

# Relationships amongst carcass traits in some breeds of domestic rabbit (*Oryctolagus cuniculus*) bucks

Mallam, I.<sup>1\*</sup>, Hussaini, Y. I.<sup>2</sup>, John, P. A.<sup>3</sup>, Sechii, J.<sup>2</sup> and Jerry, E. M.<sup>1</sup>

<sup>1</sup>Department of Animal Science, Kaduna State University, Kafanchan Campus, Nigeria.

<sup>2</sup>Department of Animal Science, Nasarawa State University, Shabu Campus, Nigeria.

<sup>3</sup>Department of Animal Science, Ahmad Bello University, Zaria, Nigeria.

\*Corresponding author: Email: mallamiliya2011@gmail.com, Tel: +234 8188146452.

Copyright © 2022 Mallam et al. This article remains permanently open access under the terms of the [Creative Commons Attribution License 4.0](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Received 26th September 2022; Accepted 21st October 2022

**ABSTRACT:** Thirty-two (32) rabbit bucks of 15-16 weeks (105-112 days) of age comprising of 10 bucks of New Zealand white (NZ), 11 bucks of Chinchilla (CH), and 11 bucks of Dutch (DH) breed with an average weight of 1266 g were used and the experiment lasted for 56 days with each rabbit in a pen. The study to determine relationships amongst carcass traits in some breeds of domestic rabbit (*Oryctolagus cuniculus*) bucks. All the parameters were weighed in grams with a digital weighing scale while the dressing percentage was calculated. The carcass traits taken were heart, liver, kidney, caecum, lungs, stomach, intestine, live weight, slaughtered weight, dressing weight, fore limb, thoracic cage, loin, skin, head, shank, hind limb, testis, body weight, dressing per cent. The degree of relationships amongst the carcass traits was determined using the Pearson Correlation Coefficient Procedure of SAS. There were several relationships with correlation coefficients ranging from high to low and positively and negatively correlated. The results obtained for relative organs gave positive and significantly ( $p < 0.05$ ) high correlation coefficients between heart and liver ( $r = 0.663$ ) and between intestine and stomach ( $r = 0.570$ ). There was no significant ( $p > 0.05$ ) difference amongst other relative organs but with positive correlation coefficients except between liver and lungs, kidney and caecum, caecum and lungs, caecum and intestine, lungs and stomach, lungs and intestine. For the other carcass traits (live weight, slaughtered weight, dressing weight, fore limb, thoracic cage, loin, skin, head, shank, hind limb, testis, body weight, and dressing per cent), the highest and positive correlation coefficient was obtained between live weight and slaughtered weight ( $r = 0.992$ ), and the least was between shank and testis ( $r = 0.025$ ). It also revealed that live weight had a highly significant ( $p < 0.01$ ) effect on slaughtered weight, dressing weight, fore limb thoracic cage, loin, skin, and hind limb. Therefore, selection for improvement should be carried out on carcass traits with high and positive correlation. More research should be conducted on relationships between carcass traits of domestic rabbit bucks of different breeds and ages.

**Keywords:** Bucks, carcass traits, breed, correlation, relationships.

## INTRODUCTION

There are different breeds of rabbits and they have the capacity for viable animal protein production consumption and could be promoted as nourishing meat. The rabbit meat is high in protein and low in fats compared to beef, chevon, pork, and mutton, amongst others. Rabbit meat is becoming popular in Nigeria because of the increasing prices of conventional meat sources. The high cost of conventional protein energy sources is largely responsible for the high price of livestock feed (Shaahu *et al.*, 2014).

Breeds such as New Zealand white, Dutch, and Chinchilla remain the most commonly identified ones which have peculiar characteristics in terms of body weight that distinguish them from one another (Okoro *et al.*, 2010). Kabir *et al.* (2012) reported that New Zealand white rabbits were superior for litter size at birth and at weaning, but the Chinchilla breed is the best for individual weight at birth and at weaning.

