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Qualitative Morphometeric Characterization of Indigenous Chicken of Gash-Barka Region in Eritrea

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Abstract

The study was conducted in three sub-zones of Gash-Barka region of Eritrea from August 2017 to January 2018, to identify and characterize the indigenous chicken based on some phenotypic traits.A total of 111 indigenous chicken owners and 500 indigenous chickens (107 males and 393 females) aged more than six months were considered under field condition to describe ten qualitative traits following FAO 2012 standard chicken descriptors and 150 fresh eggs were used for determination of external egg quality parameters. The parameters examined include plumage color, head shape, comb shape, comb color, eye color, beak color, earlobe color, feather distribution, shank color, spur presence, egg shell color, egg weight, egg length (mm), egg width (mm) and egg shape index (%). The results revealed that most frequent plumage colors are brown and black (22.2%), mixture of brown (17.6%) and black and yellow (15%) plumage colors. Plumage color of indigenous chicken in this study was highly significantly ($P<0.001$) different between sub-zones and sex. Similarly, indigenous chicken possessed flat plain head shape (73.6%), single comb shape (56%), red comb color (97.4%), red eye color (37.6%), brown beak color (40.2%) and white with red earlobe color (45.2%) for head morphology while 88.6% had normal body feather distribution (88.6%), white shank color (27.6%) and without spur presence (79.8%). External egg quality characteristics were not significantly ($p\geq0.05$) different across the sub-zones with over all mean for egg weight (44.22±0.42 gm), egg length (52.72±0.2mm) and egg width (39±0.14mm).Overall mean percentage of egg shape index was 74.01% in the study sub-zones and regarding eggshell color, over-all mean proportion of white eggshell color (71.3%) was most frequent color followed by cream (28%) and brown (0.7%) eggshell colors. Phonotypic variations were observed among the indigenous chicken populations and this information could be useful in an appropriate management, breeding program for selection, utilization and conservation of Eritrean chicken genetic resources.

Keywords: phenotypic traits, external egg quality, indigenous chicken, Gash- Barka, Eritrea

Introduction

Village chicken production is playing an important role in increasing socio-economic status of rural community and employment in rural areas (Mohammed,2018), in the developing countries particularly, indigenous chickens have been used as a source of income, cash reserves, nutrition to the family, for religious ceremonies and celebrations (Kingori *et al.*, 2010). These creatures played pivotal role in capital building up and as an important source of livelihood in the rural set up because of their low input requirements for production, short generation intervals, scavenging ability and adaptability to harsh environment conditions (Apuno *et al.*, 2011).Indigenous chicken may appear to produce less than highly specialized exotic breeds, but they are highly productive in their use of local resources and more sustainable over the long term (Emebet, 2015). Generally, they are characterized by nondescript and hyper-variable phenotypic landscape (Egahi *et al*., 2010; Melesse and Negesse, 2011). Furthermore, Smallholder farmers usually have broad breeding objectives to fulfill their versatile needs (Moges *et al*., 2010), hence they keep flock of diverse phenotypes. Literature throughout Africa revealed that these creatures are pool of heterogeneous population with remarkable genetic variation both within and between ecotype; this is manifested on their morphologies and on their biological performances. In Eritrea poultry production plays an important economic activity and majority of the Eritrean poultry population are of indigenous breeds. However, the population census and distribution pattern is not documented at all. Phenotypic characteristics are very important in describing the uniqueness of animal genetic resources, and providing data for conservation of poultry genetic resources. However, not much is known about the morphological description of indigenous chicken in Eritrea. Hence this study was undertaken with the aim of describing variabilities in the qualitative morphom-eteric characteristics of indigenous chicken in Gash-Barka region.

Materials and Methods

Description of the study areas: The study was conducted in three sub-zones of Gash-Barka zone of Eritrea, namely Shambqo, Molqi and Logo-Anseba. Gash-Barka is located in the western lowlands of the country bordering Sudan to the west and Ethiopia in the south. It adjoins Debub, Maekel and Anseba zones of the country. It lies between 14^0 25' and 15^0 51' north and between 36^0 44'and 38^0 15'east covering an area of about 33,100 km^2, which is about 27% of the whole country. The region is called the "Bread Basket of Eritrea" as it holds more than 60% of the national's livestock wealth and the major cereal producing region (NFIS, 2005). Gash Barka as a region is sub-divided into 14 sub-zones, 187 Kebabis (local administrative areas) within which there are 837 villages. With the exception of sub-zone Dighe, Logo Anseba and Molqui where the terrain is rather mountainous and hilly that form part of the highland, the remaining sub-zones belong to the western lowland.

The zone receives mean annual rainfall that ranges from below 300mm in the north-western lowlands to above 700mm per annum in the southern part. Generally, the amount and frequency of the rain decreases from humid south to semi-arid north of the zone. Frequent high winds, low relative humidity and little cloud cover results in high potential evapo-transpiration. The mean monthly air temperature of the Zone ranges between 23^0C to 29^0C. The average duration of sunshine is between 10 to12 hours daily.

However, they experience warmer temperature (MOA, 2006).

