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Performance and serum biochemical parameters of West African dwarf (WAD) goats fed unripe plantain peels as replacement for maize

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Target Audience: Small Ruminant Farmers, researchers, students and animal feed companies

Abstract

In a sixteen-week trial, the performance and serum biochemical parameters of West African Dwarf (WAD) goats (5-7 months old) fed unripe plantain peels (UPP) as a replacement for maize were evaluated. The animals were randomly allotted to five treatments in a completely randomized design. Five concentrate diets were compounded with the inclusion of UPP at 0, 25, 50, 75 and 100% levels respectively. The diets were fed to the animals at 3% of their body weights. The results showed that proximate and fibre fractions of the concentrate diets increased with increase in the inclusion of UPP. The daily gain of 0%UPP was significantly higher ($p<0.05$) compared to other diets. The crude protein and crude fibre digestibility of animals fed diets 25%, 50%, 75% and 100%UPP were significantly higher ($P<0.05$) than 0%UPP.The total cholesterol (mg/dl) levels of the animals fed diets 25% up to 100%UPPwere significant lower ($p<0.05$) than 0%UPP diet. It could be concluded that UPP as substitute for maize improved performances and had no deleterious effect on serum biochemical parameters of WAD goats.

Key words: unripe plantain peels, performance, serum, biochemical

Description of Problem

Goats are considered superior to other ruminant species in their utilization of poor quality and high fibre feeds (1). They are mostly kept for meat, milk and skin production. Other purposes of keeping goats include household income, festival celebrations and special occasions (2). Health constraints, management as well as, shortage in feed quality and quantity are the factors contributing low productivity of goats in developing countries (3). However, dry season results in a rapid decline in the quantity and quality of forages leading to low forage intake and digestibility with resultant poor animal performances. (4) observed that poor quality roughages fed to ruminants without supplementation during the dry season caused considerable weight losses. Therefore this has necessitated the search for cheap alternative feed materials that are not in high demand by humans (5). Plantain peel an agro-industrial by product contains high fibre content, capable of lowering cholesterol and help relieve constipation, its high potassium content is found to be useful in the prevention or treatment of high blood pressure and muscle cramp (6). Its nutritive value is estimated to be similar to that of cassava peels or citrus peels (7) but limited information about its utilization as dry season supplement for goats is available. Thus this study evaluates utilization of unripe plantain peels as replacement for maize in the diets of WAD Goats.

Materials and Method

The experiment was conducted at the Sheep and Goat Unit, Obafemi Awolowo University Teaching and Research Farm, Ile - Ife. A total of twenty five growing WAD goats of both sexes aged 5 to 7 months were used for the experiment. The animals were quarantined, treated with Oxycare® antibiotic injection for 3 days, dewormed with Levamizole® and ivomec® injection. The animals were randomly assigned into five dietary treatments in a completely randomized design. After collection, the unripe plantain peels (UPP) were chopped, sundried for about 3-5 days on concrete floor, milled and packed into polythene bags. Five concentrates diets were compounded with unripe plantain peels (UPP) replacing maize at 0, 25, 50, 75 and 100 % inclusion levels. The diets were fed as supplements to a basal ration at 3% of the animal body weight. Fresh drinking water was provided *ad libitum.* During digestion trial three goats were randomly selected per treatment and moved into metabolism cages with facilities for separate collection of faeces and urine. Ten percent of faecal samples were taken per day and dried in the oven at 70^{o}C for 24 hours. The daily stored samples of faeces for each animal were bulked, thoroughly mixed, ground and sub-sampled for chemical analysis. The volume of urine by each animal produced was measured daily. The daily urine was taken and volatilization of nitrogen from urine was prevented by adding 0.1N of HCl into urine collected and stored in a deep freezer for nitrogen analysis. Blood samples were collected from three animals per treatment via jugular vein of the animals on last week of the feeding trial. The blood sample (5ml) was obtained from each animal into a 10ml test tube after which it was allowed to clot. After clotting, it was then centrifuged at 3500 rev/min in the laboratory using Gallenkamp laboratory centrifuge in order to obtain the serum. The centrifugation was carried out according to (8) procedure. The separated sera was decanted into bijoh bottles and stored at -10^{0}C temperature. The serum metabolites (glucose, total protein, total cholesterol, albumin, urea and creatinine) were determined according to (9). The readings were carried out using photo spectrometer in the laboratory. All feed and faecal samples collected were analysed for proximate components using the standard procedures of the (10) while Nitrogen in urine samples was also determined by procedures of (10). Data obtained for each parameter were subjected to a one way analysis of variance using the General Linear Model Procedures of (11) while differences between means were separated using the Duncan's Multiple Range Test of the same package.

