Anjoro: International Journal of Agriculture and Business
Vol. 5 Issue 1, April 2024
p-ISSN: 2721-8678 | e-ISSN: 2721-7914. **DOI: 10.31605/anjoro.v5i1.3592**

Pectin extraction from banana pere peel at various extraction times

Musafira[1]*, Fardinah[1], Meryta Febrilian Fatimah[1], Dzulkifli[2], and Andi Siti Mulyani[3]

[1]*Faculty of Mathematics and Sciences, Universitas Sulawesi Barat, Majene, Indonesia*
[2]*Faculty of Engineering, Universitas Sulawesi Barat, Majene, Indonesia*
[3]*SMTI Makassar, Indonesia*

**Corresponding author's e-mail: musafira@unsulbar.ac.id*

Received February 5th, 2024; revised March 21st, 2024; accepted April 10th, 2024

ABSTRACT

For many years, West Sulawesi's signature plant, banana pere, has only been eaten as fruit, while its peel is often discarded as waste or used as animal feed. This study provides information on the utilization of banana pere peel in order to increase its economic value through the utilization of pectin content contained in banana pere peel. This study aims to extract pectin from banana pere peel (Loka Pere) by using the citric acid solvent extraction method. The extraction process was carried out using 5 variations of time, namely 30, 60, 90, 120 and 150 minutes. The results showed that the use of extraction time for 90 minutes resulted in a yield value of 53.11%, moisture content of 1.15%, ash content of 1.56%, methoxyl content of 2.66% and galacturonic content of 30.88%.

Keywords:
Banana pere, Extraction time, Pectin

1. Introduction

Banana production in West Sulawesi province tends to increase from year to year. In 2019, banana production reached 741,061 tons spread across five districts [1]. One type of banana produced is a local banana known as "Loka Pere". Loka pere is one of the genetic resources that is only produced in West Sulawesi province, especially in Majene Regency and Central Mamuju Regency [2]. The distinctive characteristics of the loka pere are its sweet taste, round shape, and straight and pointed fruit tip. In addition, the flesh is golden yellow with a smooth texture, has a long shelf life and remains firm even when ripe. In terms of nutrition, the potassium and nutrient content of loka pere is five times that of ordinary bananas or other nutritious foods [3].

Loka banana peres are consumed and utilized only as fruit, while the peels are thrown into the trash or used as animal feed. Therefore, an effort to minimize food waste is needed to uphold food security standards. In particular, food waste that is wasted is still fresh [4]. One of the efforts to minimize banana peel waste is to utilize banana peel as a source of pectin that can increase the economic value of banana peel. Pectin, an anionic polymer, is known for its biocompatibility, biodegradability, and safety for human consumption [5]. These characteristics make it attractive for various biomedical and pharmaceutical applications, such as in designing drug delivery systems or serving as a carrier for biologically active molecules in functional foods in the food industry [6,7]. According to Devianti et al. [8], Indonesia is still importing pectin to meet domestic pectin needs.

Research has investigated the utilization of Musa paradisiaca banana peels for pectin extraction through the acid hydrolysis method [9–12]. Pectin, which is found in various food waste sources, provides an opportunity to mitigate long-term environmental impacts by extracting it [13].

Based on the results of research [14,15], it is known that the use of citric acid as a solvent in extracting pectin produces a yield above 30%. The yield is higher than the yield produced by [16], which uses hydrochloric acid as a solvent, and the maximum yield obtained is 15%. In addition, according to Arviani [17], citric acid is a solvent both from an economic and environmental perspective. Therefore, in this study, pectin extraction from local banana peels typical of West Sulawesi (loka pere) will be extracted using citric acid with the aim of producing high yields, and the resulting pectin has standardized characteristics.

2. Methods

2.1. Materials

The materials used in this research are pure citric acid (Merck), ripe banana pere peels, a local banana from the Pamboang district and distilled water (H_2O).