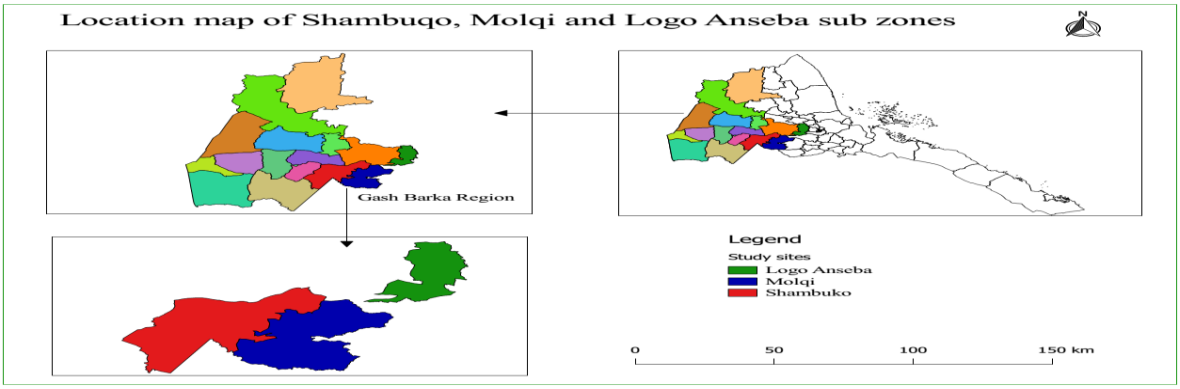

Figure 1: Map of the study area

The altitude of the zone varies between 630-2300 meters above the sea level. Gash-Barka as a zone can be divided into three distinct areas based on altitude. Theseare: The Highland (2000-2370 meters above sea level) that consists mainly of the high grounds that include parts of sub-zones Logo-Anseba, Molqi andDighe. The Midland (1500-2000 meter above sea level) that includes parts of sub-zones Logo-Anseba andMolqi, BarentuLae'lay Gash, Guluj, Shambqo, Mogolo, Gogne and Haikota. The Lowland (630-1500meters above sea level) consists of sub-zones Akurdet, Forto, Mensura, Tesseney and parts of Haikota and Dighe.

Sampling Design and Procedure

A multi-stage sampling procedure (purposive and random) was employed to select both sampled subzones and villages. Three sub-zones (Shambqo, Molqi and Logo-Anseba) and 35 villages (11, 13 and 11 villages from Shambqo, Molqi and LogoAnseba, respectively) were purposively selected based on accessibility, indigenous chicken population density, less distribution of exotic chicken lines and huge ecological variations. From the 35 villages a total of 111 households having chickens (37households from each subzones) were randomly sampled for interview from the selected villages. Size of households per village was determined upon the size of a village based on images obtained from Google Earth (2017).

For phenotypic measurements, a total of 500 indigenous chickens (393 females and 107 males) of six months of age or older from each of the selected sub-zones 180(140 females and 40 male) chickens from Shambqo and Molqi each and 140 (113 females and 27 male) from Logo-Anseb) were randomly selected and sampled. For morphological data collection, more households were used in addition to the sampled households for survey purpose; this was because 500unrelated matured chickens were not found in the 111 household during the time of study.

Methods of Data Collection

Morphological data: Data that was collected on morphological variables were adapted from chicken breed descriptor lists developed by FAO (2012). Visual observation and morphological features were recorded for phenotypic characterization of each indigenous chicken population. Qualitative traits such as plumage color, head shape, comb shape, comb color, eye color, beak color and earlobe color, feather distribution,

shank color and spur presence were observed and collected through visualization and by taking picture of each surveyed indigenous chicken that includes a total of 500 indigenous chickens (393 females and 107 males) which follows the FAO descriptors for chicken genetic resources.

Focal group discussions were held in each (three per sub-zone) of the selected sub-zone. The groups were composed of women, village leaders/administrator, key informants and socially respected individuals who are known to have better knowledge regarding indigenous chicken production system in that locality. Discussions were mainly focused on indigenous knowledge's regarding chicken management of breeding, peculiar characteristics of the local indigenous chicken ecotype and trait preference.

Evaluation of external egg quality: A total of 150 fresh eggs (50 eggs from each three sub-zones) were selected randomly for external egg features in their respected vicinity. For this study five external egg quality parameters were considered, that includes egg shell color, egg weight (gm), egg length (mm), egg width (mm) and egg shape index (%). Eggs were first visually assessed for egg shell color and then weighed on an electronic digital balance to determine their weights. Subsequently, egg length and width were measured by slide caliper. The shape index of an egg was measured for each egg by using the egg width and length with the help of the formula as described by Reddy *et al*. (1979).

$$\text{Egg Shape Index (\%)} = \frac{Egg\ width}{Egg\ length} \times 100$$

Data Analysis and Interpretation: All data were coded and recorded in Microsoft excel (2010) sheet. Statistical analyses were made separately for male and female chicken on variables that varied on sex; otherwise the data were merged and analyzed together. All the surveyed data were analyzed using Statistical Package for Social Sciences (SPSS) Version 23 (2015).

Descriptive statistics such as mean, standard error, frequency and percentage were calculated. The mean and SE for numerical survey data were subjected to analysis of variance (ANOVA) using the General Linear Model (GLM) procedure of SPSS.

Chi-square test (χ^2) was employed to test the assumption of equal proportion between the categorical variables and multiple correspondence analyses was carried out on qualitative traits. χ^2 and frequency count were used to analyze none-parametric characteristics or traits (to estimate the association between qualitative characteristics). This analysis followed the procedure of Marascuilo (1966) to determine which pairs of sub-zone have statistically differing in qualitative traits proportions.

Model statement used to investigate the effects of sub-zone difference on external egg quality characters were analyzed using Univariate Analysis with the following model

$$Y_{ijk} = \mu + A_i + \varepsilon_i$$

Where Y_{ijk}: the value of the respective variable mentioned above pertaining to the i^{th} sub-Zone (i=3, Shambqo, Molqi and Logo-Anseba)

μ: overall mean of the respective variable,

A_i: Effect of the i^{th} sub-zone (i=3, Shambqo, Molqi and Logo-Anseba) on the respective variables

Ɛij: residual error term

Results and Discussion

Qualitative Characteristics

Plumage colors: The result revealed that there were a total of 15 distinct plumage colors in all studied sub-zones with brown and black (22.2%), mixture of brownish color (17.6%) and black and yellow (15.0%) were the predominant plumage colors. Dominance of brown and black plumage color in this study is in agreement with finding of brown

and black (mixed two colors) as the dominant plumage color of Kuchi indigenous chicken ecotype of Kenya (Chesoo *et al*., 2016). Nevertheless, considerable numbers of chickens in this surveyed sub-zones showed heterogeneity and have diverse plumage color like white, golden yellow, black, red & black, red or red brown, wheaten, multicolor, white-spotted brown, white and black, red & white, white and golden yellow and brown yellow which accounted for 0.4%, 0.6%, 1.8%, 12.4%, 4.6%, 8.0%, 10.2%, 2.2%, 2.6%,1.2%, 0.2% and 1.0%, respectively (Table1).

