Review Paper:

Impact of Cashew Nut Meal on Livestock Production in Nigeria: A Review

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Abstract

It has become obvious that conventional feed materials for livestock feeding are limited and this is due to the increase in population. The raw materials for the formulation of feed are equally not sufficient thereby leading to price hike. Beside animals, humans are equally in need of these feed ingredients like cereals, pulses, legumes, oil seeds etc. for survival.

To avoid this unhealthy competition, there is a need to consider the utilization of other unconventional materials that can still be of nutritional value to livestock. This review will be looking at the impact of cashew nut meal on these livestocks.

Keywords: Cashew Nut Meal, Livestock Production, Nigeria.

Introduction

Cashew tree is a perennial, drought resistant plant, originating from and mainly restricted to tropical and subtropical regions, with some exceptions found at temperate climates. It is cultivated in almost all tropical countries around the world, with the most intensive production regions lying between 15° south and north of the equator[51] where environmental conditions are often characterized by low soil fertility, low and/or erratic rainfall and sometimes a considerable level of salinity.[16] Dedzoe et al[21] reported that good yield performances reaching 3 t/ha are obtained under high temperature, especially within the range 15–35 °C, with the optimum between 24 and 30 °C. However, the optimal temperature for seed germination is around 35 °C. Usually, a dry period of 4 months or more is required for a reasonable yield due to the fact that flowering occurs after dry spells; however, flowering can occur at any time throughout the year in the case of an undefined dry season.[21] Nevertheless, an annual precipitation range of 1,000–2,000 mm is necessary for a good yield.[72] In addition, the growth and development of the crop considerably depend on soil type and quality: though cashew grows on a wide range of soils, light to medium-textured, deep, well-drained soils are generally the most suitable. With regard to this, Luvisols, Lixisols and Acrisols have been reported to be highly suitable for cashew, being generally deep (>100–150 cm) and medium-textured.[21] Required base saturation levels should be above 35 % whereas pH should range between 5.2 and 7.

The optimum organic matter level is 1.4–3.0 %[72], even though in several areas devoted to cashew cultivation, such as in West Africa, organic matter content can be lower than 1 %.[21] In such contexts, soil fertility is usually very low, since low organic matter content is often correlated with low nitrogen and available phosphorus in soils. However, such issues can be addressed by sound management practices, as cashew has been found to positively respond to nitrogen, phosphorus and sulfur application.[36,48,68] What may hinder cashew growth and development instead is salinity.

Products of Cashew

The Kernel:

Cashew kernel: According to Azam-Ali et al[15], the kernel is the main product that cashew is cropped for. It has been estimated that about 60 % of cashew nut is consumed in the form of snacks, mostly roasted and salted. The remaining 40 % is instead used in confectionary and bakery products, often as a substitute for peanut and almond. Apart from its pleasant flavor, the widespread consumption of cashew nut is due to its nutritional properties. Such properties are mainly linked to the high content in lipids, which is predominantly given by monounsaturated (MUFAs) and polyunsaturated fatty acids (PUFAs) and have been shown to lower low-density lipoprotein (LDL) cholesterol levels and coronary heart disease risks.[40] Lipid content in cashew nut was found to range from 40 to 47 %.[34,67]

Investigations of the fatty acid profile revealed that MUFAs and PUFAs account for 79 % of total fatty acids which approaches the 85 % composition for an ideal fat.[34,73] According to Gallina et al[34], this feature is particularly relevant as such content can be attributed to oleic and linoleic acids, with the former being the most abundant MUFA and one of the most readily metabolized fatty acids and the latter is the most abundant PUFA and precursor of prostaglandin, as well as an essential fatty acid. The reduction of coronary heart diseases associated with nut consumption was also correlated with the presence of other bio-active compounds such as tocopherols, squalene and phytosterols[43] that were found to be present in cashew nut, although to a lesser extent compared to pistachio and pine nuts.[67]

