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Growth Performances and Survival Rate of Horro, Koekoek and DZ White Feathered Chicken Breeds in Ethiopia

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ABSTRACT

Experimental study was conducted on station with the objectives of evaluating young age survival rate and growth performances of the Horro chicken ecotype in comparison to the exotic Koekoek and synthetic DZ white feathered chicken breeds. Nine hundred day old chicks, three hundred of each breed were set into twelve chick pens and housed for the study. A 3 × 4 completely randomized experimental design was employed to evaluate survival rate, feed conversion efficiency, daily weight gain and age at maturity. The body weight measure at the end of chick's eight weeks age revealed that the DZ white feathered chicks built up the highest body weight (320.85 g) followed by the Koekoek (309.59 g), whereas the lowest mean body weight (281.87 g) was recorded for improved Horro chicks. The study also discovered that breed of chicken, age in weeks and interaction of chicken breed with age in weeks had showed significant (P<0.001) effect on growth performances of chicks before their eight weeks age. The highest per day overall mean feed intake (53.89 ± 14.37) was recorded for the Potchefstroom Koekoek (PK) chicken and the lowest (50.28 ± 10.50) for the DZ white feathered (DZ1), though these variation among the chicken breeds was statistically non-significant (P>0.05). In all the three breeds of chickens, males growth performance was faster than that of females (P<0.001). The low performance of improved Horro chicken both in productivity and young age survival rate leads to a recommendation that selection for chicken breed improvement shall consider the inherited tolerance capacity to environmental stress, and well organized record keeping to reduce inbreeding effect that might result in lower rate of survivability.

Keywords: Agro ecology; Ecotypes; Growth performance; Horro-chicken; Experimental design

INTRODUCTION

Poultry is an ideal livestock for small farms because of the small individual requirement for feed, water and other production inputs. In recent years, an emerging middle class urban society and urbanization with better income and more purchasing power has augmented the demand for chicken and chicken products. Over the last decades, the consumption of poultry products in developing countries grew by 5.8 percent per annum, faster than the human population growth [1]. This has led to the expansion of poultry production, particularly within urban and peri-urban areas. The growth of demand for poultry products and livestock products in general leads most to poultry related development interventions and

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promoting intensification of traditional poultry systems [2]. Thus, production and productivity of village chicken system should be improved through the type of chicken breed used, management and husbandry practices applied. The dynamism of the global poultry sector has been supported by a strong growth in demand. At global level, total poultry meat production had increased from 69 million tons in 2000 to 94 million tons in 2008, which corresponds to an increase of about 35%. This growth was reported by FAOSTAT, attained despite recurrent consumer scares and regional trade restrictions linked to the spread of various diseases, such as the outbreaks of the avian influenza and the Newcastle diseases, which represented major threats for the poultry sector, worldwide. Nationally, different efforts had been undertaken in Ethiopia by introducing the most widely used dual purpose chickens that the Rhode Island Red (RIR) was used as paternal line with ISA brown layers to produce a crossbred, and Fayoumi and Potchefstroom koekoek breeds were also imported and distributed to farmers. The most important inputs have been the introduction of improved (exotic) chicken breeds, improved feed, vaccine and medicaments and credit aiming at increased productivity [3,4]. The past genetic improvement efforts of the Ethiopian village chicken *via* exotic chicken extension was constrained by lack of comprehensive poultry technology package and extension to the end users [5,6]. The agricultural extension services and efforts exerted on chicken breed improvement activities were not participatory. The high cost of commercial poultry feed also discourages farmers from supplementing local chicken with commercial chicken feed supplements. Indigenous chickens on the other hand are less suitable for confined management systems primarily due to their poor genetic potential for growth and egg production. Raising indigenous chickens in confinement in Ethiopia resulted in high morbidities and mortalities [7,8]. A selective breeding program to improve the productivity of indigenous Horro chicken was started in 2008, with aim to improve survival and productivity of the chickens and an improvement after 6 generations of selection, the egg production was increased to 76 eggs in 6 months from 34 after the onset of egg laying and the analysis revealed positive genetic changes over generations as reported by Wondmeneh [9,10]. This study was therefore, aimed at evaluating growth performances and young age survival rate of improved indigenous Horro chickens at their 11th generation in comparison to the exotic Potchefstroom koekoek and synthetic DZ white feathered chicken breeds with the participation of farmer's on farm under varying agro climates.