Table 1: Plumage color (frequency, %) variation of indigenous chicken in three sub-zone of Gash-Barka region: Effect of sub-zone and sex

Plumage color	Sub-zone effect			χ^2	P-value	Sex effect		χ^2	p-value	Over-all F (%)
	Shambqo F (%)	Molqi F (%)	Logo-Anseba F (%)			Male F (%)	Female F (%)			
White	2(1.1%)	-	-			-	2(0.5%)			2(0.4%)
Golden yellow	3(1.7%)	-	-			-	3(0.8%)			3(0.6%)
Black	5(2.8%)	-	4(2.9%)			-	9(2.3%)			9(1.8%)
Black & Yellow	23(12.8%)	23(12.8%)	29(20.7%)			-	75(19.1%)			75(15.0%)
Brownish	44(24.4%)	32(17.8%)	12(8.6%)			3(2.8%)	85(21.6%)			88(17.6%)
Red & Black	18(10.0%)	28(15.6%)	16(11.4%)			62(57.9%)	-			62(12.4%)
Red or Red brown	10(5.6%)	12(6.7%)	1(0.7%)			18(16.8%)	5(1.3%)			23(4.6%)
Wheaten	13(7.2%)	14(7.8%)	13(9.3%)			-	40(10.2%)			40(8.0%)
Multicolor	15(8.3%)	12(6.7%)	24(17.1%)	75.807	0.001	13(12.1%)	38(9.7%)	391.076	0.001	51(10.2%)
White-spotted Brown	7(3.9%)	1(0.6%)	3(2.1%)			-	11(2.8%)			11(2.2%)
White & Black	3(1.7%)	3(1.7%)	7(5.0%)			-	13(3.3%)			13(2.6%)
Brown & black	31(17.2%)	54(30.0%)	26(18.6%)			1(0.9%)	110(28%)			111(22.2%)
Red & white	1(0.6%)	1(0.6%)	4(2.9%)			5(4.7%)	1(0.3%)			6(1.2%)
White & golden yellow	1(0.6%)	-	-			-	1(0.3%)			1(0.2%)
Brown yellow	4(2.2%)	-	1(0.7%)			5(4.7%)	-			5(1.0%)
N	180	180	140			107	393			500

F= frequency, χ^2 = Pearson chi-square, N= number of observation

Similarly, Duguma (2006) reported very diverse plumage coloration in indigenous chickens of Ethiopia and concluded that diversity in plumage color is a feature for camouflaging, adaptability and survival. Diverse plumage coloration could possibly be explained by the number of genes determining feather colors and patterns and in the absence of selection on a preferred phenotype, they do segregate in the population (Crawford, 1990). On the other hand, Adaption of indigenous chicken to microbial infections especially from bacteria which degrades feather pigments results in different feather colors. Additionally, different plumage colors may be due to the adaptive significance in the thermoregulation under tropical conditions (Goldstein *et al*., 2004). However, plumage color heterogeneity is among the traits that characterize Eritrean indigenous chickens and thus regarded as reservoir of gene pool for conscious selection and breeding program for a desired trait.

Plumage color of indigenous chicken in this study was highly significantly ($P<0.001$) different between sub-zones and sex. As presented in Table1 indigenous chicken population in Shambqo sub-zone were characterized by brownish (24.4%) plumage color followed by Mixture of brown and black (17.2%) and black and yellow (12.8%) colors. In Molqi sub-zone, indigenous chickens were characterized by brown and

black (30%) followed by brownish (17.8%) and red with black (15.6%) plumage colors. While the indigenous chicken populations of Logo-Anseba were characterized by black and yellow (20.7%), brown with black (18.6%) and multi-colored (17.1%) plumage colors.

Throughout the studied sub-zones, indigenous cocks were characterized by red and black (57.9%) plumage color while indigenous hens were characterized by brown and black (28%) plumage color (Table1). Preference of the people in the study area for red and red brown plumage might also account for the predominant occurrence of the colors since plumage color might influence consumer preference and utilization. The result of this study for dominance of red plumage colored indigenous cock is in agreement with reports from central and southern zone of Tigray, (Mearg, 2016 and Hailemichael, 2013), northern Shewa, Oromia regional state (Sena, 2017) and northern Gonder (Addis and Malede, 2014 and Netsanet, 2017). However, Wani *et al*. (2014) reported that majority of the indigenous cocks in south Kordofan state of Sudan have mixed plumage color.

Figure 2. Brown and black plumage color

Figure 3. Red/red brown plumage color

Head shape:

Few indigenous chickens in the study area had tuft of feathers on their heads as shown in (Figure2). The variation in head shape was significantly ($P<0.05$) different between the studied sub-zones as well as highly significantly ($P<0.01$) differ across the sex. Out of the total indigenous population studied 26.4% had crested head shape while the remaining 73.6% had flat plain. Across the surveyed administrative sub zones, crested head shaped indigenous chicken population were predominantly noticed in Molqi (33.3%) administrative sub-zone followed by 22.9% of Logo-Anseba and the 22.2% of Shambqo. The remaining proportion which is 66.7%, 77.1% and 77.8% were flat plain head shaped in Molqi, Logo-Anseba and Shambqo, respectively. Group discussion results revealed that villagers in Molqi administrative sub-zone believe that crested head shape indigenous chicken had better hatchability percentage over the flat plain head shaped chickens. This result of head shape shows in agreement with finding of Emebet *et al.* (2014) who reported that plain head (72.8%) is the predominant head shape in south west and south parts of Ethiopia. In chickens Crest (Cr) is an autosomal incompletely dominant mutation that causes a tuft of elongated feathers to sprout from the head,

with homozygous individuals often exhibiting a more developed crest than heterozygotes. The phenotype shows a degree of sexual dimorphism, with males exhibiting more voluminous crests than females. Homozygosity for Crest has been associated with cerebral hernia that causes a malformation of the cranium (Wang *et al*., 2012).

Figure 4: Crested head shaped indigenous chickens

Comb types: In this study, seven comb types were observed in three administrative sub-zones. Generally, the major comb types found in the study area were single (56.0%), rose (27.0%), pea (16.0%), buttercup (0.4%), carnation (0.2%), cushion (0.2%) and strawberry (0.2%). There was highly significant difference (P<0.001) in comb type across the three administrative sub-zones and between sex of the indigenous chicken population. Among the administrative sub-zones single comb type is dominant with 64.4%, 59.3% and 45% of all the chickens in Shambqo, Logo-Anseba and Molqi, respectively. Rose comb type was found second frequent in all the three sub-zones with 36.1%, 27.9% and 17.2% of the whole indigenous chicken population in Molqi, Logo-Anseba and Shambqo, respectively (Table 2).

