Pectin Isolation from Sentul Peel (*Sandorium Koetjape*) with Microwave Assisted Extraction

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ABSTRACT
Pectin is usually isolated using the conventional extraction methods are time consuming. Pectin from sentul peel has been successfully isolated by using Microwave Assisted Extraction (MAE). This method has a short processing time and little solvent needed. This study is aimed to determine the effect of extraction time on the characteristics of pectin produced from sentul peel. The extraction process was conducted using HCl and soaked using 96% ethanol. The parameters analysed were pectin yield, moisture content, equivalent weight, methoxyl content and functional group analysis using FTIR. The results of this study indicated that the yield of pectin obtained is in the range of 5.16-12.66%. The highest yield at the extraction time of 30 minutes was 12.66%, 16% moisture content, 526 mg equivalent weight and 9.85% methoxyl content and FTIR analysis showed carbonyl and ester groups. Pectin is used in food industry as gelling agents and as an ingredient for forming edible film or coating.

Keywords: *Sentul Peel, Microwave Assisted Extraction, Pectin.*

1. INTRODUCTION

Sentul (*Sandorium Koetjape*) is a medicinal plant from the Meliaceae family originating from Indo-China and the Malay Peninsula. In Indonesia, this fruit is known as Sentul. The peel of this fruit contains is a lot of sap; pectin is found in peels, especially that have a lot of sap and albedo or white sponge. Pectin is a polysaccharide found in the cell wall and can be found in some plants that grow in the soil, especially fruit and vegetables. D-galacturonic acid is the main monomer unit of pectin [1]. Basically, all photosynthetic plants contain pectin, but in varying numbers. Pectin in plant cells functions as an absorbent wall, morphogenesis, cells adhesion, forming ion-binding cell structures and fruit development [2].

Natural pectin derived from the peels of apples and oranges [3]. Pectin is usually extracted using hot water (60ºC-100ºC) at a pH of 1.5-3.0 for several hours. However, conventional extraction methods are time consuming and there are dangerous organic solvents or strong acid-base solutions [4]. Pectin is widely used in food industry as gelling agents, thickeners, emulsifiers and stabilizers. In recent years, research has been carried out on the use of pectin from the by-product of the food industry as an ingredient for forming edible films. Citrus pectin has been used as an ingredient for producing antioxidant and antimicrobial films by combining clove bud essential oil [5].

The latest extraction techniques that have been used in the extraction of pectin is with the help of MAE [6], ultrasound extraction [7] and extraction with the help of enzymes [1]. Among these techniques, MAE is the best alternative because it offers significant advantages [4]. The MAE method requires a shorter processing time and uses less solvent, has a high extraction rate, and it is low cost. Therefore, microwave irradiation has been used for the extraction of pectin from biomass that is rich in pectin such as banana peel [6], mango peel, pumpkin, and orange peel [8]. In this research, the sentul peel was extracted using MAE and the irradiation time to the yield of pectin was examined, as well as its equivalent weight, methoxyl levels and functional groups by FTIR analysis.

2. METHOD

2.1. Extraction of Pectin from Sentul Peel (Sandorium Koetjape)

Before extraction, the sentul peels are prepared by washing, chopping them into small pieces and drying in

an oven at 65°C. After drying, the sentul peels are mashed in a blender and sieved with a 100-mesh sieve. 20 grams of sentul peel powder is then dissolved in 300 mL HCl. Then the mixture was heated in the microwave at a temperature of 80°C and the heating times were varied (15, 20, 25, 30 and 35 minutes). The mixture is then filtered using a funnel, the resulting filtrate is heated on a hot plate until thick. The filtrate is added with 96% alcohol as much as 1: 1.5 by volume of liquid until a precipitate is formed. Furthermore, the precipitate is filtered with filter paper while washing with 96% alcohol. The final step was drying the neutral pectin precipitate in the oven for 8 hours at 40°C. The obtained pectin was tested for the yield, water content, equivalent weight and methoxyl content, as well as functional group analysis (FTIR).

