International Journal on Advanced Science Engineering Information Technology

Vol.5 (2015) No. 4
ISSN: 2088-5334

# Degradation of Acid Cyanide Poison in Rubber Seed (*Hevea brasiliensis*) after Treatment with Rice Husk Ash

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***Abstract*— Rubber seed (*Hevea brasiliensis*) contains protein (17.41 %) and non-essential amino acid cysteine (0.78 %) and acid cyanide poison (186.00 mg/kg). The purpose of this research was to determine the effect of rice husk ash on degradation of acid cyanide in rubber seed. This research used Completely Randomized Design (CRD) using treatment of rice husk ash concentration with 5 levels of treatments (45; 60; 75; 90; 105 %) and 4 replications. The result showed nonsignificant differences ($p>0.05$) in degradation of acid cyanide level during aging and significant differences ($p<0.05$) during soaking. Rubber seed treated with 90% of rice husk ash during aging period contained cyanide 47.25 ppm and rubber seed treated with 60% of rice husk ash during soaking period contained cyanide 40.37 ppm.**

***Keywords*— rubber seed, HCN, rice husk ash, aging, soaking.**

## I. Introduction

Rubber seeds (*Hevea brasiliensis*) are not currently in use and they are found abundantly and wasted [1]. Rubber seeds yield from rubber plantations varies from 100 to 150 kg/ha, depending on soil fertility, crop density [2]. Indonesia had estimated 539.600 ha of rubber plantation, and approximately 53960-80940 ton/ha rubber seed were wasted [3]. Rubber seed contains nutritive values that can be harnessed as human food, 3.99% moisture, 17.41 g/100g protein, 68.53 g/100g fat, 3.08 g/100g ash, and high in glutamic acid (16.13%) [4]. Rubber seed kernel contained (dry matter basis) 21.5% crude protein, 50.2% crude fat, 6.5% crude fibred, 3.6% ash and 18.2% carbohydrates, and reasonable amounts of trace minerals [5]. Despite its potential source of nutritive values, fresh rubber seeds contained a toxic factor; Cyanogenic Glycoside (186 ppm) called Linamarin ($C_{10}H_{17}NO_6$), which can be catalytically hydrolyzed and, release toxic hydrogen cyanide (HCN) ([6]; [4]). Amount of cyanide into the body should not exceed 1 mg/kg body weight/day [7].

A wide variety of different methods to reduce HCN content was soaking, boiling, drying [8] and adsorbent [9]. The improving processing methods or a combination of them (peeling, slicing, soaking, boiling, drying etc.) could be reducing cyanide content of cassava [10].

The naturally occurring materials which are used as adsorbents such as the minerals, zeolites, clays and synthetic materials which include $Al_2O_3$, $SiO_2$ [11], biomass materials and agricultural by-products such as walnut waste, maize cobs, peanut shell, cassava waste, wheat bran, maize husk, coconut shell and bagasse [12]. Rice husk ash could be used as adsorbent to remove cyanide, good scavenger and low-cost [9]. Absorbent material can adsorb HCN poison on Gadung corm using ash of wood 15 % can reduce HCN by 63.78% [13]. Aging in 30% rice husk ash solution for 24 hour could reduce HCN Lindur fruit to 3.435 ppm [14]. Soaking of Cassava chips in water for about 24 h reduced 90% HCN [10]. The effect of rice husk ash on degradation of acid cyanide as a function of contact time, pH, adsorbate concentration and temperature [9].

## II. Materials and Methods

### A. Material

The fresh rubber seeds used in this study were collected from rubber plantation in Sarolangun, Jambi, Indonesia. The samples were used for this experiment where from the same plantation. The seeds were stored in freezer (-10°C), until further required.

Preparation of Adsorbent, the rice husk used was obtained from rice Mill in Sarolangun, Jambi, Indonesia. The rice husk was incineration from 2-3 hours until dark color and sieved with 60 mesh sieve. Then the husk ash was thoroughly stored in plastic bags and sealed.

*B. Method*

The research used Completely Randomized Design (CRD) consisted of five level of treatment of rice husk ash concentrations (45; 60; 75; 90; 105 %) in three processing technique and four replications. HCN Analyses were carried out using Spectrophotometry method [15].

