Animal Nutrition xxx (2017) 1–4

Contents lists available at ScienceDirect

Animal Nutrition

journal homepage: http://www.keaipublishing.com/en/journals/aninu/

Original Research Article

Growth performance and hematology of Djallonké rams fed haulms of four varieties of groundnut (*Arachis hypogaea* L.)

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ARTICLE INFO

Article history:
Received 26 December 2016
Received in revised form
16 August 2017
Accepted 17 August 2017
Available online xxx

Keywords:
Djallonké
Hematology
Digestibility
Feed intake
Crop residues

ABSTRACT

The study was conducted to assess the chemical composition of the haulms of 4 dual-purpose groundnut (*Arachis hypogaea* L.) varieties and their effects on the growth and hematology of Djallonké rams. The groundnut varieties were ICGV 97049 (Obolo), ICGX SM 87057 (Yenyawoso), RMP 12 (Azivivi) and Manipinta. Rams (means ± SD, live weight 15.0 ± 3.0 kg) were randomly assigned to 4 sole groundnut haulm meal (GHM) treatments, with 4 rams each in an individual pen per treatment (total $n = 16$ rams). Samples of the groundnut haulms were milled and analyzed for crude protein (CP), neutral detergent fiber (NDF) and acid detergent fiber (ADF). The CP concentration was higher ($P < 0.05$) in Azivivi, Manipinta and Yenyawoso than Obolo. The highest ($P < 0.05$) NDF and ADF fractions were obtained in Obolo. Whilst no significant difference was reported in total and daily dry matter (DM) intake among the varieties, CP, NDF and ADF intake all differed between Obolo and other varieties. The apparent nutrient digestibility did not differ ($P > 0.05$) when the Djallonké rams were fed the haulms. However, significant differences were observed in final live weight and average daily live weight gain. Rams fed the Yenyawoso variety had higher ($P < 0.05$) final live weight and average daily live weight gain compared with those fed Obolo and Azivivi varieties. Consumption of any of the 4 varieties of groundnut haulms by Djallonké rams did not have any harmful effect on their red and white blood cell numbers and hemoglobin concentration. The study revealed that the different varieties of groundnut haulms differs in nutrient composition and also affects the growth performance of the rams. The Yenyawoso variety may be used as a sole diet for fattening Djallonké rams.

1. Introduction

Groundnut (*Arachis hypogaea* L.) is an important grain legume cultivated in most tropical countries including Ghana. The grains are very rich source of oil (48% to 50% of the grain), protein (26% to 28%) and carbohydrates (11% to 27%) (El Naim et al., 2011; Ibrahim et al., 2013). It is cultivated in many countries world-wide with different climatic conditions (Upadhyaya et al., 2006).

Apart from their use as food for humans, the haulms of the crop are usually conserved as hay and fed to ruminant livestock as a supplement or as the sole diet. Grain yield, days to maturity and pest or diseases resistance have, over the years, been some of the objectives of groundnut varietal improvement programs across research institutes in the world (Pande et al., 2003; Parthasarathy and Hall, 2003). However, forage yield and quality are not part of the selection criteria in groundnut improvement programs in West Africa (Larbi et al., 1999).

Whilst some authors reported differences in the nutrient composition of haulms of different groundnut varieties (Larbi et al., 1999), others did not find differences (Etela and Dung, 2011). Similarly, significant differences of the effects of different groundnuts haulms on the live body weight gain of Djallonké sheep have been reported (Etela and Dung, 2011). When groundnut haulms

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Peer review under responsibility of Chinese Association of Animal Science and Veterinary Medicine.

Production and Hosting by Elsevier on behalf of KeAi

http://dx.doi.org/10.1016/j.aninu.2017.08.006

were fed as a supplement to lambs feeding on different non-leguminous residues as a basal diet, there were significant improvements in their live weight gain (Abdou et al., 2011).

Available literature suggests that nutrient composition of groundnut haulms and their effect on growth of livestock could be affected by varietal differences. This provides justification to the current study that hypothesized that groundnut haulm nutrient composition and growth performance of Djallonké sheep fed different varieties of the groundnut haulm would differ.

Previous studies on the effect of groundnut haulm on growth of livestock have been conducted with the haulm as a supplement (Ikhatua and Adu, 1984; Abdou et al., 2011). Groundnut haulms and several other crop residues are often fed as a sole diet to ruminants in developing countries like Ghana, especially during the dry season. Devendra (1997) showed that the feed value of a crop depends on the biomass produced, voluntary intake, digestibility, and growth rate of the animal and this is best assessed through sole feeding. Literature on the effect of feeding groundnut haulm as a sole diet to ruminants is scant even though this is important information for small holder ruminant farmers. Etela and Dung (2011) found that West African Dwarf (WAD) sheep can be fed sole groundnut haulm from 6 dual purpose varieties without compromising nutrient intake and growth.

Hence, the aim of this study was to determine the nutrient composition of haulms of 4 dual-purpose groundnut varieties and their effect on the growth and the hematology of Djallonké rams.

