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Dietary Effect of *Pleurotus pulmonaris* Treated Cocoa Bean Shell meal on Fibre Fractions Utilisation by the West African Dwarf Goats

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Abstract
A sixty-three (63) day study was conducted to evaluate the dietary effect of *Pleurotus pulmonaris* treated cocoa bean shell meal diet on fibre fraction utilization of West Africa Dwarf goats aged 9 -12 months with an average live weight of 6.31±0.3kg. Six (6) diets were formulated such that wheat offal was replaced with *Pleurotus pulmonaris* treated cocoa bean shell meal at ratio 0 (A), 20% (B), 40% (C), 60% (D), 80% (E), 100% (F) in complete diets. The diets were fed to eighteen (18) West African Dwarf goats in three replicates per treatment using Completely Randomized Design experiment. The dry matter ranged 86.83 – 90.70%,diet B had the highest value, crude protein ranged between 19.73 (diet A) and 28.88% (diet F) and increased with increased inclusion of *Pleurotus pulmonaris* treated cocoa bean shell meal in the diets. The nutrients intake was significantly ($p<0.05$) influenced by the treatmentsexcept dry matter and cellulose. The crude fibre and fibre fractions were efficiently digested.Nitrogen balance, apparent digestibility and weight gain were significantly ($p<0.05$) influenced by the treatment. The goats fed diet A converted their feed to flesh better than other goats. However, goats fed diet F performed best in terms of dry matter and protein intake, weight gain, nitrogen balance and feed to gain ratio compared to other goats fed diets B, C, D and E that contained *Pleurotus pulmonaris* treated cocoa bean shell meal. It was concluded that *Pleurotus pulmonaris* treated cocoa bean shell meal incorporated in goat's diet could supply energy and protein to sustain the growth without adverse effect.

Keywords: Cocoa bean shell, fibre fractions, fermentation, *Pleurotus pulmonaris,* goats

Introduction

The adequate of quality feeds especially during the dry periods has necessitated the use of alternative feed resources. This development calls for means of achieving supply of browse forages, crop residues such as maize cob, maize husk, cassava peel, brewers grains, cocoa pod husk, cocoa bean shell and other supplements to the ruminants in the right quality and quantity.However, some of these feed resources contained anti – nutrients, have poor digestibility due to high fibre contents and unpalatable to animals (Olorunnisomo and Ibhaze, 2013). Cocoa bean shell is one of the by-products of processed cocoa beans however; lignifications and theobromine concentration of this by-product render it under-utilized bygoats.Attempts have been made to detoxify/delignify cocoa by- products using physical, chemical and biological methods. A measure of success has been achieved using physico-chemical methods (Adamafio, 2013) however, there is dearth of information on using biological method. *Pleurotus pulmonaris* is a filamentous fungus which can be used in biological method of detoxify/delignify cocoa bean shell. This treatment is a promising alternative to physico-chemical procedures, and circumvents the loss of soluble nutrients (Adamafio, 2013).

This study was therefore, designed to evaluate the dietary effect of *Pleurotus pulmonaris* treated cocoa bean shell meal on fibre fraction utilisation by the West African Dwarf (WAD) goats.

Materials and Methods

The experiment was conducted at the small ruminants unit of the Teaching and Research (T&R) Farm while the laboratory analysis were carried out at the Nutrition Laboratory of Animal Production and Health, Federal University of Technology, Akure (Latitude 7^0 18"Nand Longitude 5^0 10"E). The cocoa bean shell (CBS) was gotten from a cocoa processing company in Akure. The sun-dried and milledcassava peels were collected from a "garri" processing industry in Igbatoro, Akure while other ingredients were sourced from reputable feed miller's shop.Adequate quantity of cocoa bean shells was divided into two equal parts, one part was subjected to aerobic fermentation using the method of Aro *et al.* (2008) thereby, one litre of water was added to one kilogram of dried cocoa bean shell, mixed thoroughly, packed into black polythene bag, sterilized at (100°C) for 1hour, and allowed to cool. The CBS was inoculated with 15ml of cultured fungus (*Pleurotus pulmonaris* and potato dextrose agar solution) that contained 1.2×10^8 microbes/ml and fermented for five days and air dry for two (2) days before incorporated into the formulateddiets. Six (6) experimental diets were formulated such that wheat offal

(30.00%) was partially replaced with *Pleurotus pulmonaris* treated cocoa bean shell meal at ratio 0 (A), 20% (B), 40% (C), 60% (D), 80% (E), 100% (F). Other ingredients added to make complete diets are Cassava peels (50.00%), Palm kernel cake (15.00%), urea (1.00%), bone meal (1.50%), salt (1.50%) and premix (1.00%).

