 ml of 0.25N NaOH was added and was thoroughly shaken. The solution was allowed to stand for 30 min. at room temperature. After 30 min. 25 ml of 0.25N HCl was added to the solution. The solution was shaken thoroughly and titrated by 0.1 N NaOH until the color of the solution changes. Methoxyl content was calculated according to following formula:

$$Methoxyl\ content\ =\ \frac{ml\ of\ alkali\ x\ normality\ of\ alkali\ x\ 3.1}{Weight\ of\ sample} \tag{5}$$

2.10 Relative Viscosity

Ash and moisture free pectin sample of 0.5 g and 100 ml distilled water was taken into 250 ml beaker. The solution was stirred for 2 h till all the pectin gets dissolved in water. After 2 h, 10 ml solution was taken in Ostwald viscometer and drawn through the capillary into a bulb up to mark A. The time (seconds) required for pectin solution to flow in Ostwald viscometer from the (mark A) neck of the bulb to the bottom mark B was measured by using stopwatch. Same way, the time required to flow 10 ml distilled water was also measured by Ostwald viscometer. The temperature of distilled water was kept same as it was for pectin solution, i.e. room temperature. Relative viscosity was calculated according to formula suggested by [20].

$$Relative\ viscosity\ =\ \frac{Time\ is\ second\ to\ the\ 0.5\%\ pectin\ solution\ to\ flow\ through}{Time\ is\ second\ to\ the\ distilled\ water\ to\ flow\ through} \tag{6}$$

2.11 Jelly Grade

Grade of pectin is the number of unit weights of sugar with one unit weight of pectin. This combination forms a satisfactory jelly under suitable conditions. The jelly grade of pectin was determined by the graph plotted between relative viscosity of one percent pectin solution and jelly grade of pectin as given by [15].

2.12 Recovery of Resin

The resin used in the extraction was recovered at the end of two extractions, i.e. after complete extraction procedure. Peel residue and cation exchange resin were separated simply by washing treatment. Due to lighter weight of peel residues, it was accumulated in an upper layer while resins were deposited at the bottom. The peel residues were then removed from the top by draining along with the surface water and the resin was separated. The percent cation exchange resin recovered at the end of two extractions was calculated by dividing the weight of cation exchange resin recovered after extraction with weight of cation exchange resin used in the extraction.

2.13 Statistical Analysis

All the experiments in this study were replicated three times and the mean values were reported. Statistical analysis was done to study the effect of peel to extracting medium ratio (M) and extraction temperature (T) on yield and recovery of pectin by factorial Completely Randomized Design [17].

3 Results and Discussion

3.1 Pectin Content of Mango Peel

Pectin content in dried Kesar mango peel was estimated as percent calcium pectates. The average pectin content in the dried Kesar mango peel was found to be 15.35%.

3.2 Yield of Pectin

Graphical presentation of yield of pectin (%DWB) in first extraction, second extraction and total of it are given in Fig. 2. From the Figure, it could be seen that the yield of pectin in first extraction was ranged from 6.68 to 8.78% (DWB) with an average yield of 7.88% (DWB). While in the second extraction, it was ranged from 4.47 to 6.00% (DWB) with an average yield of 5.36% (DWB). The total yield of pectin after two extractions was ranged from 11.15 to 14.78% (DWB) with an average total yield of pectin of 13.24% (DWB). Data showed that out of the total pectin yield, 59.52% of extractable pectin could be obtained during first extraction while the remaining 40.48% of it could be obtained during second extraction. This indicated that the pectin yield during the first extraction was higher than the second extraction by 19.04%. However, in view of the recommendations given by [23], [19] and [2], two extractions were necessary to extract most of the pectin available in the mango peel. The maximum total yield of pectin (14.78%) was obtained for the treatment M3T1, i.e. peel to extracting medium ratio (1:4) and temperature (80 °C) whereas minimum of it (11.15%) was obtained for the treatment M1T2, i.e. peel to extracting medium ratio (1:2) and temperature (100 °C).

