

Morphological and Morphometric Characterization of Indigenous Chicken Populations in Sheka Zone, South Western Ethiopia

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Abstract

The study was conducted in Sheka Zone to characterize phenotypic traits of indigenous chicken populations. Multi-stage purposive random sampling technique was used to collect the data. Visual appraisal was conducted to study morphological traits of indigenous chicken populations. Quantitative data were collected on body weight and other linear morphometric measurements. A total of 720 (240 male and 480 female) chickens were considered for qualitative and quantitative traits studies. The results showed Sheka local chicken possesses normal (93.5%) and silky (6.5%) feather morphology; 86.7% normal, 10.1% Naked-neck and 3.2% crest feather distribution. The dominant shank color was yellow (44.7%) followed by white (28.5%) and gray (16.0%). With regard to earlobe colors, red (60.8%) was the dominant color followed by white (15.6%) and yellow (14.5%). The yellow (44.8%), pink (26.4%) and white (25.4%) skin colors were observed. Single comb type (63.2%) was dominant followed by rose (26.3%) and pea (8.8%). Kokima (13.5%), Kei/red (12.9%), Brown (10.3%), and Netch (8.9%) were the dominant plumage colors. The highest (1.75 kg) adult body weight was obtained from Naked-neck cocks. The average weight of adult chickens in the study zone was 1.55 kg. The overall mean of chest circumference, wingspan and body length were 27.3, 47.6 and 37.9 respectively. Accordingly keel length, shank length, shank circumference, and neck length were, 12.1, 8.5, 4.3 and 16.3 cm respectively. Therefore, the present study suggests that indigenous chicken populations might possess useful genetic potentials for improved productivity under scavenging feed resource-based production systems. Similarly morphological and phenotypic variations have been observed among the indigenous chicken populations; hence an in-depth molecular evaluation is needed to prove the level of genetic differentiation and relationship among them.

Keywords: Indigenous chicken; Sheka; Phenotypic characterization; Morphometric traits

Introduction

More than 90% of the chicken and egg output of the country comes from indigenous chickens kept under the traditional management system [1]. The total chicken populations in the country is estimated to be 56.87 million and of these 95.86% are indigenous which are mainly kept by smallholder farmers in scavenging environments [2]. This indicates the significance of local chickens as potential FAnGR in the country. Indigenous chicken contributes high quality animal protein in the form of eggs and meat for home consumption as well as for sacrifices and are also easily managed by all even the poorest of the poor including women and children [3].

Local chicken are known to possess desirable characters such as thermo tolerance, resistant to some disease, good egg and meat flavor, hard eggshells high fertility and hatchability as well as high dressing percentage [4]. The phenotypic characterization of the domestic animals is also part of the FAO Global Strategy for the management of Farm Animal Genetic Resources and phenotypic characterization based on their observable attributes contributes to breed definition (document diversity within and between distinct breeds), especially populations which are not well defined and it provides an indication of their genetic diversity.

The indigenous chickens of Ethiopia have various names and are characterized on different grounds, as in many other parts of Africa [1]. The unique adaptation features and morphological variations of Ethiopian indigenous chicken population have been recently reported by several scholars i.e., on the basis of plumage color, morphological features, morphometric traits [1,5-7]. Hence these heterogeneous types are reservoirs of genetic materials for genetic studies, improvement and conservation.

The local chickens, which are commonly classified world-wide as non-descriptive types due to lack of information, vary widely in body size, body conformation, plumage color and many other phenotypic characteristics, which is important in livelihood and household food security in rural farm families [8,9]. Information is similarly lacking with detail phenotypic characters of the Sheka area's native chicken population. Thus, it is believed that in such remote areas, genetic originality may still be found. Distinctive breeds', phenotypic characteristic is therefore crucial as a foundation for developing sustainable genetic improvement approaches. Therefore, this study was conducted systematically to characterize and describe the native chicken populations in Sheka zone.

Materials and Methods

Description of the study area

Sheka zone is found in the Southwestern part of Ethiopia in the South Nations, Nationalities and Peoples Region. Administratively Sheka zone has three districts, namely, Masha, Yeki and Andracha, which are divided, into 57 Kebeles. According to the data from the

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Zonal Rural Development Office (RDO) the Zone, lies between 7°12'-7°50' North latitude and 35°10'-35°45' East longitude with an elevation ranging 1001-3000 meters above sea level. The mean annual temperature of the zone ranges between 15.1-27.5°C and the mean annual rain fall ranges between 1172-2200 mm.

Sampling design

The districts found in Sheka administrative zone are Yeki, Andracha and Masha districts. A purposive multi-stage random sampling technique was used in order to determine the number of Kebeles and households to cover all the three districts. Accordingly, 7 Keble's from Yeki, 4 Keble's each from Masha and Andracha districts were purposively selected. From each Keble, 16 households that possess a minimum of 5 matured (one year and above) chickens were selected by purposive random sampling technique. The total numbers of households considered therefore were 240. From each household, 3 matured chickens (1 male and 2 female) sampled. A total of 720 chickens were considered for qualitative and quantitative traits studies.

