IJAFLS
e-ISSN: 2602-4381
International Journal of
Agriculture, Forestry and Life Sciences
Research Article www.ijafls.org Int J Agric For Life Sci 3(2): 307-310(2019)

Comparison of feed conditioning techniques to reduce cyanide contained in two varieties of cassava tuber

Yin Yin Kyawt[1*], Achara Lukkananukool[2] and Min Aung[1]

[1] Department of Animal Nutrition, University of Veterinary Science, Nay Pyi Taw, 15013, Myanmar
[2] Department of Animal Production Technology and Fisheries, Faculty of Agricultural Technology, King Mongkut's Institute of Technology Ladkrabang, Bangkok, 10520, Thailand

*Corresponding author email: dr.yinyinkyawt81@gmail.com

Abstract

The effects of two processing methods (soaking and wilting) and three processing times (12, 24 and 48h) on the hydrocyanic acid potential (HCNp) of two varieties of cassava tuber were evaluated. The initial HCNp content in the Red cassava (165.04 mg/kg DM basic) was higher than White cassava (103.22 mg/kg DM basic). However, both processing methods were equally effective in reducing the HCNp content in both of Red and White cassava varieties. Regarding the varieties, white cassava possessed the lower HCNp ($p<0.05$) content compared with red cassava. No influence ($p>0.05$) of processing methods on HCNp and its reduction rates of both cassava varieties were found, however the significant effect ($p<0.05$) of processing times were observed. The significant interactions ($p<0.05$) between processing methods and times were observed for both cassava varieties. The lowest ($p<0.05$) HCNp content and the highest ($p<0.05$) reduction rate are observed at 48h in both processing methods. Moreover, the longer processing time, the less ($p<0.05$) HCNp content and the more ($p<0.05$) reduction rate are detected for both processing methods. Thus, cassava tuber could be soaked or wilted for 48h before utilizing as animal feed.

Key words: *Cassava, HCNp, Soaking, Wilting*

Received: 28.09.2019 **Accepted: 22.11.2019** **Published (online): 26.11.2019**

Introduction

Cassava roots production has been increasing steadily since the 1960s, however between 1997 and 2007, its production increased by over 40% (from 161 to 224 million tonnes), and its use in animal feed increased by 76 million tonnes (FAO, 2014). The roots are rich in soluble carbohydrate (energy content) (Stupak et al., 2006), however, it contains toxic cyanogenic compounds and low protein content (Rickard, 1985). Cassava varieties are often described as being bitter or sweet by reference to the taste of fresh roots and this partly correlates with cyanogen concentrations. Bitter varieties are associated with high concentrations of cyanogenic glycosides (>100 mg/kg fresh matter) (Chiwona-Karltun et al., 2004). Sweet varieties have a high concentration of free sugars but it does not always follow that they have low concentrations of cyanogenic glycoside (King and Bradbury, 1995). However, bitter taste and high level of cyanogens can also be related to environmental stress conditions, such as drought, low soil fertility and pest attack (Bruijn, 1971).

The cassava roots need to be processed if these negative aspects are to be overcome, and experienced cassava producers are aware of different ways and methods of processing cassava (Nyirenda et al., 2011). Many different processing techniques are used for cassava roots. Depending on the nature and duration of the processing methods, the residual level of cyanogens in cassava products will differ. Processing methods used traditionally are sun-drying, soaking and fermentation. Presently, there is limited information on the comparative effects of these two methods on the HCNp content. Therefore, this study was conducted to compare those traditional processing techniques used to reduce cassava toxicity and evaluate the percentage of cyanide reduction in two varieties of cassava tuber.

Cite this artile as:
Kyawt, Y.Y., Lukkananukool , A., Aung, M. 2019. Comparison of feed conditioning techniques to reduce cyanide contained in two varieties of cassava tuber. *Int. J. Agric. For. Life Sci*., 3(2): 307-310.

Materials and Methods

Cassava tubers of two local varieties were prepared for soaking and wilting processes, respectively. From their physical appearance, one variety was named as 'Red', and the other was 'White'. Those two varieties were planted in marl (pH 7.8) soil and there was no fertilizer application at the time of planting.

For the soaking method, approximately 100 g of unpeeled cassava roots were immersed in distilled water in a clean plastic container at room temperature (28˚C). And for the wilting, another 100 g of cassava roots were spread out in the paper under the roof at 28˚C. The soaked and wilted cassavas were sampled at 0, 12, 24 and 48h for the analysis of HCNp and calculated their respective reduction rates. Dry matter (DM) content of experimental material was determined by oven drying at 70˚C to a constant weight (AOAC, 1990). Cassava tubers were analyzed for HCNp contents using acid hydrolysis method (Bradbury et al., 1991; Haque and Bradbury, 2002).

The data of HCNp and reduction rate were analyzed by two-way analysis of variances (ANOVA) in accordance with the General Linear Model using SPSS Software for windows version 16.0 (Chicago, SPSS Inc.). Differences were considered significant at $p<0.05$ and data were expressed as mean±SD.

