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EFFECT OF SEX ON BIOMETRY AND MORPHOLOGICAL INDICES OF JAPANESE QUAILS (*COTURNIX COTURNIX JAPONICA*)

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Original scientific paper

Abstract: The objective of this study was to determine the effect of sex on biometry and morphological indices of Japanese quails. A total of one hundred and fifteen finisher quails (115) comprising 30 males and 85 females of ten (10) weeks of age were used for this study. The quails were procured from the National Veterinary Research Institute (NVRI) Vom, Plateau State Nigeria. They were managed in a deep litter system of housing from day old to finisher phase (10 weeks). The sex of the quails were identified by the production of cloacal foam following the standard protocol. Female quails recorded higher ($P<0.05$) body weight, massiveness and appears to be better for long leggedness than their male counterpart. The lower values observed for the female quails for long leggedness is an indication of blockier appearance a characteristics for meatiness. The results of the Pearson correlation for the male quails indicates that there were strong positive correlation for Body weight(BW) and Body length(BL)($r=0.465$ at $P<0.01$), BW and Breast circumference(BC), BL and BC, Foot length(FL) and Wing length(WL) ($r=0.577$, 0.429 and 0.451 at $P<0.05$). For the female quails, strong positive correlation were observed for BC and WL, FL and WL ($r=0.339$, 0.332 at $P<0.01$), BL and FL, FL and TLL ($r=0.270$, 0.263 $P<0.05$). There was also a strong negative correlation observed for Thigh circumference (TC) and FL ($r=0.406$ at $P<0.01$). The result of χ^2 for the sex was also significant ($P<0.05$). This findings would aid in the selection and breeding programme for quails' improvement.

Key words: Sex**,** traits, morphological indices, rectal temperature, quails

Introduction

Japanese quail have competitive advantages over other minor poultry species such as early sexual maturity, short generation interval, rapid growth rate, and high reproductive capacity (*Varkoohi et al., 2011)*. Also, the environmental

requirements are few and production costs are rather low. Quails plays an important role in poultry production as meat and egg production. The human tendency to consume protein coming from animals has made quail production even more important (*Balcıoğlu et al., 200*5). Factors, such as a short generation interval, suitability for genetic improvement and also due to the facts that the birds cover a small space and consume a small amount of feed have led to a frequent use of quails for breeding purposes (*Koçak and Özkan, 2000)*. The Japanese quails are sexually dimorphic birds with the female having a larger body size than males. Unlike other poultry species. Accordingly, females require more time to reach sexual maturity than males (*Reddish et al., 2003*). The differences in growth pattern between the sexes are also a well-known phenomenon (*Sezer and Tarhan, 2005*). At an early age, gender determination according to the morphological characteristics of Japanese quail is not easy. After hatching, live weight increases continuously up to puberty. The sexual maturity of Japanese quails lasts 4-6 weeks. In female birds the increase in live weight goes on until the 6^{th} week of age and they generally start laying eggs during this period (*Alkan et al., 2008b*). For this reason, the first six weeks are critical in order to determine values indicating information about certain yield traits (*Cerit and Altınel, 1998).* Although it is easier to discriminate the sex from the 6th week of age due to the larger body shape of female birds as well as through observing typical behaviour of male birds (*Brunström et al., 2009*). This is too late since quails reach a weight suitable for sales markets after 5-6 weeks. It is of advantage that there are specific differences between the sexes in quails. These differences can be determined at a rate of 99% in a day-old chicks. A remarkable protrusion or a cavity at the edge of the dorsal cloaca are characteristic features of male birds. This characteristic is typically well developed in male birds. The colouring of the chest feathers in the 2^{nd} and 3^{rd} week of age is also a reliable indicator for sex discrimination. Spotted and reddish-brown feathers start sprouting in this period. From approximately the 6^{th} week on the large body shape of female birds and distinct behaviour of male birds can be recognized. During this period the production of cloacal foam can be observed in male quails (*Tservem-Gouss and Yannakopoulos, 1986*). Therefore this study aimed at determining the effect of sex on biometry and morphological indices of Japanese quails

Material and Methods

Experimental location

This experiment was carried out at the Livestock Section of the Teaching and Research Farm of the Faculty of Agriculture, Nasarawa State University, Keffi, Shabu-Lafia Campus. It is located at guinea savannah zone of North Central Nigeria. It lies at latitude $08^{0}35$N and longitude $08^{0}33$E.

