International Journal of Natural and Social Sciences
IJNSS
Print: 2617-6637 < ISSN > Online: 2313-4461

Physicochemical characterization and application of pectin extracted from seasonally available different fruits waste in jelly preparation

Dipika Majumder[1], Md. Rahim Badsha[2]*, Khadija Tul Kobra[1], Indrajit Saha[3], Md. Fahad Bin Quader[4], Shireen Akther[2]

[1]Department of Applied Food Science and Nutrition, Chattogram Veterinary and Animal Sciences University, Khulsi-4225, Chattogram, Bangladesh
[2]Department of Food Processing and Engineering, Chattogram Veterinary and Animal Sciences University, Khulsi-4225, Chattogram, Bangladesh
[3]Department of Physical and Mathematical Sciences, Chattogram Veterinary and Animal Sciences University, Khulsi-4225, Chattogram, Bangladesh
[4]Department of Applied Chemistry and Chemical Technology, Chattogram Veterinary and Animal Sciences University, Khulsi-4225, Chattogram, Bangladesh

ARTICLE INFO

Article history

Accepted 19 October 2019
Online release 29 October 2019

Keyword

Pectin
Fruits
Jelly

***Corresponding Author**

Md. Rahim Badsha
mrbadsha1322@gmail.com

ABSTRACT

This study was aimed to extract pectin from mango, guava and jackfruit peel and its utilization in the production of jelly. Pectin was extracted by using acid extraction method. Jelly was processed using the extracted pectin, then assessed the physicochemical characteristics and functional qualities of jelly. The amount of pectin extracted from jackfruit peel, mango peel and guava peel on fresh basis were 5.94%, 8.26% and 13.44%, respectively. Total soluble solids in jelly which was made using pectin extracted from jackfruit peel, mango peel and guava peel were 63.03%, 65.00% and 67.03% respectively, while the pH values were 2.59, 3.00 and 3.20; moisture content 25.11%, 24.01% and 21.75%; and ash content 0.31%, 0.28% and 0.55% respectively. It is recommended to encourage production of jelly at home using local raw materials under strict conditions as well as the using of natural pectin from local fruits for the production of jelly.

INTRODUCTION

People especially industrial people cannot properly handle fruit wastes, that's why it's a problem to the processing industries (Madhav and Pushpalatha, 2006). These wastes lead to serious pollution problem in the environment and it also represent a loss of valuable nutrients and biomass (Abbasi and Abbasi, 2010). Environmental pollution problem can be reduced by by-product recovery from fruit wastes. It also improves the overall economy of the processing unit of a food processing industry.

Pectin is a valuable by-product which can be extracted from fruit wastes (Madhav and Pushpalatha, 2006). Pectin is found in the cell wall of the fruit. If food industries use the fruit peel for the extraction of pectin, then it will reduce the pollution problem (Rudra et al., 2015). The main thing about pectin is, it has a good gelling property, which is used in different food preparation and many more things (Sharma et al., 2006). Pectin is used in manufacture of jams, jellies, marmalades, preserves etc. It is also useful as a thickening agent for sauces, ketchups, flavored syrups and as a texture agent in fruit-flavored milk deserts. Besides, it has numerous applications in pharmaceutical preparations, pastes, cosmetics etc. But, the single largest use of pectin is in the manufacture of jellies (Madhav and Pushpalatha, 2006).

How to cite this article: Majumder D, Badsha MR, Kobra KT, Saha I, Quader MFB and Akther S (2019). Physicochemical characterization and application of pectin extracted from seasonally available different fruits waste in jelly preparation. International Journal of Natural and Social Sciences, 6(3): 61-66.

Most of the commercial pectin in the world is used to make jelly and similar products (Willats et al., 2006). In our country, most of the jam or jelly production industries use commercial pectin. These industries brought pectin from other countries to produce good quality of product. Thus, it also increases the production cost. From our current understanding, we found this one as a gap in our food industry which needs to be addresses. The objectives of the study included the extraction of pectin from guava, mango and jackfruit fruit peel as well as the utilization of extracted pectin in the production of star fruit, pineapple, black-berry jelly and assessment of the products physicochemical and functional quality.

MATERIALS AND METHODS

Collection of samples

Mango, guava, jackfruit, star fruit, pineapple and black berry fruits were collected from Zawtala bazar of Chattogram district.