2.2. Tools

The tools used in this research are FTIR prestige-21 (Shimadzu, Japan), analytical balance (kern), oven (memmert, Germany), furnace (Heraeus, Germany), desiccator, hot plate, glassware commonly used in laboratories, and aluminium foil.

2.3. Procedure

2.3.1. Preparation of Banana Pere Peel as Material [14]

Banana pere peels are cleaned by rinsing them with water until they are clean and then dried under sunlight until the sample reaches a constant weight; after drying, the skin is mashed using a blender. Banana peel flour was sieved with a 60-mesh sieve.

2.3.2. Pectin Extraction [17]

Sifted banana peel flour was taken in as much as 10 grams, and 500 ml of citric acid was added with a concentration of 5%. The extraction process was carried out in a bath with a temperature of 85 °C, with a variation of extraction time of 30, 60, 90, 120 and 150 minutes with a stirring speed of 600 rpm. The extract obtained was then filtered using filter paper No.41 with the help of a vacuum filter to separate the pulp and filtrate. The resulting filtrate was then evaporated at 90-95^{0}C until its volume reached half of the initial volume and then cooled. After cooling, the filtrate was added 96% ethanol and then precipitated for 24 hours at room temperature. After 24 hours, the filtrate and residue were separated and washed until clear. The residue obtained was then dried in an oven at 50^{0}C until constant weight. The pectin was pulverized to obtain pectin powder. Pectin obtained from various variations of extraction time is then calculated to determine the extraction time that produces the highest yield. Samples that produced the highest yield were then qualitatively tested and analyzed for water content, ash content, methoxyl content and galacturonate.

2.3.3. Qualitative Test [17]

The pectin powder obtained in sub-section 2.3.2 was then put in a test tube as much as 0.01 gram, and then 1 ml of water was added. The pectin-water extract mixture in the tube was heated in a water bath for 15 minutes. The formation of a stiff gel to characterize the presence of pectin was done after the mixture was cooled.

3. Results and Discussions

3.1. Determination of Pectin Yield Based on Variation of Extraction Time

Pectin extraction is influenced by the type of solvent and extraction time. This study used citric acid solvent with a concentration of 5% because, according to Nurhaeni et al. [14] and Devianti et al [8], it is known that the use of 5% citric acid in extracting pectin from fruit peels produces the highest yield. The effect of extraction time on pectin yield was carried out using time variations of 30 minutes, 60 minutes, 90 minutes, 120 minutes and 150 minutes. The results can be seen in Figure 1. Based on the results of the extraction of banana pere peel samples at various time variations, it is known that the highest yield value is obtained when using the extraction time for 120 minutes with a yield value of 55.25%.

