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# Effect of varying levels of groundnut (*Arachis hypogaea*) haulms on the growth performance of weaners rabbits (*Oryctalagus cuniculus*)

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**Thirty two, 6 to 8 weeks old rabbits of mongrel origin, balanced for sex and weighing averagely 0.92 kg were allotted to four dietary treatments in a complete randomized design (CRD) with 8 rabbits per treatment. The diets contained groundnut haulms (GH) at 40, 50, 60 and 70% levels of inclusion with a crude protein content of 16%. The rabbits were fed for eight weeks with 6 weeks of preliminary feeding and 2 weeks of faecal collection. Data collected were subjected to analysis of variance (ANOVA). The results obtained indicated an increase in feed conversion ratio (FCR), acid detergent fiber digestibility (ADFD), crude protein digestibility (CPD) and feed cost (=N=) / kg weight gain (FC/WG), and a decrease in dry matter intake (DMI), dry matter digestibility (DMD), daily weight gain (DWG), crude protein digestibility (CPD) and digestible dry matter intake (DDMI) with increasing fibre level. There was a significant difference (P<0.01) among the mean values for acid detergent fibre intake (ADFI) and digestible acid detergent fibre intake (DADFI) indicating that these variables were affected by fibre levels. All the rabbits fed on the four diets gained weight. Taking into consideration feed cost and the availability of grains as a limiting factor to increase animal production, it can be concluded that GH, a potential crop residue can be included in the diet of growing rabbits at up to 70% level, since this did not cause any significant deleterious effect on the growth and performance of the rabbits.**

**Key words:** Groundnut haulms, growth, performance, rabbits.

## INTRODUCTION

Crop residue will increasingly become the dominant feed resource for livestock, especially in most Savannah ecosystems where more and more rangelands are being converted into crop lands. Projections of demand and supply of livestock products in Sub Saharan Africa (SSA) are daunting just as for cereals. Milk output must

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increase from the 1988 level of approximately 8.2 million tons to 35.6 million tons by 2025, a 4% compound annual growth rate. Similarly, meat output must expand at a 3.4% compound annual growth rate from 3.2 million tones in 1988 to 11.2 million tons in 2025 (Winrock International, 1992). Meat production in Africa has been on the decline since 1960 and unless urgent actions are taken to increase or sustain animal products, the much needed animal protein supply will soon disappear from most family menus (Nuru, 1988). More than 42% of the total present populations of SSA live in West Africa with Nigeria having the largest population (Winrock International, 1992). Thus, the tremendous challenges facing livestock production in SSA and Nigeria in particular is to generate a sustainable feed supply response which can match the expected demand.

The human population in Nigeria stands at 173.6 million and is growing at the rate of 2.8% per annum (PRB, 2013), much faster than the animal supply growth rate of 1.9% (Adegbola, 1998). The per capita consumption of animal protein in Nigeria at present stands below 9 g per day as compared to over 50 g per day in North America and Europe (Boland et al., 2013). There is therefore a protein: calorie deficiency in Nigeria resulting in malnutrition, whose common effects can be very debilitating especially on children (NRC, 1991). In poor countries, even the middle class eat less meat in a year than the population of North America and Europe eat in a month (Winrock International, 1992). The breakthrough in livestock production in these countries is attributed to the use of surplus grains and rich oil seed cakes to meet the nutritional requirement of the animals. In Nigeria, there is no grain surplus and cereals such as sorghum, maize and millet form the staple food of the populace and therefore cannot be used at the required level for feeding animals (Umunna and Maisamari, 1981). Faced with the shortage of grains and the zeal to bridge the gap in animal protein consumption, it becomes necessary to search for economical feed stuffs, cheap, easy and readily available such as crop residues and agro-industrial by-products, which can be used to feed animals for sustainable production (Alhassan, 1988; Okaiyeto, 1984).

