

## Nutrient digestibility and nitrogen utilization of rabbits fed on graded levels of dried okra leaves (*Abelmoschus esculentus*)

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Target Audience: rabbit farmers, vegetable farmers, Researchers

### Abstract

Forty-five unsexed rabbits crosses (Chinchilla x New Zealand White) 5-6 weeks old with average weight of 720g were used in a 70 day feeding trial to evaluate the nutrient digestibility and nitrogen utilization of growing rabbits fed on varying levels of dried okra leaves (DOL). The rabbits were assigned into five dietary treatment groups (T1, T2, T3, T4 and T5) containing DOL at 0.00%, 2.50%, 5.00%, 7.50% and 10.00% inclusion levels respectively. Each treatment had 9 rabbits consisting of three replicates with each replicate having 3 rabbits in a completely randomized design. Data collected were subjected to one-way analysis of variance (ANOVA) using a general linear procedure of SAS (2007) and significant means were separated by Duncan's multiple range test of same statistical package at 5% level of probability. Results obtained indicated that digestibility of dry matter, ether extract, and nitrogen free extract showed no significant difference ( $P>0.05$ ) among the treatments. However, the digestibility of crude protein, ash, and crude fibre were significantly difference ( $P<0.05$ ) among the treatments. The nitrogen utilization of the experimental diets indicated that the diets were not significant ( $P>0.05$ ) in the nitrogen intake, faecal nitrogen and nitrogen output. It was concluded that DOL can be included in diets for growing rabbits at 2.50% level of dried okra leaves inclusion is recommended for adoption by farmers to maximize nutrient digestibility and nitrogen utilization.

**Key words:** Okra leaves, Nutrient intake, Nutrient digestibility, Rabbits

### Description of Problem

In most developing countries, particularly Nigeria, average consumption of animal protein is very low, estimated at 4.5g per day as against minimum requirement of 35g per day (1). According to (2) reported that high cost of conventional animal feed might be responsible for the low protein consumption. This reduced animal protein intake has far-reaching implication on the health status and well-being of the populace (2). Therefore, efforts are being directed towards exploring all reasonable options to meet the recommended level at a reduced cost. Rabbits have greater ability to efficiently convert leaf meal and agro-

industrial by-products into meat compared to other ruminant livestock (3). This has necessitated the need to seek for alternative feed sources in forages. The use of okra leaves as forage is among the possible alternatives (3). This is because of the greater availability of okra leaves and ability of rabbits to convert okra leaves into meat for human consumption (4). Rabbits can be fed on off-season feeds which can be available during the dry season. Furthermore, the ability of rabbits to perform well on unconventional feeds is an added advantage. Okra (*Abelmoschus esculentus*) is one of the most well-known and utilized species of the family (*Malvaceae*). It is also

a vegetable crop grown for its immature pods that can be consumed as fried or boiled vegetable or may be added to salads, soup, and stew (5). World production of okra as fresh vegetables is estimated at six million tonnes per year (5). Okra has important sources of ingredients for use as functional foods (6). Okra leaves has essential B vitamins for creating and maintaining new cells and foliate, a vital substance for optimum pregnancy. Vitamin C aids in preventing birth defects and enables the foetus to develop completely (7). Okra leaves is commonly used both as food and for curative purposes showing low calories, a good source of edible fibre contains important bioactive compounds such as carotene folic acid, thiamine, niacin, Vitamin C, and amino acids. Okra leaves are highly perishable because of its high moisture content and respiratory activities, leading to increased post-harvest losses due to poor storage or preservation methods (8). Processing and storage foods have become integral parts of modern day food chain, and seasonal produce are processed and preserved during the peak harvest to reduce post-harvest loss, therefore making the products available all year round (9). The antioxidant activity of the okra leaves is due to its content of phenolic compounds which are effective antioxidant and can be used in the prevention of degenerative processes such as cancer, cardiovascular diseases and diabetes (10). Therefore, the present experiment was conducted to determine appropriate supplementation level of DOL that can enhance productive performance and generally improve the physiological wellbeing of growing rabbits without adverse effect(s).

