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Research Article

Nutrients Intake and Digestibility of Wild Cocoyam (Caladium Bicolor) based Diets by West African Dwarf Bucks

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Abstract

Feed consumed by animal is subject to natural processes in the animal system before it could be useful to the animal. And it is after digestion that the imbedded nutrients can be available for use by animal for various purposes. Non-conventional foodstuff could be fed to animal, but the challenge accompanying it is its digestion for the inherent nutrients to be utilized by animal. A research was conducted to evaluate the nutrient intake and digestibility by West African Dwarf (WAD) bucks fed graded level of boiled Caladium bicolor. Four matured WAD bucks were confined individually in metabolism cages and offered the diets (A-D) in a 4x4 latin square design experiment. The diets were formulated using Boiled Caladium Bicolor (BCB), cassava peels, brewer dried grain, palm kernel cake, bone meal and common salt. The percentage inclusion level of BCB in the four diets were 0%(A), 10%(B), 20%(C), and 30%(D) respectively with diet A being the control. Each animal received each of the diet for 28 days in each of the 4 phases. Urine and faecal samples were taken and analyzed for nitrogen and proximate composition. Dry Matter Intake (DMI) obtained decreased significantly (P<0-05) with increase inclusive level of boiled Caladium bicolor (54.91 - 47.01) for treatment A-D respectively. Crude protein intake, N-intake, N-absorbed, N-balance, and apparent N-digestibility followed similar trend. There were significant differences (P<0.05) between the treatment groups in all the parameters. All the animals were in positive N-balance indicating that their maintenance requirements were satisfied by all the diets. The decrease in value of N-intake, N-absorbed, N-balance and apparent N-digestibility as the value of BCB increases could be due to traces of anti-nutrients (trypsin, Hydrogen cyanid, Sapronin) in the diet. However, 10% inclusion level of boiled Caladium bicolor was best utilized by the animal, therefore could be recommended as the optimal inclusion level in WAD goat diet.

Keywords: Caladium bicolor; West African dwarf goat; digestibility; non-conventional

Introduction

The adverse weather condition in the tropics affect both quality and quantity of forage materials particularly in the dry season, resulting in scarcity and high cost of conventional feedstuffs Ahamefule [1]. Udo [2] ascertained that severe and acute scarcity of forage materials for animal render big challenge to livestock sector of the economy. As a result, production and reproduction of animal and WAD goats in particular drop drastically during this period. WAD goats serve an important role in the agriculture of rural and urban economy of West Africa as it provides meat, milk and fertilizer to the masses. This breed of livestock is classified as small ruminant due to their body size Lebbie [3]. He further term them as efficient feed converters as they can convert low quality feed into meat and milk irrespective of the environment where they are raised. Goats have not yet performed optimally due to forage scarcity during the dry season, and this leads to low reproduction and productivity Udo [4]; Sam [5]. According to Udo [4], it is important to supply adequate feed in quantity and quality for optimal goats. Nutritionist have involved in great investigation on non-conventional feed resources that does not have direct feeding value to man Aderolu [6]. The ingredient in view should be less expensive when compared to conventional feedstuffs like groundnut and soya bean cake meal

Udo [2]. Wild cocoyam (Caladium bicolor) is a tuberous root stock which can be fed to livestock as a source of energy. It is a non-human edible plant that grows along riverbanks, lakes, streams and shady areas Amadi [7]. It has prominent non-hardy corm, broader leaves that suppress other weeds under and around it. Amadi [7] describe it as perennial ornamental as well as an additive polymer. Other purposes known of Caladium bicolor are the cooked leaves and bulb can be eaten as vegetable in the tropical America, the aqueous extract has been shown to possess anti-diarrhea effect Onu [8]. The leaves and rhizomes are used topically for boils, wounds and ulcers Odugbemi [9] as well as purgatives and management of convulsions Onu [8]. Caladium bicolor appeared as a potential feed ingredient because of its availability, of U.S.A. alone (particularly in Florida) can produce as much as 50 to 70 million tubers yearly Deng [10] with a proximate composition of 89.25-89.82 DM, 7.58-8.28 CP, 76.52-78.37 NFE, 1.92-2.12 CF, and 2.83-2.85 GE Udo [2]. However, there is dearth of information on the utilization of Caladium bicolor as an ingredient in livestock feed. Thus this investigation to assay the best inclusion level of boiled Caladium bicolor in WAD goat diet.

Materials and Methods

Experimental Site

This research work was carried out at the Goat Unit of the Teaching and Research Farm, Akwa Ibom State University, Obio Akpa Campus, Akwa Ibom State, Nigeria. Obio Akpa is located in the rain forest zone lying between latitudes $5^{0}17^{1}$N and $5^{0}27^{1}$N, between longitude 7^{0} 27^{1} N and $7^{5}08^{1}$ E with an annual rain fall ranging from 3500mm-5000mm. the relative humility is between 60-90% with a monthly average temperature of 25^{0}C [11].