Rabbit production exemplifies the vast possibilities for increasing meat production in the most poverty stricken parts of the world. This is due to its high fecundity, fast growth rate, short generation interval and low feed cost. The rabbit's capacity for reproduction is legendary. A single male and four females can produce as many as 3,000 offspring a year, representing some 1,450 kg of meat - as much as an average sized cow (Oyawoye, 1989). The meat of rabbit is nutritious, all white, fine grained and appetizing, and has more protein and less fat, cholesterol, sodium and calories per grain than beef, pork, lamb or chicken (NRC, 1991; Oyawoye, 1989). It is therefore the meat of choice for coronary heart patients. With a dressing percentage of 74%, the rabbit meat is the perfect size for family consumption, requiring no special preservation like drying, curing, or refrigeration. Other important products of rabbits include the fur and pelt which are used in making garments as well as the feet and tails used in good luck charms and many other curios (NRC, 1991). The ability of rabbit to effectively utilize fibrous feedstuffs that cannot be consumed by humans, gives them their potential as an emerging meat and fur producing animal. Taking into consideration feed cost as a limiting factor in livestock production, the rabbit stands out unique because it does not compete directly with man for the scarce grains available. The objective of this study therefore was to evaluate the performance of rabbits fed groundnut haulms, a potential legume crop residue in Nigeria, as a source of fibre at levels of 40, 50, 60 and 70% inclusion in the diets.

## MATERIALS AND METHODS

### Study area

The study was carried out in Bauchi State which occupies the centre of the Northern Region in the sudan savannah (arid and semi- arid) ecological zone of Nigeria. Its centre is on latitude $10°19^{1}$ and longitude $90° 49^{1}$ at an altitude of 590 m above sea level. There are two distinct seasons in a year: the rainy season (between May- October) and dry season (between November-April). The mean annual rainfall is 1091 mm. Detailed climatic description of Bauchi is well documented (Butswat, 1994).

### Diets

Four diets were formulated using groundnut haulms at varying levels of 40, 50, 60, and 70% in each diet. The groundnut haulms were ground and mixed together with maize and groundnut cake. Table 1 shows the formulated diets and their chemical composition. The diets were in mash form.

### Experimental rabbits and management

Using the completely randomized design, 32 adapted exotic breed of rabbits of mongrel origin, balanced for sex, were allotted to four dietary treatments with eight rabbits per treatment. The rabbits had an average weight of 0.92 kg and were 6 to 8 weeks old. They were dewormed and given antibiotics prior to the commencement of the experiment. Each rabbit was housed in a metabolic cage, fitted with a catch tray beneath for easy collection of clean faeces void of urine contamination. Each rabbit was provided with 100 g of the diet in mash form in a specially manufactured metal feed trough to minimize feed wastage and 500 mls of water at 7.00 h daily. Feed refusals were collected and weighed the next morning to determine the actual quantity of feed consumed before providing fresh feed. The rabbits were fed for eight weeks, and faeces were collected on the $7^{th}$ and $8^{th}$ week. Data was collected for:

1. Feed intake variables (dry matter intake, crude protein intake, water intake and acid detergent fiber intake);
2. Growth and performance variables (feed cost =N= /kg weight gain, daily weight gain and feed conversion ratio);
3. Digestibility of nutrients (dry matter digestibility, crude protein digestibility and acid detergent fiber digestibility);
4. Digestible nutrient intake (digestible dry matter intake, digestible crude protein intake and digestible acid detergent fiber intake);

**Table 1.** Composition of the experimental diets.

| Ingredients (%) | Diets | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| | 40% | 50% | 60% | 70% |
| Maize | 37.79 | 28.90 | 19.58 | 10.31 |
| Groundnut cake | 19.21 | 18.10 | 17.42 | 16.69 |
| Groundnut Haulms | 40.00 | 50.00 | 60.00 | 70.00 |
| Bone meal | 2.00 | 2.00 | 2.00 | 2.00 |
| Salt | 0.50 | 0.50 | 0.50 | 0.50 |
| *Vitamin / mineral premix | 0.50 | 0.50 | 0.50 | 0.50 |
| **Total** | 100 | 100 | 100 | 100 |

