African Journal of Agricultural Research Vol. 3 (12), pp. 843-851, December, 2008
Available online at http://www.academicjournals.org/AJAR
ISSN 1991-637X © 2008 Academic Journals

Full Length Research Paper

On station and on-farm evaluation of two Tanzania chicken ecotypes for body weights at different ages and for egg production

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Accepted 24 November, 2008

A study was carried out to evaluate genetic potential of two chicken ecotypes of Tanzania viz. *Kuchi* and *Medium* managed both under intensive and extensive management systems. Traits studied under intensive conditions included body weights at 8 (Bwt8), 12 (Bwt12), 16 (Bwt16), and 20 (Bwt20) weeks of age, age at sexual maturity (AFE), egg number in the first 90 days after sexual maturity (EN-90), egg weight (EW), eggshell thickness (STH), egg shape index (ESI), while under extensive management it involved only body weights at various ages. There were significant differences between ecotypes with respect to body weights (P < 0.001), EW (P< 0.05) in favour of *Kuchi*; and EN-90 (P < 0.05), AFE (P < 0.05) in favour of *Medium* ecotype. However, differences between ecotypes with respect to STH and ESI were not significant (P > 0.05). Bwt8, Bwt12, Bwt16 and Bwt20 under intensive management averaged over both sexes for *Kuchi* and *Medium* ecotypes were 490 and 404 g; 954 and 776 g; 1394 and 1183 g and 1647 and 1447 g, respectively. Corresponding body weights under extensive management were 348 and 273 g; 685 and 581 g; 974 and 845 g; 1188 and 1046 g, respectively. Average AFE, EN-90, EW, and ESI under intensive managements for *Kuchi* and *Medium* ecotypes were 173 and 168 days; 45 and 49 eggs; 45 and 42 g; 75 and 74%, respectively, while average STH in both ecotypes was around 37 µ. From these results, it was concluded that *Kuchi* was superior to *Medium* ecotype in terms of body weights and converse was true for most of egg production and related traits, and further that their performance can further be improved by improving both management system and improving their genetic potential through within ecotype selection. Since *Kuchi* ecotype was superior to *Medium* ecotype in terms body weights and opposite was true for *Medium* ecotype in terms of most egg production and related traits. Therefore, *Kuchi* ecotype could be good starting genetic material for further improvement in body weight, and *Medium* ecotype in egg production traits.

Key words: Body-weights, egg-traits, chicken-ecotype.

INTRODUCTION

Animal protein intake in developing countries including Tanzania has been very low compared to the recommended level (Delgado et al., 1998 cited by Pedersen, 2002; Nielsen et al., 2003). Local chickens have high potential to offset this problem of low protein intake compared to most other livestock species due to their short generation intervals and their ability to survive in harsh environments (Pedersen, 2002; Acamovic et al., 2005; Muchadeyi et al., 2005). They are also raised by majority of the rural households. Despite of these advantages, local chickens have been associated with low productivity owing to their inherent low genetic potential (Katule, 1990; Pedersen, 2002). Various crossbreeding

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programs between local chickens and improved (exotic) chickens had been initiated in an attempt to combine desirable features from these two diverse genetic groups (that is, high productivity from exotic genotypes and high adaptability from local chicken genotypes) (Katule, 1990). However, such programs became unsustainable due to unreliable supply and high costs of acquiring and maintaining exotic breeding cocks, reduced broodiness and ability to evade predation by the crossbred birds and incompatibility of genotypes with farmers' breeding objectives and production systems (Tadelle et al., 2000; Udo et al., 2001; Kosgey, 2004; Njega, 2005). Given their low generation interval, selection within ecotype/breed could successful bring about genetic improvement within a reasonable time. In order to optimise selection response, adequate characterisation of existing ecotypes is important. Moreover, there is however, scanty information available for most of the performance traits for Tanzania local chickens. Results from random sampling of mature birds from villages done in a previous studies in Tanzania indicated *Kuchi* ecotype to be superior to other ecotypes in terms of body weight and egg weight and it was even recommended for meat production, and converse was true for *Medium* ecotype (Lawrence, 1998; Msoffe et al., 2001; Msoffe, 2003). However, no systematic study has been carried out to evaluate their average body weights at different ages under different management systems and egg production traits. Therefore, this study was carried out with the aim of evaluating these traits in the two chicken ecotypes.

