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Influence of Dietary Sunflower (*Tithonia Diversifolia*) Leaf Extracts on Performance Characteristics of Goats Fed Cassava Peeling Wastes-Based Diet

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A 56-day growth and digestibility study was carried out to evaluate the influence of crude extracts of sunflower leaves on the feeding value of an all-concentrate diet (13.64 % CP; 22.18 % CF) fed to the goat. Sixteen weanling male West African Dwarf goats having an initial body weight range of 11.8-12.6 Kg were assigned to four dietary treatments in a completely randomized design. Treatments consisted of varied concentrations (0, 20, 40 and 80 g/liter) of crude aqueous extracts of sunflower leaves designated as A, B, C and D respectively and sprayed (100 ml/ Kg DM) on a cassava-peeling wastes based concentrate diet. Dry matter intake was reduced ($P < 0.05$) in the goats fed treatment D. Goats on treatment C had higher ($P < 0.01$) dry matter and crude protein digestibility values than the other dietary groups. Crude aqueous extracts of sunflower leaf at a concentration of 20 g /liter (Treatment B) or 40 g/liter (Treatment C) caused significant ($P < 0.05$) improvement in body weight gain in the goats which was attributed to an improvement ($P < 0.05$) in dry matter and nutrients digestibility, and nitrogen metabolism. Efficiency of feed conversion was highest for goats on treatment diet B, followed by those on diet C or the control diet while goats fed diet D had the least feed conversion efficiency values. It was concluded that the cassava peeling wastes-based concentrate diet treated with crude aqueous sunflower leaf extracts (20 or 40 g /liter) improved growth performance of the goats. A study on changes in rumen environment in the goat as influenced by sunflower leaf extracts is required to ascertain the cause of the improvement.

Keywords: cassava peeling wastes; goat; performance characteristics; sunflower leaf

Introduction

The level of efficiency at which feed is utilized for productive or reproductive purposes is one major factor determining profitability in a livestock production system. Low quality feeds are characteristically deficient

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in energy and or protein nutrients but often rich in indigestible fiber. An advantage exists for ruminants on high fiber, low protein diets as a result of the presence and activities of cellulose digesting bacteria inside the rumen which often leads to microbial mass production. The microbial cells produced in the rumen are potential sources of nutrients to the host ruminant. However, the proportions of bacteria, protozoa and fungi in the rumen are influenced by diet composition, and often set the limit for biomass production and feed use efficiency. A high proportion of rumen protozoa would be unfavourable to an efficient feed utilization especially in ruminants on low-quality diets. Protozoa ingest and digest bacteria and reduce not only the rate of cellulose breakdown in the rumen but also the level of bacterial biomass production (Coleman, 1975).

A 30% sunflower leaf meal based diet was found (Ekeocha *et al.*, 2010) acceptable to pre-weaned lambs as it supported dry matter intake, optimum weight gain, weaning weight and feed conversion ratio. It is also a potential source of protein for human consumption due to its high nutritive value and lack of anti-nutritional factors (Smith, 1968; Sosulski, 1979); Ivan *et al.* (2003) observed that sunflower seed supplement was highly effective in reducing both protozoa numbers and ammonia nitrogen concentrations in rumen fluid of sheep fed silage plus concentrate diet. The present study attempts to test the hypothesis that dietary crude aqueous extracts of sunflower leaf could also be used to favourably alter the rumen microbial population with a view to achieving beneficial effects on the utilization of a high fiber, low protein concentrate diet by the goat.

Materials and methods

Preparation of Sunflower Leaf Extracts

Leaves of the wild sunflower plant (*Tithonia diversifolia* Helms. A.Gray) were harvested at the pre-flowering stage from uncultivated plots at the university Teaching and Research Farm. The leaves were dried for 5 days, on a concrete floor of a well ventilated room. Different concentrations of sunflower leaf extracts were prepared by grinding thoroughly, 20, 40 or 80 g sample of the leaves in 80 ml distilled water using mortar and pestle; the mixtures was filtered into a plastic bottle and made up to 1000 ml with distilled water.

Animals and Treatments

Sixteen (16) weanling male West African Dwarf goats with initial body weight range of 11.8-12.6 Kg were divided into four equal dietary groups in a completely randomized design. An all-concentrate diet consisting of cassava

peeling wastes (60 %); soy bean meal (20 %); rice husk (19 %); bone meal (0.5 %) and sodium chloride (0.5 %) was fed to the goats during the 56-day growth and digestibility study.

