Pb Reduction of *Avicennia marina* Fruit Flour by Soaking in *Citrus aurantifolia* Extract

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**ABSTRACT**

Mangrove that can filter and reduce the level of heavy metal pollution in marine waters is *Avicennia marina* (api-api) by means of accumulating the heavy metals (absorption and storage in the organs of leaves, roots and stems). *Avicennia marina* fruit has been used as traditional food. But it grow on mangrove which is highly polluted. This research aims to determine (1) the effect of lime soaking time on the reduction of Pb content in *Avicennia marina* flour and (2) the soaking duration in lime for *Avicennia marina* fruit flour consumption safety. The toxicity and lethal properties of PB can be eliminated by the addition of lime solution. The effect of adding organic acids such as lime (*Citrus aurantifolia*) with different soaking time on the reduction of Pb level contained in *Avicennia marina* fruit flour is studied. The results show that the longer the soaking time in lime, the higher the Pb heavy metal reduction. The highest Pb reduction 0.27 ppm (85%) was shown at 240 minutes soaking in lime while the contents of protein stood at 2.81% and of tannin at 344 ppm.

**Key words:** *Avicennia marina*, Pb, lime

**Introduction**

Mangrove has been highly beneficial to the marine waters as it filters and reduces the heavy metal pollution level in marine waters through the absorption, accumulation and inactivation of heavy metal pollutants in its leaf, root and stem tissues (Vicar, 2008). More specifically, Irwanto (2007) states that it is the *Avicennia marina* (api-api) mangrove type that filters and reduces the heavy metal pollution level by means of heavy metal accumulation (uptake and storage in leaf organs, roots and stems). From data Arisandy *et al.* (2011), accumulation of heavy metals lead (Pb) found in *A. marina* tissue equal to 13,157 ppm at river Kebon Agung, Gunung Anyar district Surabaya City. The industries and households brings solid and liquid wastes, there are five steel industries PT. Timur Mega Steel, PT.Maspiion Group, PT.Surabaya Wire, PT. Nippon Paint, PT. Ispat Indo and four paper industries PT. Suparma, PT. Surabaya Meka Box, Surabaya Kertas and Pulp Tbk., PT. Adiprma Surya Printa (Edhi *et al*., 2011).

Besides, the mangrove-based food manufacture technology has been developed, one of which is through the drying process to be used as a base for the manufacture of flour cake (Setiawan, 2008). The mangrove fruit that can be made into flour is that of the *A. marina* and is usually used as a base for making cakes. As a solution to the abundance of the *A. marina* fruit production, the community usually makes them into cakes (Sunyoto, 2008). The flour made from *A. marina* pulp after processed into food has a unique cool aftertaste and easily breaks when bitten (Whimpey, 2007). Mangrove fruit also can be made into syrup, brownies, and vinegar. These products use raw materials from mangrove fruits, and still have not made an effort to the reduction of the levels of leads (Ardhie and Suprayitno, 2011; Tamam and Suprayitno, 2011). The content of lead in the raw materials after tested still of 3.66 ppm (Prasasti, 2009).

Lime that contain citric acid is a protic hydrophilic solvent (polar), much like water and ethanol. Citric acid has a dielectric constant which is the 6.2, so that it can dissolve polar compounds such as inorganic salts and sugars as well as non-polar compounds such as oils and elements such as sulfur and iodine including Lead (Pb). Lead is a toxic metal bound in sulphydryl groups (-SH) in enzymes such as systemic, hystidic, hydroxic and...
phosphatic carboxylates in protein and purine. The toxicity and lethal nature of lead (Pb) can be eliminated by the addition of citric acid solution. The reaction of the metal binder (lemon acid) to metal ions causes the loss of their ionic properties and toxicity level (Alphatih et al., 2010).

This research aims to determine (1) the effect of lime soaking time on the reduction of Pb content in *Avicennia marina* flour and (2) the soaking duration in lime for optimal reduction of Sulphydril (-SH) contained in enzymes (e.g. in systenic, hystidic, hydroxic and phosphatic carboxylates in protein and purine) for *Avicennia marina* fruit flour consumption safety. The toxicity and lethal properties of PB can be eliminated by the addition of lime solution.

**Materials and Methods**

**Materials:**

The *A.marina* fruit obtained from the Wonorejo village, Rungkut District, Surabaya was used in this study because the Wonorejo area is highly contaminated by industrial and household wastes. The young fruit is light green in color and is not covered with fungus nor roots. The lime fruit is round in shape and yellowish green in color. Other materials used are lime obtained from the Dinoyo market in Malang.