Lafia enjoys two separate seasonal periods namely raining season (April-September) and dry season between (October-March). Annual rainfall figures range from 1100 to 2000 mm. The mean monthly temperatures in the State range between 20 and 34ºC, with the hottest months being March/April and the coolest months being December/January *(Lyam, 2000).*

Experimental birds and management

A total of one hundred and fifteen finisher quails (115) comprising 30 males and 85 female of ten (10) weeks of age were used for this study. The quails were procured from the National Veterinary Research Institute (NVRI) Vom, Plateau State Nigeria. They were managed in a deep litter system of housing from day old to finisher phase (10 weeks). At the end of the 10^{th} week of the experiment data were obtained for body weight, biometric [body length (BL), breast circumference (BC), thigh circumference (TC), foot length (FL), total leg length (TLL), wing length (WL)] as well as rectal temperature respectively. Each bird was tagged with an identification number for easy data collection. The sex of the quails were identified by the production of cloacal foam as described by *Tservem-Gouss and Yannakopoulos (1986*). In male there is production of cloacal foam when pressed while non in female. The birds were fed commercial conventional feed from day old to finisher phase. Feed and fresh clean water were supplied *ad libitum.* Routine vaccination and other management practices were strictly followed. There was also a routine administration of antibiotics, vitamins and coccidiostat (Amprolium) in the drinking water.

Body weight and biometric data collection

Body weight (BW) and six primary biometric traits: body length (BL), breast circumference (BC), thigh circumference (TC), foot length (FL), total leg length (TLL) and wing length (WL) were taken on each of the quail at the end of the10^{th} week of the experiment as adopted by *Teguia et al., (2008).* Body weight (BW):- 10-kg digital weighing balance scale was used for the individual weight measurement, Body length (BL):- Body length was taken between the tip of the Rostrum maxillare (bill) and that of the Cauda (tail, without feathers), Breast circumference (BC):- This was taken under the wings at the edge of the sternum, Thigh circumference (TC):-The circumference of the thigh was taken as the circumference of the drumstick at the coxa region, Foot length (FL):- This was taken as the distance from the shank joint to the extremity of the *Digitus pedis*, Total leg length (TLL):- This was taken as the length of the femur, shank and metatarsal, Wing length (WL):- This was taken from the shoulder joint to the extremity of the terminal phalanx, digit 111. The biometric traits measurements (cm) were taken using flexible tape rule.

Morphological indices and rectal temperature data collection

The morphological indices were determined following the procedure of *Oblakova (2007).* Massiveness (MAS):- Ratio of live body weight to body length × 100, Stockiness (STK):- Ratio of breast circumference to body length × 100, Long leggedness (LLN):- Ratio of total leg length to body length × 100, Condition index (CI):- Ratio of live body weight to wing length × 100. Rectal Temperature: Was measured using a clean clinical thermometer inserted into the vent for one minute after which the readings were taken (˚C) as described by *Yahav and McMurtry, (2001).*

Statistical analysis

The effect of sex at the end of the 10^{th} week of the experiment were assessed using the General Linear Model (GLM) of Statistical package for social science (SPSS.22). Pearson correlation matrix was performed to explain the relationship of body weight and biometrics characteristics among individual male and among female quails. Chi-square analysis of sex using goodness of fit was also performed to show significant or non-significant relationship between the sexes. The following model was employed:

$Y_{ij} = \mu + S_i + e_{ij}$

Y_{ij} = Individual mean observation

μ = General mean

S_i = Effect of sex (male and female at the 10^{th} week of the experiment)

e_{ij} = Error term.

Results and Discussion

Table 1. Effect of Sex on the body weight and biometric traits of quails

	Sex (n=115)		
Traits	Male (n=30)	Female (n=85)	Sig
Body weight (kg)	0.147 ± 0.008^{b}	0.168 ± 0.005^{a}	**
Body length (cm)	13.183 ± 0.144^{a}	13.429 ± 0.086^{a}	ns
Breast circumference (cm)	16.333 ± 0.149^{a}	16.470 ± 0.089^{a}	ns
Thigh circumference (cm)	4.233 ± 0.095^{a}	4.149 ± 0.057^{a}	ns
Foot length (cm)	3.733 ± 0.066^{a}	3.756 ± 0.039^{a}	ns
Total leg length (cm)	11.883 ± 0.156^{a}	11.714 ± 0.093^{a}	ns
Wing length (cm)	10.783 ± 0.271^{a}	11.304 ± 0.162^{a}	ns

[ab] Means on the same rows bearing different superscripts are significantly different ($P<0.05$)

** Significant at 95%, ns- not significant.

BW=Body weight, BC= Breast circumference, TC= Thigh circumference, FL= Foot length, TLL= Total leg length, WL= Wing length

Effect of sex on the body weight and biometric traits of quail is presented in Table 1. The result indicates that only body weight recorded significant effect (P<0.05) on the quails. Female quails recorded higher (P<0.05) body weight than their male counterpart. No significant difference were recorded for the other parameters measured (body length, breast circumference, thigh circumference, foot length, total leg length and wing length).

