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NUTRITIONAL EVALUATION OF TOASTED VELVET BEANS *(Mucuna pruriens* (L.) DC. var. *utilis*) *SEED* MEAL

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Abstract

This study examined the effects of toasting on the nutritional values of raw Mucuna pruriens seeds meal and its effects on some limiting anti-nutritional factors present in Mucuna pruriens seed for possible consideration as replacement for plant protein source in the diet of cultured fish. Two groups of diet, one group was toasted velvet bean meal while the other group was raw velvet bean meal were analysed for proximate composition and antinitritional factors. The toasting Process resulted in increase in protein from 29.83±0.10 to 35.13±0.04, also there was increase the crude lipid and ash content values when compared with the raw. While there were reductions in crude fibre, NFE and anti-nutritional factors of processed seeds. It was recommended that processing of Mucuna pruriens seeds by toasting could make it safe for use in fish and animal feed production.

Introduction

Mucuna pruriens also known as Velvet beans is a wild leguminous plant with a wide range of benefits ranging from food benefits, feed (forage and seeds), environmental services to medicinal use. The young leaves, pods and seeds are edible and used in several food recipe like roasted beans, coffee substitute, cooked beans and vegetables. (Eilittä *et al.*, 2003). Being a cover crop it provides fodder and green manure, it could beused used to control some stubborn weeds like *Rottboellia cochinchinensis and Imperata cylindrica* and also serve as an ornamental species (Wulijarni-Soetjipto *et al.*, 1997).

Mucuna pruriens is also well known for it's wide range of medicinal and all around beneficial properties. The main medicinal effects attributed to *Mucuna pruriens* come from the seeds, but the pod and its hairs and the plant's roots are also used in herbal preparations. The pods is used to treat snake bite in India and West Africa (Siddhuraju *et al.*, 1996; Aguiyi *et al.*, 1999). *Mucuna pruriens* seeds have been widely used to build fertility in men (Increases semen volume, sperm count *and* sperm motility), treats leucorrhoea (vaginal discharge), menorrhagia (excessive menstrual bleeding) and spermatorrhoea (involuntary ejaculation). Other uses include building of muscle in those who are weak; increase lactation in women when breastfeeding and prevention or lowering of the effects of poisonous snake bites. *Mucuna pruriens* seeds contain amino-acid L-dopa used for treatment of Parkinson's diseases, it has also been used as a uterine stimulant (Amin *et al.*, 1996; Lorenzetti *et al.*, 1998). It is also very effective in treatment of depression, insomnia and generally deepens sleep. The hairs on the mucuna pod are used to treat several species of parasitic worms (excluding tapeworms).

In additional to the nutritional and medicinal values other economic importance associated with *Mucuna pruriens are:* its fast growing rate with good yields; its ease of establishment; great resistance to pests and diseases and improvement soil fertility. It can also be used to make high quality hay and concentrate feed due to its high digestibility, crude protein (33%) and mineral contents. (Amin *et al.,* 1996).

However, presence of toxic and anti-nutritive compounds e.g L-3,4-dihydroxyphenylalanine (L-DOPA), antitrypsin factors, tannins, and cyanide in seed have limited the use as food and feed for fish and monogastric animals. Low palatability of foliage, lack of adaptation to very acidic and low fertility soils and presence of stinging hairs on its pods that resulted to itching which makes handling difficult when dry, could further limit the use of Velvet beans.

A range of Anti-nutritional and potentially toxic factors that have been reported in *Mucuna* seeds include: antitrypsin factors, tannins, and cyanide (Ravindran and Ravindran, 1988; Pugalenthi *et al.,* 2005), anticoagulants (Houghton and Skari, 1994), analgesic, antipyretic, and anti-inflammatory factors (Lauk *et al*., 1993), and others (Olaboro *et al*., 1991). L-3, 4-dihydroxyphenylalanine (L-DOPA), a potentially neurotoxic agent, is found in relatively large amounts in *Mucuna* seeds (Bell and Janzen, 1971; Daxenbichler *et al*., 1971).