Protein content was found to vary considerably, from 19 %[73] up to 36 %.[12,62] Carbohydrate content was seen to span from 1.4 %[5] to 26.8 %[12] with 20–25 % being the most common value, depending on the level of crude fat and protein, in turn determined by cashew variety and

environmental conditions.[5] The analysis of the amino acid profile revealed glutamic acid, aspartic acid and leucine being the most abundant (22.4–13.6%, 5.6–10.2% and 6.2–8.0% respectively.[12,73] The same studies, in line with previous findings confirmed high total amino acid content over crude protein up to 76 %[12] which makes cashew nut a good source of amino acids. The high quality of cashew nut amino acid supply is further confirmed by the high value of total essential amino acids, accounting for up to 47 %.[11]

Such content, however, was found sufficient to meet adult requirements for lysine and threonine but not for the requirements for infants (0–6 months) or children (up to 3 years) according to the joint FAO Expert Consultation.[31,73] Studies of mineral composition showed high content of potassium up to 38 %[12] followed by magnesium and calcium. Calcium content was found to be similar to phosphorus, which indicates that cashew nut is a good source of minerals for bone formation. Zinc and iron were found to be the least abundant.[5,12]

Cashew Apple: Akinwale[7] reported that the cashew apple has several uses and applications; its consumption as processed is far more widespread than as a raw fruit which is restricted to South America. Its diffusion is mainly due to its high content of vitamin C, since its juice is fivefold richer than citrus and fourfold richer than sweet orange 203.5 mg/100 ml of juice versus 33.7mg and 54.7mg respectively. The sugar content was observed to vary between 10 and 30 %.[15] Moreover, the apple contains a considerable level of minerals, mainly calcium and phosphorus. It also contains small proportions of tannins (up to 0.35 %) that confer an astringent flavor to the fruit.[46]

According to Akinwale,[7] such a limitation is overcome either by blending the cashew juice with others, as mango, orange and pineapple, that also serve to increase the content of vitamin C or by processing the fruit. With regard to this, different methods have been reported such as steaming, boiling in a 2 % salt solution, or treating with gelatin (0.25–0.4 %) or pectin (0.35 %).[46] Nair[46] also reported that cashew apple residues remaining after juice extraction are nutritious since they contain 9 % protein, 4 % fat, 8 % crude fiber and almost 10 % pectin. Their use to manufacture various products such as candies, jam and drinks is wide-spread, as well as cattle feed after drying. Other popular products obtained from cashew apple are cashew vinegar, cashew apple candy and jam, canned apple, cashew apple chutney, cashew pickles and a wide variety of soft drinks.

Cashew juice is also fermented to produce liquor in India, known as feni, having 40 % v/ alcohol content. Wine production from cashew apple was explored to obtain a wine characterized by low alcohol content (7 % v/v) and high tannin content, resulting in an acidic taste that consumers did not appreciate.[45] Due to its high sugar content, cashew apple juice has been found to be suitable as a source of reducing sugars for fermentative and enzymatic processes aimed at producing lactic acid, dextrane and oligosaccharides[39,69] as well as for ethanol production.[63] Cashew apple has also been traditionally consumed for its medicinal properties as it is thought to heal diarrhea and prevent cholera.[15]

Nutritional Benefits of Cashew

Winterhalter[75] reported that cashew nut is a high value edible nut. It yields two "oils," one of these found between the seed coat (or pericarp) and the nuts, is called the Cashew Nut Shell Liquid (CNSL). It is not a triglyceride and contains a high proportion of phenolic compound. It is used in industry as a raw material for brake lining compounds, as a water proofing agent, a preservative and in the manufacturing of paints and plastics. It is toxic and corrosive to the skin. Cashew apples are sometimes made locally into fruit drinks, wines and pickles. In some countries, they are also OsmoSol dried to produce a date- like caramel. Edible oil can be extracted from cashew nuts but no evidence of it being carried out commercially has been found.

