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308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
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Indigenous Chicken Ecotypes in Ethiopia: Growth and Feed Utilization Potentials

D. Tadelle, C. Kijora and K. J. Peters
Department of Animal Breeding in the Tropics and Sub-tropics, Humboldt University of Berlin,
Philippstr. 13, Haus 9, 10115 Berlin, Germany
E-mail: sarmeder@hotmail.com

Abstract: Growth performances and feed utilization potentials of six chicken populations were investigated at Debre Zeit Agricultural Research Centre, Ethiopia. Five local ecotypes originated from different Agro-ecologies and corresponding market sheds in Ethiopia, namely, *Tilili, Horro, Chefe, Jarso*, *Tepi,* and the Fayoumi breed was used as a reference breed. Ecotype had a significant ($p<0.01$) effect on overall body weight gain per bird and mean body weight gain per bird per day from day old to 12 weeks of age. The highest body weight gain per bird was recorded for Fayoumi chicks. The Fayoumi chicks were 11.9, 97.7 and 49.4% heavier than chicks from *Chefe* (heaviest locals at this age) ecotype, *Jarso* (least total body weight gain among the locals at this age) ecotype and mean daily gain of all local ecotypes, respectively at six weeks of age. *Chefe* chicks ecotypes showed 76.8% positive deviation over chicks from *Jarso* market sheds in terms of total body weight gain per bird at this age. The Fayoumi chicks consumed 41, 115 and 65% more feed than chicks from *Chefe* ecotype (highest body weight gain and feed intake among locals at this age), *Jarso* ecotype (lowest body weight gain and least feed intake among the locals at this age) and the mean feed intake of all local ecotypes, at six weeks of age, respectively. Among the local ecotypes, *Jarso* and *Tepi* had the smaller body weight gains while *Chefe* and *Tilili* had larger weight gains. The result from the analysis of variance showed a highly significant ($p<0.001$) difference on body weight gain per bird, average body weight gain per bird per day, feed intake per bird, average feed intake per bird per day and feed conversion ratio (feed: gain) among the different ecotypes and sex from six to 12 weeks of age. The highest body weight gain per bird and mean daily body weight gain per bird per day among the locals were recorded for *Tilili* growers. The Fayoumi chicks were 28, 77 and 52% heavier than chicks from *Tilili ecotypes* (heaviest locals at this age), *Tepi* ecotypes (least total body weight gain among the locals at this age) and mean body weight gain of local birds, respectively. Male growers from *Tilili ecotype* (heaviest locals at this age), *Tepi* ecotype (least total body weight gain among the locals at this age) and mean body weight gain of local birds, were 22, 30 and 33% heavier in body weight gain per bird over female chicken at twelve weeks of age, respectively. Feed conversion ratio was also significantly ($p<0.01$) affected by ecotypes. The highest feed requirement per unit gain was recorded for the Fayoumi chicks followed by chicks from *Tepi* and *Horro* chicks and the lowest feed requirement per units of gain was recorded for *Tilili* and *Chefe* chicks with feed conversion ratio of 4.95g and 5.2g feed per unit of gain, respectively.

Key words: Growth, feed utilization, local chicken ecotypes, Ethiopia

Introduction

Ethiopia has about 60% of the total chicken population of East Africa (Mekonnen *et al.,* 1991). Rural small holder farmers under scavenging management conditions raise more than 95% of this population. The remaining insignificant proportion is kept under the commercial production system.

As in most other Sub-Saharan African countries (Sonaiya, 1998), the largest proportion of the feed of village chickens in Ethiopia is based on free range Scavenging Feed Resources (SFR) constituting materials from the surrounding environment, byproducts from harvesting and processing of grains and cultivated and wild vegetation, which are frequently supplemented by household wastes (Tegene, 1995; Tadelle, 1996; Tadelle and Ogle, 2000). The amount of feed available for scavenging in relation to the carrying capacity of the land areas and flock dynamics across the different seasons and agro-ecologies is still not quantified. However, the protein and energy supplied from the SFR, as determined from chemical analyses of crop contents of scavenging local hens, were on average 8.8% and 2864 kcal/kg, respectively (Tadelle and Ogle, 2000). The protein contents are even lower during the short rainy and dry seasons, while energy supply is more critical during the drier months (Tegene, 1995; Tadelle and Ogle, 2000). These values are below the protein requirement of free ranging local hens of the tropics, estimated at about 11% CP/bird/day, and ME supply could meet the requirement of a non-laying hen only (Scott *et al.*, 1982), indicating limitations of the SFR in terms of nutrient supply to increased productivity. However, every egg or quantity of meat produced under the scavenging system represents a net increment to

