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On farm phenotypic characterization of indigenous chicken ecotypes in west Hararghe zone, Oromia region, Ethiopia

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Abstract

This study was conducted to phenotypically characterize indigenous chicken ecotypes in three districts of West Hararghe Zone, Oromia Region, Ethiopia. The districts were stratified based on agro-ecology into highland, midland and lowland. From each district 4 kebeles were selected and from each kebele 15 households were selected randomly. Phenotypic data from adult chickens (>6 months) were used to generate data on quantitative and qualitative traits from 660 adult chickens (600 females and 60 males). Descriptive statistics, General Linear Model (GLM) and multivariate procedures were used to analyze data. Results from Analysis Of Variance (ANOVA) on continuous variables showed highly significant differences among districts ($p<0.001$) and sex ($p<0.05$). Chi-square test also showed significant difference between districts ($p<0.05$) for most of the categorical variables. Canonical Discriminant (CANDISC) analysis showed quantitative traits and Mahalanobis' distances between districts were highly significant ($p<0.0001$) for female ecotypes indicating the population not to be homogeneous based on their phenotypic features. Thus genetic characterization of the ecotypes is recommended to confirm their genetic distinctiveness so that appropriate selection measures can be undertaken to improve the ecotypes for productive, reproductive and adaptability traits.

Introduction

In Ethiopia, the agricultural sector is a corner stone of the economic and social life of the people. Animal production in general and chicken production in particular plays a socioeconomic role in developing countries [1] and it is not exceptional to Ethiopia where the largest livestock population is found. The livestock sector has been contributing considerable portion and still promising to rally round the economic development of the country (Central Statistical Agency, 2013). According to CSA (2017) 59.50 million chickens are found in Ethiopia of which 94.31, 3.21 and 2.49% were reported to be indigenous, hybrid and exotic, respectively. Indigenous chickens serve as an investment for households in addition to their use as meat and egg sources both for consumption and for selling [2].

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Breeding for high productivity has caused loss of many commercial, research, and indigenous genetic resources. Many breeds are under threats leaving us without having even the very basic information about their characteristics and potential benefits. In such scenario, phenotypic characterization of available ecotypes is vital for proper management of these resources [3]. The first phase of characterization involves the identification of populations based on morphological descriptors that can also provide useful information on the suitability of breeds for selection [4]. However, the phenotypic characteristics of chickens at zonal level in western Hararghe were not undertaken. Hence, there is a need to study phenotypic characterization of chicken ecotypes in Western Hararghe zone. Therefore, the objective of this study was to characterize phenotypic variation of indigenous chicken ecotypes in the Western Hararghe zone.

Material and methods

Description of the study areas

The study was conducted in three districts of west Haraghe zone (Odabultum, Habro and Darolabu). Odabultum district is located at 362 km East of Addis Ababa and 37km from Chiro (Asebe Tefere). It is located at 8° 30′0′′- 90° 0′′N latitude and 40^0 30′ 00′′ E longitudes and altitudinal range is 1040- 2500 m.a.s.l. The annual rain fall range is 700-900mm and annual temperature range 16-24°C (Odabultum district 2017 Agriculture office annual report). Darolabu district is located at 443 km from Addis Ababa and 110 km South of Chiro, West Hararghe Zone town. It is located at 7°52′10′′-$8^0$42′30′′N latitude and 40°23′57′′-41°9′14′′E longitude and elevation ranging from 1350-2450 m.a.s.l. Annual temperature ranges from 14- 26°C and average annual rainfall is 963 mm (darolabu district 2017 Agriculture office annual report). Habro district also located at 404 km east of Addis Ababa and 75 km south of Chiro and it is located at 8^0 30′ 00′′-8°59′ 00′′ N latitude and 40° 21′ 00′′-40° 43′ 00′′ E longitude with altitude of 1300-2400 m.a.s.l with annual temperature ranges 16–20°C and annual average rainfall ranges from 650 to 1000mm (Habro district 2017 Agriculture office annual report).

