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Assessment of Nutritive Value of Annona Senegalensis Leave as a Potential Feed Resource in the Livestock Production

Abdulwaheed Adeyemi BELLO[1*], Idris Mohammed ALIYU[2], Shuaibu Mohammed DOKO [3], Bashir Adamu MU'AZU[4], Musa MA'AJI[5], Wosilat ABDULSALAM[6] , Muftau BELLO[7]

[1,3,4,5,6]Animal Health & Production Technology Department, College of Agriculture. Mokwa, P.M.B 109, Niger State, NIGERIA
[2]Basic Science Department, College of Agriculture. Mokwa, P. M. B 109, Niger State, NIGERIA
[7]Home Economics Department, College of Education, Minna, P.M.B 39, Niger State, NIGERIA

[1]https://orcid.org/0000-0002-5355-1039, [2]https://orcid.org/0009-0000-3480-9121, [3]https://orcid.org/0009-0000-6464-0224, [4]https://orcid.org/0009-0007-0919-6221, [5]https://orcid.org/0009-0007-8029-860x, [6]https://orcid.org/0009-0005-1277-8906 [7]https://orcid.org/0009-0001-1790-4562

[k]*Corresponding author: aabello2003@yahoo.co.uk

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ABSTRACT

The leaves of the majority of the browse plants have been recognized as livestock feed as a result of their high carbohydrate, protein, vitamins and mineral contents; therefore they can be considered a reliable feed resource. In view of this, *Annona senegalensis* leaves were studied for their nutritional content in the current work. The study of the nutritive value of *Annona senegalensis* leave, via the proximate; mineral; vitamin compositions, and Phyto-chemical content was accomplished by the use of standardized analysis methods. The result of the proximate composition shows that the sample contained 7.40% moisture, 2.05% ash, crude fiber 32.78%, 2.69% crude protein, 1.98% fat and oil, and 53.10% carbohydrates, mineral content of the sample indicates that calcium, potassium, magnesium, phosphorus, sodium, lead and iron values were 0.66%, 4.68%, 3.12%, 22.16, 1.88, 0.10 and 0.21. The phytochemical content in the sample indicates the existence of saponin, tannin, steroid, flavonoid, and glycoside. Based on the obtained result it is concluded that the leaves of *Annona senegalensis* are rich and a good source of carbohydrates; crude fiber; crude protein; some minerals, and vitamins Therefore, can be used as a potential livestock feed.

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INTRODUCTION

Livestock production in nearly all developing countries like Nigeria is hindered extremely by under nutrition, and this is directly attributed to the unavailability and low-quality of feed resources for livestock production. Additionally, the use of conventional feed resources to augment low-quality feeds in present-day Nigeria to boost production is nearly impracticable because of its soaring high cost, inconsistency

in supply and demand by other livestock species (Akinmutimi, 2004; Egbo et al., 2001; Amaefule, 2002 and Ndubueze et al., 2006).

Therefore, to reduce the problems of feed unavailability and undernutrition, the use of leave meals from the perennial leguminous trees can be an alternative choice; multipurpose trees supply an affordable source of protein and other nutrients, particularly during dry weather at times when quantities as well as quality of pasture plants are lowest (FAO, 2010). The leaves of almost all the browse plants such as Gmelina arbora; Leucaena leucocephala; Adansonia digitata and Parkia biglobosa and many more have been recognized as livestock feed with high carbohydrate, protein, vitamins and mineral contents; therefore they can be considered a dependable feed resource (Okoli et al., 2003). Leave meals can boost the growth; development and performance traits of growing ruminant animals fed on fibrous diets through the supply of more and better nutrients (McDonald et al., 2002).Annona senegalensis generally called the African custard apple comes either as a shrub or small tree which includes the bark with smooth or coarse texture, branches, and leaves. The leaves are grazed by livestock (Wikipedia, 2021). Annona senegalensis is traditionally called Nugberechi in Nupe land and is a species of seed vegetable which grows both in dry and wet seasons. It is a plant that is widely spread cutting across Senegal to Nigeria. This plant is found throughout Northern Nigeria, especially in the Niger, Nassarawa, Kaduna, Kano, Plateau States, and Federal Capital Territory (FCT) Abuja, (Alqasim, 2013), thus its leaves can be potential feed resources in livestock production. According to Tijjani et al. (2013), the protein found in Annona senegalensis leaves may serve as a supplement to the body's daily protein needs. Additionally, they emphasized that the presence of crucial nutrients like protein and carbohydrates suggests that the leaves could be employed as a nutritiously valued and healthful element to enhance poultry health and growth performance. According to Avomyo et al. (2020), the total DMI of Annona senegalensis leaves was within the expected 3% of animal live body weight, suggesting that they would be suitable as goats' only source of nutrition. The favoured species of fodder trees and shrubs, according to Avornyo et al. (2020), were F. albida, F. sycomorus gnaphalocarpa, A. africana, P. erinaceus, A. senegalensis, and C. molle. Due to their low amount of anti-nutritive components and excellent amino acid profile, goats appeared to prefer A. senegalensis and A. africana over the other browse species (Yisa et al., 2010; Okunade et al., 2014). However, compared to A. senegalensis and A. africana, P. erinaceus had a higher amount of anti-nutritive components, according to Gidado et al. (2013). Additionally, according to Kronqvist et al (2021) adding foliage to goat diets might enhance feed intake and daily weight gain due to the animals' dietary preferences and the nutritional content of foliage species being generally higher than that of natural or semi-natural grass species.

