Ghana Journal of Science, Technology and Development
Vol. 7, Issue 3, October 2021
www.gjstd.org
e-ISSN: 2343-6727
DOI: https://doi.org/10.47881/273.967x

Carcass Characteristics of Domestic Pigeon (*Columba livia domestica*) in the Northern Region of Ghana

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ABSTRACT

The study characterized the carcass traits of domestic pigeons in the northern region of Ghana. Data were collected on 30, 4-week-old domestic pigeon squabs consisting of 15 males and 15 females from five plumage colour varieties. These birds were intensively managed and fed with broiler mash containing 20% CP and 2776.43 ME (Kcal/kg). The pigeons were slaughtered according to standard abattoir procedures and parameters such as pre-slaughter weight, dressed weight, deplumed weight, breast weight, thigh weight, back weight, wing weight, drumstick weight and giblets (whole heart weight, liver and gizzard) weight were measured. Carcass data were analyzed using the GLM of SPSS to investigate the effect of sex and plumage colour variety on carcass measurements. Pigeon lost 11.6% of live body weight after bleeding. The effect of sex was found to be a significant ($p<0.05$) source of variation for pre-slaughter weight, dressed weight and heart weight. Except for back, lung and gizzard weights on which plumage colour varieties had a significant effect ($p < 0.05$), all other carcass parameters were not influenced ($p>0.05$) by plumage colour variety. In conclusion, male pigeons generally had significantly higher carcass characteristics (pre-slaughter weight, dressed weight and heart weight) than their female counterparts irrespective of their colour varieties in the northern region.

Key words: *carcass, pre-slaughter weight, dressed weight, sex, plumage colour.*

INTRODUCTION

Domestic pigeons (*Columba livia domestica*) are seen in many regions of the world including countries in Africa such as Nigeria, Botswana, Egypt and Ghana where they live side by side with humans and are reared as sources of food, hobby, pets and for experimental purposes. They have adapted to life in urban, suburban and rural environments and have close communication with humans (Amal *et al*., 2014; Mohammad *et al* 2014; Adang *et al*., 2008 and Mushi *et al*., 2000).

Pigeons are considered as microlivestock that are durable, requiring minimal space and capable of flourishing in urban areas because little effort is required to raise them. Domestic pigeons, like other domestic poultry are usually part of subsistence farming carried out by most poor families especially in rural areas. Rearing pigeons for food are not as common as it should have

been; moreover, of recent its potential has hardly been exploited. Meat from pigeons has a fine texture and possesses an enticing flavor making it a potential replacement of game fowl. The meat is also tender and easily digested and therefore commands a good market price (NRC, 1991). In addition, these birds grow quickly and mature rapidly. According to Mohammed *et al*. (2014), a squab reaches the stage of consumption from between 25-30 days. The life cycle of pigeons is relatively much shorter than other farm animals, additionally productivity of offsprings is high.

The domestic pigeon is one of the important Animal Genetic Resource (AnGR) in Ghana that requires attention and improvement for use to supplement protein and reduce poverty among rural and urban dwellers in Ghana. Pigeon breeds differ in body shape, structure, and colour and in the markings of their plumage according to Parés-Casanova and Kabir (2020). However, only a few studies have been carried out on their phenotypic characteristics. The need to characterize the domestic pigeon populations is quite urgent (Zerrouki *et al*. 2004 and Kristensen *et al*. 2015) since that will provide information that will guide their utilization in the country. The domestic pigeon population in Ghana is genetically uncharacterized and unimproved and no known genetic improvement program for this poultry type has ever been started. Literature on the carcass characteristics of the available pigeon population in Ghana is scanty. This study, therefore, seeks to characterize the carcass traits of the domestic pigeon in the Northern Region of Ghana.

MATERIALS AND METHODS

Location of Study

The study was conducted at the UDS Meats Unit of the Department of Animal Science, Faculty of Agriculture, Food and Consumer Sciences, University for Development Studies, Nyankpala campus. Nyankpala is about 18km west of Tamale in the Tolon District**.** The district lies between latitude 8ºN, 11ºN and longitude 0ºE 3ºW (SARI, 2008). The climate of the area is relatively dry, with a single rainy season that begins in April and ends in October. Annual rainfall varies between 750 mm and 1,050 mm. The dry season starts in November and ends in March with maximum temperatures occurring towards the end of the dry season and minimum temperatures occurring between December and January. The harmattan winds which occur from December to early February have a considerable effect on temperatures in the region, making them vary between about 14ºC to 28.2ºC at night and 40ºC to 42ºC during the day, with an average temperature of about 31ºC. Humidity is very low, aggravating the effect of the daytime heat. The main vegetation is grassland, interspersed with Guinea savannah woodland, characterized by drought-resistant trees (SARI, 2008; GSS, 2010).