MATERIALS AND METHODS

Study site, experimental materials and their management

This study was carried out at Sokoine University of Agriculture (SUA) poultry research unit, Morogoro, Tanzania and two nearby villages (that is, *Kauzeni* and *Mgambazi*). The place is located at an altitude of about 525 m, above sea level. The relative humidity at the location is about 81%, while the monthly mean and maximum temperatures are 18.7 and 30.1°C, respectively. The area has an annual mean rainfall of 846 mm. Experimental chicks were derived from two parent stocks, one representing *Kuchi* ecotype obtained from drier parts of north west Tanzania, and another representing Tanzania Medium (*Medium*) ecotype obtained from central part of the country.

Hatching and management of experimental materials for on-station trial

A total of 1468 chicks were produced in eleven hatches for on-station trial (intensive management) at the University farm with 645 and 823 chicks being from *Kuchi* and *Medium* ecotypes, produced from 163 and 175 hens, respectively. Hatched chicks were tagged and housed in floor pens up to 12 weeks of age. Thereafter, they were transferred to individual cages.

Birds were fed a starter ration (20% CP and 2800 Kcal ME/kg) from day old to 8th week of age, growers ration (16% CP and 2750 Kcal ME/kg) from 9th to 16th week of age, and layers ration (17% CP and 2700 Kcal ME/kg) from 17th week of the age to the rest of the period. Parent stock was also fed the same layers ration. Water was supplied on *ad libitum* basis. Birds were also vaccinated routinely against Gumboro and Newcastle disease (ND).

Hatching and management of experimental materials for on-farm trial

After the end of mating and hatching period in on-station experiment, the parent stock was taken to the field for on-farm experiment. The study involved two villages viz. Kauzeni and Mgambazi. A total of 285 hens from the two ecotypes (139 and 146 hens from *Medium* and *Kuchi* ecotypes, respectively), and 46 cocks (22 cocks being from *Kuchi*, and 24 cocks being from *Medium* ecotype) were supplied to 68 farmers, that is, 30 and 38 farmers from Mgambazi and Kauzeni, respectively. Criteria for the choice of the farmers were based on the willingness of a farmers to participate in construction of a chicken house, which could accommodate at least 6 adult birds on individual compartments, and to participate in a training (a three day training) on how experimental birds should be managed and willing to adopt that management system. The building materials for construction of chicken houses were supplied by the Enhancement of Health and Productivity of Smallholder Livestock in East Africa (PHSL) project. A farmer only contributed a space for building a chicken house around his/her homestead and labour.

Parent stocks were vaccinated against ND and Gumboro two weeks and one week, respectively before being taken to the field. Initially each farmer was supplied with two hens from each ecotype (4 hens per farmer), however due to fertility problems some farmers (few) were given up to 5 hens. Upon arrival to the field, hens were placed in individual compartments and mated to cocks of their own ecotypes while in individual compartments (that is, hens were not allowed to go out to meet with other hens/ unplanned cocks). Three to four nearby farmers were supplied with two cocks one from each ecotype and these farmers were sharing these cocks for mating their hens. Each farmer was staying with a breeding cock for 3 to 4 days and passes it on to another farmer. Furthermore, hens were also let to lay, incubate and hatch their eggs while in individual compartments. Confinement of hens in individual compartments during mating up to hatching was done to avoid mix-up of cocks. This was done with the help of field supervisors (two field supervisors per village). Tasks of field supervisors were recording, medication, vaccination, tagging of birds, that is, newly hatched chicks and ensuring that birds are managed by farmers according the protocol of the experiment.

During mating, incubation and hatching periods, birds were supplied with water and layers ration (17% CP and 2700 Kcal ME/kg) on *ad libitum* basis. At this period parent stocks were also given antihelmintics (*Kukuzole*®) and broad spectrum antibiotics (OTC-plus®) regularly (prophylactic treatments) according to manufacturer instructions, and their bodies/houses were dusted with pesticides (*Dudu-dust*®) to control external parasites. Feeds and medications were supplied by the project. After hatching chicks were tagged and hens continued to stay in confinement with their chicks for a period of ten days. While in confinement the birds were fed chick starter as that used in on-station trial. The purpose of confining chicks in the early days of their lives was to minimize mortalities due to predation. After the end of confinement period birds were freed and chicks left to move out (scavenging) with their mothers. At this stage birds were depending entirely on scavenging feed. A total of 554 and 690 chicks from *Kuchi* and *Medium* ecotypes were hatched. Due to fertility problems, not all hens supplied to farmers possessed chicks. Therefore the above chicks were progeny of 101 and 112 hens for *Kuchi* and *Medium* ecotype, respectively. The vaccination regimes for chicks were as in the on-station trial.

Table 1. Analyses of variances: F-values for body weights at various ages.

