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Evaluation of *Tamarindus indica* as novel feed resource in tropical animal production and management

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Target audience: Animal Scientists, Food and Nutrition Scientists, and Animal feed Producers.

Abstract

Unconventional feed resource for livestock production in the tropics has been identified as a way of reducing the challenges of shortage and high – cost of conventional feed resources because of the competition between man and animal. Therefore, nutritional value of Tamarindus indica whole fruit, hulls and seeds was investigated in this study. Determination of proximate components using standard methods was carried out on the samples separately and thereafter subjected to in-vitro digestibility evaluation. Proximate analysis results showed that the concentrations of chemical components in whole fruit, hulls and seeds respectively as determined on dry matter basis in percentage (%) were: moisture (13.39; 12.25; 4.60), ash (7.18; 5.50; 7.15), crude protein (13.75; 9.12; 22.60), crude fibre (15.50; 15.00; 10.00), ether extract (9.25; 7.72; 9.50) and metabolizable energy (4324; 4084; 4633 Kcal/Kg). This indicated that crude protein content were significantly higher (P<0.05) in the seed as compared to the whole fruit and hulls while the Tamarindus fruit hull contained significantly lower (P < 0.05) values components measured. The results of the in-vitro nutrients digestibility showed that crude protein, crude fibre and ash digestibilities respectively were significantly higher (P<0.05) for tamarind seeds (94.96 %, 53.41 %, and 64.69 %) as compared to the whole fruit and hulls which were similar (P>0.05). From the results, it was concluded that the seed of Tamarindus indica is a potential unconventional protein source for livestock production in the tropics and its in-vivo evaluation is hereby recommended prior to its use as a novel feed resource for commercial animal production.

Keywords: *Tamarindus indica*, nutritional evaluation, feed resource, animal production.

Description of the problem

Shortage and scarcity of feed resources as well as high cost are major problems facing animal production in the tropics. Consequent upon this, exploration of unconventional and/or lesser known plant feed resources for animals feeding has been on for quite a long time by various researchers. However some feedstuff of plant origin are yet to be investigated or investigated extensively. One of them is *Tamarindus indica* commonly known as Tamarind. It is a well-known plant which is distributed in the tropics and Sub-tropical parts of the world. It is reported to be indigenous to Africa but it has enjoyed great acceptability and huge cultivation in India sub-continent (1,6,12). Pattern of its availability across the world differs. In India, it is

cultivated and the country is the highest producer in the world, while in Africa, Arabian Peninsula, Caribbean and Oceania, it grow as a wild plant whose usefulness is only medicinal unlike in India sub-continent where it forms important parts of cuisine (10,11,15).

Tamarind has wide applications in different areas of human lives; all parts of the plant are recognized to possess various medicinal properties ranging from antibiotics to antioxidant activities. Ethno-traditional medical use of the plant across the world and its use as food confirm that it is a well-known tropical plant but despite information about its medicinal values bothering antibacterial, antiviral agents and its use as food, extensive reports on its nutritional value and functional properties are scarce. Therefore, this study was carried out to investigate nutritional value of its whole fruit, hulls and seeds for their potential use in animal nutrition and husbandry.

Materials and Methods

Study site

This study was carried out at the Teaching and Research Laboratory, Department of Animal Production in the School of Agriculture and Agricultural Technology, Federal University of Technology, Minna, Niger State, Nigeria. Minna is located within latitudes 4°30' 09°30' and 09°45'North and longitudes 06° 30' and 06°45 'East with an altitude of 1475 m above sea level. The area falls within the Southern Guinea Savannah agro-ecological zone of Nigeria with average annual rainfall of between 1100 and 1600 mm and a mean temperature of between 21^{o}C and 36.5^{o}C. Minna experiences two distinct seasons categorized as Dry season (November to March) and Wet or Rainy season (April to October) annually (5).

Sample collection and preparation

Stock of tamarind fruits were purchased at Gwari – a food market located within Minna metropolis. The fruits were cleaned to remove stones and other non-desirable materials while 250 g of the fruit was soaked into 500 mL of water for 48 hours to soften the whole fruit for removal of the seeds. After soaking, seeds were removed while the hulls were separated. Another 100g of whole fruit were kept under room temperature. Harvested seeds from the soaked fruits and the hulls were all sampled in triplicates for proximate analysis. Proximate analysis was carried out to determine crude protein, crude fibre, ether extract, ash and metabolizable energy of whole fruits, hulls and the seeds of tamarind using the procedures of AOAC (16). After the proximate determination, the whole fruit, hulls and seeds of tamarind were also used for *in-vitro* gastric digestion trial.

In – vitro digestion trial

In-vitro simulation of gastric digestion tract processes was produced using procedure described by (7). The procedure followed preparation of gastric simulated solution with 400 mL of pepsin-HCl solution measured into 1 litre bottle used for incubation of the samples in water bath at 39 ^{o}C for 4 hours. 20 g of each of tamarind fruit, hull and seeds sampled in triplicates were digested each in a simulated gastric bottle; after enzymatic digestion, the content of each bottle was centrifuged (3000 x g for 10 minutes at 4^{o}C), washed twice with distilled water and the residues were dried at 65 ^{o}C until constant weights were obtained and kept for determination of nutrient digestibility and was later subjected to proximate analysis.
Digestibility of nutrients was evaluated using the following formular after Giacomo *et al* (7):

$$\%\ Digestibility = \frac{Total\ nutrients\ digested - Total\ nutrients\ in\ residue}{Total\ nutrient\ digested} \times 100$$

Statistical analysis

Data generated were subjected to One-way Analysis of variance (ANOVA) using SPSS 16.0 version. Significant means were accepted at $P < 0.05$ using Duncan's Multiple Range Test while *Post Hoc* tool of the same software was used for means separation.