**Methods:**

*A. marina* fruit peeled, to separate material from the caterpillars and to eliminate the stigma. It boiled in 800 ml of distilled water and temperature of 90ºC for 60 minutes. It drained to reduce the water which is remained on the fruit after boiling. Soaking *A. marina* fruit in lime extract (concentration 25%) with following 120, 150, 180, 210 and 240 minutes. Washing *A. marina* fruit with distilled water to dissolve the citric acid in the fruit of mangrove exist after soaking. Drying is done by a dryer oven for 10 hour (70ºC ). The manucature of *A. marina* fruit flour was done by blender for 3 minutes. The *A. marina* fruit flour is soft texture and light green in color. Sieving was conducted to get soft texture using sieveing (mesh sieve size 60-80). The parameters tested were the levels of Pb, protein, and tannin.

**Result:**

**Pb Reduction:**

This study employed different soaking durations in the manufacture of mangrove (*A.marina*) fruit flour, namely 120, 150, 180, 210 and 240 minutes. The results of the soaking on the reduction of Pb are summarized in Table 1. Table 1 show that the longer the soaking time the higher the reduction of Pb in the *A. marina* fruit flour.

<table>
<thead>
<tr>
<th>Soaking Time</th>
<th>Pb Value (ppm)</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>1.78</td>
<td>-</td>
</tr>
<tr>
<td>120 minutes (A)</td>
<td>0.49</td>
<td>73%</td>
</tr>
<tr>
<td>150 minutes (B)</td>
<td>0.42</td>
<td>76%</td>
</tr>
<tr>
<td>180 minutes (C)</td>
<td>0.38</td>
<td>79%</td>
</tr>
<tr>
<td>210 minutes (D)</td>
<td>0.31</td>
<td>83%</td>
</tr>
<tr>
<td>240 minutes (E)</td>
<td>0.27</td>
<td>85%</td>
</tr>
</tbody>
</table>

The analysis showed an increase in the reduction of Pb in mangrove fruit due to long soaking time in lime. The relationship between the different soaking lengths and Pb reduction can be seen in Fig. 1.

**Fig. 1:** Regression Graph Difference Between Treatment Against Soaking duration on Pb levels.
Figure 1 shows that the regression equation of the different treatments on the Pb soaking length is 
\[ y = 3.1 x + 69.9 \] with \( R^2 \) of 0.992. This equation shows a negative relationship in which each 30 minute-long soaking increases the Pb reduction level by 3.1 with the coefficient of determination value of 0.992 meaning that 99.2% of the increase in the Pb reduction is influenced by long soaking.

**Protein and Tannin Content:**

The best of soaking duration \( A. marina \) fruit against Pb reduction is 240 minute. The treatment used to analyze protein and tannin on \( A. marina \) fruit flour. In terms of the parameter levels of protein and tannin, the best treatments are shown in Table 3.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Control</th>
<th>Best Treatment (240')</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein level (%)</td>
<td>4.65</td>
<td>2.81</td>
</tr>
<tr>
<td>Tannin level (ppm)</td>
<td>757.5</td>
<td>344</td>
</tr>
</tbody>
</table>

Protein is a body builder substance regulating substances in the body (Muchtadi, 1993). Winarno et al., (1980) state that it is the protein level in the food which determines the food quality itself. The results of the analysis of protein levels in terms of the relationship between the control and the best results (240 minutes) can be seen in Figure 2.

![Fig. 2: Results Contents of Protein.](image1)

Figure 2 shows a decrease in protein levels in the mangrove \( Avicennia marina \) fruit flour on the control of 4.65% down to 2.81%. Decreased levels of protein in the best result are 240 minutes.

Tannin are phenolic compounds that are easily available in the plant (leaves, wood, fruits, roots) and are capable of forming complexes with proteins, cellulose, starch and minerals. In addition, tannin has the ability to absorb heavy metals but it has drawbacks soluble in water (Wisnubroto, 2002). The results of tannin level analysis indicate the relationship between the control and the best results (240 minutes) as shown in Figure 3.

![Fig. 3: Results Contents of Tannin](image2)
The duration of soaking in lime significantly effects the reduction of Pb in *Avicennia marina* fruit flour.

2. The 240-minute soaking in lime resulted in the highest Pb reduction in *Avicennia marina* fruit flour with a protein content of 2.81% and tannin content of 344 ppm.
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