Rabbit farmers are interested in the relationship between

body weight and other carcass traits (Adamu *et al.*, 2022), and one of the prerequisites for genetic improvement is the knowledge of genetic parameters for important economic traits (Akanno and Ibe, 2006). The carcass of the domestic rabbit has long shown its importance in the supply of meat for human consumption in densely populated countries.

Nwagu *et al.* (2009) reported that rabbit meat has high biological value with high protein (21%), low fats (10%), low cholesterol, and low sodium contents. The study conducted by Nwagu *et al.* (2009) revealed that when the various edible parts (liver, kidney, heart, hind and fore legs, chest loin and head) were correlated with live weight and they obtained positive relationship for liver ( $r = 0.731$ ), hind leg ( $r = 0.980$ ), fore leg ( $r = 0.938$ ), chest ( $r = 0.911$ ), loin ( $r = 0.987$ ) and head ( $r = 0.709$ ), respectively.

In Nigeria, particularly in Southern Kaduna, there is little or no information on the relationships amongst carcass traits of rabbit bucks. Therefore, the study was conducted to evaluate relationships amongst carcass traits of three breeds of domestic rabbits (*Oryctolagus cuniculus*) bucks.

## MATERIALS AND METHODS

### Experimental site

The experiment was conducted at the Rabbit Unit of the Teaching and Research Farm, Kaduna State University, Kafanchan Campus, Kaduna State, Nigeria. Kafanchan is located in the Southern part of Kaduna State on latitudes 9°34'59.99"N and longitude 8°16'60.00"E (Ovimaps, 2022).

### Experimental diet

The diet was formulated as shown in Table 1.

### Experimental animals and management

Thirty-two (32) rabbit bucks of 15-16 weeks (105-112 days) of age comprising of 10 bucks of New Zealand white (NZ), 11 bucks of Chinchilla (CH), and 11 bucks of Dutch (DH) breed with an average weight of 1266 g were used for the carcass.

Before the commencement and during the experimental stage, Ivermectin injection (broad-spectrum anti-parasitic) and embazin was administered to the rabbits to treat endo and ectoparasites, respectively. Each rabbit was housed individually per pen and well-ventilated. They were fed formulated diet (Table 1) and supplemented with dried pineapple peel with clean drinking water *ad libitum*. Routine management operations such as regular cleaning of pens, feeders, and drinkers were carried out throughout the research period.

### Carcass traits

At the end of the feeding trial which lasted 56 days, the

**Table 1.** Gross composition of the experimental diets

Ingredients	Composition (%)
Maize	15.00
Maize offal	49.60
Brewers dried grain	8.70
Groundnut cake	6.00
Soybean cake	9.00
Rice husk	9.00
Limestone	1.00
Bone meal	1.00
Common salt	0.25
Vitamin/mineral premix	0.25
Lysine	0.10
Methionine	0.10
Total	100.00
Calculated analysis	
Crude Protein	16.00
Energy (Kcal/kg)	2501.15
Crude fibre	11.20
Calcium	0.72
Available Phosphorus	0.29
Lysine	0.77
Methionine	0.58

rabbits were tagged and fasted overnight for 12 hours to empty the gut, however, clean drinking water was provided. The slaughter procedure adopted includes stunning, cervical dislocation, slitting the jugular vein using a sharp knife, bleeding, flaying/processing, evisceration, and cutting (Nwagu *et al.*, 2009). Each rabbit was slaughtered, deskinning, and weighed. The live weight (pre-slaughter weight) was taken before, and after slaughtering, the slaughtered weights were taken, then the carcass weights (dressed weights) were taken in grams. The rabbits were cut into prime cuts (head, shank, fore limb, hind limb, thoracic cage, loin, skin/fur, testis), and relative organs (heart, kidney, liver, caecum, lungs, stomach, intestine). The lungs were weighed with the trachea while the small and large intestines were weighed together. All the carcass traits were weighed using a sensitive scale and the dressing percentage was calculated using the formula below:

$$\text{Dressing percent} = \frac{\text{Carcass weight}}{\text{Live weight}} \times 100$$