Data collection on quantitative and qualitative traits

The most important qualitative parameters such as plumage colour (PC), shank colour (SC), feather morphology (FM), feather distribution (FD), skin colour (SkC), ear-lobe colour (ELC), and comb type (CT), were held by visual appraisal as outlined in FAOs guide line for assessment of chicken genetic resources.

Body weight (kg) and other linear measurements of quantitative traits (cm) were taken on both sexes using a hanging balance and a tailor's tape respectively. The linear measurements include body length (BL), chest circumference (CC), and wing span (WS), neck length (NL), shank length (SL), shank circumference (SC), keel length (KL), wattle length (WL), wattle width (WW), comb length (CL) and comb

height (CH). These measurements were taken from 720 adult chickens whose age was one year and above. The birds' age was determined by "recalling method" by the interviewed farmers.

Statistical analysis

All qualitative data were analyzed using descriptive statistics, frequencies and percentages. The Collected quantitative data were statistically analyzed using GLM analysis of variance (ANOVA) procedure. Chi-square (X^2) test was also employed to test the association of different categorical variables included in this study. Correlation analyses were also done to test the relationship between variables. Farther General Linear Models Procedure of SAS (version 9.0) was used to analyze the quantitative data by fitting district as independent variable When F test showed significant; means were compared using Duncan's multiple range tests.

The statistical models used for the study was:

$$Y_{ij} = \mu + A_i + e_{ij}$$

Where: Y_i = the observed i^{th} variables (body weight or linear body measurements) in the i^{th} district

μ = overall mean

A_i = the effect of district ($i=1, 2, 3$)

e_{ij} = random residual error.

Results

Feather morphology and distribution

Of the sampled local chicken populations 92.9%, 94.3% and 93.8% from Yeki, Andracha and Masha districts respectively showed normal feather morphology (Table 1). The percentage of Naked-neck chicken

	Yeki N=336	Andracha N=192	Masha N=192	Total N=720	X^2
Feather morphology					
Normal	92.9	94.3	93.8	93.5	
Silky	7.1	5.7	6.3	6.5	
Feather distribution					25.3**
Normal	86.0	88.0	85.9	86.7	
Naked-neck	13.1	9.4	5.7	10.1	
Crest	0.9	2.6	8.3	3.2	
Shank color					13.8 ^{ns}
White	30.7	28.7	24.5	28.5	
Gray	17	15.6	14.58	15.97	
Yellow	41.4	43.2	52.1	44.7	
Black	4.5	7.8	6.3	5.7	
Blue	6.6	4.7	2.6	5.1	
Earlobe color					15.3 ^{ns}
Red	61.3	57.3	63.5	60.8	
Gray	4.5	6.3	2.1	4.3	
Black	6.3	4.2	4.2	5.1	
White	4.3	17.7	15.6	15.6	
Yellow	13.7	14.6	14.6	14.2	
Skin color					14.5 ^{ns}
Yellow	46.7	43.2	42.7	44.8	
Black	5.7	2.6	0.5	3.5	
White	25.0	25.0	26.6	25.4	
Pink	30.2	29.2	22.6	26.4	
Comb type					10.2 ^{ns}
Rose	19.1	27.1	31.3	26.3	
Single	70.3	60.9	60.4	63.2	
Pea comb	9.5	8.9	7.3	8.8	
Walnut	1.2	3.1	1.0	1.8	

The Chi-Square values denote significant differences between populations/districts ($p < 0.05$); * $p < 0.01$; ns: Not Significant

Table 1: Morphological features of indigenous chicken populations reared in sheka zone.

was higher (13.1%) in Yeki followed by 9.4% in Andracha and 5.7% in Masha districts. The proportion of chickens possessing Naked-neck plumage is decreasing from hot to cold agro-climates.

Shank, skin and earlobe colour, and comb type variation

The proportion of yellow shanks was dominant in all districts with overall mean of 44.7%. Chickens with yellow shanks were highest in Masha district (52.1%) followed by Andracha (43.2%) and Yeki (41.4%) (Table 1). Five earlobe colors namely white, red, gray, black, and yellow were reported of which 63.5% of chickens in Masha district had ear lobes with red color followed by 61.3% and 57.3% for Yeki and Andracha chickens, respectively. About 46.7%, 43.2%, and 42.7% of chickens in Yeki, Andracha and Masha districts, respectively possessed yellow skin color. The current study revealed that single comb type was the dominant comb accounting for 70.3%, 60.9% and 60.4% for Yeki, Andracha and Masha districts, respectively. The proportion of chickens with rose comb was 19.1%, 27.1% and 31.3% for Yeki, Andracha and Masha districts, respectively (Table 1).

