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Effect of plumage colour on carcass characteristics and meat quality of Nigeria local turkeys

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***Target Audience**: Breeders; Turkey farmers; Turkey marketers; Consumers*

Abstract

This study examined the effect of plumage colour on carcass characteristics and meat quality of Nigeria local turkeys. Nine 14weeks local turkeys of different plumage colour (3 blacks, 3 white, and 3 mixed colour) were studied during the experiment. The birds were allotted into treatments based on the 3 plumage colours. Data taken were carcass weight, dressing percentage, prime cuts and relative organs' weights, pH, drip loss, cook loss, meat colour and sensory attributes of cooked meat. Data collected were subjected to analysis of variance using SPSS version 25. The result obtained revealed that plumage colour affects the pH of turkey meat with a significantly higher carcass pH (5.68) from the mixed colour plumage group. It was also noted that, carcass weight, prime cuts and relative organ weight showed no significant difference (P > 0.05) irrespective of plumage colours. Similarly, the drip loss, cook loss and meat colour (lightness, redness and yellowness) were not influenced by plumage colour of the turkey while the sensory evaluation revealed that black plumaged birds group were more juicy, and had the best aroma and overall acceptability compared to others. It is therefore concluded that plumage colour affects the pH and juiciness, aroma and overall acceptability of Nigeria local turkey meat.

***Keywords**: Carcass, Plumage, Meat, Quality*

Description of Problem

One basic nutritional requirement for all classes of people is protein and which has constantly been short in supply in developing countries. Farmers as well as scientists in developing countries including Nigeria are intensifying emphasis on poultry species for provision of qualitative and quantitative animal protein because of their potentials (1). Turkey (*Meleagris gallopavo*) is an excellent forager that thrives better under arid conditions (2). It tolerates more heat when compared with broilers and some other poultry species (3). Its production is rampant in the United States and Europe unlike in developing countries like Nigeria. The rearing of local turkey in traditional production systems serves as an intermediate source of meat and income for farmers (4). According to (4), the consumption of turkeys as white meat has increased worldwide and a similar trend also exists in developing countries.

Selection in meat-type poultry has contributed to an increase in their body weight, improved carcass composition, a shorter production period, and a substantial rise in carcass dressing percentage (5) but with little or no emphasis on plumage colour. Plumage type is one of the qualitative traits which are controlled by few pairs of genes, and are seldom regarded to be economically important character in poultry (6). However, consumers of poultry in developing countries do place preference on some specific plumage colour (7). The role of consumer

preference, however, cannot be underestimated in the success of livestock investment particularly in turkey grow-out production. For instance, selling of a mature turkey in developing country like Nigeria may be prone to the problem of low consumer demand because of its price, and which may also be compounded if a specific plumage colour is also discriminated against. Thus, it is imperative to subject poultry meat from birds of different plumage colour to investigation. Thus, turkey farmers may be compelled to sell below production cost.

Consumers with increasing health challenges are becoming more conscious of the nutritional value of the foods they eat (6). The likelihood of meat of a bird with a specific plumage colour possessing a better quality might therefore, could be the reason for placing preferences on them. Thus, consumer preference for a specific plumage colour could force the poultry farmers out of business if not appropriately considered (9).

Nigeria local turkeys possess feathers of different colour which sometimes influence the demand by the individuals willing to purchase the birds for consumption. Turkey has been characterized based on different traits including plumage colour (10; 11). These different colours are attributable to melanin (12). However, information on the effect of plumage colour on meat quality is scanty. It has also been observed (13) that plumage colour is second in importance to live weight in affecting market preference for chickens by consumers in developing countries. In certain communities in Africa, plumage colours have cultural and religious functions. Producer, sellers and intermediary traders of poultry especially turkey attach high market preference to plumage colour and feather distribution (10). The effect of plumage colour on meat quality of Nigeria local turkey is not known, and requires research attention, hence this study.

Materials and Method

Experimental site: The experiment was conducted at the University of Ilorin Teaching and Research farm, Ilorin, Kwara State.

Experimental birds and slaughtering procedures: Nine 14weeks old matured local turkeys of three different plumage colours (3 black, 3 white and 3 mixed colour) were reared under the same under the same condition were used for the experiment. All the birds were fasted overnight, weighed, stunned, slaughtered and exsanguinated. The carcasses were scalded in hot water (55°c) in a bath for 2 minutes, plucked and eviscerated manually. The organs were also separated from the carcasses.