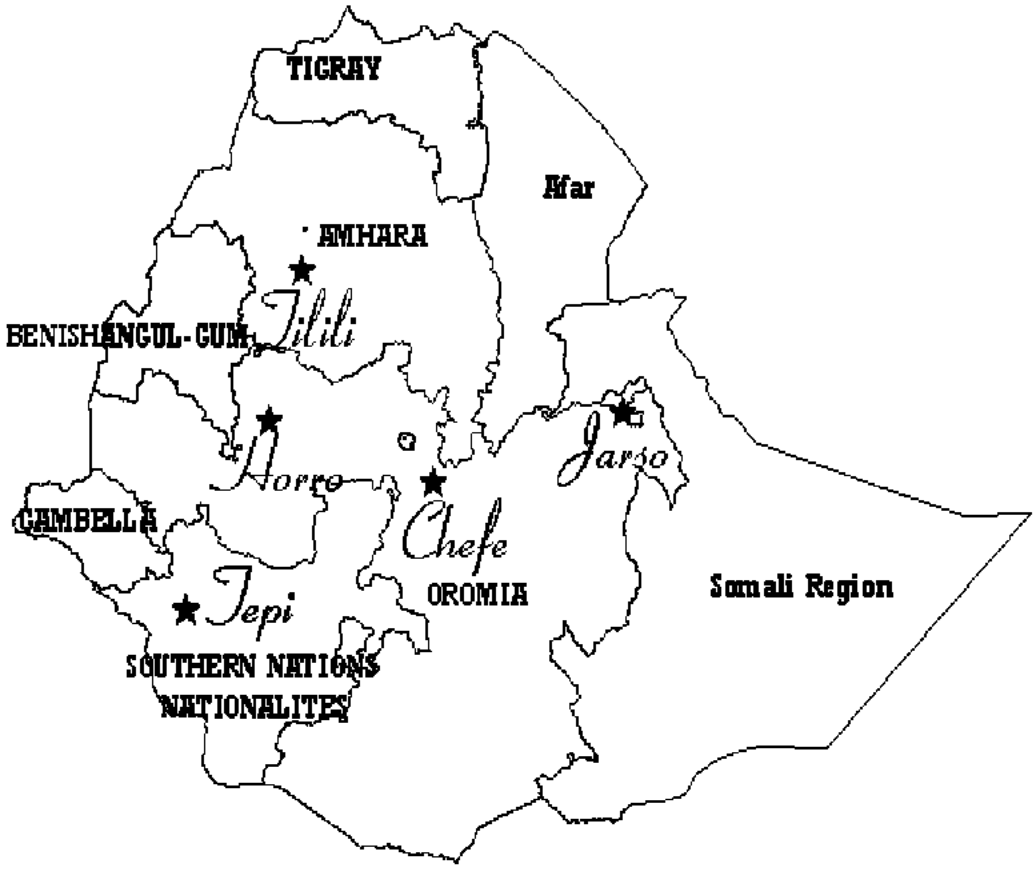

Fig. 1: Map of Ethiopia showing five of the Agro-ecological regions and corresponding market sheds where the chicks are originated

the family food supply besides the small cash income and other social functions it serves to the household. An on-farm supplementation of local birds with protein and energy nutrients gives significant improvement in egg production with little effort on growth and feed efficiency of the different ecotypes. Therefore, the main objective of this study was to investigate the feed utilization efficiency and growth potential of the different ecotypes from different ecological regions of the country under on-station management conditions.

Materials and Methods

The study site: An on-station growth and feed utilization performance evaluation of the different chicken ecotypes was conducted at the Debre Zeit Agricultural Research Centre, Ethiopia. Debre Zeit is located at 8° 44' latitude and 39° 02' longitude with an elevation of 1900 m.a.s.l. The average annual rainfall during the last 35 years was 825.4 mm, the average monthly temperature was 17.980 and the average monthly relative humidity was 52.4% (DZARC, 1999)

Study animals and management: This study involved five chicken ecotypes from five Agro-ecological regions and corresponding market sheds (Fig. 1), namely, 1=*Tilili*, 2=*Horo*, 3=*Chefe*, 4=*Jarso* and 5=*Tepi*. Eggs were collected from one representative village per market shed from each of the five agro-ecologies. The assumption is that marketing is the main cause of genetic admixture of chicken populations and in that within a market shed chicken have more homogeneity than chicken of other market sheds and eco-regions. Eggs were purchased from individual households and owners were requested to identify the hens from which eggs were purchased to avoid possible inclusion of eggs with exotic blood. In this study, the Fayoumi chicken breed was included as a reference breed. Fayoumi chicken are small, white-egg laying and originated from Egypt.