The cashew apple is very sour and astringent until fully ripe, when it becomes edible. In contrast to the nut, the apple was neglected until recently, although it is available in far greater tonnage. A number of processes have now been developed for converting the cashew apple into various products such as juice, jam, syrup, chutney and beverage.[75] The ability of cashew apples to supply and fortify the nutritional requirement for vitamin C, particularly in Africa was reported by Akinwale.[7] The author carried out a physico-chemical analysis of some tropical fruits and compared them with those of cashew apple. Cashew apple juice was found to contain the highest amount of vitamin C (203.5mg/100ml.) of edible portion and when the cashew apple was blended with other tropical fruits, it boosted their nutritional quality.

The importance of the Cashew Nut Kernel Oil and Cashew Nut Shell Liquid (CNSL) cannot be overemphasized; the fat of nut is completely natural and unprocessed which is best for the body. It is especially rich in Linoleic acid (Omega-3) and is least damaging to heart and arteries. In fact, it constitutes about 47% of the total weight of the nut. Nuts often produce oil half their weight. This could be good news for people who feel weak or debilitated. Cashew has what is called the good fat. Cashew has the right combination of fat and the ratio of saturated to monounsaturated and polyunsaturated is 1:2:1 which is ideal for human consumption. The relative abundance of monounsaturated fatty acids in cashew nut is conducive to the promotion of good health and that the relative abundance of fat in cashew nut in no way poses a nutritional risk. The advantage of cashew kernel is that it has a rich, delightful taste and is meaty and acceptable as it is.

The Cashew Nut Shell Liquid (CNSL) is a versatile industrial raw material with diverse use in friction linings, paints and varnishes, laminating and epoxy resins, foundry chemicals and as an intermediary of chemicals. The

innumerable industrial applications of CNSL are based on the fact that it leads itself to polymerization by various means. Simple phenols from petrochemicals have restrictions, hence, the range of products obtained from them are few.[1] The aim of the present study is to confirm the nutritive value of cashew nut and to investigate the properties of the Brazilian and the African species in order to verify the status of the African specie CNSL in meeting standard qualities in the production of resins.

Analysis of minerals in cashew nut: The minerals, lead, iron, copper, zinc, magnesium and calcium were determined by atomic absorption spectrophotometry.[3] 1.0 g samples in triplicate were dry ashed in a Muffle furnace at 550ºC for 5h until a white residue of constant weight was obtained. The minerals were extracted from ash by adding 20.0ml of 2.5% HCl, heated in a steam bath to reduce the volume to about 7.0ml and this was transferred quantitatively to a 50ml volumetric flask. It was diluted to volume (50 ml) with deionised water, stored in clean polyethylene bottles and mineral contents determined using an atomic absorption spectrophotometer (Perkin-Elmer, Model 2380, USA).

Sodium and potassium were determined using flame photometry.[18] Phosphorous was determined as PO_4^{3-} by the vanadium phosphomolybdate (vanadate colorimetry method) in which the phosphorous present as the orthophosphate reacts with a vanadate molybdate reagent to produce a yellow – orange complex, the absorbance of which was measured at 420nm.

Analysis of acid, saponification and iodine value: The acid and peroxide values were determined using the method of Devine and Williams.[18] The saponification number was determined by the method of Williams[74] while iodine value was obtained by the method of Strong and Kock.[71]

Proximate composition of cashew nut kernel (defatted): The proximate compositions of the cashew nut kernel (defatted) studied are shown in table 1. From the data it was observed that the cashew kernel contained crude fat (49.1%) and protein (36.3%). It also contained 7.2% moisture, ash (2.8%), crude fiber (3.2%) and carbohydrate by difference (1.4%). Some of these values were in agreement with those reported by Eromosele et al,[28] Arogba et al,[14] and Achal et al.[1] The moisture content of cashew nut was 7.2%. This value fell within the range of mean values of moisture of legumes (between 7.0% and 11.0%) reported by Arkroyed et al.[13] Seeds with low moisture content could store for a longer time without spoilage. Ash content of cashew nut in this study was 2.8%. Previous studies showed ash content of kolanut, jackbean and cowpea to be 3.1%, 3.6% and 3.2% respectively[14] and of cashew nut flour 4.4±0.1%.[12]

