CARCASS CHARACTERISTICS AND HAEMATOLOGICAL ESSAY OF WEANER RABBITS FED VARING LEVELS OF NEEM (*Azadirahcta indica)* LEAF MEAL

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Abstract
A feeding trial of 8 weeks duration was conducted to determine the effect of feeding varying levels of neem leaf meal of CP; 5.03% and ME; 3080.94kcal/kg on the carcass values and haematological assay of weaner rabbits. Twelve rabbits aged between 6 and 7 weeks were randomly allocated to four diets in a completely randomized design at three rabbits per diet. Each group of rabbits was fed one of four diets containing either 0.00, 3.00, 7.00 or 10.00% of neem leaf meal. Each diet was replicated three times. The diets were isonitrogenous (16.00% CP) but varied in energy levels from 2,837.77 (Diet A) to 2,793.79kcal/kg ME (Diet D). Diets B (2,824.48) and C (2,807.02) were lower than diet A. Live weight, bled weight, singed weight and prime cuts (forelimbs, hind limbs, breast, back, head, neck and stomach) and internal organs (liver, heart, lungs, kidney and intestine) did not vary significantly between the diets. However, carcass weight was significantly higher ($p< 0.05$) on diet B (668.00g) than on diets C (531.67g) and D (452.00g). However, diet A (628.67g) was similar ($p> 0.05$) to the other diets in carcass weight. Haematological values differed significantly between the diets but did not follow any particular trend except for WBC, Hb and PCV. White blood cell (WBC $x10^9$ml) values were significantly higher on diet C (10.62) than on the other diets. Haemoglobin concentration (Hb g/l) was higher on diet C (14.41) than on the other diets. Packed cell volume (PCV %) was significantly higher on diet C (39.60) and on diet D (39.40) than on the other diets. Therefore, weaner rabbit diets could contain as high as 10% neem leaf meal for profitable performance.
Key words: Neem leaf meal, Carcass values, weaner rabbits.

Introduction

In Nigeria, one of the major constraints confronting the livestock industry and the availability of feed stuffs is the sharp increase in the cost of conventional feedstuffs and the stiff competition between man and monogastric animals for conventional ingredients like grains, oil seeds and meals. Their exorbitant prices and erratic supply (Aregheore, 1996) makes them too expensive for small scale farmers to incorporate them into rabbit diet. Rabbits are known to be able to utilize forage materials and agro by-products and crop wastes efficiently (Patton, 1979). Sokumbi *et al*. (2003) posited that one of the method that have been utilized for some time now in alleviating these problems has been the replacement of a percent of grains and cakes in livestock diets with agro-industrial by products. It is in this light that ardent nutritionist have devoted their attention in investigating some unconventional energy and protein feedstuffs for livestock and indeed rabbit production in Nigeria. These feedstuffs should be free of competition from man and other industries (Anurudu and Ewuola, 2010). One of such unconventional feedstuffs with great potentials is the neem leaf meal (NLM).

Neem tree (*Azadirahcta indica)* has been identified as among the tropical plants that has

not been thoroughly investigated as animal feed resources (Akpan *et al.*, 2008). Neem (*Azadirachta indica)* is an indigenous tropical plant predominant in Nigeria. It is known by names such as "Ogwu-Iba" in Ibo and "Dogonyaro" in Hausa language. It is reported (Tipu *et al*., 2002) to be medicinal and could be used as insecticide and pesticide and has anticoccidial importance for broilers. Like the neem leaf, the neem seed cake has been reported by Elangovan *et al.* (2000) to be bitter and to contain toxic substances like salanin, nimbin, azadirone and triterpenoids. The Neem leaves, neem oil and de-oiled neem seed cake are used as animal feeds (Ogbuewu *et al*., 2010a). The neem leaves contain appreciable amounts of proteins, minerals, carotene and adequate amount of trace minerals (Ogbuewu *et al*., 2010b). Neem oil, bark and leaf extracts have been therapeutically used in folk medicine to control diseases like leprosy, intestinal helminthiasis, respiratory disorders, constipation, and skin infections (Biswas *et al*., 2002). Fajinimi *et al*. (1990) fed neem leaf meal to rabbits in limited amount with no adverse effects. Neem leaf meal have been used in the diets of rabbits containing up to 25% for optimal growth and performance since it resulted in a cost saving of 15.20% over the control diet (Edache *et al.*, 2009).