Based on above reported literature, the present work was designed to assess the nutritive value of Annona senegalensis leaves as a potential feed in livestock production enterprises.

MATERIALS and METHODS

Source of Experimental Materials

Annona senegalensis leaves were sourced at the college backyard along boy's Hostel Road, Niger State College of Agriculture Mokwa, Niger state, Nigeria (latitudes 9^0N and 180^0E with longitude 5^0N and 3^0E). It has an annual rainfall of between 4 mm to 14 mm and means temperature of about 24^0C to 32^0C in the day and 20^0C to 24^0C at night. The soil is sandy and loamy and the vegetation is tropical guinea savannah CAM. (2021).

Sample Collection and Preparation

The sample (Annona senegalensis leaves) was collected manually in April 2022 using a knife and washed with clean water then air-dried for one week. The dried samples were ground to a fine powder with an electric grinder and sieved using a 0.5 mm mesh size, which was stored in a well-labeled airtight polythene bag for immediate laboratory analysis at Central Service Laboratory- National Cereal Research Institute (CSL-NCRI) Badeggi-Bida Niger State, Nigeria.

Chemical Composition of *Annona Senegalensis* Leaves

The values obtained for proximate analysis were all estimated in percentages. Moisture and ash contents were determined using weight differences. The fiber contents were estimated from the loss in weight of the crucible and its content on ignition. Carbohydrate was derived when the sum of the percentage of moisture, ash, crude protein, and fats were subtracted from 100. The nitrogen value, which shows the presence of protein in a substance, was determined by micro Kjeldahl (AOAC, 1990), which comprises digestion, distillation and titration processes. The value of nitrogen was turned to protein by multiplying with a factor of 6.25. The determination of the crude lipids content of the sample was accomplished with the use of Soxhlet type of direct solvent extraction method of petroleum ether boiled at 40-60^0C for eight hours. The nitrogen free extract was calculated indirectly by subtracting the sum of crude protein, fibre, fats and ash from 100 as described in the 15^{th} and 17^{th} editions of (AOAC, 2000).

Mineral Analysis of *Annona Senegalensis* Leaves

Two grams of the sample were digested using a 10 cm3 acid mixture consisting of HClO4, H2SO4, and HNO3 in a 1:4:3 ratio on a Kjeldahl digestion block until the solution becomes quite clear. The digested solution was filtered and made up to mark with deionized water in 100 cm3 volumetric flasks. Metal concentrations of Ca, Mg, Fe, and Pb were analyzed using Atomic Absorption Spectrophotometry (A.A.S)

(Perkin Elmer Analyst 200, USA). Potassium and Na concentrations were determined using flame photometers (SA-500f, China), while phosphorus was determined colorimetrically using the Vanudo-Molybodate Colorimetrically method (Kf1700, Sweden).

Vitamins content of Annona Senegalensis Leaves in mg/100g

Vitamins analysis was performed using the method reported by the Association of Official Analytical Chemistry (AOAC, 2006).