These observations agreed with the findings made by Wani *et al*. (2014) which showed that among the four comb type observed, single comb was the most frequent comb type in south Kordofan state of Sudan. Banarjee (2012) and Cabarles *et al*. (2012) showed that single comb is the most common comb type in tropical regions such as India and Philippines regions. This could be because of the fact that the presence of single comb helps to reduce 40% of body heat, hence advantages in tropical conditions (Duguma, 2006). There is also highly significant difference (P<0.001) in comb type between cock and hen of indigenous chickens in the studied sub-zones. Both males and females in the studied sub-zones are dominated by rose (52.3%) and single (59.0%) comb type respectively.

Based on the group discussion made, villagers collectively (for pea and rose comb types) call them double comb type in local language called "*DIRB*" and believe that males with double comb type are better for breeding and mating over the single comb type counterpart. However, numerous reports have documented concerning reduced male fertility associated with the Rose-comb allele (Dahloum*et al*., 2016) and regarding the mating behavior of the rose comb type chicken, out of the three comb genotype (homozygous rose (RR), heterozygous rose (Rr), and single comb (rr)), Crawford and Smyth (1963) found that single comb male chicken mated most often followed by Rr chicken male and then RR male chicken.

Table 2: Head morphology of indigenous chicken in three sub-zones of Gash-Barka region: effect of sub-zone and sex

Qualitative traits	Sub-zone effect					Sex effect				Over-all F (%)
	Shambqo F (%)	Molqi F (%)	Logo-Anseba F (%)	X^2	p-value	Male F (%)	Female F (%)	X^2	p-value	
Head shape										
Crest	40(22.2)	60(33.3%)	32(22.9%)	6.975	0.031	16(15%)	116(29.5%)	9.180	0.002	132(26.4%)
Flat plain	140(77.8)	120(66.7)	108(77.1)			91(85%)	277(70.5%)			368(73.6%)
Comb shape										
Single	116(64.4%)	81(45%)	83(59.3%)			48(44.9%)	232(59.0%)			280(56.0%)
Rose	31(17.2%)	65(36.1%)	39(27.9%)			56(52.3%)	79(20.1%)			135(27.0%)
Pea	31(17.2%)	32(17.8%)	17(12.1%)			1(0.9%)	79(20.1%)			80(16.0%)
Carnation	1(0.6%)	-	-	26.730	0.008	1(0.9%)	-	62.856	0.001	1(0.2%)
Cushion	1(0.6%)	-	-			-	1(0.3%)			1(0.2%)
Buttercup	-	1(0.6%)	1(0.7%)			-	2(0.5%)			2(0.4%)
Strawberry	-	1(0.6%)	-			1(0.9%)	-			1(0.2%)
Comb color										
Red	175(97.2%)	176(97.8%)	136(97.1%)			107(100%)	380(96.7%)			487(97.4%)
Brown	2(1.1%)	-	-	4.068	0.397	-	2(0.5%)	3.634	0.163	2(0.4%)
Black	3(1.7%)	4(2.2%)	4(2.9%)			-	11(2.8%)			11(2.2%)
Eye color										
Pale gold	4(2.2%)	10(5.6%)	2(1.4%)			1(0.9%)	15(3.8%)			16(3.2%)
Orange	50(27.8%)	63(35%)	46(32.9%)			37(34.6%)	122(31%)			159(31.8%)
Yellow	10(5.6%)	21(11.7%)	10(7.1%)	24.016	0.008	10(9.3%)	31(7.9%)	23.965	0.001	41(8.2%)
Red	70(38.9%)	55(30.6%)	63(45.0%)			54(50.5%)	134(34.1%)			188(37.6%)
Black	2(1.1%)	4(2.2%)	2(1.4%)			1(0.9%)	7(1.8%)			8(1.6%)
Brown	44(24.4%)	27(15%)	17(12.1%)			4(3.7%)	84(21.4%)			88(17.6%)

F= frequency, χ^2 = Pearson chi-square

Both types of rose comb males mated significantly less often than single comb males. They also found that RR males were somewhat less effective at courting. Although homozygotes and heterozygotes roses are phenotypically indistinguishable, there were significant behavioral differences between the two. It seems likely that the behavioral differences are linked to the alleles for rose and single combs (Crawford and Smyth 1963). According to the study made by Egahi*et al*. (2010) and later agreed by study made in Namibia (Eiki, 2016) most chickens with pea and rose combs were found with traditional worshippers in Nigeria and Namibia and this could be the reason for high population of rose comb males in the study sub-zones.

Comb color: Regarding the comb color, there is no significant difference (P>0.05) between the studied administrative sub-zones as well as between sexes of indigenous chicken population (Table 2). Red is the predominant comb color in all the surveyed sub-zones (Shambqo (97.2%), Molqi (97.8%) and Logo-Anseba (97.1%)) and in both male (100%) and female (96.7%) indigenous chicken population. Red as a predominant comb color in this study is consistent with results obtained by Dahloum *et al*. (2016) on indigenous chickens of northwest Algeria and it also agrees with results of Guni and Ketule (2013) in Tanzania and Liyanage *et al*. (2015) in Sri Lanka. As the intensity of the red coloration is an indication of the quality of sperm in the case of male birds (Navara *et al.*, 2012), this result indicates that there is probably of good fertility in the birds investigated. Moreover, it is biologically important to study this phenotype because it is an

indicator of chickens' health and egg laying status (Dahloum*et al*., 2016).

Figure 5: Rose comb

Figure 6: Butter cup comb type

Eye color:

Across the entire three sub-zones included in the study, the over-all eye color frequency of the total indigenous chickens was red (37.6%) eye color followed by orange (31.8%), brown (17.6%), yellow (8.2%), pale gold (3.2%) and black (1.6%) eye colors (Table 2). There is significant ($P<0.05$) difference across sub-zones and sex regarding the eye color of indigenous chicken population. Red eye color is predominant in Shambqo (38.9%) and Logo-Anseba (45.0%) administrative sub-zones, while orange in Molqi (35%) is most frequent eye color. This finding is similar with Feyera (2016) who reported that predominant eye color of indigenous chicken population in western Oromia region of Ethiopia is red. Variation in eye color to a large extent depends on the pigmentation (carotenoid pigments) and blood supply to a number of structures within the eye (Eskindir *et al.*, 2013).