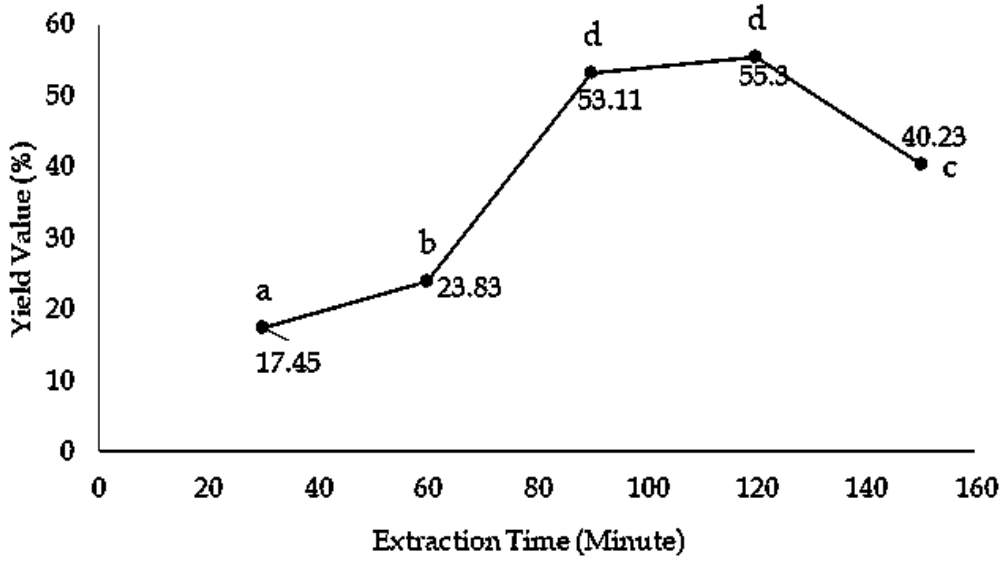

Figure 1. Pectin yield value against variations in extraction time

From these results, it is known that the longer the extraction time, the greater the value of the resulting pectin yield, but with the 150-minute extraction time, the resulting yield value decreases. This is because the longer the extraction process, the longer the solvent diffusion process into the plant tissue cells will take, so the amount of dissolved substances extracted from banana peels also increases, and the amount of protopectin that turns into pectin also increases. However, using too long an extraction time probably can degrade the pectin into pectic acid so that it probably may the caused of the reduced the pectin content [18].

Based on the results of statistical analysis using SPSS, it is known that the extraction time has a significant effect on the yield value produced (Figure 1). The extraction time treatment of 90 minutes and 120 minutes has a similar yield value. Thus, the

extraction time of 90 minutes can be recommended to be applied in the process of extracting pectin from banana pere peel.

3.2. Water Solubility of Pectin

After doing the qualitative test, it was observed that the extract dissolves in water and forms a solution that has a colloidal-like viscosity (Figure 2).

Figure 2. The qualitative test

The phenomenon is in accordance with the nature of pectin which can usually dissolve in water and form a colloidal structure. It is known that the extract obtained is a pectin compound. The extract dissolves in water and forms a solution that has a colloidal-like viscosity. This phenomenon is in accordance with the nature of pectin, which can usually dissolve in water and form a colloidal structure [14].

3.3. Pectin Characterization

The quality of pectin can be seen from its physical and chemical properties. The parameters of physical properties and chemical properties include colour, water content, ash content, methoxyl content, and galacturonic content [17].

Table 1. Characteristics of pectin

No.	Analysis	Pectin Obtained	Quality Standard of IPPA
1.	Colour	Reddish Browned	White-Yellow
2.	Water Content	1.15 %	Maximum 12 %
3.	Ash Content	1.56 %	Maximum 10 %
4.	Methoxyl Content	2.66 %	Low Methoxyl 2.5-7.12% High Methoxyl > 7.12%
5.	Galacturonate Content	30.88%	Min 35%

Source: IPPA quality standard [19]

3.3.1 Water Content

Water content in pectin can affect its quality and shelf life. This is because the high water content in pectin can make it susceptible to microbial activity. The water

content in pectin can be known by conducting a water content test. Based on the research results in Table 1, it is known that the water content of pectin from banana pere peel is 1.15%. The water content value obtained meets the quality standard value of the International Pectin Producers Association (IPPA) [19].

3.3.2 Ash Content

The purity of a pectin can be seen from its ash content. Ash content is an indicator that shows the amount of residual combustion of organic matter in the form of inorganic materials. Pectin with a high purity level will have a low ash content [19]. The addition of acid in the extraction process causes the release of minerals from pectin, so if the acid used has a high pH, the ash content will be high. In addition, the longer the time used to extract a material with acid, the more ions or minerals will be released, so the ash content will also be higher [8,19]. The results showed that the ash content of pectin obtained in Table 1 was 1.56%. The ash content is in accordance with the quality standards for pectin ash content set by IPPA.

