THE PRODUCTION OF PECTIN FROM FRUIT PEELS

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ABSTRACT. The use of gelatine in the food industry is highly questionable due to its production that comes from animals, especially cattle and swine. As a result of these problems, plant-sourced pectin has become a priority in replacing the function of gelatine in the food industry. This study focuses on the production of pectin from food waste, which is fruit peels such as oranges, bananas and pomelos, where fruit peels are among the main contributors to food waste in Malaysia. The production of pectin is made by washing the fruit peel with distilled water before cutting it into small pieces for drying in an oven at 70°C for 5 hours. Then it is finely ground until it becomes a powder. This crude pectin powder is bleached by mixing with 1 M hydrochloric acid before heating at 80°C for 4 hours. The resulting solution is filtered to obtain filtrate before it was washed with ethanol to get pure pectin. This pectin is characterized by density testing, spread testing and pH testing. The results of fruit peel extraction showed that orange peel produced the highest pectin with 44.3% compared to pomelo peel and banana peel which were 25.5% and 17.4% respectively. The spread test showed that pectin from orange peels flowed the longest, for 12.5 seconds compared to other fruit peels. The pH of pectin from all fruit peels is in the range of 4 to 6. Research data from tests conducted show that pectin from all fruit peels have properties that are almost the same as pectin that produced by previous study.

KEYWORDS: Gelatine; Pectin; Fruit Peels; Food Industry

1 INTRODUCTION

The use of gelatine in the food industry is highly questionable due to its production that comes from animals, especially cattle and swine. As a result of these problems, plant-sourced pectin has become a priority in replacing the function of gelatine in the food industry. Study of Abdalbasit and Hadia (2019) revealed gelatine is compound that contains collection of peptides is produced by partial hydrolysis of collagen extracted the skin and bone animal such as cattle, swine, fish and chicken.

Pectin is a high molecular weight carbohydrate polymer found in all plants. Kamal et. al. (2021) stated that fruit skin consists of cellulose, hemicellulose, pectin, chlorophyll pigment, carbohydrates, fibre, pectin, protein, minerals and low molecular compounds. Pectin is commonly used in food processing as a gel forming agent, food stabilizer and adhesive agent in products such as jam, drinking yogurt and other products. Most pectin for the food industry is produced from fruits and vegetables (Mao, 2020).

Nowadays, the type of food waste produced from domestic waste is mainly from the kitchen, which is food waste such as fruits and vegetables. Fruit peels are not fully used because there is no awareness of the organic content in fruit peels that ultimately produce valuable products. The extraction of pectin from fruit peel is one of the best methods to reduce the cost of food waste management and the impact of food waste disposal.

2 LITERATURE REVIEW

Rehman et al. (2019) investigated the optimum condition for extraction and precipitation of pectin from orange peel. Changes in pH, Temperature and extraction time significantly affected the extraction of pectin. Maximum pectin yield was 21% which was obtained from soaking finely ground and defatted orange peel hydrochloric acid solution with pH 2.5 at 80°C for 120 minutes. Maximum pectin was precipitated from the extract by adding 95% ethanol at 200 ml.

The study of Khamsucharit et al. (2018) showed the yield of pectin from banana peel at 15%. It also stated banana peel also contains 26.2% soluble sugar, 9.6% cellulose, 9.4% hemicellulose, 30.7%

dietary fibre and other percent from other small quantities compounds. Twinomuhwezi et al. (2020) stated that oranges peels contribute 42.5% to produce pectin. Orange peel also contains 16.9% soluble sugar, 9.2% cellulose, 5.5% hemicellulose, 17.5% dietary fibre and other percent from other small quantities compounds. Roy et al. (2017) stated that pomelo peel contains 21.6% pectin for the total weight of the fruit. Pomelo peel also contains 13% soluble sugar, 10.7% cellulose, 12.8% hemicellulose, 32% dietary fibre and other percent from other small quantities compounds.

