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Study on Carcass Characteristics of Two Improved Chicken Breeds Reared Under Intensive Management System in Tanzania

F. S. Guni [a*], S. H. Mbaga [b] and A. M. Katule [b]

[a] Tanzania Livestock Research Institute - Uyole, P.O. Box 6191, Mbeya, Tanzania.
[b] Department of Animal, Aquaculture and Range Sciences, Sokoine University of Agriculture, P.O. Box 3004, Morogoro, Tanzania.

Authors' contributions

This work was carried out in collaboration among all authors. All listed authors have made substantial contributions to the research design, or the acquisition, analysis, or interpretation of data, and drafting the manuscript or revising it critically. All authors have read and approved the final version.

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ABSTRACT

The effect of breed on the carcass characteristic of two dual-purpose chickens reared under the intensive management system was studied. A total of 40 birds from Sasso and Kuroiler breeds (20 per breed) were randomly taken as a representative sample and were slaughtered and carcass dissected manually. The parameters for all breeds included bodyweight at slaughter (BWs), carcass weight (CW), dressing percentage (DP %), parts yield including breast, drumsticks, thighs, wings, back and neck. With regard to all parameters collected, the two breeds were found to be significantly ($P<0.05$) different for all carcass characteristics. The BWs, CW and all carcass parts weight were significantly ($P<0.05$) higher for Sasso than Kuroiler. In addition, Sasso had higher

**Corresponding author: E-mail: fadhili.guni@yahoo.com;*

proportions of breast, back and wings than Kuroiler but the two breeds were comparable on thighs, drumsticks and neck. There were significant and positive phenotypic correlations between BWs and all carcass traits studied.

Keywords: Carcass traits; correlation; Kuroiler bird; Sasso bird.

1. INTRODUCTION

The poultry meat industry has experienced rapid expansion, particularly in the last 30 years which has been accompanied by the genetic development of genotypes that allow for greater meat yield [1]. Similarly, the demand for poultry and livestock products has increased significantly which leads most poultry-related development agencies to promote the intensification of improved poultry systems. When considering the improvements in the poultry industry in terms of new genotypes, it is imperative to provide information that helps producers and consumers to make informed decisions about the genetic potential of those genotypes in different production systems and environments. Sasso and Kuroiler are genetically improved dual-purpose breeds which have been introduced in Tanzania to support poverty reduction, productivity growth and increased household's animal protein intake [2]. The advantage of these breeds and other dual-purpose birds over the commercial egg or meat-type chickens is their duality where males are used for meat production and females for egg production [3]. Performance test in terms of growth, egg production and survivability of these breeds has been done, and the results have been documented [4,5,6]. In the production chain, carcass and parts yields provide valuable information to guide producers on which breed to keep or when to slaughter the birds. Some studies have shown carcass yield and proportions of carcass parts in chickens to be affected by several factors among which is the genotype. While investigating the slaughter characteristics of male dual-purpose chickens under the intensive management system, Biazen et al. [7] showed that the Kuroiler had heavier slaughter weight, dressed carcass weight, eviscerated carcass weight, breast weight, thigh weight, and drumstick weight than other breeds. Similarly, studies by Ibrahim et al. [8] and Mueller et al. [3] have shown differences among different dual-purpose chicken breeds on carcass yields as well as proportions of carcass parts. In more recent carcass evaluations, Sanka et al. [9] did not find significant differences between Sasso and Kuroiler on carcass weight and carcass parts when chickens were subjected to varying levels of feed supplementation under semi-scavenging conditions. Thus, knowledge of carcass parameters between and among different genetic groups is important in the formulation of breeding plans under different management systems. Therefore, this study intended to evaluate the carcass traits of male chickens of Sasso and Kuroiler breeds under the intensive management system.

2. MATERIAL AND METHODS

2.1 Location of the Study Area

The study was conducted at the Poultry farm of Sokoine University of Agriculture (SUA). The University is located at the foothills of the Uluguru Mountains in Morogoro, Eastern Tanzania between latitude 06^{o} 50"S and longitude 37^{o} 39"E about 550 meter above sea level. The highest mean maximum temperature is above 31ºC during the months of November, December, January and February and mean minimum temperature is around 16ºC in June, July and August. The relative humidity is 70% on average.