Data Collection

Dressing percentage and prime cuts: The eviscerated carcasses were weighed and expressed as a percentage of the live slaughter weight. The breast, thighs, drumsticks and wings (prime cuts) were cut with bone and skin intact using a scalpel blade. The prime cuts were weighed and expressed as percentages of the live weight.

Relative organ weight: The relative weights of head, neck, back, shank, gizzard, liver and kidney were obtained using the mathematical expression below:

$$\text{Relative weight} = \frac{\text{Weight of dissected carcass (g)} \times 100}{\text{Carcass body weight (g)}}$$

Meat quality evaluation: After the determination of the carcass and yield cuts, meat samples were taken from the breast muscles (*Pectoralis major)* of the carcasses 5 minutes after slaughter. These samples were placed in labeled plastic bags, sealed, chilled in ice bath, and stored at 4°C for 24 hours after which they were analyzed for various meat quality traits as indicated below.

Sensory evaluation: Well-cooked prime

cuts were given to 17 assessors: 5 males and 12 females of different ages, ranging from early to mid- twenties (20-25) to judge on day 5 following traits:

Colour: Meat colour was assessed by measuring lightness (L*), redness (a*), and yellowness (b*) using a colorimeter - Colour Flex spectrophotometer (Hunter Lab Reston, Reston, VA, USA). The colorimeter was calibrated against black and white reference tiles prior to use and the colour coordinates of samples was determined after a 30 minutes blooming period using D65 as the light source.

Drip loss: Drip loss was measured according to the method of (12). Chilled breast muscle samples were defrosted at day 1 postmortem. The samples were removed from the bags, blotted dry, weighed and recorded as W_2. Drip loss was calculated and expressed as follows: Drip loss (%) = $[(W_1 - W_2) \div W_1] \times 100$

W_1= weight of fresh meat samples on slaughter day;

W_2=weight of chilled meat after 2days postmortem

Cook loss: Cook loss was determined on days 0.

Cook loss (%) = $[(WTB - WTA) \div WTB] \times 100$

Where; WTA is the weight after cooking and WTB is the weight before cooking

pH: The pH was measured on day 2 using a handheld digital pH meter (MW102 pH meter, MILWAUKEE® instruments, Inc. NC, USA) fitted with pH (MA920B/1) and temperature (MA830R) probes. Weighed meat sample (10g) was homogenized with 50 ml of distilled water using an electric blender (S-748(6)). The homogenate was transferred into a beaker and the pH was read. Triplicate pH readings were taken for each sample. The pH probe was rinsed with distilled water after every measurement

Results and Discussion

Effect of plumage colour on the dressing percentage, prime cut and relative organ weight of local turkey meat

The effect of plumage colour on dressing percentage (DP) and prime cut of local turkey is presented in Table 1. The non-significant effect of plumage colour on carcass characteristics in the current study aligns with the observation of (4) who observed that plumage colour had no effect on carcass characteristics of turkeys. However, this result contradicts (14) who observed significant variations in carcass weight, carcass yield, and carcass parts of quails with different feather colour. This variation is attributable to differences in genotype and species of the birds**.** The DP of the turkeys used for this study ranged from 63.26% to 66.01%, though plumage colour had no significant effect on the parameter. The observed range of DP is slightly lower than 67.2 – 69.7% reported by (15) for similar variety of turkey slaughtered at the same age. Feeding and other environmental factors might account for this variation.

The report by earlier authors (16; 17) indicated a relatively higher DP (72.4 – 81.9%) for bronze and white turkeys slaughtered at 14 weeks. This implies that those breed of turkeys are better in growth performance than Nigeria indigenous variety. The relatively lower DP in the current study aligns with (18; 19; 20) who concluded that breed variation in carcass traits is not uncommon for many livestock species (18; 19; 20). Although, there was no significant effect of plumage colour on the breast weight of the turkeys but the range obtained (30.33 – 32.72%) was higher than 25.1 – 25.5% reported for bronze turkey by (15; 17) while other prime cuts as well as relative organ weight closely align with (15).

