COMPARATIVE ASSESSMENT OF GROWTH, HAEMATOLOGY AND SERUM-BIOCHEMICALS IN DIFFERENT BREEDS OF MATURED RABBITS

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ABSTRACT

A sixteen (16) weeks study was carried out in rabbit unit of the Teaching and Research Farm, Ambrose Alli University, Ekpoma on the effect of breed on body weight, body linear measurements, haematology, serum-biochemicals and hormones of male rabbits. Fifty-four (54) matured male rabbits were allotted into three groups of eighteen (18) each of Chinchilla (CHIN), New Zealand White (NZW) and New Zealand Red (NZR) breeds and were grouped into a completely randomized design (CRD) experiment. Traits measured were body weight (BW), linear body measurements such as body length, breast girth (BG), height at withers (HT), head to shoulder length (HSL), ear length (EL), ear width (EW) and tail length (TL), blood parameters and hormones. The results of this study demonstrated differences in body weight and body length of rabbits in the study population with Chinchilla (2.26 kg and 34.92 cm), New Zealand White (2.21 kg and 35.08 cm) and New Zealand Red (2.20 kg and 34.42 cm). Haematological indices showed significant differences (p<0.05) among breeds where Mean Hemoglobin, Mean Corpuscular Volume (MCV), Mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) values were higher in Chinchilla breed of rabbit followed by New Zealand White and New Zealand Red. The mean values of total protein, albumin, globulin, uric acids, urea, glucose and phosphorus significantly differed (p<0.05) among breeds with New Zealand Red having higher values followed by Chinchilla and New Zealand White breeds. The results indicate that morphometric traits play a crucial role in selecting rabbits for genetic improvement and predicting market live weight. Also, haematology, serum-biochemical and hormones data were comparable to those described in rabbits and could be used in the classification of rabbits into genetic groups and which could be utilized in crossbreeding programmes to produce crossbreds that are highly productive and adapted to the environment.

Keywords: *body weight, linear measurements, Chinchilla, New Zealand White, New Zealand Red, haematology, serum-biochemicals, hormones*

INTRODUCTION

The demand for animal protein is far higher than the supply. The high cost of animal protein has put it out of the reach of an average Nigerian person (Njidda and Isidahomen, 2009). This could be attributed to the low level of animal protein production. There is therefore an urgent need to increase livestock production in the country especially those that are highly prolific with rapid turnover rate at very low cost. The production of animals such as rabbits, with very short generation intervals and production cycles, can be the way out to the problem of protein shortage in Nigeria (Omoikhoje, 2023).

Rabbit (*Oryctolagus cuniculus*) is a micro livestock species and is one of the cheapest and fastest ways of producing high quality animal protein. They also have a number of advantages among animal farm which include reduction of protein intake, early sexual maturity, low fat and cholesterol and for research purposes in Nigeria (Ajala and Balogun, 2004; Isidahomen *et al.,* 2014; Shinkut, 2015). Rabbit meat has the cholesterol value of 169 mg/100 g (dry mater basis), and low sodium content (Fielding, 1991; Janieri, 2003). Consequently, rabbit meat has been listed in the United State Department of Agriculture (USDA) as an approved source for hypertensive patients. Changes in body weight and various phenotypic traits during the growth process, including alterations in body conformation and shape, are considered strategic aspects of growth in rabbits (Atchley and Rutledge, 1980). The blood values are widely used to determine systemic relationship and physiological/pathological adaptation including the evaluation of general health condition and diagnosis of various types of animal diseases (Shah *et al*., 2007). A variety of factors can affect the haematological and biochemical parameters in animals including the age of the animal, the breed used for the experiment, reproductive status, the sex of the animal and seasonal environmental factors (Well *et al*., 1999; Al-Elisa *et al*., 2008).

