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Comparative Study on Carcass Quality Characteristics of Indigenous Chickens and Their F1-Crosses with the Sasso Chicken Breed in Sheka Zone, South Western Ethiopia

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Abstract

The study was conducted in three districts of Sheka zone in southern Ethiopia with the objective of comparing the carcass quality characteristics of indigenous chickens and their F1-crosses with Sasso chicken breed under traditional production system. One hundred eighty households were purposely selected who possess a minimum of three adult chickens. For the evaluation of carcass quality traits, 84 male chickens were used that have been drawn from both indigenous and F1-crossbred chickens. The results indicated that the F1-crosses chickens reared within three districts had higher ($p<0.05$) values of all carcass quality traits than the local chickens except for the dressing percentages, which was highest in the local chickens. Except breast, thighs, neck, keel bone, liver and gizzard, all carcass component values of chickens raised in Anderacha and Masha districts were higher ($p<0.05$) than those of Yeki. The highest values for breast and gizzard were observed from Mash chickens and differed ($p<0.05$) from those of the two districts. The effect of genotype was highly significant for all carcass components while that of district was significant for dressed carcass, dressing percentage, breast meat, drumsticks, wings, skin, backbone, heart and gizzard. The interaction between genotype and district was significant for only neck and backbone. There was a strong and positive association among all carcass components except for dressing percentage, which had a negative correlation with carcass traits. In conclusion, the F1-crosses demonstrated the highest carcass potentials and could be used as meat or dual-purpose chickens under the smallholder settings. However, care must be taken for unjustified distribution of exotic chicken breeds in the rural community to prevent genetic dilution of the well-adapted indigenous chicken ecotypes.

Keywords

Carcass traits, F1-crosses, local chicken, Sasso chicken, Sheka zone

1. Introduction

Ethiopia, with its wide variations in agro-climatic conditions, possesses one of the largest and the most diverse plant and animal genetic resources in the world [1]. In Ethiopia, the word poultry is synonymous with domestic chicken

(*Gallus domesticus*), because other types of poultry are almost unknown as sources of egg and meat [2]. Indigenous chickens are reared in the country for basic social and economic needs including cash income; hatching for replacement home consumption as well as socio-cultural and religious ceremonies [3, 4].

In Ethiopia, chickens are the most widespread and almost every rural family owns chickens, which provide a valuable source of family protein and income [4]. The total chicken population in the country is estimated to be 60 million of these 88.5% indigenous chicken, while the rest 6.25% and 5.25% are highbred and exotics respectively, which are mainly kept by small holder farmers in scavenging environments [5]. However, the economic contribution of the sector is not still proportional to the large chicken numbers, attributed to the presence of many productions, reproduction and infrastructural constraints [6].

Indigenous chickens are preferred over exotic chickens, because of their pigmentation, taste, flavour and leanness [7]. Variations in ecology and socio-cultural preferences result in different poultry species dominating smallholder production systems in different regions of the world [8]. However, the indigenous chicken seems to have low performances comparatively with exotic or hybrid or selected poultry breeds. In this respect, most of the studies carried out in African and Middle Eastern countries on local poultries had shown that they have low size of eggs and chicks [9], also low parameters relative to meat and eggs performances, comparatively to usual norms in industrial poultry. This may be attributed, in addition to genetic limits, with the extensive poultry husbandry systems generally practiced by farmers, which are characterized by poor feeding, inadequate housing and veterinary services. However, within the aim of poultry productivity, different breed of exotic chickens (Rhode Island Red, Australorp, New Hampshire and White Leghorns) where imported to Ethiopia since the year 1950's. Higher Learning Institution, Research Institutions, Ministry of Agriculture (Livestock and Fishery Development Minister) and nongovernmental organizations (NGO's) have disseminated many exotic types of chicken to farmers and urban based small-scale poultry producers [10]. Similarly, Sasso chicken breeds have been introduced since 2015 for improvement of chicken productivity in the study zone. However, the carcass quality traits of F1 crosses between local chicken and their F1-crosses with Sasso chickens reared in the current study area has not yet studied. Therefore, the study was conducted to investigate the carcass characteristics of indigenous chickens and their F1-crosses with Sasso chicken breed.

