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Productivity and Egg Quality Traits of Sasso T44 Chicken in North Showa Zone, Ethiopia

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1 ABSTRACT

This study was conducted to egg quality traits of Sasso T44 chicken under traditional production system in North Shewa Zone, Ethiopia. Three districts were selected based on agro-ecology. From each district three kebeles were purposively selected, and simple random sampling was employed to select the respondents who had four and above Sasso T44 chickens. A total of 270 eggs were used to determine the internal egg quality traits. The collected data were analysed by statistical analysis system (SAS) Version 9.2. The study revealed that the external egg quality traits showed a significant difference (P<0.001) in egg weight, egg width, egg length, shell weight and shell thickness, but shape index had no significant difference. In addition, internal egg quality traits had significant difference (P<0.001) in yolk height, albumen height, yolk weight, albumen weight, albumen and yolk ratio except yolk colour and Haugh unit. Therefore, it could be concluded that the egg quality traits of Sasso T44 chicken encourages keeping them under traditional production system.

2 INTRODUCTION

The estimated poultry population in Ethiopia is 60.04 million, from which 88.5% indigenous, 6.25% cross and 5.25% exotic breeds (CSA, 2018). Several exotic chicken breeds have been disseminated for Ethiopian farmers to improve the egg and meat production in the country (Solomon, 2008). Mostly dual purpose and layer chicken breeds were distributed in the last 2 decades. Among the dual purpose breeds of chicken, Sasso T44 is one of the chicken breeds found in Ethiopia.

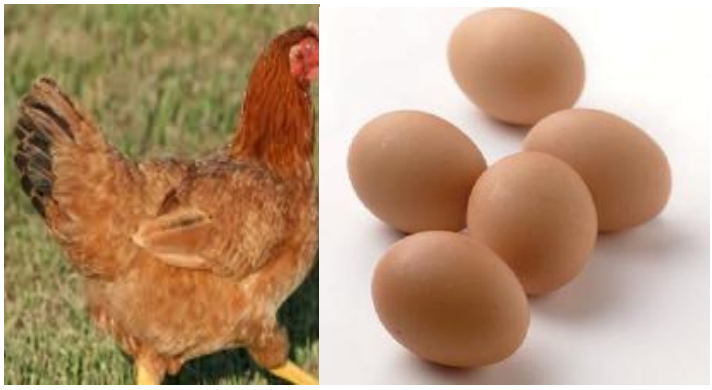

Figure 1: Sasso T44 chicken within light brown shelled eggs

Sasso T44 chickens are slow growing, robust, easy to manage, multi-coloured birds which can be grown under different rearing systems from traditional to intensive production system. Sasso T44 chicken consume more feed for every unit of egg produced. According to Osei-Amponsah *et al.* (2015) average feed intake of Sasso T44 is 145.1g/bird/day and feed conversation (FCR) 2.87. The body weight gain was higher than the local chicken. According to Richard *et al.* (2012), Sasso chicken had significantly higher weights (2.6-3.2 kg at 28 weeks) than the local chicken (1.2-1.7 kg) on the same duration. The body weight of male Sasso T44 chicken at sexual maturity was 2.98 kg and the weight of female Sasso T44 chicken at the age of greater than 20 weeks was 2.73 kg (Aman *et al.*, 2017). Egg production performance of Sasso chicken is better than local chicken. The average age at first lay for the Sasso T44 chicken in SNNPRs Region, Ethiopia was 5.95 months and the mean annual egg production was 229.14 under traditional production system (Aman *et al.*, 2017). The survival rate of Sasso chicken was 95- 97% for 19 weeks age, lay at first egg 165 days, laid 197 eggs/hen/year and 2.3 kg feed was consumed to produced 10 eggs, fertility rate of eggs 96.1%, hatching rate 78.8% and feed conversion ratio 2.45 (FAO, 2008). Sasso T44 chicken are sourced from private farms (mainly Ethio chicken) and highly distributed to smallholder farmers through the government agriculture office in North Shewa Zone, Ethiopia since 2014. However, the age of sexual maturity, the commencement of egg laying, annual egg production and egg quality traits in this Zone has not been studied yet under traditional production system. Thus, information is extensively needed to know the production performance and quality traits of eggs under farmer's management condition to take any remedial measures to improve the production and productivity of chicken. Therefore, this study was conducted to evaluate the productivity and egg quality traits of Sasso T44 breed under traditional production system in North Shewa Zone, Ethiopia.