Vitamin A Determination

Vitamin A was determined by the colorimetric method. A quantity of 1 or 2 grams of the sample and standard were measured and combined with 30 ml absolute alcohol. Afterward, 3 ml 50% KOH solution was added and boiled gently for 30 minutes under reflux. After washing with distilled water, vitamin A was extracted with three times 50 ml of diethyl ether. The extract was evaporated to dryness at a low temperature and then dissolved in 10 ml of isopropyl alcohol. One ml of prepared standard vitamin A solution and that of the dissolved extract were transferred to separate cuvettes, and their respective absorbance values were read in a spectrophotometer at 325 nm with a reagent blank set at zero.

$$\text{Conc. of vitamin A in sample} = \frac{\text{Absorbance of sample} \times \text{Conc. standard}}{\text{Absorbance of standard}}$$

Vitamin B1 Determination

One gram of the sample was placed into conical flask and dissolved with 100 ml deionized water by shaking thoroughly. Later it was heated for 5 minutes and allowed to cool and filtered. The filtrate was poured into a cuvette and the respective wavelength (261 nm) for the vitamin was set to read the absorbances the using spectrophotometer.

$$Concentration\,(mg\,\%) = \frac{A\,x\,D.F\,x\,volume\,of\,\,cuvette}{E}$$

Where A = absorbance, E = extinction coefficient = 25 for B1 and DF is dilution factor = 5

Vitamin B2 Determination

One gram of sample was weighed into a conical flask. This was dissolved with 100 ml deionized water, shaken thoroughly and heated for 5 minutes and allowed to cool and filtered. The filtrate was poured into a cuvette and the wavelength was set at 242nm for the vitamins B2 to read the absorbances using a spectrophotometer.

$$Concentration\,(mg\,\%) = \frac{A\,x\,D.F\,x\,volume\,of\,\,cuvette}{E}$$

Where A = absorbance, E = extinction coefficient = 25 for B2 and DF is dilution factor = 5

Vitamin B3 (Niacin or Nicotinamide) Determination

Five grams of sample was mixed and 100ml of distilled water was added to dissolve all Nicotinic acid or Niacin present. The volume of 5 ml of this solution was measured into a 100 ml volumetric flask and makeup to mark with distilled water. The amount of 10 to 50 ppm of Niacin stock solution was also prepared and added. The absorbances of the diluted stock solutions and sample extract were measured at a wavelength of 385nm on a Spectrophotometer.

Vitamin B6 Determination

One gram of the sample was weighed into a conical flask. This was dissolved with 100 ml deionized water, shaken well, and heated for 5 minutes and left to cool down before being filtered. The filtrate was poured into a cuvette and the spectrophotometer was set at 254 nm wavelength to measure the absorbance to obtain vitamin B6.

Where A = absorbance, E = extinction coefficient = 25 for B6 and DF is dilution factor = 5

Vitamin C Determination

This was accomplished by the titrimetric method as was reported by (Kirk and Sawyer 1991). To analyse the sample, 1 gram was homogenized in 6% EDTA/TCA solution and filtered. Then, 20 ml of 30% KI solution was added and titrated against 0.1M CuSO4 solution. The endpoint was marked by a black colouration. A reagent blank was also titrated. Vitamin C content was calculated based on the formula below. One ml of 0.1 moles CuSO4 =.88mg vit. C.

$$Vitamin\,C\ mg/100 = \frac{1\,x\,.88\,x\,titre - blank}{W}$$

Vitamin E Determination

This was determined by the Futter – Mayer colorimetric method of the Association of Vitamin Chemists. 1 A gram of the sample was mixed with 10 ml of methanolic sulphuric acid and gently boiled under reflux for 30 minutes. The mixture was then transferred to a separating funnel and treated with three times 30 ml diethyl ether, recovering the ether layer each time. The ether extract was then transferred to a desiccator and dried for 30 minutes before being evaporated to dryness at room temperature. The resulting dried extract was dissolved in 10 ml of pure ethanol. One ml of the dissolved extract and an equal volume of standard vitamin E were transferred into separate tubes. After the continuous addition of 5 ml of absolute alcohol and 1 ml of the concentrated nitric acid solution, the mixtures were allowed to stand for 5 minutes, and the respective absorbances was measured using the spectrophotometer at 410 nm with blank reagent set at zero.

$$Conc.of\ vitamimE\ in\ sample = \frac{Absorbance\ of\ sample \times Conc.of\ \text{standard}}{Absorbance\ of\ sample}$$

Qualitative Analysis of Phyto-chemical Content of *Annona Senegalensis* Leaves

The test sample was subjected to Phyto-chemical screening for the presence of Saponin, tannins, alkaloids, flavonoids, steroid, and glycosides using standard methods recommended by (A.O.A.C, 2016).