Management of Experimental Birds

Five parent colour varieties were obtained for the study. These were Blue bar, Blue check, Black, White and Pied. The parent birds were sourced from farmers interviewed in an earlier study in nine districts in the northern region (Ishaq, 2019). The districts were Tolon, Kumbungu, Sagnarigu, Tamale Metro, Gushiegu, Karaga, West Mamprusi, East Gonja and East Mamprusi. The parent pigeons were gathered and paired up according to their colours in cages under the intensive system in a large deep litter house at Nyankpala. Feed and water were administered *ad libitum*. Since there is no commercially available pigeon feed in the market for feeding pigeons, the feed was mixed using various feedstuffs provided in Table 1.

Table 1: Percentage Composition of Feedstuff for Experimental Pigeons

Feed ingredients	Percentage composition (%)
Yellow maize	10
Millet	15
Sorghum (white)	10
Sorghum (red)	15
Broken Rice	10
Soya beans	15
Pigeon pea	5
Fish meal	10
Rice bran	3.2
Vitamin Premix	0.5
Di-calcium phosphate	2
Salt	0.3
Oyster shell	4
Total	100
Calculated nutrient analysis	
CP (%)	20.142
ME (Kcal/kg)	2776.43

When the squabs (young pigeons) were approximately one month of age they were gathered for carcass characteristics experiment. Sexing was done according to the down feather, growth rate and size as reported by Ashraful Kabir (2014).

Collection of Data on Pigeon Carcass Characteristics

Data on carcass characteristics were collected from thirty (30), averagely one month old squabs, three each of males and females from the five parent colour varieties (i. e. Blue Bar, Blue Check, White, Black and Pied). Feed was withdrawn 12 hours before slaughter. Slaughter of the pigeon squabs from the colour varieties was done according to standard abattoir procedures described by Grandin (2009).

Parameters measured were:

Pre-slaughter weight (g): the weight of the live domestic pigeon before slaughter;

Deplumed weight (g): the weight of the bled carcass after the feathers has been removed;

Dressed weight (g): the weight of the bird after the removal of viscera, shanks, and the head;

Breast weight (g): the weight of both side of breasts, no wing, sternal and vertebra ribs attached;

Thigh weight (g): weight of the upper portion of the whole leg that is separated at the knee and hip joints;

Back weight (g): the weight of the back of carcass beginning from the base of the neck and extending back to the tail;

Wing weight (g): weight of the entire wing muscle with all muscle, bone and skin attached;

Drumstick weight (g): lower portion of the whole leg that is separated at the knee and hock joints;

Giblets (g): weights of whole heart, liver and gizzard.

Carcass cuts were done according to the standard procedures of Australian Chicken Meat Federation (ACMF) (2018).

Statistical Analysis

The effect of colour variety and sex on the carcass characteristics were investigated using the GLM procedure in SPSS version 17 (SPSS, 2008). The model use was:

$$Y_{ijk} = \mu + V_i + S_j + VS_{ij} + e_{ijk} \text{ ------ } (1)$$

Where Y_{ijk} = pre-slaughter weight, defeathered weight, dressed weight, carcass weight; μ = the overall mean; V_i = the effect of the i^{th} colour variety of pigeon, i =1…5 (Blue bar, Blue check, Black, White and Pied); S_j = the effect of the j^{th} sex, j = 1, 2 (male, female); VS_{ij} = is the interaction effect between i^{th} colour variety and the j^{th} sex; e_{ijk} = the random error term assumed normally and independently distributed, $(0, \sigma^2 e)$. Interaction effects were not significant hence they were removed from the model.

