International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(5): 40-43

Received: 12-08-2020
Accepted: 21-09-2020

Diptanu Das
M.V. Sc Scholar, Department of Animal Nutrition, College of Veterinary Science & A.H, CAU, Mizoram, India

AK Samanta
Professor, Department of Animal Nutrition, College of Veterinary Science & A.H, CAU, Mizoram, India

Corresponding Author:
Diptanu Das
M.V. Sc Scholar, Department of Animal Nutrition, College of Veterinary Science & A.H, CAU, Mizoram, India

Effect of processing techniques on chemical composition and hydrogen cyanide content in rubber seed (*Hevea brasiliensis*) meal

Diptanu Das and AK Samanta

DOI: https://doi.org/10.22271/chemi.2020.v8.i5a.11004

Abstract
An experiment was carried out to find out the suitable physical processing method to reduce HCN level of rubber seed meal. Rubber seed was processed and analysed for proximate composition. Chemical composition (g/kg) of raw rubber seed was found to have 11.64% crude protein, 21.58% crude fat and 23.70% crude fibre. The seeds were processed by three physical methods to check the level of principle anti nutritional factor i.e. Hydro cyanic acid (HCN). These physical processing includes overnight soaking, boiling for one hour and oven drying at 100 ± 2°C and stored for 21 days. It was observed that physical processing of rubber seed meal did not have significant effect on chemical composition. HCN level was estimated at different days of storage period i.e. 0, 7th, 14th and 21st day after the treatment. HCN content of the raw rubber seed was found to be 387 mg/kg. After different physical processing methods, the level of HCN was reduced and ranged between 129.6 to 259 mg/kg. Overnight soaking was found to be suitable processing method to reduce the HCN level of Rubber seed meal.

Keywords: Rubber seed meal, HCN, processing method, soaking, boiling, oven-drying

Introduction

It is not possible to overemphasise the value of expanded livestock production in developing countries.In order to ensure that affordable energy and protein is provided for the ever-increasing population of developing countries, livestock breeders, animal nutritionists and poultry farmers have roles to play (Aguihe *et al.*, 2017) [1]. However, as a result of high prices and competition between humans and animals, the growing production costs involved have not made this feasible (Taiwo *et al.*, 2005 and Annongu *et al.*, 2006) [2, 3]. Increasing livestock feed costs and the lack of traditional proteins and energy concentrates for feed formulation have forced the animal nutritionists to look for desirable, cheaper and easily accessible protein and energy sources in developing countries.

Rubber seed is an unconventional concentrate sourcecontained substantial amount of proximate components. Rubber seed is the sub-product of natural rubber cultivation (*Hevea brasiliensis*) which is widely available in certain states of the country (Deng *et al.*, 2015) [4]. While rubber seed provides a significant amount of protein and other nutrients, farmers do not use it in livestock diets due to the lack of scientific information on the use of rubber seed in livestock feed and the existence of an anti-nutritional element, i.e. HCN. According to Aguihe *et al.* (2017) [1] the main constraint in the use of rubber seed is the presence of this hydrocyanic acid. Narahari and Kothandaraman (1983) [5] observed that the rubber seeds kernel contained 749 mg hydrocyanic acid per kg of seed. This hydrocyanic acid can be detoxified by different physical, chemical and biological methods and the processed rubber seed meal can be used in the diet of livestock. Kinh *et al.* (2006) [6] processed rubber seed into a useful pig feed and observed that the optimal processing method was to de-hull, de-fat, mixing with water (1:5), which eliminated almost the 98% of HCN in rubber seed meal then sundry or dry in drier. Ly *et al.* (2001) [7] evaluated nutrients of rubber seed meal in Mong Cai pigs and recorded that approximately by 45 days of storage the cyanide content of the rubber seeds decreased from 82.5 to 29.3 mg/kg DM. The findings of the different workers regarding the HCN content of processed rubber seed are inconsistent. Therefore, the present study was conducted to find out the suitable and practically feasible physical processing method to reduce the HCN level in order to utilize it as pig feed.

