Trop. Anim. Prod. Invest. 17 (1): 41-46 (2014)
ISSN: 1115-2540
http://animalsci.agric.ui.edu.ng/TAPI/index.php/tapijournal/index

ORIGINAL RESEARCH PAPER

Effects of genotype and sex on carcass characteristics of Nicholas white, Nigerian local and their reciprocal crossbred poults

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ABSTRACT

A study was conducted to evaluate the effects of genotype and sex on the slaughter and carcass characteristics of Nicholas white, Nigerian local and their reciprocal crossbred turkey poults. The birds used for the study were fed on starter mash (28% CP, 3100KcalME/Kg) for six weeks and grower mash (24% CP, 3000KcalME/Kg) from 7 –20 weeks of age. In the first trial consisting of 374 turkey poults, sixteen (8 male, 8 female) poults belonging to four genotypes (Nicholas White x Nicholas White, Nicholas White x Nigerian-Local, Nigerian-Local x Nicholas White, Nigerian Local x Nigerian Local) were randomly selected for slaughter at eight weeks of age. In the second trial, another set of 16 birds were randomly selected from the same base population for slaughter at 20 weeks of age. The purebred Nicholas White poults slaughtered at 8^{th} and 20^{th} weeks had significantly higher (P<0.05) live, bled, eviscerated and pluck weights as well as weights (and %) of primal cuts, and internal organs than the other three genotypes. The Nicholas White x Nigerian local crossbred was superior in slaughter and carcass characteristics than its reciprocal cross (in both trials) possibly due to sire effects of the Nicholas male. Male poults slaughtered at 8^{th} and 20^{th} weeks had significantly higher (P<0.05) live, bled and pluck weights, weights of primal cuts and internal organs than the female poults. The interaction between genotype and sex was significant (P<0.05) for all the investigated carcass traits. All the measured economic traits were significantly correlated (P<0.05) with the eviscerated weight, with the exception of gizzard in 20 weeks old turkey. The present report showed that crossbreeding could be employed to improving the meat production of the Nigerian local turkeys.

Key words: Carcass characteristics, Crossbred turkey, Nicholas White, Primal-cuts

INTRODUCTION

Turkey is a large gallinaceous bird belonging to the family *meleagridae*. It is traditionally a native of North America but it is currently found in all parts of the world where it forms an important source of food and income. Turkey production and turkey meat consumption have increased dramatically in the past 30-40 years in many countries. However, its potential is still under-exploited in Nigeria. There are at present only 1.05 million turkeys out of the 170 million poultry population in Nigeria (FAOSAT, 2011). Majority of the 1.05 million turkeys in Nigeria are indigenous strains (Amao *et al.*, 2014). Turkey produces an excellent meat which is high in protein (Roberson *et al.*, 2003). The meat is of high digestibility and low cholesterol; hence it is of great importance to health concern consumers (Wheto *et. al.*, 2012). However, the slaughter and characteristics of turkey meat are influenced by a number of factors. For instance, Waldroup *et al.*, (1997) reported that genotype influences the carcass characteristics of turkey. Other studies (Waldroup *et al.*, 1990, Brake *et al.*, 1994; Roberson *et al.*, 2003, Majumdar *et al.*, 2005) studied the effects of sex, diet and slaughtering age on the carcass characteristics of turkey. Majumdar *et al*. (2005) observed a progressive increase in eviscerated carcass (including giblets) yield and thigh part, while bony parts like back, neck, wings and the breast showed decline with increasing age. However, there is limited information on the effects of genotypes and sex on the slaughtered and carcass characteristics of turkey in Nigeria. Nicholas white were averagely better than other genotypes of exotic turkeyat 6 and 12 week of age (Roberson *et al*. 2003), and Nicholas White was used because it is the predominant exotic turkey in Nigeria. Therefore, the objective of the present study was to determine the effects of genotypes and sex on the slaughter and carcass characteristics of Nicholas white, Nigerian local and their reciprocal crossbred turkey poults.

