Study of Optimal Condition for Extraction of Pectin from Okra and its application

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Introduction

Pectin is a polymer compound found in plants. It is one of carbohydrate compounds that can be extracted from citrus peel and apple. Pectin acts as a cellular structure. A special property of pectin is that when it is dissolved in water, it can swell into a gel. It has been widely applied in the industry.

Pectin production in Thailand is still not sufficient to meet the demand; as a consequence, pectin is still needed to import from abroad at high prices. Industrial grade pectin normally costs about 121 USD per kilogram, while pharmaceutical grade pectin costs about 212-325 USD per kilogram. (Fluka, Germany, 2552)

Thailand is a large agricultural country. Therefore, there are several studies involved the extraction of pectin made from various agricultural residues such as orange peel, apple pulp, potato, sunflower and soybean hulls.

The extracted pectin can be used for several purposes. For example, in the study of the extraction procedure from Manoi leaf in the PhuPhan mountain area by Phornprapa Chunthanon et al. It was found that pectin from Manoi leaf was suitable for the production of healthy beverages.

Based on the findings as mentioned above, we aim to study the extraction of pectin from okra which is one of local plants, common and fast growing. Okra has the ability to cure stomach and intestine utters because it contains substances such as mucus, pectin and gum that can coat the stomach and intestine.

It can also maintain a normal blood pressure [1.]. Moreover, it can be a tonic for the brain laxative properties and the trichinosis disease [1.]. As a consequence, okra is one of potential plants that can be used to extract pectin in order to be utilized in the medicine and industry in the future.

Materials and Methods

Section I: The optimum conditions for the separation of pectin from the okra pods was studied. Effect of acid type, concentration of acid, the effect of extraction temperature, pH, amounts of sodium hexametaphosphate and the extraction time were investigated.

First, the purification of okra was processed by adding 95% ethanol and sample was ground into powder to reduce the particle sizes. Then, the impurities were removed by adding 95% ethanol to 10 g of sample powder using the ratio of sample: ethanol at 1: 2.5. After that, sample was filtered by Bucher funnel and refluxed for 5 minutes. Then, 30% ethanol was added to crude sample with the ratio of crude sample : 95% ethanol was 1 : 2. The resulting mixture was stored at room temperature for 30 minutes, and the crude sample was filtered by Bucher funnel twice and washed by 95% ethanol. Next, each crude sample was separately mixed with hydrochloric acid, nitric acid, and acetic acid. The pH of each mixture was adjusted to 3.0 by citric acid. Subsequently, the solution was boiled at constant temperature (60 – 100 °C) for 50 – 110 minutes. The solution was filtered again and 95% ethanol was added to a crude that stuck on the filter. After that, the solution was stored for 12 hours. Finally, the final solution was filtered for the third time to obtain crude extract and it was dried at 60 °C.

Section II: Chemical properties and physical properties of extracted pectin from okra pods were studied and compared with the standard commercial pectin, including the amount of pectin, humidity, ash, methoxyl group and polygalactulonic acid. The chemical properties including the amount of pectin, humidity, ash, methoxyl group in pectin were analyzed by the

methodology as described by Jittra Sintonget. *et al.* (2004: 36) [5.]. The amount of galactulonic acid was also determined.

The test for physical properties including color values by CIE technique was examined. The colorimeter; Hunter Lab (ColorFlex 45/0) was used. The viscosity of the extracted pectin from okra pods was analyzed. Then, concentrations of pectin were varied at 0.5, 1.0, 1.5 and 2.0 percent weight by volume. The Brookfield viscometer DV – E was used. The result was compared with standard pectin from orange grade 150 and the measurement was repeated 4 times.

Section III: the study of molding biological plastic by extracted pectin from okra pods and some specific properties included thickness; water absorption and tensile strength were evaluated and compared with biological standard plastic that made from pectin.