Beak color:

In the current study seven beak colors were observed on the sampled indigenous chicken populations (Table3). Brown, horn and yellow beak colors were the dominant colors with frequency of 40.2%, 19.2% and 18.4%, respectively. The beak color in this study differed significantly ($P<0.05$) between sex and across the studied sub-zones. Indigenous cocks were characterized by horn (41.1%) beak color while hens were characterized by brown beak color (43.0%). Dominance of brown beak color in this study was similar with finding that brown color was most frequent beak color among the four genetic types of indigenous chicken in Sudano-Sahelian zone of Cameroon (Haoua *et al*., 2016).

Earlobe color:

Regarding earlobe colors, five colors were observed in the three studied sub-zones (Table3). The white with red (45.2%) earlobe was the most frequent color in the entire population of the surveyed sub-zones followed by equal proportion of white (24.6%) and red (24.6%) colors. In contrast, black (3.0%) and yellow (2.6%) earlobes were observed with a very low proportion in all sampled chicken populations of the study area. According to Cabarles *et al*., (2012) chickens inherited earlobe color from their parents. This result is similar with Eiki (2016) reported that mixture of red and white followed by red and then white are the most frequent earlobe colors in Namibia

Figure 7: Red eye, yellow beak & red and white earlobe

Figure 8: Orange eye and horn beak color

Table 3: Head morphology of indigenous chicken in in three sub-zones of Gash-Barka region: effect of sub-zone and sex

Qualitative traits	Sub-zone effect					Sex effect				Over-all F (%)
	Shambqo F (%)	Molqi F (%)	Logo-Anseba F (%)	X^2	p-value	Male F (%)	Female F (%)	X^2	p-value	
Beak color										
Horn	35(19.4%)	36(20.0%)	25(17.9%)			44(41.1%)	52(13.2%)			96(19.2%)
Black	19(10.6%)	12(6.7%)	23(16.4%)			10(9.3%)	44(11.2%)			54(10.8%)
Yellow	42(23.3%)	40(22.2%)	10(7.1%)			16(15%)	76(19.3%)			92(18.4%)
White	20(11.1%)	16(8.9%)	14(10%)	34.722	0.001	5(4.7%)	45(11.5%)	44.575	0.001	50(10%)
Brown	58(32.2%)	75(41.7%)	68(48.6%)			32(29.9%)	169(43%)			201(40.2%)
Green	3(1.7%)	-	-			-	3(0.8%)			3(0.6%)
gray blue	3(1.7%)	1(0.6%)	-			-	4(1.0%)			4(0.8%)
Earlobe color										
Yellow	6(3.3%)	7(3.9%)	-			3(2.8%)	10(2.5%)			13(2.6%)
Black	7(3.9%)	4(2.2%)	4(2.9%)			-	15(3.8%)			15(3%)
White	51(28.3%)	61(33.9%)	11(7.9%)	40.364	0.001	7(6.5%)	116(29.5%)	72.961	0.001	123(24.6%)
Red	40(22.2%)	37(20.6%)	46(32.9%)			58(54.2%)	65(16.5%)			123(24.6%)
White and red	76(42.2%)	71(39.4%)	79(56.4%)			39(36.4%)	187(47.6%)			226(45.2%)

F= frequency, χ^2 = Pearson chi-square

Body Feather distribution: Feather distribution, shank color and presence and/or absence of spur are summarized in Table 4. Accordingly, majority of the indigenous chicken population in the studied administrative sub-zones had normal (88.6%) body feather distribution, while naked neck, feathered shank and vulture hock body feather distribution accounts for only 5.6%, 5.4% and 0.4% of the total observed population (Table 4). There was significant ($P<0.05$) difference between sub-zones on body feather distribution of indigenous chicken population. But sex had no significant ($P\geq0.05$) influence on body feather distribution of indigenous chicken. The proportion of naked neck is significantly higher in Shambqo (13.9%) comparing to indigenous chicken population of Molqi (1.1%) and Logo-Anseba (0.7%).

Table 4: Qualitative variation (feather distribution, shank color and spur presence) of indigenous chicken of the study

Qualitative traits	Sub-Zone effect					Sex effect				Over-all F (%)
	Shambqo F (%)	Molqi F (%)	Logo-Anseba F (%)	χ^2	p-value	Male F (%)	Female F (%)	χ^2	p-value	
Feather distribution										
Normal	145(80.6%)	162(90.0%)	136(97.1%)			92(86.0%)	351(89.3%)			443(88.6%)
Naked neck	25(13.9%)	2(1.1%)	1(0.7%)			7(6.5%)	21(5.3%)			28(5.6%)
Feathered shank	10(5.6%)	14(7.8%)	3(2.1%)	45.235	0.001	7(6.5%)	20(5.1%)	1.622	0.654	27(5.4%)
Vulture hock	-	2(1.1%)	-			1(0.9%)	1(0.3%)			2(0.4%)
Shank color										
White	45(25.0%)	51(28.3%)	42(30.0%)			37(34.6%)	101(25.7%)			138(27.6%)
Red	13(7.2%)	8(4.4%)	5(3.6%)			11(10.3%)	15(3.8%)			26(5.2%)
Yellow	32(17.8%)	72(40.0%)	14(10.0%)	69.569	0.001	34(31.8%)	84(21.4%)	26.960	0.001	118(23.6%)
Gray blue	42(23.3%)	18(10.0%)	30(21.4%)			9(8.4%)	81(20.6%)			90(18.0%)
Green	36(20.0%)	26(14.4%)	25(17.9%)			13(12.1%)	74(18.8%)			87(17.4%)
Black	12(6.7%)	5(2.8%)	24(17.1%)			3(2.8%)	38(9.7%)			41(8.2%)
spur presence										
Present	37(20.6%)	38(21.1%)	26(18.6%)	0.337	0.845	101(94.4%)	-	464.865	0.001	101(20.2%)
Absent	143(79.4%)	142(78.9%)	114(81.4%)			6(5.6%)	393(100%)			399(79.8%)

χ^2 = chi-square; F= frequency

Based on the result of group discussion held in Shambqo sub-zone, villagers in that sub-zone prefer the meat of naked neck for its test. According to Ige *et al.* (2012), naked neck chickens have 30% less feathers than full feathered chicken. This reduction in feather coverage in naked neck chickens resulted in little protein for feather production and more protein for meat and egg production (Fathi *et al*., 2014).Furthermore, naked neck chickens may perform well at high temperatures because of their potential to spread heat by convection, leading to low heat stress (Ige *et al*. 2012).