Saponin

Two grams of the sample was added to about 5 ml of distilled water in a test tube and the mixture was shaken vigorously and then placed in a water bath for some minutes. The formation of foamy-like liquid at the top of the mixture confirms the presence of Saponin.

Alkaloids

In this test, Maeyers' reagent (a solution of 1.3 g HgCl2 and 5 g KI in 100 ml of distilled water) was added to about 2 ml of concentrated HCl and 1 ml of the blended sample dropwise. The formation of a creamy-like precipitate confirms the presence of alkaloids.

Quinone

One ml of concentrated H2SO4 was mixed with approximately 2 ml of the sample solution. The appearance of red coloured product indicates the presence of quinones.

Glycosides

Approximately 4 ml of the sample solution was added to 2 ml glacial acetic acid in a test tube, and a few drops of concentrated H2SO4 were let down the mixture in a test tube. The formation of a ring at the interface confirmed the presence of a deoxy sugar characteristic of cardiac glycosides.

Phenol

In this test, 2 ml of distilled water was added to one gram of sample and then some drops of 10% ferric chloride were added. The formation of blue or green colour confirms the presence of phenols.

Tannins

About one gram of the sample was boiled with 20 ml distilled water in a test tube and then filtered. Some drops of 0.1% ferric chloride were added and monitored for the appearance of blue-black colouration which shows the presence of tannins.

RESULTS and DISCUSSION

Chemical Composition

The proximate constituents of Annona senegalensis leaves are depicted in Table 1. A Lower moisture value of 7.40% was observed for Annona senegalensis leaves was observed for the Annona senegalensis leaf in this current work, the value is in agreement with the value reported by (Yisa et al., 2010). The value reported is comparable to the value reported by Tijjani, et al, (2013). Modu-Kagu et al. (2021) reported a moisture range values of 4.60 % – 17.64 % for browse leaves. The low moisture content of the sample shows that it can be stored for an extended period of time without spoiling after drying (Daramola, 2022)

Table 1. Proximate Analysis of Annona senegalensis Leaves

Parameters	Concentration (%)
Moisture	7.40
Ash	2.05
Crude fibre	32.78
Ether extracts	1.98
Crude protein	2.69
Carbohydrate	53.10

The ash content of the sample was observed to be 2.05% which is similar compared to Gnetum Africanu (1.20%). However lower than H. Sabdariffa leaves 6.55% and Mucuna urean 8.0%. The value is not within the range of 9.20% to 10.83% reported in green leafy vegetables of Nigeria (Umar et al., 2007). However, Modu-Kagu et al. (2021) reported an ash range values of 2.15 % – 12.14 % for browse leaves. The high ash contents of Nigerian green leafy vegetables may indicate higher levels of mineral elements in these samples compared to the values for Annona senegalensis leaves investigated on in the current study; this suggests that Nigerian green leafy vegetables contain more minerals than Annona senegalensis leaves reported on in the current study. The crude fiber content of the Annona senegalensis leaves was found to be 32.78% % which is higher compared to the value observed in some leafy vegetables eaten in Nigeria such as fluted pumpkin leaves 4.60% (Ekop, 2007). It is similarly higher than 28.29% reported for Tectona grandis leaf meal (Daramola, 2022). However, Modu-Kagu et al. (2021) reported a crude fiber range values of 15.39 % – 32.99 % for browse leaves. The higher crude fiber reported in the current study could be attributed to low protein content. In the present study, the value of fat content was observed to be 1.98%, this value (1.98%,) is lower when compared to 11.99% reported for Corchorus olitorius; 13.15% for G.africanum, and 4.30% for M. urean leave (Ekop, 2007, Idris et al, 2009). However, it is similar to 2.17% reported for Tectona grandis leaf meal and this is an indication of low level of cholesterol (Daramola, 2022). Similarly, Modu-Kagu et al. (2021) reported fat range values of 1.10 % – 6.73 % for browse leaves. The protein content of the Annona senegalensis leaves was found to

be 2.69% which is similar to the 2.71% value observed in Annona senegalensis leaves (Tijjani et al, 2013) but are lower than the 7.70% value observed in fluted pumpkin leave; 17.50% reported in G. africanum and 24.3% found in M. urean (Ekop, 2007) and 13.28% reported for Tectona grandis leaf meal (Daramola, 2022). However, Modu-Kagu et al. (2021) reported a Crude protein range values of 8.89 % – 24.85 % for browse leaves. The carbohydrate value as shown in the result was 53.10% which is higher compared to 19.56% observed in C. olitorius, and 10.56% in B. diffuse (Idris et al, 2009), and 40.30% reported for Tectona grandis leaf meal (Daramola, 2022). However, Modu-Kagu et al. (2021) reported carbohydrate range values of 41.98 % – 60.77 % for browse leaves. From the result of this study, Annona senegalensis leaf is a rich and a potential source of carbohydrates and this is needed for energy synthesis in animals (Ishida, et. al, 2000).