3 MATERIALS AND METHODS

3.1 Description of the Study Area: This study was conducted in three districts (Tarmaber as highland, Ankober as mid-land and Kewot as low-land) of North Shewa Zone, Amhara National Regional State, Ethiopia, which is located 130 km of Northeast of Addis Ababa. Debre Berhan is the town of North Shewa Zone. North Shewa has three different agro -ecologies i.e. high land (>2500 m.a.s.l), mid land (1500 -2500 m.a.s.l) and low land (<1500 m.a.s.l). The annual temperature is ranged from 5°C to 32 °C. The estimated number of poultry population in this zone is 2,057,757 (CSA, 2017).

3.2 Method of Data Collection : For the evaluation of egg quality traits, the total of 270 (90 for each district) freshly laid egg from SassoT44 chicken in three districts were collected and taken to Debre Zeit Agricultural Research Institute (DZARI) for evaluation of both internal and external egg quality traits.

3.3 Evaluation of external egg quality: To determine the external egg quality measurements were taken like egg weight, egg length, egg width, shell weight and shell thickness. External egg quality traits such as egg weight and shell weight were measured using digital balance (g). Other external egg quality trait likes egg length, egg width and shell thickness was measured using Digital Calliper (mm). The shell thickens were measured at the three point (centre, broad and tip or end) and calculated average of the three was used one trait. In addition, egg shell ratio and egg shape index were calculated using the following formula.

$$\text{Shell (\%)} = \frac{\text{Shell weight}}{\text{Egg weight}} \times 100$$

$$\text{Shape index (\%)} = \frac{\text{Width of egg}}{\text{Length of egg}} \times 100$$

3.4 Evaluation of internal egg quality: A total of 270 eggs were used to determine the internal egg quality traits. The eggs were broken onto a flat surface. The thick albumen height (AH) was measured at its widest part at a position half way between the yolk and the outer margin. Yolk height was measured the centre part of yolk. The yolk was carefully separated from the albumen. Albumen and yolk weight were determined by weighing with electronic sensitive balance separately. The yolk colour was determined using the Roche Colour Fan with a standard colorimetric system ranged 1-15. Individual Haugh Units (HU) was calculated from the two parameters; height of albumen (AH) and egg weight (EW) (Haugh, 1937) using the formula.

$$HU = 100\log (AH - 1.7\, EW^{0.37} + 7.6)$$

Where, HU = Haugh Unit
AH= Albumen height in millimetres
EW= Egg weight in grams
Estimate YR and AR were used the following formula:

$$\text{Yolk (\%)} = \frac{\text{Yolk weight}}{\text{Egg weight}} \times 100$$

$$\text{Albumen (\%)} = \frac{\text{Albumen}}{\text{Egg weight}} \times 100$$

3.5 Statistical Analysis: The data were subjected to analysis of variance (ANOVA) using the general linear models procedure by Statistical Analysis System (SAS version 9.2) computer software (SAS, 2008). During data analysis, egg weight, shell weight, albumen weight, yolk weight, yolk height, albumen height, yolk diameter, yolk index, haugh unit, shell thickness were analysed .When the significant ($P<0.05$)difference were found between the districts, mean separation was undertaken using Turkey HSD test. The following model was used

$$Yij = \mu + \alpha i + eij$$

Where: Yij = the response variable, μ = overall mean, αi = the effect of i^{th} districts (i=1-3), and eij = random error.

