Effect of the Acidic Food Flavors and Turmeric towards Aluminium Leachability

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Abstract: Tamarindus indica (tamarind), Garcinia atroviridis, and Curcuma longa (turmeric) are widely used in food preparation. This study was conducted to determine the aluminium leachability in acidic food flavors Tamarindus indica and Garcinia atroviridis and tumeric powder. The results showed that aluminium contents were increased accordingly to the dosage of these acidic food flavors. The results showed that aluminium leaching was higher in solutions without Curcuma longa compare to the present of Curcuma longa. The effect of the presence of Curcuma longa powder in Tamarindus indica and Garcinia atroviridis solutions were indicated by the decreasing of aluminium solubility at 67.5% and 64.7% respectively.

Key words: Aluminium leachability; Tamarindus indica; Garcinia atroviridis; acidic food.

INTRODUCTION

Almost 18% of earth crust consists of aluminium. Abundance of aluminium in the environment is due to anthropogenic and natural processes. Instead of sediment formation, aluminium usually is not soluble in water. Human can be exposed to aluminium through many resources such as aluminium contained in soil, minerals, rocks, water and foods. However, it did not have any functions in biological systems of animals and human. Aluminium can also be classified as a toxic metal ion (Soni et al., 2000; Marta et al., 2006). Aluminium was known have no adverse effects to human health. This is due to the low rate of aluminium adsorption in human gastrointestinal tract. But recently, aluminium consumptions taken by human increased to serious limit due to various aluminium applications in many aspects such as aluminium consumption in drinking-water treatment, cooking stuffs manufacturing, food containers, food additives, cosmetics, drugs and the reactions of acid rain (Marta et al., 2006). Yokel and McNamara (2001) found that the main sources of aluminium consumptions are from foods, drinking water and medical purposes. For decades, it was known that aluminium will cause neurotoxicity (Zatta, 2000). Aluminium accumulations will increase the risk of neurological and bone diseases such as Alzheimer disease, Parkinson disease, dimensia and osteomalacia (Buratti et al., 2006).

Tamarind tree or scientifically called Tamarindus indica originally from west India and continent of Africa. There are variety uses of Tamarindus indica and their fruit is one of the famous natural food ingredients in Malaysia. It is also believed that this constituent can increase food appetite and can be used to medicate cough and sore throat (Ong, 1997). The scientific name for asam gelugor tree is Garcinia atroviridis. Asam gelugor fruit which been cut into slices and been dried is named as asam keping. Just like tamarind, it is also frequently used as a natural food ingredient in Malaysia. Asam keping has been used widely as food flavor in curry and as fish marinade and also used to make pickles. Garcinia atroviridis fruit can also help in weight loss and has been produced in the form of herb tea in several researches done (Zamree et al., 2008). Spice crop of turmeric or scientifically called Curcuma longa is originally from India. This crop was then been introduced to other Asian countries like in Southeast Asia and South Asia.

Aluminium leachability is most dependent to pH in aqueous solutions (Rajwanshi et al., 1999). Inoue et al. (1988) was found that the factor of low pH (acidic) had contributed the high accumulation of aluminium in foods. Therefore, determination of dosage effect of Tamarindus indica (tamarind) and Garcinia atroviridis acidic food flavors and the presence of turmeric powder (Curcuma longa) towards aluminium leachability were the focus of this study.
Methodology:

*Tamarindus indica* and *Garcinia atroviridus* acidic food flavors and *Curcuma longa* were bought from the local market. These three materials were then been dried in the oven for 100 °C and were ground into powder. Aluminium films were cut with 5cm x 5cm in size and surface area 25cm². *Tamarindus indica* and *Garcinia atroviridus* aqueous solutions had been prepared with 10 g/L, 20 g/L, 30 g/L, 40 g/L, 50 g/L and 60 g/L doses respectively with 100mL distilled water. The pH of each aqueous solution was determined.

Each of the aqueous solutions in the conical flask will then be filtered out with 125mm in diameter Whatman® filter paper before it were then been filtered with Whatman® nylon filter membrane 0.45 µm in pore size and 47mm in diameter by the electrical pump. After that, the pH of each solution was been determined with pH meter. About 20mL each of these final solutions was been analyzed with the spectrophotometric method to determine the content of aluminium leached after the heating process. In order to determine the presence effect of turmeric powder (*Curcuma longa*), both experiments using *Tamarindus indica* and *Garcinia atroviridus* before were been repeated with the addition of 0.5g turmeric powder. The aluminium content was determined using the spectrophotometric method, Eriochrome Cyanine R® (APHA, 2005).