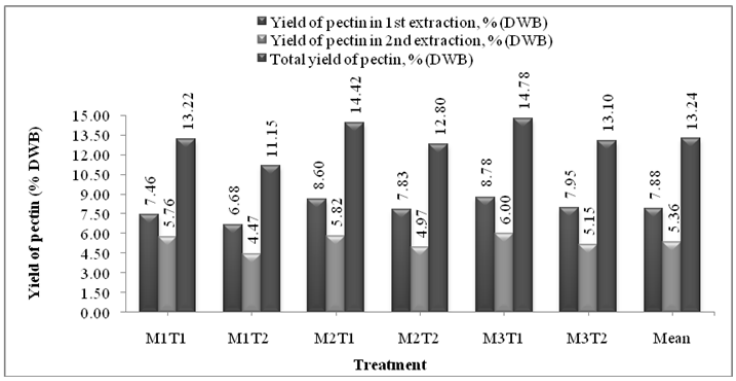

Figure 2. Yield of pectin for different treatments.

3.3 Recovery of Pectin

The treatment wise recovery of pectin in first extraction, second extraction and total as well as average of it is graphically represented in Figure3.

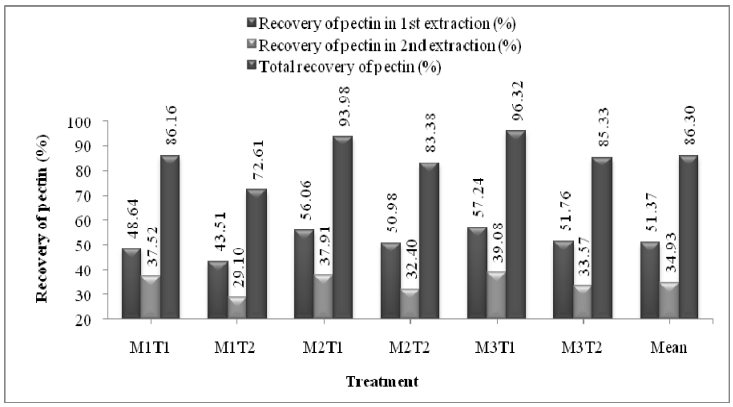

Figure 3. Recovery of pectin for different treatments.

Since the recovery of pectin was dependent on the value of yield of pectin, trend was observed similar to yield of pectin. It is evident from the Figure, that in the first extraction, the recovery of pectin was varied from 43.51 to 57.24% with an average recovery of 51.37%. Whereas, it was varied from 29.10 to 39.08% with an average of 34.93%, in the second extraction. The total recovery of pectin at the end of two extractions was found to be varied from 72.61 to 96.32% with an average total recovery of pectin of 86.30%. From the data, it could be revealed that the proportion of recovery of extractable pectin was higher (59.52%) during the first extraction than that of in the second extraction (40.48%). So, from the results it could be concluded that out of the total extractable pectin, about 19.04% more pectin can be recovered during the first extraction than that of the second extraction. The similar results were obtained by [23] during the extraction of pectin from Totapuri mango peel. Pectin recovery was found maximum (96.32%) for treatment M3T1, i.e. peel to extracting medium ratio (1:4) and temperature (80 °C) whereas minimum (72.61%) was found for treatment M1T2, i.e. peel to extracting medium ratio (1:2) and temperature (100 °C).

3.4 Effect of Peel to Extracting Medium Ratio and Temperature on Yield of Pectin

Extractability of pectin was found to be affected by the peel to extracting medium ratio (M) and extraction temperature (T). The effect of peel to extracting medium ratio, i.e. 1:2 (M1), 1:3 (M2) and 1:4 (M3) and temperature, i.e. 80 °C (T1) and 100 °C (T2) on yield of pectin in first extraction, second extraction and total yield of pectin are presented in Table 1. Data revealed that the yield of pectin was linearly increased in both, first and second extraction, with an increase in the peel to extracting medium ratio from 1:2 to 1:4. As a consequence, the total yield of pectin was also increased with an increase in the peel to extracting medium ratio.

The maximum yield of pectin was obtained at peel to extracting medium ratio of 1:4 and the minimum of it was obtained for peel to extracting medium ratio of 1:2 in both first extraction and second extraction. These results directed to give the highest total yield of pectin for peel to extracting medium ratio of 1:4 (13.94%DWB) and lowest yield of pectin for peel to extracting medium ratio of 1:2 (12.19%DWB). This showed that with an increase of peel to extracting medium ratio from 1:2 to 1:4, the yield of pectin could be increased by 1.75%. These results were in consonance with the finding of [18] who reported the increase in the yield of pectin from sunflower heads with an increase of quantity of extracting medium. Low yield of pectin at lower peel to extracting medium ratio (1:2) might be due to the insufficient quantity of extracting medium to come in contact with the pectic substances for hydrolysis and also to hold the extracted pectin [23].