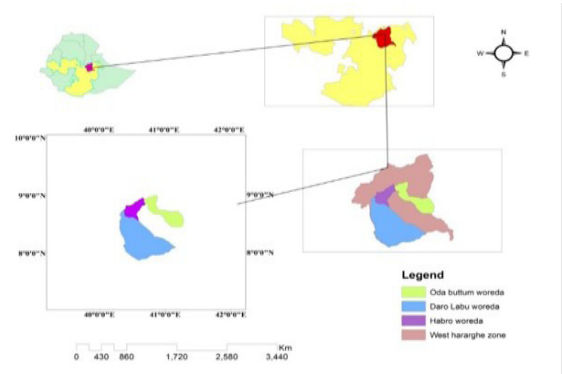

Figure 1: Map of the study areas

Method of sampling and data collection

The information regarding distribution and numbers of indigenous chickens and the presence of special ecotypes in the districts was obtained from office of livestock and fishery experts. The districts were grouped (stratified) in to three different agro ecological zones (highland, Midland and Lowland). Totally 12 (twelve) kebeles, 4 per district were randomly selected for the study. A total of 660 indigenous chickens of both sexes (600 females and 60 males) with an age of greater than 6 months were selected by simple random sampling from the three districts following the guideline of [5]. Quantitative morphological traits (shank length, shank circumference, comb height, comb length, neck length, body length, chest circumference, back length, keel length, wattle length, wattle depth, wing span top side, wing span under side were measured using a textile measuring tape. A hanging spring balance was used to measure live body weight of individual chickens. Qualitative traits (feather distribution, plumage color, skin color, shank color, shank feather, earlobe color, and eye color) were recorded by observation following the FAO descriptors for chicken genetic resources [5].

Statistical analysis

Data from body weight and linear body measurements were analyzed using General Linear Model (PROC GLM) Statistical Analysis System [6]. Mean comparisons were made for variables showing significant differences between sampled ecotypes by using least square significance test. The statistical model for weight and linear body measurement of chickens' was: $\mathbf{Y_{ab} = \mu + S_a + D_b + (S*D)_{ab} + e_{ab}}$ Where: Y_{ab} = the observed body weight or linear body measurements in the, a^{th} sex and b^{th} district μ= over all mean S_a= the effect of a^{th} sex (male or female) D_b= the effect of district (b=1, 2, 3) $(S*D)_{ab}$= sex district interaction effect e_{ab} = Random error

Multivariate analysis: The quantitative variables from female and male chickens were separately subjected to discriminate analysis using PROC DISCRIM procedure [6] to validate the differences between different ecotypes according to morphological or morpho-structural models with relationship between independent and dependent variable. PROC CANDISC [6] procedure was used to perform multivariate analysis to derive canonical variables. The analysis was performed taking individual chicken as a unit of classification. Canonical discriminate analysis measures the strength of the overall relationship between the linear composite of the predictor set of variables.

Results and discussion

Qualitative morphological traits: The result of the study revealed that all indigenous chicken ecotypes had normal feather morphology and predominantly normal feather distribution across the study districts. The feather distributions of the chicken ecotypes in the study area were 75.9-83.6, 3.2-5 and 12.3-20% with normal, necked-neck and crested, respectively (Table 1). This finding is in line with that of [7] who reported overall mean of 83.2% normal feathers and 7.90% necked-neck in southern Ethiopia. Also [8] reported low frequencies of necked neck (0-4%) chickens in indigenous chicken's populations of Ethiopia. The Naked-neck gene is described as one of the major genes in indigenous chickens of the tropics that possess desirable effects on heat tolerance and adult fitness [7,9,10]. Reduced feather coverage improves and enhances heat dissipation and consequently alleviates the effects of heat on chickens reared in hot climates. In addition, reduced feathering saves on feather proteins, which may be used for egg or meat production [11]. The reason for low frequency might those farmers did not prefer the naked neck chickens, ultimately favoring selection against this valuable gene. This implies that this special gene for tropical conditions especially for low land areas is at stake unless measures are taken towards its conservation.

