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Comparative Evaluation of Carcass Traits of Male and Female Kuchi Indigenous Chicken Ecotype of Kenya

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Abstract

Indigenous chicken (IC) is becoming popular for both egg and meat traits. However, little interventions have been made towards developing pure genotypes from IC ecotypes for these functional traits. Kuchi is one of the IC whose attributes have made it a candidate for genetic selection towards a meat breed. A study was carried to evaluate and compare carcass traits for both male and female Kuchi at 30 weeks of age. Randomly selected 18-day old Kuchi Chicken were intensively raised with a commercial mash (chick and grower) from Bunda™ Feeds up to week 17. From 18 to 30 weeks, the experimental birds were managed under a Semi-Intensive system, with a formulated Metabolizable Energy (ME) supplement of ME 2560 Kcal/kg. At week 30, a total of 6 Kuchi chicken (3 Males and 3 Females) were randomly selected, slaughtered for carcass yield and correlations of 14 phenotypic traits, namely: Live body weight (Lwt), de-feathered (Bwt), Feathers (Ft) Legs (Lg) Neck (Nk), Blood (Bl), Breast (Br), Head (Hd), Backbone (Bb), Thigh (Th), Shank Length (Sl), Gizzard (Gz), Heart (Ht), and Liver (Lv). Initial pre-slaughter mean weights for the Cocks (male) and Hens (female) were recorded before and after 18 hours of feed deprivation. Mean weights were evaluated and analyzed using Stat Graphics 16.0 software tool. Results revealed that Kuchi males were significantly ($p<0.05$) heavier in Lwt 2243±210.3g; Bwt 2144±199.6g; Br 595.7±86.3g, and Th 14.67±0.53g, compared to Kuchi female Lwt 1683±214.2g, Bwt 1600±192.8g, Br 441.3±49.1g, and Th 11.33±1.53g respectively. Moreover, both male and female Kuchi did not differ ($p>0.05$) in all other carcass traits. This suggests that genetic molecular markers for Br and Th may be utilized for selection and breeding towards meat traits and Kuchi males be taken as candidates for IC genotype for a meat breed in Kenya..

Key words: ***Kuchi, Ecotype, Carcass, Trait, Molecular Markers, Breed***

Introduction

Livestock food systems play key subsistence and income generation roles in low to middle-income countries (Carron et al., 2017). In Kenya, the livestock sub-sector of agriculture contributes significantly to the economy of Kenya both in terms of income and food security. About 12% of the country's Gross Domestic Product (GDP) and 42% of the agricultural GDP, are contributed by the Livestock sub-sector (SNV, 2008). Poultry alone contributes 1.7% of the entire livestock component, and among

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this, the indigenous chicken (IC) constitute a larger portion compared to exotic commercial genotypes. These IC genotypes are distributed in every geographical zone except in very arid northern areas such as ecological zone Seven (Chesoo Oduho, & Kios, 2016).

The raising of IC for meat rather than egg production has been recommended by many researchers (Okeno, Kahi, & Peters, 2012). The recommendation was based on several reasons. First, meat production accounted for over 70% of the total income from different IC production systems (Okeno, Magothe, Kahi, & Peters 2012). Second, systems utilizing IC for meat production realized high profits compared to that raising IC for egg production (Okeno & Jianlin., 2013). Third, Consumers preferred egg of larger sizes while IC produce small eggs with an average of 45g compared to commercial layer eggs (Okeno Magothe, Kahi, & Peters, 2012; Magothe, Okeno, Muhuyi, & Kahi, 2012). Lastly, consumers prefer indigenous chicken meat and therefore willing to pay more compared to broiler meat (Bett & Bokelmann, 2011).

The consumption of IC meat in Kenya is increasing owing to health concerns, taste and consumer preference as opposed to commercial broiler/layer products (Robinson & Pozzi, 2011). To meet this expected demand growth, IC production in Kenya is expected to increase and this requires an appropriate intervention through the selection and breeding of superior IC ecotypes. The *Kuchi* is an example of IC ecotype found in the coastal region of Kenya particularly Faza Island of Lamu County and the northwestern marginal parts of Tanzania (Chesoo, Oduho, Kios, & Rachuonyo, 2014; Ngeno, 2011; Lwelamira, Kifaro, Gwakisa, 2008).

