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Research article

FODDER POTENTIAL AND CHEMICAL COMPOSITION OF *ACACIA NILOTICA* FRUITS FOR LIVESTOCK IN THE DRY LANDS OF SUDAN

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ABSTRACT: In developing countries agriculture and grazing are the two most dominant activities of the indigenous populations for their livelihood. In such countries in which Sudan is no exception, scarcity of water constitute the major obstacle to maintain proper farming as well as grazing activities. Therefore, under these conditions the local inhabitants largely depend on some tree species suitable for grazing purposes. In the present study the nutritional value for the fruit (seeds and pods) of *Acacia nilotica* grown at the lower Atbara river basin in north-eastern part of Sudan was investigated. The principal objective of this study was to evaluate the potential of *Acacia nilotica* as an alternative fodder for livestock in the area. Field samples of *Acacia nilotica* fruits were collected fresh, each sample was kept separately in a small cloth kit. Chemical analysis of fruit samples was conducted to quantify the content of various nutritional attributes including: crude protein, crude fibers, fats, starch, ashes and moisture content in addition to some minerals namely; P, Ca, Mg, Na, K, Cu and Fe. Data of the chemical analysis revealed that the fruit of *Acacia nilotica* consists of 21.4% crude protein, 30.12% crude fibres, 24.77% fats, 93.71% dry matter and 11.67% ash content. These magnitudes demonstrate a high nutritional value of *Acacia nilotica* fruits. Similarly, mineral analysis also showed elevated concentrations of Ca, Mg and K adequate for livestock feeding; however, only meager amounts were detected for P and Na. In the light of the present data, it might be concluded that fruits of *Acacia nilotica* are nutritionally rich materials as fodder in terms of their high contents of crude protein and some essential minerals necessary for adequate growth. Further work is in-evitably needed to improve our knowledge on the nutritional value of *Acacia nilotica* fruits for its rational utilization as a promising substitute for fodder species under unfavourable browsing conditions in dry areas.

Key words: *Acacia nilotica*, livestock, fodder, nutrition, Sudan.

INTRODUCTION

Fodder trees and fodder shrubs have played a significant role in feeding domestic animals. In fact, trees and shrubs are increasingly recognized as important components of animal feeding, as suppliers of protein especially under harsh environmental conditions. In such situations, the available grazing is not generally sufficient to meet the maintenance requirement of animals, at least for part of the year. This occurs, for instance in some mountain regions and in the dry tropics where grazing is also sometimes much degraded. Thus, in extensive animal production systems in the dry areas of Africa, it is generally estimated that ligneous materials contribute up to 90% of rangeland production and account for 40 – 50% of the total available feed. Therefore, there is an urgent need not only for better knowledge, but also for better use of such potential, particularly in the present context of environmental degradation, which is affecting our planet [1].

