**Feed Intake and liveweight gain of goats fed Urochloa grass**

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**Abstract**

Crude protein and digestible dry matter are the most important components of a feed and determine animal performance. The natural pastures in Kenya are prone to great seasonal and spatial fluctuation in both quality and quantity. Consequently, there was need to explore other nutritious alternative feeds. Sixteen growing male Galla goats weighing 10 - 24 kg were used in a twelve weeks feeding trial in the coastal lowlands of Kenya. They were randomly allocated four grass diets consisting of *Urochloa brizantha* cvs. Piata and MG4, *U. hybrid* cv. Mulato II and *Chloris gayana* (Rhodes grass), which was used as the control. Regression analysis was conducted using feed intake and daily weight gains as dependent variables against nutrient intake (dry matter, crude protein, acid detergent fiber, acid detergent lignin, neutral detergent fiber and ash). The results showed that feed intake of the goats was strongly influenced by digestibility of all nutrients (R2 = 0.94, P = <0.001). Average daily gain (ADG) of the goats was best defined by the intake of all nutrients (R2 = 0.84, P < 0.0002). Crude protein intake gave a better prediction of daily gain (R2 = 0.89, P < 0.001) than dry matter digestibility and dry organic matter digestibility (R2 = 0.42, P < 0.03). Grass diet with high CP and digestibility values are most suitable for high ADG of Galla goats.

**Introduction**

The traditional pasture-based livestock systems in the arid and semi-arid regions of sub Saharan Africa (SSA) have in all occasions been prone to great seasonal and spatial fluctuation in pasture quantity and quality (Bezabih et al., 2014; Ouedraogo-Kone et al., 2006). Therefore, they are especially susceptible to increasing variant and unpredicted change of climate (Herrero et al., 2016). Reduced precipitation and increased incidence of droughts limit the primary production of rangelands and locally increase the risk of over- grazing and pasture degradation, resulting in food insecurity and resource conflicts (FAO, 2009). In the ruminant industry, feed costs can contribute up to 70% of the total production costs (Ngila et al., 2016), therefore improving the efficiency of feed conversion into milk or meat can have a significant impact on the profitability of a ruminant enterprise (Bach, 2012). Nutritive value is defined as the chemical composition, digestibility and nature of digested products of forage (Mott and Moore, 1985; Sollenberger and Vanzant, 2011) and is often expressed using crude protein (CP), in vitro dry matter digestibility (INVDMD), neutral detergent fiber (NDF), Acid detergent fiber (ADF) and/or lignin concentrations.

According to Coleman and Moore (2003), when feed is offered alone and of free choice to animals having production potential, feed quality may be defined in terms of animal performance (e.g. daily gain). Crude protein (CP) and digestible dry matter (DDM) are the most important component of a feed (Ngila et al, 2016). Tropical grasses are rarely available as a balanced diet for grazing cattle because they exhibit nutritional constraints that limit pasture intake and digestibility (Detmann et al., 2014). During the dry season, there is a drastic decrease in the nutritional quality of tropical grasses, as mainly indicated by decreased crude protein (CP) content. The limited CP availability has been recognised as the critical threshold for adequate microbial growth on the fibrous carbohydrates in basal forage (Hennessy et al., 1983; Leng, 1990), which results in decreased intake and low animal performance (Egan and Doyle, 1985; Leng, 1990; Paulino et al., 2008).

Crude protein (CP;N x 6.25) in feeds serves two main functions in ruminants. The first is to supply N for the rumen microorganisms, and the second is to supply amino acids to the small intestines for absorption and use by the host ruminant animal. Amino acid supply comes from two sources, feed protein escaping microbial degradation and microbial protein (MP), derived from assimilating ruminal Amonnia (NH3). (Broderick, 1994). Both amino sources are subsequently hydrolyzed and absorbed from the small intestine. It is the quantity of amino nitrogen, as well as the relative ratio of amino acids reaching the small intestine, that is important for optimum utilization. Until the minimum requirement for N is met in the rumen to satisfy microbial needs, ruminal fiber digestion is depressed, undigested residues accumulate in the rumen, and intake is depressed. For this reason, when dietary CP is below about 8% of the diet, CP content has a strong relationship with intake.