Despite its toxic properties, various species of *Mucuna* are grown as a minor food crop. Raw Velvet bean seeds contain about 27% protein and are rich in minerals (especially K, Mg, Ca, and Fe; Olaboro 1991). The use of *Mucuna* spp. as minor food crops has also been reported in Ghana, Mozambique and Nigeria (Infante *et al.*, 1990). There are evidences that velvet bean seeds can be fed to animals to supplement their diet without apparent problems by reduction or removal of anti-nutritional factors in feeds using different processing methods which make it safe for use in fish and animal feed production.

Different processing methods have been devised to remove or reduce the concentration of these anti-nutritional factors. Legumes represent a major source of nutrients, including valuable but incompletely balance protein. The nutritive value of legumes depends upon the processing methods, presence or absence of antinutritional or toxic factors and possible interaction of nutrient with other food components.

Toasting process denatures and destroys antinutritional factors and other nutrients are also susceptible. The antinutritional trypsin inhibitor is a major concern, as it binds to and inactivates digestive enzymes. Digestion is reduced and the animal that eats the meal attempts to produce more enzyme to make up for the excreted loss. As these digestive enzymes are rich in sulfur amino acids, a methionine deficiency occurs and growth is affected (Swick, 2002). Some other advantages which make toasting worth considering are: it improves palatability, increases energy density, destroys the urease enzyme, improves carbohydrate digestibility and improves storage. Thermal treatments such as toasting have attracted significant research attention in recent years. Studies consistently demonstrate that toasting alters both the proximate composition and anti-nutrient profile of velvet beans, with implications for nutritional quality, safety, and suitability for livestock and aquaculture applications.

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Across multiple investigations, toasting has been shown to increase crude protein Okomoda and Tiamiyu (2017) observed significantly higher crude protein and improved nutrient density in toasted *Mucuna utilis* compared to raw seeds, supporting earlier findings on the beneficial effects of heat treatment on legume matrices. Similarly, Shehu et al. (2022) reported increases in crude protein, ash content, and nitrogen-free extract following toasting, attributing these changes to both water loss and partial breakdown of structural carbohydrates. Toasting also tends to reduce crude fiber, likely through thermal degradation of cellulose and hemicellulose components.

Reduction of anti-nutritional factors is another major benefit associated with toasting Dan-Ologe et. al (2025), Ilesanmi et. al (2025), Ilesanmi et. al (2024) and Ilesanmi et. al (2025). Several authors, including Ezegbe et al. (2023) and Boniface et al. (2024), found significant decreases in tannins, phytates, and trypsin inhibitors following thermal exposure. These heat-labile compounds readily degrade at typical toasting temperatures (120–160 °C), resulting in improved digestibility and nutrient bioavailability. Feeding trials involving guinea pigs (JVRA, 2021) and poultry (Shehu et al., 2022) further demonstrated enhanced feed intake, palatability, and digestibility when toasted velvet bean meal was included, reinforcing the practical value of this processing technique.

Despite these advantages, the literature consistently highlights the limitations of toasting as a stand-alone detoxification method. In almost all reviewed studies, L-DOPA reduction through toasting alone was modest, typically in the range of 20–35%, far below the threshold required for safe inclusion in most monogastric diets. Ezegbe et al. (2023) emphasized that toasting whole seeds is particularly ineffective, as the intact seed coat shields the cotyledons from effective heat penetration. Cracking or milling the seeds prior to toasting improves L-DOPA reduction but still does not achieve above 80% decrease observed with combined methods such as soaking, boiling, fermentation, or alkaline extraction. Recent advances reported by Nyiranshuti et al. (2025) and other emerging studies continue to reinforce that integrated processing approaches outperform toasting alone in detoxifying Mucuna.

Moreover, excessive toasting especially at higher temperatures or prolonged durations can lead to nutrient degradation. Some studies report decreased ether extract (fat content), possible impairment of amino-acid availability due to Maillard reactions, and minor losses in heat-sensitive vitamins. These findings underscore the need to optimize toasting parameters to balance nutrient retention with anti-nutrient reduction.