Plumage color descriptions of indigenous chickens

As shown in Table 2, about twenty one plumage color patterns were observed in chicken populations reared in Sheka zone. The male (cock) chickens in Yeki district were predominantly characterized by Kei plumage (37.5%) and Netch (9.8%). Different plumage colorations of male indigenous chickens were shown (Figure 1). Female chickens of Yeki district were characterized by Netch and Kokima each (18.8%), Brown (14.7%), Gebsuma (8.0%) and Light-brown (7.6%)

In Andracha district, 15.6, 23.4, 14.1 and 7.8% of males were characterized by Kei, Netch-gebsima, Zigrima, and combinations of

various plumage colours, respectively. In the same district, 18.8, 9.4, 14.8 and 10.9% female chickens were characterized by Kokima, Netch, Brown and Gebsuma plumage colors, respectively. For Masha district, 33, 23, 9.4, and 6.3% of the male chickens were characterized by kei, Zigrima, Netch-gebsima and combination of various plumage colors, respectively. Female chicken were characterized by having plumages of Kokima (19%), brown (16%), Tikur teterima (10%) and Light-brown (8.6%) in this district (Table 2). Different plumage colorations of female indigenous chickens were shown (Figure 2).

Morphometric measurement variation of indigenous chicken

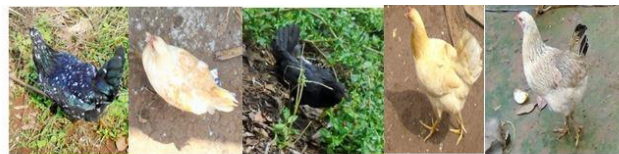
The overall mean live body weights of village chicken in Sheka zone was 1.68 kg for cocks and 1.42 kg for hens with overall mean value of 1.55 kg. There are significant ($P < 0.05$) differences among districts in body weight in which the lowest values being observed in the Yeki district for both sexes (Table 3). The overall mean values of chest circumference, wingspan, body length, keel length, shank length, shank circumference, neck length, comb length, comb height, wattle length and wattle width were 27.3, 47.6, 37.9, 11.7, 8.5, 4.3, 16.3, 4.1, 2.2, 2.7 and 2.3 cm, respectively in the study zone.

The body weight for Yeki, Andracha and Masha cocks were 1.61, 1.74 and 1.69 kg, respectively. The body weight of hens for the respective districts was 1.32, 1.48 and 1.46 kg. The average Chest circumference for both sex of adult chickens were significantly ($p < 0.05$) different among districts being lower in Yeki chickens (28.6 and 25.6 cm for cocks and hens) and higher for Andracha chickens (31.1 m in cocks and 27.1 cm in hens). The lower mean value of Wing span for Yeki chickens was 48.1 cm for cocks and 43.9 cm for hens which significantly ($p < 0.05$) differed from the other districts.

Plumage color (%)	Yeki		Andracha		Masha		Overall N=720	X ²
	M N=112	F N=224	M N=64	F N=128	M N=64	F N=128		
Kokima	-	18.8	3	18.8	3.1	19	13.5	3.4 ^{ns}
Kei	37	3.1	16	3.9	33	6.3	13	35 ^{**}
Brown	-	14.7	1.6	14.8	-	16	10	0.2 ^{ns}
Netch	-	19	1.6	9.4	1.6	6.3	8.9	26.6 ^{**}
Zigrima	8	3.6	14	2.3	23	5.5	6.1	15.6 ^{**}
Gebsuma	-	8	1.6	10.9	6.3	8.6	6.7	3.7 ^{ns}
Tikur	6.5	7.1	7.8	8.6	2.1	4.7	6	6.7 [*]
Netch-gebsima	10	3	23	3.9	9.4	0.8	6.1	14.5 ^{**}
Light-brown	1.8	7.6	-	6.3	-	8.6	5.4	40.8 ^{**}
Tikur-teterima	-	2.8	-	7	-	10	3.6	12.3 [*]
Yellow	-	6.7	-	4.7	-	3.1	3.4	1.9 ^{ns}
Black tail- white	10	-	7.8	2.3	-	2.3	3.6	12.3 [*]
Dark- brown	-	4.9	-	4.7	-	3.1	3.1	0.7 ^{ns}
Seran	8	-	4.7	-	6.3	-	2.2	2.7 ^{ns}
Silver	4.5	-	4.7	-	-	-	1.3	3.1 ^{ns}
Golden-red	2.7	-	1.6	-	6.3	-	1.3	0.7 ^{ns}
Netch-teterima	-	1.8	-	2.3	-	0.8	1.3	1.05 ^{ns}
Deep red	3.6	-	6.3	-	-	-	1.3	15.7 ^{ns}
Tikur-gebsima	3.6	-	1.6	-	1.6	-	0.8	0.9 ^{ns}
Zagolima	2.7	-	4.7	-	-	-	0.8	3.1 ^{ns}
White-pointed	1.8	-	-	-	6.3	-	0.8	5.9 [*]
Key-teterima	-	-	-	-	-	4.7	0.8	

The Chi-square values denote significant differences between populations/districts ($p < 0.05$); * $p < 0.05$; ** $p < 0.01$; ns: Not Significant; F: Frequency; Kei: Complete red plumage; Tikur: Complete black plumage; Netch: Complete white plumage; Seran: White with red strips; Gebsuma: Mixture of grayish and white plumage; Netch-Gebsuma: Mixtures of white and black with varying shades of white dominant; Tikur-Gebsuma: Mixtures of white and black with varying shades of black dominant; Kokima: Grayish strips on brown or reddish background; Zigrima: Black and white spotted feathers on red background; Zagolima: White speckles on black background; Netch-Teterima: White with black or red tins; key Teterima: Red with white tips; Tikur Teterima: Black with white tips; Names of plumage colours are in Amharic, Official working language of Ethiopia.