Extraction of pectin

The pectin extraction method was followed as described by Liew et al., (2014) with minor modifications. The mango, guava and jackfruit peels were subjected to hydrolysis by treating the raw materials with distilled water acidified at different pH levels (1.5, 1.8, 2.5), temperature 40-80^{0}C and heating time 10-40 minutes with continuous stirring to establish the extraction condition that will give the highest pectin yield. Percentage yield of pectin from initial peels can determined on both wet and dry weight basis.

$$\text{Pectin yield (\%)} = \frac{Weight\ of\ pectin}{Weight\ of\ fruits\ peel} \times 100$$

Physicochemical characterization of pectin samples

The dried pectin samples obtained from three types of fruit waste were subjected to the following test in order to characterize them. Moisture and ash content were estimated by the standard AOAC method (AOAC, 2016). Color was done by visual observation. Solubility of dry pectin in cold and hot water and solubility of pectin solution in cold and hot alkali was determined according to the method described by Kanmani et al., (2014). Equivalent weight (Titration A) was determined according to the method described by Kanmani et al., (2014). Equivalent weight was calculated using the following formula

$$\text{Equivalent Weight} = \frac{Weight\ of\ pectin\ sample \times Molarity\ of\ alkali}{Volume\ of\ alkali} \times 100$$

Methoxyl content (MeO) (Titration B) was determined according to the method described by Kulkarni and Vijayanand (2010). The percentage of methoxyl content was calculated using the following formula-

$$\text{Methoxyl content (\%)} = \frac{Volume\ of\ alkali \times Weight}{Weight\ of\ pectin\ sample} \times 100$$

The Anhydrouronic acid content (AUA) was calculated using the values of equivalent weight and methoxyl content determined earlier, according to that formula (Kanmani et al., 2014).

$$\text{AUA \%} = \frac{176 \times 100}{Z}$$

Where, 176 is the molecular weight of AUA and

$$Z = \frac{Weight\ of\ sample(mg)}{meq\ of\ Titration\ A + meq\ of\ Titration\ B}$$

The degree of esterification (DE) of pectin was calculated using the data from methoxyl and anhydrouronic acid content determinations (Aina et al., 2012).

$$\text{DE (\%)} = \frac{176 \times MeO\% \times 100}{31 \times \text{AUA \%}}$$

Preparation of jelly

Preparation of jelly (star fruit, pineapple and black-berry jelly) was followed instructions as described by Devi et al., (2014) with minor modifications. For preparation of star fruit, pineapple and black-berry jelly, firm but not over ripe fruits were chosen for jelly preparation. The pectin which was extracted from guava peel was used for preparation of star fruit jelly. For preparation of pineapple jelly, the pectin used which was extracted from mango peel and preparation of black-berry jelly, the pectin used which was extracted from jackfruit peel.

Physicochemical analysis of jelly

Moisture, ash content was estimated by the standard AOAC method (AOAC, 2016). Total soluble solids (TSS) of the samples were estimated by the standard AOAC method using a refractometer (HR SERIES- MILATO) (AOAC, 2003). The pH of samples was measured by the standard AOAC method using a digital pH meter (JENWAY) at an ambient temperature (AOAC, 2003).

Functional quality of jelly

The functional quality of jelly mainly examined by visual judgment. Rate of setting and setting time, consistency and cloudiness jellies were determined according to the method described by Madhav and Pushpalatha (2006).

Statistical Analysis

Statistical analysis was performed by using MS Excel 2013 and Statistical Package for Social Science (SPSS 16th version). Values are expressed as means ± and standard deviation (SD). One-way ANOVA and post-hoc test were used to identify the variation within the sample groups. Statistical significance was set at $P < 0.05$.

RESULTS AND DISCUSSION

Extraction of pectin

The yield of pectin from guava, mango and jackfruit peel were presented in Figure 1. The guava peel pectin showed the highest pectin yield, which was 13.44%, followed by mango peel pectin and jackfruit peel pectin with 8.26% and 5.94%; respectively. The amount of pectin in fruits also depends on the cultivar, ripeness, and extraction condition (Azad et al., 2014).

Characterization of pectin

The physicochemical characterizations of pectin depend mainly on the raw material source and conditions selected for isolation and purification of pectin (Girma and Worku, 2016). The chemical quality characteristics of guava, mango and jackfruit pectin peel pectin are summarized in Table 1. The result showed moisture content in jackfruit pectin was significantly the highest compared to mango peel pectin, and guava peel pectin. The moisture content of jackfruit pectin was 8.24%, followed by mango peel pectin 7.10% and guava peel pectin 6.41%. There were significant differences between all types of pectin. Moisture content of mango peel pectin was higher than the result reported by Fmna and Zailan (2019). The moisture content of jackfruit peel pectin was found lower than that of the results of other studies by Ahmmed et al., (2017); Begum et al., (2014) and Begum et al., (2017). It showed this pectin is safe for storage purposes at room temperature. The improved method of processing might be introduced to ensure the moisture content of pectin was less than 10%. A good quality of pectin powder must be below 10% for storage stability (Castillo-Israel et al., 2015). Low moisture content is necessary for pectin for safe storage as well as to inhibit the growth of microorganisms that can affect the quality due to the production of pectinase enzymes.

