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Response of West African dwarf does to diets containing ammoniated cocoa pod husk meal

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Target Audience: Ruminant farmers, Agro-chemical industries

Abstract

Dried composite CPH were milled, soaked in 5% urea solution for 7 days, and ensiled for 28 days under anaerobic condition to upgrade its nutritive contents to make urea-treated ensiled cocoa pod husk meal (UTCPHM). The UTCPHM were used to replace cassava peels at 0, 10, 15, 20, 25 and 30% in diets of West African Dwarf (WAD) goat-does in a 90-day feeding trial, using 24 WAD does of four replicate per treatment in a completely randomized design. Thereafter, the nutrient compositions of UTCPHM were assessed while the nutrient and fibre fraction digestibility were evaluated. Crude protein (CP) improved by 71.84%, while Crude fibre (CF), Acid Detergent Lignin, Neutral Detergent Fibre and Theobromine of UTCPHM reduced by 29.40%, 16.75%, 17.88%, 20.04% and 47.30% respectively over the raw CPHM. The CP of the diets ranged (10.52% - 12.84%), CF (17.28% - 17.37%) from 0% UTCPHM diet to 30% UTCPHM diet; and theobromine concentration (1.47%) was highest in 30% UTCPHM diet. However, DMI, CPI, nitrogen balance and daily weight gain increased progressively as the inclusion of UTCPHM increased in the diets. Thus, UTCPHM could be incorporated in goat diets up to 30%, as it supported their growth.

Key words: Ensiled cocoa pod husk, Urea treatment, Fibre fractions, Theobromine, Doe.

Description of Problem

Dry season feed in ruminant production is still a challenge in Nigeria. During this period, the challenge of seasonal fluctuation in both quality and quantity of feed available to ruminant animals calls for the exploration of some variety of multipurpose tree and shrubs / crop residues that are available / abundant year round in this region in order to determine their suitability for livestock feeding. Among the crop residues is cocoa pod husk (CPH), which is highly fibrous. For efficient utilization by goats, there is need to nutritionally upgrade the residue. But, due to the non-availability of pasture lands, more attention is now being given to tree leaves, shrubs and crop residues “agro-industrial wastes” such as cocoa pod husk for feeding small ruminants (sheep and goats) in most areas of the World (1). Cocoa pod husk is locally available crop residue produced in huge amount in Ondo State, Nigeria and forms about 80% of the cocoa fruit. It is essentially a waste product except for the negligible amount used in the manufacture of local soap and manure. A measure of success has been achieved using hot water extraction, alkali treatment and microbial treatment in nutritionally upgrading fibrous feeds. Alkali agents can cleave lignocelluloses into lignin and cellulose or hemicelluloses. Ammonia and urea, a group of alkali agents, have also been reported to be effective in improving fibrous feed quality and digestibility (2). The study, hence, looks into the efficacy of ensiling technology coupled with alkali treatment in nutritionally upgrading the crop residue.

Materials and Methods

This study was carried out at the Small Ruminant Unit of the Teaching and Research Farm and Laboratory analysis was carried out at Nutrition Laboratory of the Animal Production and Health, Federal University of Technology, Akure (FUTA) located on Latitude 7^0 18’ 01”N and Longitude 5^0 8’ 41”E, Ondo State, Nigeria after approval by the ethical committee on Research of the Department of Animal Production and Health, FUTA. The cocoa pod husk (CPH) were collected at various farmlands in Ilara-mokin and Idanre townships of Ondo State, sun-dried for 8 – 12 days, crushed at the FUTA feed mill to 2mm particle size to form cocoa pod husk meal (CPHM). 5% urea solution and lye (cocoa pod) solution were made by dissolving 5 kg of urea grains in 95 litres of potable water and allowed to stand for 24 hours before use. The CPHM was soaked in the 5% urea solution under anaerobic condition for 7 days and thereafter, decanted. Filtrates were ensiled for 28 days, dried and incorporated in West African Dwarf (WAD) goat-does ration at 0, 10, 15, 20, 25 and 30% (Table 1) in a 90-day feeding trial.Twenty-four WAD does were acclimatized for thirty days during which routine managements like feeding on grasses and concentrate supplement were practiced. The goats were vaccinated against *Pesté-Petit déRuminanté* (PPR / kata), prophylactically treated against endo- and ecto-parasite using Ivermectin, and drenched with Albendazole®. The goats were allotted to treatments dietsusing four does per replicate in a completely randomized design,served at 5% body weight and water supplied*adlibitum*. Feed intake was taken, and the goat-does were repeatedly weighed weekly in the morning before feeding, to monitor weight change throughout the experimental periods. Digestibility trials were conducted by collecting faeces and urine from each goat during the last 7days of each experimental phase according to standard procedures; the samples collected were bulked for each animal. Feed and feacal samples were analysed for chemical composition (proximate, fibre fractions and anti-nutritive factors) according to standard procedures (3) using khjedahl apparatus and soxhlet apparatus and urine samples were analysed for nitrogen and mineral contents according to standard procedures. Theobromine was determined using the methods of (4).Apparent digestibility of the nutrients by the animals weredone using standard procedures. Data generated were subjected to statistical analysis using appropriate methods as described by (5) and significant means were separated using of Duncan Multiple Range Test of the same package.

