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Effect of Cocoa Husk Meal Based Diets on the Growth Performance and Nutrient Digestibility of Weaned Rabbits

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ABSTRACT:- A twelve (12) week trial evaluated the effect of fermented and unfermented cocoa pod husk on the growth performance and nutrient digestibility of weaned rabbits. Twenty (20) weaned sexed rabbits in a ratio of 1:1 (10 bucks and 10 dies) were assigned to five dietary treatments (Fc, F0, F5, F10 and F15) comprising of four (4) weaned rabbits per treatment in a ratio of 1:1 (2 bucks and 2 does) with each rabbit per replicate. Each replicate was housed in individual hutches; feed and water were served ad libitum. Growth and apparent nutrient digestibility coefficients parameters were determined accordingly using appropriate formulae.The data was subjected to a one- way (CRD) ANOVA and means that differed significantly were separated using Duncan Multiple Range Test. Results showed significant ($P<0.05$) differences in all growth parameters across dietary treatments. The final body weight gain, feed intake and feed conversion ratio were better with the control diet. Cost per kg and cost of feed consumed per rabbit were not significantly ($P>0.05$) influenced by dietary treatments. Cost per kg gain was significantly ($P<0.05$) influenced by dietary treatments. The apparent nutrient digestibility coefficients for crude fibre and ether extract recorded significant ($P<0.05$) differences across dietary treatments. The diets compared with other treatments in dry matter, crude protein and nitrogen free extract digestibility coefficients. The study concluded that even though the control group recorded better growth performance characteristics, cheaper feed and better cost/kg gain; 10 days fermented cocoa pod husk meal proved to be a viable alternative in diets meant for rabbits.

Key words: cocoa husk, growth, nutrient retention, rabbit

I. INTRODUCTION

The use of Agro-industrial by- products and residues in feed production is a strategy that holds tremendous potential for alleviating the short supply of animal products because it lowers cost of feeds and feeding stuffs. This will lower cost of livestock production, which in turn will lower prices of animal protein. When animal protein is more affordable, its consumption will increase with the attendant benefit of improved health and productivity for the general populace and children in particular. The use of unconventional feedstuffs as substitutes for grains and other feedstuffs that are in demand for human is therefore, a very important livestock strategy. According to Olubamiwa *et al.* (2006), Cocoa husks contain good nutrients which have gained considerable interest as livestock ingredients in Nigeria. It forms about 80% of the cocoa fruit and is obtained when the fruit is broken and the bean removed. As an agro waste-product, very little of the potential locked up in this waste-product have been exploited (Egbe and Olubamiwa, 1989). The fresh cocoa husks abandoned annually on the farms in Nigeria amounts to about 2.42 million kilogram); with its high fibre content, it would seem that cocoa husks could be efficiently use only by ruminants (Ndumbe, 1980). There is, however, little or no cattle production in cocoa producing zones (South - South and South - West regions) of Nigeria as well as no intensive or large scale small ruminants production in the same zones.

The world production of cocoa *(Theobroma cacao)* as at 2011 stood at a little above 4.05 million metric tons (ICCO, 2012). Countries within the West African sub-region account for 71.40**%** of the world cocoa production and generate about 6.70 million metric tons cocoa husks, besides cocoa bean shell and cocoa bean cake, which are waste products of industrial production (Adamafio, 2013). With the attendant deficit in animal production in most cocoa-producing areas in Africa, due to the high cost of conventional animal feed ingredients, the utilization of the large quantities of discarded cocoa husks as convenient alternative animal feed

stuff would be beneficial to millions of indigent livestock farmers in such areas (Alemawor *et al.*, 2009; Hamzat and Adeola, 2011).

There is paucity of information on the use of cocoa husk meal in the feeding of monogastric animals such as pigs and chickens. Little research findings are available for rabbits fed cocoa pod husk meal in the main cocoa producing areas of Nigeria (Adeyina *et al.*, 2010; Adamafio, 2013; Ozung, 2016; Ozung *et al.*, 2016; 2017; 2019).

This study was therefore designed to determine the effect of cocoa pod husk meal based diets on the growth performance and nutrient digestibility of weaned rabbits.