Table 1: Effect of genotype on carcass traits of crossbred turkey at 8th weeks of age (Mean ±SD)

	NW xNW	NW x NL	NL x NW	NL x NL
Live bird weight	2517.50±55.01[a]	1047.50±44.98[b]	1035.00±124.16[bc]	952.75±65.54[d]
Eviscerated wt	1755.08±420.23[a]	729.25±75.39[b]	720.28±99.76[c]	662.98±57.13[d]
Bled wt	2505.83±555.83[a]	1042.93±89.19[b]	1030.38±123.21[c]	948.08±64.47[d]
Pluck wt	2464.10±551.04[a]	1015.00±91.71[b]	1012.45±122.60[c]	932.38±65.62[d]
Head	60.40±13.44[a]	26.98±2.58[b]	26.85±3.12[c]	23.83±1.65[d]
Neck	68.00±15.12[a]	26.45±2.00[c]	26.93±3.21[b]	24.78±1.70[d]
Wings	244.23±54.25[a]	103.70±8.94[b]	101.43±12.16[c]	93.33±6.38[d]
Back	530.53±118.03[a]	222.60±19.22[c]	223.55±26.85[b]	202.50±14.09[d]
Legs	463.20±102.88[a]	191.70±16.48[c]	195.60±23.45[b]	178.18±12.27[d]
Thighs	261.80±58.16[a]	107.90±9.28[c]	108.45±13.29[b]	97.65±6.72[d]
Drumsticks	201.40±44.72[a]	83.80±7.20[c]	87.15±10.17[b]	80.53±5.60[d]
Breast	587.95±130.44[a]	242.20±20.84[b]	238.43±28.62[c]	219.50±15.13[d]
Gizzard	105.58±23.43[a]	43.13±3.57[b]	41.48±5.05[c]	37.40±2.54[c]
Liver	52.90±11.76[a]	20.50±1.74[b]	20.38±2.46[c]	18.20±1.21[d]
Heart	14.45±3.12[a]	5.88±0.55[b]	5.85±0.70[b]	5.58±0.38[c]
Intestine	130.23±28.99[a]	54.03±4.67[b]	53.40±6.41[b]	48.85±3.35[c]
Lungs	18.38±4.09[a]	7.65±0.70[b]	7.55±0.93[b]	6.90±0.46[c]
Interaction G x S	*	*	*	*

[a,b,c,d] means in the same row with different superscripts are statistically different (P<0.05),* significant G is genotype, S is sex

MATERIALS AND METHODS

Description of the Study Locations

The study was carried out at a private poultry farm in Ilorin, Kwara State, Nigeria (latitude 08.98^0 N and longitude 04.56^0 E with annual rainfall range from 800 - 1500mm and daily temperature ranging from 22 to 33^0C (Amao *et al.*, 2014). Ilorin is located in northern Guinea savannah of Nigeria.

Experimental Animals

A total of 374 turkey poults belonging to four genotypes were hatched from a kerosene incubator. The birds were raised in deep litter brooders situated in close-window rooms. The birds were kept warm and natural daylight was supplemented for uniform and even warmth environment up to 23 hours of daylight daily. The poults were fed on starter mash (28% CP, 3100KcalME/Kg) for six weeks and grower mash (24% CP, 3000KcalME/Kg) from 7–20 weeks of age. At 8-weeks, sixteen (8 male, 8 female) birds belonging to four genotypes (4 Nicholas White x Nicholas White,4 Nicholas White x Nigerian-Local,4 Nigerian-Local x Nicholas White, 4 Nigerian Local x Nigerian Local) were randomly selected for slaughter. Another set of sixteen birds were randomly selected for slaughter at 20 weeks of age. Four birds from each genotype were chosen for slaughter. The selected birds were starved for 24 hours before sacrificing through single unilateral severing of the right carotid artery and jugular vein.

Data collection

Data were collected on slaughter weight, bled weight, pluck weight, eviscerated body weight and head weight. Measured parameters included neck weight, wings weight, legs weight (drumsticks and thighs), breast weight and back weight. The weights of internal organs (intestine, liver, heart, gizzard and lungs) were also measured. All weight measurements were taken in grammes. Eviscerated weights were expressed in absolute values and as percent of live weight. Weights of cut up parts (neck weight, wings weight, legs weight or drumsticks and thighs) were expressed in absolute values and or as percentage of eviscerated weight.