Mineral Element Analysis

The mineral constituents of Annona Senegalensis leaves are shown in Table 2. From the results the values of calcium 0.66%, magnesium 3.12%, potassium 4.68% sodium 1.88%, phosphorus 22.16%, iron 0.21% and lead 0.10%. The value obtained was similar except for phosphorus compared to that reported in Annona senegalensis leaves 0.47%, 1.35%, 0.24%, 0.48%, and 0.29% respectively (Yisa et al., 2010). The potassium value is 4.68% which is more compared to Sterculia satigera leaves at 1.3% and Khaya senegalensis leaves at 0.4% as was reported by Khobe, (2017). Sodium was observed to be 1.88%, this value is lower compared to Anonna negeisus leocarpus 19.47% as was reported by Khobe, (2017). Macro and micronutrients in sheep-selected diets were reported by Serra et al. (1995) as follows: Ca (0.51), K (0.93), Mg (0.19), Na (0.44), and P (0.27); and micro minerals: Cu (13.5), Fe (510.9), Mn (43.8), and Zn (29.5) in mg/kg-1DM. Ondiek et al. (2010), however, reported varying values, particularly with Ca, P, Mg, Cu, Fe, and Mn, which were typically lower.

Table 2. Mineral Content of Annona senegalensis Leaves

Minerals	Concentration in mg/g
Calcium	0.66
Magnesium	3.12
Potassium	4.68
Sodium	1.88
Phosphorus	22.16
Iron	0.21
Lead	0.10

The tree browses' mineral content ranges from a moderate level to a high level (Abdulrazak et al., 2000). According to Ondiek et al. (2010), although the Ca and P showed variance, the acacia species studied generally had high concentrations of the microelements Mn, Mo, Zn, Co, Cu, Fe, and Se, demonstrating that animals may be able to absorb enough of these nutrients without the need for general supplementation. They emphasized once more that all key minerals, with the

exception of sodium, were within the range of values previously reported (McDowell, 1985) and were thus sufficient to meet growth requirements. They claimed that previous reports (Norton, 1994; Ramirez and Ledezma-Torres, 1997; Sawe et al., 1998; Khanal and Subba, 2001) are compatible with the content of the micro-elements. Most studies (Sawe et al., 1998 and Abdulrazak et al., 2000) showed low Na content. Factors such as differences in climate, soil types, etc. could have contributed to these differences. However, Akinsoyinu and Onwuka (1988) reported the following range of values for some browse plants used in ruminant feeding in southern Nigeria as P (0.06 % – 0.47 %); Ca (0.13 % – 1.27 %); k (0.32 % – 4.34 %); Mg (0.15 % – 0.81 %); Na (0.003 % – 0.100 %); and Fe (300 ppm – 2100 ppm).

Phytochemical Screening

The results of the Phyto-chemical content of Annona senegalensis leaves are presented in Table 3. In the current investigation, Saponin, flavonoids, tannins, alkaloids, steroids, and glycosides were found.

Table 3. Phytochemical Content of Annona senegalensis Leaves

Parameters	Inference
Saponin	+ve
Flavoniod	+ve
Tannin	+ve
Alkaloid	+ve
Steroid	+ve
Glycoside	+ve

+ve: positive

Similar result by Johnson et al., (2017) shows the qualitative presence of tannins, flavonoid, alkaloids, Saponin and steroids on phytochemical screening of Annona senegalensis leaf. Furthermore, reports on Phyllanthus niruri leave by Olufayo et al. (2021) identify the presence of Saponin and Flavonoid. (Raimi et al., 2014 and Olufayo et al. 2021) also reported the presence of Saponin and Flavonoid in Manihot esculentus leave. Adebisi et al. (2021) also reported the presence Alkaloid in Syzgium aromaticum leave. However, reports by Yisa et al., (2010) showed the absence of tannin and alkaloids in Annona senegalensis plant in their study on Chemical composition of Annona senegalensis from Nupe land, Nigeria. The absence of tannin and alkaloids in their study may be attributed to method of determination.