Chickens predominantly had white and black plumage color in Odabultum (22.3%), light brown in Habro (16.4%) and black and brown in Darolabu (13.2%). The pigmentation of hair and feathers is mainly determined by the distribution of two kinds of melanin; eumelanin and pheomelanin that produce coloration ranging from brown to black and yellow to red, respectively. Both melanins are synthesized by melanocytes located in the proximal region of hair and feather follicles [12]. Feather colors and feather patterns are the result of genetic differences (feather color is sex-linked) and the presence of gonadotropic hormones [13]. However, most of the important feather colors in fowl result from the presence of pigments [14]. Plumage diversity was higher in the study districts. Possible explanation is that a specific number of genes determine feather colors and patterns and as described by [15] in the absence of selection on a preferred phenotype especially by color, various colors segregate in the population [16]. Also it might be random mating with respect to plumage color, geographical isolation as well as periods of natural and to some extent artificial selection and interbreeding of different poultry breeds for the past many years.

In this study six comb types were observed in Habro and Darolabu districts and five comb types in Odabultum district. Among these, rose comb type was predominant in all districts followed by single and pea. In the three study districts, all chicken ecotypes had only plane and crest head shape. The variation might be attributed to differences in breed type among the local chicken ecotypes in Ethiopia. Five eye colors were also observed. The dominant eye color in the study districts was orange followed by brown and red. This finding agreed with [17] who reported the dominant orange eye color in Horro and Jarso districts and disagree with that of [18] who reported 95.7 and 92% (overall) red eye color in Eastern and North Gonder zone Amhara region, Ethiopia, respectively. This variation might be a breed's-specific traits, nutritional status, genotype and reflected adaptation fitness to their environment.

Table 1: Qualitative traits variation of indigenous chicken ecotypes

Traits	Districts			X^2	p-value
	Odabultum	Habro	Darolabu		
Feather distribution					
Normal	184 (83.6)	167 (75.9)	182 (82.7)	680.082	.000***
necked neck	7 (3.2)	9 (4.1)	11 (5.0)		
Crested	29 (13.2)	44 (20.0)	27 (12.3)		
Plumage color					
White	19 (8.6)	20 (9.1)	23 (10.5)	177.909	.000***
Black	20 (9.1)	12 (5.5)	19 (8.63)		
Red	12 (5.5)	16 (7.3)	16 (7.3)		
Wheaten	11 (5.0)	12 (5.5)	10 (4.5)		
Brown	13 (5.9)	24 (10.9)	20 (9.1)		
Light brown	5 (2.3)	36 (16.4)	22 (10)		
White and black	49 (22.3)	28 (12.7)	26 (11.8)		
Dark brown	19 (8.6)	16 (7.3)	16 (7.3)		
Yellow and black	38 (17.3)	12 (5.5)	26 (11.8)		
Black and brown	18 (8.2)	32 (14.5)	29 (13.2)		
Yellowish	10 (4.5)	4 (1.8)	6 (2.7)		
Multi-color	6 (2.7)	4 (1.8)	2 (0.9)		
Golden	0	4 (1.8)	5 (2.3)		
Skin color					
White	172 (78.2)	160 (72.7)	158 (71.8)	497.273	***
Yellow	26 (11.8)	30 (13.6)	34 (15.5)		
Blue black	22 (10)	30 (13.6)	28 (12.7)		
Earlobe color					
White	31 (14.1)	18 (8.2)	26 (11.8)	923.327	.000***
Red	32 (14.5)	61 (27.7)	49 (22.3)		
white and red	121 (55.0)	135 (61.4)	127 (57.7)		
Black and red	12 (5.5)	2 (0.9)	8 (3.6)		
Yellow	24 (10.9)	4 (1.8)	10 (4.5)		