Oloche *et al*. (2014) suggested that Blood is the easiest tissue to sample by biopsy without harming the animal and ingestion of some dietary components has effect on blood constituents (Church *et al.*, 1984). Bawala *et al*. (2008) reported that nutritional studies should not be limited to performance, carcass quality and protein intake alone, but that the effect of feed materials on blood constituents is also very relevant and therefore should be evaluated. It is documented (Afolabi *et al.,* 2010) that changes in haematological parameters are often used to determine stresses due to nutrition and other factors. In recent years researchers have devoted their time and energy in the optimal utilization of neem leaf meal in feeding and medication of farm animals (Unigwe *et al.,* 2016; Esonu *et al*., 2006).

This study was therefore designed to investigate the effect of dietary inclusion of neem leaf meal on the carcass values and haematological assay of weaner rabbits.

MATERIALS AND METHODS

The study was carried at the College farm, Federal College of Animal Health and Production Technology, National Veterinary Research Institute, Vom.

Neem Leaf

Neem leafs were locally harvested from apparently healthy neem tree in Jos South LGA, Plateau State. The leaves were sundried until they became crispy and milled using the milling machine into neem leaf meal (NLM) and stored in air-tight containers. Samples were analyzed for proximate chemical contents (AOAC, 2000) and some antinutrients in neem leaf.

Rabbits, Design, Duration and Management

Twelve unsexed weaner rabbits of mixed breeds aged between 6-7 weeks with an average initial body weight of 650grams were purchased from private farms in Jos. The rabbits were randomly assigned to four diets in

a completely randomized design (CRD) as stated below:

The diets were replicated three times, with each rabbit a replicate. The feeding trial lasted for eight weeks. The rabbits were housed in standard wooden hutches netted with wire gauze covering both sides of the hutch. The hutch was previously cleaned with disinfectant for this feeding trial. Water and feed were given at ad-libitum and proper biosecurity including washing of the feed and water troughs on daily basis, cleaning the environment and regular foot-dip program were all observed.

Diets

Four isonitrogenous (15.99-16% CP) diets containing varying levels of neem leaf meal (0, 3, 7 and 10%) labelled A, B, C and D respectively were formulated. The metabolizable energy (M.E) levels of the diets varied from 2,790.00 (diet D), 2807.02 (diet C), 2824.77 (diet B) to 2837.77 kcal/kg (diet A) with increasing content of neem leaf meal.

Carcass evaluation

At the end of the eight weeks, each rabbit from each replicate was fasted overnight and slaughtered after the live weight was obtained. Each animal was dressed to determine the bled weight, singed weight, carcass weight and prime cuts (breast, back, forelimbs, hind limbs, neck, head and stomach) and internal organs (heart, kidney, liver and intestine) according to procedures described by Blasco and Ouhayoun (1993).

Blood collection

During slaughter, blood was collected via the jugular vein asceptically and into a sterile EDTA (as anticoagulant) treated bottles for determination of hematological assay; namely packed cell volume (PCV), hemoglobin concentration (Hb), white blood cell (WBC) and red blood cell (RBC) according to procedures outlined by Schalm (1975). Other blood parameters measured were mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) as described by Schalm (1975).

Statistical Analysis

Data obtained from this study was subjected to the analysis of variance as outlined by Steel and Torrie (1980) and means were separated using Duncan's New Multiple Range Test (Obi, 1990) at ($P<0.05$).

