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THE OPTIMIZATION OF PECTIN EXTRACTION FROM SHELL MARKISA (*Passiflora edulis* Sims) FRUIT: AN EFFORT TO INCREASE THE ECONOMIC VALUE OF MARKISA FRUIT

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ABSTRACT

The passion fruit (*Passiflora edulis* Sims) shells are one of the proper and cheap row material of pectin provide the waste of many small industries of passion fruit juices in South Sulawesi. The variable implicated in optimization of pectin extraction (wet acid extraction process at 100°C) are pH of acid solution (pH 2 to 4) and time of extraction (30, 45, and 60 min). Using the experimental randomized factorial design model processing data showed only the pH of acid solution affect the row pectin rendemen and that was to be quadratic trend against the pH conducting the pectin extration. The pectin rendemen curve explained the maximum of pectin rendemen obtained was situated at range of pH 2 to 3. After the shorten of pH range in eleven pH points, the trends of pectin rendemen (5.8% -5.12% was still quadratic. The quality of row pectin obtained: water content, metoxyl and viscosity, respectively tend to decrease when the pH of extraction increase, in contrary the residue melanin pigment tend to decreased.

Keywords: Pectin, extraction, markisa (*Passiflora edulis*, Sims).
OPTIMIZATION OF PECTIN EXTRACTION FROM PASSION FRUIT (Passiflora edulis Sims) SHELL: AN EFFORT TO IMPROVE ECONOMIC VALUE OF PASSION FRUIT

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Abstract

The passion fruit (Passiflora edulis Sims) shells are one of the proper and cheap raw material of pectin. The shell is the waste of many small industries of passion fruit juices in South Sulawesi. The variable implicated in optimization of pectin extraction (wet acid extraction process at 100°C) were pH of acid solution (pH 2 to pH 4) and time of extraction (in range of 30, 45, and 60 minutes). Using the experimental randomized factorial design model, it showed only the pH of acid solution affects the raw pectin yield and that was quadratic trend against the pH of the pectin extraction. The pectin yield curve explained the maximum of pectin yield obtained being at the range of pH 2 to pH 3. After contracting the pH range in eleven pH points, the trend of pectin yield (5.8 – 5.12%) was still quadratic. In terms of the quality of raw pectin obtained, water content, metoxyl and viscosity tend to decrease when the pH of extraction increased, in the contrary the dark color (melanin pigment) tend to decrease.

Keywords: Pectin, extraction, passion fruit.

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INTRODUCTION

Pectin is widely used in food, pharmacy and textile industries. The specification of available pectin in the market is determined by physical and chemical properties: for example gel setting temperature, viscosity, and degree of methylation. The properties depend on source and extraction method.

 Mostly fruits, vegetables (apples, cucurbitaceae, pineapples, bananas, tomatoes, passion fruits, etc) are well known to contain substantial amount of pectin. The chemical structure of pectin contains polymer of galacturonic acid with α (1-4) bond, on terminology sense, pectin is polygalacturonic acid chain methylated 100%, or in practice meaning, pectin is pectic acid, (3, 1).

In Makassar city (South Sulawesi Province), there are 32 small and medium industries of passion fruit juices with production capacity of 4 to 29,500 tones per year (8). The shell of passion fruit is just thrown away by the industries so it becomes waste. Moreover, the shell is a source of pectin (Subardjo, et. al., 1989). If the average weight of the passion fruit shell is 75,17% of whole fruit (by weight), (10), the total of the shell that is available as pectin source was 22,813 ton. If pectin obtained from the shell about 5,5 – 5,8% (by dry weight shell), so that from 8,828 ton dry shell will produce 1605 Kg of crude pectin.

This research will solve the waste problem of the passion fruit shell resulted from juice industries in Makassar city. The waste will be converted into a useful product (pectin) and in the same way this research will indirectly encourage the farmer to manage their passion fruit plantation better and inform them that from the passion fruit shell
pectin can be produced and it could improve the selling price of their passion fruit.

