NUTRIENT INTAKE OF WEST AFRICAN DWARF (WAD) SHEEP FED BOILED COCOA SEED TESTA AND SORGHUM MALT DUST-BASED DIETS

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Abstract
The study investigated the nutrient intake of sheep fed boiled Cocoa Seed Testa (CST) and Sorghum Malt Dust (SMD)-based diet. The feeding trial was conducted on the feed intake response of West African Dwarf (WAD) sheep in a completely randomized experimental design using boiled CST and SMD-based diet. A total of twenty-eight animals were used for the trial. The trial had seven treatment groups with four replicates. The seven dietary treatment used in the trial comprises CST at 10, 20 and 30% levels, SMD at 10, 20, 30% levels and control. The experiment lasted ninety days. Data generated were computed and subjected to a one-way Analysis of Variance. In the trial, the Dry Matter (DM), Crude Protein (CP), Ash, Ether Extract (EE), and Nitrogen Free Extract (NFE) intakes from forage were significantly ($p<0.05$) higher in diet 5 (20% SMD inclusion) than in all other diets. Also, the DM, Ash and NFE intake from concentrate were significantly ($P<0.05$) higher in diet five than 4 (10% SMD inclusion) where there was no significant difference ($P<0.05$). DM intake from concentrate increased as the level of inclusion of CST increased in the diet but decreased in diet 3 (30% inclusion of CST). DM intake increased as the level of inclusion of CST and SMD increased but decreased as the level increased to 30%. The animals had adequate dry matter intakes (g/day) that range from 401.26 to 458.29 g/d, which amounted to 4.06 to 4.78%. Available nutrients in the diet containing boiled cocoa seed testa and sorghum malt dust were significantly better in their utilization by sheep that consume boiled sorghum malt dust-based diet.

Keywords: Agricultural waste, Nutrient-intake, ruminants, WAD sheep.

Introduction

Crop residues and agro-industrial by-products can play essential roles in the feeding of sheep and goats under different management systems. Such residues can supply a substantial part of the maintenance requirements of small ruminants (Bistanji *et al*. 2006). Small ruminants suffer from scarcity in feed supply and pasture quality in the humid region of West Africa, especially during the dry season when the natural vegetation is of poor nutritive value (Akinfala and Tewe, 2002: Aye, 2007). Small ruminants such as sheep are important in feeding the rapidly expanding population of the developing world under typical harsh environmental conditions, due to their low feed and urea supplement, short vegetation interval, faster growth rate and higher environmental adaptability compared to the large ruminant (Tibbo *et al*, 2006). In Nigeria, the main feed resources for livestock are natural pastures (Aye, 2002). In the tropics, sheep and goats are kept mainly for meat production with the supply of milk, skins, hair or wool as well as manure-a secondary by-product. Unlike pork which is abhorred for consumption by many people, there are little or no religious socio-cultural constraints to the consumption of chevon (goat meat) and mutton (sheep meat) in Nigeria. Goat and sheep, therefore, provide additional sources of animal protein. Practically, most tropical sheep maintain themselves by grazing unimproved pasture containing a wide variety of grasses and legumes. A sheep in familiar locality feeds selectively. Most tropical sheep grazing is characterized by periods of plenty alternating with times of scarcity in the following season, not only the scarcity of feed but it is lignified and not nutritious. It affects the weight of sheep because of the inability to consume the required and sufficient nutrient.

There are various factors which influence the nutritional requirements of sheep. Each of those factors are usually considered while formulating their diet. Some of these factors are temperature, genetic factor, age, sex, and purpose of production (Durojaiye, 1997). Ruminants respond to environmental temperature in the same way as monogastric animals, in that prolonged exposure to heat lowers feed intake and continued exposure to cold increases it (Campling and Lean, 1983). According to Koothman (1980), there are several factors affecting feed intake by farm animals; these include animal factors, plant factors, environmental factors and their interactions. He explained that animal attributes include the species, class, individually, experience, grazing and social behaviour. Forbes (1983) indicated that animals offered high-quality feed ad libitum will continue to gain weight faster than underfeed animals similar situation with no restriction. He further stated that the compensatory growth had been attributed to both an improved efficiency in the utilization of feed and an increased dry matter intake. Forbes (1983) also indicated that animals with similar age, breed and sex but differing in live weight owing to nutritional restriction, consume the same amount of feed. The lighter animals will increase in weight faster than the more massive animals because they have a lower maintenance requirement.