4 RESULTS AND DISCUSSION

4.1 External egg quality trait: The mean of external egg quality trait is shown in Table 1. The average egg weight in the three districts were statically significant different ($P<0.001$). These differences might be due to different management practices, age of production stage and agro ecological factors. In addition, the egg width in Tarmaber district showed higher significance difference than both Ankober and Kewet districts ($P<0.001$). The average mean of egg lengths were 58.38, 56.46 and 55.26 mm in Tarmaber, Ankober and Kewet, respectively. These results was in line with the report of Nebiyu (2016) who reported that the average mean of egg length was 56.4±0.16 mm for Bovans brown layer breed. Shell thickness of an egg in Tarmaber district (0.35±0.03 mm) was slightly greater than in Ankober

(0.33±0.03mm) and in Kewet district (0.32±0.03mm). The difference might be due to agro-ecological variation as well as feed type which affects egg shell thickness; because as the temperature level increased the chicken feed intake decreased, the consequence not getting enough calcium for egg shell formation. This result was not agreement with the report of Sinha *et al.* (2017) average egg shell thickness was 0.39± 0.002 mm for Rhode Island Red. Niraj *et al.* (2014) also reported that the mean egg shell thickness of Rhode Island Red (RIR) was 0.41±0.04 mm and 0.39±0.03 mm for Bovans Whites. These variations might be due to breed and feeding management. The shape index of eggs across the three study districts were significantly differ at (P<0.05). The average shape index percentage in the study area was 76.97±4.02 which was round shape index. According to Sarica and Erenayin (2009); Duman *et al.* (2016), the shapes of egg most often encountered are sharp, normal and round eggs, and their shape indices were reported to be <72, 72-76 and >76, respectively.

Table 1: External egg quality trait (SassoT44 breed)

	Study District			
Quality parameter	**Tarmaber(H) (N=90)**	**Ankober(M) (N=90)**	**Kewet(L) (N=90)**	
External trait	Mean±SD	Mean±SD	Mean±SD	P-value
Egg weight (g)	65.57^{a}±5.26	57.43^{b}±4.61	54.88^{c}±5.23	<0.001
Egg width (mm)	45.21^{a}±2.33	42.89^{b}±1.94	42.66^{b}±2.23	<0.001
Egg length (mm)	58.38^{a}±2.83	56.46^{b}±2.76	55.26^{c}±2.92	<0.001
Shell weight (g)	8.31^{a}±0.84	6.76^{b}±0.80	6.49^{c}±0.84	<0.001
Shell thickness (mm)	0.35^{a}±0.03	0.33^{b}±0.03	0.32^{b} ±0.03	<0.001
Shape index (%)	77.52^{a}±3.95	76.08^{b}±3.88	77.32^{a}±4.22	0.034

$^{a-c}$ means within the row the same heading with different superscript which had different between in each study districts. H= highland; M= midland; L=lowland

4.2 Internal egg quality trait: Internal egg quality trait of SassoT44 chicken is indicted in Table 2. Yolk heights in the current study were 18.83±1.24, 18.79±1.04 and 18.29±1.07 mm for Tarmaber, Ankober and Kewet, respectively. The result was comparable with the report of Taddesse *et al.* (2015), yolk height revealed that 18.11±0.91mm for Bovans brown breed under village production system in East Shewa, Ethiopia. Desalew (2012) also reported that the mean yolk heights were 17.84 mm for Bovans Brown and 17.41 mm for Isa brown under village production system. This indicated that higher yolk height in the present study than the previous finding might be due to the freshness of eggs during analysis. The average height of albumen in Tarmaber district was 8.04±0.99 mm which was slightly higher than the mean of albumen height in Ankober (7.57±0.86mm) and Kewet districts (7.46±0.75mm).This might be due to agro ecological difference among the districts which could be the factor for albumen height difference. In line with the present study, Nebiyu (2016) reported that the mean albumen height was 7.1±0.08 mm for Bovans brown breed. There was no difference (P>0.05) in yolk colour in the three study area. The average mean yolk colour was 11.93±2.2, 12.17±2.02 and 11.98±1.86 in Tarmaber, Ankober and Kewet districts, respectively. The yolks colour during laboratory analysis was range from (7-15) colour. The lower yolk colour might be due to chicken feed household leftover feed type. Whereas high yolk colour (deep in yellowish colour) was due to the chicken were feed green plant and grain feed. In agreement with the present finding, Duman *et al.* (2016) reported that yolk colour analysis was 11.2. However, the result in this study was higher than the report

