Utilization of Mango Peels as a Source of Pectin

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(Received 6th January, 2003, revised 11th November, 2003)

Summary: Optimum conditions for extraction and precipitation of pectin from mango peels were investigated. Changes in pH, temperature and extraction time significantly affected the extraction of pectin. Maximum pectin yield was 21.0% which was obtained on soaking finely ground and defatted mango peel in sulphuric acid solution of pH 2.5 at 80°C for 120 minutes. Maximum pectin was precipitated from the extract by adding 95% ethanol at the rate of 200 ml litre^{-1}. Anhydrogalacturonic acid and methoxyl contents of pectin obtained under these optimum conditions were 72.80% and 9.77% respectively while equivalent weight value was 943. These chemical characteristics values of mango peel pectin were within the accepted limit of good quality pectin.

Introduction

Pectin is extensively utilized by the food processors especially for the conversion of low grade fruits into good quality products like Jam, jelly, marmalade and candies. It is also used in the preparation of different pharmaceutical products. There are various methods for the extraction of pectin from fruit and vegetable wastes but the information in literature regarding optimum conditions for extraction of pectin is scanty. The yield and quality of pectin depends mostly upon the source as well as the method employed for extraction of pectin. Pectin is usually extracted by suspending chopped fruit and vegetable wastes in different mineral acids and salt solution [1-3]. Rouse and Crandall [4] extracted 11.0, 8.15 and 6.35% of 150 grade pectin from lemon, orange and grape fruit peels at pH 1.6 respectively whereas 20% pectin was obtained from orange peels by precipitation with ferric salt [5]. Muralikrishna and Tharanathan [6] obtained only 1.43 – 5.37% pectin by soaking pulse husks in hydrochloric acid and EDTA solution at 70°C whereas many other workers extractred 9 – 10% yield of good quality pectin from potato wastes using solution of aluminum sulphate as precipitating agent [7]. Microbial enzymes were also used for the production of pectin and pigments from orange peels [8]. Industrial pectin of good gelling property was prepared from peach pomace by Pagan *et al.*, [9].

Mango peel is another good source as it contains 10 - 15% pectin [10]. However, there is scarce information in literature about the extraction of pectin from mango peels. Therefore, attempts were made to optimize the conditions for the maximum recovery of pectin from mango peels. Chemical quality characteristics of mango peel pectin were also studied.

Results and Discussion

Data presented in Table 1 show that pH, extraction temperature and time distinctly affected the extraction of pectin from finely ground defatted mango peels.

pH of the solution played a significant role in the extraction of pectin. At pH 1.5, 2.5 and 3.5 pectin yield was 12.0, 21.0 and 12.6% respectively, when mango peel powder was suspended at 80°C for 120 minutes (Table 1). It is apparent from these results that maximum yield of pectin was obtained by soaking the raw material in a solution of pH 2.5. However decline in Pectin yield was observed at pH 3.5 at all temperatures (60 - 90°C) and extraction time (30-120 minutes).

Variable amounts of pectin was obtained from mango peels at temperatures ranging from 60 - 90°C (Table 1). Maximum amount of pectin was obtained by soaking mango peels in acidic solution at 80°C. However significant reduction in pectin yield was observed when temperature was raised from 80 to 90°C. At 80°C, pectin yield was 16.0% which became only 13.0% at 90°C on soaking mango peels in acidic solution of pH 2.5 for 60 Minutes. Similar results were also obtained at other two pH values i.e., 1.5,

Table – 1: Effect of Temperature, Extraction Time and pH, on Pectin Yield (%age) from Mango Peels (%age)

Extraction Temp. (°C)	pH – 1.5 Extraction Time Period (Minutes)			pH – 2.5 Extraction Time Period (Minutes)			pH – 3.5 Extraction Time Period (Minutes)		
	30	60	120	30	60	120	30	60	120
60	8.1	8.0	8.7	10.2	12.0	15.0	8.0	9.0	9.0
	± 0.2	±0.2	±0.4	±0.4	±0.5	±0.6	±0.2	±0.3	±0.5
70	8.4	9.7	11.0	13.6	15.0	16.0	10.3	10.9	11.5
	±0.4	±0.6	±0.5	±0.7	±0.3	±0.4	±0.5	±0.1	±0.5
80	9.4	11.0	12.0	15.0	16.0	21.0	11.7	12.0	12.6
	±0.6	±0.6	±0.3	±0.5	±0.5	±0.7	±0.7	±0.4	±0.3
90	8.0	9.0	9.2	12.0	13.0	13.2	10.5	11.8	11.4
	±0.5	±0.5	±0.4	±0.3	±0.3	±0.2	±0.6	±0.2	±0.4

Mean Value ± S.D. Triplicate Determinations.

3.5. Decrease in pectin yield at higher temperature (90°C) could be attributed due to break down of pectin molecules as already observed by Chang et al., [13].

Extractability of pectin was also affected by extraction time ranging from 30 to 120 minutes. At pH 2.5, pectin yield was 15.0, 16.0 and 21.0 at 80°C after 30, 60 and 120 minutes extraction time respectively (Table 1). It is also apparent from results that maximum pectin yield was also obtained at all pH after 120 minutes. No further increase in pectin yield was observed after 120 minutes extraction time. (Results not shown after 120 minutes). These results are consistent with the findings of other workers who reported that prolonged extraction and higher temperatures adversely affected the yield of pectin from different sources [14] and [13]. Rouse and Crandall [4] extracted 11.0, 8.15 and 6.35% of 150 grade pectin from lemon, mango and grape fruit peels at pH 1.6 respectively, while 15.7% pectin yield was obtained from mango peels by precipitation with ethanol [10]. The differences between our results and reported in literature may be due to variations in particle size, extraction methods and variety of mangoes.

