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FULL LENGTH ARTICLE

Fodder value of three browse forage species for growing goats

O.A. Olafadehan [a,*], S.A. Okunade [b]

[a] Department of Animal Science, University of Abuja, Abuja, Nigeria
[b] Department of Animal Production Technology, Federal College of Wildlife Management, New Bussa, Nigeria

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Abstract The study evaluated the effects of *ad libitum* feeding of foliages of *Afzelia africana, Daniellia oliveri* and *Entada africana* supplemented with concentrate in twenty-four intact growing bucks (6 mo old, live weight (LW) 7.30 ± 0.1 kg). Goats were divided into three equal groups of similar LW in a complete randomized design. Intakes of forage, dry matter (DM), crude protein (CP), nitrogen, organic matter (OM) and digestible crude protein (DCP), average daily gain, digestibilities of DM and CP, DCP, N retention, ruminal fluid acetate, and serum urea N, albumin and globulin were greater ($P < 0.05$; 0.01) in Afzelia or Daniellia vs. Entada. Digestible energy (DE) to DCP ratio was lower ($P < 0.01$) in Afzelia or Daniellia vs. Entada and in Afzelia vs. Daniellia. Digestibility of OM, digestible OM, energy, microbial protein synthesis, ruminal volatile fatty acids and serum total protein were superior ($P < 0.05$) in Afzelia vs. Entada and in Daniellia vs. Entada ($P < 0.01$). Digestibility of fibre fractions and ruminal NH_3-N was lower ($P < 0.05$; 0.01) for Entada relative to Afzelia and Daniellia. Whereas ruminal fluid propionate was higher ($P < 0.05$; 0.01) for Daniellia compared to Afzelia or Entada, the acetate to propionate ratio was lower ($P < 0.05$; 0.01) in Daniellia than in Afzelia or Entada. Methane production was higher ($P < 0.05$) for Afzelia than for Daniellia or Entada. Serum glucose was greater in Daniellia than Afzelia ($P < 0.05$), in Afzelia than Entada ($P < 0.05$) and in Daniellia than Entada ($P < 0.01$). Results suggest Daniellia as an alternative fodder for Afzelia and indicate higher feeding value of Afzelia and Daniellia for feeding growing goats compared to Entada.

Abbreviations: ADF, acid detergent fibre; ADG, average daily gain; CP, crude protein; CT, condensed tannins; DCP, digestible crude protein; DE, digestible energy; DM, dry matter; DOM, digestible organic matter; FCR, feed conversion ratio; LW, live weight; ME, metabolizable energy; MPS, microbial protein synthesis; NDF, neutral detergent fibre; OM, organic matter; OMDR, organic matter digested in the rumen; VFA, volatile fatty acid

* Corresponding author. Tel.: +234 805 7035 527.
E-mail address: oaolafadehan@yahoo.com (O.A. Olafadehan).

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1. Introduction

A major constraint to livestock production in developing countries is the scarcity and fluctuating quantity and quality of the year-round feed supply (Olafadehan and Adewumi, 2009). Consequently, the productivity of ruminant livestock in the tropics and subtropics is limited by inadequacy of good quality and nutritive feed. This becomes critical during the long dry season when the little available standing hay forages are lignified with adverse effects on voluntary intake, digestibility, productive and reproductive performance.

Browse fodders are useful sources of cheap feed for ruminant animals in developing countries, especially during dry seasons when herbaceous pasture grasses and legumes are senescence. Since they are able to retain their green leaves and nutrient content during dry seasons, they bridge the gap normally created by decline in the nutritive potentials of natural pastures during this period. The ability of their foliages to remain green and maintain their protein content makes them potential sources of protein and energy (Olafadehan, 2013).

