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Effects of Varying Levels of Groundnut Haulms and Cowpea Shells on Performance of Weaner Rabbits

[1]G.S. Bawa, [1]S.O. Ajide, [2]I.A. Adeyinka and [2]M.K. Ajala
[1]Department of Animal Science,
[2]National Animal Production Research Institute (NAPRI),
Ahmadu Bello University, Zaria, Nigeria

Abstract: A study using 72 weaner rabbits, with an average initial weight of 276±2.16 g was conducted to determine the effects of varying levels of groundnut haulms (GNH) and cowpea shells (CPS) on their performance and nutrient utilization. The rabbits were assigned to 6 dietary treatments based on their initial live weights. There were 12 individually caged animals per treatment. The diets designated as diets 2, 3, 4, 5 and 6 contained 20% GNH + 0% CPS; 15% GNH + 15 CPS; 5% GNH + 15% CP and 0% GNH + 20% CPS, respectively. Diet 1 without groundnut haulms (GNH) and cowpea shell (CPS) served as the control. Water and feed were provided *ad libitum*. At the end of the 56 day feeding period, faeces were collected for 7 days for digestibility trial. The results showed that there were significant differences ($p<0.05$) in final live weight, feed intake, weight gain, feed conversion ratio, cost per kg gain and carcass characteristics across dietary treatments. Nutrients digestibilities were significantly ($p<0.05$) affected by treatments with diet 2 having the highest nutrients digestibilities and diet 6, the lowest. Based on the overall performance of the animals, the diet containing 20% GNH + 0% CPS is recommended for optimum performance of weaner rabbits. However, it was concluded that where both GNH and CPS are in abundance, especially at harvesting period, a combination of 15% GNH + 5% CPS (diet 3) and or 10% GNH + 10 CPS (diet 4) could be recommended for weaner rabbits.

Key words: Weaner rabbits, groundnut haulms, cowpea shells, performance, nutrient, digestibility

INTRODUCTION

The high cost and scarcity of conventional feedstuffs such as groundnut cake, soyabean cake, palm kernel cake, blood meal and fish meal is a major limiting factor to large scale commercial rabbit production in Nigeria. As more people get involved in rabbit production, it becomes imperative to develop appropriate and cost effective feeding systems for the backyard rabbit producers. Many authors opined that, the increasing scarcity of animal proteins and high cost of the conventional feedstuffs in developing countries can be solved by incorporating forages in the diets of rabbits (Owen, 1976; Cheeke, 1983; Farrel and Raharjo, 1984). Among the non ruminants, rabbits seem to be the best in the utilization of coarse materials for production of meat, preferring stuffs relatively rich in crude fibre.

Forages are cheap and readily available in Nigeria. Studies on their chemical composition show their potential as the major source of nutrients for herbivorous animals (Skerman, 1977; Telek, 1983). The potential of forages is particularly significant for rabbits since they are capable of digesting leaf proteins effectively (Cheeke and Myer, 1975). Cheeke and Patton (1979) hypothetically computed

Corresponding Author: Dr. I.A. Adeyinka, National Animal Production Research Institute (NAPRI), Ahmadu Bello University, Zaria, Nigeria

that rabbit can produce five times more meat than cattle from the same amount of alfalfa based diet. High fibre material which is usually a constraint in poultry diet is beneficial to rabbits for preventing enteritis (Cheeke and Patton, 1979).

Though providing fresh greens could be labour intensive, forages can be fed in the dry form as hay. This is of importance to backyard rabbit producers in the Guinea savannah zone, characterized by long period of dry season. Some of the abundant crop residues are groundnut haulms and cowpea shells. The availability of these crop residues is always at peak immediately after harvest which falls between October-January of every year. Despite the demand for these crop residues for the ruminants, they still remain the cheapest and most available in the dry season. Reports on the use of groundnut haulms and cowpea shells in ruminants are well documented (Bogoro *et al*., 1994; Abubakar *et al*., 2005). However, utilization of groundnut haulms and cowpea shells in rabbit diet has not been extensively studied. This study therefore, is designed to evaluate the effects of varying levels of groundnut haulms and cowpea shells on the performance of young rabbits. The specific objectives of the study include to:

- Determine the optimum level of combination of groundnut haulms and cowpea shells on the growth performance of young rabbits.
- Determine the nutrient digestibility of rabbits fed varying levels of groundnut haulms and cowpea shells.
- Evaluate the economics of raising rabbits on groundnuts and or cowpea shells.