Results and Discussion

The result obtained (Table 1) shows the proximate composition of the experimental concentrates fed to WAD goats. The dry matter, crude protein, crude fibre, ash, neutral detergent fibre, acid detergent fibre and acid detergent lignin content of the concentrate increased with increase in the inclusion of UPP while decreased in ether extract and nitrogen free extract values were observed as the inclusion of UPP increased. The increase in DM content as the level of inclusion of UPP increased in the experimental diets could probably be due to the fact that they were prepared from dried ingredients, which were characteristically high in dry matter (12). The CP content of the diets in this study is more than the 10% crude protein level recommended by (13) for minimum growth in ruminants.

The performance of the WAD goats fed experimental diets are shown in Table 3.There was no significant differences ($p>0.05$) in total feed intake and live weight gain of the animal. The daily weight gain of animals fed 0%, 25%,

50% and 75%UPP based diets were significantly higher ($p<0.05$) than 100%UPP. Report by (14) and (15) indicated that feed intake is an important factor in the utilization of feed by livestock. The result obtained for total average daily feed intake agreed with the report of (16) who observed that decreased intake of feeds by goats depend on palatability and fibre content of the diets. The daily weight gains recorded in this study were within the range of 19.8 to 77.00 g/day reported by (17) for dwarf goats. The marked variation in weight gain by WAD goats fed different level of inclusion of unripe plantain peels may be attributed to the various levels of gross energy in the diets (18). Similarly, the result of feed conversion ratio revealed that the WAD goats on 100%UPP utilized the diets for body weight gain poorly when compared with other dietary treatments. Moreover, the positive response between average daily weight gain and feed conversion ratio obtained from control diet up to 75%UPP could be probably used to further attest the superiority of goats on the treatment in terms of nutrient utilization for body weight gain over animals on 100%UPP.

Table 4 shows the nutrient digestibility of WAD goats fed experimental diets. The dry matter digestibility obtained from the 0% UPP was significantly ($p<0.05$) higher than mean values of obtained by feeding 25, 50, 75 and 100% UPP respectively. The crude protein and crude fibre digestibility coefficient of 100% UPP were significantly higher ($P<0.05$) than 0% UPP. There was significant difference ($p< 0.05$) in the digestibility coefficients of ether extract intake with animals on 0%UPP having the highest value while the animals on 100% UPP had the least value. The result obtained for nitrogen balance shows that animals on 100%UPP had the highest mean value while animals on 0% UPP had the least value. Nitrogen retention percentage was significantly higher ($p<0.05$) in animals placed on 100% UPP diet when compared with other dietary treatment. The high protein digestibility observed in 100% UPP based diet corroborate with the earlier observation of (19) who reported that an increase in the dietary protein intake level may cause changes in the process of rumen fermentation and allow more protein digestibility. The higher fibre digestibility observed in 100% UPP agreed with the findings of (20) who reported that the fibre fraction of food has the greatest influence on digestibility. Ether extract and ash digestibility appeared to decrease with increasing inclusion levels of plantain peels in the diets. This may due to the fact that it is generally recognized that increasing fiber intake depresses digestibility of other dietary components except fiber, which usually increases in digestibility (21). The result obtained for nitrogen intake may be attributed to the fact that the crude protein values of the diets were above the 10% crude protein level recommended by (13) for minimum growth in ruminant animals there by reduced the production of endogeneous nitrogen which is an additional factor increasing apparent nitrogen digestibility (22). The higher nitrogen loss in control diet corroborates with the findings of (23) which stated that when the requirement of nitrogen is met, additional dietary nitrogen increases nitrogen loss. The positive nitrogen balance observed in all animals fed the experimental diets suggested that nitrogen absorbed was well tolerated and utilized by the animals as observed by (24).