*C. Processing Techniques*

*1) Aging:* A set of rubber seed (250 g) was boiled in distilled water (100°C) for 15 min. After boiling, the water was drained off, the boiled seeds were peeled and then aging with rice husk ash on different concentration for 24 hours and then wash in water.

*2) Soaking:* A set of rubber seed (250 g) was boiled in distilled water (100°C) for 15 min. After boiling, the water was drained off, the boiled seeds were peeled and then aging with rice husk ash on different concentration for 24 hours and then wash in water. Rubber seed soaked in 500 ml of water (1:2 w/v) for 24 hours for each level of treatment.

*3) Boiling:* A set of rubber seed (100 g) was boiled in distilled water (100°C) for 15 min. After boiling, the water was drained off, the boiled seeds were peeled and then aging with rice husk ash on different concentration for 24 hours and then wash in water. Rubber seed soaked in 500 ml of water for 24 hours for each level of treatment, then boiled *(100±5°C)* for 1.5 hour for each level of treatment.

## III. Result and Discussion

*A. Aging*

The concentration of rice husk ash were not significantly differences ($p>0.05$) in degradation of HCN poison level in rubber seed, but the average value of HCN poison were decreasing by increasing of rice husk ash concentration (Table 1).

Rubber seed treated with 90%-105% of rice husk ash during aging-period contained cyanide 47.25-43.74 ppm, it is under standard from BPOM as 53.76 ppm [7].

Rice husk ash is adsorptive properties, contains strong base such as CaO (0.5-1.4%) and $K_2O$ (2.46-3.68%) [16]. It reacted with HCN and $O_2$ around it yielding CaCN and KCN salt which easily soluble in water.

Carbon could extract cyanide from the samples then transfer thought the porous carbon and absorb in to the boundary carbon so it could reduce the cyanide concentration [17].

TABLE I
HCN Poison Level (Ppm) After Aging Rubber Seed In Different Concentration of Rice Husk Ash

| Rice Husk Ash (%) | HCN (ppm) |
|---|---|
| 45 | 73.09 |
| 60 | 71.65 |
| 75 | 68.39 |
| 90 | 47.25 |
| 105 | 43.74 |

Means with the same superscript in the same column were not significantly different ($p>0.05$).

*B. Soaking*

Degradation of HCN poison level in soaking rubber seed were significantly differences ($p<0.05$). The average values of HCN poison were decreasing by increasing of rice husk ash concentration (Table 2). The decreasing HCN on soaking in the water processing technique lowest than aging alone (Table 2 and Table 1)

TABLE II
HCN Poison Level (Ppm) After Soaking Rubber Seed In Different Concentration of Rice Husk Ash.

| Rice Husk Ash (%) | HCN (ppm) |
|---|---|
| 45 | 58.61 a |
| 60 | 40.37 ab |
| 75 | 33.22 b |
| 90 | 32.86 b |
| 105 | 30.54 b |

Means with the same superscript in the same column were not significantly different ($p>0.05$).

Rubber seed treated with 60%-105% of rice husk ash during soaking-period contained cyanide 40.37-30.54 ppm, it is under standard from BPOM as 53.76 ppm [7]. These values are lowest than the rubber seed treated with soaking in running water for 24 hours values of 52.60 ppm [18].

The soaking in water caused diffusion and osmosis process, which diluted the HCN in rubber seed and produced foam and opaque solution. Rubber seed during soaking process degraded HCN level because CaO + HCN reacted to CaCN + $H_2O$. CaCN will be dissolved in water to decrease HCN poison level during soaking process. Aging rubber seed with rice husk ash followed by soaking in the water is better than aging alone in removing cyanide.

*C. Boiling*

Degradation of HCN poison level in boiling rubber seed were very significantly differences ($p<0.01$). The average values of HCN poison were decreasing by increasing of rice husk ash concentration (Table 3). The decreasing HCN on boiling processing technique lowest than soaking and aging alone (Table 2 and Table 1).

TABLE III
HCN Poison Level (Ppm) After Boiling Rubber Seed In Different Concentration of Rice Husk Ash.

| Rice Husk Ash (%) | HCN (ppm) |
|---|---|
| 45 | 33.32 a |
| 60 | 32.99 a |
| 75 | 15.72 b |
| 90 | 15.21 b |
| 105 | 11.26 b |

Means with the same superscript in the same column were not significantly different ($p>0.05$).