## Materials and Methods

### Experimental site

The experiment was conducted at the

rabbitary unit of the Directorate of University Farms (DUFARMS) Federal University of Agriculture, Alabata road, Abeokuta, Ogun state. The University is located on latitude 7° 10'N, longitude 3°2'E (Google Earth 2016) and in altitude of 76m above sea level. It lies between South-Western part of Nigeria with a prevailing tropical climate with mean annual rainfall of 1,037 mm, an average temperature of 34.7°C. The vegetation in the University represents the interphase between the tropical rainforest and the derived savannah with relative humidity of 82%.

### Source of Ingredients

The fresh forage (okra leaves) were purchased from a reputable farmer in Igboora, Oyo state. The ingredients for the formulation of the concentrate ration were purchased in Abeokuta, Ogun state.

### Animals and Management

Forty-five (45) unsexed rabbit crosses (Chinchilla X Newzealand white) of 5 - 6 weeks of age were assigned to 5 treatments groups using completely randomized design and on weight equalization basis and the rabbits were fed concentrates and forages *ad libitum*.

The rabbits were individually housed in wooden hutches and subjected to two weeks acclimatization period. They were treated against potential endo- and ecto-parasites and fed diet containing 17% crude protein and about 2300 kcal/kg metabolizable energy and they were balanced for weight. The rabbits were weighed at the commencement of the experiment and subsequently once per week. The cages were slightly raised above the floor for easy collection of faeces and cleaning. Plastic drinkers and metallic feeding troughs were provided in each cage. The drinkers were washed daily. The rabbits were fed ration of

100g in two installments at 8.00 am and 4.00pm. The five experimental diets were formulated as shown in Table 1. Diet 1 was the control and had no DOL. Variation in the diets were achieved by adding 2.50%, 5.00%, 7.50% and 10.00% respectively. Each of the diet contained at least 17% crude protein (Table 2).

### **Data Collection**

At the 9th week of the experiment, nutrient digestibility studies were carried out. 3 rabbits per treatment that is 1 rabbit per replicate (with weights closer to the average weights of the rabbits in the treatment) were selected for the determination of nitrogen utilization and nutrient digestibility. The rabbits were housed individually in cleaned and disinfected hutches designed for metabolic trials and were allowed to acclimatize for 3 days before the commencement of the trial. Each hutch was provided with a drinker and feeder. The rabbits were fed known weight of their respective experimental diets (about 5g above the daily requirements) and faecal collection for digestibility and nitrogen utilization was done for 7 days. The fresh faeces were collected daily per rabbit with a fine wire mesh tray attached to each hutch. The faeces were weighed fresh, wrapped in an aluminum foil and then oven dry at 80°C (for 24 hours. At the end of 7<sup>th</sup> day, the faecal sample for each rabbit were pooled, ground and 3g of dried faecal sample was taken for determination of proximate composition, fibre fractions and mineral constituents. These were used to calculate the percentage digestibility for each nutrient. The nutrient digestibility was calculated according to the formula proposed by (12).

### **Nutrient Digestibility (%) =**

$$\frac{\text{Nutrient in feed intake} - \text{Nutrient in faecal output}}{\text{Nutrient in feed intake}} \times 100$$

### **Statistical Analysis**

Data obtained from the experiment were subjected to one-way analysis of variance (ANOVA), using SAS (13). Means were separated using Duncan's multiple range test (DMRT) of the same statistical package.

### **Results and Discussion**

Table 3 shows the nutrient digestibility of growing rabbits fed diet containing varying levels of DOL. Digestibility of dry matter, ether extract, and nitrogen free extract showed no significant difference ( $P>0.05$ ) among the treatments. However, the digestibility of crude protein, ash, and crude fibre were significantly difference ( $P<0.05$ ). Inclusion of 0.00 % of DOL in the diets of growing rabbits increased ( $P<0.05$ ) ash digestibility (63.54%). and 10.00% DOL reduced ( $P<0.05$ ) ash digestibility (38.81%). Similarly, 0.00 % of DOL in the diets of growing rabbits increased ( $P<0.05$ ) crude protein (74.87%) and 10.00 % inclusion of DOL reduced ( $P<0.05$ ) crude protein (69.03%). However, inclusion of 7.50% DOL crude protein (70.28%) and 10.00% DOL crude protein (69.03%) are statistically similar. Inclusion of 7.50% DOL in the diets of growing rabbits increased ( $P<0.05$ ) crude fibre (77.07 %) and inclusion of 10.00 % DOL reduced ( $P<0.05$ ) crude fibre (74.68 %). However, inclusion of 5.00% DOL crude fibre (75.14%) and 10.00% DOL crude fibre (74.68%) were statistically similar. It was observed that ether extract decreased with increasing level of inclusion of dried okra leaves.

