International Journal of Science, Environment and Technology, Vol. 14, No 3, 2025, 250 – 255
ISSN 2278-3687 (O)
2277-663X (P)

EXPLORING CASTOR BEAN CAKE AS AN UNCONVENTIONAL FEED RESOURCE: A REVIEW

S. Gobika*, M. Pradeep, D. Santhiya, G. Vaishnavi, S. Senthilkumar, P. Kumaravel, R.P. Senthilkumar and P. Vasanthakumar
Department of Animal Nutrition
Veterinary College and Research Institute, Namakkal- 637 002, Tamil Nadu Veterinary and Animal Sciences University (TANUVAS)
E-mail: gobikas2000@gmail.com (**Corresponding Author*)

Abstract: Feed costs constitute 60–70% of livestock and poultry production expenses, prompting a search for unconventional alternatives. A by-product of biodiesel production, castor bean cake is rich in protein and fiber and has manure value. However, its use in animal feed is restricted due to toxic compounds like ricin, ricinine, ricinoleic acid, allergens, tannins, phytate and oxalates as natural constituents. Proper detoxification through physical, chemical, or biological methods can make it a viable feed for ruminants and non-ruminants.
Keywords: Castor bean cake, unconventional feed, anti-nutritional factors, detoxification

Introduction

Castor bean (*Ricinus communis*) is a traditionally cultivated crop in semi-arid regions of Brazil, playing a crucial economic and social importance, especially in areas with around 500 mm of annual rainfall. Biodiesel production is a key strategy for reducing greenhouse gas emissions, relying on oilseeds, many of which compete with food and feed industries. However, castor bean stands out as a sustainable alternative for biodiesel production since it does not compete with food crops (Araújo *et al*., 2021). This makes it a profitable and eco-friendly option for renewable energy. Conventional protein sources like soybean cake, groundnut cake, fishmeal, and cottonseed cake are costly and highly competitive among humans and the livestock industry (Akinmutimi, 2001). This review provides a concise exploration of castor bean cake as an alternative animal feed.

Castor bean

Castor bean (*Ricinus communis* L.), also known as castor oil bean, mole bean, or wonder tree, belongs to the Spurge family (Euphorbiaceae) and originates from tropical Africa. It is now generally cultivated as an oilseed crop and, in many parts of Asia, Central and North America, Africa, and Europe, is also grown as a decorative plant (Doan, 2004). One of its key advantages as a crop is its drought tolerance and ability to adapt to diverse growing environments (Babita *et al*., 2010).

*Received April 8, 2025 * Published June 2, 2025 * www.ijset.net*

Nutritive value of castor bean cake

Agarwal (2001) stated that castor bean meal contains significantly higher levels of methionine and tryptophan compared to soybean meal and groundnut cake. Castor bean cake contains following nutrients such as dry matter 89.6%, crude protein 35.9%, crude fibre 33.6%, neutral detergent fibre 45.9%, acid detergent fibre 34.8%, lignin 15.6%, ether extract 2.9%, ash 12%, insoluble ash 1% and gross energy 19.2 MJ/kg DM (Feedipedia, 2020). Helia (2024) suggested that the protein content (32.5%) falls within the standard range for poultry feed, making castor bean cake a viable protein supplement in poultry feed formulation.

Antinutritional factors

Castor bean cake contains ricin, ricinine, ricinoleic acid, allergens, tannins, phytates, and oxalates. Castor beans naturally consist of 40% oil, 1–5% ricin, and 0.3–0.8% ricinine (Johnson *et al*., 2005). The toxicity of *Ricinus communis* L. seeds is primarily due to ricin, a highly toxic lectin that inhibits protein synthesis, leading to cell death (Baleta *et al*., 2015; Audi *et al*., 2005). While all plant parts contain ricin, the seeds are particularly toxic and generally linked to clinical toxicosis (Albertson *et al*., 2000). Castor seeds are 20% husk and 80% soft kernel, with the kernels containing bothoil and ricin, a type II ribosome-inactivating glycoprotein, among the most potent plant toxins (Aslani *et al*., 2007). There are two types of ricin, D and E, with ricin E found in small-grain castor varieties (Lin and Liu, 1986; Woo *et al*., 1998). In addition, ricinoleic acid, a fatty acid in castor seeds, is highly irritating to the gastrointestinal mucosa and is responsible for the cathartic properties of castor oil (Diaz, 2011).