*Vitamin/Mineral premix composition per kg diet: Vitamin A, 3,200,000 iu; Vitamin D3, 1,200 iu; Vitamin E, 3,200 iu; Vitamin $K_3$, 800 mg; Vitamin $B_1$, 400 mcg; Selenium (Se), 40 mg; Manganese (Mn), 32,000 mg; Pantothenic acid, 2000 mg; folic acid, 200 mg; Chlorine chloride, 60,000 mg; Iron (Fe), 8,000 mg; Copper (Cu), 3,200 mg; Zinc (Zn), 200 mg; Cobalt (Co), 90 mg; Iodine (I), 800 mg

**Table 2. C**hemical composition of the diets (%).

| Parameter | Diets | | | |
|---|---|---|---|---|
| | 40% | 50% | 60% | 70% |
| Dry matter | 96.66 | 96.77 | 96.95 | 96.90 |
| Crude protein | 15.96 | 15.56 | 16.19 | 16.50 |
| Acid detergent fibre | 19.58 | 22.94 | 26.72 | 29.83 |
| Ash | 7.73 | 8.34 | 9.30 | 11.35 |

### Chemical analysis

Feed samples from each diet and faeces collected separately for each rabbit were oven dried for 48 h at 105°C. The faeces were then ground and both feed and faeces were stored in separate labeled sample bottles. Proximate analysis was done by the AOAC (1980) methods for the estimation of crude protein and ash, while the acid detergent fibre was determined by the method of Goering and Van Soest (1970). Table 2 shows the composition of the chemical analysis of the diets.

### Statistical analysis

The data collected for each parameter were subjected to analysis of variance (ANOVA). Significant differences among means were determined by least significant difference (LSD) test (Steel and Torrie, 1983).

## RESULTS AND DISCUSSION

Results on the effect of level of GH inclusion on nutrient intake, feed cost/kg weight gain and growth performance of rabbits fed on the different diets is shown in Table 3. There was no significant difference in the means of all the nutrient intake variables except for ADFI ($P<0.01$). The ADFI values ranged from 10.11 g on the 50% GH diet to 19.28 g on the 70% GH diet. The nutrient digestibility percentage of all the diets is recorded in Table 4. No significant difference was recorded for the dry matter, crude protein and acid detergent fiber digestibility. Among the digestible nutrient intake variables, highly significant difference ($P<0.01$) was observed for DADFI and not for the other variables (Table 5). The values ranged between 3.81 g/day on the 50% GH diet to 8.00 g on the 70% GH diet.

There was a decrease in dry matter intake (DMI) with increasing fibre levels which is at variance with the reports of Butcher et al. (1981) and Abour-Ashour and Barakat (1986). The DMI was in the range of 4.8 to 5% of their body weight and therefore comparable with the range of 4 to 7% reported by Reddy et al. (1977) for rabbits under temperate conditions. The DMI values obtained were similar to those of Aduku et al. (1986). Deblas et al. (1981) reported that the crude fibre of a diet had a significant effect on the DMI. They found a linear increase in the DMI of 2.97 g per day with each unit increase in crude fibre. Rabbits eat more of pelleted feed than feed in mash form. Reports have shown that rabbits ate 35% more feed and gained 60% more weight on pelleted feed than on mash diets (Reddy et al., 1977), and this might have been responsible for the low DMI, although there was any significant difference.