Crude protein digestibility values reported in this study indicated a high efficiency in crude protein utilization. The present digestibility values were generally higher than the values reported by (9) respectively in the tropics. In this study, the values obtained for dry matter and crude

protein is in agreement with the findings of (1).

The nitrogen utilization of the experimental diets is shown in Table 3. The result indicated that there were no significant ( $P>0.05$ ) effect of dietary treatment on the nitrogen intake, faecal nitrogen and nitrogen output but urinary nitrogen, nitrogen retained and percentage nitrogen retention were significantly ( $P<0.05$ ) affected. Urinary nitrogen were significantly difference ( $P<0.05$ ) in the inclusion of 5.00% DOL in the diets of growing rabbits increased ( $P<0.05$ ) urinary nitrogen (0.89%) and in the inclusion of 0.00 % DOL reduced ( $P<0.05$ ) urinary nitrogen (0.75%). However, inclusion 7.50% DOL urinary nitrogen and 10.00% DOL urinary nitrogen were

statistically similar. Rabbits fed 5.00 % inclusion of DOL increased ( $P<0.05$ ) nitrogen retained (1.28%) while rabbits fed 10.00% inclusion of DOL reduced ( $P<0.05$ ) nitrogen retained (1.01%). Rabbits fed 0.00% inclusion of DOL increased ( $P<0.05$ ) nitrogen retention (58.25%) while 10.00% inclusion of DOL reduced ( $P<0.05$ ) nitrogen retention (53.44%).

According to (14) the low dry moisture intake of animals resulted in maximal utilization of nutrients which are present in the foliage within the body system of animals. The nitrogen intake values were lower than the values obtained by (1). In this study, the faecal nitrogen and urinary nitrogen values were higher than the values reported by (2).

**Table 1: Gross composition of experimental diets for growing rabbits fed diets containing graded levels of dried okra leaves (DOL)**

Ingredients	0.00% DOL	2.50% DOL	5.00% DOL	7.50% DOL	10.00% DOL
Maize	41.00	41.00	41.00	41.00	41.00
SBM	6.00	6.00	6.00	6.00	6.00
PKC	8.00	7.50	6.00	5.00	4.50
GNC	9.00	8.00	7.50	7.00	6.00
Rice bran	9.00	8.00	7.50	6.50	5.50
Wheat Offal	22.00	22.00	22.00	22.00	22.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Premix	0.50	0.50	0.50	0.50	0.50
Salt (NaCl)	0.50	0.50	0.50	0.50	0.50
Okra Leaves	0.00	2.50	5.00	7.50	10.00
Total	100.00	100.00	100.00	100.00	100.00
<b>Calculated analysis of Concentrate diets</b>					
Crude protein	17.22	17.13	17.03	17.18	17.09
Crude fibre	13.30	13.35	13.50	13.50	13.45
Fat	4.97	4.81	4.65	4.54	4.38
Ca	1.05	1.06	1.08	1.09	1.11
ME (MJ/kg)	2691.16	2695.24	2695.32	2700.36	2704.44

\*1kg of vit/mineral premix contained: Vitamin A, 10,000,000 IU, vitamin D<sub>3</sub> 200,000 IU, vitamin E 12,500 IU; vitamin K, 1.30g, vitamin B<sub>1</sub> 1.30mg, vitamin B<sub>2</sub> 2,000mg, vitamin B<sub>6</sub> 1.30g; Nicotinic acid, 15.00g 12,000mg; Pantothenic acid 20.00mg Biotin 10.00mg; vitamin B<sub>12</sub> 0.01g; folic acid 0.05g; biotin 0.02g; chlorine chloride 200.00g; Manganese 48.00g; Zinc 45.00g; Copper 5.00g; Fe 25.00g; cobalt 0.20g; selenium 0.10g. BHT, 50.00g.