2.2. Edible Coating Application

Sentul peel pectin 0.2; 0.4; and 0.6 grams were dissolved in 100 ml of distilled water while stirring with a magnetic stirrer. After the solution is mixed, sorbitol is added and then stirred until the solution is homogeneous. The solution was heated at 40°C and stirred for 15 minutes until it was homogeneous and used for coating tomatoes. The tomatoes were dipped for 5 minutes and then drained and dried at room temperature. Observations were made periodically for 8 days with the parameter of weight loss of tomatoes.

3. RESULT AND DISCUSSION

3.1. The Characteristics of Extracted Pectin

3.1.1. Pectin Yield

The yield of pectin is the amount of pectin produced from the extraction of sentul peel in each variable extraction time. The longer the extraction time, the higher the pectin yield obtained (Figure 1.) The length of extraction time results in more opportunities for the solvent to diffuse into tissue cells; so that it provides the opportunity to hydrolyze the protopectin contained in the material and will increase the yield of pectin produced. The yield of pectin will decrease after 30 minutes, this is because the extraction time is too long so that the hydrolysis process is continued and the pectin compound will turn into pectin acid. The yield of pectin produced ranged from 5.16 to 12.66%. From Figure 1, it can be observed that the highest pectin yield was obtained when the sentul peels were extracted for 30 minutes, which was 12.66%. The extraction time is a positive influential factor on the pectin yield [9].

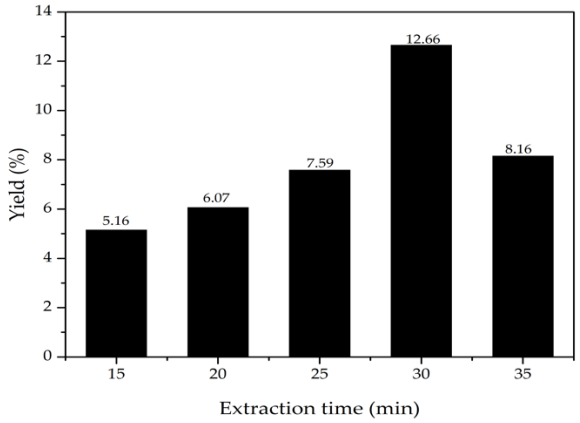

Figure 1 The effect of the extraction time on pectin yield

3.1.2. Moisture Content

The resulting moisture content ranges from 9.33–16.0%. Based on the quality standards of the International Pectin Producer Association (IPPA), the maximum permissible water content is 12%, meaning that the water content obtained in this study is still in the permissible standards. The water content obtained is affected by the pectin yield, the higher the pectin yield, the higher the water content.

The highest moisture content of pectin produced was at the extraction time of 30 minutes (16.0%) and the lowest moisture content was at the extraction time of 15 minutes as shown in Figure 2. In order to extend the shelf life of the material, the drying process is up to a certain moisture content limit. So that the process of storing products with low moisture content is relatively more stable than products with high levels.

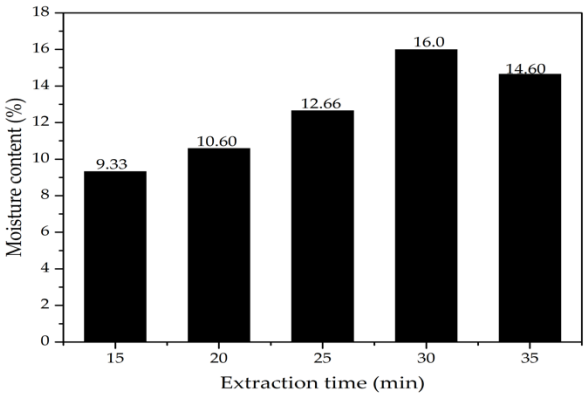

Figure 2 The effect of the extraction time on pectin moisture content

3.1.3. Equivalent Weight

The equivalent weight (Eq.W) of pectin is an indicator of gelation ability; the greater the Eq.W, the higher the gelation ability achieved [10]. The highest

equivalent weight in this study was produced in pectin with an extraction time of 15 minutes, which was 909 and the lowest equivalent weight was found in 35 minutes extraction time, which was 476.

The equivalent weight decreases with increasing extraction time. In this study, the equivalent weight of pectin extracted by the MAE method tends to decrease when the extraction time was longer, as shown in Figure 3.