Table 2: Description of plumage colors of indigenous populations of chickens in the study area.



Tikur-teterima, Netch/white, Tikur/black, buff/yellow and netch-gebsima hens from left to right



Brown, dark brown, Brown Naked-neck, black Naked-neck and Crested hen types from left to write

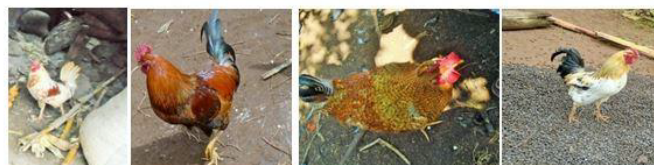
Figure 1: Sample pictures of different plumage colors of indigenous female chickens in Sheka Zone.



Kei/red, tikur/black, Netch-gebsima Naked-necks respectively and Zigrima cocks from left to right



Tikur-gebsima, black tailed white, Silver and Zagolima cocks from left to right



Seran, key/red Golden-red and Netch-gebsima type cocks from left to right

Figure 2: Sample pictures of different plumage colors of indigenous male chickens in Sheka Zone.

Andracha chickens have the highest body length (40.6 cm for cocks and 37.7 cm for hens) whereas Yeki chickens had the lowest value (39.1 cm for cocks and 35.4 cm for ns) which differed significantly ($p < 0.05$). Keel length was significantly ($p < 0.05$) different among districts with the highest values being recorded in Andracha (14.5 cm for cocks and 11.8 cm for hens) (Table 3). The lowest value was recorded in Yeki chickens (12 cm for cocks and 10.5 cm for hens). The average shank length of Andracha chickens for both sex of adult chickens were significantly ($p < 0.05$) different from those of other districts.

The highest mean shank circumference in local cokes was recorded in Andracha chickens (4.9 cm). The Yeki hens had lower mean value of shank circumference (3.7 cm) and differed significantly ($p < 0.05$) from the other districts. The lowest mean value for Neck length, comb length, comb height, wattle length and wattle width 16.0 cm (cocks) and 15.1 cm (hens), 5.1 cm (cocks) and 2.1 cm (hens), 3.1 cm (cocks) and 0.9 cm

(hens), 3.5 cm (cocks) and 1.2 cm (hens) and, 3.1 cm (cocks) and 1 cm (hens) respectively were recorded in Masha chickens.

This study presents that without considering the district variations, the overall mean of body weight, chest circumference, shank length, shank circumference, body length, comb length and height, and wattle length and width for Naked-neck chicken had higher value 1.6 kg, 28.5 cm, 9.4 cm, 4.4 cm, 38.9 cm, 4.5 cm and 2.2 cm, and 3 cm and 2.4 cm respectively than normal and crested feathered indigenous chickens in the study place (Table 4).

Correlation between body weight and other linear body measurements

The highest correlation (0.64) between body weight & body circumference followed by correlation (0.63) between body weight & wing span were estimated. Similarly correlation (0.57) between body weight & shank circumference and correlation (0.56) between body