The correlation coefficient between the different weights are written as:

$$r = \frac{\sum XY}{\sqrt{\sum X \sum Y}} \quad i = 1, \dots, N$$

Where: r = Pearson product moment correlation coefficient

**Table 2.** A combined Pearson correlation amongst relative organs in three breeds of rabbit bucks.

	Heart	Liver	Kidney	Caecum	Lungs	Stomach	Intestine
Heart	1						
Liver	0.663*	1					
Kidney	0.210 <sup>NS</sup>	0.179 <sup>NS</sup>	1				
Caecum	0.296 <sup>NS</sup>	0.029 <sup>NS</sup>	-0.253 <sup>NS</sup>	1			
Lungs	0.074 <sup>NS</sup>	-0.138 <sup>NS</sup>	0.354 <sup>NS</sup>	-0.050 <sup>NS</sup>	1		
Stomach	0.000 <sup>NS</sup>	0.342 <sup>NS</sup>	0.005 <sup>NS</sup>	0.102 <sup>NS</sup>	-0.063 <sup>NS</sup>	1	
Intestine	0.180 <sup>NS</sup>	0.464 <sup>NS</sup>	0.400 <sup>NS</sup>	-0.006 <sup>NS</sup>	-0.289 <sup>NS</sup>	0.570*	1

\*Correlation is significant at t.05, NS= Not significant.

cient,  $X_i$  = the first random variable of the  $i^{\text{th}}$  carcass trait, and  $Y_i$  = the second random variable of the  $i^{\text{th}}$  carcass trait.

The Pearson correlation is defined between -1 and +1 ( $-1 \leq r \leq 1$ ) where -1 indicates a perfect decreasing (negative) linear relationship, +1 indicates a perfect positive (increasing) linear relationship and some values between -1 and +1 in all other cases indicate the degree of linear relationship between the X and Y parameters.

### Statistical analysis

The degree of relationships amongst the carcass traits was determined using the Pearson Correlation Coefficient Procedure of SAS (2008).

## RESULTS AND DISCUSSION

Table 2 shows the combined Pearson correlation amongst relative organs in three breeds of rabbit bucks. There were positive and significantly ( $p < 0.05$ ) high correlation coefficients ( $r$ ) between heart and liver ( $r = 0.663$ ) and between intestine and stomach ( $r = 0.570$ ). There was no significant ( $p > 0.05$ ) difference amongst the relative organs except between liver and lungs ( $r = -0.138$ ), kidney and caecum ( $r = -0.253$ ), caecum and lungs ( $r = -0.050$ ), caecum and intestine ( $r = -0.006$ ), lungs and stomach ( $r = -0.063$ ), lungs and intestine ( $r = -0.289$ ) which had a negative correlation. The positively high coefficient ( $r = 0.663$ ) show that selection for the improvement of any of such traits lead to an indirect improvement in the other. Conversely negative correlation coefficients mean that selection for the improvement of one trait might lead to a decrease in another that was not selected.

The result obtained in the current study is in agreement with the report of Nwagu *et al.* (2009) who, reported no significant ( $p > 0.05$ ) difference between liver and kidney, kidney and heart. However, the positive high correlation coefficient obtained between heart and liver ( $r = 0.663$ ) in this study contradicts the report of Nwagu *et al.* (2009) who reported a negative correlation coefficient ( $r = -0.747$ ) between heart and liver. The possible reason for the

positively high correlation between heart and liver as obtained in the current study could be as known for many years that the heart and the liver are intimately related.