MATERIALS AND METHODS

The raw passion fruit shell was obtained from small industries of passion fruit juice in Makassar city. The wet extraction of pectin conducted at pH 2, 3 and 4 and at temperature 100° C on stainless steel recipient pan. Sample using 500 g of fresh clean-chopped fruits shell, HCl solution at treated pH, was added followed by heating at 100°C during 30, 45 and 60 minutes respectively. The extract was filtered and than decanted by ethanol 96% (one volume of extract by one volume of ethanol). After decantation over night, the decanted extract was filtered again and rinsed twice by ethanol 70% and then dried in oven at temperature 60–65°C to obtain constant weight, (1).

The pectin quality parameters that were analyzed were: metoxyl content, melanin content, and viscosity.

The variables in this research the extraction pH (A factor) and time of extraction (B factor). The extraction pH (A) were pH 2, 3 and 4, and the extraction time (B) were: 30, 45 and 45 minutes. The responses measured were pectin yield, water content, metoxyl, viscosity and melanin or dark color pigment of pectin. The data obtained were analysed by factorial randomized design, (6).
The result of data analysis then was continued to analyze more details whenever:

- The interaction of factor A and B was not significant: The percentage of pectin = f (factor A or B).
- The interaction of factor A and B was significant: The percentages of pectin = f (factor A or B and interaction AB).

RESULTS AND DISCUSSION

Pectin yields

In the first step of the research, the pectin yield obtained by extraction condition were about 4.12 – 5.88%. The high yield was resulted from the extraction at pH 2.8 – 3.0, which was 5.88%.

The analysis of variance (ANOVA) showed that only the pH extraction resulted a significant difference on the pectin yield (P<0.01), while the extraction time and the interaction of the two factors (pH and time) were not different significantly (appendix. 1). Percentages of pectin obtained tend to decrease when the extraction time extended to 45 and 60 minutes (Fig.1).
Table 1. Recapitulation data of yields and the quality of pectin resulted from passion shell fruits

<table>
<thead>
<tr>
<th>Sample Treatments</th>
<th>Parameters</th>
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<tbody>
<tr>
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<td>Pectin yields (%) *</td>
</tr>
<tr>
<td>A1B1</td>
<td>5.83 ± 0.11</td>
</tr>
<tr>
<td>A1B2</td>
<td>4.86 ± 0.13</td>
</tr>
<tr>
<td>A1B3</td>
<td>4.49 ± 0.08</td>
</tr>
<tr>
<td>A2B1</td>
<td>5.60 ± 0.07</td>
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<tr>
<td>A2B2</td>
<td>4.82 ± 0.02</td>
</tr>
<tr>
<td>A2B3</td>
<td>4.62 ± 0.08</td>
</tr>
<tr>
<td>A3B1</td>
<td>5.60 ± 0.10</td>
</tr>
<tr>
<td>A3B2</td>
<td>4.64 ± 0.01</td>
</tr>
<tr>
<td>A3B3</td>
<td>4.55 ± 0.06</td>
</tr>
</tbody>
</table>

A1, A2, A3 = Time of heat extraction: 30 min; 45 min; 60 min respectively
B1, B2, B3 = pH of extraction: pH 2, pH 3, pH 4 respectively
* Pectin yield (by dry weight)

The next step was to observe the function of pH (pH 2 – 4) and than the shortened interval the pH 2 – 4, by range of pH 0.2 unt to the pectin yield. In the same time the pectin yielded was measured also their parameter quality.
Figure 1. Pectin yield obtained from passion shell fruit (by dry weight) in range pH 2 to pH 4.

The heating time also affected the hydrolysis process to convert non-soluble to soluble pectin. On the other hand, the extension of heating was taken a part in disruption pectin molecules extensively to small derivates. This was facilitated by pH condition. During the separation process, the small molecules passed over the filter. The pectin colloid had the negative charge that was determined on the free carboxyl group attached on the pectin chain molecules and that is explained why the pectin yield affected by the pH of extraction. In this case, at the pH range of 2 – 3 seemed favorable to keep the extraction process be optimal but not at the outer range of the pH. The increasing of pH condition during the extraction combined by short heating time also increased the yield of pectin.
The maximum pectin yield obtained from extraction time 30 minutes, was 5.8% and the lower was 4.1% under the pH treatment pH 2 to pH 3 (Table 1).