SoV	Bwt8	Bwt12	Bwt16	Bwt20
On-station Hatch	5.9***	4.5***	3.7***	3.2***
Ecotype	375.4***	1249.6***	1484.9***	1208.6***
Sex	545.7***	734.2***	390.9***	446.2***
Hatch*Ecotype	2.8**	1.9	1.1	1.2
Hatch*Sex	0.8	1.1	0.8	0.7
Ecotype*Sex	0.3	0.0	0.2	1.1
R-square	0.66	0.70	0.68	0.74
On- farm				
Farm	2.2***	1.5***	1.9***	1.9***
Season	2.1*	11.5***	10.6***	7.9**
Ecotype	130.5***	129.3***	160.0***	175.4***
Sex	78.9***	144.1***	144.7***	154.4***
Season*Ecotype	3.5	3.1	4.5	3.3
Season*Sex	2.3	2.6	2.6	0.7
Ecotype*Sex	2.7	0.2	1.0	0.5
R-square	0.57	0.55	0.59	0.64

SoV = Source of Variation; Bwt8, Bwt12, Bwt16, and Bwt20 = Body weights at 8, 12, 16, and 20 weeks of age, respectively. *, **, *** = Significant at ($P < 0.05$), ($P < 0.01$), and ($P < 0.001$), respectively.

Traits measured

Body weights were recorded on all individual chicks at 8, 12, 16 and 20 weeks of age. For the on-station trial, hens were further assessed for age at sexual maturity, egg production, egg weight, shell thickness and egg shape index. Age at sexual maturity was measured by age at first egg in days, and egg production by number of eggs during the first 90 days from sexual maturity. Egg weight, shell thickness and egg shape index was recorded on each individual hen as the average of 3 to 4 eggs from 33^{rd} to 36^{th} weeks of age. A micrometer screw gauge was used to measure shell thickness. In each egg, shell thickness was recorded as the average of three readings taken from three different sites on the egg, that is, at the equator (middle), broad and narrow ends as it has been suggested in previous studies (Khatkar et al., 1994; Mohammed et al., 2005). Egg shape index was measured according to Chen et al. (1993) and Smith (2001) as the ratio of egg width to length (in %). A vernier calliper was used to measure egg width and length. Mortality was also recorded in the entire experimental period.

Statistical analyses

All data were checked for skewness using SAS (2000) UNIVARIATE procedure and found to conform to normal distribution. The data were then subjected to descriptive statistical analyses and least squares analyses of variances using the SAS (2000). General Linear Models (GLM) procedure using statistical models 1 and 2 for on-station and on-farm body weights respectively were employed. Statistical model 3 was used for egg production traits from the on-station trial. The models are shown below:-

$Y_{ijkl} = \mu + H_i + G_j + C_k + (HG)_{ij} + (HC)_{ik} + (GC)_{jk} + e_{ijkl}$………Model 1

Where: Y_{ijkl} = observation of l^{th} individual from k^{th} sex, j^{th} ecotype and i^{th} hatch;
μ = overall mean; H_i = fixed effect of i^{th} hatch (i = 1..11); G_j = fixed effect of j^{th} ecotype (j = 1..2); C_k = fixed effect of k^{th} sex (k = 1..2); $(HG)_{ij}$ = interaction between hatch and ecotype; $(HC)_{ik}$ = interaction between hatch and sex; $(GC)_{jk}$ = interaction between ecotype and sex; e_{ijkl} = random effect peculiar to each individual distributed as $N(0, 0, I\sigma_e^2)$.

$Y_{ijklm} = \mu + F_i + P_j + G_k + C_l + (PG)_{jk} + (PC)_{il} + (GC)_{kl} + e_{ijklm}$…Model 2

Where: Y_{ijklm} = observation of m^{th} individual from l^{th} sex, k^{th} ecotype, j^{th} hatching season and i^{th} farm; μ = overall mean; F_i = fixed effect of i^{th} farm (i = 1..65); P_j = fixed effect of j^{th} hatching season (j = 1..2); G_k = fixed effect of k^{th} ecotype (k = 1..2); C_l = fixed effect of l^{th} sex (l = 1..2); $(PG)_{jk}$ = Interaction between season and ecotype; $(PC)_{il}$ = Interaction between season and sex; $(GC)_{kl}$ = Interaction between ecotype and sex; e_{ijklm} = random effect peculiar to each individual distributed as $N(0, I\sigma_e^2)$.

$Y_{ijk} = \mu + H_i + G_j + (HG)_{ij} + e_{ijk}$ ……………………….Model 3

Where: Y_{ijk} = observation of k^{th} individual from j^{th} ecotype and i^{th} hatch; μ = overall mean; H_i = fixed effect of i^{th} hatch (i = 1..11); G_j = fixed effect of j^{th} ecotype (j = 1..2); $(HG)_{ij}$ = interaction between hatch and ecotype; e_{ijk} = random effect peculiar to each individual distributed as $N(0, I\sigma_e^2)$.