This study evaluated body weight and linear body measurements of different rabbit breeds with view to ascertain faster growing breeds capable of bridging the gap of meat shortage and breeder animals

MATERIALS AND METHODS

Experimental Site

The research was carried out at the Rabbitry Unit of the Livestock Teaching and Research Farm of Ambrose Alli University Ekpoma, Edo State. The mean ambient temperature ranges from 26° C in December to 34°C in February with relative humidity ranging from 61% in January to 92% in August and a yearly average of about 82%. The vegetation represents an interface between the tropical rainforest and the derived savanna.

Duration of Experiment, Management and Feeds of the Rabbits

A total of 54 male rabbits with age ranged from 16 weeks to 32 weeks, were used for this study. These consisted of 18 rabbits each of the three breeds; Chinchilla (CHIN), New Zealand White (NZW) and New Zealand Red (NZR). All the rabbits were tagged for proper identification and subjected to the same management practices throughout the experimental period. Medication administered were Anti-coccidal and carecillin against stress and disease. The rabbits were given access to commercial grower marsh *ad libitum* containing 15.86% crude protein and 2716 Kcal/kg Metabolizable Energy with clean water provided regularly. The experiment was carried out for a period of sixteen (16) weeks.

Parameters studied

The following parameters were considered for the experiment: body weight, body length (BL), breast girth (BG), height at withers (HW), head to shoulder length (HSL), ear length (EL), ear width (EW) and tail length (TL).

The description and measurements of the parameters were as follows;

Body weight (BW): live weight of the animal measured with a digital weighing scale in kg.

Body length (BL): the longitudinal distance from the nose to the point of attachment of the tail to the body.

Breast Girth (BG): measured as body circumference just behind the foreleg.

Head to Shoulder Length (HSL): the distance from the nose to the point of the shoulder.

Height at Withers (HW): the height from the point of the forelegs to the back.

Ear Length (EL): the distance from the base of the attachment of the ear to the head of the tip of the ear.

Ear Width (EW): the distance of the broad end to the broad of the ear.

Tail length (TL): the distance from the base of the tail to the body to the tip of the tail.

Haematological studies and Blood Chemistry

At the end of the 16 weeks' trial, six male rabbits per breed were randomly selected. A set of blood samples were collected in EDTA (*Ethyldiaminetetraacetic acid*) bottles for haematological evaluation while another set of bloods was collected in anticoagulant bottles for blood chemistry evaluation. Parameter measured under haematological studies included pack cell volume, haemoglobin, white blood cell count and red blood cell, while mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration were computed using the appropriate formulae as described by Jain (1986). The bottles were kept in cooled cotton prior to analysis. Haematological parameters and blood chemistry were evaluated according to the procedure described by Davis and Lewis (1991). The serum biochemical essay was carried out using standard chemical procedures. Albumin by bromocresol green (BCG) method (Peters *et al*., 1982), serum glucose (Toro and Ackerman, 1979), cholesterol by colorimetric enzyme method as outlined by Bush (1975), calcium was analysed using atomic absorption spectrophotometry while phosphorus was determined according to the vanadommolybdophospheric acid method (Shiou, 1996) using a spectrophotometry (Jenway 6100 UK).

Hormonal Analysis

Testosterone Assay

Serum testosterone was assayed from blood obtained from a left ventricular puncture. The samples were spun at 3000 ng/ml for 10 min in an angle head centrifuge at 25^{o}C. The samples were assayed in batches from a standardized curve using the Enzyme Linked Immuno sorbent Assay (ELIZA) method. The micro well kits used were from Syntro Bioresearch Inc., California, USA. With 10ml of the standard, the samples and control were dispensed into the number of coated wells used.

One hundred (100) ml testosterone conjugate reagent was added and then 50 ml of anti-testosterone reagent. The contents of the microwell were thoroughly mixed and then incubated for 90 minutes at room temperature. The mixture was washed in distilled water and further incubated for 20 minutes. The reaction was stopped with 100ml of IN hydrochloric acid. Absorbance was measured with an automatic spectrophotometer at 450 nm.