2.2 Management of the Birds

A total of 240 (120 Kuroiler and 120 Sasso) male chickens were raised under the intensive deep litter management system using rice husk as litter material. The house was open-sided built using concrete blocks and roofed with corrugated iron sheet. The adjacent pens were partitioned with wire mesh which allowed good air circulation within the house. Spot brooding was done using artificial heat (electric bulb). The chicks were randomly assigned to six deep litter pens (3 for each breed), each having 40 birds. Following six weeks of brooding, the same pens were used for grower birds. Each pen was equipped with enough feeders and drinkers; kept under the same management conditions like space, light, temperature, ventilation and relative humidity. The birds were offered commercial diets produced by the Silverland Company located in Iringa region. During the brooding, birds were provided with a starter diet in form of crumbles containing 2941 Kcal ME/kg and 21.2%

Table 1. Chemical composition for starter and grower rations

Constituent	Starter ration		Grower ration
	Crumble	Mash	Mash
Crude Protein (%)	21.2	20.3	15.5
Metabolizable Energy (Kcal/ KgDM)	2941	3049	2762
Crude Fat (%)	3.4	1.9	3.8
Crude Fiber (%)	2.7	2.9	6.8
Ash (%)	7.2	4.1	3.7
Dry Matter (%)	89.4	87.4	87.1
Starch (%)	42.4	49.2	42.3
Total Sugar (%)	3.49	2.99	3.82

CP (0 - 2 weeks) and chick mash containing 3049 Kcal ME/kg and 20.3% CP (3 - 6 weeks). A grower ration containing 15.5% CP and 2762 Kcal ME/kg was provided from the 7th to the end of the 16th week of the age. Clean water was provided in ad-libitum throughout the experimental period. The chemical compositions for starter and grower rations are summarized in Table 1.

2.3 Carcass Traits Measurements

At the end of the 16 weeks of age a sample of 40 birds, i.e.20 birds/breed were randomly selected and slaughtered to determine carcass weight as well as carcass parts yield. Sampled birds were starved for 12 hours but had free access to drinking water until slaughter. The birds were slaughtered by cutting the jugular vein, bled for 120 seconds and then scalded at about 55 – 60 $^{\circ}$C for 60 seconds and manually de-feathered. The carcass weight was taken after de-feathering and removal of feet, head and the viscera (gizzard, heart, spleen, liver and intestine). The eviscerated carcass, breast, thighs, drumsticks, wings, back and neck were weighed using a digital balance. Carcass weight data were used to calculate the dressing percentage and carcass part composition (%) by taking the weight of the individual parts as the percentage of the body weight at slaughter (BWs) of the chicken.

2.4 Statistical Data Analysis

The General Linear Models (GLM) procedure of SAS software [10] was used to analyze the data for body weight at slaughter, carcass weight, and parts yield with the MANOVA option for calculating partial correlation coefficients among the carcass trait variables. The breed was considered as the fixed effects while individual bird was taken as a random effect. The following Model was used

$$Yij = \mu + Bi + Eijk \quad (1)$$

Where:

Yijk = observation (Bodyweight at slaughter, carcass weight, and carcass parts yield) from the ith breed.

μ = General mean common to all observations in the study;

Bi = Effect of the ith breed (i= Kuroiler, Sasso);

Eijk= Random effect peculiar to each bird.

3. RESULTS AND DISCUSSION

3.1 Effect of Breed on Carcass Characteristics

Carcass characteristics of Sasso and Kuroiler male chickens slaughtered at 16 weeks are presented in Table 2. Significant ($P < 0.05$) differences were observed between the two breeds on body weight at slaughter, carcass weight and carcass parts weight. Sasso chickens presented heavier body weight at slaughter (2340.8 g) than Kuroiler (2000.8 g). Likewise, Sasso had significant ($P < 0.05$) higher carcass weight and Dressing percentage (DP %) than Kuroiler which implies existence of genetic differences between the two breeds in growth rate and muscle deposition.

This observation agrees with the reports of Mueller et al. [3], Ibrahim et al. [8] and Biazen et al. [7] who also revealed the existence of breed/genotype differences in the slaughter weight of chickens. As expected, birds with higher growth potentials (i.e., higher BWs) will present a higher meat production capacity (carcass yield). In the present study, the Sasso breed also had a heavier ($P < 0.05$) carcass than Kuroiler. The carcass weight (1622.50 g) for