Treatments consisted of different aqueous solutions (0, 20, 40 or 80 g/liter) designated as A, B, C and D respectively) of dried sunflower flower leaves that were hand-sprayed (100 ml/ Kg DM) on the cassava peeling wastes-based concentrate diet. Goats were treated against both internal and external parasites by intramuscular injection (1 ml/10 kg body weight) of Ivermectin and Oxytetracycline respectively. A seven-day pretreatment period during which goats were kept on the control diet alone was observed. Goats were housed individually in concrete floored pens (1.5×1 m^2) for the first 42 days of the feeding trial before being transferred into individual metabolism cages that allowed for separate collection of faeces and urine during the last seven days after a seven-day period of adjustment to the cage conditions. Fresh clean drinking water was made available to the goats *ad libitum* throughout the 56-day period.

Collection of Data and Analyses

Goats were weighed on the first day and fortnightly thereafter, during the 56-day feeding trial. Body weight change was estimated from the difference between two consecutive measurements. Record of daily feed intake was kept on each animal during the 7- day metabolism study. Feed intake was the difference between the weight of feed offered and the weight of Orts. Total urine produced daily by the individual goat was collected into a plastic bucket acidified with 10 ml of 10 % H_2SO_4 and measured with graduated measuring cylinder. 10 % aliquots of daily urine production were pooled for each goat over the collection period and preserved in plastic bottle for N-determination subsequently. Total faeces voided daily by each goat were harvested from polythene sheet fastened underneath each metabolism cage and weighed. A 10 % sample of the faeces was oven dried at 65^0 C for three consecutive days and kept (-5^0 C) for chemical analyses.

Dry matter determination on feed and faeces and chemical analyses of diet, faeces and urine were carried out following the AOAC (1990) procedures. Empirical data were subjected to analysis of variance following the procedure of Steel and Torrie (1960) with treatment means separated (Duncan, 1955) where significant differences were indicated.

Results and discussions

Results of chemical analyses of the cassava-based concentrate diet indicated CP, CF, NFE and EE contents (% DM) of 11.57, 12.31, 61.72 and 2.58 respectively that were considered with a calculated energy value of 10.14 MJ/Kg adequate, to meet maintenance requirements and support production in the goats, based on the NRC (1980) recommendations.

Data on feed intake, body weight gain and feed conversion ratio in the goats were as shown in Table 1. Goats fed sunflower leaf extracts–treated diet B or C had similar dry matter intake values when compared to the dry matter intake by the control group. The differences in dry matter intake were significant ($P < 0.05$) only at the 80 g liter level of treatment application (Treatment D) and were attributed to a reduction in palatability as the level of reduction in feed intake increased with an increase in the concentration of sunflower leaf extracts in the diets. Palatability in the livestock is a function of diet and post ingestive feedback (Burrit and Provenza, 2000). Plant extracts contain astringent phenolics compounds (Hassanpour *et al.,* 2011) that can elicit negative post ingestive feedback in ruminants (Rogosic *et al.,* 2008). Dry matter intake ($g/LW^{0.75}$ kg) range of 52.77 - 61.34 among the four dietary groups in the present study, was comparable to the values reported (Ifut, 1988) for West African Dwarf goats of similar sex, age and body size fed *Panicum maximum* hay, *Gliricidia sepium* and cassava peel ration. Effects of treatments on efficiency of feed conversion to body weight by the goats were significant ($P < 0.05$) with the goats receiving the highest concentration of sunflower leaf extracts (Treatment D) being less efficient that the other three treatment groups. The difference was attributed to a lower dry matter digestibility obtained for goats in the treatment group D (Table 1). Goats on Treatment B or C having lower feed: gain value utilized the high fiber, low protein concentrate diet for body weight gain more efficiently than those on treatment D or the control other treatment groups. Relatively high dry matter digestibility and efficient ($P < 0.05$) feed: gain ratio obtained for goats fed diet B or C were attributed to an improvement in rumen microbial profiles of the goats. A number of plant extracts were observed (Hoffmann *et al.,* 2003; Soliva *et al.,* 2005) to impact on rumen protozoa population and enhance feed digestibility. Although, no detailed study of rumen microbial composition was carried out in the present study, Ivan *et al.* (2003) had reported on the efficacy of sunflower seed supplement in reducing protozoa population in the rumen of sheep. The effects of sunflower leaf extracts on coefficients of digestibility of crude protein, crude fiber and ether extracts were significant ($P < 0.05$) with the goats on Treatment C showing higher values than the control group. Similar positive effects of leaf extracts on crude protein and crude fiber digestibility have been observed

(Mirzaei *et al.*, 2012) in sheep fed concentrate diet containing herbal plants mixtures.