Eggs were transported to the respective nearest hatchery for hatching. Hatched chicks (one day old) were transported to the Debre Zeit Agricultural Research Centre. Even though the number of eggs purchased from each region were similar, the hatchablity was highly variable and the number of chicks hatched and used in

Table 1: Ingredients and proportion used in the starter and grower dites (% bases)

Ingredients	Starter	Grower
Corn	53.00	46.00
Wh. Short	17.00	24.00
Noug Cake	17.50	21.00
M&Bone meal	10.00	05.00
Salt	00.50	00.50
Pre-Mix	02.00	02.00
Lime Stone	-	01.50
Total	100.00	100.00

the trial were 484, 89, 227, 343, 132 and 315 chicks from *Tilili, Horro, Chefe, Jarso*, *Tepi* and Fayoumi ecotypes, respectively. Chicks from each ecotype were further randomly sub-divided into replicates based on the number of chicks available and placed in deep litter pens heated by electric bulbs until 6 weeks of age. At the age of 6 weeks, chicks were transferred to a rearing house till they were 12 weeks of age. Tef *(Eragrostis tef)* straw was used as litter material. Chicks were fed a diet containing 21.7% CP and 2784.1 Kcal ME/Kg from day one, while a growers' ration containing 16.2% CP and 2920.2 Kcal ME/Kg was fed from six to twelve weeks of age (Table 2).

Feed and water were provided daily *ad libitum*. Feed refusals was measured and recorded daily. Birds from each group were weighed every two weeks. All birds were vaccinated against Newcastle Disease (at day old and 21 days of age) which is considered as the only common infectious diseases in the country and treatment was given based on the recommendation of veterinarians.

Representative samples of the starter and grower rations were analyzed following standard procedures of the Association of Official Analytical Chemists (1985) (Table 1 and 2).

Data analysis: Analysis of variance was carried out on the collected data (SAS, 1987). The Duncan Multiple range test (Duncan, 1955) was used to locate means that were significantly different.

The statistical model used were:

Day old to six weeks of age:

$Y_{ijm} = \mu + g_i + e_{ij}$

Where:

Y_{ijm} = Individual phenotypic observation
μ = The population mean
g_i = Effect of ecotype (1….6)
e_{ijm} = Residual random error

Eight to twelve weeks of age:

$Y_{ijkl} = \mu + g_i + s_j + gsk + e_{ijkl}$

Where:

Y_{ijkl} : Individual phenotypic observation
μ :The population mean
g_i :The discrete ecotype effect (1….6)
s_j :The discrete sex effect
gsk :Interaction of the discrete effects of ecotype and sex
e_{ijkl} :Residual random error

Results

Performance of ecotypes from day old to six weeks of age: The analysis of variance showing the effects of ecotype on body weight gain per bird, feed intake and feed conversion ratio (feed: gain) from day old to six weeks of age with coefficients of variation of 25.3, 35.4, and 27.1, respectively, is presented in Table 3. The least squares means of performance from day old to six weeks of age is presented in Table 4. The ecotype had a significant ($p<0.01$) effect on body weight gain per bird and mean body weight gain per bird per day. Among the local ecotypes, *Jarso* and *Tepi* had the smaller body weight gains while *Chefe* and *Tilili* had larger weight gains. The differences between the former ones are not significant ($p>0.05$) whereas a significant ($p<0.05$) difference was observed between the later ones. However, the *Horro* ecotype gained weight significantly ($p<0.05$) less than both *Chefe* and *Tilili* ecotypes and significantly ($p<0.05$) more than that of *Jarso* and *Tepi* ecotypes. The highest body weight gain per bird and mean daily body weight gain per bird per day at this age was recorded for Fayoumi chicks. The Fayoumi chicks were 12, 98 and 49% heavier than chicks from *Chefe* ecotype (heaviest locals at this age), *Jarso* ecotype (least total body weight gain among the locals at this age) and the mean daily gain of all local ecotypes, at six weeks of age, respectively. *Chefe* Chicks showed a 77% positive deviation over chicks from *Jarso* market sheds in terms of body weight gain per bird at this age.

Feed consumption levels of the *Jarso* ecotype was the lowest with an average daily intake of 10.4g followed by that of *Horro* and *Tepi*, which are averaged 12.8 and 13.6g/day, respectively. The mean daily feed intake for all the local ecotypes was 13.6g/day while the Fayoumis consumed 22.4g/day per bird at this age. The *Chefe* and *Tilili* ecotypes consumed 14 and 12% more feed than the average feed consumption levels among the locals. However, *Jarso* and *Horro* ecotypes consumed 24 and 6% less feed than the average feed consumption of the locals, respectively. The Fayoumi chicks consumed 41, 115 and 65% more feed than chicks from *Chefe* ecotype (highest body weight gain and feed intake among locals at this age), *Jarso* ecotype (lowest body weight gain and least feed intake among the locals at this age) and the mean feed intake of all local ecotypes, at six weeks of age, respectively. Feed conversion ratio was also significantly ($p<0.01$) affected by ecotypes. The highest feed requirement per unit gain was recorded for the *Tepi* chicks followed by chicks from Fayoumi and *Horro* chicks and the lowest feed requirement per units of gain was recorded for *Chefe* and *Tilili* chicks with feed

Table 2: Nutrient composition of starter and grower diets (%, air-dry basis)

Diets	DM	CP	EE	CF	TA	Ca	P	ME Kcal/kg DM
Starter feed	91.6	21.7	5.9	7.5	9.5	2.3	0.3	2784.1
Grower feed	92.0	16.2	6.9	6.9	14.9	0.9	0.2	2920.2

conversion ratios of 4.5g and 4.9g feed per unit of gain, respectively.