Variables		Yeki N=336	Andracha N=192	Masha N=192	Over all N=720
		Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Body weight	M	1.61 ± 0.2 ^a	1.74 ± 0.2 ^b	1.69 ± 0.2 ^a	1.68 ± 0.2
	F	1.32 ± 0.2 ^b	1.48 ± 0.1 ^c	1.46 ± 0.2 ^c	1.42 ± 0.2
Chest circumference	M	28.6 ± 1.5 ^a	31.1 ± 2.0 ^b	30.3 ± 1.9 ^c	29.7 ± 2.0
	F	25.6 ± 1.4 ^b	27.1 ± 1.2 ^c	26.3 ± 1.1 ^a	26.5 ± 1.5
Wing span	M	48.1 ± 2.2 ^a	52.5 ± 3.7 ^b	51.7 ± 3.2 ^b	50.7 ± 3.1
	F	43.9 ± 1.5 ^b	44.8 ± 2.2 ^a	44.9 ± 2.2 ^a	44.5 ± 2.1
Body length	M	39.1 ± 1.5 ^a	40.6 ± 1.7 ^b	40 ± 1.7 ^c	39.7 ± 1.7
	F	35.4 ± 1.8 ^c	37.7 ± 1.4 ^a	35.4 ± 1.4 ^b	35.9 ± 1.8
Keel length	M	12 ± 1.14 ^a	14.5 ± 0.9 ^b	13.1 ± 1.2 ^c	13 ± 1.5
	F	10.5 ± 1.0 ^b	11.8 ± 1.2 ^c	11.4 ± 1.2 ^b	11.1 ± 1.3
Shank length	M	8.7 ± 1.3 ^a	10.8 ± 1.2 ^b	9.1 ± 1.3 ^a	9.4 ± 1.6
	F	7.3 ± 0.8 ^b	8.2 ± 0.8 ^a	7.4 ± 1 ^b	7.6 ± 1
Shank circumference	M	4.5 ± 0.3 ^a	4.9 ± 0.5 ^b	4.6 ± 0.6 ^c	4.7 ± 0.5
	F	3.7 ± 0.3 ^b	3.9 ± 0.5 ^a	3.9 ± 0.4 ^a	3.8 ± 0.4
Neck length	M	17.3 ± 1.1 ^a	17 ± 1.1 ^a	16.0 ± 1.5 ^b	16.9 ± 1.3
	F	15.7 ± 1.2 ^b	15.8 ± 1.3 ^b	15.1 ± 1.2 ^a	15.6 ± 1.3
Comb length	M	6.4 ± 1.1 ^a	5.6 ± 1.0 ^b	5.1 ± 0.9 ^b	5.7 ± 1.1
	F	2.7 ± 0.8 ^c	2.7 ± 1.0 ^c	2.1 ± 1.1 ^a	2.5 ± 1
Comb height	M	3.4 ± 0.8 ^a	3.2 ± 0.9 ^{ab}	3.1 ± 0.7 ^b	3.3 ± 0.8
	F	1.2 ± 0.5 ^c	1.1 ± 0.5 ^c	0.9 ± 0.5 ^a	1.1 ± 0.5
Wattle length	M	4.0 ± 0.7 ^a	3.9 ± 0.9 ^a	3.5 ± 0.8 ^b	3.9 ± 0.8
	F	1.8 ± 0.7 ^b	1.4 ± 0.90 ^c	1.2 ± 0.9 ^a	1.5 ± 0.9
Wattle width	M	3.5 ± 0.8 ^a	3.4 ± 0.9 ^a	3.1 ± 0.7 ^b	3.4 ± 0.8
	F	1.5 ± 0.6 ^b	1.2 ± 0.8 ^c	1 ± 0.8 ^a	1.3 ± 0.8

^{a,b,c}Means within raw between districts with different superscripts were significantly different (p<0.05).

Table 3: Body weight (kg) and linear measurement (cm) variations of indigenous chicken populations reared in three districts of Sheka zone.

Morphometric measurements	Sex	Normal feathered	Naked-neck	Crest feathered
Body weight	M	1.64 ± 0.2 ^a	1.75 ± 0.2 ^b	1.68 ± 0.5 ^a
	F	1.35 ± 2 ^a	1.48 ± 0.1 ^b	1.42 ± 0.1 ^a
Chest circumference	M	29.7 ± 0.2 ^a	30.5 ± 1.7 ^b	28 ± 0.2 ^a
	F	26.3 ± 1.5	26.5 ± 1.3	26.7 ± 1.2
Wing span	M	51.0 ± 3.1	51.5 ± 3.3	49.9 ± 0.5
	F	45.8 ± 2.1 ^a	43.5 ± 1.6 ^b	44.5 ± 2 ^a
Body length	M	39.2 ± 1.7 ^a	40.8 ± 1.6 ^b	38.5 ± 2 ^a
	F	34.6 ± 1.7 ^a	37.6 ± 1.3 ^b	35.6 ± 2.1 ^c
Keel length	M	13 ± 1.5	13.7 ± 1.7	12.3 ± 0.5
	F	11.1 ± 1.3	11.2 ± 1.1	11.2 ± 1.3
Shank length	M	8.6 ± 1.5 ^a	10.9 ± 1.5 ^b	8.7 ± 1.2 ^c
	F	7.6 ± 0.9 ^a	7.8 ± 0.9 ^b	7.4 ± 1 ^a
Shank circumference	M	4.6 ± 0.5 ^a	4.8 ± 0.3 ^b	4.7 ± 0.7 ^c
	F	3.6 ± 0.4 ^a	3.9 ± 0.5 ^b	3.7 ± 0.4 ^c
Neck length	M	16.7 ± 1.3	17 ± 1.6	16.8 ± 2
	F	15.5 ± 1.3	15.9 ± 1.2	15.4 ± 12
Comb length	M	5.5 ± 1.1 ^a	6.0 ± 1.1 ^b	5.6 ± 2.1 ^a
	F	2.5 ± 1 ^a	3.0 ± 0.9 ^b	2.3 ± 1.3 ^c
Comb height	M	3.3 ± 0.8 ^a	3.5 ± 0.8 ^b	3.2 ± 0.6 ^a
	F	1.1 ± 0.5	1.3 ± 0.4	1.0 ± 0.7
Wattle length	M	4 ± 0.8	4.2 ± 0.7	3.7 ± 0.3
	F	1.5 ± 0.9 ^a	1.8 ± 0.9 ^b	1.2 ± 1 ^c
Wattle width	M	3.5 ± 0.8	3.5 ± 0.3	3.2 ± 0.6
	F	1.3 ± 0.7 ^a	1.4 ± 0.7 ^{ab}	1.2 ± 0.8 ^b

^{a,b,c}Means within raw between districts with different superscripts were significantly different (p<0.05).