II. MATERIALS AND METHODS

Experimental site

The study was carried out at the rabbitry unit of the Livestock Teaching and Research Farms, University of Agriculture Makurdi, Benue State. Makurdi is located on Latitude 7^0 44^I N of the equator and Longitude 8^0 54^I E of the Greenwich meridian. It is in the Southern Guinea Savanna region of Nigeria and has two distinct seasons; the wet and dry season. The wet season lasts from April-October while the dry season is from November-March. Annual rainfall ranges between 1105 and 1600 mm. Annual temperature ranges between 21^0C in January and 35^0C in March. Relative humidity ranges between 69% in August/September and 39% in January/February (Anon, 2004).

Experimental animals and management

A total of 20 (twenty) cross bred weaned rabbits of both sexes (10 males & 10 females) from a reputable farm in Makurdi were used in this study. There were 5 dietary treatments with 4 rabbits per treatment. Each rabbit served as a replicate and was housed individually in wire mesh cages (hutches) measuring 50 × 30 × 40 cm. The rabbits on arrival were allowed to adapt for a week and fed the control diet. After which they were weighed and randomly allotted to treatments after weight equalization. Measured quantities of experimental diets were then serve to the animals in concrete feeding troughs, while clean drinking water was provided *ad libitum.* This was done on a daily basis until the end of the experimental period of 12 weeks. The rabbits were subjected to administration of water soluble vitamins, antibiotics (Terramycin), anti- stress vitalyte and coccidiostat. The rabbits were weighed on a weekly basis to determine the body weight gain.

Experimental design

The experimental design used was a completely randomized design (CRD).

Processing of cocoa husk meal

The freshly broken husks from composite cocoa varieties were gathered, washed with clean water and sundried on concrete slabs to constant weight. Thereafter, the dried husks were broken into small pieces for easy milling with the hammer mill, thereafter; a portion was sampled for inclusion in diet as unfermented cocoa husk meal. Furthermore, exactly 10 litres of water per 50 kg was added to the remaining portion and thoroughly mixed. The mixture was placed in air-tight polythene bags and fermented for 5 days (F5), 10 days (F10) and 15 days (F15), after which they were sun dried and packed into bags for use in the diet formulation.

Ingredient	Control	FO	F5	F10	F15
Cocoa husk meal	-	20.00	20.00	20.00	20.00
Rice offal	15.66	10.00	10.00	10.00	10.00
BDG	15.10	25.78	26.60	26.60	24.67
PKM	13.65	15.44	13.32	13.32	17.27
Maize	30.67	13.40	12.92	12.92	13.55
Bone meal	3.79	3.80	3.72	3.72	3.85
Palm oil	2.50	2.50	2.50	2.50	2.50
SBM	17.74	8.09	10.00	10.00	7.13
Synthetic lysine	-	0.10	0.05	0.05	0.12
Synthetic methionine	0.34	0.34	0.34	0.34	0.34
Salt	0.30	0.30	0.30	0.30	0.30
Premix	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated nutrients: Crude protein	19.60	18.00	18.64	18.50	18.50
Energy (Kcal/kg)	2500	2462	2493	2492	2495
Crude fibre	12.00	14.19	15.42	15.97	15.10
Ether extracts	4.82	3.88	3.89	4.01	4.03
Lysine	0.84	0.76	0.75	0.77	0.74
Arginine	1.82	2.04	2.02	2.061	2.10
Methionine + Cysteine	0.60	0.60	0.60	0.60	0.60
Calcium	1.61	1.68	1.70	1.70	1.71
Phosphorous	0.79	0.82	0.83	0.83	0.84

Table 1: Gross Composition of Experimental Diets

Experimental diets

Five experimental diets were formulated consisting of maize without cocoa husk meal (control as T_1), unfermented cocoa husk meal (FO as T_2), fermented for 5day (F5 as T_3), fermented for 10 days (F10 as T_4) and fermented for 15 days (F15 as T_5). The gross composition of experimental diets is presented in Table 1.