Poor nutrition leads to slow or retarded growth, poor performance, susceptibility to disease, absorption, lowered milk production, reduce fertility, loss of weight, e.t.c. Deficiency disease of the sheep and eventually death may result (Awujoola, 1999). The study was to determine the nutrient intake of WAD sheep fed boiled cocoa seed testa and sorghum malt dust based diet

Research Methods

Twenty-eight (28) West African Dwarf male sheep were used for the study. The sheep were sourced from villages around Ijebu-Ode. The average live weight ranged between 10.08 and 10.66kg. Also, their age ranged between 11 and 13 months. The animals were dewormed with Levamisol at the beginning of the study. They were divided into seven groups with similar average initial live weight in a completely randomized design. Each group contains four male animals while the trial lasted for ninety days. Experimental diets used were made up of Cocoa Seed Testa and Sorghum Malt Dust based diets as supplements to *Gliricidia sepium*. Seven experimental concentrate diets were prepared using the cocoa seed testa at 10, 20 and 30% and sorghum malt dust at 10, 20, and 30% levels with cassava root meals at 58, 48, and 38%, wheat offal 30%, vitamin/mineral premix 1.0% and salt 1%. Control ration was also prepared (cassava root meal 68%, wheat offal 30%, vitamin/mineral premix 1.0% and salt 1%) as shown in Table 1.

Table 1: Composition of Experimental Diets Fed to West African Dwarf Sheep (%)

Ingredients	Diets						
	1	2	3	4	5	6	7
Cassava Root Meal	58	48	38	58	48	38	68
Boiled Cocoa Seed Testa	10	20	30	0	0	0	0
Boiled Sorghum Malt Dust	0	0	0	10	20	30	0
Wheat Offal	30	30	30	30	30	30	30
Premix *	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Salt	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Determined analysis of experimental diets (%)							
Dry matter	89.59	89.48	89.66	89.91	89.78	89.55	89.63
Crude protein	15.18	14.37	14.28	14.57	14.89	14.76	12.06
Crude fibre	15.38	15.41	15.58	14.71	14.93	14.99	15.16

*Premix (each kg contains): Vitamin A: 10,000IU; Vitamin E: 70,000IU; Vitamin D: 1, 600, 000IU; Fe: 50g; Zn: 40g; Mn: 40g; Co: 0.1g; Cu: 10g; Se: 0.1g

The nutrient intake (concentrate and forage) values were subjected to a one-way analysis of variance using SPSS (1999). Differences between treatment means were separated using Duncan's Multiple Range Test (Duncan, 1955).

Results

The chemical composition of diets (Table 2) shows higher dry matter for diets, 4, 5, and 6 prepared with boiled Sorghum Malt Dust) than diets 1, 2, and 3 (Diets prepared with boiled Cocoa Seed Testa) and 7 (Control diet). Diet 1 had higher crude protein (15.18%), though, 4, 5, and 6 still exhibit higher crude protein levels than diets 2, 3, and 7. Diets 1, 2, 3, and 7 exhibited higher fibre levels when compared with diets 4, 5, and 6. All the diets were almost at the same level for Ether extract, Ash and Nitrogen free extractives.

Table 3 shows nutrients intake of WAD sheep fed graded levels of boiled Cocoa Seed Testa and sorghum malt dust based diets. The DM, CP, Ash, EE and NFE intakes from forage were significantly (P<0.05) higher in diet 5 (20% SMD inclusion). Also, the DM, Ash and NFE intakes from concentrate were significantly (p<0.005) higher in diet five than diet 4 (10% SMD inclusion) where there was no significant difference (p>0.05) but numerically different from that of diet 5.

However, the DM intake from concentrate increased as the level of inclusion of CST increased in the diets but decreased in diet 3 (30% inclusion of CST). Also, the DM intake from concentrate increased as the level of inclusion of SMD increased in the diets but deceased in diet 6 (30% of inclusion of SMD) like that of inclusion of CST in diets. The DM intakes from concentrate ranged from 310.89 to 362.76g/d.

