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Full Length Research

Meat quality traits and sensory evaluation of Muscovy and Aylesbury ducks reared in the humid tropics

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ABSTRACT: This study aimed to determine the effects of sex and strain on the meat yield and sensory qualities of Muscovy and Aylesbury ducks reared in the humid tropics. Sex, strain and the interaction of sex and strain have been reported by various researchers to significantly affect the growth and carcass analysis of Poultry birds in Nigeria. There is limited evaluation of Muscovy and Aylesbury ducks in this region. The study was conducted in the Poultry Unit of Teaching and Research Farm of Michael Okpara University of Agriculture, Umudike, Abia State. One hundred and eighty (180) sexed ducklings, comprising 90 each of Muscovy and Aylesbury ducks, were randomly allotted to four treatment groups in a 2 x 2 factorial arrangement. Each treatment was replicated 3 times with 15 birds per replicate. The birds were reared for 20 weeks. At the end of the rearing period, 12 birds (one per replicate) of average body weight per replicate were selected and slaughtered. Different meat yield parameters were recorded, and sensory analysis was conducted. Data collected were analysed using SPSS version 20 for Windows. They were no significant differences in the effect of sex on the meat yield but significant differences was recorded in the effects of breed on the Defeathered weight (2003g, 1815g), Breast meat % (18.30, 17.95), Thigh meat % (8.05, 6.31), Drumstick meat % (8.83, 6.33), Breast bone % (5.21, 4.70), Thigh bone % (3.62, 3.50) with the Muscovy ducks having the higher values. In the interaction effect of sex and strain on the meat yield, they were significant differences in the live weight (2320g, 1811.45 g), Defeathered weight (2100.67 g, 1504.00g), Breast meat% (25.84, 10.32), Thigh meat% (12.87, 7.88), Drumstick meat % (10.53, 6.25), Breast meat to bone ratio (6.88, 4.03) with the Muscovy male recording the highest values while the Aylesbury male recorded the lowest values. In the sensory evaluation, the Aylesbury ducks had the better acceptability (7.67, 6.20) compared to Muscovy ducks. Also, Aylesbury ducks had a higher coefficient of variation in most of the parameters measured. Muscovy ducks had a higher meat yield, while the Aylesbury ducks were more acceptable. The higher variability in meat yield also suggests the potential for selective breeding to improve the meat yield of Aylesbury ducks.

Keywords: Aylesbury, humid tropics, meat quality, Muscovy, sensory evaluation.

INTRODUCTION

The Muscovy duck (*Cairina moschata*) is the most dominant breed of duck reared in Nigeria (Kadurumba *et al*. 2019). Muscovy ducks are surely identified by means of the fleshy reddish outgrowths around the eyes and bill (Manuel, 2008). The ducks could be multi-coloured, white, black and black and white in colour (Raji *et al*. 2009) and are predominantly found in southern Nigeria (Ikani, 2003). Muscovy ducks are specifically equipped for scavenging systems because of their top-notch foraging and incubation behaviour as well as high tolerance to warm environments (Raji *et al*. 2009). These local ducks have a fast growth rate, high dressed weight of drakes; they are tougher and hardier to diseases and environmental perils than chickens (Duru *et al.* 2006).

Muscovy ducks have been reported to perform better for carcass traits than the ducks, and this could be as a result

of variances in the levels of the male reproductive hormone, which accounts for better muscle development in males (Kolluri *et al*. 2015). When properly included as part of a well-balanced daily diet, duck meat and eggs supply a substantial portion of the nutrients required by humans. Duck meat, like that of chicken, can also be used to prepare sausages, meat balls and many other ready-to-eat meals (Huda *et al*., 2010; Huda *et al*., 2011; Putra *et al*., 2011).

Duck meat is beneficial to human nutrition because of its high essential fatty acid content and abundant polyunsaturated fatty acids (Heo *et al*., 2015 and Qiao *et al*., 2017). Also, it has a higher protein-to-ash ratio, less fat and water, and more red muscle fibres than broiler (Ali *et al*., 2007). Ducks have a unique advantage over chickens by utilising foodstuffs that normally go unharvested, control harmful insects, slugs, snails and unwanted aquatic plants, thrive under harsh conditions with limited shelters, resist diseases and parasites and also convert feed efficiently (Adzitey and Adzitey, 2011; Adzitey *et al*., 2011). The development of the poultry industry has been described as the fastest means of bridging the protein deficiency gap prevailing in most developing countries (Aromolaran *et al*., 2013).