Previous studies have shown that some trees and shrubs of the study area were found to be of great nutritive value as fodder for animals. [2] Carried out chemical analysis of the leaves and twigs of 10 browse species in El-Butana area, eastern Sudan at early and late dry season. The analyses showed various ranges of chemical composition of browse species samples which were expected to affect their nutritive value. Most browse species investigated showed relatively high fodder value due to high level of crude protein (05.84 - 28.98%), metabolisable energy (04.71 - 09.39 Mj/Kg), Ca (0.40 - 03.9%), Mg (0.13 - 01.37%) and K (0.41 - 03.5%). In terms of Na and P concentration, all browse species samples were nearly deficient. Tannin content for most browse species was low to moderate, except *Acacia nilotica*, *Ziziphus spina-christi* and *Hyphaene thebaica*. Leaves were rich crude protein, digestible organic matter, metabolisable energy and Ca compared to twigs, which in turn had a high content of cell-wall constituents. [2] also clarified that, in late dry season, browse species tend to be fibrous with more ash and lower crude protein content which was negatively reflected in the level of organic matter digestibility and metabolisable energy, however, considerable amount of crude protein remained, which was still enough to provide maintenance requirements and even production requirements in some cases in browse species.
The poor crude protein contents of the arid and semiarid zones forage in Sudan, is the major limiting factor for livestock production, this effect coupled with the increasing cost of the conventional protein supplements for livestock with special reference to ruminants lead to loss of weights, high mortality rates especially among the young and poorly-fed pregnant females. To alleviate such problems and to bridge seasonality of good quality forage, browsing of shrubs and trees lends itself as a feasible alternative fodder [3]. The main features of browse plants are their high crude protein and mineral contents. The concentration of crude protein in the leaves and fruit of the majority of fodder trees and shrubs is above 10% even in the dry season when it tends to decrease. Generally, Ca and K contents are higher than those of other minerals. The role of trees and shrubs in the supply of vitamins is indirectly demonstrated in dry tropical Africa by the fact that browsers such as goats and camels seldom contract photophobia or eye inflammation, which many cattle are prone to during the dry season. The dry matter digestibility, which is related to nutrient composition, varies widely among tree and shrub species. A range from 38 to 78% was given by [4] working in Botswana with Kalahari woody species. Similar findings were reported by [5] and [6]. However, digestibility alone gives a poor assessment of the nutritive value of fodder trees and shrubs. This is because there is often no relationship between digestibility and intake. The overall nutritional value of *Acacia nilotica* is difficult to evaluate as the parts browsed by the animals or lopped for fodder include variable proportions of leaves, petioles, twigs, shoots, flowers and pods at various stages of maturity. The composition of these materials, and particularly their amount of fibre and tannins, is quite variable. *Acacia nilotica* leaves and browse are not very rich in protein (10 - 20% DM) but not very fibrous either (ADF 18% in the 10 - 30% DM range with some recorded values over 30% DM). The pods are slightly poorer in protein (10 - 14% DM) and contain more fibre (ADF 17 - 27% DM). The seeds contain much more protein (19% DM) and fibre (29% DM). However, the amount of tannins can be extremely important, both in the leaves (upto 25% total extractable tannins and 5% condensed tannins [7] and in the pods, where the content in soluble phenolics is particularly high. Those phenolics tend to reduce the palatability and feeding value of *Acacia nilotica* browse and pods [8, 9]. The presence of large amounts of tannins can give rise to artificially high fibre contents [9]. To date, our information regarding the nutritional value for most of the trees and shrubs used as fodder species in dry tropical Africa is limited and knowledge of browse production and chemical composition is still lacking. Hence, the present investigation was carried out and the main objective was to evaluate the nutritive value of *Acacia nilotica* fruits as livestock fodder at lower Atbara River, eastern Sudan. To address this objective, the detailed chemical analysis was performed in addition to quantification of the mineral contents.

MATERIALS AND METHODS

Samples collection

The tree specimens were freshly collected from the field during the period (2008 – 2009) through field trips that covered all the seasons. From downstream coast of lower Atbara River, specimens were collected as twigs with leaves, flowers, and fruits. *Acacia nilotica* tree fruits collected during 2009 were frequently browsed. Random samples were manually collected from sites. These were immediately weighed and stored in cloth bags. Thereafter, samples were identified and labeled with botanical and local names.

Laboratory sample preparation

The collected fruit samples for this investigation were sun-dried and subsequently their moisture contents were calculated. The dry samples were well ground, burned to ash and treated with HCl and HNO_3 acid in order to digest any residues of the organic matter. The samples were filtered for performing the chemical analysis according to [10].

Chemical analysis

To determine the chemical components in the samples collected, a detailed proximate analysis was performed. The contents of moisture, crude protein, crude fiber, ash, fat and starch were determined by using NIRS technique (NIRS=Near-Infrared Reflectance Spectroscopy). Furthermore, the minerals content in the fruits of *Acacia nilotica* were determined for phosphorus (P), calcium (Ca), sodium (Na), potassium (K), magnesium (Mg), iron (Fe) and copper (Cu) according to the methods described by [11]. Both K and Na were analyzed by flame-photometer (Coring EEL 100) while Ca, Mg, Fe and Cu were determined by atomic absorption spectrophotometer (2380 Perkin Elmer) and P was determined by the spectrophotometer (SP 6-200 Unican).