Table 4: Comparison of normal feathered vs. naked neck and crest feathered chickens in body weight (kg) and linear body measurements (cm) in the study area (Mean ± SD).

weight and keel length were also estimated but there were significant moderate correlations between body and all other linear body measurements (Table 5).

Discussion

Feather morphology and distribution

Melesse and Negesse [1] reported that 53, 52, 66, 64 and 54% of Farta, Mandura, Horro, Konso and Sheka indigenous chickens respectively showed normal feather morphology which differs with current result. However, our findings are consistent with the value (94.3%) reported by Melesse and Negesse [1] for Sidama chicken. The finding of Melesse and Negesse [1] for normal feather distribution for Sheka chickens shows higher (96%) than the current value (86.4%); however, it was consistent with those reported by Melesse and Negesse [1] with a value of 86.7%. The proportions of Naked-neck chicken population (3.33%) reported by Melesse and Negesse [1] differed with the result of the current study (10.1%). This suggests that there might be population dynamics between normal and Naked-neck chicken populations in the study area. The existence of higher number of Naked-neck chicken populations in Yeki (lowland) and Andracha (midland) areas is in line with the reports of Melesse and Negesse [1] who pointed out the distribution of Naked-necks were attributed to the lowland environment. Naked-neck gene is described as one of the major genes in indigenous chickens of the tropics that possess desirable effect on heat tolerance [4].

Shank, skin and earlobe colours and comb type distribution

The yellow and white colors were the most frequently observed shank colors which is in good agreement with the reports of Addisu et al. [10] in North Gonder zone and Melesse and Negesse [1] for SNNPRS and Aklilu et al. [5] for Jarso and Horro districts. The largest proportions chickens found with yellow shank color (52.1%) were observed in Masha district which indicates that the presence of herbage feed sources for the formation of carotenoid pigments. When there is black pigment in dermis and yellow in epidermis, the shanks have greenish color and in the complete absence of both of these pigments, the shanks are white [1]. The distribution of white shank color was similar with the earlier reported value of Melesse and Negesse [1] in this study area. Similarly, Emebet et al. [11] reported 32.48, 33.73, 11.40 and 7.75% of chickens with yellow, white, brown and black shank colors, respectively.

The prominent red earlobe (60.8%) in current study was similar with reports of Addisu et al. [10] for North Gonder indigenous

chickens, Aklilu et al. [5] for Horro chickens. Similarly, the reports of Melesse and Negesse [1] showed that 46-48% of Wolayta, Kembata-Tembaro and Sheka chickens possess red earlobe color which differs with the current findings. Overall studied chicken populations from fourteen administrative zones of SNNPRS by these scholars showed that 46.4% red, 34.2% white and 19.4% yellow colors with 57-62% of prominent observed red earlobe color in Dawro, Hadiya and Sidama zones with similar proportions. Similar observation was also reported by Bogale [12] in Fogera indigenous chicken populations.

The difference of earlobe colors might be due the adaptability of chickens for local conditions as suggested by Cabarles et al. [9]. Duguma [13] reported that 54.5, 57.1 and 86.3% of chickens had white earlobe in Horro, Tepi and Jarso indigenous chickens respectively. Similarly, the predominance of whit earlobe was observed by Khadidja et al. [14] and Bett et al. [15], for Asian chickens. In view of this, the Sheka chickens have probably been differently adapted to other village chicken populations which are referred in above literatures. It is apparent that earlobe color is a breed specific trait, although it could affect by nutritional status of birds [1]. All standard chicken breeds that originated from Mediterranean regions (such as leghorn or Ancona exclusively possess white earlobes, whereas other breeds such as Rhode Island Red, New Hampshire have earlobes with red colour [1]. Emebet et al. [11] reported that 30.6, 26.7, 30.6, 0.6 and 0.6% of the local chickens reared in south and south west part of Ethiopia exhibited red, white, write-red, yellow and black respectively.

In the current study four different skin color diversities namely yellow, pink, white, and black colors were observed in the order of their prominence while Melesse and Negesse [1] reported only yellow and white skin colors in the study district. This might be explained by the change of gene expression attributed to the skin colorations over time due to the availability of diversified feed resources for chickens. The report of Addisu et al. [10] for North Gonder and Melesse and Negesse [1] for Farta, Mandura, Horro, Konso and Sheka zones showed higher distribution of yellow skin color which is in good agreement with the current result. In contrary, higher proportions of chickens with white (77.0%) skin color followed by yellow (22.07%) and bluish black (0.9%) was reported in Horro district. The presence and absence of the carotenoid pigments, primarily xanthophylls in the feed is responsible for the observed diversity of skin colour in local chickens as suggested by Melesse and Negesse [1].