Statistical analysis

Data were subjected to analysis of variance using the general linear model of SPSS(2011) version 20.0. The experiment was laid out in a 4 x 2 factorial in a completely randomized design. Significant means were separated using Duncan's New Multiple Range F-est at α level of 5%. Multiple correlation were determined among eviscerated weight, leg, breast, gizzard and wing cuts at 8th and 20th weeks of age

The model fitted for the effect of genotype and sex was

$$Y_{ijk} = \mu + S_i + G_j + SG_{ij} + e_{ijk}$$

where Y_{ijk} was experimental observation; μ was the overall mean for the parameters of interest, S_i was the i^{th} effect of sex (i = 1, 2), G_j was the effect of the j^{th} genotype (j = 1, 2, 3, 4), SG_{ij} was the effect of the

interaction of genotype and sex and e_{ijk} was the random error associated with each record and was assumed to be normally, independently and identically distributed, with zero mean and variance 0.

RESULTS AND DISCUSSION

Results showing the effects of genotype on live, bled and pluck weights, weights of primal cuts and internal organs of 8 weeks of poults are presented in Table 1. The purebred Nicholas White poults had significantly higher (P<0.05) live, bled and pluck weights, weights of

Table 2: Effect of genotype on carcass traits of crossbred turkey at 20th weeks of age (Mean ±SD)

	NW xNW	NW x NL	NL x NW	NL x NL
Live bird weight	6062.50±939.30^{a}	3573.50±188.13^{bc}	3575.75±108.84^{b}	2693.25±212.09^{d}
Eviscerated wt	4223.23±729.84^{a}	2484.15±173.52^{b}	2478.80±117.63^{bc}	1876.93±184.77^{bcd}
Bled wt	6024.88±943.96^{a}	3556.60±185.81^{b}	3549.00±105.93^{c}	2632.43±207.94^{d}
Pluck wt	5968.50±945.51^{a}	3495.95±125.60^{b}	3488.68±110.68^{c}	2632.43±207.94^{d}
Head	146.18±21.74^{a}	90.50±5.31^{b}	89.40±2.71^{bc}	67.50±5.15^{d}
Neck	162.93±24.39^{a}	91.73±3.85^{bc}	92.98±2.82^{b}	70.15±5.32^{d}
Wings	588.10±91.01^{a}	356.30±22.80^{b}	350.45±10.66^{bc}	263.95±20.71^{d}
Back	1277.68±198.37^{a}	759.36±40.08^{bc}	772.00±23.46^{b}	572.53±44.80^{d}
Legs	1114.83±173.57^{a}	653.98±34.46^{bc}	675.83±20.59^{b}	503.58±39.61^{d}
Thighs	644.15±115.91^{a}	370.28±17.04^{bc}	373.73±13.25^{b}	274.58±20.15^{d}
Drumsticks	473.18±67.50^{a}	284.20±17.37^{bc}	302.10±7.42^{b}	229.00±20.10^{d}
Breast	1416.20±219.42^{a}	826.53±43.41^{b}	823.88±25.11^{bc}	620.45±48.78^{d}
Gizzard	254.18±39.39^{a}	147.60±7.80^{b}	143.03±4.36^{bc}	105.60±8.33^{c}
Liver	127.35±19.71^{a}	69.93±3.70^{bc}	70.40±2.14^{b}	51.55±4.05^{d}
Heart	35.13±5.52^{a}	20.20±1.12^{b}	20.20±0.55^{b}	15.63±1.25^{c}
Intestine	313.68±48.64^{a}	184.35±9.71^{bc}	184.40±5.69^{b}	138.10±10.88^{c}
Lungs	43.83±6.52^{a}	26.08±1.45^{bc}	26.23±0.86^{b}	20.63±3.26^{c}
Interaction G x S	*	*	*	*

^{a,b,c,d} means in the same row with different superscripts are statistically different (P<0.05),* significant G represent genotype, S represent sex