Performance of ecotypes from eight to 12 weeks of age: The analysis of variance showing the effects of major factors in the model on different parameters from eight to 12 weeks of age is presented in Table 3. The result from the analysis of variance showed a highly significant ($p<0.001$) difference on body weight gain per bird, average body weight gain per bird per day, feed intake per bird, average feed intake per bird per day and feed conversion ratio (feed: gain) among the different ecotypes from eight to 12 weeks of age.

The least squares means for the performance of five local ecotypes and Fayoumi chicken under on station management conditions by ecotype from six to 12 weeks of age is presented in Table 4. Ecotype had a significant ($p<0.001$) effect on body weight gain per bird and mean body weight gain per bird per day. Among the local ecotypes *Tepi* and *Jarso* had the smaller body sizes while *Tilili* and *Chefe* had larger weights even though the differences between the different ecotypes is significant. Chicks from *Tepi* ecotype (least body weight gain among the locals at this age) showed a significantly ($p<0.01$) lower body weight gain per bird and mean daily body weight gain per bird than local chicks from the other four agro-ecological regions and the reference breed. The highest body weight gain per bird and mean daily body weight gain per bird per day among the locals were recorded for *Tilili* growers. At this stage of growth higher body weight were attained by growers from Fayoumi breed. The Fayoumi chicks were 28, 77 and 52% heavier than chicks from *Tilili ecotypes* (heaviest locals at this age), *Tepi* ecotypes (least total body weight gain among the locals at this age) and mean body weight gain of local birds, respectively. *Tepi* growers showed 39% negative deviation over growers from *Tilili* in terms of body weight gain per bird and mean daily body weight gain per bird per day.

The least squares means for the performance of five local ecotypes and Fayoumi chicken under on station management conditions by sex from eight to 12 weeks of age is presented in Table 5. As expected, it is also observed in this study that male chicks exhibited significantly ($P <0.001$) higher body weight gain compared to females from the same ecotype. Male growers from *Tilili ecotype* (heaviest locals at this age), *Tepi* ecotype (least total body weight gain among the locals at this age) and mean body weight gain of local birds, were 22, 30 and 33% heavier in body weight gain per bird over female chicken at twelve weeks of age, respectively.

There was a highly significant ($p<0.001$) difference in total and mean feed intake per bird per day among the different ecotypes. Feed intake (total per bird and mean per bird per day) was highest for the Fayoumi chicks followed by growers from *Tilili, Chefe, Horro, Jarso* and *Tepi* market sheds, respectively, which actually followed the same trend as observed in body weight gain and daily body weight gain. Feed conversion ratio was significantly ($p<0.01$) affected by ecotypes. The highest feed requirement per unit of gain was recorded for the Fayoumi growers followed by growers from *Tepi* and *Jarso* ecotypes whereas the lowest feed requirement per units of gain was recorded for *Tilili*, *Horro* and *Chefe* growers with feed conversion ratio ranging from 4.9 to 5.3g feed intake per unit of gain. Although sex has significant effect on total and mean feed intake, feed conversion ratio was not significantly ($p>0.05$) affected by sex.

The analysis of variance showing the effects of ecotype-sex interaction on body weight gain per bird, average body weight gain per bird per day, total feed intake, average feed intake per bird per day and feed conversion ratio (feed: gain) at twelve weeks of age is presented in Table 3. Ecotype-sex interaction had a significant ($p<0.001$) effect on body weight gain per bird and mean body weight gain per bird per day (Table 3). Among the local ecotypes, male growers from *Tilili* and *Horro* had the larger body weight gains at this age whereas female growers from *Horro* ecotype had the smaller body weight gain among all the local females. The highest feed requirement per unit of gain was recorded for female growers from *Horro* whereas the lowest feed requirement per units of gain was recorded for male growers from the same ecotype followed by male chicks from *Tilili, Jarso, Tepi* and *Chefe* ecotypes (Table 5 and 6) .

Performance of ecotypes from day old to 12 weeks of age: The analysis of variance showing the effects of ecotype groups on total body weight gain per bird, average body weight gain per bird per day, total feed intake, average feed intake per bird per day and feed conversion ratio (feed: gain) from day old to twelve weeks of age is presented in Table 3. The result from the analysis of variance showed a highly significant ($p<0.001$) difference in body weight gain and feed intake among the different ecotypes.