Smallholder ruminant farmers in the developing countries cannot afford concentrates and thus depend almost entirely on browse fodders for feeding their stock. *Afzelia africana*, *Daniellia oliveri* and *Entada africana* are among the all year round available major leguminous browse plants in the savannah region of Nigeria (Okunade et al., 2014a). Both *A. africana* and *D. oliveri* belong to the family Caesalpinioideae, while *E. africana* belong to the family Mimosoideae. *A. africana* is increasingly used by livestock owners and preference of herders for it among other fodders has been documented (Bayer, 1990; Gautier et al., 2005; Ouédraogo-Koné et al., 2006) while the foliages are also sold in the cities for urban and peri-urban livestock production. Similarly, its superior fodder value in a cafeteria feeding trial (Okunade et al., 2014a), *in vitro* study (Okunade et al., 2014b) and *in vivo* study (Ouédraogo-Koné et al., 2008) has been reported. *A. africana* has thus attained the status of a conventional fodder in the developing countries. Due to its recognized fodder quality for livestock feeding, and timber value for furniture and building, the tree is heavily lopped and logged. Because of this problem, the tree is now an endangered species. There is, therefore, the need to evaluate the feeding value of other browse trees as alternative fodders. Information on fodder value of *D. oliveri* and *E. africana* is scanty in the literature and little or nothing has been done in search of alternative fodders to the endangered *A. africana*, to the best of our knowledge.

It was hypothesized that *A. africana* forage could improve the overall performance of goats compared to *D. oliveri* and *E. africana* forages, and *D. oliveri* could be a better alternative fodder compared to *E. africana*. The objective of this experiment was to evaluate the fodder value of *D. oliveri* and *E. africana* as alternative fodders to *A. africana* (conventional fodder) for growing goats.

2. Materials and methods

2.1. Animal management and diets

The study site has been described by Olafadehan et al. (2014a). Twenty-four intact Red Sokoto male goats (6 mo old, live weight (LW) 7.30 ± 0.1 kg) were housed individually in well-ventilated clean pens equipped with water and feed troughs. Before the experiment, all animals were given prophylactic treatments consisting of administration of antibiotics (Oxytetracycline), dewormed with albendazole and treated against ecto-parasites. An adaptation period of 2 weeks allowed the goats accustomed to the experimental diets and pen environment. At the end of the adaptation period, the goats were divided into three equal groups of similar LW, and groups were randomly assigned to one of three experimental fodders in a completely randomized design. Goats were weighed at the start of the experiment and weekly thereafter.

The diets consisted of fresh foliages of *A. africana*, *D. oliveri* and *E. africana* collected from several mature stands of the three browse fodders at pre-anthesis stage and carefully separated from the stem and petiole before being fed. Fresh foliages of the browse fodders were offered individually at 50 g DM/kg LW in two equal parts at 09:00 and 16:00 h. *Ad libitum* forage intake was ensured by making allowance for 500 g/kg of intake of previous day. A meagre quantity (100 g) of concentrate mixture (maize 100 g/kg, wheat bran 300 g/kg, palm kernel cake 200 g/kg, corn bran 300 g/kg, groundnut cake 50 g/kg, bone meal 40 g/kg, premix 50 g/kg and salt 50 g/kg) was offered approximately two hours before afternoon feeding of the fodders. The concentrate was consumed by all goats within 60 min of offer on all occasions. All animals had unrestricted access to water. Daily feed offered and orts were recorded and LW was measured weekly in the morning before feeding. The feeding and growth trials lasted for 84 days excluding the 2-week adaptation period.

2.2. Metabolism trial

Immediately after the feeding trial, six goats were randomly selected per treatment and transferred into metabolism cages. Measurements of daily intake, faeces and urine for 7 d were preceded by 10 d of adaptation to the cages. Fresh feeds, feed refusals and faeces were sampled daily for determination of dry matter (DM) and chemical analysis. Samples of feed offered, orts, faeces and urine voided were collected every morning. Samples of the faeces and urine (100 g/kg portion of daily production) were pooled for each animal for the 7 d period and sub-sampled for analysis. The DM of feed and faeces was determined by drying to a constant weight in a forced-air oven at 60 °C. The dried samples were ground to pass through a 1 mm screen and preserved for chemical analysis. Urine was collected in plastic containers containing 20 ml of concentrated sulphuric acids to prevent loss of N by volatilization. The samples were later frozen pending chemical analysis.

2.3. Rumen liquor collection

Rumen fluid samples were collected before the morning feeding on the last day of the experiment by aspiration using stomach tube. The pH was measured immediately after collection with a digital pH metre. The liquor was then strained through four layers of muslin cloth, preserved by adding 5 ml of 1 M H_2SO_4 to 45 ml of rumen fluid and subsequently frozen pending analysis.

2.4. Serum chemistry

Blood samples were collected once at the end of the feeding period by jugular puncture into serum tubes for biochemical

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