**RESULTS AND DISCUSSIONS**

The results indicated that the pH mean range value of *Tamarindus indica* was 2.74 ± 0.04 - 3.04 ± 0.01 where for the *Garcinia atroviridus* was 1.83 ± 0.00 - 2.30 ± 0.02 (Figure 1). Therefore, the pH mean range values of both aqueous solutions were pH 4 and less, which falls into aluminium leachability range. Both *Tamarindus indica* and *Garcinia atroviridus* have organic acid such as citric acid. These organic acids will give an acidic element to these both famous acidic food flavors in Malaysia (Samina et al., 2008; Zamree et al., 2008). The mean pH values for both *Tamarindus indica* and *Garcinia atroviridus* aqueous solutions reduced when the dose increased from 10g/L to 60g/L.

![Fig. 1: pH values for Tamarindus indica and Garcinia atroviridis solutions with increasing dose.](image)

There are significant mean values between aluminium content when heated with aluminium films before and after in both *Tamarindus indica* and *Garcinia atroviridus* aqueous solutions using paired t-test analysis (p < 0.05). Even they were not been heated with aluminium films yet, the presence of aluminium contents had shown in both aqueous solutions. Muller et al. (1998) said that aluminium can be found naturally in foods; the accumulation of aluminium in plants derived from soil itself, which naturally have aluminium.

The results in Figure 2 and 3 indicated that aluminium contents were increased after heating compare to before the heating process in both aqueous solutions. Yet, cannot disregard the aluminium leachability limit even it was low at room temperature (Karbouj, 2007). Meanwhile, aluminium leachability has been greatly increased when heated at 100°C. This explained that temperature will influence the aluminium content in aqueous solutions. Sadettin (2006) found that instead of low pH value, other factors that have close related to aluminium leachability in foods include temperature and duration of cooking, shape and composition of foods and also types of aluminium-based cooking equipment used.
Paired t-test analysis indicated that there are significant different in aluminium leachability limit without Curcuma longa powder and with the presence of the powder after they were been heated with aluminium films in Tamarindus indica solution. Same results also been noted in the analysis using Garcinia atroviridus solution (p < 0.05). Figure 4 and 5 shows the effect of the presence of Curcuma longa towards aluminium leachability in Tamarindus indica and Garcinia atroviridus aqueous solutions.

It showed that the presence of Curcuma longa in both aqueous solutions can help in reducing aluminium leachability in that acidic food flavor solutions with the reduction of aluminium leachability for Tamarindus indica and Garcinia atroviridus were 67.5% and 64.7% respectively. This is because of the presence of curcumin (Figure 6) in Curcuma longa powder, which can form a complex with aluminium. Severus (1989) found that with the presence of sugar, protein, pectin and fatty acid, it will overcome the erosion effect of acidic foods towards aluminium. Sejati (2002) found that protein is one of the components contained in Curcuma longa. The presence of protein in Curcuma longa can help to overcome aluminium erosion of acidic food flavors.

**Conclusion:**
Aluminium can leach in Tamarindus indica and Garcinia atroviridus acidic food flavors aqueous solutions after been heated with aluminium films. Aluminium leachability limit towards Tamarindus indica and Garcinia atroviridus increased with the dosage. The amount of doses is inversely proportional to pH of solution, which is the higher the dose, the acidity of the aqueous solution will increase. The amount of aluminium in Tamarindus indica and Garcinia atroviridus aqueous solution was higher after been heated with aluminium films compared to before. This shows that the higher in temperature will be one of the aluminium leachability factors instead of low pH value. Aluminium leachability limit still increased with the amount of doses. The limit of aluminium leachability towards...
Tamarindus indica and Garcinia atroviridus aqueous solutions after being heated with aluminium films without Curcuma longa was higher compared to the heating with the presence of Curcuma longa. This shows that Curcuma longa have the ability to reduce the aluminium leachability limit towards Tamarindus indica and Garcinia atroviridus aqueous solutions.

Fig. 4: Aluminium leachability (ppm) in tamarind solution (Tamarindus indica) with and without the presence of turmeric powder (Curcuma longa).

Fig. 5: Aluminium leachability (ppm) in Garcinia atroviridus solution with and without the presence of turmeric powder (Curcuma longa).

Fig. 6: Structure of curcumin found in Curcuma longa powder or IUPAC name is 1,7-Bis-(4-hydroxy-3-methoxyphenyl)-hepta-1,6-diene-3,5-dione (diferuloylmethane)
REFERENCES


