EFFECTS OF PLUMAGE COLOUR, SHANK TYPE AND SHANK COLOUR ON BODY WEIGHTS OF DOMESTIC PIGEON SQUABS (*COLUMBA LIVIA*) IN MAIDUGURI, BORNO STATE, NIGERIA.

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ABSTRACT
This research was carried out to determine the effects of plumage colour, shank type and shank colour on body weights of domestic pigeon squabs at the Livestock Teaching and Research farm, Ramat Polytechnic, Maiduguri Borno state. The information collected were plumage colour, shank type, shank colour and weights at days 0-30 at three days interval. Data collected were analyzed using the statistical package for Social Sciences (SPSS) and significant means were separated by the Duncan's multiple range tests. The results obtained revealed that the mean body weight of pigeon from day old to 30 days range between 15.51±0.09 and 363.64±1.88 g. The highest body weights among the plumage color were recorded in White and Black colour combination at all ages, and the least was White Gray and Brown colour combination. In all the ages, White and Black had significantly ($p<0.05$) higher than other plumage colors. The results obtained also revealed that pigeon squabs with intermediate red shank color were significantly heavier ($p<0.05$) than their counterparts in all the age groups. Shank type had no effect ($p>0.05$) on body weight of indigenous pigeon squabs. However, improvement in body weight pigeon of squabs up 30 days of age can be achieved with intermediate red shank and black/white plumage colour combination.
Key words: Pigeon, Squabs, Plumage colour, Body weight, Shank colour

INTRODUCTION
Pigeons are found to some extent in nearly all urban areas around the world. The global population is estimated to number 260, 000,000 individuals (Rich *et al*., 2004). Pigeons have been one of man's closest associates for more than 4,000 years (Bennett, 2008). They readily adapt themselves to living under a variety of conditions. Their diets are simple, they are normally free from objectionable odours and noises made by pigeon are not loud or harsh. Therefore, it is easy to keep pigeons in cities or towns (Janssens *et al.,* 2002). Furthermore they require little space and can be obtained at reasonable cost. For these reasons pigeons enjoy considerable popularity among persons of all ages (Pigeons control resource Centre, 2009). Pigeons are bred for different purposes such as meat in the form of squabs, ornamental and show, as well as flying and racing competitions (Jerolmack, 2007) aside being useful in experiments of cognitive sciences (Wright, 2013).

Indigenous birds (domestic pigeons inclusive) are a vital reservoir of gene resources and their conservation has a technical role related to the future development of the production system as well as a socio-cultural role (Camacho-Escobar *et al*., 2008). Therefore, genetic and phenotypic evaluations of their performances such as growth cannot be overemphasized. Growth is a complex trait in animals that is controlled by genetic and non-genetic factors. Body weight and body conformations are the two important parameters for measuring growth in the domestic animals (Ogah *et al.,* 2009). Growth is the increase in weight and or size that occurs over time (i.e. age) while development is the changes that start at conception and continue up to the maturity (Alade *et al.,* 2010). There is a dearth of information on plumage color, shank type and shank color of indigenous pigeons unlike other poultry species; therefore, the objective of this study was to determine the effects of plumage color, shank type and shank color on body weights of indigenous pigeons at different age in Maiduguri, Borno State.

MATERIALS AND METHODS
The study was conducted at the Poultry and Livestock Teaching and Research Farm of the Department of Animal Production, Technology Ramat Polytechnic, Maiduguri, Borno State, Nigeria. Maiduguri the capital city of Borno State is located at latitude 11^0 51'North and longitude 13^0 05' East and at an altitude of 354 m above sea level. Maiduguri has very short duration of rainy season (3-4

months) with about 645.9 mm/annum and a long dry season of about 8-9 months (MCN, 2018). The ambient temperature could be as low as 20^{o} C during the dry cold season in December – January and as high as 44^{o} C during the dry hot season in April and May. Relative humidity is 45% in August which usually lowers to about 5% in December and January. Day length also varies from 11 to 12 hours (MCN, 2018).

A total of 106 pairs of parent's pigeon were used to produce 765 squabs for the experiment. The birds were housed in shelters provided for protection against predators and harsh weather conditions in an intensive system. The parent pigeons of breeding age were housed in wooden cage attached externally to the walls (open house type) usually in monogamous pairs or couples. They were fed with seeds and grains, varying from wheat, millet, sorghum to crushed maize and kitchen scraps, two times daily. Clean drinking water was provided *ad-libitum.*

Using a 5000 g digital sensitive weighing scale, measurements on body weights were individually collected at different intervals of 3 days from hatch to 30 days. Birds were individually observed for phenotypic expression of desired traits. Sex, plumage colour, shank type, and shank colour were recorded and kept. The data were analyzed using the general linear model of SPSS 11.0. Significant means were separated by the Duncan's multiple range tests.