Vitamin Analysis

This result of vitamin analysis indicates that the sample contains vitamin A- 3.76%, B1- 1.34%, B2 -1.86%, B3 -1 08%, B6 -0.66%, C-14.48%, E-11.48%. The vitamin content of Annona senegalensis leaves is summarized in Table 4.

Table 3. Vitamin Content of Annona senegalensis Leaves

Vitamins	Concentration mg/100 g
A	3.76
B1	1.34
B2	1.86
B3	1.08
B6	0.66
C	0.66
E	11.48

Vitamin A 3.76% showed a lower value compared to Phyllantus niruri leaves 12.78% as was reported by Olufayo et al. (2021). Vitamin E- 11.48% showed a lower value compared to Phyllantus niruri leaves 57.18% and vitamin B6- 0.66% is more compared to Phyllantus niuri leaves 0.234% as was reported by Olufayo et al. (2021). Vitamin B1 1.34% revealed more value compared to Syzygium aromaticum leaves 0.74 as was reported by Adebisi et al. (2021). Vitamin B2 1.86% has more value compared to Syzygium aromaticum leaves 0.069% and vitamin B3 1.08% revealed a similar value compared to Syzygium aromaticum 1.063% as was reported by Adebisi et al. (2021). The results observed on vitamins do not agree with the report of Olufayo et al. (2021). Except that vitamin B6 value was a little bit higher than what Olufayo et al. (2021) reported. The differences in the values could be attributed to spatial variation, which involves a number of factors including area temperature (Donhoued'e et al., 2023; Kraus et al., 2003; Iriti et al., 2009), light and ozone influences plant photosynthesis processes, altitude (Owuor et al., 1990), soil moisture, type, and the fertility of certain areas (Donhoued'e et al., 2023; Ravhuhali et al, 2020, Sariyildiz et al, 2005), and due to genetic variation (Donhoued´e et al., 2023).

CONCLUSION and RECOMMENDATIONS

Conclusions

i. The result of the present study showed that Anonna senegalensis leaves are a potential source of carbohydrate, crude fiber, fat/oil, crude protein, and which have the potential of being used for livestock nutrition.

ii. They contain essential minerals like Ca, Mg, K, Na P, and Fe, which are indispensable in livestock nutrition

iii. They indicate the presence of some important phytochemicals like saponins, tannins, alkaloids, flavonoids, steroids, and glycosides.

iv. It also contains vital vitamins like vitamins A, B1, B2, B3, B6, C and E which are essential in livestock nutrition

v. Therefore, Annona senegalensis leaves can be exploited as an alternative feedstuff for livestock production.

Recommendations

i. Annona senegalensis leave is recommended as a potential feed in livestock production

ii. Concerted effort should be made for larger scale screening of the plant for future use in livestock production in Nigeria.

iii. More research needed to be carried out to ascertain the full potential of Annona senegalensis leaves as a future candidate to be used as a newer livestock feed in livestock production.

Conflict of Interest

The authors have declared that there are no competing interests.

Authors Contribution

AAB contributed to the project idea, design and execution of the study. IMA, SMD, BAM, MB conducted the laboratory analyses. MM and WA supervised the experiment and AAB wrote the manuscript.

REFERENCES

Abdulrazak SA, Fujihara T, Ondiek JO and Ørskov ER., 2000. Nutritive evaluation of some Acacia tree leaves from Kenya. Animal Feed Science and Technology, 85: 89-98.

Adebisi AA, Olumide MD, Akintunde AO., 2021. Nutritive value and phytochemical screening of tumeric and clove as a potential phyto additive in livestock production. Nigeria Journal Animals Science, 23 (2):142-152.

Akinmutimi AH., 2004. Evalaution of Soyabean Canavalia Gladiate as an alternative feed resource for broiler chickens. PhD thesis, Micheal Okpara University of Agriculture Umudike, Nigeria.

Akinsoyinu AO, Onwuka CFI., 1988. Mineral constituents of some browse plants used in ruminant feeding in southern Nigeria. Nigerian Journal of Animal Production, 15 (1988): 57-62.

Alqasim AM., 2013. Annona Senegalensis Persoon: a multi-purpose shrub, its phytotherapic, phytophermacological and phytomedical uses. International Journal of Science and Technology, l(2): 12.