Figure 9: Vulture hock male indigenous chicken

Figure 10: Naked neck male indigenous chicken

Shank color According to Cabarles et al. (2012) a combination of pigments in the upper and lower layers of the skin decides shank color in indigenous chickens. The current study noted six shank colors in the indigenous chicken (Table 4). Overall, white shanks (27.6%) were frequent, followed by

yellow (23.6%), gray blue (18.0%) shanks, green (17.4%) shanks, black (8.2%) shanks and red (5.2%) shanks least frequent. There is a significant (P<0.05) difference in shank color across and within the sub-zones and sexes. Dominance of white and yellow shanks in this study agrees with the finding of Hailemicheal et al. (2015) who reported white shank (47.92%) was predominant color of indigenous chicken populations of Raya-azebo in southern Tigray. The shanks and most of the feet are covered with scales of various colors. Yellow is due to dietary carotenoid pigments in the epidermis when melanic pigment is absent. Varying shades of black are the result of melanic pigment in the dermis and epidermis. When there is black pigment in dermis and yellow in epidermis, the shanks have greenish appearance. In the complete absence of both of these pigments, the shanks are white.

Spur presence: Spur presence was not significantly (P>0.05) different among sub-zones while in term of sex the population of indigenous chicken in this study differs (P<0.05) significantly. Spur is prominent in almost all males (94.4% with spur) while it is rudimentary in majority of females (100%). However, Mearg (2016) reported that almost all indigenous chicken sampled had no spurs (91.6%) in central zone of Tigray in Ethiopia.

External egg quality characterization: Egg weight, height, width, egg shape index and color of egg shell are presented in Table 5. The result of this study revealed that egg weight in gm, egg shape index in % and frequency of egg shell color across the surveyed sub-zones were not statistically (P>0.05) different. The overall mean of egg weight was estimated at 44.22gm in the study sub-zones as summarized in Table 5. In accordance to the Indian standards (BIS/ Agmark standards), the egg weight finding of this study was below the standard weight of table egg (58gm) and categorized as small grade (Nilotpal and Samanta,2008). The finding in this study was higher than the 39.89gm egg weight reported in Sudan (Yousif and Eltayeb, 2011). However, this result was lower than the 49.95 and 45.75gm reported in Namibia and Ethiopia by Eiki (2016) and Ahmedin (2014), respectively. Overall mean percentage of egg shape index was 74.01% in the study sub-zones. This result is in line with the ideal egg shape index of 74% in accordance to the Indian standards (BIS/ Agmark standards) which is perfectly oval in shape (Nilotpal and Samanta, 2008). The average egg length in these studied sub-zones was 5.27cm with width of 3.9cm. Egg length of the current result was higher than the 5.09cm egg length reported in Sudan (Yousif and Eltayeb, 2011) and 4.36cm reported in Nigeria (Yakubu, 2010). But the egg length of the current study is lower than the egg length of 5.68cm reported in Namibia (Eiki, 2016). Regarding to the egg width of 3.9cm in the current study is lower than the egg width of 4.23cm reported from Sudan (Yousif and Eltayeb, 2011).

Regarding eggshell color, over-all mean proportion of white eggshell color (71.3%) was most frequent color followed by cream (28%) and brown (0.7%) eggshell colors. There is no significant (P>0.05) difference across the study sub-zones regarding the proportion of eggshell color. Caveroet al. (2012) reported that location in term of agro-ecological difference does not influence eggshell color but a pigment produced in the uterus during shell formation is responsible for eggshell color. Results of the present study confirmed this report because individual hens from similar flock and eggs from similar clutch varied in their eggshell color. Also in according to Banerjee (2012) shell color is not a sign of egg quality or nutrients the egg contains but

plays a major role in marketing because some consumers prefer eggs with certain colors.

Table 5: External egg quality parameters in the study sub-Zones

Parameter	Sub-Zone (Mean±SE)			Over all	F-value	p-value
	Shambqo	Molqi	Logo-Anseba			
Egg weight (gram)	43.38± 0.81	44.2 ± 0.53	45.07± .77	44.22± .42	1.392	0.252
Egg shape index (%)	74.08± 0.54	73.14± .54	74.82± .41	74.01± .29	2.830	0.062
Egg length	52.13±0.31	53.32±0.36	52.7±0.38	52.72±0.20	2.910	0.058
Egg width	38.61±0.28	39±0.19	39.44±0.22	39.± 0.14	3.148	0.046
Egg color N (%)	**shambqo**	**Sub-Zone molqi**	**Logo anseba**	**Over all**	**χ^2**	**p-value**
Brown	0(0%)	1(2%)	0(0%)	1(0.7%)		
Cream	15(30%)	12(24%)	15(30%)	42(28%)	2.503	0.644
White	35(70%)	37(74%)	35(70%)	107(71.3%)		

N=number of observation, χ^2 chi-square, F= frequency, %= percentage, SE standard error

CONCLUSIONS

The study revealed wide variation of qualitative morphological characteristics considered among the indigenous chickens in the study area. The study also showed that the phenotypic variability was affected by both genetic, environmental and sex factors.

REFERENCES

Addis, G., and B. Malede. (2014). Chicken Production Systems, Performance and Associated Constraints in North Gondar Zone, Ethiopia. *Journal of Fisheries Livestock Production*, **2**(2): 2-5.

AbdurahmanAhmedin. (2014). *Study of Production Practice, Fertility, Hatchability and Egg Quality of Rural Chicken in Gorogutu District, Eastern Hararghe, Ethiopia*. MSc thesis.Haramayauniversity, Haramaya, Ethiopia.