RESULTS AND DISCUSSION

The means and standard errors of the mean for body weights of pigeon squabs at various ages are shown in Table 1. The body weights ranged from 15.51 g at day old to 363 g at day 30.These results is in agreement with Darwati *et al.* (2010) who reported that mean body weight of local pigeon at day old and 5th weeks were 16.20 g and 340.00 g respectively and those of Aliyu *et al.* (2017) who similarly reported that the mean body weight of pigeon squabs at day old and 27 days were 15.19 g and 376.60 g as well as Bhowmik *et al.* (2014) who observed that live body weight of Jalali pigeon at 3, 15, 21, and 28 days of age were 31.68, 225.53, 275.59, and 324.79 respectively. It was evident that the mean body weights of pigeon remarkably increased as the squabs advanced in age up to 18 days and begin to slow down gradually thereafter. Squabs have a faster rate of relative growth (0.1466 to 0.1945 g/d) compared to other domesticated poultry species such as chicken (0.0450g/d) and quail (0.077 to 0.097 g/d) as reported by Sales (2003) and this is probably achieved by regurgitation of crop milk by both parents.

The effects of plumage colour on body weight of indigenous pigeons are presented in Table 2. Nine plumage colors were recorded in the indigenous pigeon population during the period of the study. These are White (24.1%), Gray (12.7%), Brown (6.5%), Black (14.1%), White and Black (9.9%), White and Gray (9.4%), Brown and White (8.0%), White Gray and Black (8.6%), as well as White Gray and Brown (6.7%). There was significant effect ($P<0.05$) of plumage colour on the body weight of pigeons squabs at ages. The highest body weight was observed in white and black, white and gray and gray plumage colours at most of the ages recorded. Squabs with three colour combinations seemed to have a lower body weight at most of the ages. Okoh *et al.* (2020) reported that plumage colour had significant effect on body weight of indigenous chicken. Furthermore, Raji *et al.* (2009) reported that multicoloured Muscovy ducks had heavier body weight than other colours. Thus, the differences in plumage colour could be as a result of genetic make-up of the animal, differences in climate and managerial conditions under which the birds were reared. It could also be due to selection for increased body weight.

The effects of shank color on body weight of pigeon squabs are presented in Table 3. The result shows that squabs with intermediate red colour shank had generally highest body weight ($P<0.05$) at all ages than those with light and dark Red shank colours. Pervez *et al.* (2016) observed that the shank color of Jalali pigeon were red, is in line with Bhowmik *et al.* (2014) who also reported that the color of shank of Jalali pigeon were red. Oguntunji and Ayorinde (2014) who observed that shank colour had significant effect on body weight of Muscovy ducks which are in line with the present findings.

The effects of shank type on body weight of indigenous pigeon squabs are presented in Table 4. The result shows no significant difference ($P<0.05$) in body weight at all ages among the pigeon squabs. The result of this study is in line with those of Ndiilokelwa (2011) who observed similarities in feathered and non-feathered of shank in local chickens. However, variation in body weights with shank type appears to be haphazard showing no particular trend, that is, no shank type was out rightly superior to other in all ages of pigeon squabs.

Table: 1 Descriptive Statistics of Body Weight (g) Traits in Domestic Pigeon

Grand Mean Age (days)	Body weight (g)	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
0	15.511	0.093	15.328	15.694
3	61.860	0.499	60.881	62.839
7	126.690	0.990	124.747	128.632
10	188.222	1.416	185.442	191.002
14	249.618	1.723	246.235	253.000
18	296.816	2.008	292.874	300.757
21	301.022	1.915	297.263	304.781
24	321.705	1.916	317.944	325.467
27	341.194	1.893	337.477	344.910
30	363.643	1.875	359.962	367.323