Rubber seed treated with 45-105% of rice husk ash followed soaking in the water and boiling contained cyanide 33.32-11.26 ppm, it is lowest than cyanide standard from BPOM as 53.76 ppm [7]. These values are lowest than the rubber seed treated with boiling for 10-20 minutes values of 71.78–54.15 ppm [18]. Ninety precent of free cyanide is removed within 15 minutes of boiling fresh cassava chips [19]. The adsorption of cyanide increases with increasing temperature [9].

HCN rubber seed boiled decreasing is influenced by aging rice husk ash in the previous stage in which the rice husk ash can inhibit the oxidation of toxic and carcinogenic nature neutralizes acid in the material [20]. Rice husk ash as well as an adsorbent for a porous material that can act as hydrolyzed crude fiber [9].

Processing with soaking in hot water it is one form of physical treatment that can be used to eliminate the HCN content because will reduce the activity of the enzyme so that the liberation of HCN linamarinase also be reduced. HCN can be easily lost by way of warming due to HCN is readily soluble in water and volatile [21].

### *D. Comparison HCN in Some the Processing Techniques*

Rubber seed not treated with rubber husk ash contained cyanide the highest than treated with rice husk ash in all processing technique (Fig. 1), contained cyanide 150.16 ppm (aging), 124.34 ppm (soaking), 101.28 ppm (boiling). It is also higher than standard from BPOM as 53.76 ppm [7].

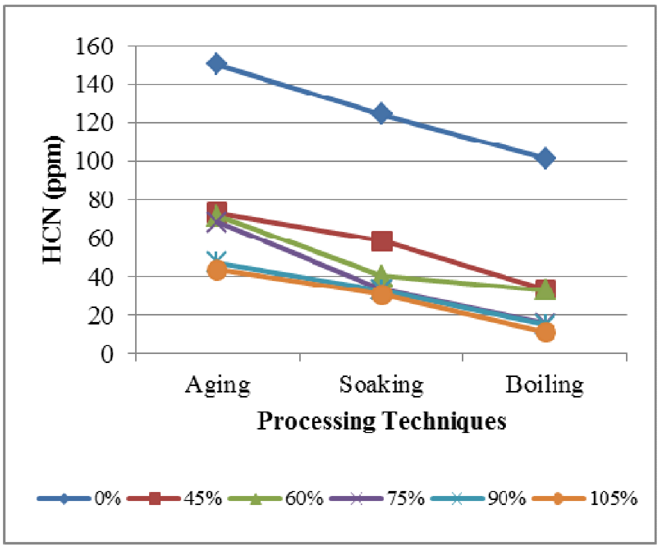


Fig. 1. HCN (ppm) in some Processing Techniques

Rubber seed treated with 90% of rice husk ash during aging contained cyanide 47.25 ppm. Rubber seed treated with 60% of rice husk ash followed soaking in the water contained cyanide 40.37 ppm. Rubber seed treated with 45% of rice husk ash followed soaking in the water and boiling contained cyanide 33.32 ppm. The addition of rice husk ash greatly affects the reduction of cyanide poison rubber seeds in the all-processing techniques.

## IV. Conclusions

Rice husk ash decreased acid cyanide level in aging, soaking and boiling rubber seed. The concentrations of rice husk ash were significantly in degradation of HCN poison level in rubber seed soaking and boiling. Aging rubber seed with rice husk ash followed by soaking in the water and boiling is better than aging alone in removing cyanide. Rubber seed treated with 90% of rice husk ash during aging contained cyanide 47.25 ppm. Rubber seed treated with 60% of rice husk ash followed soaking in the water contained cyanide 40.37 ppm. Rubber seed treated with 45% of rice husk ash followed soaking in the water and boiling contained cyanide 33.32 ppm.

## References


[1] S.C. Achinewhu, and M.A. Akpapunam, "Physical and chemical characteristics of refined vegetable oils from rubber seed (*Hevea brasiliensis*) and breadfruit (*Artocarpus altilis*)", *Qual plant foods Hum. Nutrition*, vol. 35, pp. 103–107. 1985.