Sasso chickens observed in the present study was higher than 1400.6 g for Koekoek chickens and 1415.4 g for Lohman Dual reported by Ibrahim et al. [8] but comparable to 1677 g and 1684.4 g for Sasso 51 and Novo Brown chickens reported by Mueller et al. [3] and Ibrahim et al. [8] respectively. Similarly, the carcass weight for Kuroiler chickens observed in the present study (1346.60 g) was comparable to 1400.6 g for Koekoek chickens reported by Ibrahim et al. [8] but lower than 1677 g for Sasso 51 reported by Mueller et al. [3]. Moreover, the mean carcass weights of both Kuroiler and Sasso in the present study were lower than the report of Mueller et al. [3] and Siekmann et al. [11] for carcass weight of fast-growing commercial broiler lines of Ross PM3 (1760 g) and Ross 308 (2182.5 g) respectively. Generally, the BWs and CW observed in the present study for both Sasso and Kuroiler at 16 weeks are comparable to the market weight i.e. 2kg for fast-growing chickens kept for less than 8 weeks. This supports the suggestion by Biazen et al. [7] that despite the longer growing period required for dual-purpose chicken breeds than the fast-growing broiler, males of the two breeds can still be utilized as alternative meat-type chicken in places where specialized broilers are not accessible or where the local types are considered to be un-economical given their slow growth and lower body weight at slaughter.

The dressing percentage (DP %) was higher for Sasso (70.63%) than Kuroiler (68.54%) which is likely the result of higher bodyweight of Sasso chickens. The observed dressing percentages for Sasso and Kuroiler in the present study were higher than (66.75%) for Kuroiler chickens reported by Aline [12] in Uganda, but lower than the range 71.02 – 72.97% for various broiler strains reported by Fernandes et al. [13]. The difference in dressing percentage between this study and those reported by other authors might be associated with several factors including genotype, sex, length of feed withdrawal before processing, length of starvation before slaughtering and the birds rearing system [14].

The carcass parts including the breast, thighs, drumsticks, back, wings and neck were also heavier for Sasso than Kuroiler (Table 2). The breast, thighs, drumsticks are considered the most valuable carcass parts in broiler and dual-purpose male chickens kept for meat production while the back, wings and neck are regarded as less valuable carcass parts [7]. The higher performance of Sasso in these traits might be directly related to the carcass weight, whereby Sasso had higher proportions than Kuroiler. This observation is supported by the reports of Katekhaye [15], Rezaei et al. [16], Biazen et al. [7] and several authors who have also indicated higher carcass parts weight for heavier birds.

The data for carcass parts expressed as a percentage of the BWs are presented in Table 3. The proportions of breast, back and neck were higher ($P < 0.05$) for Sasso than for Kuroiler. The proportions of thighs, drumsticks and the wings did not differ ($P > 0.05$) between the two breeds, suggesting that although the two breeds differed in body weight at slaughter and carcass weights, yet the share of thighs, drumsticks and wings to the total weight were similar. This observation is in agreement with that of Lichovníkova et al. [17] who also found insignificant differences for the proportion of leg muscle (thigh and drumstick) between fast-growing chickens and layer male chickens. The highest carcass part observed was the breast (17.86 and 16.77 % for Sasso and Kuroiler respectively), while the lowest was the neck (4.93 and 4.38% for Sasso and Kuroiler respectively). A higher proportion of breast to the total BWs might be related to the effect of selection for meat production where more attention is placed on the breast proportion [14]. Though the breeds used are not pure meat birds, by being dual-purpose birds, they thus carry genes from meat breeds. Thus, the higher carcass weight and breast proportion of the Sasso males is an indication that the breed is relatively better for meat production under intensive management than Kuroiler.

However, the choice of breed type for meat production is influenced not only by bird growth but also by the cost of production. Indeed, it would be useful and practical to undertake a study aimed at comparing carcass and parts yield for these breeds when slaughtered at different ages under different management systems to determine their cost-effectiveness and the ultimate quality of the final product i.e. meat. For example, local chickens have lower carcass weight as well as low yield of carcass parts, moreover, in terms of consumer preference, such meat scored better compared to broiler [18]. This may imply a tradeoff between time to slaughter and final product quality based on the market preference.