Head shape					
Normal/snake head	191 (86.8)	176 (80)	193 (87.7)		Ns
Crested	29 (13.2)	44 (20)	27 (12.3)		
Comb type	N (%)	N (%)	N (%)		
Single	72 (32.7)	53 (24.1)	72 (32.7)	474.255	.000***
Pea	46 (20.9)	52 (23.6)	44 (20.0)		
Rose	87 (39.5)	84 (38.2)	82 (37.3)		
Cushion	12 (5.5)	8 (3.6)	13 (5.9)		
Butter cup	3 (1.4)	4 (1.8)	4 (1.8)		
Duplex	0	19 (8.6)	5 (2.3)		
Eye color					
Orange	102 (46.4)	99 (45.0)	126 (57.3)	654.803	.000***
Brown	90 (40.9)	92 (41.8)	68 (30.9)		
Red	22 (10.0)	18 (8.2)	21 (9.5)		
Flame	6 (2.7)	9 (4.1)	5 (2.3)		
Black	0	2 (0.9)	0		
Shank color					
White	65 (29.6)	48 (21.8)	65 (29.6)	230.873	.000***
Black	32 (14.5)	28 (12.7)	33 (15)		
Yellow	96 (43.6)	122 (55.5)	101 (45.9)		
Green	27 (12.3)	22 (10)	21 (9.5)		

*** highly significant (p<0.05) across the districts; Ns= not significant

Quantitative variation in sampled ecotypes

Effect of district on quantitative morphological traits*:* The phenotypic variation in all quantitative dependent variables of female ecotypes (wing span top side, wing span under side, body weight, body length, chest circumference, shank length, shank circumference, neck length, wattle length, wattle depth, comb length, keel, comb height, keel length and back length) were significantly (p<0.05) affected by district whereas, only wing span top side, wing span under side, body weight, body length, chest circumference, shank length, shank circumference and neck length of male ecotype were significantly (p<0.05) affected by district (Table 2). This variation could be due to breed's-specific traits, nutritional status, genotype and reflected adaptation fitness to their environment [7,19].

The average live body weight of adult male and female chickens of Darolabu district was significantly (p<0.05) higher than Odabultum district chickens. The average live body weight of male ecotype of Odabultum district is comparable to the finding of [20] and lowers than the finding of [17] who reported average body weight of 1.29±0.02, 1.69±0.03 and 1.41±0.04 in north Bench, Horro and Jarso districts, respectively. The average live body weight of male ecotypes of Darolabu and Habro in the current study is comparable to Jarso chickens (1.41±0.04) and lowers than those reported by [17] and Getachew et al (2016) in Horro and South Bench districts whereby the live body weight of adult male chickens was reported to be 1.69±0.03 and 16.01±0.02, respectively [21]. Described that live weight may vary because of inaccuracies of weighing scales, individual differences in measuring accuracy, age of the bird, and season of the year in which the chicken is weighed (during seasons of relatively better feed supply most likely chickens have higher live body weight). The shank length of adult male and adult female chickens of Darolabu district was higher than that of Odabultum and Habro districts. The average shank length of cocks found in this study is in line with the reported average value of 10±0.15 cm for the Jarso ecotype by [17] and longer than the study Nigussie et al (2010) reported an average value of 9.1cm for five chicken ecotypes in Ethiopia, but shorter than the report of 11.3 cm for Horro chicken by [17]. Similarly, the female shank length is in line with the shank length of 9.2, 8.5 and 8.48cm for Horro, Jarso, Sheko chicken ecotypes reported by [17,22], but longer than 6.6-7.8 cm in five chicken ecotypes of Ethiopia [8]. Shank length may be used as` indication of skeletal size and consequently body weight and related parameters. Longer shank length also used for agility to avoid predation, Capacity to withstand diseases and adverse climatic conditions of tropical environment [23]. The longer shank length in this finding indicating there is scope for further improvement through selection.