A combined Pearson correlation amongst carcass traits in three breeds of rabbit bucks is presented in Table 3. There were various degrees of relationships with correlation coefficients ranging from high to low and positively and negatively correlated. The highest and positive correlation coefficient was obtained between live weight and slaughtered weight ( $r = 0.992$ ), and the least was between shank and testis ( $r = 0.025$ ). From the results, it revealed that live weight had a positive and high correlation with slaughtered weight (SW), dressing weight (DW), fore limb (FL), thoracic cage (TC), loin (LO), skin (SK), hind limb (HL) and a significant ( $p < 0.05$ ) effect on head (HD) and body weight (BW) while the live weight had a positive correlation but no significant ( $p > 0.05$ ) effect on shank (SL), testis (TS) and dressing percent (DP). There were positive correlations among all the carcass traits except between thoracic cage (TC) and dressing percent (DP), loin (LO) and dressing percent (DP), skin (SK) and dressing percent (DP), head (HD) and testis (TS) and, shank (SL) and dressing percent (DP) which had negative correlation coefficients.

The positive correlation coefficient means that as one carcass trait increases, the corresponding trait is also increasing. In contrast, negative correlation means that as one carcass trait is increases, the other is decreases. The high and positive relationships between live weight and other carcass traits show that other carcass traits also increase as weight increases. The result is similar to the result of Nwagu *et al.* (2009). They reported highly positive correlation coefficients ( $p < 0.001$ ) between live weight and loin, live weight and hind leg, live weight and fore leg, hind leg and loin, hind leg and loin, fore leg and hind leg ( $r = 0.987$ ,  $r = 0.938$ ,  $r = 0.980$ ,  $r = 0.990$ ,  $r = 0.683$ ,  $0.953$ ), respectively in different breeds of rabbit. The high and positive correlation coefficient between live weight, fore limb and hind limb are in agreement with the result of Okoro *et al.* (2010) who reported a high correlation between body weight and legs in the Chinchilla breed. The correlation between the fore limb and hind limb and other parameters in this current study is similar to the report of Abe *et al.* (2019) who reported a high and positive

**Table 3.** A combined Pearson correlation amongst carcass traits in three breeds of rabbit bucks.

	LW	SW	DW	FL	TC	LO	SK	HD	SL	HL	TS	BW	DP
LW	1												
SW	0.992**	1											
DW	0.972**	0.983**	1										
FL	0.808**	0.823**	0.790**	1									
TC	0.915**	0.874**	0.865**	0.780**	1								
LO	0.917**	0.909**	0.881**	0.588*	0.787**	1							
SK	0.896**	0.898**	0.846**	0.841**	0.799**	0.801**	1						
HD	0.661*	0.667*	0.666*	0.811**	0.610*	0.503 <sup>NS</sup>	0.656*	1					
SL	0.343 <sup>NS</sup>	0.292 <sup>NS</sup>	0.306 <sup>NS</sup>	0.327 <sup>NS</sup>	0.491	0.324 <sup>NS</sup>	0.242 <sup>NS</sup>	0.079 <sup>NS</sup>	1				
HL	0.777**	0.769**	0.757**	0.839**	0.837**	0.574*	0.780**	0.580*	0.242 <sup>NS</sup>	1			
TS	0.373 <sup>NS</sup>	0.360 <sup>NS</sup>	0.368 <sup>NS</sup>	0.232 <sup>NS</sup>	0.411	0.235 <sup>NS</sup>	0.258 <sup>NS</sup>	-0.075 <sup>NS</sup>	0.025 <sup>NS</sup>	0.412 <sup>NS</sup>	1		
BW	0.666*	0.698*	0.699*	0.461 <sup>NS</sup>	0.501	0.632*	0.405 <sup>NS</sup>	0.404 <sup>NS</sup>	0.239 <sup>NS</sup>	0.218 <sup>NS</sup>	0.261 <sup>NS</sup>	1	
DP	0.012 <sup>NS</sup>	0.089 <sup>NS</sup>	0.242 <sup>NS</sup>	0.041 <sup>NS</sup>	-0.095 <sup>NS</sup>	-0.049 <sup>NS</sup>	-0.099 <sup>NS</sup>	0.109 <sup>NS</sup>	-0.126 <sup>NS</sup>	0.037 <sup>NS</sup>	0.052 <sup>NS</sup>	0.221 <sup>NS</sup>	1

\*\*Correlation is significant at the 0.01 level, \*Correlation is significant at the 0.05 level, NS= Not significant, LW-live weight, SW-slaughtered weight, DW- dressing weight, FL-fore limb, TC-thoracic cage, LO-loin, SK-skin, HD-head, SL-shank, HL-hind limb, TS-testis, BW-body weight, DP- dressing percent.

phenotypic correlation among morphometric traits in New Zealand white rabbits reared under tropical conditions.