Table 1: Effect of plumage colour on the dressing percentage and prime cut of Nigeria local turkey

Parameters	Black	White	Mixed	SEM	P-value
DP (%)	63.25	66.01	65.54	0.21	0.27
Breast (%)	30.33	31.42	32.72	1.93	0.38
Thigh (%)	15.28	14.44	14.86	1.73	0.84
Drumstick (%)	15.96	15.19	16.35	1.10	0.46
Wing (%)	14.43	13.76	16.35	1.40	0.14
Back (%)	27.12	28.94	23.12	6.20	0.53
Shank (%)	4.10	3.89	4.16	0.32	0.59
Heart (%)	0.72	0.50	0.59	0.19	0.44
Neck (%)	6.80	7.42	7.33	0.81	0.63
Spleen (%)	0.14	0.19	0.19	0.10	0.77
Gizzard (%)	2.85	2.64	3.19	0.53	0.48
Crop (%)	0.95	0.65	0.56	0.27	0.25
Proventriculus (%)	0.64	0.54	0.62	0.16	0.72
Liver (%)	2.20	1.87	1.74	0.35	0.32
Abdominal fat (%)	2.54	2.80	2.78	0.92	0.93

DP: Dressing; SEM: Standard error

Effect of plumage colour on meat characteristics of Nigeria local turkey

The effect of plumage colour on drip loss, cook loss, pH, lightness, redness and yellowness of local turkey meat is presented in Table 3. There was no significant ($p>0.05$) effect of plumage colour on the drip loss, drip loss, lightness, redness and yellowness of the experimental birds. The ranges of meat colour ratings (lightness: 51.63- 54.71; redness: 1.20 – 2.20; yellowness: 4.90 –6.02) were generally lower in values compare to the ranges (Lightness: 79.4 – 80.2; redness: 7.6 -.7.7; yellowness: 9.9 - 10.2) reported for the meat of British United, Hybrid converter and Nicholas 700 strains of turkey by (21). This indicates a great variation between the meat quality of Nigeria local turkey and the exotic varieties used by the researcher. The non-significant effect of plumage colour on the cook loss was different from the report of (15) who found out that plumage colour significantly influenced the cooking loss of turkey thigh meat. The non-significant effect of plumage colour on the turkey meat contradicts (22) who found significant variations in the meat yellowness of the chicken subjected to free-range chickens. This variation reported in colour may be due to the possibility of differences in forage types grazed by the birds as compare to the present study wherein the birds were placed on similar diet before slaughtering. The current result is consistent with the findings of (23)who found that lightness, redness or yellowness is breed specific in steer. This is also in consonance with the findings of (24) and (25) in a study carried out on cockerels. The pH of the meat significantly ($p<0.05$) varied between plumage colours with the pH of the meat from white (5.68) as well as with mixed plumage colour (5.72) being comparatively higher than that of black plumaged turkey (5.49). Generally, the pH obtained in the current study was lower than 5.9 reported by (21) 24 hour postmortem. This may indicate that the breast meat of the turkey exhibit a slightly faster glycolysis (26).This study also revealed that plumage

colour had no significant difference (p>0.05) on the drip loss as well as cook loss of the experimental birds. The cook loss obtained generally fall within the range reported (26) for turkey meat that has undergone chilling prior cooking.

Table 2: Effect of plumage colour on the meat characteristics of Nigeria local turkey

Effect	Levels	Lightness	Redness	Yellowness	DL (%)	CL (%)	pH
PC	Black	51.63	2.20	-4.90	22.67	12.33	5.49[b]
	White	53.59	1.20	-6.02	20.17	10.33	5.68[a]
	Mixed	54.71	1.98	-5.40	16.50	13.67	5.72[a]
SEM		3.50	0.83	0.99	2.60	2.80	0.05
P-Value		0.67	0.43	0.54	0.28	0.07	0.03

[ab] means having different superscripts along the same column are significantly different SEM: standard error of mean; PC: plumage colour; DL represents drip loss

Sensory evaluation

The effect of plumage colour on sensory evaluation of local turkey meat is presented in Table 3. The plumage colour of the turkeys significantly influenced (P<0.05) the juiciness, aroma and overall acceptability of evaluated turkey meat. The meat of black plumage turkey was rated higher in juiciness (6.75) and overall acceptability (7.17) compare to other plumage types while the aroma of the meat of black and white plumaged turkey were rated comparably but higher than that of mixed plumaged turkey. The higher rate ranked to the juiciness and overall acceptability of black plumaged turkey meat in the current study substantiates the report by (7) which stated that plumage colour is second in importance to live weight in affecting market preference for chickens by consumers in developing countries. There was no difference in the taste, colour and texture rating of all the meat from the three plumage types.