An ash content of 1.5 - 2.5% for nuts has been recommended for suitability as animal feeds[64] but with the value of ash reported in this study, cashew nut may be unsuitable for animal feeds. This is in agreement with Aremu et al.[12] The values of fat and protein were also comparable to those obtained by Pearson.[62] The crude fat (49.1%) is comparable to the values for varieties of melon oil seeds (47.9 – 51.1%) reported by Ige et al,[41] Pumpkin seed (49.2% and 47.01%) reported by Asiegbu[4] and Fagbemi et al[29] respectively. The crude fat content was higher than those reported for soybean seed 23.5%.[61]

Aremu et al[12] reported 36.7% for crude fat in cashew nut flour; this may be due to differences in the species of the cashew nut and the environment in which they are grown. Fat promotes the absorption of fat soluble vitamins, hence it is very important in diets. This value of fat is an indication that cashew nut is a good oil seed particularly when compared with African yam bean with a fat content of 2.50%.[25] It is therefore a good source of edible oil that can be employed in cooking and food industries. The high protein and fat content reported in this work were in agreement with the work of Arogba[14] on cashew (*Anacardium occidentale*).

The protein content (36.3%) is higher than previously reported for a number of seeds like sahm seeds 22.5%, papaya seeds endosperm 20.49±0.79%; soybeans, cowpeas, pigeon peas, melon, pumpkin and gourd seeds 23.1-33.0%.[54] That the protein content of the cashew nut is higher or comparable to previous reports shows that it is nutritiously rich.[1] The protein content of cashew nut analyzed suggests that it can contribute to the daily protein need of 23.6g for adults as recommended by the National Research Council.[47] Protein also plays a part in the organoleptic properties of foods in addition to being a source of amino acid.[50] The crude fibre of cashew nut is 3.2% compared favorably with the USDA nutrient database for the fiber content of cashew nut by weight percent which ranged from 3.0-3.8%.

Aremu et al[12] recorded a lower value (1.2 ± 0.3%) for cashew nut flour. Crude fiber helps in the maintenance of normal peristaltic movement of the intestinal tract, hence diets containing low fiber could cause constipation and eventually lead to colon diseases (piles, cancer and appendicitis).[50] The value obtained for carbohydrate (by difference) 1.4% is very low compared to the expected range of mean values for legumes (20 - 26 % of dry weight).[13] This could be due to the high levels of crude fat and crude protein in the studied sample.

Mineral composition of cashew nut: The mineral content of cashew nut is shown in table 2. K had the highest concentration (27.5 ± 0.4mg/100g). This is in line with previous work on Nigerian agricultural products by Olaofe et al.[55] This was followed by Ca (21.5 ± 0.0mg/100g), Mg (19.3 ± 0.1mg/100g) and Na (8.2 ±0.3mg/100g). Mg has been reported to be involved in maintaining the electrical potential in nerves and activation of some enzyme systems.[30] The calcium content is in agreement with Aremu et al.[12] Calcium is responsible for bone formation. Phosphorous had

a mean value of 14.0 ± 0.2mg/100g. Phosphorous and calcium occur together in the body to maintain body blood. Fe (0.6±0.1mg/100g) and Zn (0.8±0.1mg/100g) were the least abundant of the minerals. This is in close agreement with the observation of Olaofe et al[55] and Aremu et al.[10]

Proximate Composition of Cashew Nut Meal (CNM): The proximate compositions of Cashew Nut Meal (CNM) have been given by many authors. According to Onifade et al[56] and Oyebimpe et al.[60] Cashew Nut Meal (CNM) can be compared with whole soybean, which is characterized as a moderate source of protein and an excellent source of energy because it contains high fat. Cashew nut meal (CNM) is a by-product from the cashew nut kernels, after toasted it has a high-energy content (27.9 MJ/kg DM) and protein concentration (22.6%). Ogunwolu et al[49] reported the percentages of moisture, fats, protein, ash and carbohydrates in Cashew Nut Meal (CNM) respectively and it is shown clearly in the table 3. Stanley et al[70] reported the proximate composition of CNM and it is shown clearly in the table 4.