Parameter measured

a. **Body Weight gain:** The animals were weighed at the beginning of the experiment and weekly thereafter; the body weight gain was determined by difference.

b. **Feed Intake:** This was determined by subtracting the unconsumed feed from the total feed offered.

c. **Feed conversion ratio (FCR):** This is the efficiency with which feed is converted to body weight and was computed as a ratio.

$$\text{FCR} = \frac{\text{Feed intake (g)}}{\text{Weight gain (g)}}$$

Digestibility

A digestibility trial was carried out at the end of the feeding trial. Three (3) rabbits; with live weight approximating their treatment mean live weight were selected from each treatment and used for digestibility trial. Faecal collection lasted for seven (7) days. During this period, the rabbits were fed weighed amount of feed in metabolic cages. Pieces of nettings were tied under individual cages to separate faeces from urine. The faeces from each rabbit were oven - dried and stored in air tight containers. At the end of seven days, faeces from each rabbit were bulked; milled and thoroughly mixed together and sampled were taken for proximate analysis according to the procedures described by AOAC (2012). Determination of apparent digestibility of feed and nutrients was according to the following equation:

$$\text{Apparent digestibility} = \frac{\text{Nutrient intake - Nutrient voided}}{\text{Nutrient intake}} \times 100$$

Economic analysis

The cost per kilogram of each experimental diet was determined based on the current prices of feed ingredients in Makurdi and the cost of processing and feed production. The cost of feeding the rabbits for the period of the study was calculated as the product of the cost per kilogram of the diet and feed conversion ratio.

Statistical analysis

All data obtained were subjected to one way analysis of variance (ANOVA) for CRD using MINITAB statistical software, and where significant differences occurred, parameter means were separated using Duncan's multiple Range Test as outlined by Steel and Torrie (1980).

Results

Proximate Composition of Unfermented, Fermented Cocoa Husk Meal

Results of the proximate composition of unfermented and fermented cocoa husk meal are presented in Tables 2. The unfermented cocoa husk meal recorded 86.8% dry matter (DM), 7.71% crude protein (CP), 4.3% ether extract (EE), 32.5% crude fibre (CF), 10.1% ash and 45.39% nitrogen free extract (NFE). The 5 days fermented cocoa husk meal recorded 89.2% DM, 7% CP, 1.25% EE, 45% CF, 5% ash and 41.75% NFE; while the 10 days fermented cocoa husk meal had 88.5% DM, 8.75% CP, 1.75% EE, 40% CF, 5% ash and 44.5% NFE and 15 days fermented cocoa husk meal had 91% DM, 9.62% CP, 2% EE, 35.5% CF, 75 ash and 45.88% NFE, respectively.

Proximate composition of experimental diets

Table 3 shows the proximate composition of the experimental diets. The crude fat content was similar for the control (10.60 %), F0 (11.00 %) and F10 (10.90 %) although F0 had numerically higher value. Similar values were obtained for F5 (9.65 %) and F15 (9.80 %) with diets with F5 having the lowest. The crude fibre content ranged from 26.90 – 30.85 %. The highest was recorded for F0 while F5 recorded the least. The crude protein content of diet with F10 (36.35 %) was higher although not different from the 36.05 % recorded for F0 while F5 recorded the least. The value of 13.27, 15.37, 14.43, 16.23 and 14.17 % was recorded for the control and diets with F0, F5, F10 and F15, respectively. Ash content was highest for F10 (16.23 %) followed by those with F5 (14.43 %), F0 (15.37 %), F15 (14.17 %) while the least value was recorded for the control (13.27 %). The value of nitrogen free extract ranges from 10.77 – 25.37 %.