RESULTS AND DISCUSSION

Body weights at various ages

Least squares analyses of variances for body weights at various ages are presented in Table 1. Least squares

Table 2. Body weights under intensive management (on-station) summarized by sex and ecotype.

		Kuchi			***Medium***		
		N	**Lsmeans ± s.e**	**Range**	**N**	**Lsmeans ± s.e**	**Range**
M	Bwt8 (g)	279	540.7 ± 3.2	280-748	368	457.4 ± 2.3	231-615
	Bwt12 (g)	278	1025.6± 5.8	701-1460	365	845.5 ± 4.5	586-1175
	Bwt16 (g)	274	1448.5± 6.1	1035-2060	360	1240.2 ± 4.9	991-1720
	Bwt20 (g)	270	1706.2± 6.9	1295-2318	360	1512.0±6.1	1186-2040
F	Bwt8 (g)	317	438.4 ± 2.5	242-662	395	350.1 ± 1.9	202-545
	Bwt12 (g)	315	883.2 ± 5.6	655-1316	393	705.6 ± 3.5	478-1013
	Bwt16 (g)	312	1339.2 ± 5.9	1048-1804	391	1124.9± 4.3	836-1634
	Bwt20 (g)	310	1586.8±6.2	1296-2053	388	1382.1± 4.6	1070-1906
M+F	Bwt8 (g)	596	489.6 ± 2.3	242-748	763	403.7 ± 1.7	202-615
	Bwt12 (g)	593	954.4 ± 4.1	655-1460	758	775.6 ± 3.2	478-1175
	Bwt16 (g)	586	1393.9 ± 4.5	1035-2060	751	1182.5 ± 3.5	836-1720
	Bwt20 (g)	580	1646.5 ± 4.9	1295-2318	748	1447.1 ± 4.4	1070-2040

M, F and M+F= Males, females and both males and females, respectively; Bwt8, Bwt12, Bwt16, and Bwt20 = Body weights at 8, 12, 16, and 20 weeks of age, respectively.

Table 3. Body weights under extensive management (on-farm) summarized by sex and ecotype.

		Kuchi			***Medium***		
		N	**Lsmeans ± s.e**	**Range**	**N**	**Lsmeans ± s.e**	**Range**
M	Bwt8 (g)	201	374.9±3.9	190-518	248	305.0±3.0	178-421
	Bwt12 (g)	195	739.1±7.4	470-987	238	630.1±5.8	450-864
	Bwt16 (g)	190	1023.5±9.4	735-1329	230	897.2±7.4	752-1253
	Bwt20 (g)	186	1240.2±10.2	902-1567	215	1097.5±9.4	858-1419
F	Bwt8 (g)	203	320.1±3.5	180-509	266	240.9±2.4	171-407
	Bwt12 (g)	197	631.7±7.2	454-920	254	531.0±4.7	425-831
	Bwt16 (g)	192	924.5±8.3	731-1281	244	793.60±6.0	697-1226
	Bwt20 (g)	187	1135.2±9.6	870-1470	223	994.10±8.0	817-1406
M+F	Bwt8 (g)	404	347.5±2.8	180-518	514	273.0±2.0	171-421
	Bwt12 (g)	392	685.4±5.3	454-987	492	580.5±3.7	425-864
	Bwt16 (g)	382	974.0±6.4	731-1329	474	845.4±5.2	697-1253
	Bwt20 (g)	373	1187.7±7.3	870-1567	438	1045.8±6.8	817-1419

M, F and M+F = Males, females and both males and females, respectively; Bwt8, Bwt12, Bwt16, and Bwt20 = Body weights at 8, 12, 16, and 20 weeks of age, respectively.

means along with their standard errors are presented in Tables 2 and 3. Results from analyses of variances indicate that there was a significant effect of hatch, sex and ecotype on body weights under intensive management ($P < 0.001$). Furthermore, most of the interactions between these main effects were not significant ($P > 0.05$). Under extensive management system, body weights were also significantly influenced by ecotype and sex ($P < 0.001$). In addition, effect of farm and hatching season were also significant ($P < 0.01$). Effect of various interactions between main effects included in the statistical model was not significant ($P > 0.05$).