MATERIALS AND METHODS

Description of the Study Area

The study was conducted on station in Nekemte city (located at 330 km west of Addis Ababa) in the western Ethiopia. The area experiences an extended rainy season, which frequently begins in March and extends to mid-October ranging from 1000–2400 mm per annum and the monthly mean temperature varies between 11.5°C to 27.5°C. Breeds of chicken used for the study were Improved Horro (IH), Potchefstroom Koekoek (PK) and the DZ white feathered (DZ1) chickens. The Horro is an indigenous chicken type named after the geographic region of origin located in the western part of Ethiopia near the Blue Nile gorge and is more adapted to low management systems. The Horro chicken used for the present study were subjected to a breeding program to improve production level of Ethiopian indigenous chickens at the Debre Zeit Agricultural Research Center (DZARC) in Ethiopia and the group of animals used for this particular study were at their 11th generation of breed improvement. The Potchefstroom Koekoek chicken breed was a composite breed of the White Leghorn, Black Australorp and Bared Plymouth Rock bred at the Potchefstroom agricultural college, in South Africa during the 1950's. Whereas the DZ white feathered chicken are synthetic chicken breed produced at DZARC through crossbreeding and is a combination of exotic Lohnmann silver, Koekoek, and local white chickens. The group of birds used for the present study was at their 9th generation. All chicks were vaccinated against marek's at the hatchery, Newcastle disease virus at day 3 (HB1) and 27 (LaSota), Gumboro at day 14 and 21 and fowl typhoid on day 45 based on the vaccination schedule set by the national poultry research case team of DZARC. The chicks were provided ad lib with a standard chick (0-8 weeks: 20% CP and 2950 Kcal/kg of ME) starter ration, grower (8-20 weeks: 18% CP and 2750 Kcal/kg of ME) growers ration and layers (week 20 onwards: 16% CP and 2750 Kcal/kg of ME) layers diet with a coccidiostat (to prevent the disease coccidiosis) [11-15].

Data Collection

Data on growth performance was collected by weighing chicks per pen every week till they were eight weeks of age. At week eight, male and female chicks were separated and penned. Feed consumption was recorded for each pen and Average Feed Consumption (AFC) per bird was calculated after correcting for mortality at entry into the experimental pens [16]. Body Weight Gain (BWG) was calculated as the difference between bodies weights measured in consecutive measurements/records (biweekly). Morbidity and mortality rate was also recorded as happened (both on farm and on station), to calculate relative disease tolerance and survival rate before age at first egg.

Statistical Analysis and Statistical Models Used

A Completely Randomized Design (CRD) was used for the evaluation of the breeds. A three way ANOVA with week as repeated factor (a within subject factor), and two factors (breed and sex of chickens) as between subject factors was used for analysis. A generalized linear model procedure of SAS 9.1.2, was used with the model including the effects of breed, sex, weeks and their interactions.

Statistical model used for early growth performance (on station).

$Yijkl=\mu+Ai+\beta j+A\beta ij+eijkl$

Where:

Yijkl output (growth performance and body weight gain) on station.

μ=overall mean.

Ai=fixed effect of chicken breed. i=3 (koekoek, DZ white feather and Improved Horro across 12 chick pens).

βj=fixed effect of sex of chicken j=2 (male and female).

Aβij=interaction of fixed effects of genotype and sex.

eijkl=random error of chicken pens.

RESULTS

Early growth performance of chicks till their eight weeks age is presented in **Table 1**. Three breeds namely the Potchefstroom Koekoek (PK), DZ white feathered (DZ1) and improved indigenous Horro chicken breeds were used on station for experimental study. There was no significant difference (P>0.05) in their mean weight in gram for the PK, DZ1 and Improved Horro chicken breeds at their day old age, however, the koekoek day old chicks were slightly heavier than the day old chicks of both breeds. The survival rate of DZ1 chicken until their eight weeks age was the highest (97.63%) followed by improved Horro chicks (91.03%) where the survival rate for the Koekoek was the lowest (88.26%). There was significantly higher weight gain at (P<0.05) for DZ white feathered chickens in comparison to improved indigenous Horro chicken at the end of their eight weeks age. However, the difference in their mean weight among DZ white feather and Koekoek, and among the Koekok and improved Horro chicks was not significant during their starter age.

Table 1: Early growth performance and survival rate of improved Horro, Koekoek and DZ white feather chicks.

Chicken breed and sources of variation	Mean body wt at hatch (in gm)	Survival rate in (%) day old to eight weeks	Mean body wt (in gm) week eight	Least sq mean (SE) of weight gain for chicks from weeks (1-8)	On farm survival rate (%) (week 10-20)	On station survival rate (%) (week 10-20)
DZ white feather	28.74	97.63	320.85	173.70 ± 3.31	83.33	88.64
Koekoek	30.43	88.26	309.59	172.57 ± 3.31	84.67	88.98
Improved Horro	28.83	91.03	281.87	156.87 ± 3.31	72	73.33
			Source of variation			
Breed	-	-	-	***	-	-
Age in weeks	-	-	-	***	-	-
Breed*age in weeks	-	-	-	***	-	-

Wt: Weight; gm: gram and *** : highly significant difference at (P<0.01).

