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LEAD AND CADMIUM MOBILIZATION FROM *ANAS MOSCHA* AND *CAIRINA MOSCHATA* TISSUE USING PINEAPPLE EXTRACT AS CHELATING AGENTS

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ABSTRACT

An assesment of dietary risk of heavy metal exposure to humans is important since it is the main source of exposure. This study aimed to messure the level of contamination of heavy metal especially Lead (Pb) and Cadmium (Cd) and the efforts to reduce contamination Pb and Cd in *Anas moscha* and *Ciarina moschata* Tissue. The concentration of Pb and Cd in *Anas moscha* and *Ciarina moschata* tissues were lower than the maximum acceptable level for Pb and Cd respectively. (1 mg/Kg for Pb; 0.5 mg/Kg for Cd, SNI 2009). The result indicated that after soaking and boiling in citric acid solution form pineapple extract at concentration 100 % for 60 min at 100 ^{0}C reducing heavy metals Pb in *Anas moscha* from 0.03 mg.Kg^{-1} to 0.003 mg.Kg^{-1} and Cd in *Anasmoschata* and *Cairinamoschata* from 0.027 mg.Kg^{-1} to 0.003 mg.Kg^{-1} and 0.022 mg.Kg^{-1} to 0.001 mg.Kg^{-1}. The highest reduction of Pb and Cd level up to 80 % when samples were boiled in pineapple extract for 1 hour at 100^{0}C. The study concludes that boiled samples in pineapple extract has a potential to reduce the contamination of Pb and Cd.

KEY WORDS : Citric Acid solution, Pineapple extract, Heavy metal

INTRODUCTION

Human activites such as industrial and mining operations, population increase and urbanization and to unplanned, unsciencetific disposal methods are the major contributing factor for rapid increase in the concentrations of heavy metals such as lead, copper, zinc, chromium, cobalt, cadmium in quiferss (Kumariand Sobha, 2016). Lead and cadmium pollution is increasing due to anthropogenic activities such as mining, metallurgical industry, the application of phosporus fertilizer and pesticides (Zhang *et al*., 2015) and former additive in automotive gasoline as tetra ethyl lead ($(CH_3CH_2)_4Pb$) (Mielke and Reagen, 1998).

Lead and cadmium have no known biological functions for the physiological and biochemical processes in cells and are toxic even when present at low concentratons to living organism (Salt *et al*., 1995). The accumulations of metals in the edible plants part and dietry food can adverse health effect to the human. Contamination of lead poses a serious problem of human health such as human depressed immune status, mental impairment, cancer, High blood pressure, IQ loss, neurological disorder, DNA damage and hematological, pathological dysfunctions (Fextrell *et al*., 2004; Flora *et al*., 2007; Ahamed and Siddiqui, 2007; Manikantan *et al*., 2010; Poreba *et al*., 2011). Cadmium (Cd) is known for its effect at cellular level with the inhibition of the mitocondrial electron transfer cahin and the induction of reactive oxygen species (ROS) (Wang *et al*., 2004).

Lead and Cadmium have contaminated various foodstuff product such as traditional food, vegetables, fruits, cereals, meat, fish, chicken and white pekin ducks (Ali and Al-qohtani, 2012; Amani *et al*., 2012; Djohan, 2015; Bordeleau *et al*., 2016; Sigma *et al*., 2017). These metals cannot be degraded

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or destroyed, although they can change their formula forms. Once the lead cadmium are dispersed into water, soil air, plants, animals and dietary food can accumulate them (Cheng *et al.*, 2017). Although the relative contributions for heavy metal intake have not been clearly established, dietary intake is considered to be critical exposure pathway, accounting for >90 % of exposure, with inhalation and dermal contact the other exposure routes (Kachenko and Singh, 2006; Islam *et al.*, 2015)

The technologies used to reduce contaminations in food are using organic acids as a chelating agent. Citric acid has potential as chelating agent to remove toxic metals (Chen *et al.*, 2003; Astuti *et al.*, 2016; Aderholt *et al.*, 2017). Pineapple (*Ananas comosus*) is one of the fruits that have high concentrations of citric acid. Citric acid includes a chelating agent which is a stabilizer at food processing. Citric acid binds the heavy metals in the form of complex bond and can reduce side effects of heavy metals in food (Hikmawati and Lilis, 2016).

Interaction of citric acid with heavy metals can be enhanced by soaking (Ulfa *et al*., 2014) and boiling process at high temperature (Sari *et al.*, 2014). The aim of the experimentations was to evaluate the metal mobilization induced by citric acid from pineapple extract when samples were soaking and boiled until 60 minutes.

MATERIALS AND METHODS

Experimental site

The experiment was performed in food and beverage analysis laboratory, faculty of health science, musi charitas catholic university, Palembang, Indonesia.

Sample preparations

Anasmoschata and *Cairina moschata* were purchased from Gandus Area in Palembang, South Sumatera, Indonesia. Samples of *Anasmoschata* and *Cairinamoschata* was washed and separated their shells and meat. Meat of *Anas moschata* and *Cairina moschata* was soaked in a extract of citric acid at 75 %, 100 % for 30 min, 60 min at 50 ^{0}C, 100 ^{0}C.

Heavy metals analysis

The heavy metals such as Pb and Hg at juaro fish meat were analyzed by atomic absorption spectrophotometer (AAS) AA 700 in industrial research and standardization laboratory Palembang and environmental health and disease control laboratory Palembang. Sample (5 g) were dissolved in 25 mL $H_2SO_{4(p)}$, 20 mL $HNO_{3(p)}$, 20 mL HNO_3-$HClO_4$(1:1) then analyzed using AAS.