The results on the effects of genotype on the relative proportions of economic traits in 8 and 20 weeks old turkey poults are in Table 3. The breast constituted the highest proportion of the eviscerated weight in poults slaughtered at 8 and 20 weeks of age (33.15-33.61% and 33.11-34-37%, respectively), while the gizzard constituted the lowest proportions (5.65-6.04% and 5.64-6.04%, respectively) of the eviscerated weight in poults slaughtered at 8 and 20 weeks of age in the four genotypes. There were significant differences (P<0.05) among genotypes in the relative proportions (%) of the economic traits for poults slaughtered at 8 and 20 weeks of age. The purebred NW x NW had significantly higher (P<0.05) proportions of breast (%) and gizzard (%) than other genotypes at 8 and 20 weeks of age. It was however significantly lower (P<0.05) than the purebred NL x NL in the proportion of leg cuts.

The effects of sex on live, bled and pluck weights, weights of primal cuts and internal organs of 8 and 20 weeks old poults are shown in Table 4. Male poults had significantly higher (P<0.05) live, bled and pluck weights, weights of primal cuts and internal organs than the females. The males had significantly higher (P<0.05) live, bled and pluck weights as well as weights of primal cuts and internal organs than females in both 8 and 20 weeks old turkey poults. There were significant differences (P<0.05) between the two sexes in the relative proportions (%) of economic traits. The females poults were significantly higher (P<0.05) in the proportions of primal cuts including legs, breast and the gizzard (Table 5).

Table 3: Effect of genotype on Relative proportions (%) of Economic traits in 8 and 20 weeks old turkey poults

Age	8 weeks of age				20 weeks of age			
	NW xNW	NW x NL	NL x NW	NL x NL	NW xNW	NW x NL	NL x NW	NL x NL
Eviscerated	69.51 ±1.26^{ab}	69.56 ±1.21^{a}	69.47 ±1.30^{b}	69.52 ±1.22^{ab}	69.52 ±1.27^{ab}	69.46 ±1.26^{ab}	69.31 ±1.31^{b}	69.61 ±1.41^{a}
Legs	26.48 ±0.48^{c}	26.33 ±0.46^{d}	27.21 ±0.51^{a}	26.91 ±0.47^{b}	26.45 ±0.47^{c}	26.35 ±0.47^{d}	27.23 ±0.45^{a}	26.89 ±0.52^{b}
Breast	33.61 ±0.62^{a}	33.26 ±0.58^{b}	33.17 ±0.62^{c}	33.15 ±0.58^{d}	34.37 ±1.80^{a}	33.30 ±0.61^{b}	33.26 ±0.63^{c}	33.11 ±0.67^{d}
Gizzard	6.04 ±0.11^{a}	5.93 ±0.12^{b}	5.77 ±0.10^{c}	5.65 ±0.11^{d}	6.04 ±1.10^{a}	5.95 ±0.11^{b}	5.70 ±0.11^{c}	5.64 ±0.12^{d}
Wings	13.96 ±0.26^{d}	14.24 ±0.25^{a}	14.11 ±0.27^{b}	14.10 ±0.25^{c}	13.96 ±0.25^{d}	14.35 ±0.22^{a}	14.05 ±0.20^{b}	14.09 ±0.14^{c}

^{a,b,c,d} means in the same row with different superscripts are statistically different (P<0.05). NW and NL represent White-Breasted and Nigerian-Local poults, respectively.

Table 4: Effect of sex on carcass traits of crossbred turkey at 8th and 20th weeks of age (Mean ±SD)