Apuno, A. A., S. T. Mbap and T. Ibrahim (2011). Characterization of local chicken (Gallus gallusdomesticus) in Shelleng and Song local government areas of Adamawa State, Nigeria. *Agriculture and Biology Journal of North America*, **2**(1): 6-14.

Banerjee, A. K. (2012). An assessment of vertical integrated contract poultry farming: a case study in Bangladesh. *International Journal of Poultry Science*, **4**(3): 167-176.

Cabarles, J. C., A. L. Lambio, S. A. Vega, S. S. Capitan and M. S. Mendioro. (2012). Distinct morphological features of traditional chickens (*Gallus gallusdomesticus* L.) in Western Visayas, Philippines. *Animal Genetic Resources*, **51**(1):73–87.

Cavero, D., M. Schmutz, W. Icken and R Preisinger (2012). Attractive eggshell color as a breeding goal. *Lohmann Information*, **47**(2):15-21.

Chesoo, B. K., G. W. Oduho and D. K. Kios. (2016). Assessment of Morphological Characteristics of Kuchi Indigenous Chicken Ecotype of Kenya. *African Journal of Education, Science and Technology*, **3**(1): 39-48.

Crawford, R. D. and J. R. Smyth. (1963). The influence of some genotype on mating behavior in the domestic fowl. *Poultry Science*, **42**(2): 115-122.

Crawford, R. D. (1990). Origin and history of poultry species. In: R. D. Crawford (edns) *Poultry Breeding and Genetics*. Elsevier science publishers, Amsterdam, Netherlands.

Dahloum L., N. Moula, M. Halbouche, and S. Mignon-Grasteau. (2016). Phenotypic characterization of the indigenous chickens (*Gallus gallus*) in the northwest of Algeria. *Archives of Animal Breeding*, **59**(1): 79-90.

Duguma, R. (2006). Phenotypic characterization of some indigenous chicken ecotypes of Ethiopia. *Livestock Resource and Rural Development*, **9**(1): 18.

Egahi, J. O., N. I. Dim, O. M. Momoh and D. S. Gwaza. (2010). Variations in qualitative traits in the Nigerian local chicken. *International Journal of Poultry Science*, **9**(1): 978– 979.

Eiki, N. (2016). *Determination of phenotypic characteristics, production systems, productivity and contribution of local chickens to households in north-central Namibia*. M.Sc. thesis. University of South Africa, South Africa.

Emebet, M., H. Singh, T. Sisaye and A. M. Johansson. (2014). Phenotypic Characterization of Indigenous Chicken Population in South West and South Part of Ethiopia. *British Journal of Poultry Sciences*, **3**(1): 15-19.

Emebet, M. (2015). *Phenotypic and genetic characterization of indigenous chicken in south west Shewa and Gurage zones*. Ph.D. thesis, Addis Ababa University, Addis Ababa, Ethiopia.

Eskindir, A., K. Kefelegn, D. Tadelle and A. K. Banerjee. (2013). Phenotypic characterization of indigenous chicken population in Ethiopia. *International Journal of Interdisc.Multidisc. Stud*. **1**(1): 24–32.

FAO (Food and Agricultural Organization). (2012). Phenotypic Characterization of Animal Genetic Resources. FAO Animal Production and Health Guidelines No. 11. Rome

Fathi, M., A. Galal, S. El-Safty and M. Mahrous. (2014). Naked neck and frizzle genes for improving chickens raised under high ambient temperature: Blood parameters and Immunity. *World's Poultry Science Journal*, **70**(1):165-172.

Feyera, B. E. (2016). Phenotypic characterization of indigenous chicken and their production system in GobuSayo, BakoTibe and Danno districts of western Oromia, Ethiopia. M.Sc. Thesis, Haramaya University, Haramaya, Ethiopia.

Google Earth pro. (2017). Version 7.3.0 Available at: http://www.Earth.Google.com/download- earth.htm. [access: 5 May 2017]

Goldstein, G., Flory, K., Browne, B., Majid, S., Ichida, J. M. and Burtt, J. E. H. (2004). Bacterial degradation of black and white feathers.*Auk* **121**(1): 656–659.

Guni, F. S. and A. M. Katule. (2013). Characterization of local chickens in selected districts of the Southern Highlands of Tanzania: qualitative characteristics. *Livestock Resource Rural Development*, 25(9).

Hailemichael, N. (2013). *On-farm phenotypic characterization of indigenous chicken and chicken production systems in southern zone of Tigray, northern Ethiopia*.

M.Sc.Thesis. Haramaya university, Haramaya, Ethiopia.

Hailemichael, N., K. Kefelegn and A. Negassi. (2015). Survey on Indigenous Chicken Production and Utilization Systems in Southern Zone of Tigray, Northern Ethiopia. *Food Science and Quality Management*, **45**(1): 91-99.

Haoua, M.T, M.Y Poutougnign, T.C Keambou and Y. Manjeli. (2016). Morpho-biometrical diversity of the indigenous chicken's population in the Sudano-sahelian zone of Cameroon. *Scientific Journal of Animal Science,* **4**(11):133-154

SPSS (Statistical Packages for Social Sciences). (2015). IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corporation.

Ige, A.O., A.E. Salako A. Yakubu and S. A. Adeyemi. (2012). Qualitative Traits Characterization of Yoruba and Fulani Ecotype Indigenous Chickens in Derived Savannah Zone of Nigeria. *International Journal of Poultry Science*, **11**(10):616-620.

Kingori, A. M, A. M. Wachira and J. K. Tuitoek. (2010). Indigenous Chicken Production Kenya. *International Journal of Poultry Science*, **9**(1):309-316.

Liyanage, R. P., C. M. B. Dematawewa and G. L. L. P. Silva. (2015). Comparative study on morphological and morphometric features of village chicken in Sri Lanka. *Tropical Agricultural Resource*, **26**(1): 261–273.

Marascuilo, L. A. 1966. Large-sample multiple comparisons. *Psychology Bulletin*, **65**(1):280-290.

Mearg, F. (2016). *Phenotypic characterization of local chicken ecotypes in the central zone of Tigray in northern Ethiopia*. MSc. thesis, Jimma University, Jimma, Ethiopia.