Table 1
Proximate composition of cashew kernel (Defatted sample)

Composition	%
Moisture	7.2
Ash	2.8
Oil	49.1
Protein	36.3
Crude Fibre	3.2
Carbohydrate (by difference)	1.4

Akinhanmi et al[5]

Table 2
Mineral composition of defatted cashew nut kernel

Mineral	Composition (mg/100g)
Magnesium (Mg)	19.3 ± 0.1
Calcium (Ca)	21.5 ± 0.0
Sodium (Na)	8.2 ± 0.2
Zinc (Zn)	0.8 ±0.1
Iron (Fe)	0.6 ± 0.1
Potassium (K)	27.5 ± 0.4
Phosphorus (P)	14.0 ± 0.2

Akinhanmi et al[5] Values are means ± standard deviation of triplicate determinations

Table 3
Proximate Composition of Cashew Nut Meal (Dry Weight Basis)

Composition	Cashew Nut	Cashew Nut Meal.
Moisture (%0	1.81±0.01	0.85 ± 0.04
Fat Content (%)	48.38 ± 0.05	4.80 ± 0.05
Protein Content (%)	20.56 ± 0.06	43.30 ± 0.04
Ash Content (%)	3.40 ± 0.06	3.00 ± 0.04
Carbohydrates Content (%)	62.70 ± 0.06	75.20 ± 0.06

Ogunwolu et al[49]

Table 4
Proximate composition of CNM

Composition	Percentage (%)
Crude Protein	31.15
Crude Fibre	3.09
Crude Fat	30.98
Ash	4.97
Moisture	10.42
Dry Matter	89.58
Nitrogen Free Extract (NFE)	19.39

Stanley et al[70]

Animal Production in Nigeria

According to Health and Development Initiative,[38] livestock refers to animals that are domesticated primarily for food. They can also be referred to as "food animals". In Nigeria, the common livestock animals are poultry birds (Chicken, Turkey, Quail, Duck), cattle, small ruminants (Goats, Sheep), pigs, rabbits and in some parts of the northern region of the country, donkeys, camels and horses. The most commonly reared ones are chickens, cattle, goats and sheep. According to a Federal Ministry of Agriculture and Rural Development[32] report, the number of livestock animals produced annually in Nigeria was as follows: 180 million poultry birds; 76 million goats, 43.4 million sheep, 18.4 million cattle, 7.5 million pigs, 1.4 million equines (horses, donkeys etc.).

Responses of Livestock fed diets containing Cashew Nut Meal: Magalhães et al[44] evaluated the use of cashew nuts meal (CNM) in diets for sheep, raised in feedlot. According to the worker, feed intake was estimated as g/animal/day, percentage of body weight (%BW) and g/BW 0.75. However, a significant difference was observed in the intake of DM, CP and EE when fed concentrated with 0 % and 36% CNM according to Magalhaes et al.[44] Also, intake of DM, CP and NDF tended to decrease as the levels of CNM increased in the diet. EE intake increased according to the different CNM levels. The diet did not significantly affect either weight gain or feed conversion.

Therefore, cashew nut meal can be included up to 24% in the concentrate, but the total diets should not have more than 6% of fat considering that CNM has more than 40% EE and 22% CP. It has been hypothesized that CNM can be used as an alternative feed supplement for lambs due to their energetic and proteic content. Thus, the study was carried out to evaluate the nutrients intake, digestibility, nitrogen balance and ingestive behavior of lambs fed with Tifton 85 (*Cynodon spp*.) hay and supplemented with CNM.[19]

Oseni et al[58] reported the partial replacement of soybean meal with cashew nut meal on haematological indices and serum biochemical profile of weaned rabbits investigated using 30 weaned rabbits. According to Oseni,[58] the partial replacement of soyabean with cashew nuts meal resulted in significant difference on the haematological indices of the rabbit. However, results of haematological indices showed that the partial replacement of soybean meal with cashew nut meal resulted in a significant (P0.05) treatment. Rabbit fed diet 3 recorded highest total protein (5.03g/dl) while the lowest total protein value (4.31g/dl) was obtained for rabbits fed diet 1.