AOAC., 1990. Official Method of Analysis. 14th Ed, Association of Official Analytical Chemists, Washington, D.C. USA.

AOAC., 2000. Official Method of Analysis. 17th Ed, Association of Official Analytical Chemists, Washington, D.C. USA.

AOAC., 2006. Official Method of Analysis. 18th Ed, Association of Official Analytical Chemists, Washington, D.C. USA

AOAC., 2016. Official Method of Analysis. 15th Ed, Association of Official Analytical Chemists, Washington, D.C. USA.

Avomyo FK, Partey ST, Zougmore RB, Asare S, Agbolosu AA, Akufo NM, Sowah NA, Konlan SP., 2020. In vivo digestibility of six selected fodder species by goats in Northern Ghana. Tropical Animal Health and Production, 52: 473-480.

Avornyo FK, Zougmoré RB, Partey ST., 2020. Managing local fodder species for a competitive gender-sensitive goat value chain: achievements and lessons learnt from Climate-Smart Villages in northern Ghana. CCAFS Info Note. Wageningen, Netherlands: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS).

CAM., 2021. Meteorological unit Niger State College of Agriculture, Mokwa, Nigeria

Daramola OT., 2022. Proximate composition and phytochemical screening of Teak (Tectona granadis) leaves as phytogenic feed additive in poultry diets. Nigerian J. Anim. Sci., 24(1): 121-127.

Donhoued´e JCF, Salako KV, Assogbadjo, AE, Ana IF, Ribeiro-Barros AIF, Ribeiro N., 2023. The relative role of soil, climate, and genotype in the variation of nutritional value of Annona senegalensis fruits and leaves. Heliyon, 9(2023): e19012 https://doi.org/10.1016/j.heliyon.2023.e19012

Egbo ML, Doma UD, Lacdaks., 2001. Characteristics of small-scale rabbit production and management in Bauchi metropolis. Proceedings of the 26th Annual conference of Nigeria society for Animal production. ABU Zaria pp: 160-162.

Ekop AS., 2007. Determination of Chemical Composition of Gneturm Africanaum (AFANG) Seeds. Pakistan Journal of Nutrition, 6:40-43.

FAO., 2010. Food and Agriculture Organization Food and Agriculture, Organization of the United Nations, Rome, Italy.

Gidado OG, Kibon A, Gwargwor ZA, Mbaya P. Baba MJ., 2013. Assessment of anti-nutritive factors and nutrient composition of some selected browse plants use as livestock feeds in Taraba State. Inter. J. Appl. Sci. Engr., 1:5-9.

Idris S, Ndukwe G, Gimba C., 2009. Preliminary phytochemical screening and antimicrobial activity of seed extract of Persea Americana (Avocado pear) Bayero. Journal of Pure and Applied Sciences, 2(1): 173-176.

Iriti M, Faoro F., 2009. Chemical Diversity and Defence Metabolism: How Plants Cope with Pathogens and Ozone Pollution. Int. J. Mol. Sci., 10: 3371–3399.

Ishida HH, Suzuno H, Sugiyama S, Innami T, Todokoro T, Maekawa A., 2000. Nutritional and evaluation of chemical component of leaves, stalks and stems of sweet potatoes (Ipomoea batataspoir). Food Chemistry, 68: 359-367.

Johnson TO, Olatunde A, Nwachukwu, L., 2017. Phytochemical composition of Annona senegalensis leaf and its antioxidant activity during Trypanosoma brucei brucei induced oxidative stress in mice. Journal of Pharmacy & Bioresources, 14(2): 219-227.

Khanal RC, Subba DB., 2001. Nutritional evaluation of leaves from major fodder trees cultivated in the hills of Nepal. Animal Feed Science and Technology, 92:17-32.

Khobe D., 2017. Evaluation of the nutritive value of plants browsed by livestock at Gongoshi grazing reserve, Nigeria. Rep Opinion, 9(8) : 1 – 8.

Kirk RS, Sawyer R., 1991. Pearsons Food Composition and Analysis (4th Edition). Macmillan Publisher Company United Kingdom.

Kraus TEC, Yu Z, Preston CM, Dahlgren R, Zasoski RJ., 2003. Linking chemical reactivity and protein precipitation to structural characteristics of foliar tannins. J. Chem. Ecol., 29: 703–730.

Kronqvist C, Kongmanila D, Wredle E., 2021. Effects of replacing grass with foliage on growth rate and feed intake in Goats—A Systematic review and meta-analysis. Animals, 11(11): 3163. https://doi.org/10.3390/ani11113163.