Table 5 shows the effects of feeding varying levels of unripe plantain peels on serum biochemical indices of WAD goats. The glucose (mg/dl) level of animals fed diets 0% and 25%UPP were significantly higher ($p<0.05$) than 50%, 75% and 100%UPP diets. Also, the total cholesterol (mg/dl) levels of the animals fed diets 25% up to 100%UPPwere significantly lower ($p<0.05$) than 0%UPP diet.

There was significant difference ($p<0.05$) in the total protein (g/dl) of animals with goats on 25%UPP having the highest mean value while the 0% had the least value. Animals fed 0%UPP had the highest urea content while animals on 100%UPP had the least mean value. The blood glucose level of animals on 0%UPP diet up to 75%UPP inclusion was within the range of 45 - 60 mg/dl reported by (25) for clinically healthy goats while low blood glucose level was observed in animals on 100%UPP. This corresponds with the findings of (26) who reported that concentration of blood glucose increased based on the characteristics of the diet's fed to the animals. It is important to note that serum protein values obtained in this study were within the range of 6.1 - 7.5 g/dl reported by (27) for clinically healthy dwarf goats. The serum albumin ranged from this study was similar to the range of 3.90 - 4.45 g/dl reported for WAD goats by (28) but higher than the range of 2.98 - 3.43 g/dl reported by (21) and (29) respectively. The total cholesterol levels decreased as the level of inclusion of unripe plantain peels increased in the experimental diets. This is partially in agreement with the research of (6) who reported that plantain peel contains a high fibre content and thus capable of lowering blood cholesterol. Serum urea range of 22.09 - 39.19 g/dl was in line with that of 20.70 - 30.04 g/dl and 37.9 g/dl reported by (21) and (29) respectively. Average lower serum urea concentration may be an indicator of better protein quality (30) while high level of serum has been attributed to excessive tissue protein catabolism associate with protein deficiency (31). The higher serum urea value observed in control diet when compared with 100% UPP based diet indicates poor dietary protein utilization. Treatment diets did not appear to influence ($P>0.05$) the creatinine level in the blood serum of goats, indicating that treatment diets have no effect on this variable. This explains the effectiveness of body mass function in goats (21).

Conclusions and Application

The results showed that:

1. Inclusion of UPP in the diet of WAD goat up to 75% as substitute for maize led to improved performances
2. UPP as substitute for maize had no deleterious effect on serum biochemical parameters of WAD goats.
3. UPP can be incorporated as substitute for maize in the diet of WAD goats to minimize cost of production especially in the dry season when forages are scarce and limiting in essential nutrients.

Table 1: Gross composition of the experimental diets

	Diets				
Ingredients (%)	0%UPP	25%UPP	50%UPP	75%UPP	100%UPP
Maize	40.00	30.00	20.00	10.00	-
Plantain Peels	-	10.00	20.00	30.00	40.00
Brewer's dried grain	30.00	30.00	30.00	30.00	30.00
Palm Kernel Cake	26.00	26.00	26.00	26.00	26.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Salt	0.50	0.50	0.50	0.50	0.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00
Calculated Analysis					
Crude protein (%)	14.08	14.28	14.48	14.68	14.88
Crude fibre (%)	9.92	11.32	12.72	14.12	15.52

Table 2: Chemical composition of unripe plantain peel (UPP) and experiment

Parameter (%)	UPP	0% UPP	25% UPP	50% UPP	75% UPP	100% UPP
Dry Matter	93.38	91.75	92.05	92.34	92.54	93.17
Crude protein	11.23	18.57	19.45	19.80	20.15	20.70
Crude fibre	9.01	5.58	7.36	7.99	8.13	8.47
Ether Extract	4.03	7.41	7.22	7.14	6.87	6.12
Ash	10.17	8.76	9.82	11.15	11.03	11.72
Nitrogen free Extract	58.94	51.43	48.20	46.26	46.36	46.17
Fibre Analysis	-					
Neutral detergent fibre	-	45.33	47.43	49.63	53.44	60.45
Acid detergent fibre	-	17.52	18.96	19.59	19.61	22.44
Acid detergent lignin	-	2.70	3.10	4.21	5.69	7.43
Hemicellulose	-	27.81	28.47	30.02	33.83	38.01
Cellulose	-	14.82	15.86	15.38	13.92	14.99