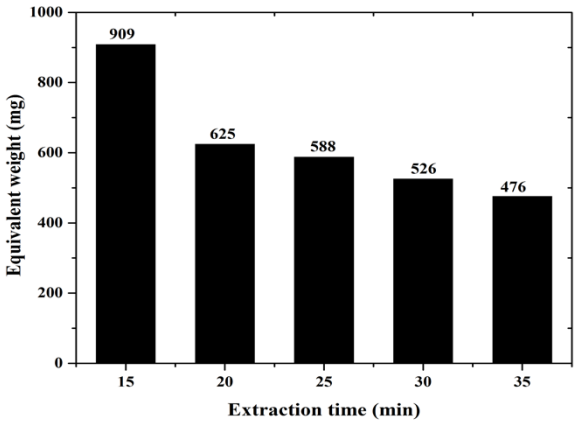

Figure 3 The effect of the extraction time on pectin equivalent weight

3.1.4. Methoxyl Content

Methoxyl content is an important indicator that must be analyzed because it represents the distribution ability of pectin in water and gel [11]. Pectin extraction with MAE resulted in methoxyl levels ranging from 3.59-10.85%. Figure 4 shows that the longer the extraction time, the higher the methoxyl content produced.

The increase in methoxyl levels is due to the increasing esterified free carboxyl groups. The highest yield at the extraction time of 30 minutes produced 9.85% methoxyl. In the Food Chemical Codex, low methoxyl in pectin ranges from 2.5-7.2%. Therefore, the pectin obtained in this study is classified as a low methoxyl pectin.

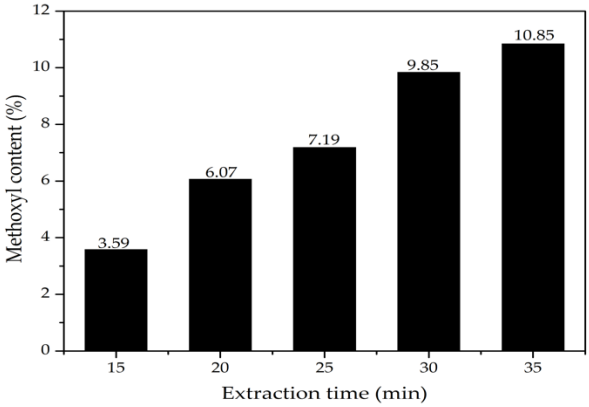

Figure 4 The effect of the extraction time on pectin methoxyl content

3.1.5. Pectin Analysis with FTIR Spectrum

Pectin analysis using FTIR serves to determine the functional groups contained in pectin. Based on the research that has been done, the main functional groups of pectin are usually in the region between 1000 and 2000 cm-1 of the FTIR spectrum. The carbonyl bond at 1630 - 1650 cm^{-1}, the ether bond at 1100 cm^{-1}, the cyclic carbon bond at 1200 cm^{-1} and the esterified carbonyl bond are at wave numbers 1740-1760 cm^{-1}. Table 1 shows the composition of pectin compounds analyzed by FTIR. In the wavelength range of 1630 -1650 cm^{-1} there is a carbonyl group, thus identifying that the sample is classified as a pectin, due to the existence of carbonyl group; where it shows the ester group in the pectin. The absorption bond at 1200 cm^{-1} indicates a cyclic carbon group derived from the ether in the ring structure of the pectin molecule [11].

Table 1. Compound composition of research result

	Absorption Bonds (cm^{-1})			
	Carbonyl (cm^{-1})	Carboxylates (cm^{-1})	Ether (cm^{-1})	Cyclic Carbon (cm^{-1})
Standard	1630-1650	1740-1760	1050-1300	1200
15 minutes	1648.76	1746.23	1104.99	1188.09
20 minutes	1648.76	1732.90	1062.92	1132.69
25 minutes	1648.76	1732.90	1147.05	1174.76
30 minutes	1648.76	1760.60	1202.46	1160.39
35 minutes	1634.40	1732.90	1244.52	1188.09

Figure 5 and Figure 6 showed a spectrum with absorption peaks at the same wavelength, but there is a difference between transmittance value of each variation of pectin research results and commercial pectin. The difference in the transmittance value shows the difference in the intensity of the functional groups in the pectin compound in each variation. The different transmittance intensity in each of these variations still shows pectin

compounds because the absorption of IR rays is still in the main functional group absorption area of the pectin compound.