of Desalew (2012), Niraj *et al.* (2014), Taddesse *et al.* (2015) and Nebiyu (2016) in different breeds and in different areas. Haugh unit did not show significant difference (P>0.05) among the three study districts. Average means of Haugh unit (HU) in Tarmaber, Ankober and Kewet districts were 88.04, 87.58 and 87.78, respectively. The present finding was in line with the report of Taddesse *et al.* (2015) reported that Haugh unit value of Bovans brown breed was 87.45±6.35 for East Shewa, Ethiopia. Niraj *et al.* (2014) also reported that the value of Haugh unit of Bovans brown breed was 82.15±3.39 and Rhode Island Red was 83.67±3.78 which was lower than the current result. The higher in Haugh unit value in the present study than the previous findings might be due to the freshness of the eggs considered for egg quality traits analysis. Average yolk ratio was 24.9, 27.83 and 26.79 in Tarmaber, Ankober and Kewet districts, respectively. Yolk ratio showed significant difference (P<0.001) among the three districts. The result of the current study was less than the finding of Sinha *et al.* (2017) the yolk ratio was 33.85 for intensive production system. On the other hand, average albumen ratio was 61.80, 59.73 and 60.78 in Termaber, Ankober and Kewet districts, respectively. This result was nearly in line with the finding of Nebiyu (2016) who reported that average albumen ratio of Bovans brown layer strain was 58.7.

Table 2: Internal egg quality trait (SassoT44 breed)

Parameter	Study District: Tarmaber(H) (N=90)	Ankober (M) (N=90)	Kewet(L) (N=90)	
Internal trait	**Mean±SD**	**Mean±SD**	**Mean±SD**	**P-value**
Yolk height (mm)	18.83^{a}±1.24	18.79^{a}±1.04	18.29^{b}±1.07	0.002
Albumen height (mm)	8.04^{a}±0.99	7.57^{b}±0.86	7.46^{b}±0.75	<0.001
Yolk weight (g)	16.28^{a}±1.81	15.99^{a}±2	14.68^{b}±2.06	<0.001
Albumen weight (g)	40.56^{a}±4.41	34.47^{b}±3.17	33.41^{b}±4.22	<0.001
Yolk colour (RYCF)	11.93^{a}±2.2	12.17^{a}±2.02	11.98^{a}±1.86	0.716
Haugh unit	88.04^{a}±5.75	87.58^{a}±4.93	87.78^{a}±4.53	0.830
Yolk ratio	24.9^{c}±2.65	27.83^{a}±2.49	26.79^{b}±3.13	<0.001
Albumen ratio	61.80^{a}±3.42	59.73^{c}±3.27	60.78^{b}±3.38	<0.001

RYCF** =Roche yolk colour fan. $^{a-c}$ means within the row the same heading with different superscript which had different between in each study districts. H= highland, M= midland and L=lowland

4.3 Correlation between external egg quality traits: The correlation between external egg qualities traits is shown in Table 3. They were statistically significant (P<0.01) and positively correlated between egg weights with external egg quality traits such as egg width, egg length, shell weight and shell thickness. Similarly, Ukwu *et al.* (2017) reported that the correlations between egg weight with egg length, egg width, egg shell weight were highly positive and significant (P<0.01). These were a negative correlation between egg weight and shell ratio and a significant difference (P<0.05), this result was in agreement with the report of Simeon and Babatope (2017). Egg width showed significant difference (P<0.01) and positively correlated among egg length, shell weight and shape index. Significant difference and negative correlation was observed between shape index and egg lengths which are consistent with the finding of Nebiyu (2016).

Table 3: Correlation between external egg quality traits

Parameter	Egg weight	Egg width	Egg length	Shell weight	Shell thickness	Shape Index	Shell Ratio
Egg weight	1	0.551**	0.538**	0.619**	0.212**	0.23	-0.124*
Egg width		1	0.447**	0.353**	0.05	0.54**	-0.57
Egg length			1	0.21**	0.021	-0.509**	-0.223**
Shell weight				1	0.273**	0.148*	0.698**
Shell thickness					1	0.069	0.147*
Shape index						1	0.164*
Shell ratio							1

*Correlation is significant at P<0.05 level; **Correlation is significant at P<0.01 level