The *Kuchi* ecotype is superior in terms of mature body weight and related traits. Furthermore, its performance can better be enhanced by improving both the management system and their genetic potential through the selection and line-breeding towards meat traits. To curtail the over-reliance to exotic genotypes for meat and egg production which is hitherto a drain of foreign exchange, disease risks and unmanageable costs of production, there is a need therefore to develop tailor-made IC ecotypes towards the mitigation of this scenario. The Kuchi ecotype serves as a good starting genetic material for further improvement towards meat traits (Magonka *et al*., 2016; Chesoo Oduho, Kios, & Rachuonyo, 2014; Lwelamira, Kifaro, Gwakisa, 2008).

Thus, the present study comparatively evaluated and assessed the carcass yield and the relations of each trait for Kuchi IC adult males and females kept under a semi-intensive management system. The results will be utilized as part of bridging the information gap currently existing for breeding purposes towards a Kenyan IC meat breed.

Materials and Methods

Study Site

The study was carried out at the poultry farm, Department of Animal Science of the University of Eldoret (UoE) in Uasin Gishu County, located at l0^{o} 31”N, Longitude

35^{o} 17” E, with an altitude of 2154 M, above sea level. The rainfall pattern is unimodal with an average of 1000mm to 1520mm per annum. The rains span from late February to August and the temperatures of the site range from 23.6^{o}C day to 9.6^{o}C night (MoA, 2018).

Experimental Chicken

The experimental chicken was derived from one to five-day-old Kuchi eggs (n=209) sourced from three sites, two in Kerio Valley (Sambalat and Muskut) of Elgeyo-Marakwet County and others from pure Kuchi flock kept for the current study at the UoE farm. An artificial hatching process was carried out using a commercial incubator® with due adherence to the manufacturer's recommendations. The hatched chicks were then managed in a brooder for 4 weeks, using a commercial Super Feeds® Chick mash. The Kuchi growers were then fed with a commercial Super Feeds® Grower's mash from week 5 to 10 of age before transferring them to the study site on week 11. At week 17 of age, 18 randomly selected Kuchi adults, were subjected to the experiment. Initial mean weights were taken and disease control protocol against common poultry diseases such as Gumboro, Marek's, New Castle, Fowlpox and Fowl typhoid diseases were strictly followed. Water was provided *ad libitum* to the experimental birds.

Management System

A free-range scavenge conditions from 0700 to 0600 hours within an area of 100m^2 with a cafeteria feeding system (Chemjor, 1998) was provided to the experimental chicken with an energy ration supplement provided up to 30 weeks of age. Water was provided *ad libitum.* The housing pen dimension was of 12m^2. This feeding system was carried for 12 weeks when the chickens were 30 weeks of age.

Table 1

Supplementary Diet of 2564 MEkcal/Kg: 18.35 CP; 0.9% Lys; 0.4% Met; 7% CF; 0.5% Ca^{++}

Ingredient	Quantity(g)
Maize grain	28
Maize germ	20
Wheat pollard	20
Sunflower	5
Cotton cake	12
Fish meal	5
Vegetable oil	4
Iodized salt	0.3
Limestone	0.3
Sand	3

Slaughtering Procedure

At 30 weeks of age, six (3 cocks and 3 hens) randomly selected Kuchi IC were weighed and their pre-slaughter mean weights recorded. The chickens were bled by section of the jugular vein and then scalded in hot water (70-80°C) and plucked manually. Then, they were eviscerated and the heart, the kidney, the crop, and the intestines were taken off.

Then de-feathering was done weights and mean weights of the feathers for both cock and hen. Then bled and slaughtered after 16 h of water and feed withdrawal according to Tougan *et al*., (2013) procedure. Mean weights for feathers, legs, breast, backbone, thigh, neck, heart, liver, gizzard, blood, head and the shank were computed and analyzed for carcass yield using Stat Graphics 16.0 software tool to compare the relationship of all the carcass parameters for both Kuchi cock and hen.

Results and Discussion

The pre-slaughter mean Lwt was 2376g and 1683.3g for cock and Hen, respectively. Kuchi cock was significantly ($p < 0.05$) heavier in both Lwt and Bwt than Kuchi hen of the same age, Table 2. Malawian IC cocks have been reported to be heavier to hens of the same age (Chigoma & Tanganyika, 2017). This result corroborates those of Magonka *et* al. (2016), for mature Tanzanian Kuchi IC at 24 weeks (2070g) under semi-intensive management conditions.

Means of 14 Carcass Traits for Kuchi Cock and Hen

The mean weights (Table 1) for Ft, Br, Hd Bb, Gz and Lv, were not significant (p>0.05). Weights of live body weight (Lwt), de-feathered (Bwt), legs, necks and drumsticks differed between sexes (p<0.05). Shank length also significantly differed between sexes (p> 0.05). There was no significant difference between male and female blood volume (p> 0.05). Mean weights for Carcass traits of Cock and Hen with the same superscript letter were not significant (p> 0.05). Kuchi hen was lighter (p<0.05) in Lwt than Cock in terms of Th, Sl, Lg and Nk traits.