Tropical grasses are rarely available as a balanced diet for grazing ruminants because they exhibit nutritional constraints that limit pasture intake and digestibility. For this reason, there is a demand to identify the nutritional limitations of tropical pastures, in order to avoid constraints on animal production.

Literature provides little information on relationship among feed intake, daily gain and nutrient intake in goats fed Brachiaria grasses. This study therefore, was an attempt to provide more information on regression equations among the parameters (feed intake, daily gain and nutrient intake) for goats fed Urochloa grasses

**Materials and Methods**

**Site**

The feeding trial was conducted at the sheep and goat multiplication centre, Matuga (4° 9’6’S, 39° 32’40’E), in Kwale County, Kenya. This area is located in a low altitude zone (60 m.a.s.l) coastal lowland 3 (CL3) agro-ecological zones, also referred to as the Coconut-cassava zone (Jaetzold *et al.*, 2006). The average annual rainfall is 1100 mm while the relative humidity ranges from 70-80% and an average temperature from 22-30°C.

**Experimental design and data collection**

Sixteen Galla goat bucklings of liveweight (10-24kg) were selected and divided into four groups of four animals each. The animals were randomly assigned to four dietary treatments which were; *Brachiaria brizantha* cv. Piata and MG4*, Brachiaria* hybrid Mulato II and Rhodes grass and animals standing as replicates i.e. four replicates. The weight of the goats were balanced in each treatment before the experiment begun.

There was an acclimatization period prior to data collection of about 14 days. During this period, the animals were dewormed against endo and ecto parasites. Individual pens were cleaned every morning.

The Brachiaria cultivars used for feeding were; Brachiaria brizantha cvs. Piata and MG4 and Brachiaria hybrid Mulato II. Chloris gayana (Rhodes grass) was used as the control grass. All animals received commercial concentrate supplements (100 g/day) made of maize germ that was purchased to last the entire experiment. The supplement was given before the basal diets were offered at 7.00 am in the morning. Water and mineral block were provided ad libitum.

The grasses were harvested 5cm above ground, and were allowed to dry for three days before they were baled into hay and transported to Matuga where the experiment took place. The harvested forages were chopped (5cm length) using a motorized chaff cutter before feeding. Chopping the forages prevented diet selection by the goats.

After the adaptation period of days, daily feed offers and refusals were weighed and recorded for a period of 12 weeks (20th April 2016-13 July 2016). Growth performance, expressed by weight gain was recorded weekly at around 9 am (fasting weight) using a portable electronic weighing scale.

Daily feed dry matter (DM), organic matter (OM) and crude protein (CP), were calculated as the difference between feed offer and refusal corrected for the respective contents in the original sample (Balehegn et al., 2014, Ngila et al., 2016).

Feed conversion ratio was obtained by dividing the feed intake and average daily gain.

**Experimental Diets fed to the goats**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Proximate composition | Control (Rhodes grass) | Piata | Mulato II | MG4 |
| Dry matter | 91.18 | 91.14 | 91.76 | 92.26 |
| Crude protein | 6.74 | 12.10 | 3.00 | 12.59 |
| NDF | 68.75 | 57.05 | 70.72 | 56.98 |
| ADF | 44.28 | 36.85 | 46.93 | 35.43 |
| ADL | 5.50 | 4.34 | 6.26 | 3.65 |
| Ash | 7.72 | 10.68 | 5.04 | 10.77 |
| DoMD | 39.83 | 48.74 | 38.22 | 49.02 |
| DMD | 44.62 | 55.47 | 41.36 | 54.96 |
| Ca | 0.39 | 0.27 | 0.27 | 0.27 |
| P | 0.08 | 0.22 | 0.19 | 0.20 |

**Chemical composition of feeds used**

Small amounts of herbage were taken from each bale used for feeding and a composite sample of about 2kg constituted for analysis. The samples were grinded to pass through a 1-mm screen. The samples were then analyzed in duplicates for chemical composition at the Animal and Nutrition Laboratory at KALRO – Muguga. Ash was determined by igniting the samples in a furnace at at 600°C for 2 hours.