In case of female chickens, the wattle length, wattle depth, comb length and comb height were significantly (p<0.05) affected by districts as well. The mean wattle length and wattle depth of female chickens of Darolabu district were higher than that of Odabultum district and comb length and comb height of female chickens in Habro district was higher than that of Odabultum and this might be most of the agro ecology in the Darolabu and Habro districts is lowland.Earlier study [24] explained that the comb and wattles have a large role in sensible heat losses. This specialized structure makes up about 40% of the major heat losses, through radiation and convection of heat produced from body surfaces at the environmental temperature above 26.7 ^{0}C.

Table 2: Effect of sex and district on the quantitative traits of indigenous chicken ecotypes (linear body measurements in cm and body weight in kg)

Traits	Sex	Districts (LSM±SE)			Overall	p-value
		Odabultum	Habro	Darolabu		
Wing span top side	Male	38.83±.239[b]	40.53±.58[a]	40.75±.34[a]	40.03±.26	.003
	Female	32.45±.12[c]	34.31±.15[b]	35.57±.20[a]	34.11±.10	.000
Wing span under side	Male	40.13±.334[b]	42.20±.33[a]	42.45±.67[a]	41.59±.30	.001
	Female	33.75± .13[c]	35.63±.15[b]	37.00±.20[a]	35.46±.11	.000
Body weight	Male	1.25±.04[b]	1.38±.04[a]	1.42±.05[a]	1.35±.02	.025
	Female	1.07±.01[c]	1.12±.01[b]	1.15±.01[a]	1.085±.01	.001
Body length	Male	38.23±.55[b]	39.78±.47[a]	39.85±.44[a]	39.28±.29	.036
	Female	34.85±.14[b]	34.85±.13[b]	35.70±.13[a]	35.13±.08	.000
Chest circumference	Male	23.98±.32[b]	25.86±.39[a]	26.44±.47[a]	25.42±.26	.000
	Female	21.81±.08[c]	22.66±.14[b]	23.18±.10[a]	22.55±.07	.000
Shank length	Male	9.95±.20[b]	10.07±.21[b]	10.64±.17[a]	10.22±.12	.033
	Female	8.27±.03[b]	8.33±.04[b]	8.61±.05[a]	8.40±.03	.000
Shank circumference	Male	3.60±.11[b]	4.02±.14[b]	4.11±.136[a]	3.91±.08	.014
	Female	3.02±.014[c]	3.23±.02[b]	3.35±.03[a]	3.2±.014	.000
Neck length	Male	17.30±.23[b]	18.23±.28[a]	18.63±.23[a]	18.05±.16	.001
	Female	15.97±.07[b]	16.51±.07[a]	16.54±.09[a]	16.34±.05	.001
Wattle length	Male	2.96±.20	3.20±.20	3.30±.17	3.15±.10	.30
	Female	.99±.02[b]	1.12±.03[a]	1.13±.01[a]	1.08±.01	.001
Wattle depth	Male	2.51±.26	3.14±.24	3.16±.23	2.93±.14	.110
	Female	.28±.01[b]	.38±.021[a]	.365±.015[a]	.34±.01	.000
Comb length	Male	4.90±.31	4.78±.30	5.15±.37	4.94±.20	.713
	Female	1.25±.02[b]	1.4±.04[a]	1.33±.04[ab]	1.33±.02	.006
Comb height	Male	1.2±.68	1.67±.17	2.25±.27	1.84±.12	0.055
	Female	.31±.01[c]	.40±.02[b]	.46±.02[a]	.40±.01	.000
Keel length	Male	11.14±.34	11.15±.19	11.23±.22	11.17±.15	.967
	Female	8.35±.03[c]	8.57±.05[b]	8.73±.06[a]	8.55±.03	.000
Back length	Male	20.74±.45	21.43±.63	22.20±.28	21.46±.28	.101
	Female	19.31±.12[c]	20.12±.10[b]	20.59±.13[a]	20.01±.07	.000

[a,b,c] means in a row with different superscript letters denote significant differences between ecotypes or sampling districts ($p < 0.05$).

Multivariate analysis: Quantitative variables varied between sex groups thus multivariate analysis was done separately for female and male sample ecotypes.