2. Materials and Methods

2.1. Description of the study area

The study was conducted in Sheka-Zone of the South Nation Nationality People Regional State (SNNPR). Administratively, it is divided to three districts, namely, Masha, Yeki and Anderacha (Gecha), which are further divided into 57 peasant associations (SZLFDO, 2017). According to the data from the Livestock and Fishery Development Office (LFDO), the Zone lies between $7^0$12'- $7^0$89'North latitude and 35^0 24'- $37^0$90' East longitude with an elevation ranging 1,001-3,000 meters above sea level.

The main agricultural practice in the area is, coffee plantations, spices, pulses & cereal crop production, cattle fattening, apiculture, and animal farming. According to the land utilization data of the region, 64,425.58 ha cultivated land, 4,387 ha grazing land, 115,192 ha of land is covered by forest, bushes and shrub and 30,760 ha of land covered by others.

The agro-ecology of the zone includes 17.61% Kola (lowland), 59.81% Weina-dega (midland), and 22.58% Dega (highland) (SZLFDO, 2017). The mean annual temperature of the zone ranges between 15.1-27.5 5^0C and the mean annual rain fall ranges from 1,172 to 2,200 mm. The climate of the area is characterized by a long rainy season (June-November) accounting for 75% of the annual rainfalls with a peak fall in September. The short rainy season extends from March to May with a peak fall in May and the dry season occurs between November and March. Agricultural seasons of the zone are "Mehar" and "Belg". Mehar is a rainy season which ranges from June to October while Belg from March to May.

2.2. Sampling design

A purposive multi-stage and random sampling technique was used in order to determine the number of Kebeles and households to cover all the three districts. At 1st stage, after consulting the district Agricultural experts, extension agents, and key informants, about F1-crosses and 2 Kebeles from each district (in total 6 Kebeles) were selected purposively based on the availability of chickens (F1-crosses of Sasso with local) and the accessibility of the Kebeles. In the 2nd stage of sampling, 30 households (15 for local and 15 for F1-crosses) were selected purposively from each Keble, that possess a minimum of 5 adult (one year and above) F1-crossesand local chickens. The total numbers of households considered therefore were 180 of which 90 households that possess local chicken and 90 that possess F1-crosses chickens. For the assessment of carcass quality characteristics, eighty-four households were randomly selected from 180 households, which possess 3 adult chickens (1 male and 2 females from each local and their F1-crosses). Accordingly,

84 chickens consisting of 42 indigenous and 42 F1-crosses were sampled. All crossbred chickens included in this study are the first generations of crosses (F1-crosses) that were obtained from the Sasso chicken breeds that had been distributed in 2015 in the study area and this was checked and verified by asking individual households during the survey period.

2.3. Data collection procedures

The live weight of the chickens was taken immediately before slaughtering them. Each chicken was slaughtered by cutting of jugular vein for proper bleeding; then it immersed in moderately hot water for 2 to 4 minutes in order to facilitate the de-feathering process manually. Finally, the carcass components were separated from the offal and the following commercial carcass components were determined: breast meat exclusive of bone, thighs, drumsticks, wings, keel bone meat, skin, backbone (including thorax), neck and giblets (heart, gizzard and liver). Except the live weight, the remaining carcass components were measured by using a digital balance.

2.4. Statistical analysis

All the data were analysed using the GLM procedure of Statistical analysis of software (SAS, 2012, ver. 9.4). Mean comparisons were conducted using Tukey's Standardized Range (HSD) test. The values were considered significant at $P< 0.05$ unless noted otherwise. The following statistical model was used for the analysis of the data:

$Y_{ijk}= \mu + B_i + D_j + Bi*D_j + e_{ijk}$

Where:

Y_{ijk} = the value of the dependent observed variables

μ = overall mean

B_i= the effect of i^{th} chicken genotype (i = local, F1-crosses)

D_j = the effect of j^{th} district (j=1, 2&3)

$B_i * D_j$= the interaction of genotype by district

e_{ijk} = random error term

3. Results

The average values of major carcass components of the two chicken genotypes and the three districts are presented in Table 1. Except breast, thighs, neck, liver, keel bone and gizzard, all carcass component values of chickens raised in Anderacha and Masha districts were higher ($p<0.05$) than those of Yeki. The highest breast and gizzard values were observed from Mash chickens and differed ($p<0.05$) from those of the two districts. The F1-crosses were superior in all carcass comments to the local chickens except for dressing percentage, which was highest in the local chickens.