RESULTS AND DISCUSSION

Carcass Characteristics of Pigeons

Mean weights of pigeons before slaughter, weight after defeathering, dressing weight and dressing percentage were 280.30g, 247.67g, 196.33g and 69.69% respectively. All other means of carcass measurements are shown in Table 2. Khargharia *et al*. (2002) in an experiment on carcass characteristics of domesticated pigeon squabs aged 5 to 8 weeks procured from farmers practicing the traditional system of feeding and management in wooden cages recorded lower values of 215.88±3.83g, 194.63±3.85g, 166.03±3.54g, respectively for the traits mentioned above except for dressing percentage (71.48±0.59%) which was higher than the value in this study. However, the dressing percentage recorded in this present finding was lower than the values reported by several other authors for pigeons (Hasan *et al.,* 2016; Islam, 2010; Omojola *et al.,* 2012; Ibrahim and Bashrat, 2009). The average live weight recorded in this study was higher than the 229.50 live weight of Giribaz squab reported by Islam (2010) and Hasan *et al.* (2016). Similarly, the live weight recorded in this study was higher than the values reported for Gola squab (Azad, 2009; Asaduzzaman, 2008).

The higher values recorded in this study compared to other reports could be attributed to good husbandry practices carried out to manage the birds in this study compared to the extensive and semi-intensive systems used by others in their studies. In a comparative study of pigeons and quails carried out by Hena *et al*. (2012), 270.88±4.08g and 160.57±7.79g respectively were reportedly observed for pre-slaughter weight which is lower than the values reported for this study. The findings in this study can be explained using the assertions made by Sanford (1996) and Husein *et al.* (2017) that an animal that has been reared on a low level of nutrition will have a lower dressing-out percentage than one reared on a high level of nutrition and vice versa. Several researchers have reported to date that genotype (Leterrier *et al.,* 1999) and age (Mareko *et al.,* 2008; Pudyszak *et al.,* 2005; Porwal *et al.,* 2002) have much influence on dressing percentage, body weight, carcass composition and meat quality of birds. Besides, carcass traits are affected by diet composition (Chiericato *et al.,* 2001; Adeyemo *et al.,* 2004), housing system (Mareko *et al.,* 2006; Mareko *et al.,* 2008), husbandry system and environmental conditions (Leterrier *et al.,* 1999) and sex (Leterrier *et al.,* 1999; Baéza *et al.,* 2001). The differences in carcass traits observed between this study and other studies might be due to strain, variety or breed differences, age of birds, gut content, management practices or more so, variation in measurements between the researchers (Husein *et al.,* 2017). Additionally, the means for the wholesale cuts i. e. back, thighs, wings and drumstick

weights in this study (as shown in Table 2) are 34.70 ± 0.75g, 7.83 ± 0.21g, 28.30 ± 0.95g, 5.47 ± 0.16g respectively are lower than 39.03±1.01g, 10.30±0.37g, 32.90±0.64g and 10.45±0.20g respectively reported by Khargharia *et al*. (2002) except for 66.00 ± 2.31g for breast obtained in this study which was higher than 48.25±1.30g reported by Khargharia *et al*. (2002).

From the results of the present findings for sale cut (carcass parts), the biggest carcass parts were the breast followed by back, wing and thigh. Omojola (2012) and Khargharia *et al*., (2002) reported similar results that the pigeon breast had the highest carcass percentage compared to other carcass parts. The appearance and structure of the heart of pigeons is similar to that of mammals according to Sakas (2002); besides, the liver was observed to be unwrinkled, deep brown in colour and shining in appearance as reported by Hena *et al*. (2012). The heart, liver and gizzard weights in this study were 3.433±0.129g, 6.267±0.163g and 6.467±0.189g respectively. Comparatively, heart and liver weights in this study were higher than 2.95±0.22g and 5.96±0.44g reported in a similar study of pigeons and 2.38±0.25g and 4.53±0.29g for quails (Hena *et al*., 2012). The weight of the liver of pigeon in this study did not agree with the 5.59g reported for an adult pigeon liver by Pauline *et al*. (1997). A study carried out in pigeons by El-Shafey *et al*. (2008) reported that the weight of liver constituted 3.2% of their total body weight. This is contrary to the findings in this present study in which the liver weight was 2.5% of the total body weight. The size of the heart was found to be larger relative to the body mass of pigeons in this study. This concurs with the findings of Anonymous (2012) who observed that this may relate to the high demand to meet the physiological activities of the birds since birds are known to have a much higher metabolic rate than mammals.