The least squares means for the performance of five local ecotypes and Fayoumi chicken under on station

Table 3: Means Squares from the analysis of variance for the performance of five local chicken ecotypes and Fayoumi under on station management in Ethiopia (0-6 weeks, 8-12 weeks and 0-12 weeks of age)Parameter

Sources of variation	d.f	Parameter				
		0-6 weeks of age				
		Gain (gram/bird)	Average Daily gain (gram/bird)	Total feed intake/bird (gram/bird)	Average daily feed intake (gram/bird)	Feed conversion ratio (feed: gain)
		MS	MS	MS	MS	MS
Ecotype	5	67001.4**	37.9**	2028337.5***	1149.8***	143.2**
Error	21	68.7	0.039	4557.2	2.6	0.34
R^2		0.99	-----	0.96	------	0.96
CV %		25.3	-----	35.4	------	27.1
		8-12 weeks of age				
Model	12	273900.8***	155.5***	8205581.8***	4650.9***	75.1***
Ecotype	5	26077.0**	14.9***	1090204.6***	617.5***	1.3***
Sex	1	50073.4***	27.4***	1894160.2***	1073.6***	0.04^{NS}
Ecotype* sex	5	2148.4***	1.2***	82193.6**	46.8**	1.2**
Error	18	0.005	0.001	13918.3	7.9	0.162
R^2		0.99	----	0.97	----	98
CV %		25.7	----	29.5	----	12.9
		Whole period (0-12 weeks of age)				
Ecotype	5	850173.1***	5.9***	1644817.9***	233.1***	0.55*
Error	18	7755.6	1.1	142657.6	20.2	0.8
R^2		0.96	----	0.97	----	0.97
CV %		27.9	----	27.0	----	14.8

d.f =Degrees of freedom; MS= Mean squares;

*=p<0.05 **= p<0.01; ***= p<0.001;

R^2 = adjusted value; CV= Coefficients of variation

Table 4: Least square means for the performance of five local ecotypes and Fayoumi chick*en under on station management* conditions in Ethiopia (0-6 weeks 6-12 weeks and 0-12 weeks of age),

Parameters	Ecotypes							
	Tilili (LSM ± SE)	Horro (LSM ± SE)	Chefe (LSM ± SE)	Jarso (LSM ± SE)	Tepi (LSM ± SE)	Mean (Local) (LSM ± SE)	Fayoumi (LSM ± SE)	Grand mean (LSM ± SE)
0-6 weeks of age								
Gain (g/bird)	128.8±3.1^{c}	102.9±4.8^{d}	147.3±3.7^{b}	82.4±3.4^{e}	87.2±4.8^{e}	109.7±1.7	165.6±4.8^{a}	119.1±1.7
Average daily gain (g)	3.1±0.07^{c}	2.5±0.11^{d}	3.5 ±0.1^{b}	2.0 ±0.1^{e}	2.1±0.1^{e}	2.6 ±0.4	3.9±0.11^{a}	2.8±0.04
Total feed intake/bird(g)	637.4±52.3^{b}	539.3±39.1^{bc}	670.3±30.2^{b}	436.6 ±27.6^{c}	569.7±39.0^{bc}	570.7±9.5	939.9±39.1^{a}	688.6± 13.8
Average daily feed intake(g)	15.2±1.2^{b}	12.8±1.0^{bc}	15.9±0.7^{b}	10.4 ±0.7^{c}	13.6±1.0^{bc}	13.6 ±0.23	22.4±0.1^{a}	16.4±0.4
Feed intake; g DM /day X g 0.75	0.96± 0.07^{b}	0.93±0.11^{b}	0.92±0.09^{b}	0.88±0.08^{b}	1.11±0.11^{ab}	0.96±0.19	1.38±0.11^{a}	1.03±0.04
FCR (feed:gain)	4.9±0.4^{c}	5.7±0.3^{b}	4.5±0.3^{d}	5.2 ±0.2^{c}	6.4±0.3^{a}	5.3±0.1	5.7±0.3^{b}	5.8±0.12
Mortality %	32.4±3.2^{a}	15.8±4.8^{b}	27.0±3.7^{ab}	25.1±3.4^{ab}	18.7±4.8^{ab}	24.0±1.9	3.9±4.8^{c}	20.6±1.7
6-12 weeks of age								
Gain (g/bird)	360.3± 0.4^{b}	289.4± 0.4^{d}	329.7± 0.4^{c}	277.2± 0.4^{e}	259.2± 0.4^{f}	303.1±0.02	459.6± 0.4^{a}	392.2± 0.02
Average daily gain (g)	8.6±0.01^{b}	6.9±0.01^{d}	7.9±0.01^{c}	6.6±0.01^{e}	6.2±0.01^{f}	7.2 0±0.01	10.9±0.01^{a}	7.8 ± 0.01
Total feed intake/bird(g)	1783.5±54^{b}	1393.3±54^{d}	1738.8±54^{c}	1511.4±54^{d}	1399.1±54^{d}	1632.0±24	2599.6±54^{a}	1793.3±21.9
Average daily feed intake(g)	42.0±1.3^{b}	33.2±1.3^{d}	41.4±1.3^{c}	35.9±1.3^{d}	33.3±1.3^{d}	38.9±0.6	61.9±1.3^{a}	42.7±0.5
FCR (feed:gain)	4.9± 0.2^{d}	5.0± 0.2^{cd}	5.3± 0.2^{b}	5.5± 0.2^{ab}	5.5± 0.2^{ab}	5.4 ±0.09	5.6± 0.2^{a}	5.5±0.08
0-12 weeks of age								
Day old body Wt (g)	30.7± 0.25^{c}	28.7± 0.37^{d}	32.4± 0.29^{b}	25.8± 0.26^{e}	26.0±0.37^{e}	28.7± 0.15	41.04± 0.37^{a}	30.8± 0.13
Total gain (g/bird)	478.8±39.4^{b}	428.8±50.9^{c}	466.1±39.4^{bc}	349.1±39.4^{d}	369.8±50.9^{d}	405.2±18.1	657.7±50.9^{a}	458.4±18.6
Average daily gain (g)	5.7±0.5^{b}	5.1±0.6^{c}	5.6±0.5^{bc}	4.2±0.5^{d}	4.4±0.7^{d}	4.8±0.2	7.8±0.6^{a}	5.5.±0.2
Total feed intake/bird(g)	2360.4±168b^{c}	2022.8±228.1^{c}	2409.1±168.9^{bc}	1926.3±168^{c}	2038.1±218.1^{c}	2216.0±70	3867.9±218.1^{a}	2541.6±79.6
Average daily feed intake(g)	28.1±2.0b^{c}	24.1±2.6^{c}	28.7±2.0^{bc}	22.9±2.0^{c}	24.3±2.6^{c}	25.6±0.8	46.1±2.6^{a}	30.3±0.95
Feed intake ; g DM /day X g 0.75	1.11±0.04^{c}	1.31±0.05^{ab}	1.31±0.05^{ab}	1.18±0.05^{bc}	1.21±0.05^{bc}	1.22±0.02	1.44±0.05^{a}	1.26±0.02
FCR (feed:gain)	4.95±0.4^{b}	5.72±0.5^{a}	5.20±0.0.4^{b}	5.63±0.4^{a}	5.7 2±0.5^{a}	5.62±0.16	5.93±0.0.5^{a}	5.64±0.2