Table 2. Least square mean values for the effects of breed on carcass yield of dual-purpose male chickens slaughtered at 16th week of age

Variable	Breed		SEM	P-value
	Kuroiler	Sasso		
BW at slaughter (g)	2000.80[b]	2340.80[a]	57.52	0.0001
Carcass weight (g)	1346.60[b]	1622.50[a]	39.90	<.0001
Dressing %	67.56[b]	69.20[a]	0.51	0.0299
Breast weight (g)	335.10[b]	419.00[a]	12.42	<.0001
Thigh weight (g)	247.70[b]	271.90[a]	7.34	0.0252
Drumstick weight (g)	221.40[b]	252.50[a]	6.96	0.0031
Back weight (g)	257.20[b]	335.40[a]	9.25	<.0001
Wing weight (g)	188.00$_b$	212.30[a]	5.09	0.0017
Neck weight (g)	87.60[b]	115.70[a]	3.35	<.0001

[a-b] Means with different superscripts within a row differed significantly (P<0.05), SEM = Standard error of the mean; BW= Bodyweight

Table 3. Least square mean values for the effects of breed on carcass yield of dual-purpose male chickens slaughtered at 16th week of age (carcass parts expressed as a percentage of the BWs)

Variable	Breed		SEM	P-value
	Kuroiler	Sasso		
Breast weight	16.77[b]	17.86[a]	0.28	0.0096
Thigh weight	12.38	11.83	0.13	0.0562
Drumstick weight	11.12	10.75	0.14	0.0806
Back weight	12.92[b]	14.28[a]	0.22	0.0001
Wing weight	9.48	9.06	0.16	0.0788
Neck weight	4.38[b]	4.93[a]	0.08	<.0001

[a-b] Means with different superscripts within a row differed significantly (P<0.05), SEM = Standard error of the mean, BWs = Body weight at slaughter

Table 4. Correlation coefficients (r) between body weight at slaughter, carcass weight, and carcass traits of Sasso and Kuroiler chickens

Breed	Trait	Slaughter weight	Carcass	Breast	Thigh	Drumstick	Back	Wing	Neck
Sasso	Slaughter weight	1	0.99***	0.98***	0.88***	0.92***	0.90***	0.85**	0.73*
Kuroiler		1	0.99***	0.95***	0.82**	0.93***	0.92***	0.90***	0.80**
Sasso	Carcass		1	0.98***	0.90***	0.92***	0.91***	0.85**	0.74*
Kuroiler			1	0.95***	0.83**	0.92***	0.93***	0.91***	0.82**
Sasso	Breast			1	0.93***	0.96***	0.91***	0.84**	0.73**
Kuroiler				1	0.91***	0.92***	0.96***	0.88***	0.91***
Sasso	Thigh				1	0.85**	0.86**	0.67*	0.75*
Kuroiler					1	0.72*	0.87***	0.65*	0.94***
Sasso	Drumstick					1	0.84**	0.87***	0.60*
Kuroiler						1	0.86**	0.90***	0.76**
Sasso	Back						1	0.62*	0.89***
Kuroiler							1	0.86**	0.87**
Sasso	Wing							1	0.36^{ns}
Kuroiler								1	0.68*
Sasso	Neck								1
Kuroiler									1

*** (P < 0.0001); **(P < 0.001); *(P < 0.05); ^{ns}(P > 0.05)

3.2 Correlation Coefficients of Carcass Characteristics

Correlation coefficients (r) between BWs and CW and parts yield of Sasso and Kuroiler chickens are shown in Table 4. Significant positive correlations were obtained between BWs, CW and other carcass traits of the two breeds except for the relationship between wing and neck weight for Sasso, which was positive but not significant (0.36). The highest correlation was observed between body weight at slaughter (BWs) and carcass weight (0.99) in both breeds, while the lowest was between wing weight and neck weight (0.36 and 0.68 for Sasso and Kuroiler respectively). With regard to the correlation between BWs and carcass parts, the breast had the highest correlation (0.98 and 0.95 for Sasso and Kuroiler respectively) while the neck had the lowest (0.73 and 0.80 for Sasso and Kuroiler respectively).

The positive correlation values recorded in this study for all carcass traits and BWs of the two breeds suggest that there are genetic relationships between and among carcass traits and hence, the BWs of chicken can be used to predict the carcass weight as well as parts yield from live body weight before slaughter. This observation is in accordance with the finding of Olawumi [19] on Arbor and Acre chickens in Nigeria.

4. CONCLUSION

Based on the results of the present study, it is concluded that Sasso males showed higher body weight at slaughter, higher carcass weight and higher parts weight than Kuroiler. The correlation between body weight at slaughter with carcass weight and carcass parts were high and positive.

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ETHICAL APPROVAL

National and institutional procedures for the care and use of animals were followed. The study was approved by International Livestock Research Institute Institutional Animal Care and Use Committee (ILRI IACUC) with reference number: IACUC-RC2016.26.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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