Sex, strain and the interaction of sex and strain have been found by different researchers to significantly affect the growth and carcass analysis of broiler and duck strains in Nigeria (George *et al*., 2014; Udeh *et al*., 2011; Udeh *et al*., 2015; Amao *et al*., 2011; Ojedapo *et al.*, 2008; Ajayi and Ejiofor, 2009). They are limited information on Muscovy and Aylesbury ducks research tested in the study area. This research aimed to determine the effect of sex and strain on the meat yield and sensory evaluations of these breeds of duck and compare it to the limited available knowledge in the area.

MATERIALS AND METHODS

The study was conducted in the Poultry Unit of Teaching and Research Farm of Michael Okpara University of Agriculture, Umudike, Abia State. Umudike lies between latitude 05°29' N, longitude 07°33' E and an altitude of 122 m above sea level. The town is within the humid rainforest zone of South-Eastern Nigeria and has a bimodal rainfall pattern with a total annual rainfall range of 1700mm to 2100mm. The minimum and maximum daily temperatures of the area range from 18.6 to 23°C and from 26 to 36°C during the rainy and dry seasons, respectively, while the humidity ranges from 57.0 to 91.0% depending on the season of the year. The climatic data were taken from the meteorological station of the National Root Crops Research Institute, Umudike (NRCRI).

One hundred and eighty (180) Muscovy and Aylesbury ducks were used for this experiment. They were purchased from local markets in Ndoro Ikwuano LGA of Abia State and the MOUAU Research Farm, respectively. The birds were reared on a deep litter pen, fed with commercial Poultry feed and served water ad libitum. The birds were sexed at the tenth week using the vent sexing method by a trained veterinarian. The birds were completely randomised into four treatment groups in a 2 by 2 factorial arrangement, having Muscovy male (T1), Muscovy Female (T2), Aylesbury male (T3), and Aylesbury female (T4). Each treatment had 45 birds with 3 replications and 15 birds per replicate. The experiment lasted for 20 weeks.

Carcass analysis

At the end of the experiment (20 weeks), 12 birds (one per replicate) of average weight per replicate were selected for carcass evaluation. The birds were weighed, slaughtered and dressed. Cleaned carcass weight and the meatiest parts, breast, thigh, drumstick, were purposely removed and deboned; the weights of the meat and bone were recorded. The weights of the cut-up parts were expressed as a percentage of the carcass weight. The meat-to-bone ratio of the breast, thigh, and drumstick was also calculated.

$$\text{Dressing percentage} = \frac{\text{Carcass weight}}{\text{Live weight}}\ x\ 100$$

$$\text{Percentage weights of cut} - \text{up parts} = \frac{\text{Weight of cut} - \text{up parts}}{\text{Carcass weight}}\ x\ 100$$

$$\text{Meat to bone ratio} = \frac{\text{Weight of meat}}{\text{Weight of bone}}$$

Sensory evaluation

After the carcass analysis, some portion of breast (deboned) meat from Muscovy and Aylesbury ducks was cooked at 100°C for 50 minutes, cooled and served to a group of trained Panel members. The panel consists of five males and five females (made up of both staff and students between the ages of 25 and 50 years). The Panel members evaluated the appearance, colour, texture, juiciness, tenderness, taste, flavour and acceptance on a nine-point hedonic scale.

Experimental design and statistical analysis

Data collected were analysed using SPSS version 20 for Windows. Data collected for meat yield was analysed using the general linear model to analyze. Significant means were separated using Duncan's Multiple Range Test. A linear addition model for the design is as follows;

$$Xijk = \mu + Si + Stj + SStij + eijk$$

Table 1. Effect of sex on the meat yield of the two breeds of duck.