Eighteen WAD goats aged9-12 months and weighed 6.31±0.03kg were usedfor the feeding trial, selected from the flocks of goats unit of Teaching and Research Farm (TRF), Federal University of Technology, Akure. The goats were medicated against *Pesté-Petit dé Ruminanté* (PPR / kata) and other infections. The goats were randomly assigned (three per treatment) to the experimental diets in Completely Randomized Design and the experiment lasted for 63 days. The last 14 days of the experimental period were used for collection of faeces and urine for laboratory analysis. The goats were fed the experimental diets daily early in the morning (7:00 am) and fresh water was given *ad libitum* throughout the experimental period. The feed intake, digestibility, daily weight gain, nitrogen balance and feed to gain ratio were determined. All chemical analysis was carried out using methods of AOAC (2000).

All data generated were subjected to analysis of variance (ANOVA) and means were compared using the methods of Duncan (1955).

Results and Discussion

The chemical composition of the*Pleurotus pulmonaris* treated cocoa bean shell complete diets as shown in Table 1. The dry matter of the experimental diets ranged 86.83 – 90.70%, these values compared favourably to the values of 86% - 92% reported by Bamikole (2004). The crude protein ranged from 19.73% to 28.88%. The observed CP in the diets was above the critical 8% crude protein required by ruminants for optimum microbial activities in the rumen (Norton, 2003). The crude fibre ranged between 7.40 (diet F) and 12.23% (diet A), the CF decreased with increased inclusion of *Pleurotus pulmonaris* treated cocoa bean shell meal in the diets.The neutral detergent fibre ranged between 41.18 (diet B) and 46.00% (diet E), this might be due to the lignocellulose content of the diets.

Table 1: Chemical composition of untreated and *Pleurotus pulmonaris* treated cocoa bean shell diets

Parameters	Diets					
	A	B	C	D	E	F
Dry matter	89.21	90.70	88.77	86.83	88.87	86.83
Crude protein	19.73	23.16	25.38	27.13	27.45	28.88
Crude fibre	12.23	10.79	10.34	9.03	8.79	7.40
Ether extract	16.04	13.31	11.63	11.88	10.01	9.39
Ash	11.80	11.77	11.66	10.59	10.04	9.78
Nitrogen free extract	40.10	40.97	40.99	41.37	43.71	44.55
Neutral detergent fibre	43.14	41.18	43.14	44.00	46.00	45.00
Acid detergent fibre	31.37	32.08	34.62	35.29	35.29	35.64
Acid detergent lignin	13.29	14.97	16.05	17.39	17.59	17.56
Hemicellulose	11.76	9.10	8.52	9.71	10.71	9.46
Cellulose	18.08	17.11	18.57	17.90	17.70	18.08

The results of nutrients intake by the goats fed the experimental diets were shown in Table 2.The dry matter intake by the goats ranged 267.61 – 349.00 g/day, the goats fed diet F had highest DM intake and this might be attributed to the protein quality of the diet. The DM intake values compared favourably to the findings of Adamafio (2013) who reported that the inclusion of cocoa bean shell in ruminant diets stimulated feed intake and growth of ruminant animals. The crude protein intake by goats fed diets B, C, D, E and F were high compared to other goats fed diets A, this CP intake might be influenced by the crude protein of the *Pleurotus pulmonari* treated cocoa bean shell meal included in the diets (Adamafio 2013). The high crude fibre intake by the goats could be traced to the combination of delignification and improved protein quality of the diets.

Table 3 presents the result of apparent digestibility, nitrogen balance, daily weight gain and feed to gain ratio of the goats. All parameters determined were significantly ($P < 0.05$) influenced by the treatment except feed to gain ratio. The apparent digestibility of dry matter, crude fibre and fibre fractions were above 50.00% in all diets, this observation might be due to microbial degradation of fibre, protein quality, acceptability and palatability of the diets.This observation corroborated by the report of Fajemisin *et al.* (2012) that adequate protein content and fibre fraction in livestock diets enhanced nutrients intake and digestibility.

The gaily weight gainranged between 23.81and 47.62 g/day, the goats fed diet A had the highest value however, the goats fed F had the best weight (42.38g/day) compared to goats fed diets B, C, D and E. This observation might be attributed to protein quality of the diet which was influenced by the inclusion of *Pleurotus pulmonari* treated cocoa bean shell in the diets. This agreed with the findings of Fajemisin *et al* (2012)that weight gain was dependent on dry matter, protein intake and digestibility of the nutrients.The best feed to gain ratio (7.24) was observed in goats fed diet A, indicating the ability of goats fed diet A to convert their feeds to flesh than goats fed other diets and this might be attributed to high dry matter intake. Considering the goats fed diets that contained *Pleurotus pulmonari* treated cocoa bean shell meal, the goats fed diet F utilized (8.24) their feed better than other goats fed *Pleurotus pulmonari* treated cocoa bean shell diets. It implied that diet F met the nutrient requirementof the goatsthus; the diet suppliedadequate energy and protein that sustained the growth of the goats without adverse effect.