MATERIALS AND METHODS

Experimental Site

The study was conducted at the Ahmadu Bello University, Teaching and Research Farm, Zaria, Nigeria.

Source and Processing of Groundnut Haulms and Cowpea Shells

The groundnut haulms and cowpea shells used for this study were obtained as a post harvest waste from the Institute of Agricultural Research (IAR), Ahmadu Bello University, Samaru, Zaria. These ingredients were milled before incorporation into the experimental diets.

Experimental Animals and Their Management

Seventy-two young rabbits with average initial weight of 276 g obtained from the Rabbitary unit of the Department of Animal Science, Ahmadu Bello University, Zaria, Nigeria were used for the study. After balancing for the initial weight, the animals were grouped into 6 and randomly allotted to each dietary treatment. Each of the group constituted a treatment and each rabbit within a group was a replicate. The experimental design was Completely Randomized Design (CRD).

The rabbits were housed individually in wire cages, measuring 40×60 cm in dimension. The cages were located inside a rabbit building, equipped with vents and windows for proper ventilation. Each hutch was equipped with aluminum drinkers and feeders (15×10×10 cm) and a wooden tray for collection of faecal droppings.

During the pre-experimental period, the rabbits were fed the control diet for one week. The health and welfare of the animals were strictly monitored. They were given antibiotics (tetracycline capsule) orally and also dewormed with piperazine dewormer. The animals were weighed at the beginning of the trial and thereafter on weekly basis. They were offered feeds and water *ad libitum* twice daily at 8 and 16 h, respectively. All feed refused were removed daily, air dried and weighed. Daily feed intake, weight gain and feed to gain ratio were computed.

Experimental Diet

Six iso-nitrogenous diets (19% crude protein) were formulated in which cowpea shell and groundnut haulms were included at various levels such that, the two ingredients collectively constituted 20% of the diets. Diet 1 (devoid of cowpea shells and groundnut haulms) served as the control. Diet 2 contained 20% groundnut haulms plus 0% cowpea shells. Diet 3 contained 15% groundnut haulms plus 5% cowpea shells. Diet 4 contained 10% groundnut haulms plus 10% cowpea shells. Diet 5 contained 5% groundnut haulms plus 15% cowpea shells and diet 6 contained 0% groundnut haulms plus 20% cowpea shells. Ingredients inclusion rate of the experimental diets is presented in Table 1.

Nutrient Digestibility Trial

The digestibility trial, which followed the feeding trial at the end of the 8th week, involved the collection of faecal samples from each of the rabbit for 7 days. At the end of the 56 day, feeding period, all the animals were fasted for 24 h and thereafter fed 90% of their *ad libitum* intake for 7 days. Faeces arising from the 7 day feeding plus that from another 24 h fasting period were collected. This was to ensure total collection of faecal droppings associated with the feed consumed. Faeces voided daily by each animal were collected, weighed and oven dried at 105°C for 24 h. At the end of the collection period, all samples from each animal were bulked, thoroughly mixed and 10% sub-samples were taken for determination of proximate composition, Acid Detergent Fibre (ADF) and Neutral Detergent Fibre (NDF).

Chemical Analysis

The experimental feed and faecal droppings were analyzed for proximate composition using AOAC (1990) methods, while Acid Detergent Fibre (ADF) and Neutral Detergent Fibre (NDF) were determined by the method of Goering and Vansoest (1970). The chemical composition of the experimental diets and some of the major feed ingredients are presented in Table 2 and 3, respectively.