	Male	Female	Male	Female
Live body wt	1569.25±885.17^{a}	1207.13±511.95^{b}	4284.50±1037.16^{a}	3668.00±1068.00^{b}
Eviscerated wt	1107.84±624.94^{a}	825.95±350.17^{b}	3024.50±1157.06^{a}	2507.05±729.37^{b}
Bled wt	1561.58±881.04^{a}	1202.03±509.57^{b}	4248.66±1644.81^{a}	3632.79±1063.00^{b}
Pluck wt	1535.61±869.00^{a}	1176.95±501.69^{b}	4206.53±1631.35^{a}	3586.23±1045.60^{b}
Head	41.40±24.52^{a}	31.68±14.38^{b}	105.88±37.70^{a}	90.91±24.74^{b}
Neck	38.75±20.60^{a}	29.78±1.78^{b}	112.24±45.18^{a}	96.65±29.84^{b}
Wings	153.31±85.24^{a}	118.03±49.11^{b}	420.34±156.86^{a}	359.06±101.50^{b}
Back	333.26±185.15^{a}	256.33±106.58^{b}	910.65±341.75^{a}	780.13±220.82^{b}
Legs	290.65±161.72^{a}	223.69±93.14^{b}	794.14±297.94^{a}	679.96±191.86^{b}
Thighs	162.83±92.35^{a}	125.08±53.52^{b}	450.59±185.23^{a}	380.78±111.47^{b}
Drumsticks	127.83±69.39^{a}	98.61±39.65^{b}	344.80±116.83^{a}	299.44±80.61^{b}
Breast	364.13±208.13^{a}	279.91±120.87^{b}	993.38±387.34^{a}	850.05±251.43^{b}
Gizzard	64.36±38.04^{a}	49.43±22.26^{b}	175.35±71.66^{a}	149.85±47.11^{b}
Liver	31.70±19.40^{a}	24.29±11.42^{b}	86.11±36.79^{a}	73.50±24.32^{b}
Heart	8.96±5.06^{a}	6.91±2.99^{b}	24.59±9.63^{a}	20.99±6.18^{b}
Intestine	81.03±45.99^{a}	62.28±26.69^{b}	221.08±85.27^{a}	189.19±53.31^{b}
Lungs	11.45±6.47^{a}	8.79±3.75^{b}	31.66±11.18^{a}	26.71±7.73^{b}

primal cuts and internal organs than the other three genotypes. The Nigerian-local poults were poorest in all the traits. Nicholas White x Nigerian-local crossbred poults were significantly higher (P<0.05) in bled, eviscerated and pluck weights, they were also superior (P<0.05) in weights of primal cuts like neck, wing and breast and in some internal organs like gizzard and the liver than the reciprocal crosses. Effects of genotype on live, bled and pluck weights, weights of primal cuts and internal organs of 20 weeks old poults are presented in Table 2. The purebred Nicholas White exotic poults had significantly higher (P<0.05) live, bled, eviscerated and pluck weights as well as weights of primal cuts and internal organs than the other three genotypes. Nicholas White x Nigerian-local crossbred poults were not significantly different (P>0.05) from the reciprocal cross, except in the bled and pluck weights. The interaction between genotype and sex was significant (P<0.05) for all the carcass traits in the present study. Table 6 shows the multiple correlations among eviscerated weight, % leg cut, % breast, and % wing and % gizzard for poults slaughtered at 8 and 20 weeks of age. All the measured economic traits were significantly correlated (P<0.05) with the eviscerated weight, with the exception of gizzard (%) in 20 weeks old turkey. The correlation among leg, wing and breast cuts were generally significant (P<0.05) but the correlations of these traits with the gizzard were not significant (P>0.05), especially in turkey slaughtered at 20 weeks of age.

The live weight of Nicholas White at 8th and 20th weeks in the present study were lower than the 3.32 and 7.51 reported by Laudadio *et al.* (2009) for Nicholas Large