Table 2: Proximate Composition of Unfermented and Fermented Cocoa Husk Meal (%)

Duration of fermentation (hours)	CP	EE	CF	ASH	NFE	DM
0	7.71	4.30	32.50	10.10	45.39	86.80
120	7.00	1.25	45.00	5.00	41.75	89.20
240	8.75	1.75	40.00	5.00	44.50	88.50
360	9.62	2.00	35.50	7.00	45.88	91.00

CP = Crude protein
EE = Ether Extract
CF = Crude Fibre
NFE = Nitrogen free extract
DM = Dry matter
0 hours = Unfermented Cocoa Husk Meal

Table 3: Proximate Composition of Experimental Diets (% dry matter basis)

Parameter	FC	F0	F5	F10	F15	SEM	P-value
Dry matter	88.35^{ab}	89.05^{a}	90.40^{a}	87.20^{b}	89.25^{a}	0.36	0.002
Ether extract	10.60^{a}	11.00^{a}	9.65^{b}	10.90^{a}	9.80^{b}	0.19	<0.001
Crude fibre	13.83^{b}	15.43^{a}	13.45^{b}	14.78^{a}	14.78^{a}	0.36	0.001
Crude protein	16.78^{b}	18.03^{a}	16.13^{b}	18.18^{a}	16.85^{b}	0.46	0.025
Ash	13.27^{c}	15.37^{b}	14.43^{ab}	16.23^{a}	14.17^{bc}	0.77	0.027
NFE	33.87^{a}	29.22^{c}	36.74^{a}	27.11^{c}	33.65^{b}	0.21	<0.001

^{a,b,c}Means along the same row with different superscripts are significantly (P<0.05) different; FC=Control diet; F0 = Unfermented; F5 = 5 days Fermented; F10 = 10 days Fermented; F15 = 15 days Fermented Cocoa Pod Husk Meal; SEM = Standard error of mean; NFE = Nitrogen free extracts

Growth Performance Characteristics of Weaned Rabbits Fed Diets Containing Cocoa Husk Meal Based Diets

Result of the growth performance characteristics of rabbits fed fermented and unfermented cocoa husk meal based diets is summarized in Table 4. The final weight, total weight gain, average daily weight gain, average daily feed intake and feed conversion ratio (FCR) of rabbits recorded significant differences (P < 0.05)

between dietary treatments. The highest values for body weight was recorded with rabbits fed the control diet (FC) (1605.50 g/rabbit), followed by F0 (1213.25 g/rabbit), F10 (1119.67 g/rabbit), F15 (1009.25 g/rabbit). Rabbits fed five days fermented cocoa husk meal (F5) recorded the least values of final body weight (852.00 g/rabbit). Total weight gain was better for rabbits fed control diet with 1095.75 g/rabbit. Average daily gain (ADG) values were 13.04, 8.26, 3.79, 7.91 and 5.93 g/rabbit/day fed the control, F0, F5, F10 and F15 diets, respectively. Results further revealed that the control group consumed significantly higher feed (total feed intake and average daily feed intake). The average daily feed intake (ADF) of rabbits was highest in the control diet. The values were 90.19, 77.14, 71.50, 72.60 and 76.95 g/rabbit/day for the control, F0, F5, F10 and F15 diets respectively. The control group recorded the best feed conversion ratio (6.92) while rabbits fed F5 had the worst values of feed conversion ratio (FCR) (18.87).

Nutrient digestibility by weaner rabbit fed fermented and unfermented cocoa husk by-products

Results of nutrient digestibility coefficient of rabbits fed diets containing fermented and unfermented cocoa husk by-products are presented in Table 5. Digestibility parameters like crude fibre and ether extract recorded significant effect ($P < 0.05$) of dietary treatments, while the values for dry matter, crude protein and nitrogen free extract were not significantly ($P>0.05$) different. The highest digestibility value of dry matter (73.88 %), CF (78.67 %), CP (80.21 %) and ether extract (85.45 %) was recorded for control diet. The digestibility value for NFE (91.30 %) was highest for F10.

Table 4: Growth performance characteristics of weaned rabbits fed cocoa husk meal based diets

Parameter	FC	F0	F5	F10	F15	SEM	P-value
Av. Initial Weight (g/rabbit)	510.25	519.25	533.75	455.25	510.75	84.04	0.094
Av. Final Weight (g/rabbit)	1605.50^{a}	1213.35^{b}	852.00^{c}	1119.67^{b}	1009.25^{bc}	70.58	<0.001
Av. Total Wt. Gain (g/rabbit)	1095.25^{a}	694.00^{b}	318.25^{c}	664.42^{b}	498.50b^{c}	76.42	<0.001
Av. Daily Weight Gain (g/rabbit)	13.04^{a}	8.26^{a}	3.79^{c}	7.91^{b}	5.93^{bc}	1.29	<0.001
Av. Daily Feed Intake (g/rabbit)	90.19^{a}	77.14^{b}	71.50^{b}	72.60^{b}	76.95^{b}	5.23	0.020
Feed Conversion Ratio	6.92^{c}	9.34^{c}	18.87^{a}	9.18^{c}	12.98^{b}	2.17	0.