Table 1: Composition of diets containing varying levels of groundnuts haulms and cowpea shell fed to weaner rabbits

	Diets					
Ingredients (%)	1	2	3	4	5	6
Maize	53.86	36.86	36.71	36.55	36.42	36.21
Soyabean fullfat	34.24	31.24	31.39	31.55	31.68	31.89
Groundnut haulms	0.00	20.00	15.00	10.00	5.00	0.00
Cowpea shell	0.00	0.00	5.00	10.00	15.00	20.00
Wheat offal	8.00	8.00	8.00	8.00	8.00	8.00
Bone meal	2.50	2.50	2.50	2.50	2.50	2.50
Limestone	0.50	0.50	0.50	0.50	0.50	0.50
Salt	0.30	0.30	0.30	0.30	0.30	0.30
Lysine	0.20	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20	0.20
Vitamin premix	0.20	0.20	0.20	0.20	0.20	0.20
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated nutrients levels						
Metabolizable energy (Kcal kg)	2789.00	2694.00	2698.00	2690.00	2698.00	2689.00
Crude protein (%)	19.00	19.00	19.00	19.00	19.00	19.00
Crude fibre (%)	3.97	8.01	8.52	9.03	9.54	10.05
Ether extract	8.73	9.29	9.22	9.15	9.07	9.00
Ash	2.79	4.45	4.48	4.52	4.55	4.59
Calcium (%)	1.20	1.19	1.19	1.19	1.19	1.19
Phosphorus (%)	0.88	0.81	0.81	0.81	0.81	0.81
Ca: P	1.36	1.47	1.47	1.47	1.47	1.47
Lysine (%)	1.23	1.11	1.11	1.12	1.12	1.12
Methionine+cysteine (%)	0.51	0.46	0.46	0.46	0.46	0.46
Cost per kg (N)	34.31	29.09	29.11	29.13	29.15	29.19

[a]: Roche VM502 contributed the following per kg of diet; Vitamin A: 12000 I.U; Vitamin D_3: 12000 I.U; Vitamin E: 3.6 I.U; Vitamin K: 1.8 mg; Vitam in B_2: 3.6 mg; Nicotinate: 18 mg; Calcium-d-Pantothenate: 9.6 mg; Biotin: 0.36 mg; Vitamin B_{12}: 0.12 mg; Choline chloride: 120 mg; Chlotetertacycline: 4.8 mg; Manganese: 24 mg; Iron: 48 mg; Zinc: 96 mg; Copper, 60 mg; Iodine: 1.8 mg; Cobalt: 48 mg

Table 2: Chemical analysis of experimental diets containing varying levels of groundnut haulms and cowpea shell fed to weaner rabbits

	Diets					
Nutrients (%)	1	2	3	4	5	6
Dry matter	94.88	95.84	95.78	95.61	95.68	95.68
Crude protein	19.56	19.62	19.56	19.81	19.61	19.70
Crude fibre	3.17	7.57	6.49	6.34	6.67	7.61
Ether extract	7.10	9.34	7.68	6.55	8.16	8.83
Ash	7.65	10.86	11.78	10.47	9.48	9.84
Nitrogen free extract	62.52	52.61	54.49	56.83	56.08	54.02
Acid detergent fibre	6.01	10.78	10.68	9.95	10.01	10.89
Neutral detergent fibre	19.45	23.39	25.24	24.90	16.30	17.06

Table 3: Chemical composition of major feed stuffs used for the experiment

Nutrients (%)	Maize	Soyabean full fat	Cowpea shell	Groundnut haulms
Dry matter	91.80	93.76	95.41	91.52
Crude protein	8.96	41.64	12.97	15.31
Crude fibre	2.46	5.02	33.40	23.26
Ether extract	3.18	4.01	7.00	8.93
Ash	1.65	3.45	10.70	10.11
Nitrogen free extract	83.75	23.64	41.63	43.51
Acid detergent fibre	-	-	50.14	46.48
Neutral detergent fibre	-	-	24.71	30.81