DM intakes from forage followed the same pattern as that of concentrate. It increases as the level of inclusion of CST and SMD in the diets increased but decreased by 30% levels of inclusion of both CST and SMD. The total DM intake ranged from 409.36 to 458.29g/d and significantly increased (p<0.05) as the level of inclusion of CST and SMD increased in the diets but declined at 30% levels of inclusion of both CST and SMD in the diets. There was also a decline in the total DM intake of animals on control diets. The total CP intake shows some variation and ranged from 99.57 to 121.37g/d. The total CP intakes were significantly (p<0.05) different from each other for both CST and SMD based bidets except diets 2 and 4 (20% inclusion of CST and SMD in the diets).

Table 2: Chemical Composition of *Gliricidia sepium*

Parameters	*Gliricidia sepium*
Dry matter	30.12
Crude protein	19.30
Crude fibre	12.80
Ash	10.12
Ether extract	2.16
Nitrogen free extract	55.62
Gross energy (kcal/g)	4.61

*Average of 2 replicates

Table 3: Chemical composition of boiled cocoa Seed Testa and Sorghum Malt Dust based-diets g/100gDM)

Parameters	Diets						
	1	2	3	4	5	6	7
Dry matter	89.59	89.48	89.66	89.71	89.78	89.55	89.63
Crude protein	15.18	14.37	14.28	14.57	14.89	14.76	12.06
Crude fibre	15.38	15.41	15.58	14.71	14.92	14.99	15.16
Ether extract	2.55	2.59	2.64	2.66	2.58	2.61	2.53
Ash	11.16	10.68	10.76	10.96	10.91	10.46	11.13
Nitrogen Free Extract	45.32	46.43	46.40	46.81	46.48	46.78	48.75

Discussion

The crude protein of the basal diet (*Gliricidia sepium*) was 19.30% and fell within the range of 10 to 37% for protein contents reported for some browse plants by Mecha and Adegbola (1980), but lower than the protein contents reported (22 – 23%) by Aye and Adegun (2013) Ifut (1987) also reported a range of 9.2 to 34.0% for *Gliricidia sepium.* The reported value in this study may be affected by some factors such as time of harvesting and nutrient composition of soil in which it was planted (Odeyinka and Ademosun, 1995). DM intake increased as the levels of inclusions of cocoa seed testa (CST) and sorghum malt dust (SMD) increased but decreased as the level increased to 30%. The animals had adequate dry matter intake (g/day) that ranged from 401.26 to 458.29g/d which amounted to 4.06 to 4.78% (NRC, 2007) of their body weight.

DMI intake obtained in this study was contrary to the result of Bawala *et al*. (2008) who obtained reduced dry matter intake as the levels of CST and SMD increases in the diet. Processing allows for a more convenient supply of nutrients and palatability (Rupp, 2003). In addition, ruminants respond to environmental temperature in the same way as monogastric because prolonged exposure to heat lowers feed intake (Campling and Lean, 1983), this may account for higher dry matter intake by experimental sheep because the animals were not exposed to unnecessary heat. (ONDRI, 1988). It has been shown that protein intake is a significant determinant of ruminant performance due to increased availability of fermentable nitrogen and other nutrients required by rumen bacteria, as well as the more significant opportunities for some of the protein to escape rumen fermentation. In this experiment, the highest DM intake was obtained at 20% inclusion of SMD. The total DM intakes 401.26 to 458.29g/d obtained in this study were lower than the values of 450.72 to 530.81g/d obtained by Bawala *et al*. (2008).

The metabolic DM intakes value obtained in this study, 89.65 to 97.55g/Dw$^{0.75}$ were higher than the values of 66.32 to 77.02g/dW$^{0.75}$ obtained by Oduguwa et al. (2007). It may be as a result of the feed components about palatability, and preferential intake of plants are relatively being influenced by an array of choice of variables such as the animal itself, stage of growth and the chemical make-up of feed (Malachek and Provenza,1981)

The CP intake values were in the range of CP requirements for sheep in the tropics (NRC, 2007). The protein requirement for growing sheep, as recommended by ONDRI (1988) is between 12 and 13%. The crude protein content of the feedstuff as determined was adequate to meet the requirement of the animals since it is still within the standard recommendation.