^{abcd} Means within a row followed by different superscripts are significantly different,

FCR= Feed Convertion Ratio;

*=P<0.05; **= P<0.01; ***= P<0.001

Table 5: Least square means for the performance of five local ecotypes and Fayoumi chicken under on station management conditions by sex and ecotype in Ethiopia (6-12 weeks of age)

Parameter	Ecotypes							
	Tilili (LSM ± SE)	Horro (LSM ± SE)	Chefe (LSM ± SE)	Jarso (LSM ± SE)	Tepi (LSM ± SE)	Mean (Local) (LSM ± SE)	Fayoumi (LSM ± SE)	Grand mean (LSM ± SE)
Male								
Gain (g/bird)	382.2 ± 0.5^{a}	365.5 ± 0.5^{a}	349.5 ± 0.5^{a}	311.8 ± 0.5^{a}	304.1 ± 0.5^{a}	342.6 ± 0.03	512.4 ± 0.5^{a}	370.9 ± 0.2
Average daily gain (g)	9.1 ± 0.01^{a}	8.7± 0.01^{a}	8.3 ± 0.01^{a}	7.4 ± 0.01^{a}	7.2 ± 0.01^{a}	8.1 ± 0.01	12.2 ± 0.01^{a}	8.8 ± 0.01
Total feed intake/bird(g)	1996.6 ± 83.4^{a}	1611.2 ± 83.4^{a}	2013.3 ± 83.4^{a}	1605.3 ± 83.4^{a}	1572.9 ± 83.4^{a}	1849.8 ± 37.6	3049.3 ± 83.4^{a}	2049.7 ± 34.1
Average daily feed intake(g)	47.6 ± 2^{a}	38.4 ± 2^{a}	47.9 ± 2^{a}	38.2 ± 2^{a}	37.5 ± 2^{a}	44.0 ± 0.9	72.6 ± 2^{a}	48.8 ± 0.8
FCR (feed:gain)	5.2 ± 0.3^{NS}	4.4 ± 0.3^{NS}	5.8 ± 0.3^{NS}	5.2 ± 0.3^{NS}	5.2 ± 0.3^{NS}	5.4 ± 0.14	5.9 ± 0.3^{NS}	5.5 ± 0.1
Female								
Gain (g/bird)	338.3 ± 0.4^{b}	213.3 ± 0.4^{b}	309.9 ± 0.4^{b}	242.6 ± 0.4^{b}	214.2 ± 0.4^{b}	263.7 ± 0.02	406.8 ± 0.4^{b}	287.5 ± 0.18
Average daily gain (g)	8.1 ± 0.01^{b}	5.1 ± 0.01^{b}	7.4 ± 0.01^{b}	5.8 ± 0.01^{b}	5.1 ± 0.01^{b}	6.3 ± 0.01	9.7 ± 0.01^{b}	6.9 ± 0.01
Total feed intake/bird(g)	1530.5 ± 66.1^{b}	1175.4 ± 66.1^{b}	1555.8 ± 66.1^{b}	1417.5 ± 66.1^{b}	1225.2 ± 66.1^{b}	1414.2 ± 30.7	2149.9 ± 66.1^{b}	1536.8 ± 27.8
Average daily feed intake(g)	36.4 ± 1.6^{b}	28.0 ± 1.6^{b}	37.0 ± 1.6^{b}	33.7 ± 1.6^{b}	29.2 ± 1.6^{b}	33.7 ± 0.7	51.2 ± 1.6^{b}	36.6 ± 0.7
FCR (feed:gain)	4.5 ± 0.2^{NS}	5.5 ± 0.2^{NS}	5.0 ± 0.2^{NS}	5.8 ± 0.2^{NS}	5.7 ± 0.2^{NS}	5.4 ± 0.11	5.3 ± 0.2^{NS}	5.4 ± 0.1

