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Comparison of different poultry breeds under station and on-farm conditions in Ethiopia

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ABSTRACT

A selective breeding program was implemented to improve the performance of indigenous chickens. Improved chicken from the 7th generation was compared with commercial layer, crossbred and unselected indigenous chickens both on-station and on-farm. A total of 870 chickens were used. More than 600 chickens ($n=150$ and $n=120$ from each breed during growing and laying period respectively) arranged in completely randomized design were followed on-station, and 270 (90 from commercial, crossbred and improved during laying period) were evaluated on-farm in Ada ($n=6$ farms) and Horro ($n=9$ farms) districts in a split-plot design. Body weight, cumulative feed intake, and survival were recorded while feed conversion ratio was calculated at week 8, 12, 16 and 20 during the growing period on-station. Age at first egg and total egg number during lifetime were recorded once. Survival and hen housed egg production were recorded at month 3, 6, 9 and 12 of age both on-station and on-farm. Egg weight, and feed per egg were recorded and used to calculate feed conversion ratio during the laying period on-station. Significant effect of breed ($P<0.001$) and interaction with time ($P<0.001$) was observed for traits measured on-station during the growing and laying period. Similarly significant effect of breed, village and breed–village interactions were observed on-farm ($P<0.001$). Improved indigenous chickens had higher performance than indigenous chickens for all traits measured on station ($P<0.05$). 10 farmers out of 16 in the Ada district and 7 out of 16 in the Horro district dropped out after month 3 at different times either due to high chicken mortality or reduced motivation of the farmer. Improved chickens have been genetically improved as compared to unimproved, but their performance is still low compared to commercial chickens.

1. Introduction

Earlier studies indicated that the average annual egg production of indigenous chickens under village conditions was between 30 and 60 eggs per year with an average egg weight of 38 g (Kidane, 1980). The productivity of indigenous chickens can be improved by providing improved housing, disease control, improved genetics and nutrition. Upgrading the genetic level of local chickens by using cockerels of exotic breeds has been considered to be the most important strategy for improvement (Tadelle et al., 2000). Although improved livestock have been introduced in favorable areas of the tropics, many of the attempts have failed (Philipsson et al., 2011). Some on-farm studies involving crossbreeding of indigenous chickens with exotic cocks (WLH and RIR) have been performed (Dana and Ogle, 2000; Tadelle and Ogle, 2001). However, such programs were unsustainable partly due to unreliable supply and high costs of acquiring and maintaining exotic breeding cocks (Tadelle et al., 2000; Udo et al., 2001). Implementing a selective breeding program to improve indigenous chickens is an alternative for crossbreeding to increase productivity.

A selective breeding program to improve the productivity of indigenous Horro chicken in Ethiopia was started in 2008 (Dana et al., 2011). The program used mass selection and aimed to improve survival and productivity of the chickens. The breeding goal identified after consultation of local farmers included age at first egg, egg production, body weight and survival (Dana et al., 2010). The body weight of the base generation chickens was 701 (528) g in males (females) and egg production in the base population was 34 eggs in 6 months after onset of egg laying (Dana et al., 2011). After 6 generations of selection, the egg production was increased

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to 76 eggs in 6 months after the onset of egg laying and the analysis revealed positive genetic changes over generations (Wondmeneh et al., 2014). The selective breeding program was conducted at Debre Zeit Agricultural research center under controlled group housed conditions. The aim of the program was to breed chickens for village production systems. Due to possible genotype by environment interaction, the selection response observed on station does not necessarily translate into similar response under village conditions. It is, therefore, important to evaluate the performance of the improved chickens under on-farm management condition in the villages. Comparing breeds or strains under different environments may reveal genotype by environment interaction. The aim of this study is to evaluate the performance of improved indigenous (Horro) chickens in comparison with commercial, crossbred and unimproved indigenous chickens under controlled conditions on station and on-farm condition in villages.

2. Materials and methods

2.1. Description of on-station and on-farm systems

This study was carried out on-station and on-farms. The on-station experiments were carried out at the Debre Zeit Agricultural Research Centre, Debre Zeit (Ethiopia). The selective breeding program was carried out on the same station. Two districts (Ada and Horro) were used for an on-farm evaluation of the different chicken breeds. The Horro district was the origin of the ancestors of the improved Horro chickens, and Ada was used as a reference.