Parameters	Male	Female	SEM
Live weight (g)	2114	1875	168.55
Defeathered weight (g)	1933	1741	88.52
Carcass weight (g)	1645.64	1613.22	78.23
Dressing percentage (%)	72.55	76.60	3.11
Breast meat %	16.73	17.23	4.81
Thigh meat %	7.88	8.53	0.73
Drumstick %	7.68	6.95	0.57
Breast bone %	4.22	4.51	1.56
Thigh bone %	3.53	3.82	0.73
Drumstick bone %	2.52	2.45	0.47
Meat to bone ratio (Breast)	5.31	5.35	0.63
Meat to bone ratio (Thigh)	2.90	2.84	0.55
Meat to bone ratio (Drumstick)	2.23	2.48	0.32

[abc]Means with different superscripts on the same row are significantly different (p<0.05).

Table 2. Effect of sex on the meat yield of the two breeds of duck.

Parameters	Muscovy	Aylesbury	SEM
Live weight (g)	2274	1950	183.11
Defeathered weight (g)	2003[a]	1815[b]	67.28
Carcass weight (g)	1750.43[a]	1732.84[b]	80.35
Dressing percentage (%)	82.30	80.08	5.25
Breast meat %	18.30 [a]	17.95	6.15
Thigh meat %	8.05[a]	6.31[b]	0.55
Drumstick %	8.83[a]	6.33[b]	0.73
Breast bone %	5.21[a]	4.70[b]	0.93
Thigh bone %	3.62[a]	3.50[b]	0.58
Drumstick bone %	2.82	2.61	0.74
Meat to bone ratio (Breast)	5.85[a]	5.63[b]	0.91
Meat to bone ratio (Thigh)	3.28	2.90	0.68
Meat to bone ratio (Drumstick)	2.77	2.61	0.57

[abc]Means with different superscripts on the same row are significantly different (p<0.05).

Where: Xijk is individual observation, μ is the population mean, Si is the sex effect, Stj is the Strain effect, SSti is the interactive effect of Sex and Strain, and eijk is the experimental error of residual.

The coefficient of variation of parameters between strains was computed using the formula.

$$\mathrm{CV} = \frac{\delta}{\mu}\, x\, 100$$

Where: δ is the standard deviation of the parameter, while μ is the mean of the parameter.

Data collected for sensory evaluation were subjected to one-way analysis of variance. The difference between the treatment means was separated using Duncan's New Multiple Range Test (Obi, 2001). A linear addition model is as follows;

Xij =μ + ti + eij

Where: Xij is the individual observation, μ is the population or overall mean, ti is the treatment effect, and eij is the experimental error of the residual.

RESULTS

The main effect of sex on the meat yield of the two breeds of duck is shown in Table 1. There were no significant differences (p<0.05) between the two sexes in all the parameters evaluated. Table 2 shows the effect of strain on the meat yield of the two breeds of duck. There were significant differences (p<0.05) in the defeathered weight,

Table 3. Effect of sex and strain interaction on meat yield of two breeds of duck.

Parameters	Muscovy		Aylesbury		SEM
	Male	Female	Male	Female	
Live weight (g)	2320[a]	1933[b]	1811.45[b]	1903.11[a]	148.35
Defeathered weight (g)	2100.67[a]	1643.2[b]	1504[b]	1611[a]	132.04
Carcass weight (g)	1802.70[a]	1633.36[b]	1555.11[a]	1412.61[b]	163.77
Dressing percentage (%)	80.35	82.14	77.28	78.23	3.80
Breast meat %	25.84[a]	23.91[b]	10.32[b]	10.50[a]	1.20
Thigh meat %	11.75[a]	10.11[b]	7.01[b]	8.83[a]	0.58
Drumstick %	10.53[a]	9.02[a]	6.25[b]	8.03[b]	0.36
Breast bone %	5.63	5.41	3.45	3.05	0.70
Thigh bone %	3.01	3.12	2.83	2.88	1.67
Drumstick bone %	4.13	4.07	3.38	3.31	0.91
Meat to bone ratio (Breast)	6.88[a]	5.91[b]	4.03[b]	4.18[a]	0.82
Meat to bone ratio (Thigh)	5.10[a]	4.88[b]	4.22[b]	4.51[a]	0.67
Meat to bone ratio (Drumstick)	3.23	3.44	3.05	3.18	0.53

[abc]Means with different superscripts on the same row are significantly different ($p<0.05$).