Researches available on toasting as a valuable preliminary processing technique that enhances the nutritional profile, reduces several key anti-nutrients, and improves feed acceptability of velvet beans are limited for mono-gastric animals like fish. Hence, this study investigated the effect of toasting on the nutritional value of velvet beans for potential use in the diet of *Oreochromis niloticus* fingerlings.

Methodology

The *Mucuna pruriens* seeds used in this study were of the variety *Mucuna pruriens utilis.* They were procured from the International Institute of Tropical Agriculture (11TA). 20kg of which were divided into two batches one batch (10kg) was subjected to processing method (toasting) and the second batch was left unprocessed. The unprocessed seeds were dehulled and milled into powdered form, packed into a cellophane bag and labelled raw and stored for chemical analysis.

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The processed seeds were toasted following the method described by Ukachukwu and Obioha, 2007 at 80^{o}c for 15minutes until the seed became crispy, with an aroma of toasted bean and the colour changed from cream to brown. The seed coat of the toasted seeds were removed then milled in a hammer mill machine into powdered form and stored for chemical analysis.

The proximate composition of the raw and processed *Mucuna pruriens* seed meal were determined. The moisture contents were determined by drying samples into a constant weight in an oven. This was repeated until a decrease in weight between successive weighing did not exceed 0.05 mg of the sample (fresh weight basis). Loss in weight was reported as moisture content.

Protein content was determined by kjeldahl method, Crude lipid in each sample was extracted with petroleum ether following automated method using Soxtec System (HT6 Model). Each sample was defatted with petroleum ether using Soxhlet System as described for crude fat. Ash content and the Nitrogen Free Extract were determined by subtracting the sum of moisture, ash, crude protein, ether extract, and crude fibre from 1000. (AOAC, 1990)

The anti nutritional factors determined include: Tannin contents using method described by AOAC (1990). Phytic acid by the modified method of McCance *et al.* (1979), the total oxalate content by the modified method of Abeza *et al.* (1968) and Crude saponin content was by the modified method of Khalil and El-Adawy (1994).

Essential amino acid profile of the samples were analysed using the method described by Benitez (1989).

Results and findings

Table 1: Proximate Composition (%) and gross energy (KJ/g) of raw and toasted *M. pruriens* Seed Meal (MSM)

Proximate composition	Raw	Toasted
Moisture content	4.50 ± 0.02 [a]	3.83 ± 0.03 [b]
Crude protein	29.83±0.10 [b]	34.95±0.06 [a]
Crude lipid	5.09 ± 0.06 [b]	9.67±0.04 [a]
Crude fibre	7.34± 0.02 [b]	8.65± 0.04 [a]
Ash content	3.75± 0.03 [b]	6.84± 0.04 [a]

Nitrogen free extract	49.49± 0.06 [a]	36.06±0.05 [b]
Gross Energy	18.81±0.098[b]	19.75± 0.069[a]

The proximate composition of raw and processed *M. pruriens* seed meal is presented in Table 1 Generally the results showed that processing (toasting) affected the proximate composition of M. *pruriens* seed meal. The moisture content (4.5%) in raw *M. pruriens* seed meal was significantly ($p<0.05$) reduced in toasting (3.83%). The crude protein contents (29.83%) of raw *M. pruriens* seeds meal significantly ($p<0.05$) increased (34.95%) in toasted sample. Toasting significantly ($p<0.05$) improved crude lipid content (9.67%) over raw *M. pruriens* meal (5.09%). The crude fibre was higher (8.65%) in the toasted *M. pruriens* seed meal and lower (7.34%) in the raw meal. The ash content was also higher (6.84%) in the toasted *M. pruriens* seed meal and lower (3.75%) in the raw meal. Nitrogen free extract was however lower (36.06%) in the toasted *M. pruriens* seed meal than in the raw (49.49%). The calculated gross energy content of the *M. pruriens* seed meal was higher for toasted (19.75 KJ/g) than for the raw (18.81 KJ/g). This values represent a significant increase in the gross energy content of the raw *M. pruriens* seed meal.