Table 1. The mean (±SD) value of the carcass quality characteristics (gm) in local chickens and their F1-crosses reared in the three districts (N=84)

Carcass components	District			Genotype	
	Yeki	Anderacha	Masha	Local	F-crosses
Live weight	1,987±383	1,959±417	2,005±446	1,610±149^{b}	2,357±185^{a}
Dressed carcass	1,281±192^{b}	1,353±223^{a}	1,390±228^{a}	1144±78^{b}	1,538±101^{a}
Dressing percentage	65.1±4.35^{b}	69.8±4.21^{a}	70.3±4.34^{a}	71.4±4.49^{a}	65.4±3.04^{b}
Breast	151±18.2^{b}	156±19.2^{b}	176±30.0^{a}	142±11.6^{b}	180±20.1^{a}
Thighs	233±40.5	236±39.0	239±38.5	200±14.9^{b}	271±15.6^{a}
Drumsticks	199±31.9^{b}	214±44.6^{a}	218±41.4^{a}	175±15.3^{b}	246±20.8^{a}
Wings	117±19.3^{b}	138±28.2^{a}	140±25.9^{a}	110±12.8^{b}	153±17.9^{a}
Neck	69.7±13.4	72±11.4	72.7±11.5	61.4±5.54^{b}	82.1±6.7^{a}
Skin	116±23.5^{b}	122±25.9^{a}	123±25.7^{a}	97.1±5.85^{b}	144±9.4^{a}
Keel bone	134±15.1	136±18.6	135±16.5	121±6.35^{b}	149±9.7^{a}
Backbone	196±24.3^{b}	206±33.4^{a}	213±33.6^{a}	177±12.6^{b}	233±14.0^{a}
Heart	9.52±2.22^{b}	10.4±2.57^{a}	10.7±2.61^{a}	8.19±1.28^{b}	12.2±1.63^{a}
Gizzard	28.5±6.01^{c}	31.6±4.41^{b}	35.1±4.77^{a}	28.0±4.90^{b}	35.4±3.81^{a}
Liver	25.1±5.24	25.9±5.12	26.5±3.70	22.6±3.23^{b}	29.1±3.57^{a}

Note: ^{a,b,} Means between districts with different superscript letters are significantly different ($p<0.05$).

The effect of district, genotype and their interactions on carcass quality parameters are presented in Table 2. The effect of genotype was highly significant for all carcass components. Nevertheless, the effect of district was only significant for dressed carcass, dressing percentage, breast meat, drumsticks, wings, skin, backbone, heart and gizzard. The interaction between genotype and district was significant for only neck and backbone.

Table 2. The effect of district, genotype and their interaction on carcass quality parameters (Mean±SD; N=84)