It is evident from Table 2 that maximum amount of pectin 21.0% was obtained with sulphuric acid solution of pH 2.5 at 80°C after 120 minutes extraction time while minimum amount of pectin (13.45%) was obtained with hydrochloric acid solution under the same extraction conditions. However nitric acid solution extracted 15.11% pectin from mango peels, which is comparatively more than hydrochloric acid solution of pH 2.5. Earlier workers also obtained variable amounts of pectin from different fruit waste materials using different mineral acids [15-17]. Better extraction of pectin with sulphuric acid might be due to the presence of sulphate ions in soaking solution.

Table – 2: Effect of Different Mineral Acids Solution on the Yield of Pectin (%age)

Extractants	Extraction Condition pH	Temp. (°C)	Time (Minutes)	Yield Percentage
Hydrochloric Acid	2.5	80	120	13.45±0.7
Sulphuric Acid	2.5	80	120	21.0±0.5
Nitric Acid	2.5	80	120	15.11±0.5

Mean Value ± S.D. Triplicate Determinations.

About 7.20, 11.00 and 21.0% pectin was precipitated when ethanol was added into the filtrate at the rate of 50, 100 and 200 ml litre^{-1} respectively. Similarly, pectin yield was 5.40, 9.00 and 14.44% after the addition of acetone in the filtrate at the rate of 50, 100 and 200 ml litre^{-1} respectively (Table 3). These results revealed that maximum amount of pectin (21.0%) was obtained on the addition of ethanol at the rate of 200 ml litre^{-1}.

Table – 3: Effect of Different Precipitating Agent on the Yield of Pectin (%age)

Precipit a-ting Agent	Amount Added ml/litre	Extraction Conditions pH	Temp. (°C)	Time (Minutes)	Yield Percentage
Ethanol	50	2.5	80	120	7.20±0.5
	100	2.5	80	120	11.00±0.6
	200	2.5	80	120	21.0±0.8
Acetone	50	2.5	80	120	5.40±0.1
	100	2.5	80	120	9.00±0.3
	200	2.5	80	120	14.44±0.5

Mean Value ± S.D. Triplicate Determinations.

Chemical Quality Characteristics of Pectin

Table 4 summarizes the chemical quality characteristics of mango peel pectin. It is apparent from these results that pH, temperature and extraction

Table – 4:Chemical Quality Characteristics of Mango Peels Pectin Extracted at 80°C

Chemical Characteristics	pH – 1.5 Extraction Time Period (Minutes)			pH – 2.5 Extraction Time Period (Minutes)			pH – 3.5 Extraction Time Period (Minutes)		
	30	60	120	30	60	120	30	60	120
Anhydrogatacturonic Acid (%)	66.73 ±1.6	67.45 ±1.4	68.72 ±1.4	70.88 ±1.4	71.45 ±1.3	72.80 ±1.3	60.77 ±1.5	61.00 ±1.3	62.44 ±1.3
Methoxyl Content (%)	8.11 ±0.10	8.15 ±0.10	8.33 ±0.11	9.20 ±0.10	9.67 ±0.12	9.77 ±0.12	8.03 ±0.14	8.24 ±0.15	8.72 ±0.11
Equivalent Weight	815 ±2.0	820 ±2.5	835 ±2.5	932 ±2.6	939 ±2.6	943 ±2.1	798 ±2.4	801 ±2.3	803 ±12.0

Mean Value ± S.D. Triplicate Determinations.

time affected the chemical quality characteristics of mango peel pectin. However, chemical quality of pectin obtained at pH 2.5 was comparatively better than the pectin obtained at pH 1.5 and 3.5. Anhydrogalacturonic acid and methoxyl contents were 72.80% and 9.77% respectively, while equivalent weight value was 943 for pectin extracted at pH 2.5, 80°C after 120 minutes. These results were within the range of reported values for anhydrogalacturonic acid (68.5 – 75.0%) and methoxyl contents (8.4 – 9.7%) of good quality mango peel pectin [18].

Experimental

Fresh mango peels were collected from a local commercial fruit processing plant. The peels were washed with running water to remove excess of pulp and then dried in a cabinet dryer at 65°C to reduce moisture content to 5 - 6%. The dried peels were finely ground to 80 mesh size and then defatted using hexane before extraction.

Extraction of Pectin

Ground and defatted mango peels were mixed well with water of different pH (1.5, 2.5, 3.5), keeping substrate to water ratio 1:40 (w/v). The desired pH of the mixture was adjusted with 0.1 N sulphuric acid on pH meter (PYE UNICAM Model-1292) and then incubated at different temperatures (60 - 90°C) for different time periods (30-120 minutes) with frequent stirring. After incubation, the contents were filtered through cheese cloth and pectin from the filtrate was precipitated with 95% ethanol. The obtained pectin was dried in a vacuum oven at 40°C to constant weight and ground finely to study chemical quality characteristics.

Yield was calculated as dried pectin g/100g dried mango peels. Anhydrogalacturonic acid content, equivalent weight and methoxyl contents were determined as quality characteristics of mango peels pectin by the standard methods of Owens et al., [11]. Triplicate determinations were performed for all parameters and standard deviations (SD) were calculated according to the method of Steel and Torrie [12].

Conclusions

It is concluded that good quality pectin with maximum yield (21%) can be obtained by soaking finely ground defatted mango peels in sulphuric acid solution of pH 2.5 at 80°C for 120 minutes. Ethanol can be successfully used as precipitating agent for maximum recovery of pectin from the extracted filtrate.

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