Table 2

Comparative Mean Weights for Carcass Traits Kuchi Weights at 30 Weeks old Means of Variables for Adult Male and Female Chicken

Parameter	Male (n=3)	Female (n=3)
Lwt	2243±210.3[a]	1683±214.2[b]
Bwt	2144±199.6[a]	1600±192.8[b]
Ft	115.7±9.5[a]	83±27.9[a]
Lg	105.3±18.5[a]	52.7±7.4[b]
Nk	104±11.5[a]	47.3±7.4[b]
Bl	100±20[a]	66±28.9[a]
Br	595.7±86.3[a]	441.3±49.1[a]
Hd	72±18.5[a]	63.7±25.5[a]
Bb	334±39.3[a]	293±56.03[a]
Th	14.67±0.53[a]	11.33±1.53[b]
Sl	591.33±42.62[a]	346.3±37.11[b]
Gz	42.33±5.13[a]	48.7±13.43[a]
Lv	14±2.0[a]	9.33±3.51[a]
Ht	30.67±6.7[a]	35±4.0[a]

[a] Weights measured in g, lengths in cm and volumes in ml and with their standard deviations.
[b]Means followed by the same letter are not different between sexes, t-test ($p > 0.05$).
[c]n = sex sample size.

Correlation (r- is the correlation coefficient) of Kuchi cock and hen carcass traits of male Kuchi.

The neck, head, gizzard and liver weight in male birds slaughtered were all highly correlated ($p<0.05$) with life bodyweight (Lwt) (Table3). De-feather body weight (Bwt) of male birds was highly correlated with wing bone muscle (Bb), backbone, drumstick, and heart. The neck was highly correlated to head and gizzard but negatively correlated to blood in ml and shank length. These findings are higher than those reported (Singh & Pathak, 2016; Kibret, 2008), on the carcass traits of IC.

Table 3

Summary of Parameters Correlations between Recorded Measurements Estimated for Cock

	Lwt	Bw	Ft	Lg	Nk	Bl	Br	Hd	Bb	Sl	Th	Gz	Ht	Lv
Lwt		0.50	0.50	0.86	1.00*	-0.50	0.50	1.00*	0.50	-0.86	0.50	1.00*	0.50	1.00*
Bw	0.50		1.00*	0.00	0.50	-1.00*	1.00*	0.50	1.00*	-0.86	1.00*	0.50	1.00*	0.50
Ft	0.50	1.00*		0.00	0.50	-1.00*	1.00*	0.50	1.00*	-0.86	1.00*	0.50	1.00*	0.50
Le	0.86	0.00	0.00		0.86	0.00	0.00	0.86	0.00	-0.50	0.00	0.86	0.00	0.86
Nk	1.00*	0.50	0.50	0.86		-0.50	0.50	1.00*	0.50	-0.86	0.50	1.00*	0.50	1.00*
Bl	-0.50	-1.00*	-1.00*	0.00	-0.50		-1.00*	-0.50	-1.00*	0.86	-1.00*	-0.50	-1.00*	-0.50
Br	0.50	1.00*	1.00*	0.00	0.50	-1.00*		0.50	1.00*	-0.86	1.00*	0.50	1.00*	0.50
Hd	1.00*	0.50	0.50	0.86	1.00*	-0.50	0.50		0.50	-0.86	0.50	1.00*	0.50	1.00*
Bb	0.50	1.00*	1.00*	0.00	0.50	-1.00*	1.00*	0.50		-0.86	1.00*	0.50	1.00*	0.50
Sl	-0.86	-0.86	-0.86	-0.50	-0.86	0.86	-0.86	-0.86	-0.86		-0.86	-0.86	-0.86	-0.86
Th	0.50	1.00*	1.00*	0.00	0.50	-1.00*	1.00*	0.50	1.00*	-0.86		0.50	1.00*	0.50
Gz	1.00*	0.50	0.50	0.86	1.00*	-0.50	0.50	1.00*	0.50	-0.86	0.50		0.50	1.00*
Ht	0.50	1.00*	1.00*	0.00	0.50	-1.00*	1.00*	0.50	1.00*	-0.86	1.00*	0.50		0.50
Lv	1.00*	0.50	0.50	0.86	1.00*	-0.50	0.50	1.00*	0.50	-0.86	0.50	1.00*	0.50	

Significant indicated with an asterisk; * $p<0.0$

For the female birds, breast (Br) and heart (Ht) weights were all highly correlated (P<0.05) with life bodyweight (Lwt) (Table 4). The Breast, heart, and liver, were positively and highly correlated to de-feathered body weight (P<0.05). Heart and liver weights were also highly correlated to Bb (P<0.05). However, other measurements such as head weight were negatively correlated with Bb (P>0.05).