Animal Management

Four matured West African Dwarf bucks with average body weight of 18 kg were used for the experiment. The bucks were quarantined for fourteen days and dewormed of internal and external parasites using Ferbendazole and Pfizona respectively. Before the commencement of this research, the 4 WAD goats were raised under zero grazing and fed with the four formulated diets for acclimatization.

Experimental Diet

Table 1: Constituents of Experimental Diet.

Ingredients (kg)	A(0%BCBM)	B(10%BCBM)	C(20%BCBM)	D(30%BCBM)
Caladium bicolor	0.00	10.00	20.00	30.00
Palm kernel cake	17.00	17.00	17.00	17.00
Cassava peel	40.00	40.00	40.00	40.00
Brewer dried grain	40.50	30.50	20.50	10.50
Bone meal	2.00	2.00	2.00	2.00
Salt	0.50	0.50	0.50	0.50
Total	100	100	100	100

BCBM= Boiled Caladium bicolor meal

Four diets were formulated to contain 0%, 10%, 20% and 30% Boiled Caladium Bicolor Meal (BCBM) with other ingredients as shown in Table 1.

Processing of Caladium bicolor

Some quantities of wild cocoyam were washed and introduced into cooking pot with boiling water that has reached 100^{0}C and allowed to boil for 30 minutes, before descanted. The product was thereafter peeled and sliced into small pieces (for quick drying) and sun dried for 7 days, milled to have boiled Caladium bicolor meal. The processing was done in batches.

Experimental Design

The four WAD bucks were transferred into an individual metabolism cages that has provision for urine and faeces collection. The experimental diets were given in a 4x4 Latin square design in 4 phases. Each phase lasted for 28 days of which each animal received 1 kg of one of the formulated diets with clean drinking water throughout the research period. Daily feed intake was also determined for each buck. The last 7 days of the trial (22-28) was used to collect the total faeces and urine voided by animals in phase 1. In phases 2-4, each buck received each of the remaining 3 diets in rotational period of 28 days each. The last 7 days in each phase was used to collect faeces and urine as in phase 1. samples of diets fed were analyzed for proximate composition following AOAC [12] procedure. Leftovers of diets were recorded and used to determine voluntary feed intake. Faeces voided were collected in the morning before feeding and watering in the last 7 days (22-28), in each of the period. The total faeces voided were weighed fresh, dried and bulked for each animal. A sub-sample from each animal was dried in a forced-draft oven at 100-105^{0}C for 48 hours and used for Dry Matter (DM) determination. Another sample was dried at 60^{0}C for 72 hours for proximate composition determination. Total urine for each buck was collected daily in the morning before watering and feeding. The urine was trapped in a graduated transparent plastic container placed under each cage of which 1.5ml of 25% concen-

trated sulphuric acid was added, to minimize the volatilization of ammonia from the urine Ahamefule [13]. The total output of urine per buck was recorded and about 10% of the daily outputs were saved in numbered plastic bottles and stored in a deep freezer at -5^{0}C. Samples were collated for each animal, bulked and sub-samples taken at the end of every 7 days collecting period.

Analytical Procedure

All feed and faecal samples were analyzed for proximate composition using AOAC [13] method while nitrogen in urine samples was analyzed by AOAC [13] methods. The data obtained were subjected to analysis of variance (ANOVA) applicable for 4x4 Latin square design using SPSS 15.0 [14] statistical package. Significant means were separated using Duncan's Multiple Range Test Duncan [15].

Results and Discussion

Proximate composition of the diets

The constituents of the experimental diets are shown in Table 2. Nutrient composition of the formulated diets containing 0-30% inclusion level of boiled wild cocoyam (Caladium bicolor) showed comparable Dry Matter (DM) values of 89.81, 89.85, 90.07 and 90.11 for treatment A, B, C and D respectively. The Crude Protein (CP) value ranged of 9.24-12.39 indicates a CP level that can be utilized by WAD goat. However, CP values decreases as the inclusion level of Boiled Caladium Bicolor Meal (BCBM) increase. Crude Fiber (CF) (13.32, 12.29, 10.41 and 8.67), ether extract (5.87, 5.33, 4.77 and 4.43), ash (5.81, 5.45, 5.39 and5.09) and gross energy (4.01, 4.00, 4.44 and 4.00) followed the same trend in their values as that of the CP (increasing as BCBM inclusion increases) for treatment A, B, C and D respectively. The value of nitrogen free extract obtained in this study: 52.41, 55.26, 59.31 and 62.68 for treatments A, B, C and D increases as the inclusion level of BCBM increases; indicating that BCBM is a good source of energy.