Table 1. Effect of peel to extracting medium ratio (M) and temperature (T) on yield of pectin.

Effect	Yield of pectin (% DWB)		
	1st extraction	2nd extraction	Total yield
Peel to extracting medium ratio (M)			
1:2 (M1)	7.07	5.12	12.19
1:3 (M2)	8.21	5.40	13.61
1:4 (M3)	8.37	5.57	13.94
S.Em±	0.0753	0.1122	0.1693
CD at 5%	0.2319	0.3459	0.5217
Extraction temperature (T)			
80 °C (T1)	8.29	5.86	14.15
100 °C (T2)	7.48	4.87	12.35
S.Em±	0.0614	0.0917	0.1382
CD at 5%	0.1893	0.2824	0.4260
Interaction M x T			
S.Em±	0.1064	0.1587	0.2394
CD at 5%	NS	NS	NS
C.V.%	2.34	5.13	3.13

In case of extraction temperature, the yield of pectin decreased, in both, first and second extraction, with an increase of extraction temperature. As a consequence, the maximum yield of pectin was obtained at 80 °C (14.15%DWB) and the minimum at 100 °C (12.35%). Decrease in pectin yield at higher temperature (100 °C) could be attributed due to break down of pectin molecules as already observed by [7] and [21] during the extraction of pectin from mango peel. The similar results were also reported by [1] as well as [6] during the extraction of pectin from sour orange peels and citrus fruit wastes viz. lime peel, spent guava extract, apple pomace etc., respectively.

For the yield of pectin, all three peel to extracting medium ratios (M) and extraction temperatures (T), their individual effects found statistically significant whereas their interaction M x T was showed statistically non-significant difference at 5% level of significance (Table 1).

3.5 Effect of Peel to Extracting Medium Ratio and Temperature on Recovery of Pectin

As the recovery was derived on the basis of yield data, the trend just similar to yield of pectin was observed in case of recovery also. It was found to be significantly affected by the peel to extracting medium ratio, i.e. 1:2 (M1), 1:3 (M2) and 1:4 (M3) and temperature, i.e. 80 °C (T1) and 100 °C (T2). The data pertains to recovery of pectin in first extraction, second extraction and total recovery of pectin are presented in Table 2.

It is apparent from the data that there was increase in recovery of pectin in both, first and second extraction, with an increase in the peel to extracting medium ratio from 1:2 to 1:4. Due to this, the total recovery of pectin was also increased with an increase in the peel to extracting medium ratio.

The recovery of pectin, in both, first and second extraction was found to be highest at peel to extracting medium ratio of 1:4 and the lowest recovery was observed at peel to extracting medium ratio of 1:2. As a result of these, the recovery of pectin remained highest when extracted at peel to extracting medium ratio of 1:4 (90.83%) and remained lowest when extracted at peel to extracting medium ratio of 1:2 (79.38%) which showed the increase in recovery of pectin by 11.45% with an increase in peel to extracting medium ratio from 1:2 to 1:4. These results were in agreement with the findings of [18] and [23].

The extraction temperature has shown its adverse effect on the recovery of pectin. Data revealed that the recovery of pectin was declined as the temperature was increased from 80 °C to 100 °C. The maximum total recovery of pectin was achieved at 80 °C (92.15%) and the minimum at 100 °C (80.44%). These results were in consonance with the results reported by [7], [21], [1] as well as [6] as explained in case of yield of pectin. The decrease in recovery of pectin with the increase in temperature had already been justified by [7], [21], [1] and [6] during the extraction pectin from various fruit waste.

For the recovery of pectin, all three peel to extracting medium ratios (M) and extraction temperatures (T), their individual effects found statistically significant whereas their interaction M x T was showed statistically non-significant difference at 5% level of significance (Table 2).

Table 2. Effect of peel to extracting medium ration (M) and temperature (T) on recovery of pectin.