Table 4. The mean, standard deviation (SD), and the coefficient of variation (COV) of the two breeds of duck.

Parameters	Muscovy			Aylesbury		
	Mean	SD	COV	Mean	SD	COV
Live weight (g)	2130.65	233.81	11.27	1908.51	296.25	15.53
Defeathered weight (g)	1910.64	215.38	16.93	1631.10	236.05	14.12
Carcass weight (g)	1824.20	156.81	10.35	1591.54	150.38	20.66
Dressing percentage %	81.53	6.15	5.08	79.45	3.74	3.22
Breast meat %	27.17	3.03	6.24	10.18	5.18	57.32
Thigh meat %	12.67	3.66	30.18	8.35	6.41	40.13
Drumstick %	11.25	4.04	35.17	7.03	2.46	41.80
Breast bone %	6.10	3.39	22.58	4.57	1.08	36.11
Thigh bone %	3.83	1.74	32.83	0.64	1.15	24.15
Drumstick bone %	4.70	0.46	28.03	4.05	0.81	35.20

SD – Standard Deviation, COV – Coefficient of Variation.

breast meat, thigh meat, drumstick meat, breast bone, thigh bone, and meat-to-bone ratio of the breast. Live weight, carcass weight, the dressing percentage, drumstick bone, meat to bone ratios of thigh and drumstick were not significantly affected ($p>0.05$).

The effects of the interaction of sex and strain are shown in Table 3. There were significant ($p<0.05$) differences in all parameters except dressing percentage, breast bone, thigh bone, drumstick bone and drumstick meat to bone ratio. Muscovy male had the highest values, followed by Muscovy female, while Aylesbury male had the least values in all the parameters evaluated. Table 4 shows the mean, standard deviation and the coefficient of variation of the meat yield parameters in the two breeds. Muscovy had the highest mean value among those of Aylesbury in most of the parameters evaluated. The Aylesbury had the highest standard deviation in the live weight, defeathered weight, carcass weight and the breast meat, but the Muscovy had the highest values in the remaining parameters. The Aylesbury had the highest coefficient of variation in all parameters except the dressing percentage and the breast bone. Table 5 shows the sensory evaluation of the Muscovy and Aylesbury ducks. There were significant differences ($P<0.05$) in all the parameters except colour, tenderness and texture. The Aylesbury was the most preferred of the breed, followed by the Muscovy breed.

DISCUSSION

The results of the effect of sex on the meat yields of the two breeds of duck are in agreement with the results of most research, where there is a significant sex effect on

Table 5. Sensory evaluation of two breeds of duck.

Parameters	Muscovy	Aylesbury	SEM
Appearance	5.88[b]	7.57[a]	0.66
Colour	7.41	7.75	0.45
Texture	6.80[b]	7.25[a]	0.33
Juiciness	7.91[b]	8.44[a]	0.25
Tenderness	8.62[a]	7.52[b]	0.42
Taste	7.50[b]	8.80[a]	0.53
Flavour	7.08[b]	8.74[a]	0.46
Acceptance	6.20[b]	7.67[b]	0.21

[abc]Means with different superscripts on the same row are significantly different ($p<0.05$).

the carcass of broilers with males having a heavier carcass than the females (Shim *et al*., 2012; Udeh *et al*., 2015). Pingel (2009) also stated that ducks have contributed greatly to the improvement of the nutritional standard of the human population via is meat content. Ducks are considered the most preferred poultry after chicken, also known to possess unique disease resistance and adaptability. Nutrient composition of duck meat and eggs is comparable to that of chicken (Tai and Tai, 2001; Adzitey *et al*., 2012).

The results of the effect of strain on the meat yield of the two breeds of duck are in agreement with Ihuoma *et al.* (2016), Ojedapo *et al*. (2008), Ajayi and Ejiofor (2009) and Udeh *et al.* (2015), who all reported significant ($p<0.05$) strain differences in their research, but do not agree with the findings of Amao *et al*. (2011), who reported significant ($p< 0.05$) higher live weight between the studied broiler strains. The insignificant ($p<0.05$) strain difference suggests that the Aylesbury ducks are comparable with the Muscovy ducks as reported by Nwachukwu *et al.* (2006), Huda *et al*. (2010 and Ihuoma *et al.* (2016).