Luteinising Hormone Assay

This was carried out using enzyme immune assay kits, catalog number: BC-1031. The assay utilizes two anti Luteinising Hormone (LH) monoclonal antibodies. The process involves immunoextraction, labeled antibody reaction and colour development. A solid phase is incubated with a coloured enzyme substrate for one hour at 37^{o}C. The process of alkaline phosphate causes a colour change from yellow to pink. The intensity of the pink colour is a measure of the labeled antibody hence LH.

The LH concentration was measured off a calibration curve.

Experimental Design and Statistical Analysis

The experiment was carried out in a completely randomized design (CRD). All data collected were subjected to one way analysis of variance (ANOVA) with breed as the only factor using the Statistical Analysis System Institute (SAS, 1999) software. Significant differences were computed and Duncan's Multiple Range Test (Gomez, 1984) was used to separate the means.

RESULTS AND DISCUSSION

The effect of breed on body weight and linear body measurements of rabbits are presented in Table 1. The results of the body weight and body length of the three breeds of male rabbit indicate that there were no significant ($p>0.05$) differences among the breeds on body weight and body length with values for Chinchilla (2.26 kg and 34.92 cm), New Zealand White (2.21 kg and 35.08 cm) and New Zealand Red (2.20 kg and 34.42 cm) presented in Table 1. However, there were significant ($p<0.05$) differences among breeds for breast girth, height at withers, head to shoulder, ear length, ear width and tail length. The breast girth of New Zealand Red (29.92 cm) was higher than that of Chinchilla (29.33 cm) and New Zealand White (28.00 cm). Ear width followed the same trend of significant ($p<0.05$) difference among the breeds with value for New Zealand Red (5.64 cm) being higher than that of Chinchilla (5.57 cm) and New Zealand White (5.37 cm). There were significant ($p<0.05$) differences among the breeds with Chinchilla having the highest values in height at withers (14.75 cm), head to shoulder (14.33 cm) and ear length (11.21 cm), whiles tail length was highest in New Zealand White (7.88 cm). The New Zealand White rabbit has been noted as a dam breed based on its outstanding maternal genetic merits for litter size, milking and general maternal ability (Lebas *et al.,* 1997; McNitt *et al.*, 2000). Okorie (1983) earlier reported that Chinchilla breed of rabbit is characterized by fast growth rate and good mothering ability and is extensively used for breeding. This is important in making fast genetic progress when considering growth traits. Body conformation and size are important traits used for meat production in animals, and have been largely estimated quantitatively by the use of body weight and linear body measurements. The importance of body weight and linear body measurements in the assessment of the economic value of farm animals cannot be overemphasized. The relationships among quantitative traits such as body weight, body length, ear length, tail length and limb lengths have been investigated among domestic rabbits (Chineke, 2002; Abdullahi *et al.,* 2003; Isaac *et al.,* 2011; Atansuyi *et al.,* 2011). Simple linear body measurements that can readily predict body weight without rabbit being slaughtered is therefore highly desirable as it will ensure the selection of animals that will reach market weight and size at relatively faster rate. It will also serve as a tool for breeders in selecting animals destined for use as breeding stock

The haematology findings for three male rabbit breeds, as detailed in Table 2, indicate significant differences ($p<0.05$) among breeds. New Zealand Red rabbits displayed the highest White Blood Cell count ($6.31\times10^3/\mu$), whereas Chinchilla and New Zealand White breeds exhibited

Table 1: Body weight and linear body measurements of rabbit as influenced by breeds

Traits	Chinchilla	New Zealand White	New Zealand Red
Body weight (kg)	2.26±0.04	2.21±0.03	2.20±0.03
Body length (cm)	34.92±0.40	35.08±0.56	34.42±0.43
Breast girth (cm)	29.33±0.41^a	28.00±0.44^b	29.92±0.51^a
Height at Withers (cm)	14.75±0.35^a	11.67±0.38^b	10.83±0.24^b
Head to Shoulder (cm)	14.33±0.43^a	14.66±0.08^a	12.58±0.31^b
Ear Length (cm)	11.21±0.10^a	10.67±0.15^a	7.83±0.32^b
Ear width (cm)	5.57±0.12^{ab}	5.37±0.05^b	5.64±0.08^a
Tail Length (cm)	6.55±0.09^b	7.88±0.10^a	6.73±0.08^b