Dry Matter Intake and Nutrient Digestibility

Table 3 presents digestibility, dry matter, and nutrient intake by WAD bucks. The feed intake (g/d), DMI (g/d) and DMI (Wkg$^{0.75}$) showed the same pattern of significant (P>0.05) differences among the treatment groups, with treatment A and B being statistically similar (P>0.05) but both differed significantly (P>0.05) from treatment C and D that were also similar in values statistically (P>0.05). The DMI (g/d) values recorded for treatment A, B, C and D were 549.10, 543.80, 479.40 and 470.10 respectively. The values for DMI (Wkg$^{0.75}$) were 113.42, 112.61, 102.45 and 100.96 for treatment A, B, C and D respectively. Dry matter intake as percent body weights were 3.18, 2.98, 2.28 and 2.47 treatments A, B, C and D respectively. The DMI as % BW in treatments B, C and D (2.98, 2.28 and 2.47) indicates that goats on the three inclusion levels of BCBM showed positive DM status by consuming almost the recommended 3% DM of their body weight for meat type goat in the tropics Ahamefule [16]; Devendra [17]. Nitrogen intake (g/d), nitrogen absorbed (g/d) nitrogen balanced (g/d) and apparent nitrogen digestibility (%) differed significantly (P0.05) among the treatment groups. This suggests that animals in each group utilize their diet efficiently, though in a definite trend. The pattern of significant (P>0.05) differences observed in these parameters were in consonance with the result reported by Ahamefule [1] on their feeding of pigeon pea-based diets to WAD goats.

Table 2: Proximate Constituents of Boiled Caladium bibolor diets.

Parameters (%)	A(0%BCBM)	B(10%BCBM)	C(20%BCBM)	D(30%BCBM)
Dry Matter	89.81	89.85	90.07	90.11
Crude Protein	12.39	11.52	10.19	9.24
Crude Fiber	13.32	12.39	10.41	8.67
Ether extract	5.87	5.33	4.77	4.43
Ash	5.81	5.45	5.39	5.09
Nitrogen free extract	52.41	55.26	59.31	62.68
DE (Kcal/g)	4/01	4.01	4	4

NFE = Nitrogen free extract, GE = Gross energy.

Table 3: Nutrient Intake and Digestibility of Caladium bicolor by West African Dwarf Buck.

Parameters (%)	A(0%BCBM)	B(10%BCBM)	C(20%BCBM)	D(30%BCBM)	SEM
Final body weight (kg)	17.25c	18.25bc	21.00^a	19.00^b	0.56
Body weight (Wkg$^{0.75}$)	8.46^c	8.83b^c	9.81^a	9.10^b	0.21
Feed intake (g/d)	611.40^a	605.23^a	532.25^b	521.70^b	10.94
DMI (g/d)	549.10^a	543.80^a	479. 40^b	470.10^b	9.49

DMI (g/d/Wkg$^{0.75}$)	113.42^{a}	112.61^{a}	102. 45^{b}	100.96^{b}	1.28
DMI as % BW	3.18^{a}	2.98^{b}	2.28^{d}	2.47^{c}	0.09
CP intake (g/d)	75.75^{a}	69.72b	54.24^{c}	48.21^{d}	2.9
N-intake (g/d)	12. 12^{a}	11.16^{b}	8.68^{c}	7.71^{d}	0.46
N-faeces (g/d)	2.62^{c}	2.88^{b}	2.99^{b}	3.15^{a}	0.06
N-urine (g/d)	0.51^{c}	0.51^{c}	0.55^{b}	0.58^{a}	0.01
N-absorbed (g/d)	9.50^{a}	8.28^{b}	5.69^{c}	4.56^{d}	0.51
N-balance (g/d)	8.99^{a}	7.77^{b}	5.14^{c}	3.98^{d}	0.52
N-balance (g/d/Wkg$^{0.75}$)	5.19^{a}	4.65^{b}	3.41^{c}	2.81^{d}	0.2
App.N-digestibility (%)	78.33a	74.19^{b}	65.55^{c}	59.14^{d}	1.93

BCBM = Boiled Caladium bicolor meal

The low nitrogen in urine and faeces indicated that rumen microorganisms efficiently utilize the CP in all the treatment diets of boiled Caladium bicolor meal. The values for CP intake (g/d) were 75.75, 69.72, 54.24 and 48.21 for treatment A, B, C and D respectively; while nitrogen intake (g/d) values were 12.12, 11.16, 8.68 and 7.71 for diets A, B, C and D respectively. The two parameters showed significant (P>0.05) differences across the four treatment groups. Treatment A differed significantly (P>0.05) from B, C and D in CP intake and nitrogen intake. Diet C (20% BCBM) differed significantly (P>.0.05) when compared with diets A, B and D in CP intake and nitrogen intake. The low DM intake by WAD bucks obtained in this study agrees with the findings of Swanson [18], who reported low DM intake when ruminants were supplemented with protein concentrate; Ahamefule [13] who fed goats with pigeon pea seed based diets and Anya [19], who fed goats with African yambean-cassava peel meal based diets respectively. However, this study reveals that 10% boiled Caladium bicolor enhances best feed intake, dry matter intake, dry matter intake $^{0.75}$, dry matter intake as % BW, crude protein intake, N-absorbed, N-balanced and apparent N-digestibility; is therefore recommended as the optimal inclusion level in West African dwarf goat diet. Based on the energy content in boiled Caladium bicolor, could be used mostly as an energy source in animal feed formulation.

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