From the previous study also stated orange peel, banana peel and pomelo peel also have highly percentage in their peels. This is why it was chosen for this study to produce more pectin than other fruit peels. This study also focuses on the production of pectin from waste material, which is the fruit peel such as oranges, bananas and pomelos, where fruit peels are among the main contributors to food waste in Malaysia.

3 METHODOLOGY

3.1 Preparation of Pectin

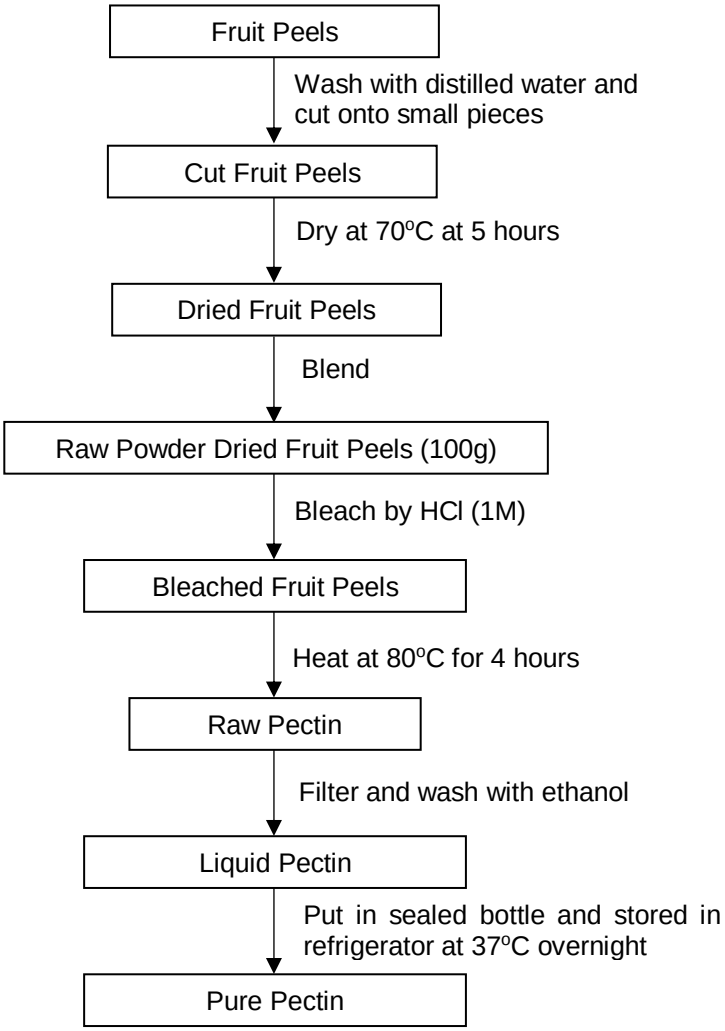

Figure 1: Process Flow of the Preparation of Pectin

Figure 1 shows the peels of fruits consisting of oranges, bananas and limes are washed with distilled water before being cut into small pieces. Cut fruit peels are placed in a Memmert UF30 oven at 70°C for 5 hours for drying purposes. The peel of the dried fruit is then blend into a powder. Raw pectin powder was weighed as much as 100 g before bleaching by mixing together 1 M hydrochloric acid before heating at 80°C for 4 hours. The resulting solution was filtered to obtain filtrate before it was washed with ethanol to obtain pure pectin. The pure pectin produced was then placed in a sealed sample bottle and stored in a refrigerator at 37°C overnight.

3.2 Characterization of Pectin

The characterization was performed to determine the physical and chemical properties of the produced pectin. This pectin is characterized by density determination using a Brannan hydrometer. The density is determined to ensure that the density of pectin produced equals or nearly equals the density of commercialized pectin. A pH test is performed to determine the acidity of the pectin produced to ensure that excess hydrochloric acid has been removed. This test was performed using a pH meter (Mettler Toledo EL20). The spread test is performed to determine the level of pectin flow by placing liquid pectin on a flat surface before tilting it by 90^{o} and allowing it to flow until it stops. Time will be taken when the pectin stops flowing. The best pectin is determined by the length of time it takes for the pectin to flow.