Results and discussion

The processing methods could not influence ($p>0.05$) on the HCNp content of two cassava varieties. However, regarding the varieties, white cassava possessed the lower HCNp ($p<0.05$) content compared with red cassava (Table 1). These variations could be explained by the fact that the content of HCNp in cassava tuber depends on variety (Vetter, 2000). Moreover, Garcia and Dale (1999) also reported that the composition of cassava depends on the specific tissues (roots or leaves), geographic location, variety, age of the plant and environmental conditions.

Table 1. Effects of varieties and processing methods on cyanide content and its reduction rate of red and white cassava

Varieties (V)	Methods (M)	Mean±SD	
		HCNp (mg/kg DM)	Reduction (%)
Red cassava	Soaking	123.60±39.57	25.11±23.92
	Wilting	122.03±35.19	26.06±21.26
White cassava	Soaking	76.80±26.98	25.59±26.13
	Wilting	77.38±21.52	25.03±20.84
P value	Varieties (V)	0.001	0.968
	Method (M)	0.957	0.977
	V*M	0.907	0.910

SD: standard deviation, DM: dry matter

No influence ($p>0.05$) of processing methods (soaking and wilting) on HCNp and its reduction rates of both cassava varieties were found, however the significant effect ($p<0.05$) processing times were observed (Table 2). The significant interactions ($p<0.05$) between processing methods and times were observed for both cassava varieties. The lowest ($p<0.05$) HCNp content and the highest ($p<0.05$) reduction rate are observed at 48h in both processing methods (soaking and wilting). Moreover, the longer processing time, the less ($p<0.05$) HCNp content and the more ($P<0.05$) reduction rate are detected for both processing methods (Table 2). Ravindran (1992) reported that the destruction of cell wall structures by different methods (like soaking and wilting) favors the intracellular reaction of linamarase with the cyanogenic glucosides present in cassava, thus contributing to a rapid HCN elimination from the material.

Soaking in water caused tissue cellular disruption that results in comparatively greater susceptibility to the actions of bacteria, as indicated by the fall in pH values, and the enzymes α-amalyse and endogenous linamarase (Cooke, 1979). Moreover, Nambisan and Sundaresan (1985) also stated that cyanoglucoside in the tuber is leached out into the water and the volume of water should be adequate for optimum dissolution of cyanoglucoside. Oke (1994) identified that the cyanogen removal process can be improved by increasing the soaking and fermentation times. It was supported by the researchers, Westby and Choo, (1994), who described that more than 90% of total cyanogens were removed after 3 d of fermentation and about one-third of initial linamarin was found in the water. Moreover, Kyawt et al. (2014) also reported that increase of ensiling period could help better reduction of the HCNp content in red and white cassava varieties. Wilting also provided adequate time for the linamarase to act on the cyanoglucosides of cassava root, thereby removing an appreciable amount of HCN from it (Nambisan and Sundaresan, 1985). This was also confirmed by the researchers, Hang and Preston (2005) and Phengvichith and Ledin (2007). They showed that wilting fresh cassava foliage in a shed could reduce the HCNp content by 58% and 45%, respectively.

Table 2. Effects of processing methods and times on cyanide content and its reduction rate of red and white cassava

Methods	Processing times (h)	Varieties			
		Red cassava (mean±SD)		White cassava (mean±SD)	
		HCNp (mg/kg DM)	Reduction (%)	HCNp (mg/kg DM)	Reduction (%)
Soaking	0	165.04±6.51^{a}	0.00±0.00^{f}	103.22±0.19^{a}	0.00±0.00^{e}
	12	139.56±6.38^{b}	15.44±3.86^{e}	88.94±1.88^{b}	13.83±1.83^{d}
	24	126.69±5.53^{c}	23.23±3.35^{d}	80.24±7.79^{b}	22.23±7.54^{d}
	48	63.11±6.05^{f}	61.76±3.67^{a}	34.80±2.40^{e}	66.28±2.33^{a}
Wilting	0	165.04±6.51^{a}	0.00±0.00^{f}	103.22±0.19^{a}	0.00±0.00^{e}
	12	141.68±5.00^{b}	14.15±3.03^{e}	88.77±5.34^{b}	14.00±5.17^{d}
	24	101.35±7.72^{d}	38.59±4.68^{c}	66.81±8.12^{c}	35.27±7.87^{c}
	48	80.04±6.59^{e}	51.50±3.99^{b}	50.72±4.71^{d}	50.86±4.56^{b}
P values	Method (M)	0.552	0.489	0.772	0.773
	Time (T)	<0.001	<0.001	<0.001	<0.001
	M*T	0.001	0.001	0.001	0.001

$^{a, b, c, d, e, f}$: different superscripts in the same column mean the significantly difference at p<0.01.
SD: standard deviation, DM: dry matter

Conclusion

The two processing methods (soaking and wilting) could reduce the HCNp content and improve the reduction rate of two cassava varieties; however the HCNp reduction activities between two processing methods were not different. Moreover, for both processing methods, the longer processing time, the less HCNp content and the more reduction rate are observed. Thus, cassava tuber could be soaked or wilted for 48h before utilizing as animal feed.