Results show that *Kuchi* was heavier than *Medium* ecotype under both management systems. Body weights for *Medium* ecotype were around 80 to 89% of that of *Kuchi* under both management systems, and there was a significant reduction (of 24 to 27%) in body weights in both ecotypes under extensive management system. Low body weights under extensive management could be attributed to hash environment (that is, feed shortages, high prevalence of diseases and parasites) that is usually prevailing under such a system (Magwisha et al., 2002; Hørning et al., 2003; Rosa dos Anjos, 2005).

The superiority of *Kuchi* over *Medium* ecotype in terms of body weight demonstrated in the present study supports the results of a previous study by Lawrence (1998) done in random samples of mature birds from villages, in which mean mature body weights for *Kuchi* and *Medium* ecotypes were reported to be 2708 and 1850 g for males, and 1828 and 1108 g for females, respectively. For body weights at 8 weeks of age under intensive management, results of the present study are higher than those below 400 g, averaged over both sexes reported for local chickens of Nigeria (Adedokun and Sonaiya, 2001; Fayeye et al., 2005) and Ethiopia (Demeke, 2003). Slightly higher values (600 g) were reported by Segura-Correa et al. (2004) in Mexican (*Creole*) local chickens. Concerning body weights at 12 weeks of age under intensive management, the mean weight for *Kuchi* obtained in the present study (954 g) over both sexes is close to the average weight of 973 g by Ramlah (1996) in Malaysian local chickens, but higher than the reported figures of 775 g (Manjeli et al., 2003), around 600 g (Nwosu et al., 1984; Adedokun and Sonaiya, 2001) and 375 to 510 g (Tadelle et al., 2003) for local chickens of Cameroon, Nigeria, and Ethiopia, respectively. The value for *Medium* ecotype is in the middle of the above range. At 16 weeks of age under intensive management, the overall mean body weights for *Kuchi* and *Medium* ecotypes of 1394 and 1183 g, respectively are somewhat higher than the mean weight of 802 g (Nwosu et al., 1984) obtained for local chickens of Nigeria. On the other hand, the value for *Medium* ecotype is close to the lower end of the range (1136 to 1520 g) reported for local chickens of Thailand and Malaysia (Theerachai et al., 2003), and some strains of South African local chickens (ARC, 2005), while that of *Kuchi* is in the middle of this range. Average body weight at 20 weeks in the current study for both sexes in *Kuchi* under intensive management is in agreement with the range (1600 to 2000 g) obtained for South African local chickens by ARC (2005). For *Medium* ecotype, the present results are not dissimilar to the average body weight at 20 weeks of age under intensive management reported for Vietnamese local chickens, which varied from 1300 to 1500 g (FAO, 2005). Further, the current body weight for *Medium* ecotype agrees closely with the findings by Demeke (2003) of 1300 g in Ethiopian local chickens.

Quite a number of studies have also reported the performance of local chicken under extensive management. With regard to average body weight at 8 weeks of age, a value of 197 g (Demeke, 2003) and 187 g (Tadelle and Ogle, 1998 cited by Tadelle et al., 2003) averaged over both sexes were reported for Ethiopian local chickens. These values are lower than the current observations in both ecotypes. On the other hand, Pedersen (2002) and Sandra (2005), working independently both reported a mean weight of 250 g for Zimbabwean and Malawian local chickens, which is close to the current finding for *Medium* ecotype (273 g) but somewhat lower than the value obtained for *Kuchi* (348 g). Concerning body weights of local chicken at later ages under extensive management, apart from mature body weight, relatively few studies have reported average body weights at more than 8 weeks of age. Average body weights at 12 weeks of age regardless of sex were reported to be 631 and 640 g in Burkina Faso (Sall, 1990 cited by Sonaiya and Swan, 2004) and in Zimbabwean local chickens (Pedersen, 2002), respectively. These values are in between the weights for *Kuchi* (685 g) and *Medium* (581 g) ecotypes obtained in the present study. On the other hand, weights obtained by Sall (1990) cited by Sonaiya and Swan (2004) (of 860 g), and Pedersen (2002) (around 1000 g) for body weight at 16 weeks of age were close to corresponding weights for *Medium* (845 g) and *Kuchi* (974 g) ecotypes.

Regarding average body weights at 20 weeks of age, the values of 1300 g (Ramlah and Shukor, 1987) for Malaysian, and around 1000 g (Pedersen, 2002) for Zimbabwean local chickens under extensive management tend to concur with the current findings for *Kuchi* (1188 g) and *Medium* ecotype (1046 g), respectively.