The results of the interaction of sex and strain are in agreement with the results of Ajayi and Ejiofor (2009), Olawumi *et al*. (2012) and Udeh *et al.* (2015), who reported a significant difference ($p<0.05$) in the interaction of sex and strain. The Muscovy male had a higher value than the Muscovy female, supporting the superiority of the male in gaining heavier weight Ihuoma *et al.*, 2016). The Muscovy female is comparable to the Aylesbury female. Consequently, the Aylesbury male was observed to have a lower value than the female counterparts in most of the parameters evaluated. It was observed that there was a high disparity in the weights of the Aylesbury ducks. This suggests the effects of the environment on these breeds of duck and the selection process used in developing them. Saxena and Kolluri (2018) stated that the development in the poultry breeding over the years has been a result of the combination of pure line selection and crossbreeding programs, and an increase in production volume and productivity per bird may largely be attributed to the combined crossbred and purebred selection (CCPS).

The results of the standard deviation and coefficient of variation indicate that there is higher variability in the Aylesbury ducks for these parameters, which aligns with the high disparity in the weights of the Aylesbury. The greater difference in the coefficient of variation values of the breast meat suggests an intensive selection for the breast meat in the Muscovy compared to the Aylesbury.

Shim *et al.* (2012) and Abdullah and Matarneh (2010) reported that because of a shift in the consumers' demand from whole chicken to carcass parts, there has been an emphasis on the improvement of breast meat yield and muscle mass development by the poultry breeder industry. Because breast meat is one of the most valuable portions of the chicken carcass in the market, even small differences in breast yield among strain crosses could have a significant economic impact (Shim *et al*., 2012). These results confirm that selection for breast meat muscling was not intense in the Aylesbury ducks, although more pronounced in the Muscovy.

Results of the sensory evaluation suggest that in the study area, the Aylesbury ducks are the most acceptable breed compared to the Muscovy ducks. This result is in agreement with the reports of Heo *et al*. (2015) and Qiao *et al*. (2017), who reported that duck meat is beneficial to human nutrition because of its high essential fatty acid content and abundant polyunsaturated fatty acids. Also, it has a higher protein-to-ash ratio, less fat and water, and more red muscle fibres than broiler (Ali *et al*., 2007). George *et al*. (2014) also stated that a good sensory evaluation recorded in ducks could be due to the younger age and broiler characteristics of these ducks. Kuttanad duck meat showed comparatively lower value for moisture and higher values for protein, fat, ash, cholesterol and sodium. Meat from Kuttanad ducks had higher flavour and juiciness scores and lower overall tenderness and acceptability scores (George *et al*., 2014).

There is a higher preference for broiler chicken meat in the past because of its high sensory evaluation advantage, but in this study area, it was observed that Aylesbury ducks displayed a good meat quality that is similar to that of broiler chicken, and their preference by the members of the panel was high. Duck meat has combined characteristics

of red meat - contains high levels of phospholipids, precursors of aromas and the dietetic characteristics of poultry meat – contains high levels of monounsaturated fatty acids, especially oleic and linoleic acids, which constitute about 60 % of total fatty acids. With recommendations for the reduction of red meat intake due to its association with cardiovascular pathologies, the consumption of white meats and duck meat is gaining more attention.

Conclusion

It was concluded that there was no sex effect, whereas there were strain and sex and strain interaction effects on the meat yields of the Muscovy and the Aylesbury duck breeds. Muscovy ducks had a better meat yield than that of the Aylesbury. The Aylesbury ducks had a better sensory acceptance than the Muscovy ducks in the study area and could be used slightly as a broiler bird alternative, mainly suited for grilling or frying, due to its adequate tender meat and flavour as compared to their Muscovy counterpart.

Recommendation

It is recommended that more breeding programmes in Muscovy and Aylesbury duck production should be encouraged in order to have a larger population of them among the poultry market to reduce the cost of broiler chicken meat, and also to enhance egg production and availability, since they are high egg producers yearly. There is a need for further intense selection for meat yield (precisely the breast meat) in the Aylesbury.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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