2. Materials and methods

2.1. Location of the study

The animal experimentation and chemical analyses were conducted at the livestock unit and the Forage Evaluation Unit, respectively of the Department of Animal Science, Faculty of Agriculture (FOA) of the University for Development Studies (UDS), located at Nyankpala. Nyankpala is situated on longitude 0° 58′42″W and latitude 9° 25′41″N and at a height of 183 m above sea level in the dry savanna ecological zone of Ghana.

Nyankpala has a unimodal rainfall pattern that begins in late April and ends in October. The mean annual rainfall is 1,043 mm. Temperatures generally fluctuate between 15 °C (minimum) and 42 °C (maximum) with a mean annual temperature of 28.5 °C. The mean annual day time relative humidity is 54%. The area experiences dry cold Harmattan winds from November to February and a period of warm dry conditions from March to Mid-April. The dry season therefore stretches from November to late April.

2.2. Experimental animals and diet

Sixteen Djallonké rams were obtained from the Animal Research Institute of the Council for Scientific and Industrial Research (CSIR) at Nyankpala in Ghana. The rams had average initial live weight of 15.0 ± 3.0 kg and were randomly assigned to 4 sole groundnut haulm meal (GHM) treatments with 4 rams per treatment. The GHM was fed as the only ingredient in the diet and the animals were housed indoors for the entire period of the experiment.

The GHM were obtained from 4 varieties of groundnut cultivated on the agronomic trial fields under Africa Research in Sustainable Intensification for the Next Generation (RISING) project of the International Institute of Tropical Agriculture (IITA) in Tamale. The groundnut varieties were ICGV 97049 (Obolo), ICGX SM 87057 (Yenyawoso), RMP 12 (Azivivi), and Manipinta. With the exception of Yenyawoso which is classified as a short duration variety with 90-day maturity, all other varieties were long duration with maturity ranging from 110 to 120 days. Each variety was cultivated on 4 different replicate fields measuring 40 m × 25 m. A pre-emergence herbicide (glyphosate; 3 L/ha, 1 ha = 10,000 m^2) was sprayed immediately after planting whilst pendimethalin (3 L/ha) was sprayed post-emergence. Weed removal was done by hoes 5 weeks after planting. At full pod maturity, the groundnuts were harvested manually and the pods separated from the residues/haulms. The haulms were mainly leaves and twigs and were transported to the livestock farm of the Animal Science Department of UDS for shade drying which lasted for about 14 days. The dry residues were chopped to an average length of 3.5 cm for feeding.

2.3. Chemical analysis and feeding trial

The rams were housed in individual wooden pens with concrete floors and fed the dry GHM *ad libitum* daily for 8 weeks (56 days). Feed orts were weighed at the end of each day and sampled for dry matter (DM) determination. Prior to this, the rams were allowed 10 days adjustment to the feed. Daily feed samples (100 g) were collected from each replicate animal at the time of feeding and bulked together for each animal after the experimental period. The bulked feed were further sampled (200 g) in duplicate and dried in a forced air oven at 60 °C for 48 h for DM determination. The weight of the dried ort and feed offered were used in the calculation of DM feed intake. After drying, the samples were ground through a 2-mm screen for chemical analyses.

Each ram was fitted with a faecal collection bag after 14 days of adjustment to the feed and the faecal bag. The bags were removed twice daily (07:00 and 17:00) to weigh the fresh faecal matter. After weighing, a sample of about 20 g of each ram's faecal matter was frozen (−4 °C) until the experiment was over. The daily faecal matter collected from each ram was bulked together after the experiment and 200 g duplicate sub-samples dried. The dried faecal samples were ground to pass through a 2-mm screen for chemical analyses.

Both feed and faecal matter were analyzed for nitrogen using the Kjeldahl method, after which the crude protein (CP) was calculated by multiplying the nitrogen by 6.25 (AOAC, 2000). Neutral detergent fiber (NDF) was determined with sodium sulfite and a-amylase and exclusive of residual ash, whilst acid detergent fiber (ADF) was determined exclusive of residual ash in accordance to Van Soest et al. (1991) using the Ankom200 fiber analyzer (Ankom ADF method 5 and NDF method 6).

Djallonké lambs were weighed weekly to enable calculation of the live weight parameters. At the end of the 56 days, blood was taken from the jugular vein of the rams using a sterile syringe and needle, and put into plastic test tubes containing ethylene diamine tetraacetic acid (EDTA). The blood was analyzed for red blood cells (RBC), white blood cells (WBC) and hemoglobin (Hb) concentrations using the Wintrobes Microhematocrit, improved Neubauer hemocytometer and Cyanmethemoglobin methods, respectively (Baker and Silverton, 1990).

2.4. Statistical analysis

Differences in chemical composition, feed intake, weight gain, digestibility and hematology were analyzed using the Generalized Linear Model Procedure (PROC GLM) of SAS (1999) in a one-way analysis of variance. The chemical composition data was analyzed using the model:

$$Y_{ijk} = \mu + B_i + C_j + e_{ijk},$$

where Y_{ijk} is an observation, μ is experimental mean, B_i is block effect, C_j is variety effect, and e_{ijk} is residual.