Partial Characterization of Watermelon Albedo Pectin Extracted Using Citric Acid Combined with Microwave Assisted Extraction

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Abstract. The aim of this study was to determine the influence of microwave power and extraction time on pectin chemical characteristics of watermelon albedo using citric acid combined with Microwave Assisted Extraction (MAE) method. Microwave power variations being applied were 50% (225 W), 75% (315 W), and 100% (450 W) and the extraction times were 1 minute, 2 minutes and 3 minutes. The data obtained was statistically analysed using two-way Analysis of Variance at a significance level of 5% continued by Duncan Multiple Range Test if there was a significant difference. The results showed that the variation of power and extraction time significantly affect yield, equivalent weight, degree of methylation, galacturonic acid content, and degree of esterification. Pectin yield was ranging from 2.19% to 5.34% and equivalent weight of the pectin ranging from 441.09 mg to 1432.00 mg. Pectin from the watermelon albedo was classified as low methoxyl pectin with degree of methylation ranged from 4.82%–6.92%. Galacturonic acid content of the pectin obtained was ranging from 39.83% to 79.21%. The pectin had a degree of esterification ranging from 49.57% to 68.74% which was classified as high ester pectin.

1. Introduction
Watermelon is one the most economically fruit among the Curcurbitaceae family fruit [1]. It has variety in flesh color including red which most commercial, besides yellow, orange and pink [2]. In Indonesia, watermelon flesh usually consumed as fresh cut fruit. Watermelon consumption in Indonesia itself grows 6.14% from 2014 to 2018 [3]. Increasing consumption of watermelon flesh raises new problem of its rind waste if not properly handled. According to Kumar et al., the rind contribute about 30% of the total weight of the fruit [4]. Though watermelon rind contain pectin 13%, thus made it as a prospective alternative source of pectin [5]. Commercial pectin usually being extracted from orange peel and apple pomace [6][7].

Pectin is naturally present in plant’s cell wall and cellular layer. It could form spreadable gel when interact with sugar and acid or calcium ions. Pectin characteristic is influenced by its source and extraction treatment [8]. Pectin extraction could be done using acid, both strong acid and weak acid [9]. Strong acid results more effective extraction but less safe than weak acid [10]. Citric acid is one of weak acid that had been used in pectin extraction, such as pectin from banana peel [10], red dragon fruit peel

[10]
Pectin extraction using acid combined with Microwave Assisted Extraction (MAE) considered need shorter extraction time with similar quantity and quality of pectin [14] and give better result [15][16]. However, this kind of extraction techniques also reported did not affect quality of pectin compared to the conventional method using high temperature [14]. This research objective was to study the effect of microwave power and extraction time on chemical characteristics of pectin from watermelon albedo (Citrullus lanatus) extracted using citric acid combined with Microwave Assisted Extraction (MAE) method.

2. Materials and Methods

2.1. Materials
Red-fleshed watermelon rinds were obtained from Lor In Hotel’s kitchen located in Karanganyar, Central Java, Indonesia. Solvent for extraction and chemicals for analysis were from Sigma-Aldrich and Merck.

2.2. Pectin extraction

2.2.1. Albedo powder preparation. The white part of watermelon rinds, albedo, was separated, washed and cut onto cubes with side length 1 cm. The albedo cubes was being dried at 55°C for 20 hours in a cabinet dryer, dry milled and sieved through 60 mesh sieve. Before extraction, the albedo powder was packed in a plastic bag and stored at room temperature.

2.2.2. Microwave Assisted Extraction of pectin. Pectin extraction was conduct using method developed by Wang et al. [17] with a slight modification. 20 g albedo powder was diluted using 200 ml distilled water, stirred, and added with citric acid to adjust pH until pH 2. The mixture was stirred and heated using microwave oven SHARP R-200J at various power level (225 W, 315 W, and 450 W) and extraction time (1 minute, 2 minutes, and 3 minutes), cooled into room temperature and filtered using filter cloth to gain pectin filtrate. Ethanol 96% was added to the filtrate in ratio 1:1 then stirred for 14 hours to conduct precipitation. Pectin precipitate was neutralized using ethanol 70% several times to remove acid. Finally, wet pectin was dried using cabinet dryer at 45±5°C for 10 hours and grinded to obtain pectin powder.

2.3. Analysis
Pectin yield was calculated as ratio between pectin powder weight and albedo powder weight. Equivalent weight, degree of methylation, and galacturonic acid content was analyzed using method described by Ranganna [18] whether degree of esterification was calculated using formula described by Azad et al. [6]. Data obtained from three replicate samples was statistically analyzed using two way ANOVA followed by Duncan’s Multiple Range Test if there was a significantly different at α=5%. SPSS was performed as the tool for statistic’s analysis.

3. Results and Discussion

3.1. Effect of extraction using citric acid combined with MAE on extracted pectin
Yield of the extracted pectin enhance as the microwave power and extraction time increase (Figure 1). According to ANOVA, there was no interaction between microwave power and extraction time on pectin yield. Microwave exposure causes cell rupture and raises solvent penetration so pectin will be better extracted [19][20]. Pectin yield ranged from 2.19% to 5.34% with the highest value achieved by combination microwave power 450 W and extraction time 3 minutes. Pectin yield in this research was about 30% lower compare to the watermelon rind pectin extracted using same solvent without MAE with a duration of almost 7 times [21].
3.2. Effect of extraction using citric acid combined with MAE on extracted pectin characteristic

Figure 2 showed the higher microwave power and the longer extraction time, the lower pectin equivalent weight. Statistically, microwave power and extraction time did influence the equivalent weight of the pectin. Higher power and longer time for extraction induces greater temperature that will lead the deesterification process and reduce the equivalent weight. Equivalent weight of the pectin gained in this research was ranging from 441.09 mg to 1,432.00 g.

ANOVA result showed that microwave power, extraction time and interaction between both factors had affected degree of methylation of the pectin. Increasing of microwave power and extraction time lead to the ascending of the degree of methylation (Figure 3).
Figure 3. Effect of extraction using citric acid combined with MAE on degree of methylation

Microwave power and extraction time gave influence to the galacturonic acid content as well as the interaction between the two factors. Higher power and longer time of extraction resulted higher pectin purity as shown as galacturonic acid content. Similar trend was reported by Sari et al. [22]. Galacturonic acid content ranged from 39.83% (225W, 1 min) to 79.21% (450W, 3 min) (Figure 4).

Figure 4. Effect of extraction using citric acid combined with MAE on galacturonic acid content

Microwave power and extraction time gave influence to the galacturonic acid content as well as the interaction between the two factors. Higher power and longer time of extraction resulted higher pectin purity as shown as galacturonic acid content. Similar trend was reported by Sari et al. [22]. Galacturonic acid content ranged from 39.83% (225W, 1 min) to 79.21% (450W, 3 min) (Figure 4).
4. Conclusion

Increasing microwave power and extraction time in watermelon albedo pectin extraction did enhancing pectin yield, degree of methylation, and galacturonic acid content but lowering equivalent weight and degree of esterification.

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