Carcass components	Yeki		Anderacha		Masha		Sources of variation		
	Local	F1-crosses	Local	F1-crosses	Local	F1-crosses	Genotype(G)	District (D)	G*D
Live weight	1645±178^{b}	2328±149^{a}	1578±131^{b}	2339±177^{a}	1605±138^{b}	2403±225^{a}	<.001	0.599	0.438
Dressed carcass	1097±51.2^{b}	1465±38^{a}	1153±80^{b}	1553±104^{a}	1183±77^{b}	1597±100^{a}	<.001	<.001	0.547
Dressing (%)	67.1±4.80^{a}	63.1±2.74^{b}	73.2±2.67^{a}	66.5±2.31^{b}	73.8±1.9^{a}	66.7±2.74^{b}	<.001	<.001	0.115
Breast meat	136±9.88^{b}	166±9.79^{a}	141±10.5^{b}	171±13.5^{a}	148±11.5^{b}	203±11.9^{a}	<.001	<.001	<.001
Thighs	195±15.3^{b}	271±6.64^{a}	200±13.2^{b}	272±15.4^{a}	205±15.5^{b}	271±22.1^{a}	<.001	0.412	0.498
Drumsticks	168±7.76^{a}	230±5.11^{a}	176±19.3^{b}	252±24.2^{a}	181±14.7^{b}	256±18.1^{a}	<.001	<.001	0.166
Wings	99.8±7.40^{b}	135±6.69^{a}	114±12.4^{b}	163±15.4^{a}	117±10.7^{b}	163±13.1^{a}	<.001	<.001	0.084
Neck	57.0±3.59^{b}	82.4±2.98^{a}	63.4±3.79^{b}	81.9±8.46^{a}	63.7±6.19^{b}	81.8±7.84^{a}	<.001	0.095	0.037
Skin	93.8±7.04^{b}	138±4.85^{a}	98.5±3.90^{b}	147±10.6^{a}	98.9±5.06^{b}	147±9.22^{a}	<.001	0.001	0.513
Keel bone	120±5.33	148±5.88	121±6.52^{b}	151±13.5^{a}	121±7.47^{b}	149±8.84^{a}	<.001	0.637	0.814
Backbone	174±9.16^{b}	219±6.35^{a}	177±17.4^{b}	236±10.9^{a}	181±9.49^{b}	244±10.2^{a}	<.001	<.001	0.009
Heart	7.67± 1.10^{b}	11.4±1.28^{a}	8.22±1.24^{a}	12.6±1.32^{a}	8.7±1.35^{a}	12.7±1.95^{a}	<.001	0.006	0.639
Gizzard	23.5±3.63^{b}	33.5±3.02^{a}	28.3±3.61^{b}	34.7±2.29^{a}	32.2±3.05^{b}	38.0±4.44^{a}	<.001	<.001	0.059
Liver	20.8±2.35^{b}	29.5±3.31^{a}	22.8±4.01^{b}	28.9±4.27^{a}	24.1±4.01^{b}	28.8±3.27^{a}	<.001	0.318	0.091

Note: ^{a,b} Means between districts with different superscript letters are significantly different ($p<0.05$).

Except dressing percentage and keel bone, all carcass quality traits in Yeki district were significantly higher for F1 crosses than local chickens. Similar trend has been also found for the other two districts of the same traits. On the other hand, significantly lower dressing percentage value was observed in F1 crosses as compared with local chickens. No significance difference between local and F1 crosses reared in Yeki district was observed for keel bone meat. However, F1 crosses reared in the other two districts had higher keel bone values than the local chickens.

As shown in Table 3, except for dressing percentage, there was a strong positive relationship of live weight with dressed carcass weight, breast weight, thigh weight, drumstick weight, neck weight, skin weight, keel bone weight, backbone weight, heart weight, gizzard weight and liver weights. The dressing percentage negatively and significantly correlated with all carcass components.

Table 3. Pearson correlation coefficients of carcass quality traits (N=84)

	LW	DCW	DP	BT	TH	DK	WG	NK	SN	KN	BN	HT	GD
LW													
DCW	0.96***												
DP	-0.76***	-0.55***											
BT	0.85***	0.91***	-0.44***										
TH	0.96***	0.97***	-0.64***	0.84***									
DK	0.93***	0.98***	-0.54***	0.86***	0.94***								
WG	0.86***	0.95***	-0.38***	0.86***	0.88***	0.94***							
NK	0.91***	0.92***	-0.56***	0.83***	0.92***	0.88***	0.84***						
SN	0.95***	0.98***	-0.59***	0.84***	0.96***	0.95***	0.90***	0.91***					
KN	0.93***	0.96***	-0.58***	0.82***	0.94***	0.94***	0.89***	0.90***	0.93***				
BN	0.93***	0.98***	-0.52***	0.88***	0.93***	0.95***	0.92***	0.88***	0.95***	0.92***			
HT	0.88***	0.91***	-0.50***	0.83***	0.90***	0.87***	0.86***	0.85***	0.90***	0.86***	0.89***		
GD	0.69***	0.78***	-0.23***	0.76***	0.72***	0.73***	0.78***	0.70***	0.72***	0.69***	0.73***	0.73***	
LR	0.73***	0.76***	-0.41***	0.63***	0.72***	0.75***	0.71***	0.71***	0.71***	0.75***	0.68***	0.63***	0.76***

Notes: *** p<.0001, LW = live weight, DP = dressing percentage, DCW = dressed carcass weight, BT = breast, TH = thighs, DK = drumsticks, WG = wings, NK = neck, SK= skin, KN = keel bone, BN = backbone, HT = heart, GD = gizzard, LR = liver.