RESULTS AND DISCUSSIONS

Neem leaf meal was analyzed to contain 5.46% moisture, 2.04% fat, 2.14% ash, 5.03% crude protein, 2.99% crude fibre and 85.29% carbohydrate. Values for moisture, crude protein and carbohydrate reported in this study varied widely from that of Madaki *et al*. (2016). They reported 9.50 moisture, 1.58 crude protein, 2.81 ash, 2.07 fat, 5.97 crude fibre and 78.12% carbohydrate. Monday and Godwin (2017) reported that neem leaf contains, 12.10 moisture, 4.04 crude protein, 3.88 ash, 3.18 fat and 9.25% crude fibre. Apart from moisture and crude fibre, figures reported by Monday and Godwin (2017) are close to that reported in this study. Variations reported in the analysis may be due to varietal differences and soil nutrient conditions. Values for antinutritional factors in this study were; tannins, 1.23%, oxalate, 2.05%, phytate, 0.40%, saponins, 0.91%, hydrogen cyanide,

1.01% and haemagglutinins, 0.02%. Values for tannins, 1.12, saponins, 1.94 and hydrogen cyanide, 1.21% reported by Monday and Godwin (2017) were at variance with the report of this study. The carcass characteristics of the rabbits are shown on table 3. It was observed that the inclusion of neem leaf meal had no significant (P> 0.05) effect on the live weight, dressed weight, dressing percentage, bled weight and singed weight but carcass weight was significantly higher in rabbits fed 3% neem leaf meal than in rabbits fed 7 and 10% NLM. The significant difference obtained in this present study for carcass weight is at variance with values reported by Olorunsanya *et al*. (2007). The results of live weight recorded were in consonance with the range of 1375.00-1650.00g as reported by (Eustace *et al*., 2003) but are lower than 986.25g-1800.22g reported by (Wafar *et al*., 2017) who fed raw kapok seed meal to weaner rabbits.

Table 4 presents the result of the prime cuts of the experimental rabbits. The non-significant (P>0.05) effect of the diets on the prime cut is an indication of better utilization of the neem leaf meal by the animals. This result agrees with the findings of Olanike *et al*. (2013) and Agunbiade *et al*. (1999) who reported that primal cuts were not significantly affected by dietary treatment. It is further observed in this present study that the percent weight of the prime cuts did not follow any regular pattern, hence did not reveal any particular influence of the neem leaf meal.

Table 5 presents the result of the internal organs of the rabbits. The internal organs observed in this study were not significantly affected (P>0.05) by the dietary inclusion of neem leaf meal. The weight of the internal organs did not follow any particular pattern, hence did not reflect the influence of the neem leaf meal on the internal organs of the animals. This finding agrees with the report of Adewunmi *et al*. (2000) and Olanike *et al*. (2013) for rabbits fed fibrous ingredients. The values reported in this study are lower than that reported by Olorunsanya *et al*. (2007) for weaner rabbits fed sun-dried cassava waste meal and may be due to differences in breed and body weight.

Haematology

The values of the haematological assay of the rabbits fed neem leaf meal are presented in Table 6. All of the haematological constituents showed a significance difference (P<0.05) among the diets. With respect to Packed cell volume (PCV), there was no significant difference (P>0.05) when diet C and diet D were compared but there was a significant difference (p<0.05) when compared with A and B. For haemoglobin concentration (Hb), a significant differences (p<0.05) exist when diet B, C and D were compared to A. There was a significant difference (P<0.05) among treatments with respect to Red blood cell (RBC). Diet A, B and C were significantly different from diet D while values on diets B and C differed significantly from diet A. White blood cell (WBC) values on Diet C were significantly higher (P<0.05) than values on the other diets. The Mean corpuscular volume (MCV), Mean corpuscular haemoglobin (MCH) and Mean corpuscular haemoglobin concentration (MCHC) differed significantly among the treatments. The slight but significant variations in these values may be due to certain factors in neem leaf meal but