Results and Discussion

Table 2 presented the chemical and anti-nutrients composition of replacement levels of urea-treated cocoa pod husk meal (UTCPHM) for cassava peels based-diets fed to WAD goat-does, and all the parameters observed were significantly (P<0.05) influenced by the replacement levels of UTCPHM in the diets except the dry matter (DM) and crude fibre (CF). The observed DM values ranged from 89.34% (diet A) to 89.64% (diet F) and these values were lower compared to 98.86 to

99.37% DM reported by (6) when cassava peels were treated with 8% urea. The disparity could be attributed to the effect of sun-drying on the pods which led to the marked reduction in moisture content. More so, urea has the ability to absorb moisture when in higher quantity. Crude protein contents of the diets ranged progressively from 10.52% (diet A) to 12.84% (diet F) as crude fibre content of the diets decreased withincresing level of replacement of cassava with UTCPHM. The increased CP and NFE content of the diets could be attributed to the effect of increased inclusion of UTCPHM in the diets. The protein increment proved the extent to which ammonia as a gas or generated from urea (bacterial and plant ureases in the ensiling process) hydrolyses the chemical/physical bonds between lignin, cellulose and hemicellulose in the plant cell walls (7). This accounted for the reduction in the crude fibre, NDF, ADL contents reported. Thus, could enhance the growth and activities of rumen microbes for effective utilization of the diets. The observed increase in the gross energy of the experimental diets might be attributed to increased ether extract, nitrogen free extract and crude fibre of the diet with increased inclusion of UTCPHM in the diets and would enable the does to carry out their physiological and anatomical functions.

The concentration of theobromine increased in the diets accordingly, as there was no trace in diet A however, the highest value (1.47%) was recorded for diet F while least value (0.77%) was recorded for diet B. The anti-nutrient was tolerable and could not interfere / hinder digestion and metabolism of nutrients (8). Hence, the diets supplied adequate nutrients to the goat-does, and were highly digestible by them.

Table 3 presented the nutrients intake (g/day) by WAD Does. Nutrients intake was significantly ($p<0.05$) influenced by the dietary treatment. The highest DMI value (449.84 g/day) was recorded for WAD Does fed diet F and least (347.02 g/day) in does fed diet A. These values are reflection of the protein quality of the diets and the tolerable level of anti-nutrients. The least CPI value (40.86%) was recorded for diet A while the highest value (63.53%) was recorded for diet F. The crude fibre intake (CFI) ranged from 67.16% (diet A) to 87.15% (diet F).

This result was in accordance with the report of (9) when the growth performance of WAD sheep fed cocoa pod husk with soursop pulp meals was evaluated. The NDF and ADF intake increased with increased DM and CP intakes, and this report agreed to the report of (10) when the nutrient intake of steers fed urea-treated cocoa pod husk was evaluated. The reduced gross energy intake with increased inclusion level of UTCPHM could be attributed to the reduced dry matter intake. However the decreased intake values of crude fibre, ether extract, neutral detergent fibre and acid detergent fibre of the diets may be attributed to the more fibrous nature of the experimental diets as the inclusion level of UTCPHM increased.

The higher crude protein digestibility observed in does fed diet B to F might be attributed to the effect of urea treatment of the cocoa pod husk. The digestibility of dry matter, crude protein and acid detergent fibre in diets B to F against the control diet (diet A) observed in this study is similar to the report of (2) when the nutrient digestibility of urea treated corncob silage diet was evaluated. The improvement observed in these digestibility coefficient values could be attributed to the ability of the diets to provide fermentable nitrogen for microbial propagation in the rumen. However, urea treatment confers improved digestibility on fibrous materials (7). The theobromine intakes were a positive reflection of feed intake, and were well degraded in their rumen. However, anti-nutrients are capable of binding the available nutrients thereby resulting in reduced performance of the animals fed higher concentration (11 and 12).