Pectin was extracted from okra pods and it was molded at the optimum condition reported by Mollea, C. ,Chiampo, F. and Conti, R.[4.] as follows: cassava and pectin; at the ratio of 1: 2 (dry weight) was mixed with plasticizer and molded on the flat glass. Then, 15% glycerol was added to the mixer and the film was dried at 60 °C for 4 hours. After that, the film was removed and its specific physical properties including thickness, water absorption and tensile strength were analyzed

Results and Discussion

The results from the study of optimum conditions, characteristics of extracted pectin from okra and its application were presented as follows;

Part 1: For the optimum conditions of pectin extraction from okra, hydrochloric acid was used for the extraction with the percentage yield of 9. 97% pectin. The optimal acid concentration of acid was 0. 03 N of HCl with %yield of 10. 94%. After adjusted pH to 3, the extraction gave %yield of 11. 39%. When the solution was boiled at 90 ºC, the yield was increased to 12. 69%. The best boiling time was 90 minutes giving yield of 12. 69%. It was also found that when sodium hexametaphosphate was added to increase the extraction efficiency, percentage yield was increased to 15.98%.

Part 2: It was observed that most physical and chemical properties of pectin extract from okra was similar to commercial pectin, except for ash content, but these were in range of standard level. (Table 1 - 3)

Table 1: Chemical properties of pectin extracted from okra compared to standard commercial pectin.

Type of pectin	Pectin extract from okra (%)	Moisture (%)	Ash content (%)	Methoxyl (%)	Galacturonic acid(%)
Standard pectin	-	-	2.0	>2.5	>65
Industrial grade pectin	22.55	4.26	3.59	5.08	69.89
Lab and pharmaceutical	-	4.81	2.23	6.29	78.54
Pectin from Okra	15.98 ±0.02	4. 32 ±0.02	4.12 ±0.02	6.68 ±1.54	66. 28 ±1.53

Table 2: Viscosity of pectin extract from okra and commercial pectin (orange grade 150)

Type of pectin	Viscosity at pectin concentration			
	0.5%	1.0%	1.5%	2.0%
From Okra	33.96 ± 0.02	68.46 ± 0.02	119.35 ± 0.02	176.96 ± 0.01
From orange grade 150	35.12 ± 0.01	72.35 ± 0.01	128.47 ± 0.01	186.42 ± 0.01

Table 3 Color values of pectin extract from okra and commercial pectin (orange grade 150)

Type of pectin	Color values[1]		
	L*	a*	b*
From Okra	66.41 ± 1.63	7.46 ± 1.62	26.97 ± 1.79
From orange grade 150	82.77 ± 0.00	3.14 ± 0.00	18.92 ± 0.00

Note : [1]CIE color value : L* = brightness (100 = bright, 0 = dark) a* = (+) Red, (-) Green b* = (+) Yellow, (-) Blue

Part 3: The property of biofilm from the mixture of extracted pectin from okra and some characteristics was studied. The characteristics of the biofilm from okra was in range of standard

pectin[3.] (Table4); therefore, the results indicated that it had similar physical appearance as compared to commercial grade pectin.

Table 4: Characteristics of biodegradable plastic molding from extracted pectin from okra and standard pectin.

Type of degradable film	Thickness (mm)	Water permeability (second)	Tensile strength (N/mm^2)	Physical of the film
standard pectin	0.0228 ± 0.0021	45 ± 0.11	15.20 ± 0.44	
Pectin from Okra	0.0221 ± 0.0032	42 ± 0.12	19.20 ± 1.06	

Conclusions

The appropriate condition for pectin extraction from okra was 0.03 N hydrochloric at pH 3.0 and 90 °C with 4% sodium metaphosphate which produced percentage yield of pectin at 15.98 ± 0.02%. The study of some properties showed that pectin from okra had similar characteristics as compared to industrial pectin, except for ash content. However, it was in the range of standard pectin which was close to pectin from orange peel grade 150. Pectin extracted from okra was useful in industry and could be applied to bioplastic production. Moreover, the import of pectin to the country could be decreased.

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