this will need further investigation. Significant effect of neem leaf products on blood parameters has been reported previously (Unigwe *et al*. (2016). The blood indices show normal physiological ranges as established by Kronfield and Mediway (1975); Mitruka and Rawnsley (1977). Meanwhile, diet C showed superiority in terms of PCV, Hb and RBC which suggested that the oxygen carrying capacity of the blood was somewhat enhanced in rabbits fed 10% NLM. Neem leaf meal probably promotes more red blood cells. According to Surapong and Pedro (2012) increase in red blood cells increases the oxygen carrying capacity of the blood. The result of the present study agrees with the finding of Unigwe *et al*. (2016) but disagrees with the findings of Sadre *et al*. (1984) and Biu *et al*. (2009) that neem preparations fed to laying hens significantly reduced the content of haemoglobin, erythrocyte count and packed cell volume. The decrease in Hb and RBC observed in this study beyond 7% NLM (diet C) may require further investigation because as stated previously (Surapong and Pedro (2012) neem leaf meal seem to support erythropoiesis. George (1947) had reported that large doses of cobalt inhibit erythropoiesis but there will be need to establish if neem leaf meal contains high levels of cobalt. The WBC values ranging from 9.14-10.62 were normal and indicate that the experimental animals were not challenged by any disease condition. The WBC values (9.18-10.62) reported in this present study are in consonance with those reported by (Unigwe *et al*., 2016). There was a slight increase beyond normal range (Kronfield and Mediway, 1975; Mitruka and Rawnsley, 1977) in the MCV of rabbits on diets B, C and D suggesting increased erythropoiesis. Though the MCH was slightly outside the range for rabbits on diets B and D, the MCHC fell within normal range (RAR, 2009; Mitruka and Rawnsley, 1977) and it has been shown that MCHC is the most accurate and absolute value that indicates anaemic condition in animals (Aster, 2004; Thompson, 2006). The value of MCHC could indicate anemia because this is the measure of the concentration of hemoglobin in the red blood cells. According to George (1947), only when the total circulating hemoglobin is determined and adjusted to a unit of surface can the true severity of the anemia be appreciated. Therefore, the results of this experiment support that 10% NLM could enhance haematological values in rabbits without endangering the animal productive potentials.

CONCLUSION

The result of the carcass characteristics and blood profile shows that the experimental animals were healthy and converted the feed to meat without any deleterious effect as observed. Although, there were chances of erythropoiesis at above 7% level of NLM inclusion, the oxygen carrying molecules were within normal range across the treatments. This means that NLM could be incorporated up to 10% in rabbits' diets without negative effect, suggesting its usefulness as unconventional feed ingredients for rabbits.

Table 1: Composition of Experimental Diet

Ingredients	A (0%)	B (3%)	C (7%)	D (10%)
Maize	52.26	48.91	44.48	41.14
Neem leaf meal	-	3.00	7.00	10.00
Groundnut cake	13.54	13.89	14.32	14.66
Palm kernel cake	25.00	25.00	25.00	25.00
Rice offal	4.00	4.00	4.00	4.00
Fish meal	1.00	1.00	1.00	1.00
Bone meal	2.00	2.00	2.00	2.00
Limestone	1.50	1.50	1.50	1.50
Salt	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Methionine	0.1	0.1	0.1	0.1
Lysine	0.1	0.1	0.1	0.1
	100	100	100	100
Calculated Analysis				
Crude protein %	15.99	16.00	15.99	16.10
ME (Kcal/kg)	2837.77	2824.48	2807.02	2793.79
Calcium	1.42	1.43	1.43	1.44
Crude fiber	4.36	4.39	4.45	4.48
Cost/kg (₦)	111.08	108.04	104.00	100.96

* Bio Mix Layer premix supplied the following per 100kg of diet: Vitamin A, 850,000 I.U; Vitamin D3, 150,000 I.U; Vitamin E, 1,000 I.U; Vitamin K, 1000 mg; Thiamin (B1), 150 mg; Riboflavin (B2), 450mg; Pyridoxine (B6), 300mg; Niacin, 1500mg; Vitamin B12, 1.5mg; Pantothenic acid, 450mg; Folic acid, 60mg; Biotin, 50mg; Choline chloride, 17,500mg; Anti-oxidant, 125mg; Manganese, 4000mg;, Zinc, 3000mg; Iron, 2000mg; Copper, 300mg; Iodine, 100mg; Selenium, 20mg; Cobalt, 20mg. Key: C.P, crude protein; M.E, metabolizable energy; Ca, calcium; P, phosphorus; C.F, crude fibre