The highest value of Albumin (2.01g/dl) was obtained for rabbits fed diet 5 while the lowest value (1.12g/dl) was recorded for rabbits fed diet 2. Rabbits fed diet 3 recorded the highest globulin value (3.73g/dl) while the lowest value (2.96g/dl) was obtained for rabbits fed diet 5. It can be concluded that cashew nut meal can be fed to rabbits without having any adverse effect on haematological indices and serum biochemical profile of weaned rabbits.

Danilo et al[20] carried out a research to evaluate the effects of cashew nut meal inclusion (CNM) on nutrient digestibility, performance and carcass characteristics of meat quails. According to regression analysis carried out by Danilo et al[20] the inclusion of CNM, at levels above 50 g/kg, provided a linear reduction in digestibility of dry matter and metabolizable energy of diets, linear increase in feed intake and an increase in feed conversion ratio, not influencing weight gain and carcass characteristics. Comparing the results obtained with the different inclusion levels compared to those obtained with the diet without CNM (control group), it was noted that diets with 200 g/kg of CNM inclusion, the dry matter digestibility and metabolizable energy of diet were lower and the level of 250 g/kg provided higher feed intake. Considering the results, it can be inferred that cashew nut meal can be used as a feedstuff in meat quail's diets at levels up to 250 g/kg.

Stanley et al[70] investigated the effects of partial and total dietary inclusion of cashew nut meal (CNM) on growth, haematology, carcass composition, serum biochemistry and intestinal histology of juvenile African catfish (*Clarias gariepinus)*. According to the reporter, fish group fed 50% CM based diet had the best growth performance and haematological protein level when compared to 100% CM fish group and the control group. Insignificant changes in serum biochemical parameters were observed in CM fed fish groups when compared to the control. Histological examination of fish intestinal morphology revealed no adverse changes in the cellular structure of mucosal layer and villi in 50% CM fed fish, while mild histo-morphological changes were observed in 100% CM fed fish group.

Significant increases in villi length and weight were observed in fish group fed CM based diets when compared to the control. The findings of the present study revealed that partial replacement (50%) of soybean with cashew nut meal improved growth performance and haematological protein level of *C. gariepinus.*

Ojewola et al[52] reported from their five weeks feeding trial where Cashew Nut Meal (CNM) was substituted for Soyabean meal at 0, 25, 50, 75 and 100% and the diets were respectively designated as diets 1, 2, 3, 4 and 5 in a completely randomized design. Body weight changes, feed intake, feed-to-gain ratio and the economics of production were investigated. The feed-to-gain ratio was significantly ($p<0.05$) influenced while other parameters were not. Diet 3 gave the best value (2.24) followed closely by diets 4 (2.25) and 2 (2.28) respectively while diet 1 had the poorest value (2.53) followed by diet 5 (2.40).

The mean daily feed intake numerically improved as the percent Cashew Nut Meal (CNM) substitution increased

from 0 to 100%. Birds fed diet 4 had the highest value (120.58g) while birds fed diet 1 had the least value (115.84g). The mean total body weight gain (g) was highest (2214g) for birds fed diet 3 while birds fed diet 1 had the least value (1878.00g). The cost/kg diet (N) decreased as the dietary inclusion of the test ingredient increased from 0 to 100%. At the end of the trial, the highest marginal revenue was obtained from birds fed diet 4 (N415.32). This was closely followed by birds fed diets 3, 5, 2 and 1. Cashew Nut Meal is therefore recommended as a substitute for the expensive conventional plant proteins at 25, 50 and 75% levels.

Conclusion

From the nutrient composition of Cashew Nut Meal (CNM) and the various results gotten from the researches for both aquatic, monogastric and ruminant animals respectively, Cashew Nut Meal in the feed of livestock will be of high advantage considering the price hike of other conventional feedstuffs. Livestock farmers should consider the utilization of Cashew Nut Meal in order to minimize the cost of production and yet getting the desired and appreciable results.

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(Received 17th May 2022, accepted 25th June 2022)

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