Crude protein intake (CPI) depends on the crude protein of the diet, nature of the diet and environmental

**Table 3.** Effect of level of groundnut haulms on nutrient intake and performance of Weaners' rabbits.

| Parameter | Diets | | | | | |
|---|---|---|---|---|---|---|
| | 40% | 50% | 60% | 70% | S.E | LOS |
| DMI(g) | 65.04 | 63.44 | 59.63 | 63.57 | 2.40 | NS |
| CPI (g) | 10.37 | 9.87 | 9.65 | 10.46 | 0.38 | NS |
| ADFI(g) | 12.74 | 10.11 | 15.93 | 19.28 | 0.54 | ** |
| DWI(ml) | 370.44 | 387.80 | 309.48 | 322.00 | 19.33 | NS |
| FCR | 5.24 | 6.12 | 7.14 | 7.49 | 0.79 | NS |
| DWG (g) | 12.68 | 10.85 | 8.64 | 9.01 | 1.18 | NS |
| FC(=N=)/kg WG | 218.52 | 240.64 | 256.72 | 261.04 | 28.24 | NS |

DMI: Dry matter intake; CPI: Crude protein intake; ADFI: Acid detergent fibre intake; DWI: Daily water intake; FCR: Feed conversion ratio; DWG: Daily weight gain; FC (=N=)/KgWG: Feed cost in naira per kilogram weight gain; ** - P<0.01; NS: Not Significant; LOS: Level of Significance.

**Table 4.** Mean and Standard error of nutrient digestibility (%) in weaner rabbits fed on graded levels of GH

| Parameter (%) | Diets | | | | | |
|---|---|---|---|---|---|---|
| | 40% | 50% | 60% | 70% | S.E | LOS |
| DMD | 63.41 | 63.13 | 62.45 | 64.89 | 2.71 | NS |
| CPD | 72.09 | 67.73 | 71.51 | 71.16 | 3.12 | NS |
| ADFD | 39.74 | 37.53 | 41.12 | 41.57 | 1.96 | NS |

DMD: Dry matter digestibility; CPD: Crude protein digestibility; ADFD - Acid detergent fibre digestibility.

**Table 5.** Mean and standard error of digestible nutrient intake (g/day) in weaner's rabbits fed graded levels of GH.

| Parameter (g/day) | Diets | | | | | |
|---|---|---|---|---|---|---|
| | 40% | 50% | 60% | 70% | S.E | LOS |
| DDMI | 41.03 | 40.03 | 37.46 | 39.26 | 2.51 | NS |
| DCPI | 7.48 | 6.67 | 6.96 | 7.46 | 0.47 | NS |
| DADFI | 4.94 | 3.81 | 6.80 | 8.00 | 0.33 | ** |

DDMI: Digestible dry matter intake; DCPI – Digestible crude protein intake; DADFI – Digestible acid detergent fibre intake; ** - P< 0.01; NS - Not significant; LOS - level of significance.

effects. The CPI obtained in this study was lower than the values stipulated by the NRC (1977) for rabbits under temperate conditions. The CPI ranged from 9.65 to 10.46 g/day and is comparable to those reported by Doma (1994). The low CPI might have been due to the low DMI of the diet caused by the nature of the diet and high ambient temperatures of the sub-humid tropics. High ambient temperatures have an adverse effect on voluntary feed intake by causing stress and discomfort (Anonymous, 1972). Despite the slightly higher crude protein intake by the rabbits in diet 4, its effect could not be felt because of the high fiber content of the diet thereby masking its digestibility and eventual utilization (Table 3).

Acid detergent fiber intake (ADFI) of rabbits on diet 4 (70% GH diet) was significantly (P<0.01) higher than those for the other diets, thus revealing that ADFI was influenced by the level of inclusion of GH in the diet. This is in agreement with the report of Spreadbury and John (1978), who stated that feed consumption increased with increase in the ADF of the diet. The values ranged from 10.11 g/day on the 50% GH diet to 19.28 g/day on the 70% GH diet.

Water Intake (WI) is a function of the nature of diet, age of the animal and ambient temperature; the drier the diet the more water is consumed. Generally, literature information on water intake estimates is scarce because in most experiments, water is usually given *ad libitum*. The WI ranged from 309.48 ml per animal per day on the 60% GH diet to 387.80 ml on the 50% GH diet. Cheeke

and Patton (1987) reported that rabbits drank about 120 mls per kg at 70 days of age and the amount decreased to about 64 ml at 340 days under environmental temperature of 28°C. They also observed that when temperature drops to 9°C, water intake was 76 ml and decreasing to 46 ml per kg of feed consumed.