RESULTS AND DISCUSSION

The present study was performed for assessment of the chemical composition of *Acacia nilotica* fruits with regard to its potential use as an alternative fodder species under severe grazing conditions. The current findings generally showed that the nutritive attributes of this species are within the wide range of data reported for acacia and other browse species [2, 12, 13, 14]. In an early investigation, [6] reported that the crude protein content of browse plants is generally considerably higher than that for the grasses at all times other than the early growing season. This is obviously seen in the crude protein content of the samples of *Acacia nilotica* examined in this study which reached 21.40 and this value is superior to those reported by [7] who stated that the *Acacia nilotica* pods are slightly poorer in protein (10 - 14% DM) and contain more fibre (ADF 17 - 27% DM). The seeds contain much more protein (19% DM) and fibre (29% DM). *Acacia nilotica* leaves and browse are not very rich in protein (10 - 20% DM), but not very fibrous either (ADF 18% in the 10 - 30%. The high protein content of the fruit might be due to that the whole fruit (pods and seeds) was involved in the chemical analysis, and hence summation of protein of the seed and the pod added this high value, but both of them is higher than protein content of the pasture grasses and forage. The crude fiber content of *Acacia nilotica* fruit in this study is 30.12%, fat (ether extract) is 24.77%, DM is 93.71% and the ash content is 11.76% (Table 1). This clarifies why dwellers rely on fruits of some acacias named 'Oleaf or Baram' for the grazing of their animals. The protein content of animal feeds increases the appetite especially when it exceeds 7% in the feed and this fact might explain the increased palatability of *Acacia nilotica* fruits. However, the amount of tannins can be extremely important, both in the leaves (upto 25% total extractable tannins and 5% condensed tannins [7], and in the pods, where the content in soluble phenolics is particularly high. However, those phenolics tend to reduce both palatability and the feeding value of *Acacia nilotica* browse and pods [8, 9]. The presence of large amounts of tannins can give rise to artificially high fiber contents [9]. Despite containing tannins, the acacias were suitable protein supplements for dry season diets. They were readily consumed and often produced growth rate similar to those based on Lucerne or cowpea hay, the net effect of tannins was thus minor [15]. Table 2 below shows the mineral composition of fruits of commonly grazed *Acacia nilotica* in the study area. The Ca content in this study was 0.96%, which is well within the range of values reported by [2] for trees in El-Butana area of the Sudan, but lower than the value reported for Nigerian samples of *Acacia nilotica* by [16] as 1.45% Ca content, the same pattern is applicable to P content which was found 0.14%, while it was 6.4ppm in the Nigerian samples of *Acacia nilotica*.

Table 1: Proximate analysis of *Acacia nilotica* fruits in the study area

Nutrient	(%)
Dry Matter (DM)%	93.7
Crude protein (CP)	21. 4
Crude fiber (CF)	30.5
Fat	24.77
Ash	11.67

Mineral concentrations vary among species and locations, ranging from toxic to in-adequate for livestock production. [17, 18] reported P deficiencies in most acacias tested, leading to imbalance in the Ca:P ratio in foliage. Similarly, for most species the levels of K, Na and S were low [17], but [18] found that most acacias tested had adequate Na levels. Such differences may reflect differences in soil and growing conditions rather than differences between species.

Table 2: Mineral composition of fruits of Acacia nilotica species in the study area

Mineral	Composition
Ca	0.96%
P	0.14%
K	1.15%
Mg	0.15%
Na	98 ppm
Fe	39 ppm
Cu	4.95 ppm

CONCLUSIONS

The dry zone of tropical Africa is endowed with indigenous fodder tree and shrubs species, which are important feed source for livestock in the area. Unfortunately, details of browse production and nutritive value are still lacking for most of the species identified. In our current investigation, our findings provided evidence that the chemical composition as well as mineral concentrations were within the ranges reported elsewhere in comparison with other browse species. The fruits tend to have relatively higher protein content and lower minerals content. Although the study focused only on *Acacia nilotica* species, nevertheless, there is an indication of the potentials of acacia species as feed source and supplements. These results warrant further investigations on evaluating other parts and species and animal feeding trials are required to establish the nutritive values of these species.

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