Table 2. Effect of Sex on the morphological indices and rectal temperature of quails

	Sex (n=115)		
Traits	Male (n=30)	Female (n=85)	Sig
Massiveness (MAS)	1.113±0.063[b]	1.262±0.037[a]	**
Stockiness (STK)	125.462±16.403[a]	139.445±9.803[a]	ns
Long-leggedness (LL)	90.134±1.505[a]	86.435±0.900[b]	**
Condition index (CI)	1.369±0.112[a]	1.534 ±0.067[a]	ns
Rectal temperature (RT) (^{0}C)	40.480±0.550[a]	41.312±0.329[a]	ns

[ab] Means on the same rows bearing different superscripts are significantly different (P<0.05)
** Significant at 95%, ns- not significant.

Effect of sex on the morphological indices of quails is presented in table 2. The results were significant (P<0.05) for massiveness (MAS) and long leggedness (LL). Female quails recorded higher (P<0.05) significant value for massiveness and appears to be better for long leggedness. The lower values observed for the female quails for long leggedness is an indication of meat characteristics and this is observed by a blockier appearance. However there were no significant difference (P<0.05) recorded for stockiness (SK), condition index (CI) and rectal temperature (RT).

Correlation matrix of the body weight and biometrics characteristics among individual male and among female (hen) quails at 10th week of age is presented in table 3. The results for the male quails indicated that there were strong positive correlation for BW and BL (r=0.465 at P<0.01), BW and BC, BL and BC, FL and WL (r=0.577, 0.429 and 0.451 at P<0.05). For the female (hen), strong positive correlation were observed for BC and WL, FL and WL (r=0.339, 0.332 at P<0.01), BL and FL, FL and TLL (r=0.270, 0.263 P<0.05) whereas there was a strong negative correlation observed for TC and FL (r=0.406 at P<0.01).

Table 3. Correlation matrix of body weight and biometrics characteristics among individual male quails and among female quails at 10th week of age.

	Male						Female					
	BL	BC	TC	FL	TLL	WL	BL	BC	TC	FL	TLL	WL
BW	0.465**	0.577*	0.259	-0.043	0.340	-0.016	0.002	-0.017	0.115	-0.035	0.003	-0.127
BL		0.429*	0.060	0.051	0.214	0.213		0.171	-0.126	0.270*	0.050	0.185
BC			0.114	0.059	0.063	0.315			-0.125	0.105	0.088	0.339**
TC				-0.112	0.098	-0.294				-0.406**	0.019	-0.168
FL					0.055	0.451*					0.263*	0.332**
TLL						0.237						0.161

: P<0.01; *: P<0.05. BW=Body weight, BC= Breast circumference,** TC= Thigh circumference, FL= Foot length, TLL= Total leg length, WL= Wing length

Table 4. Test of homogeneity for the effect of sex on body weight, biometric and morphological indices of quails.

Parameters	F	df1	df2	Sig.
BW	0.602	1	112	0.440
BL	0.000	1	112	0.985
BC	4.456	1	112	0.037
TC	0.608	1	112	0.437
FL	0.683	1	112	0.410
TLL	0.074	1	112	0.786
WL	0.055	1	112	0.814
MAS	0.746	1	112	0.390
STK	1.714	1	112	0.193
LL	0.528	1	112	0.469
CI	0.122	1	112	0.728
RT	0.044	1	112	0.834

df1 and df2-degree of freedom, F- calculated value.

Results of the test of homogeneity for the effect of sex on body weight, biometric and morphological indices of quails (Table 4) indicates that all the parameters were

homogenous except for BC (sig values > 0.05 indicates not significant or homogenous and <0.05 indicates significant or heterogenous).

Table 5. Chi-Square analysis of Sex using goodness of fit

Sex	Frequency	Percentage	Mean	SD	χ^2	Df	P-Value
Male	30	26.100					
			1.739	0.441	26.304	1	0.000**
Female	85	73.900					

SD- standard deviation, df- degree of freedom, χ^2- Chi-square

There result of chi-square for the goodness of fit is presented in table 5. The result of the sex was significant (P<0.05). The χ^2 – value of 26.304 was recorded.