Table 2: Carcass Parameters of Pigeons, their Means and Standard Errors

Parameter	Mean	±SE	Range	
PSW (g)	280.30	6.01	267.77	292.83
DFW(g)	247.67	5.50	236.20	259.13
DW(g)	196.33	4.22	187.54	205.13
DP (%)	69.69	0.85	67.92	71.46
BW(g)	66.00	2.31	61.18	70.82
BCKW(g)	34.70	0.76	33.13	36.27
THW(g)	7.83	0.21	7.40	8.27
W(g)	28.30	0.95	26.33	30.27
DSTC(g)	5.47	0.16	5.13	5.81
H(g)	3.43	0.13	3.16	3.70
L(g)	6.27	0.16	5.93	6.61
G(g)	6.47	0.19	6.07	6.86

PSW= Pre-slaughter weight, DFW= defeathered weight, DW= dressed weight, DP = Dressing percentage, BW= breast weight, BCKW= back weight, THW=thigh weight, W= wing weight, DSTC= drumstick weight, H=hearth weight, L= lung weight, G= gizzard weight,

The average body temperature of an avian is about 41-45 degrees Celsius, compared to mammals which have relatively lower body temperatures. According to Anonymous (2012), the pulse rate of birds can reach as high as 400 beats/min. All these factors place

a great demand on the heart of birds which has to work much harder than the heart of mammals. According to Hena *et al*. (2012), the heart of birds are adapted to handle the increased stress placed on it by its high metabolic rate.

Carcass Characteristics Expressed as a Percentage of Live Weight of Pigeons

The pigeons lost 11.6% of their live weight after bleeding and defeathering and lost 30% of their live body weight after dressing (Table 3). The loss of live body weight of pigeon after bleeding in this study is different from the 3% reported in rabbits (Husein *et al*., 2017). Sah (2008) also reported that Guinea fowls lost 8% of the live weight after bleeding. The dressing percentage was higher than 53.88% reported by Hasan *et al.* (2016). The high dressing percentage could be due to the intensive management system employed in this research work. It could also be due to differences in breed, age and climate between the studies. The percentage values of 1.2% for the heart and 2.3% for gizzard in this study were almost similar to the values of 1.09% and 2.13% reported respectively by Hasan *et al.* (2016) in Giribaz squab. However, the value recorded for the liver in this study was lower than 3.59% reported by Hasan *et al.,* 2016 for the liver of Giribaz squab.

Table 3: Carcass Characteristics Expressed as a Percentage of Live Weight

Carcass Characteristics	Percentage Live Weight (%)
Defeathered weight	88.4
Dressing percentage	70.0
Breast weight	23.5
Back weight	12.8
Thigh weight	2.8
Wing weight	10.1
Drumstick weight	2.0
Heart weight	1.2
Liver weight	2.5
Gizzard weight	2.3

Effect of Sex on Carcass Characteristics of Pigeon

An important carcass characteristic for animal production is the live weight and dressing weight**.** The effect of sex was found to be a significant ($p<0.05$) source of variation for preslaughter weight, dressed weight and heart weight. All other carcass parameters were not influenced ($p > 0.05$) by sex (Table 4). Male pigeons had significantly higher pre-slaughter weight, dressed weight and heart weight. This finding is similar to reports by Omojola (2012) and Khargharia *et al*. (2002) that the male pigeons are superior in carcass traits (preslaughter weight, dressed weight and heart weight) than their female counterparts. For the rest of the carcass traits, this present result found no difference between males and females, thus disagrees with the findings of Omojola (2012) and Khargharia *et al*. (2002). The significant effect of sex on certain carcass characteristics suggests the existence of sexual dimorphism (Yakubu and Akinyemi, 2010; Husein, *et al*., 2017). Researchers found the sex of animals to be a significant source of variation for carcass traits (Baéza *et al*., 2001). Based on the present findings, farmers and policy

makers should consider sex as a factor when pricing their animals (Husein *et al*., 2017). Likewise, producers, consumers and all pigeon meat users could consider male pigeons for slaughter since they have high meat output (dressed weight).