[2] E. Nwokolo, and J. Smat. *Food and Feed from Legumes and Oil Seed*. Britain & Hall Food. 1996.

[3] Badan Pusat Statistik website. (2014) [Online]. Available: http://www.bps.go.id/tab_sub/view.php?kat=3&tabel=1&daftar=1&id_subyek=54&notab=1.

[4] H.D. Eka, Y. Tajul Aris and W.A. Wan Nadiah. "Potential use of Malaysian Rubber (*Hevea brasiliensis*) seed as Food, Feed and Biofuel". *International; Food Research Journal*, vol. 17, pp. 527-534. 2010.

[5] V. Ravindran and G. Ravindran. "Some Nutritional and anti-nutritional Characteristics of para-rubber (*Hevea brasiliensis*) Seeds". *Food Chemistry*, vol. 30, Issue 2, pp. 93-102. 1988.

[6] G.W. Butler. "The Distribution of The Cyanoglucosides Linamarin and Lotaustralin in Higher Plants". *Phytochemistry*, vol 4, pp. 127-13. 1965

[7] POM website., (2010). [Online]. Available: http://www.pom.go.id/public/siker/desc/produk/racunalamitanaman.pdf.

[8] J.E. Ukpebor, E.O. Akpaja, E.E. Ukpebor, O. Egharevba and E. Efedue. "Effect of the Edible Mushroom, *Pleurotus tuberregium* on the Cyanide Level and Nutritional Contents of Rubber Seed Cake". *Pakistan Journal of Nutrition*, vol.6, ed. 6, pp. 534-537, 2007.

[9] S. Naeem, U. Zafar and T. Amann." Adsorption Studies of Cyanide (CN)". *Bangladesh J. Sci. Ind. Res*, vol. 46, Issue 1, pp.101-104, 2011.

[10] *A. Nebiyu, and E Getachew.* "Soaking and drying of cassava roots reduced cyanogenic potential of three cassava varieties at Jimma, Southwest Ethiopia". *African Journal of Biotechnology*, vol. 10, No. 62, pp. 13465-13469. 2011.

[11] Y. Y. Tsoung. "Removal of cyanide from water". U.S. Patent. 5112494 May. 12, 1992.

[12] A. J. Thomas, Niveta J., Joshi H. C. and Prasad S. "Agricultural and agro-processing wastes as low cost adsorbents for metal removal from wastewater: A review". *J Scientific & Industrial Research*, vol.67, pp. 647-658. 2008.

[13] L. A.Ahmad, W. Ariska, and M. Djoko. "*Penghilangan Racun Asam Sianida (HCN) dalam Umbi Gadung dengan Menggunakan Bahan Penyerap Abu*". *J. Teknologi Kimia dan Industri*, vol. 1, No. 1, pp. 14-20. 2012

[14] Sulistyawati, Wignyanto, and S. Kumalaningsih. "Low Tannins and HCN of Lindur Fruit Flour Products as an Alternative Food". *J. Teknologi Pertanian*, vol. 13 No. 3, pp. 187-198, 2012

[15] S. Sudarmadji, B. Haryono dan Suhardi. *Prosedur Analisa Untuk Bahan Makanan dan Pertanian (edisi keempat)*. Liberty, Yogyakarta, 2007.

[16] R. Siddique. *Waste Materials and By-Products in Concrete*. Springer Science & Business Media, Berlin, 2007.

[17] E. V. Rhinehart. (2014). Wqpmag website. [Online]. Available: http://www.wqpmag.com/activated-carbon-basics.

[18] O. Rahmawan and Mansyur. "Detoxification of HCN from Rubber Seed Meal by Physical Treatments". Seminar Nasional Teknologi Peternakan dan Veteriner , *pp*.789-796. 2008

[19] O. O. Tewe. (2014). FAO website. [Online]. Available. http://www.fao.org/docrep/003/t0554e/t0554e06.htm.

[20] R. Pambayun. *Kiat Sukses Teknologi Pengolahan Umbi Gadung*. Ardana Media. Yogyakarta. 2010.

[21] H. Damayanti, H. "Penggunaan Biji Karet dan Bungkilnya dalam Ransum Ternak". M.Si. Thesis, Institut Pertanian Bogor, Bogor. 1973.