Rabbits on all four diets gained weight. The daily weight gain (DWG) ranged from 8.64 g/day on the 60% GH diet to 12.68 g/day on the 40% GH diet. These values were lower than 17.4 g/day reported by Aduku et al. (1986) for rabbits fed groundnut haulm diets, 41.1 g/day reported by Pote et al. (1980) for exotic breed of rabbits feed 50% alfalfa and 19.1 g ADF diets under temperate conditions and 45.1 g/day obtained by Harris et al. (1984) on diets containing 40% *Desmodium*. The trend in DWG observed among the mean values of the diets is in agreement with the findings of Spreadbury and John (1978), who stated that rabbits performed better on a low fibre than on a high fibre diet. The low values obtained in our study may be due to low DMI, genetic as well as environmental effects.

The feed conversion ratio (FCR) is an index of the efficiency of converting unit feed into unit weight gain (Feed/gain). There was an increase in the FCR with increasing fibre level though this was not significant. The increase is in agreement with the findings of Pote et al. (1980). Alawa and Amadi (1991) observed that rabbits consume more of a high fibre diet to compensate for the low energy content of such a diet. The FCR of 5.24 on the 40% GH diet was higher than 3.20 observed by Pote et al. (1980) on 40% alfalfa- based diet.

Feed cost per kg weight gain is an estimate of the cost in naira of the quantity of feed required to obtain a kilogram weight of rabbit meat. The lowest value was observed on the 40% GH diet (218.52 naira) and the highest value of 261.04 naira was recorded on the 70% GH diet. These differences were, however, not significant.

Digestibility is a measure of that portion of a feed which is not recovered in the faeces and is therefore considered to have been absorbed and assimilated that is, put into use by the animal (Ositelu, 1980). The dry matter digestibility (DMD) of the diets ranged from 62.46% on the 60% GH diet to 68.89% on the 70% GH diet. The 40% and 50% GH diets had similar DMD's of 63.14% and 63.13% respectively. The DMD value obtained on the 40% GH diet was lower than those obtained by Doma (1994) on 40% Cowpea Shells (CPS) and 40% Maize Cobs (MC) diets which were 67.74 and 67.38% respectively. The trend obtained in DMD was similar with the findings of Adegbola and Akinwande (1981) who reported a decrease in DMD with increasing fibre level.

The crude protein digestibility (CPD) of the diets was fairly high, ranging from 67.73% on the 50% to 72.09% on the 40% GH diets respectively. The high CPD is in agreement with the report of Ekpenyong (1986), who observed that rabbits are able to digest non-fibre bound protein in fibrous materials as much as in cattle and even utilizing it more efficiently since the protein will not be broken down into ammonia as is the case in the rumen. The CPD value of 72.09% observed on the 40% GH diet was comparable to 71.62% obtained by Doma (1994) on 40% CPS diet. The decrease in CPD with increasing fibre level is in agreement with the findings of Esonu and Udedibie (1993), who attributed this to increasing metabolic faecal nitrogen and the masking effect of fibre on protein digestion.