^{a,b,c} Means with different superscripts are significantly ($P<0.05$) different; FC= Control diet; F0 = Not fermented; F5 = 5 days fermented; F10 = 10 days fermented; F15 = 15 days fermented; SEM = Standard error of mean.

Table 5: Nutrient digestibility by weaner rabbits fed fermented and unfermented cocoa husks

Parameter	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	SEM	P
(%)	Control	20.00% FO	20.00% F5	20.00% F10	20.00% F15		
Dry matter	73.88	48.15	70.19	40.04	55.05	1.35	0.481
CF	78.67^{a}	63.22^{ab}	74.97^{a}	66.71^{ab}	55.10^{b}	0.42	0.065
CP	80.21	59.42	43.02	63.53	63.44	1.55	0.651
NFE	88.08	86.31	86.78	91.30	84.58	0.27	0.591
Ether extracts	85.45^{a}	62.00^{c}	80.39^{ab}	66.90^{bc}	64.12^{c}	0.40	0.035

^{a,b,c}Means with different superscripts are significantly ($P<0.05$) different from each other; F0 = Not fermented; F5 = 5 days fermented; F10 = 10 days fermented; F15 = 15 days fermented; SEM = Standard error of mean; P = P-value; NFE = Nitrogen free extracts

V. DISCUSSION

Proximate Composition of Cocoa Husk Meal and Experimental Diets

The crude protein, crude fibre and dry matter contents of the unfermented and fermented cocoa husk meal (Table 2) obtained in study fell within the ranges of 7.7 – 9.37% CP, 53.37 – 61.8% CF and 84.4 – 94.6% respectively for differently treated (raw, fermented and hot – water treated) forms of cocoa husk meal as reported by Ozung (2016). The dry mater content was also similar to the value 94.18 % reported by Onifade *et al*. (1999) for cocoa husk meal; implying that cocoa husk meal, irrespective of its processing method is low in crude protein but high in crude fibre. The proximate composition values of experimental diets (Table 3) in this study are within the recommended ranges for growing rabbits. The crude protein content of diets (16.13 - 18.03 %) was with the recommended levels (16 – 18 %) for both growing and breeding rabbits (NRC, 1984;

Fielding, 1991, Aduku, 1993; Ojebiyi *et al*., 2006; Amaefule and Ironkwe, 2007). The crude protein was also within the range of 17.96 – 22.33 % reported by Aregheore (2011). Rabbits have been observed to adapt effectively to low and poor protein diets unlike poultry, because of coprophagy (NRC, 1977). However, crude protein levels of 12, 15, 16 and 17 percent have been reported as optimum for rabbits in terms of maintenance, gestation, growth and lactation, respectively (Aduku and Olukosi, 1990; Onifade *et al*., 1999). The crude protein content in this study was adequate, proved satisfactory and met the nutrient requirements of the rabbits (Aregheore, 2011). The crude fibre content (13.45 – 15.43 89%) of the experimental diets was slightly higher than the recommended level (10 – 14 %) for growing rabbits (Lebas, 1980) and 16.98 – 22.35 % crude fibre reported by Bouafou *et al*. (2011) and (22.96 – 32.06 %) reported by Ijaiya *et al*. (2005). The high crude fibre levels were apparently due to the high crude fibre content of the test ingredient (cocoa husk meal) used in this study. According to Champ and Maurice (1983), a crude fibre level in excess of 9 % is needed for normal growth in rabbits and to reduce incidence of enteritis; while a high fibre level in excess of 20 percent may induce caecal impaction and limit energy intake (Aduku and Olukosi, 1990). However, rabbits fed higher levels of fibre in this study did not show any obvious adverse effect. In another study, Cheeke (1984) reported that crude fibre levels of between 10 to 17 % have been found to support weight gain; with the optimum gain of 41.30 g/day/rabbit obtained at a fibre level of 14.80 %. Accordingly, satisfactory performance has been recorded in weaned rabbits fed high fibre (22.96 – 32.06 %) and high energy (3,523.54 – 3,897.46 Kcal/kg ME) diets (Ijaiya *et al*., 2005). The range of 13.27 – 16.23 % obtained in this study for ash is slightly higher than the range of 10.54 – 11.68% reported by Aregheore (2011); implying that the diets were adequate in essential minerals needed for skeletal development and promotion of good health status of the rabbits.