Ash

Ground dried samples were weighed and then ignited in a furnace at 600°C for 2 hours, to oxidize all organic matter. Ash was the determined by weighing the resulting inorganic residue [18].

Calcium

The samples were ignited at 550°C to burn all organic material. The remaining minerals are digested in 6 M HCl to release calcium, which is then determined using a spectrophotometric assay based on reaction of calcium with o-cresolpthaleincomplexone (CPC) in alkaline solution. The Calcium was then calculated as follows;

% Calcium=(C x V x DF)/(W x 10)

Where, C: Concentration calcium in measure solution (mg/litre), V: Volume of solution (in litres, i.e., 0.025 (L)), DF: Dilution factor (normally, i.e., 1), W: Weight of the sample (g), and 10: Factor to convert g/kg to % [19,20].

Phosphorous

Feed material was ashed following digestion in hydrochloric acid. Molybdovanadate reagent is added which results in a characteristic yellow colour after reacting with phosphorus, which was measured spectrophotometrically. Percentage of phosphorous is calculated;

% Phosphorus=(C x V x DF)/(W x 10)

Where, C: Concentration phosphorus in measured solution (mg/ litre), V: Volume of solution (in litres, i.e., 0.025 L), DF: Dilution factor (normally, i.e., 1), W: Weight of the sample (g), and 10: Factor to convert g/kg to % [21].

*In vitro* dry matter digestibility

The samples were incubated under anaerobic conditions with rumen microorganisms for 48 hours at 39°C, under anaerobic conditions. This was then followed up by a 24 hour acid-pepsin digestion phase at 39°C, also under anaerobic conditions. Following this 72 hour incubation, residual plant materials was later collected, filtrated and oven dried (105°C for 12 hours).

The IVDMD was calculated using the formula;

%IVDMD=(1-wd-wb/ws)\*100

Where; wd: Weight of dry plant residue, wb: Weight of dry residues from blank, and ws: Dry weight of original plant sample [22,23].

Crude protein

The Nitrogen content of the feed is the basis for calculating the crude protein (CP). The method established by Kjeldahl converts the nitrogen present in the sample to Ammonia which is determined by titration [24]. Assuming that the average nitrogen content of proteins is 16% multiplying the nitrogen content in% obtained via Kjeldahl analysis with 6.25 gives an approximate protein content of the sample.

CP=6.25 x %N where CP is crude protein and N is nitrogen.

Crude Fiber

Fibre analysis was done using the Ankom fibre method which is a modification of the Van Soest System [19-25] of forage analysis. The carbohydrates in a feed sample are retrieved in two fractions; Crude fibre, Nitrogen free extractives (CF, NFE) of the proximate analysis. The fraction, which is not soluble in a defined concentration of alkalis and acids, is defined as crude fiber (CF). This fraction contains cellulose, hemicellulose and lignin. Sugars, starch, pectins and hemicellulose etc. are defined as nitrogen-fee extractives (NFE). This fraction again is not determined chemically it is rather calculated by subtracting CP, EE and CF from organic matter.

**Analytical Procedure**

**Statistical Analysis**

Data collected from the experiment were subjected to multiple (Y=a + b1X + b2X + bnX) regression analysis between feed intake, daily gain as dependent variables against nutrient intake (dry matter, crude protein, Ash, NDF, ADL, DMD) (Rstudio)

Results

Multiple regression between feed intake, average daily gain and nutrient intake of growing goats fed Brachiaria cultivars

References