Carcass and Organ Evaluation

At the end of the feeding trial, three rabbits selected from each treatment based on the group average weight were slaughtered for carcass evaluation. Prior to slaughtering, the animals were starved over night to clear the gut and live weights were recorded. The rabbit were sacrificed by cutting the jugular vein with sharp knife. The tail close to the base was first removed and then the head, feet and pelt. Evisceration of the carcass was carried out and the internal organs and other gut contents were carefully removed, weighed separately and their corresponding weights expressed as percentages of live weight. The dressed carcass was weighed and expressed as percentage of the live weight. The carcasses were then divided into primal parts and each part expressed as percentage of live weight.

Statistical Analysis

All data collected were subjected to analysis of variance (ANOVA) for a complete randomized design. Differences between the treatment means were separated using Duncan's New Multiple Range Test. All statistical procedures were according to methods of Steel and Torrie (1980) and Duncan (1955) as packaged in SAS (1997).

RESULTS AND DISCUSSION

Growth Study

There were significant differences ($p<0.05$) in final live weight, feed intake, weight gain and cost per kg gain between dietary treatments (Table 4). No mortality was recorded in the course of the experiment. The carcass characteristic results (Table 5), also showed significant ($p<0.05$) differences across dietary treatments.

The significantly ($p<0.05$) depressed feed intake observed in the rabbits fed the control diet could be due to the relatively low fibre content of the diet. The higher feed intake of rabbits on groundnut haulms and cowpea shell based diets could be due to decrease in the caloric density of the diets with corresponding increase in dietary fibre. This is in consonance with earlier reports that high fibre diets tend to increase feed intake in rabbits (Deblas *et al*., 1981; Jokthan *et al*., 2006; Osofowora *et al*., 2006). Rabbits, like most monogastric animals voluntarily adjust their feed intake to meet their energy requirements (NRC, 1977). Alawa and Amadi (1991) reported that various by-products of fibre can

Table 4: Performance of weaner rabbits fed varying levels of groundnut haulms and cowpea shell diet

	Diets							
Parameters	1	2	3	4	5	6	SEM	LOS
Average Initial live weight (g)	278.33	276.67	276.67	278.83	276.67	276.67	14.99	NS
Average final live weight (g)	1249.17^{ab}	1398.00^{a}	1390.00^{a}	1358.00^{ab}	1326.00^{ab}	1214.00^{ab}	22.27	*
Average daily feed intake (g)	38.53^{b}	46.41^{a}	46.68^{a}	46.74^{a}	47.47^{a}	49.50^{a}	0.82	*
Average daily weight gain (g)	17.41^{b}	20.11^{a}	20.00^{a}	19.44^{ab}	19.28^{ab}	18.08^{b}	0.32	*
Feed conversion ratio	2.24^{a}	2.31^{a}	2.33^{a}	2.40^{ab}	2.41^{ab}	2.74^{b}	0.06	*
Feed cost per kg gain (₦)	76.85^{b}	67.20^{a}	67.82^{a}	69.91^{ab}	70.25^{ab}	70.58^{ab}	2.81	*
Mortality	0.00	0.00	0.00	0.00	0.00	0.00	-	-

^{abc}: Means within the same row bearing different superscript are significantly different ($p<0.05$), LOS: Level of Significance, *: Significant ($p<0.05$) difference; NS: Non Significant difference

Table 5: Carcass characteristics of weaner rabbits fed varying levels of groundnut haulms and cowpea shell