Discussion

The sexual differences in quails are believed to evolve under the pressure of natural and sexual selection, which implies that genes controlling sexually dimorphic characteristics differ between males and females (*Mignon-Grasteau et al., 2004*). It is important to have a wider knowledge of genetic correlations between live weight and other important traits for quail production to develop an optimal total merit index. This will also complement our understanding of the evolutionary consequences of the sexual dimorphism. The result of this study indicates that only body weight recorded significant effect (P<0.05) on the quails. Female quails recorded higher (P<0.05) body weight than their male counterpart. No significant difference were recorded for the other parameters measured (body length, breast circumference, thigh circumference, foot length, total leg length and wing length). The significant difference (P<0.05) recorded for the body weight in this study agreed with the work of *Alkan et al. (2008a)* who report that live weight and body length in Japanese quails are critical from week 2 on for discriminating the sex. However our study do not recorded significant difference (P<0.05) in the body length for the male and female quails. The result of this study on the significant difference recorded for the body weight is congruous with the report of *Faith et al. (2018)* and *Genç et al. (2009)* who observed significant effect for live weight in chickens and quails respectively. It is observed in other literatures that female quails are slow in attaining sexual maturity and however still appears to gain more body weight than the males (*Alkan et al., 2008a; Genç et al., 2009; Türkmut et al., 1999*). Female quails recorded higher (P<0.05) significant value for massiveness and appears to be better for long leggedness. The lower values

observed for the female quails for long leggedness is an indication of blockier appearance, a good characteristics for meatiness. Generally, a higher phenotypic variation of traits indicates a higher genetic variation, which guarantees a sufficient selection response. This is important because of directional selection on morphological traits and commonly occurs in natural populations (*Kingsolver et al., 2001*). The results of the correlation matrix for the male quails indicated some forms of strong positive correlation for BW with some of the biometric traits. The estimates of correlation in the present study are comparable to those reported by earlier workers for chicken (*Mancha et al., 2008*).

Conclusion

Female quails recorded higher body weight, massiveness and appears to be better for long leggedness than their male counterpart. The lower values observed for the female quails for long leggedness is an indication of blockier appearance a characteristics for meatiness. The results of the Pearson correlation for the male quails indicates that there were strong positive correlation for Body weight(BW) and Body length (BL), Body weight (BW) and Breast circumference (BC), Body length (BL) and Breast circumference (BC) as well as Foot length(FL) and Wing length (WL). For the female quails, strong positive correlation were observed for Breast circumference (BC) and Wing length (WL), Foot length (FL) and Wing length (WL), Body length (BL) and Foot length (FL) as well as Foot length (FL) and Total leg length (TLL) respectively. There was also a strong negative correlation observed for Thigh circumference (TC) and foot length (FL). Body weight and other biometric parameters could jointly be used in the assessment of quails in times of sexual differences and meat characteristics. The result of χ^2 for the sex was also significant ($P<0.05$). The results of this findings will aid in the selection and breeding for quails improvement programme.

Uticaj pola na biometriju i morfološke indekse japanskih prepelica (*Coturnix coturnix japonica*)

Faith E. Akumbugu, Musa U. Obakpa, Aya V. Ebuga, Thomas S. Esson

Rezime

Cilj ove studije bio je utvrditi uticaj pola na biometriju i morfološke indekse japanskih prepelica. Za ovu studiju korišćeno je ukupno sto petnaest prepelica (115) koje čine 30 mužjaka i 85 ženki starosti deset (10) nedelja. Prepelice su nabavljene od Nacionalnog instituta za istraživanje veterine (NVRI) Vom, država Plateau Nigeria. Držani su u sistemu duboke prostirke, od starosti jednog dana do završne faze (10 nedelja). Pol prepelica identifikovan je proizvodnjom kloakalne pene sledeći standardni protokol. Ženke prepelica zabeležile su veću ($P<0,05$) telesnu masu, veličinu i čini se da su bolje za osobinu dužina nogu od muških ptica. Niže vrednosti koje se primećuju kod prepelica ženskog pola zbog dugih nogu pokazatelj su blokerijevog izgleda što je karakteristika za mesnatost. Rezultati Pearsonove korelacije kod muških prepelica pokazuju da je postojala snažna pozitivna korelacija za telesnu masu (BW) i dužinu tela (BL) ($r = 0,465$ na $P <0,01$), BW i obim grudi (BC), BL i BC, dužina stopala (FL) i dužina krila (WL) ($r = 0,577$, $0,429$ i $0,451$ pri $P <0,05$). Za ženske prepelice primećena je snažna pozitivna korelacija za BC i WL, FL i WL ($r = 0,339$, $0,332$ na $P <0,01$), BL i FL, FL i TLL ($r = 0,270$, $0,263$ $P <0,05$). Takođe je primećena snažna negativna korelacija za obim bataka (TC) i FL ($r = 0.406$ na $P <0.01$). Rezultat χ^2 za pol takođe je bio značajan ($P <0,05$). Ovi nalazi bi pomogli u programu selekcije i uzgoja za poboljšanje prepelica.

Ključne reči: pol, osobine, morfološki indeksi, rektalna temperatura, prepelice

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