Growth Performance of Weaned Rabbits Fed Diets Containing Fermented and Unfermented Cocoa Husk Meal

The growth performance characteristics of rabbits fed cocoa husk meal based – diets (Table 4) were significantly ($P<0.05$) influenced by dietary treatments. Rabbits on the control diets had highest body weight while those on F5 had the lowest. The values from this study for control (FC) and F0 were higher than the range of values 1005 – 1141.3 g/rabbit reported by Adeyina *et al*. (2010) for rabbits fed cocoa bean shell meal based - diets; while F5 had lower value. The differences observed may be due to the test ingredient and prevailing environmental conditions. The ADF decreased significantly ($P < 0.05$) in the diets with cocoa husk meal group from 90.19 g/rabbit/day in the control diet (FC) to 77.14, 71.50, 72.60 and 76.95 g/rabbit/day in the diet with F0, F5, F10 and F15; implying the rabbits consumed more feed in the control diet. The values for ADF (71.50 – 90.19 g/day/rabbit) obtained in this study are higher than the range of 63.46 – 70.46 g/rabbit/day reported by Isika *et al*. (2012) who evaluated the replacement value of processed cocoa bean meal for groundnut cake in rations for fryer rabbits. These values were however, far higher than the range of 51.28-71.88 g/rabbit reported by Attah and Ekpeyong (1998), 48.72 – 55.36g reported by Orunmuyi *et al*. (2006) and 60.08 - 62.86 g reported by Agunbiade *et al*. (1999) for the same species of animal; but compared favourably with the values of 77.64 - 87.51 g/rabbit reported by Attah *et al*. (2011) and 63.89 - 82.46 g/rabbit reported by Ingweye and Effiong (2015). The differences in ADF values could be attributed to age disparity, differences in feed materials and environmental influences. Metabolic processes increase with age in animals, just as the feed intake to meet maintenance and performance functions (Isika *et al*., 2012). This finding is not in agreement with the report of Onyema and Iwuala (2011) who stated that the consumption of high fibre diets resulted in increased feed intake. However, the decreased feed intake in the cocoa husk meal diets could be attributed to the high anti- nutrient (theobromine) content. Theobromine has been reported to be a key anti – nutrient in cocoa products (Alexander *et al*., 2008). Its presence is reported to limit feed intake by animals and consequently, zootechnical parameters (FAO, 2002). However, the ADF was significantly ($P < 0.05$) highest in F15 cocoa husk meal group. This validates the report of Adeyina *et al*. (2010) who stated that feed intake and weight gain were high in rabbits fed water treated cocoa bean shell up to 200g/kg. This is so because the water treatment and fermentation methods have been reported to reduce the theobromine content in cocoa by – products (Adeyina *et al*., 2010). The weight gain of 3.79 – 13.04 per rabbit per day was lower than 17.65 – 18.57 g/day reported by Agunbiade *et al*. (1999) and 18.00 – 20.00 g/day reported by Aduku *et al*. (1998), but was within the range of 4.94 – 14.80 g/day reported by Bawa *et al*. (2005) who fed rabbits with different levels of cocoa by - products. The values for ADG fluctuated across dietary treatments with no definite pattern. In all the processed forms of cocoa husk meal, F5 percent recorded the least ADG, implying that its associated theobromine and unpalatable nature adversely affected weight gain. This agrees with the findings of Marcel *et al*. (2011) who reported that the use of cocoa husk meal above certain permissible levels (60 – 75%) will depress the weight gain of animals. The feed conversion ratios (6.92 – 18.87) obtained in this study were poor and indicated lower feed utilization when compared to 2.93 – 4.20 obtained by Adamafio (2013), 5.33 – 7.43 obtained by Attah and Ekpeyong (1998) and 4.38 – 6.85 obtained by Ingweye and Effiong (2015). Several factors including the nature of the feed and age of the animal are known to affect FCR. The poor feed efficiency may be attributed to the high levels of fibre and