Ash content determination was important as ash represent the total mineral content in pectin. Jackfruit peel pectin has significantly the highest in ash content, which was 5.93% compared to mango peel pectin and guava peel pectin with ash content of 4.70% and 1.43%, respectively. Ash content of mango peel pectin was lower than the result reported by Fmna and Zailan (2019). The ash content of jackfruit peel pectin was found lower than that of the results of other studies (Ahmmed et al., 2017; Begum et al., 2014). Lower ash content indicates good quality of pectin. The upper limit of ash content for good-quality pectin is considered to be 10% from the view point of gel-formation (Girma and Worku, 2016). Therefore, with respect to this parameter, the pectin isolated in this study may be considered to be of satisfactorily good quality.

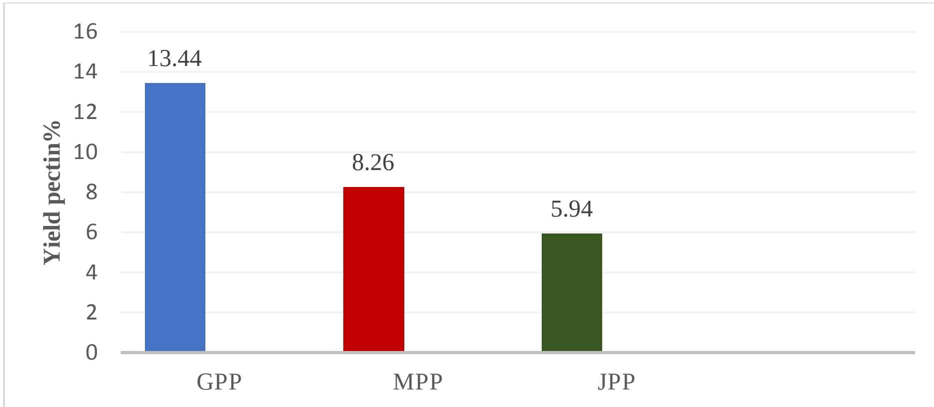

Figure 1
Percent yield of pectin from guava peel, mango peel and jackfruit peel. GPP: Guava Peel Pectin; MPP: Mango Peel Pectin; JPP: Jackfruit Peel Pectin).

Table 1:
Characterization of pectin

Sample	Guava peel	Mango peel	Jackfruit peel	Significance
Moisture content (%)	6.41±0.04[c]	7.10±0.02[b]	8.24±0.03[a]	**
Ash content (%)	1.43±0.03[c]	4.70±0.03[b]	5.93±0.04[a]	**
Equivalent weight	548.23±0.04[b]	634.89±0.03[a]	460.79±0.06[c]	**
Methoxyl content (%)	3.42±0.02[b]	6.25±0.04[a]	3.34±0.04[c]	**
AUA (%)	53.92±0.05[a]	53.21±0.03[b]	43.52±0.02[c]	**
DE (%)	54.24±0.04[a]	53.33±0.07[b]	35.94±0.04[c]	**

Mean ± SD (Three determinations). Mean values in the same row with different letters are significantly different ($p < 0.05$).

Table 2
Physicochemical properties of jelly product.

Sample	Star fruit jelly	Pineapple jelly	Black berry jelly	Significance
Moisture content (%)	21.75±0.11[c]	24.01±0.12[b]	25.11±0.08[a]	**
Ash content (%)	0.55±0.03[a]	0.28±0.02[b]	0.31±0.01[b]	**
Total soluble solids	67.03±0.15[a]	65.00±0.10[b]	63.03±0.15[c]	**
Active acidity(pH)	3.20±0.02[a]	3.00±0.02[b]	2.59±0.01[c]	**

Mean ± SD (Three determinations). Mean values in the same row with different letters are significantly different ($p < 0.05$).