Accordingly, the DZ white feather chicks build up the highest body weight (320.85 g) followed by Koekoek (309.59 g) and the lowest mean body weight (281.87 g) was recorded for improved Horro chicks. During brooding period, therefore, genotype had a significant (P<0.05) effect on the overall mean body weight gain and on the growth performance of chicken breeds. The study revealed that breed of chicken, age in weeks and interaction of chicken breed with age in weeks had showed significant effect at (P<0.001) on growth performances of chicks before their eight weeks age. Survival rate during the growing period (week ten to twenty) for the three chicken breeds Potchefstroom Koekoek (PK), DZ white feather (DZ1) and improved indigenous Horro was higher on station compared to the survival rate on farm. The current study revealed that under on station management, survival rate of koekoek and DZ white feather was much higher than the survival rate of their contemporary's on farm. However, the survival rate of improved indigenous Horro chicken was much lower both on farm and on station though slight difference was observed in growth performance of the breed among the two production systems. The least square means and standard error weight in gram, effect of breed, age in weeks, and interaction of breed with age in week is described on **Table 1**. There were significant effects of breed, age in week and interactions of (breed X age) in week at (P<0.001) for mean body weight gain of the chicks studied and repeated measurements taken during (1-8 weeks) age in weeks of chicks. The difference in mean daily weight gain (1.12 ± 4.68) among Potchefstroom Koekoek and DZ white feather had no statistical difference at (P>0.05) where a large gap was observed on the mean difference among Koekoek and improved Horro (15.71 ± 4.68) and between DZ white feather and improved Horro (16.83 ± 4.68) at (P<0.01) chicken breeds. The on station growth performance of the experimental animals (three breeds of chicken) during their 10-18 weeks age is presented in **Table 2**.

Table 2: Mean and standard deviation weight of chicken until their 18 weeks age.

Breed of chicken	Sex of chicken	Mean weight in gram					Range at week 18	
		Week 10	Week 12	Week 14	Week 16	Week 18	Min	Max
Koekoek	Male	492.40 ± 38.68	555.50 ± 54.40	717.55 ± 52.98	837.95 ± 73.20	1079.30 ± 80.73	453	1735
	Female	403.75 ± 36.28	488.40 ± 45.25	644.50 ± 54.21	804.50 ± 67.75	962.40 ± 66.11	498	1554
DZ WF	Male	459.70 ± 23.59	548.50 ± 33.68	665.10 ± 28.56	847.35 ± 36.49	966.95 ± 45.93	609	1248
	Female	423.35 ± 24.74	520.75 ± 32.81	629.55 ± 38.77	816.85±39.56	901.80 ± 48.10	442	1177
IH	Male	392.70 ± 18.9	452.65 ± 24.48	558.15 ± 37.3	714.35 ± 43.31	865.50 ± 44.92	600	1405
	Female	306.50 ± 22.87	370.60 ± 27.56	449.15 ± 26.39	540.05 ± 27.14	659.75 ± 28.60	383	819
		Tests of B/n-subjects effects						
Breed		***	***	***	***	***	-	-
Age in weeks		***	***	***	***	***	-	-
Sex of chickens		***	***	***	***	***	-	-
Breed * Weeks * sex		NS	NS	NS	NS	NS	-	-

DZWF: Debrezeyite White Feather; IH: Improved Horro chicken; B/n: Test of between subjects effects

In all the three breeds (koekoek, DZ white feather and improved Horro) of chicken males grow faster than females where sex of chicken significantly affects growth performance at ($P<0.001$). The mean and standard deviation change in weight of Koekok chicken breed was the highest followed by the mean and standard deviation of DZ white feather chicken breeds where the change in weight for improved Horro chicken breed was the lowest. Breed and age in weeks of chicken at all and every two weeks of their age had significant effects at ($P<0.001$) on growth performance of chicken however, (breed of chicken X age in week) interactions for growth performance had non-significant difference at ($P>0.05$). The maximum weight (1735 gm) at the end of week 18 was recorded for male Potchefstroom Koekoek chicken where the least weight (383 gm) was recorded for female improved Horro chicken. The mean and standard deviation chickens daily feed consumption, daily weight gain and feed conversion efficiency till their 18 weeks age is presented in **Table 3**.