Table 4
Summary of Parameters Correlations between Recorded Measurements Estimated for Kuchi Hen

	Lwt	Bw	Ft	Lg	Nk	Bl	Br	Hd	Bb	Sl	Th	Gz	Ht	Lv
Lwt		0.99	0.79	-0.64	-0.06	-0.14	0.99*	-0.73	0.64	0.75	0.67	0.97	0.99*	0.98
Bw	0.99		0.73	-0.70	-0.14	-0.05	0.99*	-0.79	0.57	0.69	0.61	0.95	0.99*	0.99*
Ft	0.79	0.73		-0.04	0.55	-0.71	0.74	-0.17	0.97	0.99*	0.98	0.90	0.75	0.69
Le	-0.64	-0.70	-0.04		0.80	-0.66	-0.69	0.99	0.17	0.01	0.12	-0.45	-0.68	-0.74
Nk	-0.06	-0.14	0.55	0.80		-0.97	-0.13	0.72	0.72	0.60	0.69	0.16	-0.12	-0.20
Bl	-0.14	-0.05	-0.71	-0.66	-0.97		-0.06	-0.56	-0.85	-0.75	-0.82	-0.35	-0.08	0.00
Br	0.99*	0.99*	0.74	-0.69	-0.13	-0.06		-0.78	0.58	0.70	0.62	0.95	0.99*	0.99*
Hd	-0.73	-0.79	-0.17	0.99	0.72	-0.56	-0.78		0.04	-0.11	0.00	-0.56	-0.77	-0.82
Bb	0.64	0.57	0.97	0.17	0.72	-0.85	0.58	0.04		0.98	0.99	0.79	0.59	0.52
Sl	0.75	0.69	0.99*	0.01	0.60	-0.75	0.70	-0.11	0.98		0.99	0.88	0.71	0.65
Th	0.67	0.61	0.98	0.12	0.69	-0.82	0.62	0.00	0.99*	0.99		0.82	0.63	0.56
Gz	0.97	0.95	0.9	-0.45	0.16	-0.35	0.95	-0.56	0.79	0.88	0.82		0.95	0.93
Ht	0.99*	0.99*	0.75	-0.68	-0.12	-0.08	0.99*	-0.77	0.59	0.71	0.63	0.95		0.99
Lv	0.98	0.99*	0.69	-0.74	-0.20	0.00	0.99*	-0.82	0.52	0.65	0.56	0.93	0.99	

Significant indicated with an asterisk; * $p<0.0$

The **r** symbol is the correlation coefficient. It measures the relationship between two sets of figures e.g. r=1: the two sets run together or match perfectly. If r=0.900 - they match very well, r=0.750 - they match well, r=0.300-they match weakly = 0.00 - they do not match at all and if **r** is negative, the numbers match according to the above scale, but in the reverse.

Mean weights for popular meat cuts such as the Bb and Br were highly correlated with Bw, Th, Ht, Gz and the Lv. The Ft were strongly related to Bwt, Bb and Th meat traits. This suggests that they are linked genetically and molecular markers can be identified and utilized for selection and breeding for meat yield in the IC of Kenya, particularly from the *Kuchi*. Adult *Kuchi* weights were higher than those reported by Payne (1999), but relatively lower than those of Yongolo (1996), for On-Farm free-ranging IC of Tanzania. Furthermore, Kuchi cock and hen weight of 2244g and 1683.3g are closer to the recommendations of Jadhav and Siddiqui(2007) for the Egg Type Leghorn, These results corroborates those of Tswana, Iranian naked neck and Bangladesh IC (Moreki, Tiroesele & Chiripasi, 2012; Badubi, Rakereng & Marumo 2006; Vali 2008; Nishibori & Islam, 2009), slightly lower but consistent to cold dressed weights for culled hybrid broilers and layers of Kenya (MoLD, 1994).

Conclusion and Recommendation

Major cuts such as the breast, backbone and thigh muscle for both adult Kuchi Cocks and Hen were significantly different in terms of meat yield and therefore Kuchi males may be utilized as candidates for selection and breeding using appropriate molecular markers towards IC meat breed. Findings from the current study, *Kuchi* together with other IC of Kenya should be genetically studied to generate information towards developing meat and dual-purpose breeds, not only in Kenya but also in other developing tropical regions.

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