Detoxification methods

Various physical, chemical, and biological methods have been explored for castor cake detoxification, but large-scale application remains economically impractical (Severino *et al*., 2012). Anandan *et al.* (2005) tested various methods, including soaking, steaming, boiling, autoclaving, and chemical treatments (ammonia, formaldehyde, lime, sodium chloride, tannic acid and sodium hydroxide). Among these, autoclaving at 15psi for 60 minutes and calcium hydroxide treatment (40 g/kg residue) were the only methods that completely eliminated toxins. Godoy *et al*. (2009) used fermentation with *Penicillium simplicissimum*, while Madeira Jr. *et al*. (2011) found that Brazilian wild *Paecilomyces variotii* strain efficiently detoxified castor residue through solid-state fermentation, producing tannase and phytase enzymes. Genetic approaches have also been explored. Auld *et al*. (2003) two strategies *viz*., conventional sexual hybridization used to develop F6 lines of castor, which has reduced ricin and other toxins (ricinine, *Ricinus communis* agglutinin - RCA toxins, 2S albumin) by 70–75%, and transgenic castor plants, which could potentially achieve over 99% toxin reduction.

Use as feed of ruminants

Studies have explored the feasibility of replacing soybean meal (soya bean meal) with castor bean meal (castor bean meal) in livestock diets, with varying results. Reddy *et al*. (1986) found no adverse effects when replacing 30% of groundnut cake with castor bean meal in buffalo feed. Robb *et al*. (1974) reported that castor bean meal could serve as a satisfactory protein supplement for lactating dairy cows, with no harmful effects on calves consuming milk from castor bean meal-fed cows (10–20% inclusion). Purushotham *et al*. (1986) successfully fed 10% autoclaved castor bean meal to Deccani lambs without issues. Barros *et al*. (2011) and Araújo *et al*. (2021) found that increasing castor bean meal levels reduced dry matter (DM) intake in grazing heifers and crossbred steers but did not affect animal performance. Diniz *et al*. (2010) showed that castor bean meal supplemented with calcium oxide (60 g/kg) fully replaced soya bean meal in cattle diets without negative effects on digestion or ruminal parameters. Novaes *et al*. (2020) found that detoxified castor bean meal could replace up to 100% of soya bean meal in lamb diets, improving DM digestibility and nitrogen efficiency without compromising growth. Araújo *et al*. (2019) observed that sodium hydroxide-treated castor bean meal reduced DM intake but improved NDF rumination efficiency in lactating goats, with no signs of stress. However, Lima *et al*. (2021) reported that castor bean meal negatively affected nutrient digestibility, milk yield, and composition in dairy cows, making it unsuitable for them. Melgar *et al*. (2022) found that detoxified castor bean meal could replace up to 90% of soya bean meal in steer finishing diets without affecting production performance.

Use as feed of non-ruminants

Agarwal (2001) found that NaCl-treated castor bean meal (CBM) could replace costly oil cakes in rabbit diets without affecting feed intake or performance. Vilhjalmsdottir and Fisher (1972) reported that hot water-extracted CBM, supplemented with lysine and tryptophan, was a viable protein source for chicks. Akande and Odunsi (2012) found that heat and lye-treated CBM could safely replace 50% of groundnut cake in broiler diets. Dairo *et al*. (2014) determined that 10.57% trans-esterified CBM was the optimal inclusion level for broilers without detoxification. Ombugu *et al*. (2022) reported that fermented CBM could replace 25% of soybean cake for improved growth and carcass yield in broilers. Ferreira *et al*. (2013) found that 5–10% detoxified CBM was effective in growing pigs. Oliveira *et al*. (2016)

demonstrated that 8% CBM inclusion had no negative effects, but 12% reduced performance in pigs.

Conclusion

Castor bean cake is a nutrient-rich, cost-effective alternative to conventional animal feed. Despite its toxic compounds (e.g., ricin), proper detoxification and formulation make it a practical livestock feed. Its high protein content improves its potential, but further research on processing techniques, safety protocols, and nutrient optimization is needed for sustainable use. With proper handling, castor bean cake can help address feed scarcities and diversify feed resources in animal production.

References

[1] Agarwal, S.K. (2001). Performance of rabbits fed on processed castor (Ricinus communis) bean meal incorporated diet. M.V.Sc. thesis. Deemed University, IVRI, Izatnagar.

[2] Akande, T.O., and Odunsi, A.A. (2012). Nutritive value and biochemical changes in broiler chickens fed detoxified castor kernel cake-based diets. *African Journal of Biotechnology*, 11(12): 2904-2911.

[3] Akinmutimi, A.H. (2001). The effect of potash-cooked lima beans (*Phoseolus lunatus*) in broiler starter diet. *Nigerian Agricultural Journal*, 32: 109-118.

[4] Albretsen, J.C., Gwaltney-Brant, S.M., and Khan, S.A. (2000). Evaluation of castor bean toxicosis in dogs: 98 cases. *Journal of the American Animal Hospital Association*, 36(3): 229-233.