	Diets							
Characteristics	1	2	3	4	5	6	SEM	LOS
Pre slaughter weight (g)	1350.00^{bc}	1470.00^{a}	1453.33^{ab}	1445.33^{ab}	1386.67^{b}	1300.00^{c}	12.95	*
Carcass weight (g)	775.98^{c}	983.10^{a}	959.07^{a}	949.63^{bc}	899.54^{ab}	830.32^{b}	10.15	*
Dressing percentage	57.68^{b}	65.85^{a}	65.95^{a}	65.70^{a}	64.77^{a}	63.90^{a}	0.43	*
Heart (% of carcass)	0.28	0.27	0.29	0.27	0.31	0.28	0.01	NS
Lung "	0.98^{a}	0.72^{b}	0.66^{b}	0.82^{ab}	0.77^{ab}	0.68^{b}	0.02	*
Liver "	3.26^{a}	3.81^{ab}	3.22^{b}	4.37^{a}	3.62^{ab}	3.45^{b}	0.07	*
Kidney "	0.96	1.02	1.14	1.18	1.17	1.00	0.03	NS
Stomach "	1.99^{a}	1.72^{a}	1.40^{b}	1.78^{a}	1.22^{b}	1.81^{a}	0.03	*
Intestine "	20.07^{b}	21.90^{ab}	15.29^{c}	18.90^{bc}	19.56^{bc}	25.59^{a}	0.40	*
Head "	12.33	11.77	11.08	12.13	11.56	11.42	0.25	NS
Skin "	10.96^{ab}	12.59^{a}	10.73^{ab}	12.74^{a}	11.55^{ab}	9.77^{b}	0.25	*
Feet "	3.13	2.62	2.62	2.65	2.59	2.57	0.10	NS
Tail "	1.16	1.26	1.08	1.06	1.25	1.12	0.03	NS
Shoulder "	25.66	27.42	26.99	23.90	25.66	25.30	0.31	NS
Loin "	21.45^{a}	17.37^{b}	20.41^{ab}	27.78^{a}	19.86^{ab}	23.67^{a}	0.34	*
Thigh "	29.65	24.91	23.44	26.02	26.01	25.31	0.64	NS
Length of small intestine (cm)	88.33	92.33	84.33	91.33	91.33	82.67	1.43	*
Length of large intestine (cm)	257.00	313.33	261.33	300.00	265.50	283.33	5.73	*

^{abc}: Means within the same row bearing different superscripts are significantly different ($p<0.05$); SEM: Standard Error of Mean; LOS: Level of Significance; *: Significant ($p<0.05$) difference; NS: Non Significant difference

affect voluntary feed intake depending on the nature of fibre. The relatively high crude fibre and ash contents of the groundnut haulms and cowpea shells diets could be an indication of low Metabolizable energy of these diets. Thus animals on these diets consumed more feed in order to satisfy their energy requirements.

Animals on the control diet had significantly ($p<0.05$) reduced weight gain than those on diets containing varying levels of groundnut haulms and cowpea shells. This is in agreement with Taiwo *et al*. (2005), who observed reduced growth rate in weaned rabbits fed low fibre diets. There was a significant increase in the level of fibre when the diets were supplemented with groundnut haulms and cowpea shell. It is possible that animals on the control diets with low fibre had prolonged retention time of digesta in the Cecum, which might have affected both the feed intake and the weight gains. Rabbits on diet 2 (20% GNH + 0% CPS) had the highest weight gain, followed by those on diet 3 (15% GNH + 5% CPS), 4 (10% GNH + 10% CPS), 5 (5% GNH + 15% CPS) and diet 6 (0% GNH + 20% CPS), respectively. The higher weight gains of rabbits on diets 2 and 3 could be due to higher feed intake and more efficient utilization of nutrient by the animals. As the dietary level of cowpea shell inclusion increased, there was a slight decrease in weight gain by the rabbits. This could be an indication of poor conversion of the feed by the animals. Alawa and Amadi (1991) had earlier reported that the ability of rabbits to utilize highly fibrous diets may depend on the level of replacement, nature of the fibre source, age of the rabbit and length of the adaptation period of their digestive system to the fibre source. The cowpea shell used in this study had slightly lower crude protein and higher level

of Acid Detergent Fibre (ADF) than the groundnut haulm (Table 3). The ADF consist primarily of cellulose and lignin which might have affected the digestibility and utilization of nutrients resulting in depressed growth rate for animals on diet 6 (0% GNH + 20% CPS).