[1]*Means ± along the same row with different superscript are significantly different (p<0.05)*

similar values, 4.80, and 4.80×10^3/μ respectively. Conversely, New Zealand White rabbits showed lower Red Blood Cell count (5.66×10^6/μ), Pack Cell Volume (34.63×10^6/μ), and platelet count (214.25 mm^3). In terms of hemoglobin, Mean Corpuscular Volume, and Mean Corpuscular Hemoglobin Concentration, the Chinchilla breed displayed higher values compared to New Zealand White and New Zealand Red. However, Mean Corpuscular Hemoglobin values (16.45, 16.38, and 14.30 pg) varied slightly among the breeds, with Chinchilla rabbits having the highest values. Overall, the trends in Mean Hemoglobin, MCV, MCH, and MCHC values followed a similar pattern, with the Chinchilla breed showing the highest values, suggesting a potential increase in erythropoietic activity in this breed. However, factors such as activity, diet, environmental temperature and sex may also affect erythropoietic activity. These findings were not in agreement with the results obtained in Chinchilla by Jakubow *et al*. (1984), but in tandem with the findings of El-Safty *et al.* (2006) who reported the superiority of the Chinchilla breed in PCV compared to that of the other genotype. This could be a boost to the growth and productive life of the rabbit breed. The implication of this is that Chinchilla and New Zealand White breeds of rabbit have high body weight capacity for maintenance of their kits and have potential to transmit desirable genes for fast growth rate. This is important in making fast genetic progress when considering growth traits.

Serum biochemical parameters of rabbit breeds were presented in Table 3. Mean values of total protein, albumin, globulin, uric acids, urea, glucose and phosphorus showed significant ($p<0.05$) differences among breeds while cholesterol, creatinine and calcium were not affected. Total protein (6.93 ml), Albumin (4.50 ml), Uric acids (7.25 ml), Urea (40.75 ml), Glucose (185.92 m/dl), and phosphorus (5.55 m/dl) values were significantly higher ($p<0.05$) in the New Zealand Red breed compared to the other breeds. The present findings are inconsistent with the reports of earlier workers (Mitruka and Rawnsley, 1981; El-Safty *et al.,* 2006; Moseri *et al.,* 2018). Total protein, Albumin and Globulin values obtained in our study increased with breed in accordance with previous reports in house mice (Gromadzka-Ostrowska and Zalewska, 1985; Mira and Mathias, 1994). Higher levels of glucose in New Zealand Red rabbits may be due to the effect of handling adults. Handling alone has been shown to cause increase in blood glucose (Knudtzon, 1988), and physical exertion or tissue damage during blood collection will elevate AST levels (Harcourt-Brown, 2002) and fall within the normal range. This difference may be related to animal species and the effect of the breed and season. The reason for the difference

Table 2: Haematological parameters of rabbit as influenced by breeds

Parameters	Chinchilla	New Zealand White	New Zealand Red
White Blood Cells (×10^3/μ)	4.80±0.03^b	4.80±0.02^b	6.31±0.03^a
Red Blood Cells (×10^6/μ)	5.71±0.01^b	5.66±0.00^c	6.54±0.01^a
Hemoglobin (g/dl)	9.65±0.05^a	9.48±0.03^b	8.54±0.02^c
Pack Cell Volume (%)	34.90±0.04^b	34.63±0.03^c	35.53±0.05^a
Mean Corpuscular Volume (fe/l)	61.53±0.04^a	61.28±0.03^b	56.18±0.06^c
Mean Corpuscular Hemoglobin(pg)	16.38±0.05^a	16.45±0.05^a	14.30±0.08^b
Mean Corpuscular Hemoglobin Concentration (%)	27.60±0.06^a	27.20±0.04^b	24.58±0.06^c
Platelet (mm^3)	220.75±0.13^a	214.25±3.18^b	220.58±0.15^a