The overall mean indicated that 63.2%, 26.3%, 8.8% and 1.8% of the studied chicken populations were characterized by single, rose, pea and walnut comb types respectively. Consistent with our findings, Emebet

	BW	CC	WS	SL	SC	NL	KL	CL	CH	BL	WL	WW
BW												
CC	0.64**											
WS	0.63**	0.75**										
SL	0.44**	0.52**	0.58**									
SC	0.57**	0.63**	0.69**	0.48**								
NL	0.28**	0.31**	0.39**	0.26**	0.32**							
KL	0.56**	0.59**	0.60**	0.5**	0.5**	0.26**						
CL	0.43**	0.56**	0.7**	0.48**	0.56**	0.42**	0.4**					
CH	0.47**	0.6**	0.75**	0.5**	0.57**	0.4**	0.45**	0.8**				
BL	0.4**	0.53**	0.57**	0.46**	0.5**	0.28**	0.49**	0.5**	0.53**			
WL	0.36**	0.51**	0.64**	0.43**	0.51**	0.36**	0.39**	0.76**	0.76**	0.46**		
WW	0.37**	0.50**	0.64**	0.44**	0.52**	0.35**	0.4**	0.75**	0.76**	0.46**	0.96**	

**Correlation is significant at 0.001% level; BW: Body weight, BL: Body length; CC: Chest circumference; WS: Wing span; NL: Neck length; SL: Shank length; SC: Shank circumference; KL: Keel length, WL: Wattle length; WW: Wattle width; CL: Comb length; CH: Comb height.

Table 5: Correlation between body Wight and other linear body measurements.

et al. [11] reported 41.5%, 4.6%, 43.6%, 10.3% rose, strawberry, single and double comb types respectively in South West Showa and Gurage zones. Similar proportions of comb types were also observed in other countries [15-17]. In the intensive management system of Bangladesh, all native chicken have single comb [18]. The high proportion of single followed by rose comb for North Gonder zone local chickens reported by Addisu et al. [10] were agreement with the current result.

Plumage colors variations

Plumage colors have become an important component in breeding practices by influencing both the market demand and supply chains of indigenous chicken breeds in developing countries [1,11,17]. Emebet et al. reported that the predominant plumage color of local chicken population in south west Shewa and Gurage zones of Ethiopia was brown (32.8%), followed by gray mixture (14.4%) and red-brownish with black (14.4%) which agrees with current findings. The great variability of phenotypes might show that the animals are not subjected to selection for their specific function. In the current study, very diverse (twenty one) plumage colorations was observed among the indigenous chickens of Sheka zone from which about thirteen plumage colors were different from those reported for North Gonder zone, North Western Ethiopia and Fogera district [10,12,19]. This might be due to geographical differences of Sheka zone which might have favored lack of environmental homogeneity between locations. The occurrence of different varieties of plumage colours might be due to segregation of alleles from random mating among birds possessing different plumage patterns [16].

Maintaining of this plumage color diversity is indicative of many genes governing the trait in such a way that these colors are certainly due to the presence of genes with major effects and interactions between some of them. Multiple uncontrolled crossbreeding over several decades between animals with different colors of plumage gives birth to other combinations, probably those found in small proportions [14]. Netch plumage color was predominant in lowland (Yeki district) agro-climate zone which might exhibit adaptive trait against hot environment. However Brown, Zigrima, White/Netch, different types of Teterima, black/Tikur, Gebsuma and golden types of plumage colors agrees with the results of Melesse and Negesse [1] in this study area.

Morphometric measurement variations

Body weight: According to the reports of Emebet et al. [1] chickens reared in south west and south part of Ethiopian weigh 1.41 kg which was lower than the current result. Similarly, the mean body weight of local chickens across Sheka zone (1.55) was higher than native chickens of Namibia, Oman, Dekina, Pakistan and Bangladesh, North Gonder, SNNPRS, Fogera and western Ethiopia [1,3,12,15,17,19,20]. The mean body weight of cocks reported by Halima [19], in western Ethiopia and Ssewanyana et al. [21] in Uganda were heavier than observed in the current study. Nevertheless, female adult chickens in the current study have higher body weight than reported by above scholars.

The higher body weight of chickens in Andracha than in other agro-climate might be attributed to reduced efforts needed by these birds to scavenge their feed areas in this district which is characterized by highly productive vegetable cultivation, potentially offering plenty of feeds like kocho firfir in year round. This agro ecology is located in midland which might favor chickens in thermal neutral zone that maintains normal physiological growth without cold and heat stresses. Naked-neck chickens possess higher values of body weight, chest and shank circumferences than normal feathered cocks which is in line with the reports of Melesse and Negesse [1] for chickens reared

in SNNPRS and Ige et al. [22] for Nigerian chicken populations. This study suggests that these ecotypes might perform better than other indigenous chickens.

Chest circumference: The mean value of chest circumference for cocks and hens were lower than those reported by Daikwo et al. [20] for Dekina and for Seri Lanka and Vietnam indigenous chicken populations [15]. However, the current linear measurement values were similar with the report of Eskindir et al. for Horro and Jarso chickens. However, higher than the value, reported by Bett et al. [15] for Bangladesh and Pakistan native adult chickens. Semakula et al. [23] reported that chest circumference produced the most accurate estimate of body weight. Similarly, Ige [24] reported that chest circumference was the reliable trait in genetic study because this trait is a good predictor of body weight [16].