SE= Standard error

Table: 2 Mean ± SE of Body Weights (g) by Plumage Colour in Domestic Pigeon

Age (Days)	White	Gray	Brown	Black	White and Black	White and Gray	Brown and white	White, Ash and Black	White, Gray and Brown
0	15.52±0.18^{bc}	16.37±0.24^{a}	15.46±0.34^{bc}	14.73±0.23^{c}	16.46±0.27^{a}	16.08±0.28^{ab}	14.87±0.31^{c}	15.30±0.29^{bc}	14.65±0.34^{c}
3	59.18±0.94^{b}	63.15±1.30^{ab}	61.26±1.81^{ab}	64.89±1.23^{a}	65.28±1.47^{a}	62.68±1.51^{ab}	62.26±1.64^{ab}	59.05±1.57^{b}	58.41±1.79^{b}
7	126.01±1.87^{abc}	132.37±2.58^{ab}	122.96±3.59^{c}	125.34±3.44^{abc}	133.66±2.91^{a}	132.18±2.99^{ab}	124.05±3.25^{bc}	122.12±3.12^{c}	120.55±3.51^{c}
10	187.86±2.68^{bc}	196.36±3.67^{ab}	186.60±5.13^{bc}	187.45±3.49^{bc}	206.25±4.16^{a}	191.67±4.28^{bc}	180.924.65^{cd}	183.76±4.47^{bcd}	171.82±5.08^{d}
14	246.66±3.26^{bc}	260.58±4.49^{ab}	244.34±6.24^{bc}	245.48±4.25^{bc}	270.86±5.06^{a}	259.78±5.66^{ab}	237.31±5.20^{cd}	252.91±5.44^{bc}	226.45±6.18^{d}
18	293.76±3.79^{bc}	303.25±5.23^{bc}	288.02±7.28^{c}	291.24±4.95^{bc}	323.70±5.90^{a}	309.72±6.59^{ab}	289.33±6.06^{c}	301.65±6.33^{bc}	266.80±7.20^{d}
21	300.22±3.62^{bc}	305.27±4.98^{bc}	292.08±6.94^{c}	296.21±4.72^{bc}	328.16±5.63^{a}	313.85±6.29^{ab}	292.93±5.78^{c}	305.89±6.04^{bc}	272.57±6.87^{d}
24	321.61±3.62^{bc}	326.32±4.99^{bc}	312.60±6.94^{c}	318.83±4.72^{c}	348.05±5.63^{a}	337.61±5.79^{ab}	315.39±6.29^{c}	321.356.05^{bc}	291.33±6.88^{d}
27	342.74±3.58^{cd}	345.01±4.93^{bcd}	328.70±6.86^{d}	334.70±4.67^{cd}	368.83±5.56^{a}	360.15±6.21^{ab}	330.97±5.72^{cd}	347.05±5.97^{bc}	309.84±6.79^{e}
30	367.34±3.54^{bcd}	367.34±4.88^{bc}	351.46±6.80^{d}	355.23±4.62^{cd}	390.55±5.51^{a}	382.19±6.15^{ab}	350.98±5.66^{d}	368.86±5.92^{bc}	334.25±6.73^{e}

SE= Standard error *abcde= means within the row bearing different superscripts are statistically significant (p<0.05).*

Table 3: Mean ± SE of Body Weights (g) by Shank Colour in Domestic pigeon

	Shank color		
Age (days)	Light Red	Intermediate Red	Dark Red
Hatch	15.43±0.16[a]	15.64±0.12[a]	14.26±0.51[b]
3	57.85±0.81[b]	64.19±0.61[a]	55.87±2.66[b]
7	120.46±1.60[b]	131.26±1.21[a]	114.22±5.29[b]
10	180.56±2.32	185.00±1.75	193.90±7.67
14	239.71±2.83[b]	256.73±2.13[a]	235.35±9.34[b]
18	284.27±3.34[b]	305.03±2.51[a]	285.00±11.00[b]
21	288.60±3.14[b]	309.83±2.37[a]	290.13±10.37[b]
24	309.77±3.15[b]	330.54±2.37[a]	313.09±10.39[b]
27	329.60±3.12[b]	350.15±2.35[a]	330.52±10.29[b]
30	354.30±3.12[b]	371.57±2.35[a]	354.00±10.28[b]

SE= Standard error. *ab= means within the row bearing different superscripts are statistically significant (p<0.05).*

Table 4: Mean ± SE of Body Weights (g) at Different Ages by Shank Type in Domestic Pigeon

	Shank Type	
Age (days)	Feathered	Unfeathered
Hatch	14.256 ±0.35	14.498±0.42
3	58.112±1.77	59.734±2.13
7	117.00±3.73	121.94±4.50
10	175.57±5,19	182.14±6.25
14	231.48±6,64	237.26±8.00
18	265.24±7.91	270.84±9.53
21	282.56±7.26	291.24±8.75
24	304.69±7.36	311.30±8.88
27	320.82±7.85	328.89±8.57
30	343.21±6.82	350.16±8.22

SE= Standard error. *Statistically no significant difference (p>0.05).*

CONCLUSION

This study reveals that White and Black plumage colour pigeon squabs at all ages were generally heavier than birds with other plumage colour, while White Gray and Brown had the lowest at all ages. Squabs with intermediate red colour shanks were heavier at all ages while shank type was not a source of variations. Therefore heavier body weights of domestic pigeon squabs can be improved with plumage and shank colours. However, assessment of body weight of this species of bird beyond 30 days of age is recommended.

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