Conclusion

Nutrient available in the diet contained Boiled Cocoa Seed Testa, and Sorghum Malt Dust was significantly better in their utilization by sheep that can consume Boiled Sorghum Malt Dust-based Diet. The inclusion of CST in sheep ration will; serve as a means of disposing of the huge amount of these waste, a reduction in environmental pollution, decrease feed cost and increase the supply of available nitrogen and other essential nutrients.

Table 4: Nutrient intake of WAD sheep fed graded levels of boiled Cocoa Seed Testa and Sorghum Malt Dust based diets

Parameter	Diet1	Diet2	Diet3	Diet4	Diet5	Diet6	Diet7	SEM
DM intake from concentrate	310.89^{a}	338.64^{b}	329.53^{c}	357.34^{a}	362.76^{a}	330.62^{c}	321.46^{d}	6.25^{e}
DM intake from forage	90.37^{d}	93.51^{b}	88.58^{e}	91.74^{c}	95.53^{a}	93.14^{b}	87.90^{f}	1.02
Total DM intake	401.26^{g}	432.15^{c}	418.11^{e}	449.08^{b}	458.29^{a}	423.76^{d}	409.36^{f}	5.10
Metabolic DM intake ^{b}	89.65^{d}	94.78^{b}	92.46^{c}	97.55^{a}	99.05^{a}	93.39^{bc}	91.00^{cd}	2.05
CP intake from concentrate	52.76^{d}	54.38^{c}	52.48^{d}	58.03^{b}	60.16^{a}	54.49^{c}	43.25^{e}	0.78
CP intake from forage	57.90^{b}	59.91^{a}	56.75^{c}	58.78^{b}	60.12^{a}	59.68^{ab}	56.32^{c}	0.95
Total CP intake	110.66^{d}	114.29^{c}	109.23^{e}	116.81^{b}	121.37^{a}	114.17^{c}	99.57^{f}	1.18
Metabolic CP intake	34.11^{e}	43.95^{a}	33.78^{f}	35.53^{c}	36.56^{b}	34.92^{d}	31.52^{g}	0.08
Ash intake from concentrate	38.72^{d}	40.41^{b}	39.54^{c}	43.65^{a}	44.08^{a}	38.61^{d}	39.91^{c}	0.80
Ash intake from forage	30.36^{b}	31.41^{a}	29.76^{c}	30.82^{b}	32.09^{a}	31.29^{a}	29.53^{c}	0.92
Total ash intake	69.08^{e}	71.82^{c}	69.30^{e}	74.47^{b}	76.17^{a}	69.90^{d}	64.44^{f}	0.50
Metabolic ash intake ^{b}	23.96^{e}	24.67^{c}	24.01^{e}	25.35^{b}	25.78^{a}	24.17^{d}	22.74^{f}	0.30
EE intake from concentrate	8.84^{f}	9.80^{c}	9.70^{c}	10.59^{a}	10.42^{b}	9.36^{d}	9.07^{e}	0.10
EE intake from forage	6.48^{e}	6.70^{b}	6.35^{f}	6.57^{d}	6.85^{a}	6.67^{c}	6.30^{g}	0.02
Total EE intake	15.32^{b}	16.50^{a}	16.05^{b}	17.16^{a}	17.27^{a}	16.03^{b}	15.37^{b}	0.79
Metabolic EE intake ^{b}	7.74^{b}	8.18^{ab}	8.01^{ab}	8.43^{a}	8.47^{a}	8.01^{ab}	7.76^{b}	0.68
NFE intake from concentrate	157.26^{e}	175.71^{b}	170.53^{d}	186.45^{a}	187.80^{a}	172.71^{c}	174.84^{b}	1.95
NFE intake from forage	166.87^{d}	172.67^{b}	163.57^{e}	169.40^{c}	176.40^{a}	171.93^{b}	162.32^{f}	1.01
Total NFE intake	324.13^{f}	348.38^{b}	334.10^{e}	349.85^{b}	362.20^{a}	344.64^{c}	337.21^{d}	3.18
Metabolic NFE intake	76.39^{f}	80.63^{c}	76.14^{f}	80.89^{b}	83.02^{a}	79.98^{d}	78.69^{e}	0.05

b=g.dw$^{0.75}$, others= gd^{-1} SEM = Standard Error of Means

^{abcdefg} means along the same row with different superscripts are significantly different (P<0.05)

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