2.2. On-station management

More than 600 chickens from 4 breeds were followed at Debre Zeit Agricultural Research Centre during the growing period ($n=600$ from week 0–20) and laying period ($n=480$ for 52 weeks after the onset of egg laying). Starters were provided with a chick feed (20% CP and 2950 kcal/kg) until 8 weeks of age, and grower feed (18% CP and 2850 kcal/kg) from 8 to 20 weeks. From 20 weeks onwards all female birds were provided with ad libitum layer feed (16% CP and 2750 kcal/kg). The chickens were kept in an open house in deep litter system with concrete floor filled with *teff* straw until 20 weeks of age under a standard housing space, with natural lighting after 8 weeks of age. After 20 weeks of age approximately 120 chickens from each breed were randomly picked and transferred to a layer house and reared by breed in pens partitioned with mesh wire. All chickens were housed in the same house and managed by one person to minimize environmental variation. All chickens were vaccinated against Newcastle (HB1 strain at day 1 and Lasota at day 21), Marek's disease (day 1), Gumboro (day 7), and fowl pox (week 14).

2.3. On-farm management

A total of 32 farmers from four villages in each of the two districts were identified. For the on-farm study, the unselected Horro chicken was not used as farmers were not willing to invest in housing to keep these birds. Farmers were given a five days training on how to manage the chickens and keep records. Formulated ration, feeders, drinkers, medicaments, and monthly monitoring visits were provided by Debre Zeit Agricultural Research Centre. Farmers constructed a poultry house with a run made from wood and mud. Each farmer received 18 three-month-old chickens and 5 cockerels of one of the three breeds (commercial, crossbred and improved chicken). Farmers requested to also get cockerels as they believed chickens can only produce eggs in the presence of cocks. Most farmers sold out 3 of the 5 cocks and kept 2 with their flock. Each farmer received only one type of breed, therefore a farm and a breed are confounded in the on-farm study. The same rearing and vaccination program as on-station was followed for chickens in the on-farm study.

2.4. Breeds

Four breeds were used for the on-station study. The breeds were improved chicken (Horro), crossbred between improved chickens and RIR cock, Bovan brown commercial egg layers, and unimproved indigenous chicken. The RIR-type cocks for the production of crossbreds were commercial parent stock, provided by ISA, selected for egg production and growth. All breeds except for the indigenous were also used for the on-farm study. The breeds were produced as follows. (1) Hatching eggs of improved Horro chicken from generation 7 parents were collected to produce improved indigenous chicken. (2) RIR-type cocks (150) were imported as one-day old chicks from the ISA (Boxmeer, The Netherland) and were used to produce hatching eggs of crossbreds by artificially inseminating improved chickens of generation 7. (3) 2160 hatching eggs of Bovans brown layers (commercial) were imported from ISA. (4) A total of 2500 eggs of indigenous chickens were collected from the Horro district. All eggs were hatched at Debre Zeit Agricultural Research Centre.

2.5. The breeding program

The breeding program aimed to achieve genetic improvement in the body weight (growth) and egg number through the use of mass selection. The performance of individuals was used in making selection decisions. Selection criteria were body weight at 16 weeks of age on both males and females and egg number at 45 weeks of age on females. The target was to reach 1500 g of body weight at 16 weeks and 200 eggs per hen per year. Each generation 50 males and 300 females were selected to produce the next generation. This represents selected proportions of approximately 10–20% in the males and 50–60% in the females.

2.6. Traits recorded

On all growing birds, data on body weight (individual, weekly), cumulative feed intake (pen, weekly), and survival (individual, week 20) were recorded, and feed conversion ratio (pen, weekly) was calculated. Data were summarized at week 8, 12, 16 and 20 on all chickens in a pen during the growing period (0–20 weeks) on-station. During the laying period, age at first egg was recorded for the chickens at pen level (approximately 40 hens per pen) as the number of days between hatching date and date of the first eggs (when 5% of the chickens in a pen start egg laying) both on-station and on-farm. Similarly, total egg number per year was recorded both on-station and on-farm by counting the number eggs produced up to one year after first egg. Survival was recorded and hen housed egg production was calculated at month 3, 6, 9 and 12 both on-station and on-farm. Hen housed egg production was calculated as a ratio of total eggs produced during the laying period to the total number of chickens housed at the beginning of the laying period multiplied by 100 (North, 1984). Additionally, on station also egg weight was recorded, and feed per egg and feed conversion ratio were calculated at pen level. During the period of the on-farm study, 10 farmers out of 16 in the Ada district and 7 out of 16 in the Horro district withdrew from the study or stopped data collection. The major reasons behind drop out farmers were separately analyzed. Finally, data over the full period of one year from 15 farms (6 from Ada and 9 from Horro) were analyzed. In the on-farm study feed intake, egg weight were not recorded. As a