The similarity in the texture, taste and colour aligns with the assertion of (27) who concluded that majority of variations in sensory evaluation were more significantly impacted by strains or breed.

Table 3: Effect of plumage colour on the sensory evaluation of local turkey meat

Parameters	Plumage colour			SE	P-Value
	Black	White	Mixed		
Juiciness	6.75[a]	5.96[b]	5.78[b]	0.33	0.01
Taste	7.00	6.37	6.55	0.33	0.15
Aroma	6.82[a]	6.211[b]	5.94[b]	0.32	0.02
Texture	6.29	6.37	5.78	0.40	0.21
Colour	6.57	6.09	6.04	0.31	0.17
OA	7.17[a]	6.43[b]	6.12[b]	0.31	0.002

Footnote: Means with different superscript in the same row are significantly p<0.05 different from one another. SE represents standard error, OA represents overall acceptance

Conclusion and Applications

1. This study concludes that plumage colour has significantly influence on the pH, juiciness, aroma and overall sensory acceptability of Nigerian local turkey meat.
2. Selection of Nigeria local turkey for meat purpose should be tailored towards black plumage variety.

References

1. Ironkwe, M.O., Esonu, B.M., Akinola,

L.A.F. (2015). Performance Characteristics and Carcass Yield of Indigenous Turkeys Fed Indomie Waste-Based Diets. *Journal of Agriculture and Veterinary Science*, 8(1): 88-91.

2. Asaduzzaman, M., Salma, U, Alli, H.S., Hamid, M.A., and Miah, A.G. (2017). Problems and prospects of turkey (*Meleagris gallopavo*) production in Bangladesh. *Research in Agriculture, Livestock and Fisheries*, 4(2): 77.
3. Yakubu, A., Abimiku, K., Musa Azara, I.S., Idahor, K.O., Akinsola, O.M. (2013). Assessment of flock structure, preference in selection and traits of economic importance of domestic turkey (Meleagris gallopavo) genetic resources in Nasarawa state, Nigeria. *Livestock Research for Rural Development. (25*), 18.
4. Safiyu, K.K.L., Sogunle, O.M., Egbeyale, L.T. and Shittu, T.A. (2019). An exploratory study on the effects of rearing system and plunagecolour on performance, carcass characteristics and meat quality of local turkeys. *International Journal of Health, Animal Science and Food Safety (6)*: 1-15
5. Murawska, D. (2017). The effect of age on growth performance and carcass quality parameters in different poultry species. *Poultry science 3*(1): 34-50
6. Ibe, S.N. (1998). *An introduction to genetics and animal breeding*. Longman Nigeria Plc. Pp 26.
7. Terfa, Z.G.,Garikipati, S., Kassie, G.T., Dessie, T. and Christley, R.M. (2019). Understanding farmers' preference for traits of chickens in rural Ethiopia. *Agricultural Economics*, 50(4): 451 – 463.
8. Jukna, V., Klementaviciute, J., Meskinyte-Kausiliene, E., Peciulaitiene, N., Samborskyte, M. and Ambrasunas, L. (2012). Comparative evaluation of quality and composition of ostrich, turkey and exotic meat. *Biotechnology in Animal Husbandry*, 28: 385-392.
9. Popovic, I., Bart A. G. Bossink, B.A.G. and van der Sijde, P.C. (2019). Review Factors Influencing Consumers' Decision to Purchase Food in Environmentally Friendly Packaging: What Do We Know and Where Do We Go from Here? *Sustainability*, 11, 7197.
10. Guni, F.S. and Katule, A.M. (2013). Characterization of local chickens in selected districts of the Southern Highlands of Tanzania: I. Qualitative character. *Livestock Research for Rural Development*, 25: 9.
11. Rizzi, C. (2018). Plumage colour in Padovana chicken breed: growth performance and carcass quality. *Italian Journal of Animal Science*, 17: 3
12. Gunnarsson, U., Hellström, A.R., Tixier-Boichard, M., Minvielle, F., Bed'hom, B., Ito, S., Jensen, P., Rattink, A., Vereijken, A. and Andersson, L. (2007). Mutations in *SLC45A2* cause plumage colour variation in chicken and Japanese quail. *Genetics*, 175(2): 867 – 877.
13. Sabow, A.B., Sazili, A.Q., Zulkifli, I., Goh, Y.M., Ab Kadir, M.Z.A., and Adeyemi, K.D. (2015). Physio-chemical characteristics of *longissimuslumborum* muscle in goats subjected to halal slaughter and anaesthesia (halothane) pre-slaughter. *Animal Science Journal. doi:10.1111/asj.12385*
14. Inci, H., Sogut, B., Sengul, T., Sengul, A.Y., Taysi, M.R. (2015). Comparison of fattening performance, carcass characteristics, and egg quality characteristics of Japanese quails with different feather colours. *Revista Brasileira de Zootecnia*, 44(11): 390-396.15. Ojewola, G.S., Ukachukwu, S.N. and Onyenucheya, F. (2000). Comparative carcass characteristics of indigenous turkey poults fed different agro-industrial by-products. *Tropical Journal of Animal Science*, 3(2): 159 –