The nitrogen utilization of WAD goats were significantly ($p<0.05$) influenced by the dietary treatment. The observed values of nitrogen balance ranged from 5.83 to 8.94g/day, the goats fed diet F had the highest value (8.94g/day) while the goats fed diet A had the least value (5.83g/day). The increment in nitrogen balance agreed with the reports of (2) when WAD rams were fed urea treated corn cob silage diets and (10) in an experiment to improve the nutritional quality of cocoa pod through chemical and biological treatment for ruminant feeding. The urea treatment provided an additional source of nitrogen which can be utilized by rumen microbes for their microbial protein synthesis and subsequent utilization of the protein by the host animals and this is evident in the does fed diet F as they performed better than others. The probable conversion of volatile fatty acid from urea treated CPHM, produced by microbial action in the rumen to metabolisable energy is a major advantage of treating cocoa pod with urea (7).

The highest weight gain (2.97kg) and the subsequent least feed to gain ratio (13.36) by does fed Diet F after the experiment period proved that quality feed and or feed intake is an important factor in the utilization of feed by ruminant livestock and a critical determinant of energy intake and performance in small ruminants (13). Palatability of the diets could be attributed to the astringent property as a result of its ability to bind with protein of saliva and mucosa membranes. Consequently from the foregoing, all the nutrients were adequately utilized and digested, as the goat-does converted the feed to flesh.

Conclusion and Application

1. The study established that UTCPHM could be incorporated in goat diets up to 30%, as it supported their growth as nutrient intake, digestibility, nitrogen utilization and weight gain were improved.

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Table 1: Gross composition of experimental diets fed to WAD goat-does

	Level of UTCPHM Replacement (%)					
			Diets			
	0	**10**	**15**	**20**	**25**	**30**
Ingredients (%)	**A**	**B**	**C**	**D**	**E**	**F**
Urea-ensiled CPHM	0.00	5.00	7.50	10.00	12.50	15.00
Cassava peels	50.00	45.00	42.50	40.00	37.50	35.00
Brewer dried grain	27.00	27.00	27.00	27.00	27.00	27.00
Wheat offal	5.00	5.00	5.00	5.00	5.00	5.00
Palm kernel cake	15.00	15.00	15.00	15.00	15.00	15.00
Bone meal	1.00	1.00	1.00	1.00	1.00	1.00
Salt	1.00	1.00	1.00	1.00	1.00	1.00
Vitamin-mineral Premix	1.00	1.00	1.00	1.00	1.00	1.00
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

**UTCPHM - Urea-treated Cocoa Pod Husk Meal*

Table 2: Chemical and anti-nutrient composition of experimental diets fed to WAD does

	Level of UTCPH Replacement						
	0	**10**	**15**	**20**	**25**	**30**	
Parameters (%)	**A**	**B**	**C**	**D**	**E**	**F**	**SEM**
Dry matter	89.34	89.41	89.39	89.64	89.71	89.64	0.52
Crude protein	10.52^{d}	10.87^{d}	11.35^{c}	12.53^{b}	12.67^{ab}	12.84^{a}	0.26
Crude fibre	17.37^{a}	17.36^{a}	17.34^{b}	17.32^{bc}	17.31^{c}	17.28^{c}	0.14
Ether extract	2.33^{d}	2.67^{c}	3.07^{b}	3.14^{ab}	3.16^{a}	3.17^{a}	0.22
Ash	5.47^{a}	5.33^{ab}	5.19^{b}	5.11^{b}	5.02^{c}	5.01^{c}	0.38
Nitrogen free extract	53.64^{a}	53.18^{ab}	52.45^{b}	51.56^{b}	51.57^{b}	51.35^{b}	1.34
Gross energy (KJ/100gDM)	14.50^{b}	14.60^{b}	14.71^{ab}	14.78^{a}	14.81^{a}	14.81^{a}	0.16
Neutral detergent fibre	73.90^{a}	72.62^{ab}	71.91^{b}	70.68^{c}	70.58^{c}	69.13^{d}	0.41
Acid detergent fibre	51.66^{a}	49.62^{bc}	50.83^{ab}	49.13^{bc}	49.59^{bc}	48.42^{c}	0.33
Acid detergent lignin	25.14^{a}	23.37^{b}	22.42^{b}	23.17^{b}	23.19^{b}	22.48^{b}	0.26
Theobromine	ND	0.77^{a}	0.95^{b}	1.12^{c}	1.33^{d}	1.47^{e}	0.12

abc = means within the same row with different superscripts are significantly ($P<0.05$) different *ND – Not Determined.*

Table 3: Nutrients and anti-nutrients intake by WAD does fed replacement levels of UTCPHM for cassava peel based-diets