[5] Anandan, S., Kumar, G.A., Ghosh, J., and Ramachandra, K.S. (2005). Effect of different physical and chemical treatments on detoxification of ricin in castor cake. *Animal Feed Science and Technology*, 120(1-2): 159-168.

[6] Araújo, F.L., de Souza, K.A., de Moura Santana, N., de Carvalho Santana, L.R., da Silva, C.S., de Oliveira, K.N., and Bagaldo, A.R. (2021). Animal performance, ingestive behavior, and carcass characteristics of grazing-finished steers supplemented with castor bean (*Ricinus communis* L.) meal protein. *Tropical Animal Health and Production*, 53(2): 1-11.

[7] Aslani, M.R., Maleki, M., Mohri, M., Sharifi, K., and Najjar Nezhad, V. (2007). Castor bean (*Ricinus communis*) toxicosis in a sheep flock. *Toxicon*, 49(3): 400-406.

[8] Audi, J., Belson, M., Patel, M., Schier, J., and Osterloh, J. (2005). Ricin poisoning: A comprehensive review. *Journal of the American Medical Association*, 294(18): 2342-2351.

[9] Auld, D.L., Rolfe, R.D., and McKeon, T.A. (2001). Development of castor with reduced toxicity. *Journal of New Seeds*, 3(3): 61-69.

[10] Baleta, F.N., Ramos-Castro, M.M., and Canceran, M.A.S. (2015). Molluscicidal and piscicidal activities of extracts of castor (*Ricinus communis*) bean for aquaculture management. *Israeli Journal of Aquaculture* - BAMIGDEH, 67. Available at: http://hdl.handle.net/10524/49193

[11] Barros, L.V.D., Paulino, M.F., Detmann, E., Valadares Filho, S.D.C., Lopes, S.A., Rocha, A.A., and Almeida, D.M.D. (2011). Replacement of soybean meal by treated castor meal in supplements for grazing heifers during the dry-rainy season period. *Revista Brasileira de Zootecnia*, 40: 843-851.

[12] Diaz, G.J. (2011). Toxic plants of veterinary and agricultural interest in Colombia. *International Journal of Poisonous Plants Research*, 1: 1-19.

[13] Feedipedia (2020). Available at : https://www.feedipedia.org/node/11950

[14] Godoy, M.G., Gutarra, M.L., Maciel, F.M., Felix, S.P., and Bevilaqua, J.V. (2009). Use of a low-cost methodology for biodetoxification of castor bean waste and lipase production. *Enzyme and Microbial Technology*, 44(5): 317-322.

[15] Helia (2024). Determination of protein content and proximate analysis of castor cake for protein supplementation in poultry feed. *Sustainable Systems*, 5(1).

[16] Johnson, R.C., Lemire, S.W., Woolfitt, A.R., Ospina, M., and Preston, K.P. (2005). Quantification of ricinine in rat and human urine: A biomarker for ricin exposure. *Journal of Analytical Toxicology*, 29(3): 149-155.

[17] Lin, J.Y., and Liu, S.Y. (1986). Studies on the antitumor lectins isolated from the seeds of *Ricinus communis* (castor bean). *Toxicon*, 24(8): 757-765.

[18] Madeira, J.V., Macedo, J.A., and Macedo, G.A. (2011). Detoxification of castor bean residues and the simultaneous production of tannase and phytase by solid-state fermentation using *Paecilomyces variotii*. *Bioresource Technology*, 102(15): 7343-7348.

[19] Purushotham, N.P., Raghavan, G.V., Naidu, M.M., and Mahender, M. (1986). Haematological studies on experimental feeding of castor bean meal (*Ricinus communis*). *Indian Journal of Veterinary Pathology*, 9: 70-73.

[20] Reddy, B.G., Reddy, M.R., and Reddy, G.V.N. (1986). Nutrient digestibility and rumen metabolism in buffaloes fed castor bean meal in the concentrate feeds. *Indian Journal of Animal Sciences*, 56: 567-572.

[21] Robb, J.G., Laben, R.C., Walker, H.G., and Herring, V. (1974). Castor meal in dairy rations. *Journal of Dairy Science*, 57: 443-450.

[22] Severino, L.S., Auld, D.L., Baldanzi, M., Câdido, M.J., and Chen, G. (2012). A review on the challenges for increased production of castor. *Agronomy Journal*, 104(4): 853-880.

[23] Vilhjalmsdottir, L., and Fisher, H. (1972). Castor bean meal as a protein source for chickens: Detoxification and determination of limiting amino acids. *Journal of Nutrition,* 101(9): 1185-1192.

[24] Woo, B.H., Lee, J.T., and Lee, K.C. (1998). Purification of sepharose-unbinding ricin from castor beans (*Ricinus communis*) by hydroxyapatite chromatography. *Protein Expression and Purification*, 2: 150-154.