antinutrient in cocoa husk meal in the diets that even fermentation could not address, and this agrees with Devender (1978); Day and Dilworth (1984); Marcel *et al*. (2011) who have recommended low levels of cocoa husk meal and other cocoa by – products inclusion in animal diets. High intake of highly fibrous feeds by rabbit has been reported to cause reduced feed efficiency (Gidenne *et al*., 2000).

Nutrient Digestibility by Weaned Rabbits Fed Fermented and Unfermented Cocoa Husk Meal

Some of the apparent nutrient digestibility co - efficients (digestible crude protein, crude fibre and ether extract) (Table 5) of rabbits fed fermented and unfermented cocoa husk meal based-diets were significantly ($P < 0.05$) influenced by dietary treatments. The digestibility co - efficients obtained in this study were however fair in all parameters, implying that the rabbits were able to utilize nutrients in the diets for their growth. The digestible crude protein declined across dietary treatments in the unfermented and fermented cocoa husk meal diets. The crude protein digestibility in this study ranges from 43.02 – 80.21 %, only the control was in line with the range (80.40 – 88.01 %) recorded by Adedire *et al.* (2012). The decline in crude protein digestibility in cocoa husk meal diets may be associated with the anti-nutrient – (theobromine) content of the cocoa husks, which has been reported to limit its utilization in animals (Marcel *et al*., 2011) and also due to the increasing level of fibre in the diets. The decline in protein digestibility, compared with the control diet confirms the result of negative influence of fibrous substances on nutrient digestibility in farm animals (Nicodemus *et al*., 1999; Ndindana *et al*., 2002). Reduced digestibility could be attributed to the reduction in mean retention time of feed in the alimentary canal (Marcel *et al*., 2011). It has also been reported that increasing the concentration of cocoa by – products in diets will increase the concentration of neutral detergent fibre, acid detergent fibre and acid detergent lignin that reduce the action of digestive enzymes in the intestine (Kass *et al*., 1980). The digestible crude fibre values in this study were quite high. Meffeja *et al*. (2006) reported that high fibre concentrations would lead to copious production of mucus which helps in protecting the lining of the digestive tract. The co - efficients of nutrient digestibility in this study were higher than the values reported by Meffeja *et al*. (2006) for cocoa shell meal. This is because the food value of cocoa shell meal is lower than that of cocoa husk meal and because of the low digestibility of the nutrients in cocoa shell meal; it has been recommended for animals at the finishing phase than those under rapid growth (Meffeja *et al*, 2006). The digestible crude fibre (55.10 – 78.67 %) content obtained in this study is comparable to the range (55.61 – 62.88 %) reported by Adedire *et al*. (2012). The differences in nutrients digestibility between the separate studies could be attributed to age disparity of the rabbits, different feeding materials used as test ingredients, processing methods and associated fibre levels. The result obtained revealed that digestible protein did not improve significantly with unfermented and fermentation cocoa pod husk meal compared with the control group. This may be due to the inherent anti – nutrients (theobromine and caffeine) and insoluble fibre in the cocoa husk meal which was not effectively digested; as insoluble fibre can be further fermented in the caeca of rabbits to derive more protein and vitamins through coprophagy or caecotrophy (Oduguwa *et al*., 1999).

VI. CONCLUSION

Within the present experimental conditions, this study concluded that for optimum growth performance and nutrient digestibility, up to 20% cocoa husk meal should not be included in diets meant for rabbits. The study recommended that even though the control group recorded better growth performance characteristics, cheaper feed and better cost/kg gain; 10 days fermented cocoa pod husk meal proved to be a viable alternative in diets meant for rabbits.

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