4. Discussion

In the current study, except for the dressing percentage, the remaining carcass components of local rooster chicken were lower than those of F1-crossbred chickens reared in Yeki, Anderacha and Masha, which could be attributed to the genetic potential of the Sasso breed that has been introduced to the local chicken through crossbreeding.

The live weight (slaughter weight) of the local (1,610g) and F1-crosses (2,357g) was higher than the findings of [11] for indigenous and RIR commercial chicken breeds. On the other hand, the average live weight of the current study is lower than the findings of [12] for indigenous chicken raised in Kashmir. However, the average live weight of male F1-crosses of the current finding is comparable with that of [13] reported for indigenous male chicken in South Africa. The differences in body weight of local scavenging chickens raised in various regions might be due the variations in genetic makeup of chickens, management system and environmental conditions [14, 15].

The dressed carcass weight of local chicken are lower than the F1-crosses and Yeki adult male chicken had lower dressed carcass weight than Anderacha and Masha adult male chicken. These differences might be due to the result of the introduction of improved genetic blood into the local chicken as well as the management, feed type and environmental variations among the districts.

The average dressed carcass weight for local male chickens of the current finding is lower than that of [13] who reported 1,303 and 1,282g for South African Ovambo and Potchefstroom Koekoek indigenous chickens that were reared under intensive management. However, the value was higher than reported by [16] for savannah and forest chickens. Such differences might be due to the genetic makeup, management system, environmental condition and ages of rearing local chickens considered in the study. The observed dressing percentage of 71.4% and 65.4% for the respective local and F1-crossbred chickens was in line with the finding of [17]. However, it is higher than the value reported by [14] for the exotic strains and native chicken ecotypes of Sudan and [18] for the Thai native chickens and their crosses with Barred Plymouth Rock under intensive management system.

The average dressing percentage (71.4%) of local chicken was higher than observed [11], who reported an average value of 65.7 for three chicken ecotypes reared in Northwestern Ethiopia. Furthermore, the average dressing percentage of local chicken in the current study is in line with the findings of [15] for local Ugandan chicken; but was higher than those reported by [19] for Koekoek chickens. This variation might be due to age of the chicken when slaughtered and carcass components that were included in the dressed carcass during the calculation of the dressing percentage. Another appealing finding of the current study is that the dressing percentage of local chickens was significantly higher than that of the F1-crossbred chickens. This phenomenon might be explained by the small slaughter weight of local chickens relative to their dressed carcasses. Moreover, it might be due the presence of more non-edible offal in the carcass of F1-crosses than that of the local chicken.

In general, the average carcass yield of the carcass cuts of local chickens was lower than the F1-crosses, which is apparently attributed to the improved genetic makeup of the Sasso chicken breed. Most of the carcass components in the current study were higher than the findings of [16] and [14] reported for both F1-crosses and native chickens. However, values of different carcass cuts reported by [13] for Ovambo and Potchefstroom Koekoek indigenous chickens in South Africa were higher than those observed in the current study. These variations might be attributed to dissimilarities of chicken ecotypes in their genetic makeup as well as the type of management system used by the producers and or researchers.

5. Conclusion

The F1-crosses were superior in all carcass comments to the local chickens except for dressing percentage, which was highest in the local chickens. The F1-crossbred chickens are recommended to be used as meat or dual-purpose chickens in the study area. However, care must be taken not to completely dilute the local genetic resources through unjustified distribution of exotic chicken breeds in the study area. A comparative on-farm performance study in the adaptability and disease resistibility potentials, preference of the farmers of both genotypes and market acceptability of local chickens, pure Sasso chicken breed and their F1-crosses are recommended as future researchable area.

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