Melesse.A. and Negesse T. (2011). Phenotypic and morphological characterization of indigenous chicken populations in southern region of Ethiopia. *Animal Genetic Resources*, **49**: 19–31.

MOA (Ministry of Agriculture) for the state of Eritrea. (2006). Zoba background information. Planning and statistics division. Asmara, Eritrea.

Moges F, Mellesse A and Dessie T. (2010). Assessment of village chicken production system and evaluation of the productive and reproductive performance of local chicken ecotype in Bure district, north-west Ethiopia. *African Journal of Agricultural Research*, **5**(13): 1739–1748.

Mohammed Ahmed. (2018). Major constraints and health management of village poultry production in Ethiopia: Review School of Veterinary Medicine Jimma University. 4(1): 1-10

Navara, K. J., Anderson, E. M., and Edwards, M. L. (2012). Comb size and color relate to sperm quality: a test of the phenotype-linked fertility hypothesis. *Journal of Behavioral Ecology*. **23**:1036–1041

Netsanet, T. (2017). *On-Farm Phenotypic Characterization of Indigenous Chicken and their Husbandry and Breeding Practices in Debark and Dabat Districts, North Gondar, Ethiopia*. M.Sc. thesis, Haramaya University, Haramaya, Ethiopa.

National Food Information System of Eritrea. (2005). Baseline Study on Livelihood Systems in Eritrea. Phase

I: Preliminary Identification of Livelihood Systems through Research on Secondary Sources (Draft) Zoba (Region) Gash-Barka. January. Available at http://www.fivims.net/documents/pdf/Livelihood%20Systems%20in%20Zoba%20Gashbarkal%20final%20BPS.pdf [accessed 12 may 2017]

Nilotpal, G. and R. Samanta. (2008). Manual on Avian Production and Management.1st ed. IBDC international book distributing CO., New Delhi.

Reddy, P. M., V. R. Reddy, C. V. Reddy and P. S. P. Rap. (1979). Egg weight, shape index and hatchability in Khaki Campbell duck egg. *Indian Journal of Poultry Science*, **14**(1):26-31.

Sena, T. (2017). Production system and phenotypic characterization of indigenous chicken in three agro-ecologies of north Shewa zone, Oromia regional state, Ethiopia. M.Sc. thesis, Bahir-Dar university, Bahir Dar, Ethiopia.

Wang, Y., Y. Gao, X. Hu and N.Li. (2012). The Crest Phenotype in Chicken is Associated with Ectopic Expression of HOXC8 in Cranial Skin. *PLOS one*, **7**(4):1-11.

Wani, C. E., I. A. Yousif, M. E. Ibrahim, H. H. Musa and K. M. Elamin. (2014). Morphological, reproductive and productive characteristics of Sudanese native chicken. *Animal Genetic Resource*, **54**(1):33-41.

Yakubu, A. 2010. Indigenous chicken flocks of Nasarawa state, Nigeria: Their characteristics, husbandry and productivity. *Tropical and Subtropical Agro-Ecosystems*, **12**(3): 69–76.

Yousif, I. A., and N. M. Eltayeb .2011. Performance of Sudanese Native Dwarf and Bare neck chicken raised under improved traditional production system. *Agricultural and BiologicalJournal of Animal*, **2**(5): 860-866.

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الخواص الظاهرية والنوعية للدجاج البلدي بإقليم قاش بركة في إريتريا

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المستخلص

أجريت هذه الدراسة في ثلاثة مديريات تابعة لإقيلم قاش بركة في إريتريا منذ أغسطس 2017 الي يناير 2018م, لتحديد ووصف الدجاج البلدي مرتكزاً علي بعض الصفات الخارجية. نظرت الدراسة علي عدد 111 شخص مالك للدجاج البلدي و 500 دجاجة بلدية (107 ديوك و393 دجاجة) أعمارهم أكثر من 6 شهور لوصف الخواص الوصفية متبعة طريقة الوصف القياسي للدجاج لمنظمة ال FAO 2012واستخدمت 150بيضة جديدة لتحديد الجودة والقياسات الخارجية.القياسات التي أُخذت تضمنت لون الريش, شكل الرأس, شكل العرف, لون العرف, لون العيون, لون المنقار, لون شحمة الأذن, توزيع الريش, لون الساق, وجود الشوكة في رجل الديك, لون قشرة البيض, وزن البيض, طول البيض (مليمتر), عرض البيض (مليمتر) ودليل شكل البيض (%).أظهرت النتائج بأن معظم الدجاج تتصف لون الريش باللون البني بالأسود (22.2%), بني مخلوط (17.6%), أسود بالأصفر (15%). لون الريش للدجاج البلدي في هذه الدراسة كانت ذو أهمية بالغة (*P<0.001*) ومتفاوتة مابين الأقاليم الثلاثة ومابين نوع الجنس. وايضاً الدجاج البلدي إستولي علي شكل الرأس العادي المسطح (73.6%), شكل العرف المفرد (56%), لون العرف الأحمر (97.4%), اللون الأحمر للعين (37.6%), لون المنقار البني (40.2%), اللون الأبيض بالأحمر لشحمة الأذن (45.2%) للشكل الظاهري (المورفولوجي) للرأس, بينما (88.6%) لديهم التوزيع العادي للريش في أجسادهم, بينما لون الساق (27.6%) و التي ليست لها نتوّات شوكية (79.8%).خواص الجودة الخارجية للبيض لم تكن ذو أهمية معنوية (*p<0.05*) علي مختلف الأقاليم الثلاثة وكان إجمالي المتوسطات لوزن البيض (44.22±0.42جرام), وطول البيض (52.72±0.2مليمتر) و عرض البيض (39±0.14مليمتر). كانت نسبة جميع المتوسطات لدليل شكل البيض في الأقاليم الثلاثة متعلقة بلون قشرة البيض, نسبة جميع المتوسطات لقشرة البيض ذو اللون الأبيض (71.3%) كانت متكررت الألوان من اللون الأصفر الشاحب (28%) و اللون البني (0.7%).كان هنالك تباين مشاهد وواضح للشكل الظاهري لكل عشائر الدجاج البلدي وهذه المعلومات مهمة للإدارة الملائمة, برنامج التربية للإنتخاب, الإستخدام والمحافظة علي الثروات الوراثية للدجاج البلدي الأريتري.