McDonald P, Edwards RA, Green High JFD., 2002. Animals Nutrition. 65th Edition. Longman, London and New York. 5430.

McDowell LR., 1985. Nutrition of grazing ruminants in warm climates. Academic Press/Harcourt Brace, London.

Modu-Kagu HA, Zarah AI, Abba-Aja HK, Abbator FI, and Mohammed, ID., 2021. Evaluation of nutritive value of selected browse plants for dry season supplementation in Semi-Arid Nigeria. Nig. J. Anim. Sci. Tech., 4 (2): 28-42.

Ndubueze AI, Ukachukwu SN, Ahamefule FO, Ibeawuchi JA., 2006. Milk yield and composition of grazing white Fulani cows fed poultry waste – cassava peel based diets. Pakistan Journal of Nutrition, 5(5): 436-440.

Norton BW., 1994. The nutritive value of tree legumes, In: Forage tree Legumes in Tropical Agriculture (eds. Gutteridge, RC. and Shelton, M.). CAB International, Wallingford, pp 177-191.

Okoli IC, Ebere CS, Uchegbu MC, Udah CA, Beawuchi II., 2003. A Survey of the diversity of plants utilized for small ruminant feeding in South-Eastern Nigerian. Agriculture Ecosystems and Environment, 96(1-3): 149-154.

Okunade SA, Olafadehan OA, Isah OA., 2014. Fodder potential and acceptability of selected tree leaves by Goats. J. Anim. Nutr. Feed Techn., 14: 489-498.

Olufayo OO, Tayo GO, Olumide MD, Akintunde AO., 2021. Assessment of the nutritive value of Phylanthus niruri hinn. (Stone breaker) leave. Nigeria J. Anim. Sci., 23(3): 108-115.

Ondiek JO, Abdulrazak SA, Njoka EN., 2010. Chemical and mineral composition, in-vitro gas production, in-sacco degradation of selected indigenous Kenyan browses. Livestock Research for Rural Development, 22(2). from http://www.lrrd.org/lrrd22/2/ondi22025.htm

Owuor PO, Gone FO, Onchri D, Jumba IO., 1990. Levels of aluminium in green leaf of clonal teas, black tea and tea liquors, and effects of rates of nitrogen fertilizers on the levels of aluminium in black tea. Food Chem., 35: 59–68.

Raimi MM, Oyekanmi AM, Farombi AG., 2014. Proximate and phytochemical composition of leaves of ceiba pentendra, Manihot esculentus Abelmuschus esculentus in South West Nigeria. Scientific Research Journal (SCIRJ), 11: 2: 30-34.

Ramirez RG, and Ledezma-Tores RA., 1997. Forage utilization from native shrubs Acacia regula and Acacia fernesiana by goats and sheep. Small Ruminant Research, 25: 43-50.

Sariyildiz T, Anderson J., 2005. Variation in the chemical composition of green leaves and leaf litters from three deciduous tree species growing on different soil types. Forest Ecology and Management, 210 (1-3): 303–319.

Sawe J, Tuitoek JK, Ottaro JM., 1998. Evaluation of common tree leaves or pods as supplements for goats on range area of Kenya. Small Ruminant Research, 28:31-37.

Serra AB, Serra SD, Serra FB, Domingo IJ, Cruz, LC, Fujihara T., 1995. Diets of the Philippine indigenous sheep: Its comparison to indigenous goats diets and influence of sampling methods. Asian-Australasian Journal Animal Science, 8: 163-169.

Tijjani MA, Abdulrahman FI, Abba YS, Idris M, Baburo BSI, Mala GA, Dungus MHM, Aji BM, Abubakar KI., 2013. Evaluation of proximate and phytochemical composition of leaves of Annona senegalensis pers. Journal of Pharmaceutical and Scientific Innovation, 2(1): 7-9.

Umar KJ, Hassan LG, Dangoggo SM, Ladan MJ., 2007. Nutritional composition of water spinach leaves. J. Appl. Sci., 7(6): 804-807.

Wikipedia, 2021. Title Annona Senegalensis leave oldid-1058683219 “https://en.wikipedia.org/wl index. Php?

Yisa J, Egila JN., Darlinton AO., 2010. Chemical composition of Annona senegalensis from Nupe land, Nigeria. African Journal of Biotechnology, 9(26): 4106-4109.