Equivalent weight of jackfruit peel pectin, mango peel pectin and guava peel pectin were 460.79, 634.89 and 548.23 respectively. The maximum value of equivalent weight of mango peel pectin is higher than guava and jackfruit peel pectin. The present results have supported by Shaha et al., (2013) and Devi et al., (2014). Methoxyl content of jackfruit peel pectin, mango peel pectin and guava peel pectin were 3.34%, 6.25% and 3.42% respectively. Methoxyl content is an important factor in controlling the setting time of pectin and the ability of the pectin to form gels (Girma and Worku, 2016). The range of reported values of methoxyl contents was 3.34 to 6.25 for good quality of mango peels pectin. The anhydrouronic Acid (AUA) of jackfruit peel pectin, mango peel pectin and guava peel pectin were 43.52%, 53.21% and 53.92% respectively. The anhydrouronic Acid (AUA) indicates the purity of the extracted pectin and its value should not be less than < 65% (Castillo-Israel et al., 2015). In this study the highest AUA content of Guava peel pectin was with slightly acceptable limits of pectin purity. The degree of esterification (DE) of jackfruit peel pectin, mango peel pectin and guava peel pectin were 35.94%, 53.33% and 54.24% respectively. There is a significant difference between guava, mango and jackfruit peel pectin in terms of degree of esterification. Based on DE pectin can be classified as low methoxyl pectin with ≤ 50% DE and high methoxyl pectin with > 50% DE (Girma and Worku, 2016).

The color of guava, mango and jackfruit pectin were whitish to light brown, grayish to light brown and light brown respectively. The color of pectin was performed by visual inspection. The solubility of dry pectin extracted from mango peel, guava peel, jackfruit peel was insoluble in cold water and soluble in hot water. The solubility of pectin solution extracted from mango peel, guava peel, jackfruit peel was formed yellow precipitation in cold alkali and white precipitation in hot alkali. The solubility of pectin was important to ensure the pectin was solubilized to produce good quality of end products. Insoluble pectin can affect final products quality in terms of the appearance of the product itself (Fmna and Zailan, 2019).

Physicochemical analysis of jelly

Physicochemical characteristics of different types of jelly was presented in Table 2. The result showed moisture content in black berry jelly was significantly the highest compared to pineapple jelly and star fruit jelly. Moisture content of black berry jelly was 25.11%, followed by pineapple jelly 24.01% and star fruit jelly 21.75%. There were significant differences between all types of jelly. Moisture content of jelly products were lower than the result reported by Sarower et al., (2015). Ash content determination was important as ash represent the total mineral content in pectin. Star fruit jelly has significantly the highest in ash content, which was 0.55% compared to black berry jelly and pineapple jelly with ash content of 0.31% and 0.28%, respectively. Ash content of jelly products were lower than the result reported by Sabatini et al., (2009) and similar to the results reported by Sarower et al., (2015). Total soluble solids (TSS) of star fruit jelly, pineapple jelly and black berry jelly were 67.03, 65.00 and 63.03 Brix, respectively. These values were lower than the standard TSS values which range between (65 – 70 Brix) reported by Sarower et al., (2015). The pH of star fruit jelly, pineapple jelly and black berry jelly were 3.20, 3.00 and 2.59 respectively. The pH of jelly products was lower than the result reported by Sabatini et al., (2009) and similar that of results reported by Sarower et al., (2015). The pH value determined in the current study is close to the reported pH 3.2 for optimum gel formation. The Brix value and pH 3.44 recorded for jelly in the present study conform to values recommended for jelly to hinder microbial growth and maintain keeping quality.

Functional quality of jelly

Guava peel pectin and mango peel pectin shows very fast setting and it took 20-30 minutes for proper setting of jelly. Jackfruit peel pectin took 45-60 minutes for setting of jelly. The results of setting time are higher than the results reported by Madhav and Pushpalatha (2006). Desirable consistency was observed from those three types of jelly made from pectin extracted from guava peel, mango peel and jackfruit peel. But there was no cloudiness in these jellies which indicate that no loss of transparent nature of jelly (Madhav and Pushpalatha, 2006).

CONCLUSIONS

Every year our country produces lots of fruits which eventually give a large amount of fruit wastes. If we can extract pectin in our country from fruit wastes like guava peel, mango peel and jackfruit peel, it will be economically viable for industries and as well as will be eco-friendly. From this study, it was observed that fruit wastes like guava peel, mango peel and jackfruit peel are rich in pectin which was used for preparing the jelly to minimize postharvest loss. However, further investigation is necessary to study the sensory quality and economic aspects of the jelly products before recommending for commercial production.

ACKNOWLEDGEMENTS

Authors want to give the deepest sense of gratitude to the Department of Applied Food Science and Nutrition, Faculty of Food science and Technology and Poultry Research and Training Center (PRTC), Chattogram Veterinary and Animal Sciences University, Chattogram, Bangladesh for institutional support and assistance at the time of laboratory work.