3.3.3 Methoxyl Content

Methoxyl content can affect the structure and texture of the pectin gel [8,14,19]. The greater the methoxyl content, the greater the gel-forming ability. Pectin is classified as high methoxyl if the percentage of methoxyl content is 7% or more, while pectin is categorized as low methoxyl if the percentage of methoxyl content is below 7%. The results of this study resulted in a methoxyl content of 2.66% (Table 1). This means that the pectin obtained is pectin with low methoxyl content because it has a methoxyl content value of less than 7% and is in accordance with the quality standards of pectin based on IPPA [8,19]. This is more profitable because low methoxyl pectin can be produced directly without the need to go through a demethylation process. This type of pectin is used in making various products such as salad sauces, puddings, fruit gels in ice cream, jams and jellies with low-calorie content, so it is suitable for people who want to reduce sugar intake [19].

3.3.4 Galacturonate Content

The purity of a pectin can also be seen from its galacturonic content. Galacturonic content plays an important role in determining the functional properties of pectin solutions. These functional properties have a role in the gel formation process [20,21]. The research results obtained that the galacturonic content of pectin from banana pere peel amounted to 30.88% (Table 1). The galacturonic content obtained has not met the established standards and is lower than the results of previous researchers [8,19]. The low levels of galacturonic content in this study could be caused by the presence of nonuronic compounds that were also extracted into the pectin [20]. According to Fitria [20], it is known that in addition to galacturonic acid, pectin also contains other compounds in the form of neutral sugars, such as D-galactose, L-arabinose, and L-rhamnose. These compounds are non-uronic compounds that can be carried during the pectin clumping process. These compounds affect the composition of pectin compounds. Differences in the composition of pectin compounds will affect galacturonic content, which can be caused by the extraction method used. Non-uronic compounds can be removed by re-dissolving the pectin in water and agglomeration, but not all non-uronic compounds can be removed.

4. Conclusion

Using an extraction time of 90 minutes is the most suitable time to use to extract pectin from banana pere peels with a yield of 53.11%. The pectin characteristics include a moisture content of 1.15%, ash content of 1.56%, methoxyl content of 2.66%, and galacturonic content of 30.88%.

Acknowledgements

The authors extend their appreciation to the LPPM, Universitas Sulawesi Barat for funding this research through the DIPA funding program. The author wishes to thank Syahmidarni Al Islamiyah for useful discussions.

References

1. BPS Sulawesi Barat. Sulawesi Barat Province in figures 2020. Mamuju: 2022.
2. Balitbangda Sulawesi Barat. Analisis kandungan nutrisi "loka pere" di Sulawesi Barat: Laporan akhir pelaksanaan kegiatan. Mamuju: 2021.
3. Balitbangtan BPTP Sulawesi Barat. Profil sumber daya genetik tanaman lokal Provinsi Sulawesi Barat. Mamuju: 2017.
4. Saputro WA, Purnomo S, Salamah U. Study of food waste of farmers' households in Klaten to support food security. Anjoro Int J Agric Bus 2021;2:58–64. https://doi.org/10.31605/anjoro.v2i2.1166.
5. Zainudin BH, Wong TW, Hamdan H. Design of low molecular weight pectin and its nanoparticles through combination treatment of pectin by microwave and inorganic salts. Polym Degrad Stab 2018;147:35–40. https://doi.org/10.1016/j.polymdegradstab.2017.11.011.
6. Hu K, Huang X, Gao Y, Huang X, Xiao H, McClements DJ. Core–shell biopolymer nanoparticle delivery systems: Synthesis and characterization of curcumin fortified zein–pectin nanoparticles. Food Chem 2015;182:275–81. https://doi.org/10.1016/j.foodchem.2015.03.009.
7. Krivorotova T, Cirkovas A, Maciulyte S, Staneviciene R, Budriene S, Serviene E, et al. Nisin-loaded pectin nanoparticles for food preservation. Food Hydrocoll 2016;54:49–56. https://doi.org/10.1016/j.foodhyd.2015.09.015.
8. Devianti VA, Chrisnandari RD, Darmawan R. Pengaruh metode ekstraksi terhadap mutu pektin dari kulit pisang raja nangka. J Kim Ris 2019;4:170–9. https://doi.org/10.20473/jkr.v4i2.15753.
9. Castillo-Israel KAT, Baguio SF, Diasanta MDB, Lizardo RCM, Dizon EI, Mejico MIF. Extraction and characterization of pectin from Saba banana [Musa 'saba'(Musa acuminata x Musa balbisiana)] peel wastes: A preliminary study. Int Food Res J 2015;22:202–7.
10. Khamsucharit P, Laohaphatanalert K, Gavinlertvatana P, Sriroth K, Sangseethong K. Characterization of pectin extracted from banana peels of different varieties. Food Sci Biotechnol 2018;27:623. https://doi.org/10.1007/S10068-017-0302-0.