Results and Discussion

Proximate analysis (Table 1) showed that out of all the sampled parts of tamarind, the seed significantly (P<0.05) had highest protein value (22.60 %) and corresponding value of calculated metabolizable energy of 4633 (Kcal/kg) thereby indicating that the seed of tamarind is rich in protein and energy. It is also a good source of fibre in comparison with the hulls and the whole fruit which contained lower protein but similar levels of fibre and energy.

Considering the protein content of the seed of tamarind, it thus have potential of being used as an alternative source of protein for animal feeding. Further research incorporating the seed of tamarind as source of protein in animal diets is advocated to fulfil the need as an alternative cheaper protein resource that is not competed for human consumption and one which its cultivation may hold no environmental concerns unlike other protein sources such as soybean.

Apart from higher protein content, *in-vitro* digestion of the seed also showed that the protein digestibility is the highest as compared with other parts of the fruit (Table 2). The digestibility of protein was 94.42 % which was very high, although its bioavailability assessment is required to confirm and investigate true nutritional value of tamarind in a biological system of nutrition for animal production and management. Analysis of amino acid profile is also highly desirable for the purpose of determining its protein quality.

Table 1: Chemical composition of Tamarindus indica fruits, seeds and hull

Sample	Moisture (%)	Crude Protein (%)	Crude Fibre (%)	Ether Extract (%)	Ash (%)	ME (Kcal/Kg)
A	13.39^{c}	13.75^{b}	15.50^{b}	9.25^{b}	7.18^{b}	4324^{b}
B	12.25^{b}	9.12^{a}	15.00^{b}	7.72^{a}	5.50^{a}	4084^{a}
C	4.60^{a}	22.60^{c}	10.00^{a}	9.50^{b}	7.15^{b}	4633^{c}
SEM	1.38	1.97	0.88	0.30	0.33	79.45

abc= means with different superscripts on the same column are significantly different (P<0.05), SEM= Standard error of mean, A–Whole Tamarind fruit. B–Tamarind fruit hulls. C–Tamarind seeds. ME=Metabolizable energy

Evaluation of tamarind whole fruit, hulls and seeds in this study revealed that the plant is a rich under-utilized feedstuff in the tropics, especially Nigeria. It also showed that the tamarind evaluated is richer in nutrients especially for protein than those reported in the works of (2,3,8) where they differently reported tamarind seeds and hulls to contain average of 15.4 % and 7.2 % crude protein respectively. Although the tamarind analyzed by these workers were not of Nigeria origin, this can be an indication that Nigeria tamarind is more nutritious because tamarind was obtained from different locations for this study (Oyo and Kano). The physical and chemical evaluations showed they have great potentials

for jam production considering their nutritional values. Since the tamarind in this study and the ones reported in other study were all from Nigeria, it can be inferred that tamarind of Nigeria origin is of higher nutritional value as compared with tamarind from other places as reported previously.

Table 2: *In-vitro* nutrient digestibilities of Tamarind fruits, seeds and hull

Sample	Dry Matter (%)	Crude Protein (%)	Crude Fibre (%)	Ash (%)
A	75.57^{c}	75.00^{a}	43.50^{a}	53.75^{a}
B	65.65^{a}	75.00^{a}	46.00^{b}	55.75^{a}
C	70.00^{b}	94.96^{b}	53.41^{c}	64.69b
SEM	1.43	3.32	1.52	1.76

abc= means with different superscripts on the same column are significantly different (P<0.05), SEM= Standard error of mean, A–Whole Tamarind fruit. B–Tamarind fruit hulls. C–Tamarind seeds.

In-vitro evaluation of the tamarind also supported the fact that the material needs further investigation in order to incorporate it as non-conventional source of nutrients for animals. Earlier reports by researchers supported this with positive results in feeding tamarind components to animals. The leaves of tamarind was investigated for feeding sheep and it was reported to be most palatable in comparison with other leaves of other plant species among about 40 multipurpose trees in Ethiopia as reported by (8). Studies earlier on *Tamarind* recommended the use of tamarind seeds as protein meal for cattle while tamarind whole fruits in its pod was recommended as potential source of methane abatement because of its high tannin components (2,3,8). However, excellent *in-vitro* digestibility of the protein in tamarind seeds in this study gave more support to the use of the seeds as source of protein in the diets of poultry and other monogastric animals (2) alike which consume bulk of conventional protein feedstuffs. Although, the use of the tamarind seeds may require further processing before feeding to animals such as oil extraction for removal of anti-nutritional factors because when fed to broilers, tamarind seeds at 30% inclusion rate in the diet was reported to have negative effects on broilers, including lower feed intake, lower daily weight gain and higher mortality rate.

Apart from being a potential feed resource, tamarind can also be a functional material which in addition to regular supply of nutrients can serve as antioxidants, anti-lipid and other health promoting roles because when tamarind seeds was fed to laying hens, at the inclusion rate of 2% in diet, it gave positive effects on production yield and led to a lower yolk cholesterol content and better feed conversion, egg production and egg weight (4).

Conclusion and Applications

1. Tamarind has great trade and economic advantages if it can be turned into a valuable feed resource for feeding livestock.
2. Tamarind grows in the wild in Nigeria and many tropical countries where they are harvested at low cost,

requiring less processing and hence it can be obtained cheaply.

3. Its use for production of meat, eggs and milk would reduce feed cost as compared with the expensive materials such as soybean thereby reducing the prices of animal products and thus increase affordability by poor consumers of animal products in order to promote food security.

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