Table 3: Daily feed consumption, weight gain and feed conversion efficiency.

Variables	Breed of chicken	Age in weeks and feed consumption rate and feed conversion efficiency					P value
		Week 12	Week 14	Week 16	Week 18	Overall mean ± sd	
Feed per day in gm	Koekoek	45.48 ± 2.98	49.47 ±10.18	55.67 ± 23.93	64.93 ± 18.17	53.89 ± 14.37	0.81
	DZ WF	39.41 ± 3.69	42.81 ± 2.88	58.37 ± 3.63	60.52 ± 7.01	50.28 ± 10.50	
	IH	40.55 ± 1.46	47.93 ± 8.73	61.52 ± 11.21	65.74 ± 15.45	52.70 ± 12.43	
Daily weight gain in gm	Koekoek	5.28 ±1.09	11.37 ± 0.31	8.75 ± 1.76	17.27 ± 6.16	10.67 ± 5.29	0.292
	DZWF	6.65 ± 0.44	8.05 ± 0.39	11.55 ± 0.23	11.28 ± 1.86	8.69 ± 2.07	
	IH	4.43 ± 0.21	7.57 ± 0.06	7.73 ± 2.89	8.52 ± 2.04	7.75 ± 2.90	
Feed conversion efficiency (%)	Koekoek	11.72 ± 3.16	23.41 ± 4.18	18.08 ± 10.93	26.29 ± 2.12	19.87 ± 7.54	0.054
	DZ WF	16.99 ± 2.71	19.09 ± 0.72	19.83 ± 1.62	17.31 ± 1.24	17.47 ± 2.79	
	IH	10.92 ± 0.13	13.67 ± 0.35	12.33 ± 2.45	13.98 ± 1.76	13.56 ± 2.74	

DZWF: Debrezeyit White Feather; IH: Improved Horro

The highest overall mean and standard deviation per day feed consumption (53.89 ± 14.37) was recorded for the Potchefstroom koekoek chicken breed and the lowest for DZ white feather (50.28 ± 10.50) where the variation among the chicken breeds was statistically non-significant at (P>0.05). However, the per day rate of feed consumption was getting higher and higher for improved Horro chicken breed as the age in weeks was advancing. During those growing periods, mainly from week (10-18), the overall mean and standard deviation daily weight gain (10.67 ± 5.29) for the Potchefstroom Koekoek chicken breed was the highest followed by DZ white feather (8.69 ± 2.07) and the least (7.75 ± 2.90) for improved indigenous Horro chicken. The mean and standard deviation feed conversion efficiency (17.47 ± 2.79) of DZ white feather was higher than the feed conversion efficiency (13.56 ± 2.74) of improved indigenous Horro chicken breeding, though the difference was statistically non-significant. The correlation among feed intake, daily weight gain and feed conversion efficiency of the three breeds of chicken across age in weeks is presented in **Table 4**. The study revealed that there is strong correlation among daily weight gain and feed conversion efficiency, however, feed intake of chicks until their eighteen weeks age had weak correlation with daily weight gain and had negative correlation with feed conversion efficiency which though, the improved Horro chicks consume more feed as their age was advancing.

Table 4: Correlation of feed intake, daily weight gain and feed conversion efficiency with age of chicks in week.

Control variables		Feed intake per day	Daily weight gain	Feed conversion efficiency
Age of chick in weeks	Feed intake per day	1	0.275	-0.317
	Daily weight gain		1	0.774**
	Feed conversion efficiency			1

DISCUSSION

The study revealed that day old weight of the improved indigenous Horro, the exotic Koekoek and DZ white feathered chickens had a slight figurative difference though they had non-significant (P>0.05) statistical differences. The result of the current study disagrees with the report by Teketel and Shanwany who documented that the hatching weights of chicks followed the egg weight pattern in the parental population. The non-significant chicks day old weight difference found during the present study also disagrees with the report by Halima, who documented that significant (P<0.05) differences in day old and final body weights were observed within the indigenous and between the indigenous and RIR chicken lines. However, the significant (P<0.001) effects of breed, age in week and interactions of (breed × age in week) for mean body weight gain of the chicks identified in the current study agrees with the report by Alewi and Melesse who documented during post brooding period, the overall mean body weight of RIR crosses was significantly (p<0.05) higher than those of Fayoumi crosses and Kei for both sex groups.