Table 2: Essential Amino Acid Composition (g/100g protein) of Raw and Toasted *M. pruriens* seed meal.

Essential Amino acid	Raw	Toasted
Histidine	2.01	2.50
Isoleucine	3.96	4.98
Leucine	6.68	8.36
Lysine	5.80	7.43
Methionine	1.16	1.49
Threonine	8.72	10.86
Phenylanine	0.72	0.89
Valine	4.48	5.38
Arginine	5.03	5.39

Table 2 shows the amino acid profile of the raw and toasted *M. pruriens* seed meal. Lysine and methionine, the two limiting amino acids in plant proteins were generally higher (7.43mg/g, 1.49mg/g) in the toasted than in the raw (5.80mg/g, 1.16 mg/g) *M. pruriens* seed meal. These values represent an increase over raw *M. pruriens* seed meal. Threonine, Histidine, Isoleucine, Leucine, Phenylanine, Valine, Arginine were also of higher values in the toasted *M. pruriens* seed

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meal. Tryptophan could not be measured with the procedure used in the present study because of its destruction on acid hydrolysis.

Table 3: Anti-nutritional composition (mg/g) of toasted and raw *M. pruriens* seed meal.

Anti-nutritional Factor	Raw	Toasted
Tannin	0.0588±0.001 [a]	0.0586± 0.002 [a]
Oxalate	9.09 ± 0.055 [b]	13.51± 0.052 [a]
Saponin	16.239±0.003 [b]	16.670± 0.015 [a]
Phytate	58.50± 0.047 [a]	37.08± 0.000 [b]

Table 3 shows the antinutritional compound assayed in *M. pruriens* seed meal; these included tannin, oxalate, saponin, and phytate. The antinutritional factors of raw *M. pruriens* seed meal were generally affected by the processing method. Toasting significantly reduced oxalate, Saponin and Phytate content (9.09mg/g, 16.24mg/g, 58.50mg/g) of raw *M. pruriens* seed meal respectively. The tannin content was also reduced. Toasting resulted in the enhancement of the nutritive value of the raw *Mucuna pruriens* seed meal. The proximate composition of raw *Mucuna pruriens* seed meal was similar to those reported in previous studies (Ogunji *et.al.*, 2003; Mugendi and Njagi, 2010);

It has been established that toasting brings about numerous biochemical, nutritional and organoleptic changes in raw materials, one of these changes include breakdown of constituents. Increase in protein content of toasted *M. pruriens* could be due to the concentration of other nutrients consequent of water loss to dry thermal treatment. The reduction in tannin level consequent upon heat treatment employed in the present study may be as result of heat degradation of tannin molecules or formation of insoluble complexes as explained by Van der Poel *et.al.*, (1991). Decrease in Phytic acid content of toasted meal may be as a result of the formation of insoluble complexes between phytate and other components such as phytate protein and phytate mineral complexes.

The nutritive value of protein depends primarily on its amino acid profile and their bioavailability (Oshodi *et.al*., 1999). The amino acid profile of the raw and toasted *Mucuna pruriens* seed meal used in the present study were similar to those of other common tropical grain legumes (Vadivolend Jonadbian, 2000). The increase in essential amino acids content observed in this study might be attributed to the breakdown and degradation of some other amino acids. This result agrees with the work of Saleh and El Adawy (2006) and Khattab *et.al*., (2009). The unusually high lysine content could be as a result of overestimation occasion by Millad reaction non enzymatic browning, in which lysine react with non reducing sucrose to produce indigestible brown polymer known as lysine (Porres *et.al*., 2002). Desulphuration, transamination and deamination reaction have been reported to be responsible for change in amino acid profile of processed meal.

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The conclusion that can be derived from this study is that toasting processing methods affect the nutrient composition and antinutritional factors content of *M. pruriens* seed meal in different ways. It also resulted in products with higher crude protein content and better amino acid profile than the unprocessed *M. pruriens* seed meal and could produced be utilized in fish and and animal feed.