Effect	Recovery of pectin (%)		
	1st extraction	2nd extraction	Total recovery
	Peel to extracting medium ratio (M)		
1:2 (M1)	46.08	33.30	79.38
1:3 (M2)	53.52	35.16	88.68
1:4 (M3)	54.50	36.23	90.83
S.Em±	0.4898	0.7319	1.1030
CD at 5%	1.5093	2.2554	3.3990
	Extraction temperature (T)		
80 °C (T1)	53.98	38.17	92.15
100 °C (T2)	48.75	31.69	80.44
S.Em±	0.3999	0.5976	0.9006
CD at 5%	1.2324	1.8415	2.7753
	Interaction M x T		
S.Em±	0.6927	1.0351	1.5595
CD at 5%	NS	NS	NS
C.V.%	2.34	5.13	3.13

3.6 Recovery of Cation Exchange Resin

Resin used in the extraction of pectin was recovered only after completing two extractions. Treatment wise total cation exchange resin recovered from extracted solution at the end of two extractions is graphically represented in Figure 4.

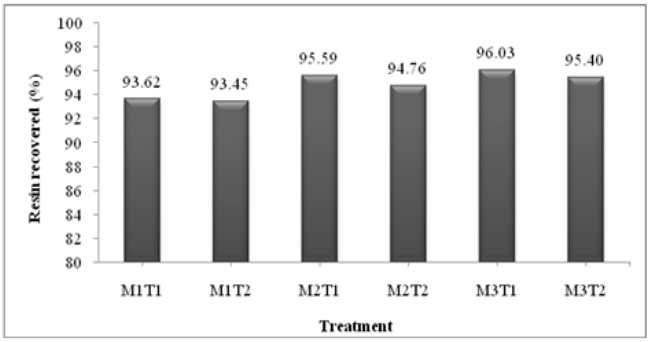

Figure 4. Recovery of cation exchange resin for different treatments.

From the figure, it could be observed that average percent recovery of cation exchange resin separated at the end of two extractions was varied from 93.45% to 96.03%. The highest recovery of cation exchange resin (96.03%) was found for the treatment, M3T1, i.e. peel to extracting medium ratio (1:4) and extraction temperature (80 °C) whereas the lowest recovery of it (93.45%) for the treatment, M1T2, i.e. peel to extracting medium ratio (1:2) and extraction temperature (100 °C). [16] also reported that 80 to 95% cation exchange resin can be recovered by centrifugal action.

3.7 Standardization of Extracting Condition and Quality of Pectin

The yield and recovery of pectin from mango peels at 80 and 100 °C with peel to extracting medium

ratio of 1:2, 1:3 and 1:4 by cation exchange resin are discussed in above sections. From the above discussion, it was clearly noted that, yield and recovery of pectin was found better when extracted at 80 °C with peel to extracting medium ratio of 1:4. Hence, based on the study, the extracting conditions as given in Table 3 were standardized for extraction of pectin from mango peel by cation exchange resin. The quality parameters of the pectin extracted by standardized condition are presented in the Table 4.

Table 3. Standardized extraction conditions for mango peel pectin by cation exchange resin.

Particulars	Extraction Condition
Raw material	Mango peels (Variety : Kesar)
Extracting medium	Cation exchange resin
Extraction pH	2.56
Extraction temperature	80 °C
Peel to extracting medium ratio	1:4
Extraction time	60 min per extraction
Number of extractions	2

Table 4. Quality of mango peel pectin extracted according to standardized extraction condition using cation exchange resin.

Particulars	Pectin quality
Yield of pectin (%DWB)	14.78%
Recovery of pectin	96.32%
Ash content	1.22%
Alkalinity of ash	9.85%
Equivalent weight	857.20
Methoxyl content	3.91%
Relative viscosity	6.25
Jelly grade	170
Recovery of cation exchange resin	96.03%
Number of extractions	2

4 Conclusion

The results of this study indicated that the use of cation exchange resin for extraction of pectin from mango peel exhibited the high process yield and recovery of pectin. Additionally, the pectin obtained had a good quality characteristics like especially the jelly grade, a characteristic associated with the good jelly formation of the product. Further, the resin utilized in the extraction is recoverable at the end of process and hence can be used for another extraction. Therefore, the use of cation exchange resin as an extracting medium to extract the pectin from mango peel can be an alternative to increase the yield and recovery of pectin, with good quality characteristics of the produced pectin.

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