Table 1. Influence of Dietary Crude Sunflower Leaf Extracts on Growth Performance Characteristics of the Goats

Item/Treatment	A	B	C	D	± SEM
Dry matter Intake, Digestibility and Body weight gain					
Initial Live weight, Kg	11.5	11.2	10.4	10.9	1.56
Final Live weight, Kg	13.6	13.3	12.8	12.2	2.18
Average Live Weight Gain, g/day	36.8^{b}	38.0^{ab}	42.78^{a}	24.56^{c}	3.62
Dry Matter Intake, g/day	378^{a}	374^{a}	371^{a}	318^{b}	9.31
Dry Matter Intake, g/Kg $BW^{0.75}$/day	59.1^{ab}	59.5^{ab}	61.34^{a}	52.77^{b}	5.14
Feed Conversion Ratio (Feed: Gain)	10.3^{ab}	9.8^{b}	8.69^{b}	12.98^{a}	1.67
Dry Matter Digestibility, %	67.2^{a}	69.7^{a}	68.96^{a}	60.11^{b}	3.52
Nutrients Intake & Digestibility					
Crude Protein					
Intake, g/Kg LW/day	6.83	6.89	7.09	6.10	1.41
Digestibility, %	70.8^{b}	72.4^{b}	76.4^{a}	67.1^{c}	3.85
Crude Fiber					
Intake, g/Kg LW/day	7.28	7.34	7.56	6.50	1.26
Digestibility, %	65.9^{b}	68.9^{a}	68.9^{a}	67.5^{a}	2.31
Ether Extracts					
Intake, g/Kg LW/day	1.52	1.54	1.58	1.36	0.15
Digestibility, %	62.7^{b}	64.6^{a}	65.3^{a}	63.8^{b}	1.46

^{abc} *Means in the same row without common letter are different at P<0.05*

Data on nitrogen balance (Table 2) indicated an improvement in the efficiency of nitrogen utilization that can be attributed to dietary crude sunflower leaf extracts treatments. Intake of dietary nitrogen (g/day) was 6.98, 6.92, 6.87 and 5.88 for goat fed diets A, B, C, and D respectively. Goats that received sunflower leaf extracts treatments excreted more ($P < 0.05$) nitrogen via the urine than the control group. Mbatha (2001) had however, reported a reduced urinary nitrogen excretion in goats fed exogenous tannins. Sunflower leaf contains condensed tannins and some other secondary plant metabolites (Fasuyi *et al.*, 2010).

Table 2. Influence of Dietary Crude Sunflower Leaf Extracts on Nitrogen Metabolism in the Goats

Parameters/Treatment	A	B	C	D	± SEM
Nitrogen Intake, g/day	6.98^{a}	6.92^{a}	6.87^{a}	5.88^{b}	1.22
Faecal Nitrogen Output, g/day	2.72^{a}	2.17^{a}	2.04^{a}	1.52^{b}	1.86
Urinary Nitrogen Output, g/day	2.78^{b}	3.23^{a}	3.19^{a}	3.31^{a}	1.05
Nitrogen Digestibility, %	61.0^{b}	68.6^{a}	70.3^{a}	68.2^{a}	2.34
Nitrogen Retention, g/day	1.48a	1.52^{a}	1.64^{a}	1.05^{b}	1.19
Retained Nitrogen as % of Nitrogen Intake	21.2^{a}	22.0^{a}	23.9^{a}	17.9^{b}	1.16

^{ab} *Means in the same row without common letter are different at P<0.05*

Nitrogen retention (g/head/day) was higher for goats on Treatment B (1.52) or Treatment C (1.64) than for those on Treatment D (1.05) but similar ($p > 0.05$) to the value (1.48) obtained for the control group. Nitrogen retention as an index of protein nutrition status in ruminants reflects differences in dietary nitrogen intake (Ajayi *et al.*, 2005) and crude protein digestibility (Willms *et al*., 1991).

Conclusion

Treatment of cassava peeling wastes-based diet with crude aqueous extracts of sunflower leaf at regulatory levels used in Treatments B and C caused significant improvement in nutrient digestibility, nitrogen retention and body weight gain by the West African Dwarf goats. The improvement was attributed to the positive influence of bioactive substances in the sunflower leaf extracts on the rumen microbial environment. A study of the rumen of goats in response to the treatments would be required to further elucidate the cause of the improvement.

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