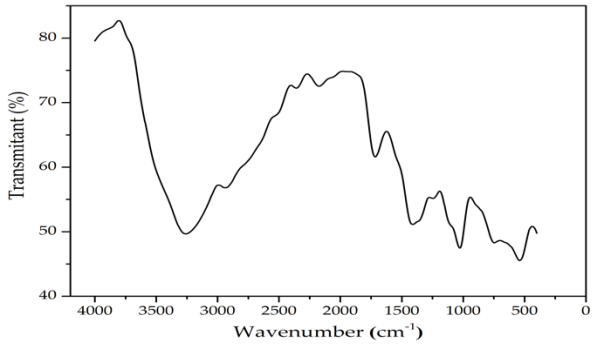

Figure 5 FTIR Spectrum of Commercial Pectin

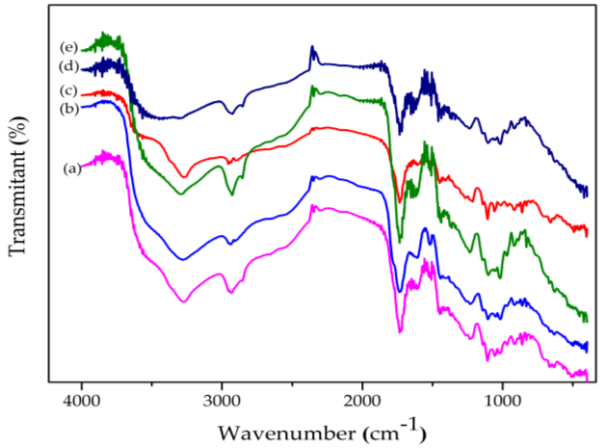

Figure 6 Graph of Relationship between Wavelength and FTIR Spectrum Transmittance (a) 15 minutes, (b) 20 minutes, (c) 25 minutes, (d) 30 minutes and (d) 35 minutes

3.2. Pectin Application as Edible Coating on Tomato

Coating applications are increasingly developing to extend the shelf life of vegetables and fruits [12]. The coated tomatoes were observed for weight loss and physical changes. Weight loss is the loss of fruit weight during post-harvest storage. Losing weight changes in texture and shrinkage which adversely affects tomato quality. In Table 2, it can be seen that the coating treatment using 0.6 gr pectin has the smallest weight loss percent value on the 8th day of storage is 3.396%. The higher the pectin concentration used, the higher the thickness and thickness of the layer, which causes the pores of tomatoes to be closed and the process of respiration and aspiration can be suppressed. The reduction in tomato fruit weight loss was reduced from all treatments because coating with pectin can act as a barrier against gas and moisture exchange [13].

Table 2. Characterization of tomato fruit after storage on the 8th day

Treatment	Weight loss
Without coating	5,336
Pectin 0.2 gr	4,734
Pectin 0.4 gr	4,511
Pectin 0.6 gr	3,396

The addition of pectin also affects the physical appearance of tomatoes. Water is the highest main component in tomatoes (more than 93%) so that tomatoes rot easily. During the ripening process, respiration and moisture content will increase while the texture of the fruit becomes soft. Tomato fruit will experience rot when stored at room temperature for 3-4 days so that without special handling, the shelf life of tomatoes is relatively short [12]. Edible coating coating from pectin can improve the color and physical condition of tomatoes. The physical changes of tomatoes on the 8th day of observation can be seen in Table 3. It can be seen in table 3 that tomatoes without coating experience rot and shrinkage, while tomatoes with pectin coating 0.6% are better than tomato coating with pectin 0.2% and 0.4.

Table 3. Tomatoes are stored at room temperature for 8 days

Treatment	Day 8
Without coating	
Pectin 0.2 gr	
Pectin 0.4 gr	
Pectin 0.6 gr	

4. CONCLUSION

Based on the research that has been done, it is found that pectin meets the standards in the Food Chemical Codex. From the data obtained, the pectin from sentul peel is included in the low methoxyl pectin, due to the methoxyl content being less than 50%. The best extraction time to produce pectin from sentul MAE peel was 30 minutes. The addition of 0.6 grams of pectin in the coating process can reduce the smallest weight loss on the 8th day of storage is 3.396% in tomatoes and can extend shelf life.

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