The mean body weight (281.87 g) recorded for Improved indigenous Horro chicks at the end of their starter age (eight weeks) was lower than the mean weight of Koekoek and DZ white feathered chicks grown under the same management, however, their final starter weight was much higher than the report by Tadelle and Olge who documented that the mean weight 157 g for local chicks under farmers management and lower than the mean weight reported who documented 2012 g for different local chicken ecotypes studied on station. The growth performance of Horro, the Koekoek and DZ white feathered chicks body weight gain at the end of their eight weeks age is higher than the 183 g (male) and 153 g (female) local kei chicks, 206 (male) and 167 g (female) kei X Fayoumi chicks and 222 g (male) and 179 g (female) kei X RIR chicks' body weight gain reported by Alewi and Melesse in Ethiopia.

The survival rate 97.63% for DZ white feather chicks, 91.03% for improved Horro chicken and 88.26% identified for Koekoek chicks till their eight weeks age was higher than the survival rate reported by Babes where the death rate of up to 40-60% of the hatched chicks lose during the first eight weeks of age mainly due to disease and predators attack in Ethiopia. The result revealed that the DZ white feather chicks were superior to both Koekoek and improved Horro chicks in chicks survival. On farm mortality rate 16.67% for Koekoek and 15.33% for DZ white feather of the current study was comparable to the mortality rate recorded for Fayoumi crosses (15.8%) and it was much lower than the mortality rate for RIR crosses (25.9%) reported for the study conducted in South western Ethiopia by Alewi and Melesse. However, the death rate of 28% recorded for improved Horro chicken during the 10-20 weeks age is much higher than the mortality rate documented for local Kei chickens (17.8%) by Alewi and Melesse at the same study area. The high death rate recorded for improved Horro both on farm and on station in comparison to the survival rate recorded for local Kei on farm by Alewi and Melesse and for improved Horro at debrezeyite agricultural

research center might be because of the climatic difference among the study areas, and selection of Horro chicken for increased productivity and continuous inbreeding might affect the adaptive capacity of improved Horro chickens. The survival rate of improved Horro chicken before their eight weeks and eight to twenty weeks of their age in the current study was much better than the survival rate reported by Besbes, who documented about 40-60% of the chicks hatched die during the first eight weeks of age mainly due to disease and predators attack.

The daily body weight gain and growth performance traits measured indicated that both the exotic koekoek (10.67 ± 5.29) and the crossbred DZ white feather chickens (8.69 ± 2.07) were superior to the improved indigenous Horro chicks whose overall mean weight was (7.75 ± 2.90) where the result mainly the daily weight gain of improved indigenous Horro chicks is comparable and Alewi and Melesse who documented under intensive management condition, an average daily weight gain was 7.2 g for local chickens between 6 and 12 weeks of age. The breed and sex of chicks and age of chicken in weeks had significant effect on mean body weight of chicks during their 10-18 weeks of age that agrees with the same author who reported, there were significant effects at ($p<0.001$) of breed, week and breed week interactions for body weight, though the result on cumulative feed intake and feed conversion ratio disagree with that the daily feed consumption, daily weight gain and feed conversion efficiency of the chicken breeds was not significant.

The negative correlation among daily feed consumption (intake) and feed conversion efficiency with respect to an increase of age in weeks which might be because of the highly growing daily feed intake of improved Horro chicks whose daily weight gain was lower in comparison to their koekoek and DZ white feather counterpart. There was significant difference in feed consumption per day among the three breeds of chicken where the result does not agree with the report by Alewi and Melesse, in southern regional state of Ethiopia, who documented no significant ($p>0.05$) difference was observed in feed consumption between local Kei and Fayoumi crosses.

CONCLUSION

The improved Horro chicken kept under the current studies both on farm and on station was at their eleventh generation that passed through successive mass selection programmers. However, survival rate, growth performance and feed conversion efficiency were lower and age at first egg was extended as compared to the exotic Potchefstroom Koekoek and the DZ white feathered synthetic chickens which might be because of the continuous mass selection undertaken while improving the productivity mainly with number of egg per hen that might had affected their disease resistance capacity.

All breeds of chickens studied perform differently across the three agro ecologies both in terms of survival and growth performances. The DZ white feathered chickens performed best amongst the three breeds of chickens and the lowland agro ecology among the three climatic areas was the best suitable agro climatic area for the chicken breeds both for survival and mature age weight. All study chicken strains mainly the DZ white feathered chickens in the present study were more favoured at the lowland agro ecology with respect to growth performances, age at maturity, reproductive and productive performances followed by on farm improved chickens at the mid altitude. The improved Horro chicken breeds performance even if it was lower compared with the DZ white feathered and exotic Koekoek chicken breeds, they were much better performing than the unimproved local Horro chickens both in reproductive and productive performances. Therefore, improvement of Horro chicken ecotypes through selection should be maintained by considering improvement in productive performance, reproductive capacity and livability or survival.

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