Materials and Methods

Procurement and preparation of rubber seed meal

The fruit of the rubber tree has a 3-lobed, 3-seeded ellipsoid capsule and 1 seed for each carpel. The seeds are ellipsoidal, colour is mottled brown, 2.5-3 cm long, variable in size, lustrous and weighing 2-4 g each. For our experiment rubber seed was procured from the farmers of the state Tripura. All the procured rubber seeds were hammer-milled prior to experimental processing to produce the respective meals as soaked RSM (SRSM), boiled RSM (BRSM) and oven dried RSM (ORSM).

Chemical analysis

Rubber seed meal were analyzed (AOAC, 2000) [8] for dry matter (DM; method 934.01), CP (method 968.06; Kelplus, Pelican Equipments, Chennai, India), crude fiber (CF; Fibre plus, Pelican Equipments, Chennai, India) and ether extract (EE; method 920.39; Socsplus, Pelican Equipments, Chennai, India). All the samples for the analysis were weighed using an electronic balance (Model No.ABS 220-4, Kern & Sohn GmbH).

Processing of RSM

Soaking: The collected rubber seed was subjected to grinding followed by overnight (18-20 hrs) water soaking, sun drying and stored for 21 days. While in storage the dried rubber seed meal was checked for the HCN level at 0 day, 7th day, 14th day and 21st day.

Boiling: Rubber seed was boiled for 1 hr after grinding followed by sun drying and stored for 3 weeks. Level of HCN was estimated by following standard procedure (AOAC, 1995) [9] at 0 day, 7th day, 14th day and 21st day while in storage.

Heat treatment: In this method, rubber seed was subjected to grinding followed by dry heating at 100±2^{0}C for 60 minutes and stored up to 21 days. Level of HCN was checked at 0 day, 7th day, 14th day and 21st day while in storage.

Results and Discussions

Proximate Composition of Fresh/raw and Processed Rubber Seed Meal

The rubber seed used in the present study was analysed for proximate principles before and after different physical processing method in the laboratory and are presented in Table No.1.

The crude protein value of fresh/raw rubber seed meal in the present study were similar to the observation made by Narahari and Kothandaraman (1984) [10], Ly *et al.* (2001) [7], Tean *et al.* (2002) [11] and Oyewusi *et al.* (2007) [12]. They found the crude protein content as 11.50, 14.94, 12.19 and 10.30% respectively. However, the crude protein value in the present study contradicts with Sharma *et al.* (2014) [13], Suprayudi *et al.* (2014) [14], Hossain *et al.* (2015) [15], Khatun *et al.* (2015) [16], Pha-obnga *et al.* (2016) [17], Aguihe *et al.* (2017) [1], Deng *et al.* (2017) [18], Ahaotu (2018) [19], Udo *et al.* (2018) [20], Kouakou *et al.* (2018) [21], Oluodo *et al.* (2018) [22], Farr *et al.* (2019) [23], who reported higher values in their experiments.

The ether extract of RSM was similar to the observation made by Tean *et al.* (2002) [11], Samkol *et al.* (2002) [24], Aguihe *et al.* (2017) [1], Oluodo *et al.* (2018) [22] and Kouakou *et al.* (2018) [21] but lesser than the values observed by Chanjula *et al.* (2011) [25], Sharma *et al.* (2014) [13], Suprayudi *et al.* (2014) [14], Pha-obnga *et al.* (2016) [17] and Udo *et al.* (2018) [20], and higher than the values observed by Hossain *et al.* (2015) [15], Khatun *et al.* (2015) [16], Khatun and Khan (2015) [26] Deng *et al.* (2017) [18], Ahaotu (2018) [19] and Farr *et al.* (2019) [23]. The variation in the crude protein and ether extract content can be attributed to rubber tree varieties, or may be climatic condition.