Table 3: Performance characteristics of WAD goats fed the experimental diets

Parameter	0%UPP	25%UPP	50%UPP	75%UPP	100%UPP	SEM (±)	PROB
ADFI(g/day)							
Concentrate	173.54	168.08	166.97	165.12	158.64	6.92	0.88
Panicum	140.16	139.60	139.21	139.09	137.78	7.29	0.89
Total ADFI (g/day)	313.70	307.68	306.18	304.21	296.41	14.21	0.89
AILW(kg)	7.10	7.06	7.10	7.10	7.16	0.25	0.89
AFLW(kg)	10.33	9.85	9.53	9.21	8.85	0.41	0.84
TWG(kg)	3.23^{a}	2.79^{ab}	2.43^{ab}	2.11^{ab}	1.69^{b}	0.22	0.02
ADG(g)	38.45^{a}	33.21^{ab}	28.93^{ab}	25.12^{ab}	20.12^{b}	2.60	0.02
FCR	9.09^{b}	10.27^{b}	11.20^{ab}	12.06^{ab}	16.73^{a}	0.86	0.03

ADFI; Average daily feed intake, AILW: Average initial live weight, AFLW: Average final live weight, TWG: Total weight gain, FCR: Feed conversion ratio

Table 4: Apparent digestibility of the experimental diets fed to WAD goats

Parameters %	0% UPP	25%UPP	50%UPP	75%UPP	100%UPP	SEM
Digestible dry matter	51.08^{a}	47.44^{b}	48.86^{b}	47.15^{b}	45.15^{c}	0.67
Digestible crude protein	61.04^{b}	65.46^{ab}	68.35^{a}	70.02^{a}	70.06^{a}	1.21
Digestible crude fibre	58.34^{c}	61.18^{bc}	63.59^{ab}	64.92^{a}	65.81^{a}	0.93
Digestible ether extracts	71.50^{a}	67.07^{b}	59.84^{c}	62.60^{c}	54.19^{d}	2.02
Digestible ash	68.44^{a}	66.10^{ab}	65.78^{ab}	63.98^{bc}	61.13^{c}	0.87
Digestible nitrogen free extract	68.00^{a}	65.06^{b}	63.99^{b}	62.88^{bc}	63.01^{c}	0.66
Nitrogen Intake (g/day)	7.08	7.15	7.21	7.24	7.15	0.06
Feacal Nitrogen (g/day)	2.76a	2.47ab	2.28ab	2.17b	2.14b	0.09
Urinary Nitrogen (g/day)	0.72a	0.68a	0.58b	0.55b	0.38c	0.04
Nitrogen Loss (g/day)	3.48a	3.15ab	2.86bc	2.72bc	2.52c	0.12
Nitrogen Balance (g/day)	3.60c	4.00bc	4.35ab	4.52ab	4.63a	0.13
Nitrogen Retention (%)	50.80c	55.99bc	60.36ab	62.44ab	64.75a	1.75

Table 5: The serum biochemistry of the experimental animals

Parameter	0%UPP	25%UPP	50%UPP	75%UPP	100%UPP	SEM
Glucose (mg/dl)	53.33^{a}	52.94^{a}	50.67^{ab}	47.27^{ab}	43.57^{b}	1.45
Total Cholesterol (mg/dl)	133.70^{a}	123.52^{ab}	116.08^{ab}	107.45^{ab}	89.96^{b}	6.25
Total protein (g/dl)	6.42^{c}	7.41^{a}	7.02^{ab}	6.92^{b}	6.46^{c}	0.11
Albumin (g/dl)	3.79	3.76	3.56	3.51	3.22	0.10
Globulin (g/dl)	2.63^{b}	3.65^{a}	3.46^{a}	3.41^{a}	3.25^{ab}	0.13
urea (g/dl)	39.19^{a}	33.76^{ab}	28.12^{bc}	27.33^{bc}	22.09^{c}	1.77
Creatinine (mg)	2.10	2.19	2.13	2.10	2.05	0.04

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