The results for the final live weight followed the same trend with that of the weight gains. Animals on diet 2 (20% GNH + 0% CPS) had the highest final live weight (1398.00 g) while those on diet 6 (0% GNH + 20% CPS) had the least final live weight. Supplementing the rabbits concentrate diets with GNH and or CPS resulted in higher final weight of the animals.

Feed conversion ratio results showed that, rabbits on the control diet were more efficient with a trend towards poorer feed conversion ratio as the level of groundnut haulms decreased and cowpea shell increased in the diets. Rabbits with 0% GNH + 20% CPS had the least feed conversion ratio. This suggests poorer conversion of cowpea shell diets to weight gain than groundnut haulms. The feed cost per kg was slightly higher (₦34.31) for the control diet compared to diets 2-6 with varying levels of GNH and CPS. The control diet had the highest feed cost per kg gain of ₦76.85 and the lowest was recorded by rabbit fed 20% GNH + 15% CPS. A combination of 5% GNH + 15% CPS or 0% GNH +20% CPS in diets of rabbits resulted in slight increase in the cost per kg gain compared to those on diet 2 (20% GNH + 0% CPS) and diet 3 (15% GNH + 5% CPS). No mortality was observed at the course of the experiment, suggesting that there was no significant ($p>0.05$) effect of treatments on the health status of the animals.

Carcass Characteristics

The differences among dietary treatments were significant ($p<0.05$) for the pre-slaughter weight, carcass weight and dressing percentage (Table 5). Animals fed diet 2 (20% GNH + 0% CPS) had the highest pre-slaughter weight, carcass weight and dressing percentage. The significant ($p<0.05$) decrease in carcass weight and dressing percentage of animals on diet 1 could be a reflection of depressed feed intake of animals on the control diet. The percentage yield of liver and lung showed significant differences across dietary treatments ($p<0.05$). However, percentage yield of heart, kidney and thigh were non significant ($p>0.05$) across dietary treatments. The length of the small and large intestine are significant across the dietary treatments ($p<0.05$). Animals on the GNH and CPS tended to have longer intestines than those on the control diet. The percentage yield of the stomach is significant ($p<0.05$) across dietary treatments.

Nutrient Digestibility Trial

Generally, significant differences ($p<0.05$) among dietary treatments were observed for dry matter intake and apparent dry matter, crude protein, crude fibre, ether extract, ash, nitrogen free extract, Acid Detergent Fibre and Neutral Detergent Fibre, digestibility (Table 6). Rabbits on diet 6 (0% GNH + 20% CPS) had the highest dry matter intake, while those on the control diet had the least. Feed

Table 6: Nutrient digestibilities of weaner rabbits fed varying levels of groundnut haulms and cowpea shell

	Diets							
Parameters	1	2	3	4	5	6	SEM	LOS
Dry matter intake	40.44^{b}	52.71^{ab}	48.05^{ab}	47.42^{ab}	47.73^{b}	58.37^{a}	1.71	*
Apparent digestibility								
DM	86.92^{a}	87.03^{a}	81.38^{ab}	75.75^{ab}	74.41^{ab}	61.16^{b}	2.91	*
CP	81.18^{a}	87.24^{a}	79.71^{ab}	78.75^{ab}	77.34^{b}	76.28^{b}	0.85	*
CF	38.88^{c}	68.87^{a}	59.46^{ab}	58.88^{ab}	55.32^{ab}	50.31^{b}	2.73	*
EE	91.38^{ab}	93.92^{a}	91.38^{ab}	88.36^{b}	88.10^{b}	88.36^{b}	0.48	*
Ash	82.55^{a}	85.85^{a}	72.93^{b}	66.44^{bc}	63.98^{bc}	60.53^{c}	1.33	*
NFE	89.42^{a}	87.31^{a}	80.14^{b}	77.89^{b}	76.82^{b}	73.70^{b}	0.87	*
ADF	66.26^{ab}	70.02^{a}	51.37^{b}	48.89^{c}	47.81^{c}	46.37^{c}	2.21	*
NDF	62.86^{ab}	74.02^{a}	63.49^{ab}	58.62^{b}	54.09^{c}	50.69^{c}	1.79	*