References

AOAC (1990). Official Methods of Analysis, 15th ed. Association of Official Analytical Chemists. Washington DC. pp. 69-88.

Bradbury, J.H., Egan, S.V., Lynch, M.J. (1991). Analysis of cyanide in cassava using acid hydrolysis of cyanogenic glucosides. Journal of the Science of Food and Agriculture. 55 (2): 277-290. https://doi.org/10.1002/jsfa.2740550213.

Bruijn, D. (1971). A study of the cyanogenic character of cassava. Meded land bouwhoge school Wageningen. 71: 1-40.

Chiwona-Karltun, L., Brimer, L., Saka, J.D.K., Mhone, A.R., Mkumbira, J., Johansson, L., Bokanga, M., Mahungu, N.M., Rosling, H. (2004). Bitter taste in cassava roots correlates with cyanogenic glucoside levels. Journal of the Science of Food and Agriculture. 84 (6): 581-590. https://doi.org/10.1002/jsfa.1699.

Cooke, R.D. (1979). Enzymatic assay for determining the cyanide content of cassava and cassava products. (Eds. T. Brekelbaum and G. Gomez). Cassava Information Center. Cali, Columbia Series 05EC-6. pp. 14.

FAO (Food and Agriculture Organization of the United Nations). (2014). Food Outlook. Biannual report on global food markets.

Garcia, M., Dale, N. (1999). Cassava root meal for poultry. The Journal of Applied Poultry Research. 8 (1): 132-137. https://doi.org/10.1093/japr/8.1.132.

Hang, D.T., Preston, T. (2005). The effects of simple processing methods of cassava leaves on HCN content and intake by growing pigs. Livestock Research for Rural Development. 17 (109).

Haque, M.R., Bradbury, J.H. (2002). Total cyanide determination of plants and foods using the picrate and acid hydrolysis methods. Food Chemistry. 77 (1): 107-114. DOI: https://doi.org/10.1016/S0308-8146(01)00313-2.

King, N.L.R., Bradbury, J.H. (1995). Bitterness of cassava: identification of new apiosyl glycoside and other compounds that affect its bitter taste. Journal of the Science of Food and Agriculture. 68 (2): 223-230. https://doi.org/10.1002/jsfa.2740680214.

Kyawt, Y.Y., Imai, Y., Yara, T., Kawamoto, Y. (2014). Effect of Ensiling process and additive effects of fermented juice of epiphytic lactic acid bacteria on the cyanide content of two varieties of cassava. Animal Nutrition and Feed Technology. 14 (3): 447-460. DOI:https://do.orrg/10.5958/0974-181X.2014.01347.X.

Nambisan, B., Sundaresan, S. (1985). Effect of processing on the cyanoglucoside content of cassava. Journal of the Science of Food and Agriculture. 36 (11): 1197-1203. https://doi.org/10.1002/jsfa.2740361126

Nyirenda, D.B., Chiwona-Karltun, L., Chitundu, M., Haggblade, S., Brimer, L. (2011). Chemical safety of cassava products in regions adopting cassava production and processing-Experience from Southern Africa. Food and Chemical Toxicology. 49 (3): 607-612. doi: https://doi.org/10.1016/j.fct.2010.07.025.

Oke, O.L. (1994). Eliminating cyanogens from cassava through processing: technology and tradition. Acta Horticulturae. 375: 163-174. DOI: https://doi.org/10.17660/ActaHortic.1994.375.14.

Phengvichith, V., Ledin, I. (2007). Effect of a diet high in energy and protein on growth, carcase characteristics and parasite resistance in goats. Tropical Animal Health and Production. 39 (1): 59-70. DOI: https://doi.org/10.1007/s11250-006-4443-z.

Ravindran, V. (1992). Preparation of cassava leaf products and their use in animal feeding. In: Roots, tubers, plantains and bananas in animal feeding. (Eds. D.H. Machin and S. Nyvold). FAO Animal Production and Health paper. 95: 111-126.

Rickard, J.E. (1985). Physiological deterioration of cassava roots. Journal of the Science of Food and Agriculture. 36 (3): 167-176. https://doi.org/10.1002/jsfa.2740360307

Stupak, M., Vandeschuren, H., Gruissem, W., Zhang, P. (2006). Biotechnological approaches to Cassava protein improvement. Trends in Food Science and Technology. 17 (12): 634-641. https://doi.org/10.1016/j.tifs.2006.06.004.

Vetter, J. (2000). Plant cyanogenic glycosides. Toxicon. 38 (1): 11-36. DOI: https://doi.org/10.1016/s0041-101(99)00128-2.

Westby, A., Choo, B.K. (1994) Cyanogen Reduction during Lactic Fermentation of Cassava. Acta Horticulturae. 375: 209-215. Doi. https://doi.org/10.17660/ActaHortic.1994.375.19.