### Conclusion and Recommendation

The results of this study indicated various degrees of relationships from low to high correlation, positive and negative correlation amongst the carcass traits of three breeds of rabbit bucks. Positive and highly significant correlations among some carcass traits are indications that, increases in one trait led to an increase in the corresponding trait and that shows that selection for improvement of any of such trait will lead to an indirect improvement in the other. In contrast, negative correlation implies that an increase in one parameter leads to a decrease in the corresponding one.

For relative organs, the relationship between heart and liver, stomach and intestine ( $r=0.663$  and  $r=0.570$ ), were high and positively correlated. Selection for improvement of these rabbit bucks should be carried out based on liveweight (LW), slaughtered weight (SW), dressing weight (DW), fore limb (FL), thoracic cage (TC), loin (LO), skin (SK), hind limb (HL). This is due to the highly significant relationships that existed among the aforementioned parameters in this study.

Liver and heart should be explore more to look at the relationship between them since they had the highest and positive correlation among relative organs studied. Furthermore, live weight and slaughtered are recommended amongst other carcass traits for selection and improvement of rabbits.

Further research should be conducted on different breeds of rabbits at different ages to establish more relationships between carcass traits in the rabbit.

### CONFLICT OF INTEREST

The authors declared that they have no conflict of interest.

### REFERENCES

- Abe, O. S., Amusan, S. A., & Ozoje, M. O. (2019). Phenotypic correlation among morphometric traits in New Zealand white rabbits reared under tropical conditions. *Nigerian Journal of Animal Production*, 46(5), 17-22.
- Adamu, J., Adam, A. A., Yahaya, A., Raji, A. O., Abbaya, H. Y., & Ogu, I. E. (2022). Phenotypic correlation of body weight and morphometric measurements of two breeds of rabbit. *Journal of Animal Science and Veterinary Medicine*, 7(1), 1-5.
- Akanno, E. C., & Ibe, S. N. (2006). Weight of domestic rabbits at different stages of growth using linear body measurements. *Nigerian Journal of Animal Production*, 33(1), 3-8.

- Kabir, M., Akpa, G. N., Nwagu, B. I., & Adeyinka, I. A. (2012). Litter traits in a diallel crossing of three rabbit breeds in Northern Guinea Savannah Zone of Nigeria. *Proceedings of 10th World Rabbit Congress-September 3-6, 2012* Sharm El-Sheikh-Egypt. p.7.
- Nwagu, B. I., Kabir, M., & Suleiman, B. H. (2009). Carcass characteristics of different breeds of rabbits raised in Zaria. *Nigeria Savannah Journal of Agriculture*, 4: 14-19.
- Okoro, V. M. O., Ezeokeke, C. T., Ogundu, U. E., & Chukwudum, C. (2010). Phenotypic correlation of bodyweight and linear body measurement in Chinchilla rabbits (*Oryctolagus cuniculus*). *Journal of Agricultural Biotechnology and Sustainable Development*, 2(2), 27-29.
- Ovimaps (2022). Ovi map location: Ovi earth imagery.
- SAS (2008). Users Guide Version 8.1. Statistical Analysis System Institute Inc, Cary, Nc, USA.
- Shaahu, D. T., Dzungwe, N. E., & David-Shaahu, P. N. (2014) Growth performance, economic value and carcass characteristics of rabbits fed lablab seed as major protein source in diet. *International Journal of Advances in Agricultural Science and Technology*, 2(6), 8-18.