Discriminant analysis for female: The lower error count estimate was exhibited for Odabultum chicken ecotype and the larger error count was exhibited for Habro chicken ecotype. Most of the chicken ecotype in Habro district was mixed with Darolabu chicken ecotype. The correct classification ranged from 41 to 84 percent in the case of female population (Table 3). The highest correct classification percentages were calculated for Odabultum district and the lowest correct classification percentages were calculated for Habro and Darolabu districts. This might be explained by migration of chickens from Darolabu district to Habro due to market share because Habro is more adjacent to Darolabu district. This result indicated lower correct classification than [25] for Metekel zone, northwestern Ethiopia indigenous chicken female populations for which overall average error count estimate was 1.59 percent for all observations and 98.41 percent of the samples correct classification.

Table 3: Number of observations and percent classified (below in bracket) in different districts for female sample ecotypes using discriminant analysis

From district	Odabultum	Habro	Darolabu	Total
Odabultum	168 (84.00)	26 (13.00)	6 (3.00)	200 (100.00)
Habro	54 (27.00)	82 (41.00)	64 (32.00)	200(100.00)
Darolabu	21 (10.50)	47 (23.50)	132 (66.00)	200 (100.00)

Canonical discriminant analysis for female sample ecotypes: The pair-wise squared Mahalanobis' distances between districts for female sample ecotypes were calculated. The shortest distance (1.19) was measured between Darolabu and Habro districts and while between Habro and Odabultum the distance was (1.95). The longest distance (4.80) was measured between Odabultum and Darolabu (Table 4). In this study larger difference in each morphological variable is observed between Darolabu and Odabultum chicken ecotypes. This shows that female ecotypes have distinct and measurable group differences across the districts.

Table 4: Squared Mahalanobis distance between districts for the female sample ecotypes

From district	Odabultum	Habro	Darolabu
Odabultum	+++		
Habro	1.95	+++	
Darolebu	4.80	1.19	+++

The multivariate statistics for differences between the districts was also highly significant (P<0.0001) in all of the four multivariate tests (Wilks' lambda, Pillai's trace, Hotelling–Lawley trace and Roy's greatest root) for female sample ecotypes (Table 5). Wilks' lambda, the ratio of within-group variability to total variability on the discriminator variables, is an inverse measure of the importance of the discriminant functions [28]. The Wilks' lambda test for the female sample ecotypes was 0.51. This shows that about 50 percent of the variability in the discriminator variables was because of differences within ecotypes and the remaining 50% was due to variation between ecotypes. This, within variability is important for improvement of the local chickens through selection.

Values close to 1 indicate that almost all of the variability is due to within-group differences (differences between cases in each group); values close to 0 indicate that almost all of the variability in discriminator variables is due to group differences [26].

The procedure for canonical discriminant analysis extracted two canonical variates for female sample ecotypes, of which the first canonical variate (can1) accounted for about 91.46 percent of the total variation (Table 5). The second canonical variate (can2) accounted for 8.54 percent of the total variance.

The first canonical variate (can1) separation was due to the high between group variability as Eigen value was higher and the second canonical variate (can2) accounted for within group variability with lower Eigen value. In second canonical variate (can2) separation of Habro district female sample ecotype from Odabultum and Darolabu districts female sample ecotype might be due the existence of high within group variation in Habro district. Hence, Habro district female sample ecotype shares the features of Odabultum and Darolabu female sample ecotypes.

Table 5: Multivariate statistics and F approximations of female ecotypes

Statistic	Value	F-Value	Num DF	Den DF	Pr > F
Wilks' Lambda	0.51	16.50	28	1168	p<.0001
Pillai's Trace	0.52	14.61	28	1170	p<.0001
Hotelling-Lawley Trace	0.89	18.46	28	1026.2	p<.0001
Roy's Greatest Root	0.81	33.87	14	585	p<.0001

Can	Eigen Value	Difference	Proportion	Cumulative	Likelihood ratio	Approximate F value	Num DF	Den DF	Pr > F
1	0.81	0.7349	0.9146	0.9146	0.51	16.50	28	1168	<.0001
2	0.0757		0.0854	1.00	0.93	3.41	13	585	<.0001