	Level of UTCPH Replacement						
	0	**10**	**15**	**20**	**25**	**30**	
Parameters (g/d)	**A**	**B**	**C**	**D**	**E**	**F**	**SEM**
Dry matter	347.02^{e}	353.66^{d}	413.59^{c}	416.64^{b}	420.90^{b}	449.84^{a}	16.33
Crude protein	40.86^{e}	45.60^{d}	49.59^{c}	56.55^{bc}	59.82^{b}	63.53^{a}	2.72
Crude fibre	67.16^{e}	72.66^{d}	75.94^{c}	80.65^{b}	81.17^{b}	87.15^{a}	8.91
Ether extract	9.05^{d}	11.20^{c}	13.41^{bc}	14.72^{b}	14.72^{b}	15.90^{a}	1.48
Ash	21.25^{d}	22.36^{c}	22.68^{c}	23.34^{b}	23.88^{b}	25.17^{a}	1.46
Nitrogen free extract	208.70^{d}	223.27^{c}	228.96^{c}	239.10^{b}	240.57^{b}	258.09^{a}	11. 15
Gross energy	56.32^{d}	61.25^{cd}	64.28^{c}	68.95^{b}	69.07^{b}	74.26^{a}	4.59
Neutral detergent fibre	279.32^{d}	310.03^{c}	317.31^{bc}	322.08^{bc}	330.30^{b}	353.91^{a}	11.60
Acid detergent fibre	197.44^{d}	216.73^{c}	216.81^{c}	225.59^{b}	229.59^{b}	248.66^{a}	8.25
Acid detergent lignin	87.09^{c}	105.47^{b}	102.12^{b}	104.74^{b}	108.28^{b}	116.28^{a}	4.02
Theobromine	ND	3.23^{e}	4.15^{d}	5.23^{c}	6.67^{b}	6.85^{a}	0.66

abc = means within the same row with different superscripts are significantly ($p<0.05$) different
ND – Not Determined.

Table 4: Digestibility, nitrogen utilization and weight gain (g/day) by WAD does fed experimental diets

	Level of UTCPH Replacement						
	0	**10**	**15**	**20**	**25**	**30**	
Parameters	**A**	**B**	**C**	**D**	**E**	**F**	**SEM**
Nutrient Digestibility							
Dry matter	69.23[d]	70.65[d]	72.16[c]	72.78[c]	73.20[b]	80.34[a]	2.03
Crude protein	68.61[b]	69.70[b]	71.33[b]	71.66[b]	78.56[a]	84.86[a]	1.56
Crude fibre	62.35[e]	64.92[d]	68.35[c]	71.50[bc]	74.51[b]	79.88[a]	2.08
Ether extract	70.69[d]	71.36[cd]	72.02[c]	72.51[c]	75.55[b]	78.85[a]	0.30
Nitrogen free extract	70.56[d]	72.10[cd]	72.16[c]	72.23[c]	73.31[b]	75.46[a]	0.38
Gross energy	69.17[d]	70.08[d]	71.08[c]	72.19[b]	74.48[ab]	75.88[a]	0.65
Neutral detergent fibre	72.03[d]	72.08[d]	72.64[cd]	73.50[c]	75.76[b]	79.30[a]	0.41
Acid detergent fibre	70.37[d]	71.43[cd]	71.58[cd]	72.83[c]	73.50[b]	75.79[a]	0.50
Acid detergent lignin	77.85[c]	79.30[b]	80.07[b]	81.16[ab]	81.39[ab]	82.56[a]	0.47
Nitrogen utilization							
Nitrogen intake	6.53[e]	7.27[d]	7.93[c]	9.37[b]	9.55[b]	10.17[a]	0.42
Nitrogen in faeces	0.47[d]	0.51[c]	0.64[bc]	0.69[b]	0.71[ab]	0.73[a]	0.02
Nitrogen in urine	0.24[d]	0.29[d]	0.37[c]	0.41[b]	0.42[b]	0.49[a]	0.01
Nitrogen balance	5.83[d]	6.50[cd]	6.92[c]	8.27[b]	8.44[b]	8.94[a]	0.11
Performance							
Initial weight (kg)	9.93	9.93	9.95	10.02	10.02	10.01	0.23
Final weight (kg)	12.10[d]	12.13[d]	12.50[c]	12.58[b]	12.60[b]	12.96[a]	0.31
Weight gain (kg)	2.18[c]	2.20[c]	2.56[b]	2.57[b]	2.58[b]	2.97[a]	0.17
Weight gain (g/day)	24.22[e]	24.44[e]	28.43[d]	28.55[c]	28.66[b]	32.99[a]	1.87
Feed gain ratio	14.39[b]	14.47[b]	14.58[b]	14.64[b]	14.66[b]	13.73[a]	0.08

abc = means within the same row with different superscripts are significantly ($P<0.05$) different