References

Abegaz, K., Beyene, F., Langsrud, T. and Narvhus, J. A. (2002). Parameters of processing and microbial changes during fermentation of *borde*, a traditional Ethiopian beverage. *The Journal of Food Technology in Africa,* **7**, 85-92.

Aguiyi, J. C, Igweh, A. C, Egesie, U. G, and Leoncini, R. (1999). Studies on possible protection against snake venom using *Mucuna pruriens* protein immunization. Fitoterapia 70: 21–24.

Amin, K. M. Y, Khan, M. N, Zillur-Rehman, S, Khan, N. A. (1996). Sexual function improving effect of *Mucuna pruriens* in sexually normal male rats. Fitoterapia LXVII 67: 53–56.

Bell, E. A., and D. H. Janzen, (1971). Medical and ecological considerations of L-Dopa and 5-HTP in seeds. Nature 229:136–137.

Boniface, F., Washa, W. B., & Nnungu, S. (2024). Comparison of nutritional values of Mucuna pruriens L. (velvet bean) seeds with commonly preferred legume pulses. Food Production, Processing & Nutrition, 6, Article 17. https://fppn.biomedcentral.com/articles/10.1186/s43014-023-00187-4 — Open-access article. (OUCI)

Daxenbichler, M. E., C. H. Van Etten, E. A. Hallinan, F. R. Earle, and S. A. Barclay, 1971. Seeds as sources of L-Dopa. J. Med. Chem. 14:463–465.

Eilitta M, Mureithi J, Muinga R, Sandoval C, Szabo N (eds), Proceedings of the International Workshop on Increasing *Mucuna*'s Potential as a Food and Feed Crop, Mombasa, Kenya, September 23–26, 2002. Trop Subtrop Agro-Ecosyst 1: 71–76.

Ezegbe, C. C., Nwosu, J. N., Owuamanam, C. I., Victor-Aduloju, T. A., & Nkhata, S. G. (2023). Proximate composition and anti-nutritional factors in Mucuna pruriens (velvet bean) seed flour as affected by several processing methods. Heliyon, 9, e18728. https://doi.org/10.1016/j.heliyon.2023.e18728 — Full text PDF is openly available. (ScienceDirect)

Houghton, P. J., and Skari, K. P. (1994). The effect on blood clotting of some West African plants used against snakebite. J. Ethnopharm. 44:99–108. http://www.hear.org/pier/species/mucuna_pruriens.htm

Infante, M. E, Perez, A. M, Simao, M. R, (1990) Outbreak of acute toxic psychosis attributed to *Mucuna pruriens*. Lancet 11-3-1990;336(8723):1129. *International Journal of Food Science and Technology,* **43**, 658–665.

Ilesanmi A. I., Ayegba E.O., Dan-Ologe I. A. and Awanu F. E. (2025): Growth and Feed Utilization Response of Clarias gariepinus to Turmeric and Soursop in Aflatoxin-

Contaminated Diets. UAES Journal of Innovation Science and Technology for Development (UJISTD) 3(1)104-120 (Online). Doi:https://doi.org/10.5281/zenodo.16782486

Ilesanmi, A. I., Bubu-Davies, O. A., Osemwegie, O.O., Abu, O. M. G, Dan-Ologe, I. . and Ayegba, E. O. (2024). Effect of pelleting on the total aflatoxin concentration in fish feed. Eds: A. E. Obayelu, O.M. Olosunde, P. B. Abdulsalam-Saghir, O.S. Sowande, E.O. Fakoya and J.J. Atungwu. *Theme: Climate Change: Agricultural Innovations and Bio-entrepreneurship for Sustainable Development, Food Sufficiency and Economic Transformation. ADAN Journal of Agriculture.* Pg 82-85.

Ilesanmi, A.I., Bubu-Davies, O., Dan-Ologe I. and Abu OMG., 2023. Impacts of mycotoxin on cultured fish. *Journal of Aquatic Sciences*. 38. 89-107. 10.4314/jas.v38i1.8.