Although *Kuchi* had higher body weights than *Medium* ecotype, their weights are not far from those reported in the literature clearly indicating that local chickens in developing countries have poor growth rate when compared to the improved stocks. It can also be discerned that generally local chickens can be marketed at body weights of around 1 kg and above (Pedersen, 2002; Theerachai et al., 2003; Acamovic et al., 2005) which in both ecotypes and sexes could be attained at about 16 and 20 weeks of age under intensive and extensive management systems, respectively. This implies that market weight in the studied local chicken populations is attained at rather late ages compared to 8 weeks of age for meat type chickens, and 12 weeks for the crosses between local chickens and meat type chickens (Ali et al., 2000; Pedersen, 2002; Theerachai et al., 2003) under intensive management. Marketable body weight for these ecotypes could probably be further improved to enhance market value, or let them to be attained at earlier age following genetic improvement through selection. However this will depend on the existence of substantial additive genetic variation in these populations with regard to body weight. The *Kuchi* would be a better ecotype to start with in this endeavour because of their higher body weight compared to *Medium* ecotype.

Egg production traits

Results from analyses of variance (Table 4) indicate the existence of significant differences between ecotypes with respect to age at sexual maturity ($P < 0.01$), egg number ($P < 0.05$), and egg weight ($P < 0.01$).

Differences between ecotypes with regard to shell thickness and egg shape index were not significant ($P > 0.05$). The effect of hatch in most of the above traits was

Table 4. Analysis of variance: F-values for egg production and related traits.

SoV	AFE	EN-90	EW	STH	ESI
Hatch	1.0	1.4	0.8	1.3	1.9*
Ecotype	7.6**	4.6*	6.8**	0.0	0.3
Hatch x Ecotype	1.1	1.5	0.7	1.9	1.1
R-square	0.67	0.66	0.69	0.58	0.66

SoV = Source of Variation; AFE = Age at first egg (Days); EN-90 = Egg number in the first 90 days after sexual maturity; EW = Egg weight (g); STH = Egg shell thickness (µ); ESI = Egg shape index (%). *, ** = Significant at ($P < 0.05$) and ($P < 0.01$), respectively

was not significant ($P > 0.05$).

Results from Table 5 show that *Medium* ecotype tended to attain sexual maturity 5 days earlier than *Kuchi* (173 days vs 168 days), however, findings from both ecotypes are still within the range of 153 to 203 days reported in literature for unimproved local chickens in other countries (Choprakarn et al., 1998; Adedokun and Sonaiya, 2001; Demeke, 2003; Khalil et al., 2004). Despite the fact that *Medium* ecotype matured earlier than *Kuchi*, its average egg weight was noticeably lower than that of *Kuchi* (42 g vs 45 g). Compared to the previous studies, the value obtained in *Medium* ecotype for egg weight is very close to those of around 40 g given by Fayeye et al. (2005), Pedersen (2002) and Islam et al. (2001) for local chickens of Nigeria, Zimbabwe and Bangladesh, respect-tively, but lower than the value of around 49 g reported by Chen et al. (1993) in Taiwan local chickens. On the other hand, the average egg weight for *Kuchi* of 45 g obtained in the present study falls in the middle of the range reported in these previous studies.

Average egg number in the first 90 days of laying was significantly higher in *Medium* ecotype than in *Kuchi* (49 vs 45). These figures correspond to laying intensities of 54 and 50% for *Medium* ecotype and *Kuchi*, respectively. Katule and Mgheni (1990) and Khalil et al. (2004) working with some chicken ecotypes of Tanzania and Saudi Arabia, respectively both reported egg number in similar periods of laying that corresponded to a slightly higher laying intensity of around 58%. However, the current values in both ecotypes are within the range of 40 to 55% derived for local chickens of Sudan (Mohammed et al., 2005), Nigeria (Adedokun and Sonaiya, 2001), and Thailand (Choprakarn et al., 1998).

Analyses of variance revealed no significant differences between ecotypes with respect to eggshell thickness and egg shape index. The average egg shape indices for *Kuchi* and *Medium* ecotype were 75 and 74%, res-pectively. These values are within the range of 72 to 80% reported by Njega (2005) for some Kenyan chicken ecotypes, and Khan et al. (2004) for crosses between Bangladesh local chickens and RIR and *Fayoumi*, but higher than the value of 58% given by Fayeye et al. (2005) for Nigerian local chickens. Average shell thick-thickness in both ecotypes in this study was around 37 µ. The value is on the upper side of the range (34 to 37 µ) reported for Sudanese local chickens (Arad and Malder, 1982; Mohammed et al., 2005), and very close to the value of 38 µ presented by Chen et al. (1993) in Taiwan local chickens. The values for average shell thickness and egg shape index obtained for both ecotypes in this study were also within the range recommended in litera-ture by several authors (Bao, 1978 cited by Khang and Ogle, 2004; Eshwaraish, 1988 cited by Ali, 2002; Smith, 2001; Mohammed et al., 2005). Since shell thickness and egg shape index have been shown to be optimal, selection programmes geared at improving genetic potential for egg production traits in the studied ecotypes should be based on improving egg number, egg weight and age at sexual maturity. However, as with body weight, this will depends on the existence of substantial additive genetic variation for these traits in the two ecotypes for selection to be effective. In this case the *Medium* ecotype could be a good material to start with because it is somewhat superior to *Kuchi* with respect to these traits.