Shan length and circumference neck length and wing span: Emebet et al. [11] reported that chickens reared in South West and South part of Ethiopian had a shank length measure 10.6 cm which is higher value than the results obtained from the current study. The recorded shank length (9.4 cm) for male adult chickens in the present study is also similar to that of Melesse and Negesse [1]. Very long (15.3 cm male, 12.9 cm female) shanks for both sexes were reported from Seri Lanka [16].

The higher shank length for chickens reared in Andracha district may correspond to their higher body weight. Faruque et al. [18] reported that there is a strong positive correlation of shank length with body weight in intensively managed native chickens of Bangladesh. High phenotypic and genotypic correlations of body weight and shank length were also reported in Ghana [25]. The shank length is regarded as a good indicator of skeletal development, which is related to the amount of meat a chicken can carry Melesse and Negesse [1]. Thus the present study suggests that the Naked-neck chickens possess better bon strength, which could be associated with their active walking potential to cover long distance in search of feed as suggested by Melesse and Negesse [1].

The measured shank circumference of male indigenous chickens of Bangladesh as reported by Bett et al. [15] is in agreement with the current value. However, the study conducted by Addisu et al. [10] in North Gonder recorded comparatively lower value (3.81 cm). The current study suggests that large shank circumference observed in Sheka indigenous chickens could be indicator of good meat producing ability (in fact broad shank is the trait of broilers). Female chickens in the current study had also higher shank circumference value than reported by Addisu et al. [10] but lower than those reported by Bett et al., [15]. The recorded mean wing span of Sheka chicken populations was 47.6 cm which is in line with the findings of Guni et al. [26] for chickens reared in the Southern highlands of Tanzania. However, the wing span values in the current study were much higher than those reported by Addisu et al. [10] in North Gonder zone. The observed variation might be due to differences in genotype, feed availability and other environmental factors.

Body and keel lengths: Body length of Sheka chickens in current study is in line with the reports of Aklilu et al. [5] for Horro chicken (40 cm). However, this value was higher than reported by Addisu et al. [10] for chickens reared in North Gonder and Emebet et al. [11] for south west and south part of Ethiopian. On the other hand, the values obtained from the current study were lower than those reported by Faruque et al. [18] in indigenous chickens managed under intensive production system. Sheka adult female chickens had large body length

(35.9 cm) than those reported by Daikwo et al. [20], Aklilu et al. [5] and Addisu et al. [10]. The observed high body length with high body weight in female chickens reared in Sheka zone suggests the existence of a positive relationship between these two traits as reported by Addisu et al. [10].

Semakula et al. [23] reported that keel length of Ugandan chickens was lower than this study value. Similarly the current findings are higher than those reported by Bett et al. [15], Liyanage et al. [16] and Addisu et al. [10]. The keel length reported by Aklilu et al. [5] for Horro and Jarso chicken populations was higher than observed in Sheka chickens [27-29]. The variations of body dimension measurement between different country and age at which measurements were taken might be possible explanations for the observed differences [30-32].

Comb and wattle dimensions: The values obtained from the current study for comb and wattles were comparable to those reported by Aklilu et al. for Horro and Jarso chicken population but were higher than those reported by Daikwo et al. This study revealed that larger ($p < 0.05$) comb and wattle size was recorded in chickens reared in the lowland (Yeki district) and midland (Andracha) agro ecologies which is consistent with the findings of Ige et al. who reported that large combs and wattles are important morphological traits that allow better heat dissipation in the tropical hot environment. Naked-neck chicken's possess higher wattle and comb dimensions than other native chickens might indicate better tolerant for hot agroclimatic condition. Moreover, comb and wattle size was different from those findings reported by Faruque et al. and Addisu et al. which might be due to differences in chicken population, agro-ecological and geographical setups.

Correlation between body weight and linear body measurements: The highest correlation between body weight and other body measurements was agreed with Faruque et al. reported high degree of correlation between body weight and linear body measurements and they observed the best correlation in Naked Neck chicken while Daikwo et al. found body weight of chicken in Dekina highly correlated with back length and body circumference. So, results of the present study and findings of other scientists suggested that selection for any of these linear body measurements will cause direct improvement in body weight.

Conclusion

The findings of this study revealed that normal feather morphology and distribution, yellow shank and red earlobes were the predominant phenotypic traits of indigenous chickens in the study zone. The most prevalent plumage color in all agro-climatic zones was Kei/red males and Kokima in females occurring at comparable proportions. The population of indigenous chickens studied showed heterogeneity in most morphological traits considered. The highest adult body weight was obtained from Naked-neck chicken. The highest body weight of chickens in midland than in other agro-climate was also investigated. The highest importance attached to adaptation traits such as comb length and width, comb type, feather distribution (Naked-neck), yellow shank colors, yellow skin colors and the existence of particular preferences for chickens of traits plumage colors and shank size were also found to have effects on developing new breeds for village chicken production systems. Hence, information on phenotypic performance is important for initiating the new breeding, management improvement and conservation programs. It is thus recommended that the improvement strategies have to consider the traits that favors direct economical importance's received from such chicken population at scavenging environment and in-depth molecular evaluation is needed

to prove the level of genetic differentiation and relationship among them for better standardization of phenotypic descriptors, conservation and genetic utilization.

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