Iyabo Dan-Ologe**,** Ayokunle Ilesanmi and Folakemi Awanu (2025): Mitigating Potentials of Garlic and Turmeric in Aflatoxin-Contaminated Feeds of *Oreochromis niloticus.* Nature Environment and Pollution Technology, 25(1),

Lauk, L., Galati, E. M. Kirjavainen, S. Forestieri, A. M. and Trovato, A. (1993). Analgesic and antipyretic effects of *Mucuna pruriens*. Int. J. Pharmacog. 31:213–216.

Lorenzetti, F, MacIsaac, S, Arnason, J. T, Awang, D. V. C, and Buckles, D. (1998). The phytochemistry, toxicology and processing potential of the cover crop velvet bean (Cowage, Cowitch) (*Mucuna* Adans. spp., Fabaceae). In: Buckles D, Et`eka A, Osiname O, Galiba M, Galiano N (eds), Cover Crops in West Africa. Contributing to Sustainable Agriculture. Ottawa, Canada: IDRC, pp 67–84.

Ogunji, J. O., Uwadiegwu, N., Osuigwe, D. I. and Wirth, M., (2005). Effects of Different Processing Methods of Pigeon Pea (*Cajanus cajan*) on the Haematology of African Catfish (*Clarias gariepinus*) Larvae. Conference on International Agricultural Research for Development 2005 Stuttgart-Hohenheim, October 11-13, Deutscher Tropentag

Olaboro, G., M. W. Okot, J. S. Mugerwa, and J. D. Latshawa, (1991). Growth-depressing factors in velvet beans fed to broiler chicks. E. Afr. Agric. For. J. 57:103–110.

Okomoda, V. T., & Tiamiyu, L. O. (2017). Nutritional evaluation of toasted Mucuna utilis seed meal and its utilization in the diet of Clarias gariepinus (Burchell, 1822). Journal of Applied Aquaculture, 29(2), 167-182. https://doi.org/10.1080/10454438.2017.1278733 — Full-text PDF is publicly available. (ResearchGate)

Oshodi, A.A., H.N. Ogungbenle and M.O. Oladimeji, 1995. Chemical composition, nutritionally valuable minerals and functional properties of benniseed (*Sesamum radiatum*), pearl millet (*Pennisetum typhoides*) and quinoa (*Chenopodium quinoa*) flours. *Int. J. Food Sci. Nutr*., 50: 325-331.

Pugalenthi, M. Vadivel, V. and Siddhuraju, P, (2005). Alternative Food/Feed Perspectives of an Underutilized Legume *Mucuna pruriens* var. Utilis—A Review. Plant Foods Hum. Nutr., 60: 201–218

Ravindran, V., and G. Ravindran, (1988). Nutritional and antinutritional characteristics of Mucuna (*Mucuna utilis*) bean seeds. J. Sci. Food Agric. 46:71–79.

Shehu, I. I., Ishaya, A., & Ojo, A. (2022). Effects of inclusion of processed Mucuna seed meal on performance characteristics of Noiler chicks. African Journal of Agriculture and Food Science, 5(2), 16-23. https://doi.org/10.52589/AJAFS-I7DPGVAU — Open-access PDF available. (AB Journals)

Swick, R. A. (2002) Soybean Meal Quality - Assessing the Characteristics of a Major Aquatic Feed Ingredient. American Soybean Association. *Global Aquaculture Alliance*. 541 Orchard asaras@pacific.net.sg

Ukachukwu, S. N. Uzoech, S. O. and Obiefuna, J. N. (2007). Aspects of growth performance and nutrient retention of starter broilers fed ***Mucuna cochinchinensis***-based diets supplemented with methionine. Aust. J. Exp. Agric., 47 (2): 132-135

Wulijarni-Soetjipto, N and Maligalig, R. F., (1997). ***Mucuna pruriens*** (L.) DC. cv. group ***Utilis***. Record from Proseabase. Faridah Hanum, I ; van der Maesen, L.J.G. (Editors). PROSEA (Plant Resources of South-East Asia) Foundation, Bogor, Indonesia