^{abcd} Means within a row (both sexes) and columns (sex) followed by different superscripts are significantly different, *=P<0.05; **= P<0.01; ***= P<0.001

Table 6: Least square means for the performance of five local ecotypes and Fayoumi chicken under on station management conditions by ecotype-sex interaction in Ethiopia (6-12 weeks of age)

Parameter	Ecotypes							
	Tilili (LSM ± SE)	Horro (LSM ± SE)	Chefe (LSM ± SE)	Jarso (LSM ± SE)	Tepi (LSM ± SE)	Mean (Local) (LSM ± SE)	Fayoumi (LSM ± SE)	Grand mean (LSM ± SE)
Sex								
Male								
Gain (g/bird)	382.2±0.5^{b}	365.5±0.5^{c}	349.5±0.5^{d}	311.8±0.5^{e}	304.1±0.5^{f}	342.6±0.03	512.4±0.5^{a}	370.9±0.2
Average daily gain (g)	9.1 ± 0.01^{b}	8.7± 0.01^{c}	8.3± 0.01^{d}	7.4± 0.01^{e}	7.2± 0.01^{f}	8.1±0.01	12.2± 0.01^{a}	8.8±0.01
Total feed intake/bird(g)	1996.6±83.4^{c}	1611.2±83.4^{d}	2013.3±83.4^{b}	1605.3±83.4^{d}	1572.9±83.4^{d}	1849.8±37.6	3049.3±83.4^{a}	2049.7±34.1
Average daily feed intake(g)	47.6±2^{c}	38.4±2^{d}	47.9±2^{b}	38.2±2^{d}	37.5±2^{d}	44.0±0.9	72.6±2^{a}	48.8±0.8
FCR (feed:gain)	5.2 ±0.3^{bc}	4.4±0.3^{c}	5.8±0.3^{a}	5.2±0.3^{bc}	5.2±0.3^{bc}	5.4±0.14	5.9±0.3^{b}	5.5±0.1
Female								
Gain (g/bird)	338.3± 0.4^{b}	213.3± 0.4^{e}	309.9± 0.4^{c}	242.6± 0.4^{d}	214.2± 0.4^{e}	263.7±0.02	406.8± 0.4^{a}	287.5±0.18
Average daily gain (g)	8.1±0.01^{b}	5.1±0.01^{e}	7.4±0.01^{c}	5.8±0.01^{d}	5.2±0.01^{e}	6.3±0.01	9.7±0.01^{a}	6.9±0.01
Total feed intake/bird(g)	1530.5±66.1^{bc}	1175.4±66.1^{e}	1555.8±66.1^{bc}	1417.5±66.1^{cd}	1225.2±66.1^{de}	1414.2±30.7	2149.9±66.1^{a}	1536.8±27.8
Average daily feed intake(g)	36.4±1.6 ^{bc}	28.0±1.6^{e}	37.0±1.6 ^{bc}	33.7±1.6^{cd}	29.2±1.6^{de}	33.7±0.7	51.2±1.6^{a}	36.6±0.7
FCR (feed:gain)	4.5±0.2^{b}	5.5±0.2^{a}	5.0±0.2^{b}	5.8±0.2^{a}	5.7±0.2^{a}	5.4±0.11	5.3±0.2^{a}	5.4±0.1

^{abcd} Means within a column followed by different superscripts are significantly different, FCR= Feed convertion ratio *=P<0.05; **= P<0.01; ***= P<0.001; NS= Not significant