Mortalities

Results from Table 6 show that percent survivals up to 12 weeks of age were 91.9 and 70.8% for *Kuchi*, and 92.1 and 71.3% for *Medium* ecotype under intensive and extensive management systems, respectively. This corresponds to percent loss of about 8.1 and 29.2% for *Kuchi*, and 7.9 and 28.7% for *Medium* ecotype, res-pectively, indicating high mortality rate in both ecotypes under extensive management compared to intensive management. Differences between ecotypes in both management systems were not significant ($P > 0.05$). Causes of chick loss under extensive management were mainly diseases (42%) and predators (33%), while under intensive management system, apart from diseases (36%), cannibalism mainly at the age of 4 weeks and above also contributed a significant loss of 29% (Figure 1 and 2). Visible disease symptoms before chicks died under extensive management system were mainly swollen head, lesions in the head, diarrhoea (gastroin-testinal problems), emaciation/weakening, and sometimes respiratory signs, while under intensive management it was mainly diarrhea (gastrointestinal pro-blems). Further-more, a few chicks from extensive management system were sampled for further laboratory analysis at SUA and some of them were found to have worms.

Compared to the previous studies, the percent loss/mortalities under intensive management are within the range (0 to 24%) reported in literature (Nwosu et al., 1984; Pedersen, 2002; Demeke, 2003; Tadelle et al., 2003; Lwelamira and Katule, 2004). Regarding the values under extensive management, despite of the confinement of the chicks in the first ten days of their lives in the current experiment, percent loss/mortality rate were only

Table 5. Egg production and related traits (Lsmeans ± s.e) summarized by ecotype.

Ecotype	Trait	Lsmeans ± S.E	Minimum	Maximum
		Age at sexual Maturity (N = 300)		
Kuchi	**Age at first egg (Days)**	173.2 ± 0.8	142	236
		Egg number and egg quality (N = 296)		
	Egg Number (90-Days)	44.5 ± 0.5	23	78
	Egg weight (g)	45.0 ± 0.2	35	54
	Shell thickeness (μ)	37.3 ± 0.2	30	55
	Egg shape index (%)	74.8 ± 0.3	68	86
		Age at sexual maturity (N = 381)		
Medium	Age at first egg (Days)	167.92 ± 0.7	145	232
		Egg number and egg quality (N = 373)		
	Egg Number (90-Days)	48.9 ± 0.5	31	77
	Egg weight (g)	42.4 ± 0.2	34	53
	Shell thickeness (μ)	37.3 ± 0.2	32	54
	Egg shape index (%)	74.1 ± 0.3	65	85

Table 6. Cumulative survival/ mortalities up to 12 weeks of age summarized by management system and ecotype.

Management	Ecotype	N	No. Died/Lost	% Died/lost	No. Survived	% Survived	χ^2- Value
Intensive	*Kuchi*	645	52	8.1	593	91.9	0.04^{NS}
	Medium	823	65	7.9	758	92.1	
Extensive	*Kuchi*	554	162	29.2	392	70.8	0.28^{NS}
	Medium	690	198	28.7	492	71.3	

NS = Non-sigificant (P > 0.05).