white at 8th and 20th weeks of age. However, the present result is consistent with the report of Ilori *et al.* (2010). The present results suggested that the breast muscle is the biggest cut up part of the eviscerated weight. This is consistent with the report of Laudadio *et al.* (2009), who reported values ranging between 33.43 and 33.96%. This aggreed with the earlier submission of Crouch *et al.* (2002) that changes in breast development can produce transformation in the growth of other muscles. The percentage eviscerated body weight in this study agrees with the earlier submission of Wheto *et al.* (2012) which suggest that the eviscerated body weight constitute more than half of the live body weight. Percentage (%) eviscerated weights obtained in the present study were lower than 71.2% - 77.9% reported by Majumdar *et al.* (2005) for 6 - 14 weeks age turkey poults. The difference may be due to the strains of poults involved and the different methods used in estimating the % eviscerated weight in turkey because Majumdar *et al.* (2005) included the gibbets in the calculation of % eviscerated weight, which was not included in the present study. The similarity in the relative proportion of economic traits suggests that turkey poults may be slaughtered from 8 weeks onward. The superior performance of Nicholas white turkey poults over the Nigerian local turkey may be because the latter has not been selected for meat production. The observed differences among genotypes in live weight and carcass traits in this study are consistent with literature. For example, Işgüzar (2003) observed that Bronze turkeys were superior to White turkeys in carcass traits and meat quality. The present report showed that crossbreeding could be employed to improve the meat production of the Nigerian local turkeys. The superior performance of Nicholas White x Nigerian local in the slaughter and carcass characteristics than its reciprocal cross may be attributable to sire effects of the Nicholas female.

Table 5: Effect of sex on Relative proportions (%) of Economic traits in 8 and 20 weeks old turkey poults.

	8 weeks of age		20 weeks of age	
	Male	Female	Male	Female
Eviscerated	70.59±0.02^{a}	68.44±0.08^{b}	70.61±0.19^{a}	68.35±0.14^{b}
Legs	26.31±0.36^{b}	27.15±0.39^{a}	26.32±0.38^{b}	27.14±0.38^{a}
Breast	32.78±0.19^{b}	33.81±0.21^{a}	32.78±0.22^{b}	34.24±1.10^{a}
Gizzard	5.75±0.16^{b}	5.94±0.16^{a}	5.75±0.17^{b}	5.91±0.21^{a}
Wings	13.88±0.11^{b}	14.32±0.10^{ab}	13.93±0.22^{b}	14.29±0.16^{ab}

*= Significant (P<0.05). Upper diagonal = Correlation at 8th weeks of age, Lower diagonal = Correlation at 20th weeks of age

Table 6: Correlation between economic carcass traits at 8th and 20th weeks of age

	Eviscerated wt	Legs	Breast	Gizzard	Wings
Eviscerated wt	1	0.79*	0.69*	0.38	0.71*
Legs	0.78*	1	0.37	0.16	0.40
Breast	0.94*	0.60*	1	0.62*	0.38
Gizzard	0.54*/	0.20	0.76*	1	0.42
wings	0.91*	0.67*	0.76*	0.41	1

*= Significant (P<0.05). Upper diagonal = Correlation at 8th weeks of age, Lower diagonal = Correlation at 20th weeks of age.

The differences observed in reciprocal crosses in this study is consistent with the report of Nestor *et al.*(2005) when they crossed an experimental line F which had been selected for higher 16-week BW with a primary breeding sire line C. However, Nestor (2001) did not observe reciprocal effects among the crosses of large-bodied turkey lines. The superior performance of male poults in the present study corroborates the earlier submissions of Ikeobi *et al.* (1995), Ilori *et al.* (2010) and Işgüzar (2003). For instance, Işgüzar (2003) observed that male were superior to females in carcass traits and meat quality among Bronze and White turkeys reared in Isparta province of Turkey. Ilori *et al.* (2010) also opined that differences in phenotypic values between male and female turkeys were due to differences in hormonal profile, which also translate to aggressiveness and dominance of male when both sexes are reared together. This could be due to sexual dimorphism that exists between male and female turkeys.

The high correlations among the body parts in the present report is similar to that obtained by Isidahomen *et al.* (2010) on the correlation among carcass parameters of Nigerian local chicken. The significant correlations among many of the traits suggest that developmental mechanisms leading to transformation in

the various body parts are closely related (Crouch *et al.,* 2002), except for the gizzard.

CONCLUSION

The study showed that genotypes and sex had significant effects on the slaughter and carcass characteristics of turkey poults. Crossbreeding involving Nicholas White exotic and Nigerian local female led to an improvement in the slaughter and carcass characteristics of Nigerian local poults than its reciprocal cross. The similarity in the relative proportion of economic traits suggests that turkey poults may be slaughtered from 8 weeks. The correlation among carcass economic traits and the eviscerated weight suggests an association among the alleles that influences the traits.

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