SBM---soya bean meal, PKC---palm kernel cake, GNC---groundnut cake

**Table 2: Proximate composition of the experimental diets (on dry matter basis) Levels of Inclusion of dried okra leaves (%)**

Parameters	0.00	2.50	5.00	7.50	10.00
Dry matter	90.00	89.50	89.70	89.50	90.60
Ash	12.50	12.50	13.70	13.00	10.00
Crude fibre	14.50	15.00	15.00	15.00	14.50
Ether extract	5.50	4.50	3.50	4.50	5.50
Crude protein	16.80	16.68	16.63	16.68	16.55
NFE	51.70	53.49	51.12	52.82	55.45
ME(Kcal/kg)**	2905.20	2800.27	2715.42	2782.77	2952.33

NFE—Nitrogen free extract; ME---Metabolizable energy

\*\* Calculated according to the formula of Pauzenga (1985):

**Table 3: Nutrient digestibility of rabbits fed diets containing varying levels of dried okra leaves (*Abelmoschous esculentus*)**

Parameters	Levels of Inclusion of okra dried leaves (ODL) (%)					SEM	P Values
	0.00	2.50	5.00	7.50	10.00		
Dry Matter	71.34	71.43	70.93	72.52	71.95	0.31	0.06
Ash	63.54 <sup>a</sup>	52.57 <sup>ab</sup>	57.36 <sup>ab</sup>	54.88 <sup>ab</sup>	38.81 <sup>b</sup>	2.77	0.02
Crude protein	74.87 <sup>a</sup>	71.32 <sup>ab</sup>	71.57 <sup>ab</sup>	70.28 <sup>b</sup>	69.03 <sup>b</sup>	0.66	0.01
Crude fibre	76.79 <sup>ab</sup>	76.70 <sup>ab</sup>	75.14 <sup>b</sup>	77.07 <sup>a</sup>	74.68 <sup>b</sup>	0.55	0.01
Ether extract	76.00	75.15	74.29	73.72	72.34	1.83	0.07
Nitrogen free extract	38.97	29.91	32.11	29.58	29.92	1.56	0.06

<sup>ab</sup>Means in the same row bearing different superscript differ significantly (p<0.05)

SEM = Standard error of mean

**Table 4: Effect of diets containing varying levels of dried okra leaves on Nitrogen utilization of growing rabbits**

Parameters	Levels of inclusion of dried okra leaves %					SEM	P Values
	0	2.50	5.00	7.50	10.00		
Nitrogen Intake	1.94	1.92	2.24	1.92	1.92	0.17	0.07
Faecal Nitrogen	0.05	0.06	0.07	0.06	0.07	0.10	0.06
Urinary Nitrogen	0.75 <sup>b</sup>	0.80 <sup>ab</sup>	0.89 <sup>a</sup>	0.80 <sup>ab</sup>	0.83 <sup>ab</sup>	0.08	0.00
Nitrogen output	0.80	0.86	0.96	0.89	0.88	0.09	0.06
Nitrogen retained	1.14 <sup>ab</sup>	1.06 <sup>ab</sup>	1.28 <sup>a</sup>	1.03 <sup>b</sup>	1.01 <sup>b</sup>	0.10	0.01
(%) Nitrogen retention	58.25 <sup>a</sup>	55.21 <sup>ab</sup>	57.14 <sup>ab</sup>	53.65 <sup>b</sup>	53.44 <sup>b</sup>	2.78	0.03

<sup>ab</sup>—Means in the same row with different superscripts differ significantly (P<0.05)

SEM = Standard error of mean.

### Conclusion and Applications

From the present study, it could be inferred that:

- i. Inclusion levels up to 2.50% DOL improved nutrient digestibility of growing rabbits.
- ii. The present experiment has shown that the dried okra leaves are

potential good source of protein and are sufficient to meet the requirements of growing rabbits.

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