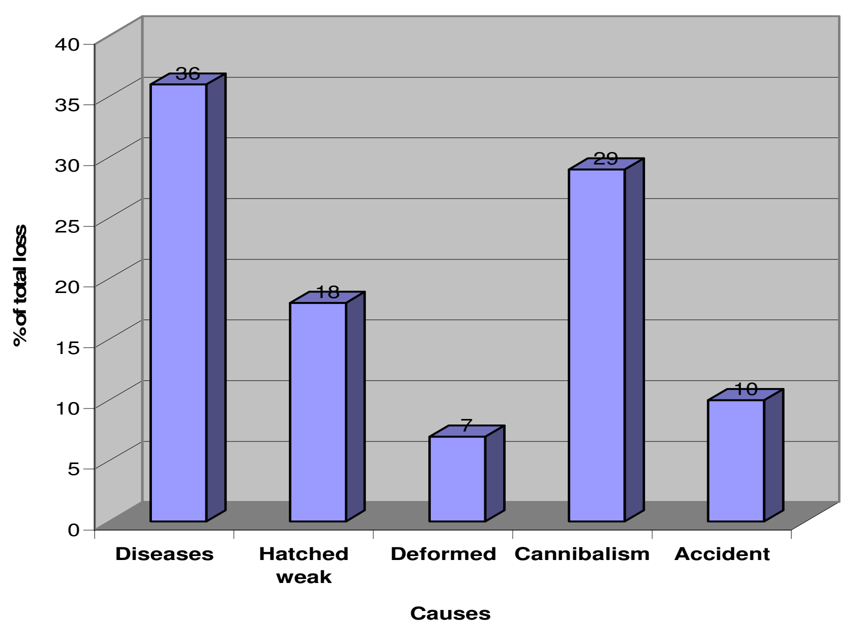

Figure 1. Causes of chick loss under on-station management.

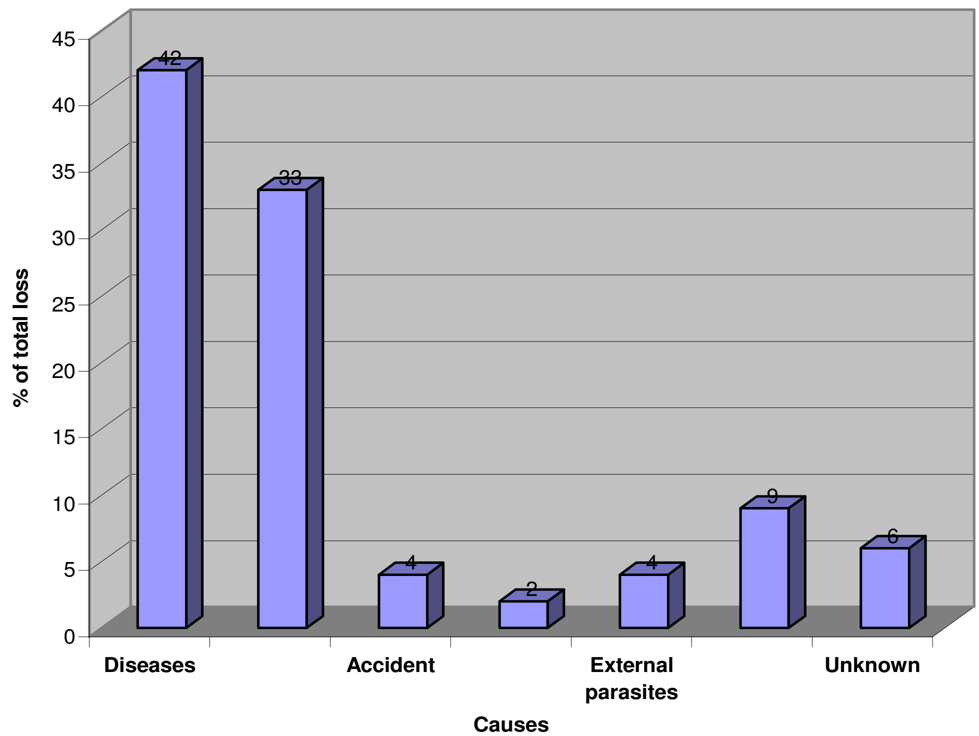

Figure 2. Causes of chick loss under on-farm management.

reduced by a small margin when compared to some other previous studies. For example, mortality rate up to 12 weeks of age under extensive management without early confinement of birds were reported to be 45% for Zimbabwean local chickens (Pedersen, 2002), and 41% for Botswana local chicks (Mushi et al., 2005) compared to the values close to 30% obtained in the current experiment under the same age. This could pose a threat to breeding programmes under extensive management. Hence, confinement of chicks for a bit longer period before being released to the field and regular disease control regimes seem to be required.

Conclusion

From the results of the present study it can be concluded that *Kuchi* was superior to *Medium* ecotype in terms of body weights and converse was true for age at sexual maturity (that is, age at first egg) and egg number. However, their performance can further be improved by improving both management system and improving their genetic potential through within ecotype selection. Since *Kuchi* ecotype was superior to *Medium* ecotype in terms of body weights and opposite was true for *Medium* ecotype in terms of most egg production and related traits. Therefore, *Kuchi* ecotype could be good starting genetic material for further improvement in body weight, and *Medium* ecotype in egg production traits.

ACKNOWLEDGEMENT

This study was part of Ph.D work of the senior author. Financial support of DANIDA through PHSL project at Sokoine University of Agriculture is highly acknowledged.

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