Table 2: Nutrient intake (g/day) of West African Dwarf goats fed microbial treated cocoa bean shell diets

Parameters	Diets						
	A	B	C	D	E	F	SEM
Dry matter	344.60	324.36	267.61	302.51	279.15	349.00	12.04
Crude protein	59.96^{c}	75.13^{ab}	67.91^{bc}	82.05^{b}	76.63^{bc}	100.77^{a}	3.54
Crude fibre	42.14^{a}	35.00^{b}	27.67^{c}	27.32^{c}	24.54^{c}	25.83^{c}	1.58
Ether extract	55.27^{a}	43.17^{b}	31.12^{de}	35.94^{c}	27.94^{e}	32.77^{cd}	2.52
Ash	40.66^{a}	38.18^{a}	31.04^{bc}	32.04^{bc}	28.03^{c}	32.77^{b}	1.14
Nitrogen free extract	188.18^{a}	132.89^{c}	109.69^{e}	125.15^{d}	122.02^{d}	155.50^{b}	6.34
Neutral detergent fibre	148.66^{ab}	133.57^{ab}	115.45^{b}	133.10^{ab}	128.41^{ab}	157.40^{a}	5.26
Acid detergent fibre	108.10^{ab}	104.06^{ab}	92.67^{b}	106.75^{ab}	98.51^{ab}	127.52^{a}	4.08
Acid detergent lignin	45.80^{b}	48.56^{ab}	42.95^{b}	52.60^{ab}	49.10^{ab}	61.28^{a}	2.00
Hemicelluloses	40.52^{a}	29.52^{b}	22.80^{b}	26.35^{b}	29.93^{b}	29.87^{b}	1.65
Cellulose	62.30	58.96	49.70	54.15	49.41	62.75	2.42

abc = Means within the same row having different superscripts differ significantly (P < 0.05

Table 3: Nutrient digestibility (%), nitrogen balance, weight gain and feed to gain ratio of West African Dwarf goats fed untreated and Pleurotus treated cocoa bean shell diets

Parameters	Diets						
	A	B	C	D	E	F	SEM
Dry matter	68.18^{ab}	68.79^{ab}	73.07^{a}	68.19^{ab}	60.53^{b}	66.11^{b}	0.90
Crude protein	61.73^{c}	67.05^{abc}	73.41^{a}	69.19^{ab}	65.76^{bc}	73.00^{a}	1.23
Crude fibre	66.04^{b}	78.24^{a}	75.28^{ab}	72.47^{ab}	71.56^{ab}	75.38^{ab}	1.43
Ether extract	70.80^{bc}	71.50^{bc}	81.78^{a}	67.84^{c}	79.22^{ab}	78.88^{ab}	1.54
Nitrogen free extract	65.01^{ab}	72.73^{a}	69.74^{a}	68.38^{ab}	55.74^{c}	59.41^{bc}	1.72
Neutral detergent fibre	54.33^{b}	67.27^{a}	57.28^{b}	52.47^{b}	52.98^{b}	58.27^{b}	1.43
Acid detergent fibre	63.22^{ab}	68.10^{a}	60.64^{bc}	54.57^{a}	55.39^{cd}	58.14^{bcd}	1.28
Acid detergent lignin	75.39^{a}	67.66^{b}	54.27^{c}	55.36^{c}	54.48^{c}	62.05^{b}	3.27
Hemicelluloses	50.77^{b}	60.72^{a}	54.23^{ab}	59.15^{ab}	56.69^{ab}	58.85^{ab}	1.29
Cellulose	65.99^{c}	76.84^{a}	71.16^{b}	58.68^{d}	56.40^{d}	57.49^{d}	1.92
Nitrogen balance (g/day)	5.53^{c}	7.19^{bc}	7.55^{bc}	8.67^{b}	7.82^{bc}	11.46^{a}	0.51
Weight gain (g/day)	47.62^{a}	33.33^{ab}	23.81^{b}	33.33^{ab}	31.75^{ab}	42.38^{ab}	2.82
Feed to gain ratio	7.24	9.73	11.24	9.08	8.79	8.24	2.22

abc = Means within the same row having different superscripts differ significantly (P < 0.05)

Conclusion

The result revealed thatwheat offal replaced with *Pleurotus pulmonari* treated cocoa bean shell meal (20 – 100%) in the diets B, C, D, E and F improved the protein quality and feed intake. The goats fed diet A converted their feed to flesh better than other goats. Considering the goats fed diets that contained the *Pleurotus pulmonari* treated cocoa bean shell meal,the goats fed diet F utilized (8.24) their feed better than other goats fed *Pleurotus pulmonari* treated cocoa bean shell diets. It implied that diet F met the nutrients requirement of the goats. Hence,maize offal substituted with 100% *Pleurotus pulmonari* treated cocoa bean shell meal could be a

good source of energy and protein to support goat production, purposeful use of cocoa bean shell and reducing high cost of feed.

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