**Pectin Quality**

The water and ash content of pectin yield tended to decrease by the extraction time (Fig. 2 and Fig. 3) and also, the ANOVA (not presented) showed that the heating time was influenced by the water and ash content of pectin.

![Figure 2. Water Content of Pectin Obtained from Passion Fruit Shell](image-url)

Prolonging the heating time during the extraction led to the breaking of pectin molecules (depolymerization). Consequently, the liberated small molecules were not capable to tightly bind to the water like the big pectin molecules. In drying process, the water hold by small molecules of pectin was easier to loose compared to the big pectin molecules. The water binding capacity of pectin also
determined by hydroxyl group, (1, 2), this condition also was improved by statement that metoxyl group content of pectin obtained from passion fruit shell was low. The other explanation stated that the water content of pectin influenced more or less by the size of pectin molecules holding the hydrogen bonds on hydroxyl groups formed during extraction process.

In a different case, the ash content of pectin differed significantly by the extension of extraction time. It tended to decrease by the extraction time (fig.3). The results suggested that the long heating on low pH condition (strong HCl) resulted the demineralization of pectin.

![Figure 3. Ash Content of Pectin Obtained from Passion Fruit Shell](image)

On the contrary to the water and ash content, the extraction time was not significantly different to the metoxyl group of pectin but only released the pectin from cellulose compound and other polysaccharides of passion fruit shell (Fig. 4). The ANOVA, of
metoxyl, melanin and viscosity of pectin differed significantly by heating time and extraction pH (P< 0.05) (not showed). The breaking of galacturonic acid chains of pectin by heating and pH established other alteration on the melanin content and pectin viscosity obtained while metoxyl group of pectin was not affected, it seems that it just released the pectin from other compounds (cellulose and other polysaccharides). However, the diminishing of viscosity and melanin (Fig.5 and Fig.6) could be caused by strong hydrolysis of pectin during extraction process converted to small molecules and this also reduced the viscosity of pectin (1, 4, 7, ).

Figure 4. Metoxyl Content of Pectin Obtained from Passion Fruit Shell
In the case of melanin (dark color), it decreased with the extraction pH. The dark color was derived from oxidation of anthocyanin pigment that presences in fresh passion fruit shell. It seems that the melanin of pectin much brighter when the pH condition low and become darker or paler on the low pH, (2, 5, 7).

**Figure 5.** Pectin Viscosity Obtained from Passion Fruit Shell

**Figure 6.** Meanin Content of Pectin Obtained from Passion Fruit Shell
CONCLUSION

The passion fruit shell as waste from small and medium passion fruit juice industries in South Sulawesi province can be as raw materials to produce pectin.

The pH range of 2 to 3 and the heating time for 30 minutes was the best treatment for the pectin extraction of the passion fruit shell. This was based on the maximum pectin yielded (5.5 – 5.8%, by dry weight) and other parameter qualities (water content, ash, metoxyl and melanin content and viscosity).

The quality of obtained pectin was characterized by low metoxyl (0.2 – 4%), ash 3.0–6.9%, viscosity 1060–3180 cp, the gel setting at 35°C in present Ca²⁺ ion (observed in the same time when the viscosity measured), the color was violet pale to dark. The pectin look like oxidized antocyanin pigment and tannin that were soluble in the pectin extract during the extraction process. This color of pectin was measured by the melanin content (0.5 – 0.7%) and by where this color tended to decrease when the pH extraction was increase.

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Yenni Tosani (1998). Distribution pattern of physic dimension and yield of markisa (*Passiflora edulis* Sims) fruit according the fruits positions on branches. (unpublished). Department of Agricultural Technology-Faculty of Agriculture and Forestry –Hasanuddin University.
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Judul Makalah : The Optimization Of Pecin Extraction From Shell
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Increase the Economic Value Of Markisa Fruit

Penulis Makalah : Dr. Ir. Mariyati Bilang, DEA

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