Effect of Colour on Carcass Characteristics of Pigeon

Except for back, lung and gizzard weights on which plumage colour varieties had significant effect ($p > 0.05$), all other carcass parameters were not influenced ($p > 0.05$) by colour variety (Table 5). This is similar to findings in poultry (Mogre, 2009), who observed significant effect of colour variety on carcass characteristics of local guinea fowls in northern Ghana. It is however different from the findings by Husein *et al*. (2017) in rabbits who found no effect of colour on their carcass characteristics. However, plumage colour variety did not influence ($p>0.05$) the major carcass parts such as dressed weight, thigh and breast weight, suggesting that the assertion by Husein *et al*. (2017) that colour does not influence the growth and development of the animals may be true.

Table 4: Means and standard errors for carcass measurements of domestic pigeon based on sex

Parameter	Male	Female	*P-Value*
PSW (g)	293.60±8.49	267.00±8.49	*0.039*
DFW(g)	258.67±7.77	236.67±7.77	*0.059*
DW(g)	206.33±5.97	186.33±5.97	*0.028*
DP (%)	70.25±3.27	69.13±3.26	*0.520*
BW(g)	70.53±3.27	61.47±3.27	*0.064*
BCKW(g)	35.20±1.06	34.20±1.04	*0.514*
THW (g)	8.27±1.23	7.54± 1.06	*0.453*
W(g)	27.87±1.34	28.73±1.34	*0.652*
DSTC(g)	5.73±0.23	5.20±0.23	*0.118*
H(g)	3.73±0.18	3.13±0.18	*0.031*
L(g)	6.00±0.23	6.53±0.23	*0.118*
G(g)	6.40±0.27	6.33±0.27	*0.272*

P-value = probability value, g = grams, PSW= Pre-slaughter weight, DFW= defeathered, DW= dressed weight, DP =Dressing percentage, BW= breast weight, BCKW= back weight, THW=Thigh weight, W= wing weight, DSTC= drumstick weight, H=heart weight= liver weight, G= gizzard weight

Table 5: Means and standard errors for carcass measurements of domestic pigeon based on colour variety

Parameters (g)	COLOUR					P-Value
	White	Black	Pied	Blue Bar	Blue Check	
PSW	269.17±13.43	285.83±13.43	269.00±13.43	280.00±13.43	297.50±13.43	0.539
DFW	235.83±12.29	256.67±12.29	240.83±12.29	244.17±12.29	260.83±12.29	0.569
DW	198.17±9.43	199.83±9.43	189.67±9.43	196.83±9.43	2.6.17±9.43	0.683
DP	72.38±1.90	70.12±1.90	70.42±1.90	66.20±1.90	69.33±1.90	0.268
BW	63.00±5.16	61.00±5.16	59.67±5.16	71.67±5.16	74.67±5.16	0.190
BCKW	30.67±1.68	39.50±1.68	33.50±1.68	34.17±1.68	35.67±1.68	0.020
THW	7.00±0.47	8.17±0.47	7.67±0.47	8.00±0.47	8.33±0.47	0.310
W	28.17±2.12	28.67±2.12	27.33±2.12	26.00±2.12	31.33±2.12	0.499
DSTC	5.67±0.29	5.33±0.28	5.33±0.28	5.33±0.28	5.67±0.28	0.906
H	3.00±0.29	3.17±0.29	3.50±0.29	3.50±0.29	4.00±0.29	0.175
L	5.00±0.37	7.67±0.37	6.00±0.37	6.00±0.37	6.67±0.37	0.001
G	6.67±0.42	6.00±0.42	6.00±0.42	6.00±0.42	7.67±0.42	0.043

P-value = probability value, g = grams, PSW= pre slaughter weight, DFW= defeathered, DW= dressed weight, DP = Dressing percentage, BW= breast weight, BCKW= back weight, THW=Thigh weight, W= wing weight, DSTC= drumstick weight, H=heart weight, L= liver weight, G= gizzard weight

CONCLUSION AND RECOMMENDATION

Male pigeons had significantly higher carcass characteristics (pre-slaughter weight, dressed weight and heart weight) than their female counterparts. Male pigeons should therefore be considered by both producers and consumers when selling or buying pigeons respectively especially for meat purposes. This information generated through the investigation of the carcass characteristics of indigenous pigeon in the Northern region of Ghana is thought to be useful particularly when relevant literature on pigeons in the study area is very limited.

ACKNOWLEDGEMENT

We acknowledge with gratitude the support received from the pigeon farmers in the various districts where the study took place.

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