Table 2. Proximate and anti nutritional content of neem leaf (g/100gram)

Proximate	Moisture	Fat	Ash	Crude protein	Crude fibre	Carbohydrate
	5.46	2.04	2.14	5.03	2.99	85.29
Antinutrients	Phytate	Oxalate	Hydrocyanic acid	Saponins	Tannins	Haemagglutinins
	0.40	2.05	1.01	0.91	1.23	0.02

Table 3: Carcass characteristics of weaner rabbits fed varying levels of neem leaf meal

Parameters	A (Control)	B (3% NLM)	C(7% NLM)	D(10% NLM)	SEM
Live weight (g/rabbit)	1340.30	1525.30	1654.00	1354.30	185.60 NS
Bled weight (g/rabbit)	1280.30	1411.70	1411.70	1283.10	227.60 NS
Singed weight (g/rabbit)	1068.70	1316.70	1323.30	1192.30	227.60 NS
Carcass weight (g/rabbit)	628.70^{ab}	668.00^{a}	531.00^{b}	452.00^{b}	57.80 *

a,b, means with difference superscript letters within rows are significantly different ($p<0.05$).

Table 4: Prime cuts of weaner rabbits fed varying levels of Neem leaf meal (grams)

Parameter	A(Control)	B (3% NLM)	C (7% NLM)	D (10%NLM)	SEM
Fore limb	127.33	161.00	109.00	97.00	62.33NS
Hind limb	161.33	136.00	142.33	127.33	77.59NS
Breast	203.00	182.00	205.00	201.33	31.90NS
Head	127.67	113.67	128.33	121.67	17.02NS
Neck	36.67	41.33	39.00	37.00	10.22NS
Back	272.37	299.33	337.67	284.67	78.04NS
Stomach	48.67	35.00	80.67	48.00	18.44NS

Table 5: Internal organs of weaner rabbits fed varying levels of Neem leaf meal (grams)

Parameter	A (control)	B (3% NLM)	C (7% NLM)	D (10% NLM)	SEM
Liver	39.67	41.33	49.00	47.00	8.86NS
Heart	14.67	10.33	14.00	10.33	1.29NS
Intestine	155.00	175.00	220.67	192.00	72.29NS
Kidney	10.00	9.33	9.33	10.33	1.58NS
Lungs	14.67	10.33	14.00	10.33	3.67NS

Table 6: Haematological indices of weaner rabbits fed varying levels of Neem leaf meal

Paramters	A (Control)	B (3% NLM)	C (7% NLM)	D(10% NLM)	SEM
WBC ($x10^9$ml)	10.10^c	9.14^a	10.62^d	9.49^b	0.12
PCV (%)	37.74^a	38.45^b	39.60^c	39.40^c	0.14
Hb (g/l)	13.51^a	14.22^c	14.41^d	13.71^b	0.08
RBC($x10^6$ml)	4.94^c	4.85^b	4.90^{bc}	4.67^a	0.40
MCV (fl)	78.52^a	81.95^c	81.93^c	84.84^b	0.40
MCH (pg)	28.07^a	29.86^c	29.40^b	30.08^d	0.12
MCHC (pg)	35.85^a	36.95^c	36.39^b	35.80^a	0.06

a,b,c; mean with difference superscript are significantly different ($p<0.05$). Key: PCV = packed cell volume, Hb = haemoglobin, RBC = red blood cell, WBC = white blood cell, MCV = mean corpuscular volume, MCH = mean corpuscular haemoglobin, MCHC = mean corpuscular haemoglobin concentration

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