11. Oliveira TÍS, Rosa MF, Cavalcante FL, Pereira PHF, Moates GK, Wellner N, et al. Optimization of pectin extraction from banana peels with citric acid by using response surface methodology. Food Chem 2016;198:113–8. https://doi.org/10.1016/j.foodchem.2015.08.080.
12. Tanaid RAB, Lauzon RD. Extraction optimization of pectin from unripe banana (Musa acuminata × balbisiana var. Cardaba) peel. Int J Food Eng 2018;4:308–15. https://doi.org/10.18178/ijfe.4.4.308-315.
13. Petkowicz CLO, Vriesmann LC, Williams PA. Pectins from food waste: Extraction, characterization and properties of watermelon rind pectin. Food Hydrocoll 2017;65:57–67. https://doi.org/10.1016/j.foodhyd.2016.10.040.
14. Nurhaeni, Atjiang NA, Hardi J, Diharnaini, Khairunnisa. Karakterisasi pektin dami kulit dan dari buah cempedak (Artocarpus chempeden). KOVALEN J Ris Kim 2018;4:304–15. https://doi.org/10.22487/kovalen.2018.v4.i3.11857.
15. Demsi RP, Ruslan, Rahim EA, Hardi-Ys. Ekstraksi pektin pada kulit buah kluwih (artocarpus camansi blanko) pada berbagai suhu dan konsentrasi asam sitrat. KOVALEN J Ris Kim 2019;5:100–8. https://doi.org/10.22487/kovalen.2019.v5.i1.11591.
16. Randa A, Hermawati, Tang M. Ekstraksi pektin dari kulit pisang kepok (Musa paradisiaca L.) dan diaplikasikan pada selai tomat (Solanum lycopersicum). Saintis 2021;2:34–41.
17. Arviani. Studi perbandingan metode ekstraksi pektin pada kulit jeruk (Citrus Sp). Universitas Tadulako, 2009.
18. Zahrotun EN, Nugraheni Y, Rusdiansjah. Pengaruh suhu dan waktu terhadap hasil ekstraksi pektin dari kulit buah nanas. Pros. Simp. Nas. RAPI XII, Surakarta: Universitas Muhammadiyah Surakart; 2013, p. K-39-K-43.
19. Putri MP, Lukis PA, Mawarni LP. Isolation and characterization of pectin from waste of "raja nangka" banana peels (Musa acuminata (AAA cv)). EduChemia (Jurnal Kim Dan Pendidikan) 2020;5:60–71. https://doi.org/10.30870/educhemia.v5i1.6737.
20. Fitria V. Karakterisasi pektin hasil ekstraksi dari limbah kulit pisang kepok (Musa balbisiana ABB). Uin Syarif Hidayatullah Jakarta, 2013.
21. Rahmi SCA, Satibi L. Pengaruh waktu ekstraksi kulit buah pisang kepokdengan pelarut HCl 0,1 N pada pembuatan pektin. J Konversi 2014;3. https://doi.org/10.24853/konversi.3.2.%25p.