Discriminant analysis for male ecotypes: The correct classification ranged from 70 to 90 percent and the highest correct classification percentages were calculated for Odabultum district and the lowest correct classification percentages were calculated for Habro and Darolabu districts (Table 6) and the reason is not different from those of female ecotypes. Most of the chicken ecotype in Habro district was mixed with Darolabu chicken ecotype due to the same reason that mentioned for female. This result indicated similar correct classification with [17] who reported 83.46 % for male ecotypes of Horro and Jarso but lower correct classification than [25] for Metekel zone, northwestern Ethiopia indigenous chicken male populations for which overall average error count estimate was 6.27 percent for all observations and 93.73 percent of the samples correct classification.

Table 6: Number of observations and percent classified (below in bracket) in different districts for male sample ecotypes using discriminant analysis.

From district	Odabultum	Habro	Darolabu	Total
Odabultum	18 (90.00)	2 (10.00)	0 (0.00)	20(100.00)
Habro	2 (10.00)	14 (70.00)	4 (20.00)	20 (100.00)
Darolabu	0 (0.00)	5 (25.00)	15 (75.00)	20 (100.00)

Canonical discriminant analysis for male sample ecotypes: The pair-wise squared Mahalanobis' distances between districts for male sample populations showed that male populations across the districts have distinct and measurable group differences than the female counter part which could be explained by the of small number of sampled male ecotypes (Table 7). The shortest distance (2.19) was observed between Habro and Odabultum districts and the longest distance was observed between Odabultum and Darolabu districts. Similar to female, larger difference in each morphological variable is observed between Darolabu and Odabultum chicken ecotype.

Table 7: Number of observations and percent classified (below in bracket) in different districts for male sample ecotypes using discriminant analysis.

From district	Odabultum	Habro	Darolabu
Oda Bultum	+++		
Habro	2.19	+++	
Daro Lebu	7.95	5.73	+++

The multivariate statistics for differences between the districts was also highly significant ($p< 0.0001$) in all of the four multivariate tests (Table 8). This shows that most (72 percent) of the variability in the discriminator variables was because of differences between ecotypes rather than variation within populations.

The procedure for canonical discriminant analysis extracted two canonical variates for male sample ecotypes, of which the first canonical variate [29] accounted for about 81.40 percent of the total variation (Table 8). Like the female sample ecotypes, the Eigen values for male ecotypes were larger for can 1 than can 2 indicating their better discriminating capacities. The second canonical variate [30] separated Habro district from Odabultum and Darolabu based on within group variability. This within variability is important for improvement of the local chickens through selection. The canonical discriminant analysis revealed that the total variation (81.4 percent) for first canonical variate [29] was much larger than total variation (18.60 percent) unlike in case of female sample population which might be due to low sample size of male sample ecotypes.

Table 8: Multivariate statistics and F approximations of male ecotypes

Statistic	Value	F Value	Num DF	Den DF	Pr > F
Wilks' Lambda	0.28	2.77	28	88	0.0002
Pillai's Trace	0.88	2.53	28	90	0.0005
Hotelling-Lawley Trace	1.96	3.02	28	73.355	<.0001
Roy's Greatest Root	1.59	5.12	14	45	p<.0001

Can	Eigen Value	Difference	Proportion	Cumulative	Likelihood ratio	Approximate F value	Num DF	Den DF	Pr > F
1	1.5937	1.2295	0.814	0.8140	0.28	2.77	28	88	0.0002
2	0.3642		0.186	1.0000	0.73	1.26	13	45	0.2715

Conclusion

indigenous chicken ecotypes of Odabultum, Habro and Darolabu districts were found to be not homogenous on their phenotypic features, and genetic characterization of the ecotype is recommended to confirm their genetic distinctiveness so that appropriate selection measures can be undertaken to improve the ecotypes for productive, reproductive and adaptability traits.

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