^{abc}: Means within the same row bearing different superscripts are significantly different ($p<0.05$); SEM: Standard Error of Mean; LOS: Level of Significance; *: Significant ($p<0.05$) difference; NS: Non Significant difference

intake and consequently, dry matter intake in monogastrics is a function of dietary fibre and energy (Dairo, 1999). The slight increase in the dry matter intake of rabbits fed groundnut haulms and cowpea shell diets could be attributed to increase in the level of dietary fibre.

The apparent dry matter digestibility for animals on diet 6 (0% GNH + 20% CPS) was significantly ($p>0.05$) depressed compared to those on the control diet and diet 2 (20% GNH + 0% CPS). Studies have shown that as dietary fibre or cell wall material levels increased, the apparent digestibility of dry matter was depressed (Yaakugh *et al*., 1988). This has been confirmed in the present study. As the level of cowpea shell increased in the diets, the dietary crude fibre and Acid Detergent Fibre levels also increased. This could be responsible for the significant decrease in the apparent dry matter digestibility for rabbits on diet 6. The apparent dry matter digestibility result is in agreement with the reports of Fomukong (1997) and Abubakar *et al*. (2005) who observed reduced apparent dry matter digestibility, on animals fed high amount of cowpea shells.

The apparent crude protein digestibility was generally high for all the animals on the experimental diets. However, inclusion of groundnut haulms and or cowpea shells in the diets resulted in decreased crude protein digestibility. Fibrous feeds are known to decrease the digestibility of crude protein. It is most likely that the presence of fibre in diets of rabbits fed groundnut haulms and cowpea shells sped up the rate of passage of feed along the gastro intestinal tract with consequent decrease in crude protein digestibility among other nutrients. Increased excretion of endogenous protein in the faeces when high fibre diets are fed could be a factor in reducing apparent crude protein digestibility. The relatively higher fibre and lowered crude protein content of cowpea shells compared to groundnut haulms could also be a reason for the decreased crude protein digestibility as the level of cowpea shells increased and groundnut haulms decreased in the diets.

The digestibility values for crude fibre were generally lower than those of the other nutrients. The crude fibre digestibility values decreased as the level of cowpea shells and crude fibre increased in the diets. Agunbiade *et al*. (2002), had earlier reported significant decrease in crude fibre digestibility with increasing level of fibre in the diets. The variation in the crude fibre digestibility values among rabbits fed varying levels of groundnut haulms and cowpea shells could be due to the type of fibre in the diets. Fibre from different sources could vary in their digestibility depending on the proportions of cellulose, hemicellulose and lignin. Cowpea shells used in the present study had higher fibre content (33.40%) than groundnut haulms (23.26%).

High levels of fibre in diets normally speed up the rate of feed passage in the gut. The feed is thus exposed to the action of enzymes for a shorter period which could be responsible for reduction in its digestibility as observed in animals fed higher levels of cowpea shells. The significantly lowered ($p<0.05$) crude fibre digestibility of animals on the control diet compared to the other diets could be a reflection of the lower crude fibre content. The ether extract, ash and nitrogen free extract digestibility followed the same trend with that of the dry matter and crude protein digestibility. The NDF and ADF apparent digestibility also followed the same pattern with that of the crude fibre digestibility. The overall apparent nutrient digestibility results supported the growth performance study.

CONCLUSION

Generally, the results obtained from this study supported the need for supplementing rabbit concentrate diets with fibrous forage materials for optimum growth performance. The performance of the animals on diet 2 could be an indication of the superiority of groundnut haulms over cowpea shells in terms of their nutritive values. However where both ingredients are in abundance especially at harvesting period, a combination of 15% GNH + 5% CPS (diet 3) and or 10% GNH + 10% CPS (diet 4) could be recommended for weaner rabbits.

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