The crude fibre value was similar to the findings of and Khatun and Khan (2015) [26] but higher than the values reported by Sharma *et al.* (2014) [13], Suprayudi *et al.* (2014) [14], Khatun *et al.* (2015) [16], Deng *et al.* (2017) [18], Aguihe *et al.* (2017) [1], Udo *et al.* (2018) [20], Ahaotu (2018) [19] and Farr *et al.* (2019) [23] and lower than the values reported by Hossain *et al.* (2015) [15]. In the present study, the total ash in RSM was found to be similar to the findings of Sharma *et al.* (2014) [13], Suprayudi *et al.* (2014) [14], Hossain *et al.* (2015) [15], Khatun *et al.* (2015) [16], Khatun and Khan (2015) [26], Pha-obnga *et al.* (2016) [17] and Farr *et al.* (2019) [23] but lesser than the observation made by Chanjula *et al.* (2011) [25], Deng *et al.* (2017) [18], Oluodo *et al.* (2018) [22], Udo *et al.* (2018) [20], Aguihe *et al.* (2017) [1] and Ahaotu (2018) [19]. The NFE value was similar to the values reported by Udo *et al.* (2018) [20] and Deng *et al.* (2017) [18] and contradicts with Suprayudi *et al.* (2014) [14], Hossain *et al.* (2015) [15], Khatun and Khan (2015) [26] and Aguihe *et al.* (2017) [1].

After processing the seeds, there was no such change in the crude protein content of soaked, boiled and oven-dried rubber seed meal. Ether extract and crude fibre values have been lower in processed rubber seed meals than in fresh/raw seed meal, suggesting that during the processing of rubber seeds, some of these nutrients may have been lost. However, nitrogen free extract was higher in all the processed RSM than the fresh/raw RSM. The total ash amount was higher in ORSM and BRSM than the values obtained in fresh/raw rubber seed meal and SRSM.

Table 1: Proximate constituents (g/kg DM) of RSM after physical treatment

Attributes	Fresh/raw RSM	SRSM	BRSM	ORSM
Moisture	63.88±0.45	88.66±0.38	95.20±0.36	95.31±0.26
DM	936.12±0.45	911.34±0.38	904.80±0.36	904.69±0.26
Crude protein	116.40±2.72	114.60±2.55	113.80±2.58	117.16±0.66
OM	976.09±0.48	982.00±0.19	971.77±0.63	971.27±0.43
Ether extract	215.80±1.35	187.60±1.34	159.60±1.64	200.60±2.49
Crude fibre	237.06±2.09	175.60±1.34	159.80±1.26	229.00±1.21
Total ash	23.91±0.48	18.00±0.19	28.23±0.63	28.73±0.43
Nitrogen free extract	406.84±1.67	504.20±4.5	538.57±3.76	424.51±2.63

HCN content of the fresh/raw RSM and processed RSM

The HCN levels of RSM were determined after different processing method and are presented in Table No.2. The HCN level was checked after soaking, boiling and dry heating at different day of storage period after treatment i.e. 7th, 14th and 21st day and was found to be in the range of 129.60±1.72 to 187.00±2.97 for soaked, 144.00±4.40 to 198.00±3.27 for boiled and 201.60±1.78 to 259.00±3.36 for oven dried. However, the storage of fresh / raw rubber seeds can also reduce the hydrogen cyanide content. In the present study, the hydrogen cyanide content of the fresh/raw RSM was 387 mg/kg, which was similar with the observation of Sharma *et al.* (2014) [13] and contradict the value reported by Thuy and Ly (2002) [27], Tean *et al.* (2002) [11], Suprayudi *et al.* (2014) [14], Eka *et al.* (2010) [28], Kouakou *et al.* (2018) [21], Pha-obnga *et al.* (2016) [17], Ly *et al.* (2001) [7], Farr *et al.* (2019) [23] and Aguihe *et al.* (2017) [1].