4 RESULT AND DISCUSSION

Table 1: Percentage of the Production of from Fruit Peel Pectin and Density of Fruit Peel Pectin.

Fruit Peel	Percentage of Produced Pectin (%)	Percentage of Pectin from Previous Study (%)	Density of Produced Pectin (kg/m^3)	Density of Pectin from Previous Study (kg/m^3)
Orange	44.3	42.5	810	812
Pomelo	25.5	21.6	807	805
Banana	17.4	15	750	746

Table 1 shows the produced pectin from orange peel is the highest percentage with 44.3% compared to the pectin of pomelo peel and banana with 25.5% and 17.4% respectively. While the density test performed shows that the pectin of orange peel, pomelo peel and banana peel have a density of 810 kg/m^3, 807 kg/m^3 and 750 kg/m^3 respectively. This test shows that orange peel pectin has the highest density compared to other fruit peel pectins.

From Table 1, orange peel pectin shows high production at 44.3% compared to 42.5% orange peel pectin from previous study. Pomelo peel pectin and banana peel pectin show 25.5% and 17.4% compared to pomelo peel pectin and banana peel pectin from previous study with 21.6% and 15% respectively. From this data, it shows fruit peel pectin show highly percentage compared to pectin that produced from previous study. This research proves this production of pectin from fruit peel is the best method for preparing the production of pectin compared to other fruit peels.

While Guiherme et al. (2019) states density of orange peel pectin, pomelo peel pectin and banana peel pectin from previous study show 812 kg/m^3, 812 kg/m^3 and 812 kg/m^3 that similar with pectin that produced from orange, pomelo and banana peels. This proves that pectin is produced which has the same properties as pectin which is almost the same as pectin produced by previous studies.

Table 2: Spread Test and Humidity Test for Fruit Peel Pectin.

Fruit Peel	Spread Test (second)	Humidity Test
Orange	12.5	Low wet
Pomelo	11.2	Moderate wet
Banana	9.1	Moderate wet

The Spread test showed that orange peel pectin flowed longer with 12.5 seconds compared to pomelo peel pectin and banana peel pectin which flowed for 11.2 seconds and 9.1 seconds respectively as shown in Table 2. The moisture test showed that orange peel pectin was less moist than pectin of the other fruits peels that are moderately moist. The low moisture nature of orange peel pectin contributes to the increased density of this pectin compared to other fruit peel pectins.

Table 3: pH Test, Melting Point and Solubility for Fruit Peel Pectin

Fruit Peel	pH	Melting Point (^{o}C)	Solubility	
			Water	Ethanol
Orange	5.53	93	Soluble	Insoluble
Pomelo	5.12	85	Soluble	Insoluble
Banana	4.82	80	Soluble	Insoluble

Based on the pH test that has been done as shown in Table 3, orange peel pectin has a less acidic pH with 5.53 compared to pomelo peel pectin and banana peel pectin which are 5.12 and 4.82

respectively. These pectins are less acidic due to the successful removal of hydrochloric acid that has been used as a bleaching agent during the preparation of the fruit peel pectin.

While the melting point of all fruit peel pectins shows their respective melting points in the melting point range of pectin that has been commercialized which is in the range of 78^{o}C to 110^{o}C (Iijima et al., 2018). The solubility test for fruit peel pectin shows that each is soluble in water and insoluble in ethanol.

5 CONCLUSION

The results of fruit peel extraction showed that orange peel produced the highest pectin with 44.3% compared to lime peel and banana peel which were 25.5% and 17.4% respectively. The density of pectin from orange peel is the highest which is 810 kg/m^3 compared to others. The spread test showed that pectin from orange peels flowed the longest, for 12.5 seconds compared to other fruit peels. The pH of pectin from all fruit peels is in the range of 4 to 6. Research data from tests conducted show that pectin from all fruit peels have properties that are almost the same as pectin that produced by previous study.

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