Statistical analysis

The normality value of multiple groups were analyzed by one-way analysis of variance (ANOVA) with $p < 0.05$ was classified as statistically significant.

RESULTS AND DISCUSSION

Lead (Pb) Content in *Anasmoschata*

Lead is a soft metal that had many applications over the years. The main sources of this element are primarily from automobile emissions, paint chips, fertilizer, pesticides and Pb-acid batteries. The spreading of Pb pollution from major emission sources are mainly through air. The bioaccumulation of Pb in dietary food should be reduced by using chelating agent. Citric acid as a chelating agent with vary concentration from pineapple extract, soaking time and boiled temperature was used to reduce the level of Pb in *Anasmoschata.*

The level of Pb Studied were successfully reduced by citric acid and are presented in Fig. 1. The obtanined results from AAS showed that Pb content in juaro fish before soaking and boiled treatment was 0,03 mg.Kg^{-1}. The value shows that the Pb levels in *Anas moschata* are under the permissible limit. Based on Indonesia National standard the permissible limits of Pb content was 1 mg.Kg$^{-1.}$

Lead (Pb) can enter the human body through uptake of food (65%), such as fruit, green vegetables, meats and crop products, edible sea life, cold drinks, cigarette and alcohol may contain significant amounts of Pb in water (20%) and air (15%) (Ahmad, 2016) . Lead (Pb) in *Anasmoschata* successfully remove above 80 % after soaked and boiled with 100 % pineapple extract for 60 min at 100 ^{o}C.

Citric acid was effective for the removal lead ions which is likely due to its C=C bond (Jiang *et al.*, 2017). Removal effect of toxic metals among organic acids is more effective at acidic condition. Citric acid has large pka (pka = 3.15) provide anions to complex with metals (Doores, 2005). The statistical analysis showed that each treatment was

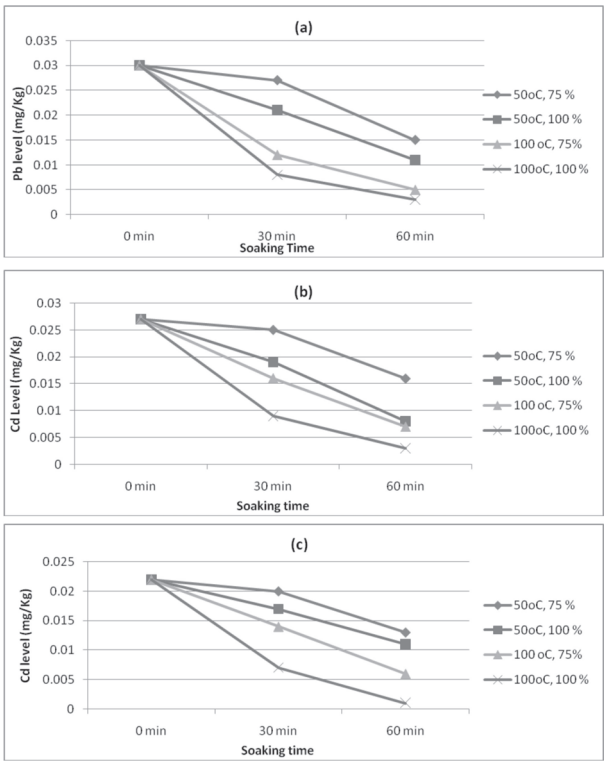

Fig. 1. Reduction of Heavy Metals. (a) Pb in *Anas moscha,* (b) Pb in *Anas moscha*, (c) Cd in *Cairina moschata*.

significantly different and suggest that the higher boiled temperature and longer period of treatment time at any concentration of citric acid can increase the removal of Pb out from *Anas moschata.*

Cadmium (Cd) content in *Anas moschata* and *Cairina moschata*

Cadmium (Cd) is a transition metal with no known biological function in living organism. Cadmium compounds are extremely toxic even at low concentrations because of their bioavailability and solubility in environments. Citric acid with varying concentration of pineapple extract, soaking time and boiling temperature was used to reduce level of Cadmium in *Anas moschata* and *Cairina moschata*. The levels of Cd studied were successfully reduced by Citric acid presented in fig. 2 and 3. The Cd level in *Anasmoschata* and *Cairinamoschata* from AAS instrument before soaking dan boiling treatment was 0.003 mg.Kg^{-1} and 0.022 mg.Kg^{-1}. The value shows that the Cd levels in 0.003 mg.Kg^{-1} under the permissible limit.

Heavy metals especially cadmium has contaminated aquatic system (Malvardi, 2017), seafood species (Morgano *et al.*, 2013) and duck (Waseloh, 1994). The cadmium accumulated in body upon the consumption of contaminated duck. The adverse effect of Cd can caused kidney damage in humans. Cadmium in *Anas moschata* and *Cairina moschata* successfully removed above 80 % after soaked and boiled with 100 % pineapple extract for 60 min at 100 ^{o}C.

The statistically analysis showed that each treatment was significantly different and suggest that higher boiled temperature and longer period of treatment at any concentration of citric acid can increase removal of Cd out from in *Anas moschata* and *Cairina moschata*. It was indicates that an higher temperature related to increase the offered energy to separate the chemical bond of mercury metals in the materials and longer period of treatment time will give enough time for chelating agent to chelate with the heavy metals and extracted out from the juaro fish (Azele *et al.,* 2014; Gzar *et al.,*2014)

CONCLUSION

Citric acid was able to chelate the lead and cadmium metals in in *Anas moschata* and *Cairina moschata*. The increasing of boiled temperature and longer period of treatment at any concentration of citric acid from pineapple extract can increase of removal heavy metals.

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