REFERENCES

Abbasi T and Abbasi S (2010). Biomass energy and the environmental impacts associated with its production and utilization. Renewable and sustainable energy reviews, 14: 919-937.

Ahmmed R, Inam A, Alim M, Sobhan M and Haque M (2017). Extraction, Characterization and Utilization of Pectin from Jackfruit (Artocarpus heterophyllus L.) Waste. Journal of Environmental Science and Natural Resources, 32: 57-66.

Aina V, Barau MM, Mamman O, Zakari A, Haruna H, Umar MH and Abba YB (2012). Extraction and characterization of pectin from peels of lemon (Citrus limon), grape fruit (Citrus paradisi) and sweet orange (Citrus sinensis). British Journal of Pharmacology and Toxicology, 3: 259-262.

AOAC (2016). Official methods of analysis of the Association of Official Analytical Chemists. 20th Edition, Washington, DC, USA.

AOAC (2003). Official methods of analysis of the Association of Official Analytical Chemists. 17th Edition, Washington, DC, USA.

Azad A, Ali M, Akter MS, Rahman MJ and Ahmed M (2014). Isolation and characterization of pectin extracted from lemon pomace during ripening. Journal of Food and Nutrition Sciences, 2: 30-35.

Begum R, Aziz M, Uddin M and Yusof Y (2014). Characterization of jackfruit (Artocarpus heterophyllus) waste pectin as influenced by various extraction conditions. Agriculture and Agricultural Science Procedia, 2: 244-251.

Begum R, Yusof YA, Aziz MG and Uddin MB (2017). Structural and functional properties of pectin extracted from jackfruit (Artocarpus heterophyllus) waste: Effects of drying. International journal of food properties, 20: 190-201.

Castillo-Israel K, Baguio S, Diasanta M, Lizardo R, Dizon E and Mejico M (2015). Extraction and characterization of pectin from Saba banana peel wastes: A preliminary study. International Food Research Journal, 22: 202-207.

Devi WE, Kumar RSKBA and Mishra A (2014). Extraction of pectin from citrus fruit peel and its utilization in preparation of jelly. International Journal of Engineering Research, 3: 1925-1932.

Fmna A and Zailan N (2019). Physicochemical Properties of Pectin Extracted from Selected Local Fruits By-Product. International Journal on Advanced Science, Engineering and Information Technology, 9: 904-910.

Girma E and Worku T (2016). Extraction and characterization of pectin from selected fruit peel waste. International Journal of Scientific and Research Publications, 6: 447-454.

Kanmani P, Dhivya E, Aravind J and Kumaresan K (2014). Extraction and analysis of pectin from citrus peels: augmenting the yield from citrus limon using statistical experimental design. Iranica Journal of Energy & Environment, 5: 303-312.

Kulkarni S and Vijayanand P (2010). Effect of extraction conditions on the quality characteristics of pectin from passion fruit peel (*Passiflora edulis f. flavicarpa* L.). LWT-Food Science and Technology, 43: 1026-1031.

Liew SQ, Chin NL and Yusof YA (2014). Extraction and characterization of pectin from passion fruit peels. Agriculture and Agricultural Science Procedia, 2: 231-236.

Madhav A and Pushpalatha P (2006). Quality upgradation of jellies prepared using pectin extracted from fruit wastes. Journal of Tropical Agriculture, 40: 31-34.

Rudra SG, Nishad J, Jakhar N and Kaur C (2015). Food industry waste: mine of nutraceuticals. International Journal of Sciences and Environmental Technology, 4: 205-229.

Sabatini AG, Marcazzan GL, Caboni MF, Bogdanov S and Almeida-Muradian L (2009). Quality and standardisation of royal jelly. Journal of Apiproduct and Apimedical Science, 1: 1-6.

Sarower K, Uddin B and Jubayer F (2015). An approach to quality assessment and detection of adulterants in selected commercial brands of jelly in Bangladesh. Croatian Journal of Food Technology, Biotechnology and Nutrition, 10: 50-58.

Shaha RK, Nayagi Y, Punichelvana AP and Afandi A (2013). Optimized extraction condition and characterization of pectin from kaffir lime. Research Journal of Agriculture and Forestry Sciences, 1(2): 1-11.

Sharma B, Naresh L, Dhuldhoya N, Merchant S, Merchant U (2006). An overview on pectins. Times Food Processing Journal, 23: 44-51.

Willats WG, Knox JP and Mikkelsen JD (2006). Pectin: new insights into an old polymer are starting to gel. Trends in Food Science and Technology, 17: 97-104.