management conditions by ecotype from day old to 12 weeks of age is presented in Table 4. Ecotype had a significant ($p<0.001$) effect on total body weight gain per bird and mean body weight gain per bird per day. At this stage of growth higher body weight were attained by growers from Fayoumi breed. Among the local ecotypes, *Jarso* and *Tepi* had the smaller body sizes while *Tilili* growers had larger total body weight gains. Chicks from *Jarso* and *Tepi* ecotypes (least total body weight gains among the locals at this age) showed a significantly ($p<0.01$) lower total body weight gain per bird and mean daily body weight gain per bird than local chicks from the other three agro-ecological regions and the reference breed. The highest body weight gain per bird and mean daily body weight gain per bird per day among the locals were recorded for *Tilili* growers. The Fayoumi growers showed 36, 85 and 63% more body weight gain than chicks from *Tilili* ecotypes (heaviest locals at this age), *Jarso* ecotype (least total body weight gain among the locals at this age) and mean body weight gain of local birds, respectively. *Jarso* growers showed 35% negative deviation over growers from *Tilili* in terms of total body weight gain per bird from day old to twelve weeks of age. Feed consumption levels of *Jarso* ecotype was the lowest with daily average of 22.9g followed by that of *Horro* and *Tepi*, which are averaged 24.1 and 24.3g/day, respectively. The mean daily feed intake for all the local ecotypes was 25.6g/day while the Fayoumis consumed 46.1g/day per bird. The *Chefe* and *Tilili* ecotypes consumed 12 and 10% more feed from the average feed consumption levels among the locals. However, *Jarso*, *Horro and Tepi* ecotypes consumed 11, 6 and 5% less feed than the average feed consumption of the locals, respectively. The Fayoumi chicks consumed 64, 101 and 80% more feed than chicks from *Tilili* ecotype (with highest feed intake among locals at this age), *Jarso* ecotype (least feed intake among the locals at this age) and mean feed intake of all local ecotypes, from day old to twelve weeks of age, respectively. Feed conversion ratio was also significantly ($p<0.01$) affected by ecotypes. The highest feed requirement per unit gain was recorded for the Fayoumi chicks followed by chicks from *Tepi* and *Horro* chicks and the lowest feed requirement per units of gain was recorded for *Tilili* and *Chefe* chicks with feed conversion ratio of 4.95g and 5.2g feed per unit of gain, respectively.

Discussion

Results from this study show a large variation in growth and feed utilization potentials between the different ecotypes which agrees with other previous reports from Ethiopia and elsewhere in the tropics (Teketel, 1986; Olori, 1994; Sonaiya *et al.*, 1999; Tadelle and Ogle, 2001) who state that there are many ecotypes, breeds and strains of indigenous poultry that are well adapted to their production environments. According to Teketel (1986) and Shanawany (1987), the hatching weights of chicks followed the egg weight pattern in the parental population. The mean hatching weight of chicks from *Chefe* and *Tilili* ecotypes were bigger as compared to other three local ecotypes and at the increasing ages the differences which were indicated at hatching remained obvious. A more recent study at the Assela Livestock Farm revealed that the average egg weight of local chickens in Ethiopia is 38 g under scavenging conditions (Brännäng and Pearson, 1990) and according to Negussie (1999) the average egg weight of Fayoumi chicken was reported to be 46 g. This study showed that a 1g difference in egg weight increased to an 1.5g difference in body weight at hatch, to 7g at six weeks and to 32g at 12 weeks of age based on hatching weight and mean body weight gains of local ecotypes and Fayoumi chicken. This result showed similarity to the findings of Al-Murrani (1978) and Teketel (1986) where it was reported that 1g difference in egg weight was reflected in about 8 to 10g difference in chick weight at 2 months of age.

The mean body weight gain of local ecotypes in this study at eight weeks of age was 212g which is higher than reported by Tadelle and Ogle (2001), who reported 157g average body weight gain under farmers management conditions in the central highlands of Ethiopia even though both studies reported almost similar average hatching weights. This indicates that changing the management could bring measurable changes in the growth performances of local chicken ecotypes.

Mixed sexed local chicken ecotypes from Ethiopia had a mean body weight gain of 405g at 12 weeks of age ranging from 349 to 479g, which is lower than reported by Mafeni (1995) for the Cameroon indigenous chicken (538g) and higher than reported by Omeje and Nwosu (1984) for Nigerian chickens (371g) and Teketel (1986) for southern Ethiopian chickens (351g).

The average daily feed intake per bird among local ecotypes ranged between 23g for *Jarso* ecotype and 28g for *Tilili* ecotype illustrated the strong relationships existing in average daily body weight gain in the different genetic lines. The *Tilili* ecotype, with the average daily body weight gain of 5.7 g was the fastest growing and recorded highest feed intake per bird per day. The pooled correlation coefficient between body weight gain and feed intake in this study showed positive and significant relations. However, average feed intake per metabolic body weight showed the same trend except *chefe* and *Horro* ecotypes that consumed more feed per metabolic body weight.

The growth and feed utilization performances of ecotypes studied underlines the rather large difference between ecotypes with some exhibiting a remarkably higher performance levels than the other ecotypes which

is in agreement with reports of Mathur *et al.* (1989) and Nwosu (1979) that whenever evaluation schemes were implemented, it has been found that there are highly productive indigenous birds. Local ecotypes have a higher feed conversion efficiency, which might be perhaps due to their smaller maintenance requirements as compared to the Fayoumi chicken. This study has shown that the local ecotypes have the genetic ability to produce if properly managed. The growth performance of ecotypes studied underlines the rather large difference between ecotypes with some exhibiting a remarkably higher performance levels than the other ecotypes.

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