[1]*Means ± standard error along the same row with different superscript are significantly different ($p<0.05$)*

in the parameters mentioned may be due to the increase in the osmotic pressure exerted by albumin, which is responsible for the osmotic pressure of the blood to a great extent, so preventing the discharge of water from the blood vessels. The cholesterol, creatinine and calcium showed no significant difference among breeds. Phosphorus levels were influenced by breed. Serum parameters are important in the proper maintenance of the osmotic pressure between the circulating fluid and the fluid in the tissue space so that the exchange of materials between the blood and cells could be facilitated. They also contributed to the viscosity and maintenance of the normal blood pressure and pH. The values obtained in these studies which is still within the normal physiological range for rabbits is indicative of normal functioning of the kidneys of rabbits, as Hammond and Belilies (1980) reported that with normal kidney function, the amount of creatinine in the blood remains relatively constant and normal. All the values obtained from the minerals were all within range (Mitruka and Rawnsley, 1981). The implication is that breeds/strain may affect the electrolyte values.

The hormonal profiles of these rabbit breeds are outlined in Table 4. The mean values of testosterone (0.15, 0.14, and 0.15 ng/ml) and luteinising (0.15, 0.16, and 0.15 miu/ml) hormones exhibited no significant differences ($p>0.05$) among the breeds studied. However, even after neutering, rabbits retain circulating hormones in their bodies. Neutering doesn't completely eliminate testosterone, the primary hormone in males. During spring, wild rabbits experience a peak in breeding activity, marked by a surge in hormones. Similarly, domestic rabbits may exhibit social, sexual, and occasionally aggressive behaviours, albeit typically mild. These findings align with the results reported by Oyeyemi and Okendiran (2007).

Table 3: Serum biochemical parameters of rabbit influenced by breeds

Parameters	Chinchilla	New Zealand White	New Zealand Red
Total protein (ml)	6.75±0.25[a]	6.13±0.25[b]	6.93±0.02[a]
Albumin (ml)	3.68±0.09[b]	3.40±0.00[b]	4.50±0.18[a]
Globulin(ml)	3.18±0.14[a]	2.80±0.00[b]	1.93±0.08[c]
Glucose (m/dl)	181.75±0.54[b]	180.00±0.00[c]	185.92±0.84[a]
Cholesterol (mg/dl)	195.00±0.36	194.00±0.00	195.83±01.63
Uric acid (ml)	4.75±0.25[b]	4.00±0.00[c]	7.25±0.33[a]
Urea (ml)	38.25±0.13[b]	38.00±0.00[b]	40.75±0.25[a]
Creatinine (ml)	1.28±0.03	1.28±0.03	1.25±0.02
Calcium (mg/dl)	9.7±0.04	9.6±0.00	9.4±0.16
Phosphorus (m/dl)	5.50±0.04[a]	5.40±0.00[b]	5.55±0.02[a]

[1]Means ± standard error along the same row with different superscript are significantly different ($p<0.05$)

Table 4: Hormonal parameters of rabbit influenced by breeds

Parameters	Chinchilla	New Zealand White	New Zealand Red
Testosterone (mg/ml)	0.15±0.02	0.14±0.03	0.15±0.02
Luteinizing (miu/ml)	0.15±0.02	0.16±0.01	0.15±0.02

CONCLUSIONS

The study shows that New Zealand Red, New Zealand White and Chinchilla breeds of rabbit have high growth ability and the genetic potential to transmit desirable genes for fast growth rate. This is important in making fast genetic progress when considering growth traits. Therefore, the two genotypes could be considered as choice genotypes for improvement of growth traits of rabbits in this region. Blood characteristics of the rabbit genotype could be used in the classification of rabbit into genetic group, and for the improvement and sustainability of rabbit production in this part of Nigeria, which depends on the best selected male rabbit in this study as high-quality genotype for breeding programme. Breeders need to exploit the preponderance of additive genes in the rabbit population to bring about improvement in the growth traits. The impact on the animal protein production and consumption of the citizenry will justify the effort.

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