4.4 Correlation between internal egg quality traits: The correlation between internal egg qualities traits is indicated in Table 4. Yolk height had positive correlation with albumen height, yolk weight, albumen weight, yolk colour and Haugh unit, and this result was in line with the previous report of Nebiyu (2016). Albumen height and Haugh unit showed significant (P<0.01) and positively correlated. The result in the current study was similar with the finding of Bobbo *et al.* (2013). In this result the albumen height and Haugh unit were strongly correlated because an increase in albumen height value might be increased Haugh unit value during calculation because of albumen height the determinate factor of Haugh unit quality. As result good albumen storage condition high albumen value correspondingly high standard Haugh unit value which inducted good quality egg. In the current study, yolk weight was highly significant (P<0.01) and positively correlated with yolk ratio, but albumen ratio was negatively correlated with yolk weight. This result was comparable with the report of Nebiyu (2016). This implied that yolk weight is directly proportional with yolk ratio, and albumen ratio is directly proportional with albumen weight.

Table 4: Correlation between internal egg quality traits

Parameter	YH	AH	YW	AW	YC	HU	YR	AR
Yolk height	1	0.031	0.083	0.03	0.069	0.013	0.58	-0.013
Albumen height		1	0.059	0.057	0.12*	0.957**	0.094	-0.081
Yolk weight			1	0.076	0.097	0.091	0.736**	-0.62**
Albumen weight				1	0.051	0.3**	-0.582**	0.645**
Yolk colour					1	0.137*	0.036	-0.025
Haugh unit						1	0.145*	-0.127*
Yolk ratio							1	-0.847**
Albumen ratio								1

*Correlation is significant at P<0.05 level; **Correlation is significant at P<0.01 level

4.5 Correlation between internal and external egg quality traits: Correlation occurred between external and internal egg quality traits either positively or negatively as indicated in Table 5. This result was supported by the report of Islam and Dutta (2010) noted that correlations existed for both external and internal egg quality traits. The correlations between eggs weight with internal egg equality like yolk height, Haugh unit, yolk and albumen weight were positive and highly significant (P<0.01), which showed similarity with the finding of Debnath and Ghosh (2015). This implied that an increase egg weight resulted increase in yolk height, Haugh unit, albumen height, yolk weight and albumen weight. There

were positive correlations between eggs width with albumin ratio, yolk and albumen weight, but negative correlations observed with yolk colour and yolk ratio. In addition, egg length showed positive correlation with yolk weight, albumen weight, Haugh unit and yolk ratio (P<0.01). These were in agreement with the report of Sari *et al.* (2016) who reported that significant (P<0.01) and positive relationships were observed between egg length with yolk ratio, yolk and albumen weight. With regarding to egg shell thickness, significantly (P<0.01) and positively correlated with yolk and albumen weight but yolk and albumen height had no significant (P>0.05) difference. This result in the current study was comparable with the findings of Nebiyu (2016) who reported that a statistically significant positive correlation (P<0.05) found between shell thickness with yolk weight and albumen weight, but non-significant correlation observed between shell thickness with yolk height and albumen height.

Table 5: Correlation between internal and external egg quality traits

Parameter	Egg Weight	Egg Width	Egg length	Shell weight	Shell thickness	Shape index
Yolk height	0.16**	0.044	0.149*	0.122*	0.117	-0.118
Albumen height	0.154*	0.127*	0.076	0.164**	0.019	0.055
Yolk weight	0.569**	0.36**	0.396**	0.381**	0.203**	-0.026
Albumen weight	0.915**	0.612**	0.582**	0.655**	0.269**	0.642
Yolk colour	0.059	-0.062	-0.043	0.047	0.042	-0.018
Haugh unit	0.219**	0.121*	0.163**	0.127*	0.109	0.042
Yolk ratio	-0.32**	-0.217**	0.172**	-0.312**	-0.092	-0.049
Albumen ratio	-0.217**	0.168**	0.140*	0.027	-0.023	0.028

***Correlation is significant at P<0.05 level; **Correlation is significant at P<0.01 level

5 CONCLUSION

The external egg quality traits of Sasso T44 chicken were a significantly different in egg weight, egg width, egg length, and shell weight and shell thickness; however, there was no difference in shape index in the three districts of the study area. In addition, internal egg quality traits were significantly different in yolk height, albumen height, yolk weight, albumen weight, albumen ratio and yolk) except yolk colour and Haugh unit. As result, egg quality traits were different in different districts within the same breed in North Shewa Zone.

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7 COMPETING INTERESTS

The authors declare that they have no competing interests.

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