Because of genetic and environmental factor, season, location and soil conditions, cyanogenic glycosides can vary widely (Ermans *et al.*, 1980) [29]. Moreover, reductions in hydrogen cyanide (HCN) levels were effective with the implemented treatment approaches and this revealed that on 0 day cyanide level in the fresh/raw seed reduced by 51.68%, 48.84% and 33.07% for soaking, boiling and oven-drying respectively. The higher concentration of hydrogen cyanide reduced in the SRSM and BRSM were in agreement with the reports from previous researchers (Udo *et al.*, 2016, Farr *et al.*, 2019 and Nambisan. 1994) [20, 23, 30] that soaking and boiling tends to reduce the RSM HCN concentration.

Table 2: HCN level (mg/kg) of RSM after physical processing method

Period	Fresh/raw RSM	SRSM	BRSM	ORSM
Day-0	387.00±2.92	187.00±2.97	198.00±3.27	259.00±3.36
Day-7	376.00±2.85	169.20±1.59	194.40±4.16	252.00±2.5
Day-14	359.00±2.93	143.60±2.32	176.40±2.74	244.80±1.37
Day-21	344.00±1.96	129.60±1.72	144.00±4.40	201.60±1.78

Conclusion

The findings of this experiment revealed that water soaking caused substantial reduction in hydrogen cyanide content in the rubber seeds without change of chemical composition and overnight soaked and dried rubber seed meal may be utilized as pig feed.