The acid detergent fibre digestibility (ADFD) ranged from 37.53% on the 50% to 41.57% on the 70% GH diets, indicating an increase with increasing fibre level. The increase is at variance with the findings of Esonu and Udedibie (1993) and Adegbola et al. (1985). Rabbits are much less able to digest fibre than ruminants, since fibre digestion in rabbits is post gastric. Rabbits are hindgut fermenters, selecting and retaining small rather than large particles. Normal peristaltic movements propel the large, less dense fibre particles through the colon while contraction of the haustra of the colon moves fluids and small particles in a retrograde manner to the Caecum (Oyawoye, 1989). Cheeke et al. (1986) reported that fibre is poorly digested in the rabbit because it is rapidly propelled through the colon and excreted as hard faeces. The rabbit tends to ignore the fibre and concentrate on the 75 to 80% non-fibre fraction which is retained for prolonged period in the caecum, allowing extensive fermentation. They concluded that caecotrophy in rabbits is more important in the digestion of forage protein than fibre utilization due to selective retention of non-fibre components in the caecum. Spreadbury and John (1978) concluded that for optimum growth, it is advisable to maintain the level of ADF in the diet above 50 g and preferably at about 100 g ADF per kg of diet. They also found that feed consumption increased from 80g to 115 g/day as the ADF concentration in the diet increased from 39 to 270 g ADF per kg, and recommended 140 g per kg for growing rabbits and up to 250 g per kg for replacement of breeding stock in their later stages of growth. The ADF of the diets ranged from 19.58% on the 40% GH diet to 29.83% on the 70% GH diet (Table 2), representing 195.8, 229.4, 267.2 and 298.3 g of ADF per kg on the 40, 50, 60 and 70% GH diets respectively.

The highest digestible dry matter intake (DDMI) of 41.03 g was obtained in rabbits fed 40% GH diets and the lowest value of 37.46 g on the 60% GH diet, indicating a decrease in DDMI with increasing fibre level. The DDMI of 41.03 g obtained on the 40% GH diet was comparable to 43.33 g obtained by Doma (1994) on 40% CPS based diets. The DDMI is related to the DMI and the nature or quality of the diets. In this experiment, the diets were fed in mash rather than pellet form. The digestible crude protein intake (DCPI) was similar for the 40 and 70% GH diets being 7.48 and 7.46 g/day as well as for the 50 and 60% GH diets being 6.69 and 6.96 g/day respectively. Despite the high crude protein content of the

60 and 70% GH diets (16.19 and 16.50% respectively), the digestible crude protein intake did not reflect correspondingly because of the low digestible energy of the diets resulting from the high fibre causing inefficient protein utilization. The DCPI of the 40%, 50 and 70% GH diets represented 11% of the feed consumed while the value for the 60% GH diet was 12%. These results are in agreement with NRC (1977) values, which gave estimates of digestible protein (DP) requirement for growth of rabbits as 11 to 12% of the diets consumed. The digestible acid detergent fibre intake (DADFI) ranged from 3.81 g on the 50% GH diet to 8.00 g on the 70% GH diet respectively, thus revealing an increase in DADFI with increasing fibre level. There was a significant ($P<0.01$) effect on the DADFI, indicating that DADFI of the diets depended on the level of inclusion of groundnut haulms. The DADFI of the 70% GH diet was significantly higher than that of the other diets. These values are comparable to those reported by Doma (1994). The low values obtained for DADFI indicates that acid detergent fibre is less digestible, probably due to its high lignin content. Champe and Maurice (1983) reported that rabbits require crude fibre in excess of 9% to reduce the incidence of enteritis, whilst high fibre levels in excess of 20% may lead to caecal impaction and limit energy intake. Cheeke et al. (1986) stated that dietary fibre level for rabbits should be in the range of 15 to 20%. The fibre levels in this experiment ranged from 19.58% on the 40% GH diets to 29.83% on the 70% GH diet (Table 2). Juan and Stahh (1982) stated that inclusion of forage in the diets of rabbits greatly economizes the amount of concentrate feed needed.

## CONCLUSION AND RECOMMENDATIONS

On the bases of the above findings, the 40% GH diet gave better results for most of the parameters studied, though with no significant difference. Thus, we can conclude that, groundnut haulms can be added to rabbit diets at up to 70% level, taking into consideration that the availability of concentrates or grains is the limiting factor to increased animal production. Therefore, it can be recommended that groundnut haulms may be added at up to 70% in rabbit diets since this level did not cause any deleterious effect or significant depression in daily weight gain and feed conversion efficiency in the weaner rabbits under study.

## Conflict of Interests

The author(s) have not declared any conflict of interests.

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