164.

16. Isguzar, E. and Testik, A. (2001). An investigation on growth, carcass characteristics and meat quality of Bronze turkeys with every day herding in extensive conditions as primitive in Turkey. *GAP II Agricultural Congress*, 2: 1125-1131.
17. Işgüzar, E. (2003). Growth, carcass traits and meat quality of Bronze and White turkeys in Isparta province of Turkey. *Arch. Tierz., Dummerstorf* , 46 (5): 471-481.
18. Ojedapo, L. O., Akinokun, O., Adedeji, T. A., Olayeni, T. B., Ameen, S. A and Amao, S. R. (2008). Effect of strain and sex on carcass characteristics of three commercial exotics reared in deep litter system in the derived Savannah Area of Nigeria. *Journal of Animal Breeding and Genetics*, 4:487–91.
19. Marcu, A.O, Marcu, A., Dănăilă, L., Dronca, D. and Kelciov, B. (2013). The influence of genotype and sex on carcass characteristics at exotic chickens. *LucrăriŞtiinţifice-SeriaZootehnie*, 59:17–21.
20. Uhlíová, L., Tmová, E., Chodová, D., Vlková, J., Ketta, M. and Volek Z, *et al.* (2018). The effect of age, genotype and sex on carcass traits, meat quality and sensory attributes of geese. *Asian-Australasian Journal of Animal Science*, 31: 421–8.
21. Roberson, K.D., Rahn, A.P., Balander, R.J., Orth, M.W., Smith, D.M. , Booren, B.L., Booren, A.M., Osburn, W.N. and Fulton, R.M. (2003). Evaluation of the growth potential, carcass components and meat guality characteristics of three commercial strains of tom turkeys. *The Journal of Applied Poultry Research*, 12(2): 229 – 236.
22. Funaro, A., Cardenia, V., Petracci, M., Rimini, S., Rodriguez-Estrada, M.T. and Cavani, C. (2014). Comparison of meat quality characteristics and oxidative stability between conventional and free-range chickens. *Poultry Science*, 93:1511–1522.
23. PapaleoMazzucco, J., Goszczynski, D.E., Ripoli, M.V., Melucci, L.M., Pardo, A.M., Colatto, E. and Villarreal, E.L. (2016). Growth, carcass and meat quality traits in beef from Angus, Hereford and cross-breed grazing steers, and their association with SNPs in genes related to fat deposition metabolism *Meat Science*, 114: 121–129.
24. Michalczuk, M., Łukasiewicz, M., Zdanowska-Sąsiadek, Ż. and Niemiec, J. (2014). Comparison of selected quality attributes of chicken meat as affected by rearing systems. *Polish Journal of Food and Nutrition Sciences*, 64(2): 121-126.
25. Skrivanova, V., Tumova, E., Englmaierova, M., Chodova, D. and Skrivan, M. (2017). Do rearing system and free-range stocking density affect meat quality of chicken fed feed mixture with rapeseed oil? *Czech Journal of Animal Science*, 62: 141–149.
26. Rathgeber, B.M., Boles, J.A. and Shand, P.J. (1999). Rapid postmortem pH decline and delayed chilling reducequality of turkey breast meat. *Poultry Science*, 78 (3): 477 – 484.
27. Javid, A., Hussain, A. and Ashraf, M., Mahmud, A., Altaf, M., Hussain, S.M. and Bukhari, S.M. (2017). Variations in carcass yield and meat sensory quality attributes between turkeys (*Meleagris gallopavo*) reared in free-range and confinement rearing systems. *Indian Journal of Animal Research*, DOI: 10.18805/ijar.voiOF.9141