References

1. Aguihe PC, Kehinde AS, Ospina-Rojas CI, and Murakami AE. Evaluation of Processing Methods of Rubber (*Hevea brasiliensis*) Seed Meal for Use as a Feed Ingredient for Broiler Chickens. J Poult. Res 2017;14(1):20-27.
2. Taiwo AA, Adejuyigbe AD, Adebowale EA, Oshotan JS, David OO. Performance and nutrient digestibility of weaned rabbits fed forages supplemented with concentrate. Niger. J. Anim. Prod 2005;32(1-2):74-78.
3. Annongu AA, Ogundun NJ, Joseph KJ, Awopetu V. Changes in chemical composition and bioassay assessment of nutritional potentials of almond fruit waste as an alternative feedstuff for livestock. Biokemistri 2006;18(1):25-30
4. Deng J, Mai K, Chen L, Mi H, Zhang L. Effects of replacing soybean meal with rubber seed meal on growth, antioxidant capacity, non-specific immune response, and resistance to *Aeromonas hydrophila* in tilapia (*Oreochromisniloticus*× *O. aureus*). Fish Shellfish Immunol 2015;44(2):436-444.
5. Narahari D, Kothandaraman P. The influence of processing and storage on hydrogen cyanide and tannin contents of para-rubber seed and its products. Anim. Feed Sci. Tech 1983;9(4):319-323.
6. Kinh LV, Kopinski JS, Burren B, Ninh PH, Trung VN. Processing rubber seed into a useful pig feed. XII^th AAAP Animal Science Congress. Bexco, Busan, Korea, September 2006, 18-22.
7. Ly J, Ty C, Phiny C. Evaluation of nutrients of rubber seed meal in Mong Cai pigs. Livest. Res. Rural Dev 2001;13(2).
8. AOAC. Official Methods of Analysis. 17th edn., Association of Official Analytical Chemists, Washington DC 2000.
9. AOAC. In Natural Toxins (49^th chapt.). Official Methods of Analysis of AOAC International, 16th Edn., Vol. II, Virginia, USA 1995, 37-49.
10. Narahari D, Kothandaraman P. Chemical composition and nutritional value of para-rubber seed and its products for chickens. Anim. Feed Sci. Technol 1984;10(4):257-267.
11. Tean B, Sath K, Samkol P, Ly J. Utilization by pigs of diets containing Cambodian rubber seed meal. Livest. Res. Rural Dev 2002;14(1).
12. Oyewusi PA, Akintayo ET, Olaofe O. The proximate and amino acid composition of defatted rubber seed meal. J. Food Agric. Environ 2007;5(3/4):115.
13. Sharma BB, Saha RK, Saha H. Effects of feeding detoxified rubber seed meal on growth performance and haematological indices of *Labeo rohita* (Hamilton) fingerlings. Anim. Feed Sci. Tech 2014;193:84-92.
14. Suprayudi MA, Inara C, Ekasari J, Priyoutomo N, Haga Y, Takeuchi T, *et al.* Preliminary nutritional evaluation of rubber seed and defatted rubber seed meals as plant protein sources for common carp *Cyprinuscarpio* L. juvenile diet. Aquac. Res 2014;46(12):2972-2981.
15. Hossain ME, Karim MH, Alam S, Nath SK. Nutritive value of rubber seed (*Hevea brasiliensis*). Online J. Anim. Feed Res 2015;5:18-21.
16. Khatun MJ, KarimMZ, Das GB, Khan MKI. Effect of the Replacement of Soybean Meal by Rubber Seed Meal on Growth, Economics and Carcass Characteristics of Broiler. Iran. J. Appl. Anim. Sci 2015;5(4):919-925.
17. Pha-obnga N, Aiumlamai S, Wachirapakorn C. Nutritive value and effect of different levels of rubber seed kernel in total mixed ratio on digestibility using *In Vitro* gas production technique. Asia. Pac. J Sci. Technol 2016;21(3):51-62.
18. Deng J, Chen L, Mai K, Mi H, Zhang L. Effects of replacing soybean meal with rubber seed meal on digestive enzyme activity, nutrient digestibility and retention in tilapia (*Oreochromisniloticus* × *Oreochromisaureus*). Aquac. Res 2017;48(4):1767-1777.
19. Ahaotu E. Nutritional Evaluation of Rubber Seed Meal with Blood Meal in Broiler Rations. Int. J Anim. Sci 2018;2(3):1026.
20. Udo MD, Ekpo U, Ahamefule FO. Effects of processing on the nutrient composition of rubber seed meal. J Saudi Soc. Agric. Sci 2018;17(3):297-301.
21. Kouakou NDV, Angbo-Kouakou CEM, Koné GA, Yeboué FP, Kouadio KB. Enhancement of rubber seeds (*Hevea brasiliensis*) in pig feeding in Ivory Coast. Proceeding of International Rubber Conference and IRRDB Annual Meetings, Sofitel Abidjan, Côte d'Ivoire 2018, 32.
22. Oluodo LA, Huda N, Komilus CF. Potential Utilization of Rubber Seed Meal as Feed and Food. Int. J. Eng. Technol 2018;7(4.43):64-71.
23. Farr HM, Donkoh A, Boateng MK, Mensah KB. Evaluation of methods of processing rubber seed meal in terms of chemical composition and energy value. Livest. Res. Rural. Dev 2019;31(6).
24. Samkol P, Sovanno P, Preston TR, Ly J. Digestibility studies in growing pigs fed diets based on full-fat rubber seeds or soya beans supplemented with water spinach. Livest. Res. Rural Dev 2002;14:6.
25. Chanjula P, Siriwathananukul Y, Lawpetchara A. Effect of feeding rubber seed kernel and palm kernel cake in combination on nutrient utilization, rumen fermentation

characteristics, and microbial populations in goats fed on *Briachiaria humidicola* hay-based diets. Asian Australas J Anim. Sci 2011;24(1):73-81.
26. Khatun MJ, Khan KIK. Different types of maize silage and unconventional feed resources and their nutritive values. Forage Res 2015;41(1):1-9.
27. Thuy NT, Ly J. A short-term study of growth and digestibility indices in Mong Cai pigs fed rubber seed meal. Livest. Res. Rural Dev 2002;14(2):35-37.
28. Eka HD, Tajul AY, Wan NWA. Potential use of Malaysian rubber (*Hevea brasiliensis*) seed as food, feed and biofuel. Int. Food Res. J 2010;17(3):527-534.
29. Ermans AM, Mbulamoko NM, Delange F, Ahluwalia R. Role of Cassava in the Etiology of Endemic Goitre and Cretinism. International Development Research Centre, Ottawa, Ontario, Canada 1980.
30. Nambisan B. Evaluation of the effect of various processing techniques on cyanogen content reduction in cassava. ActaHortic 1994;375:193-202.