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Egg Quality Parameters Evaluation of Indigenous and Sasso Chicken in Sidama Region, Ethiopia

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Abstract: A study was conducted at Aleta Wondo district of Sidama Region to evaluate quality parameters of eggs collected from indigenous and Sasso chickens reared under a traditional management system. About 100 eggs from each chicken type were collected from households who keep indigenous or Sasso chicken. Eggs were transported to Hawassa university poultry farm for quality parameters analysis. External and internal egg quality analysis was done according to laboratory procedure. Collected data was analyzed using SAS (Version 9.0). Results indicated that eggs collected from Sasso chicken showed superiority over indigenous chicken's eggs for egg weight, egg length, egg width, shell weight, shell thickness and surface area. There is no significant difference on shape index and shell percentage of eggs collected from indigenous and Sasso chickens. Shape index recorded was 72.66 and 74.04 for indigenous and Sasso chickens respectively. Albumen weight was statistically higher for eggs collected from Sasso chickens (P<0.0001). Eggs from indigenous chickens have superiority over Sasso's eggs for yolk ratio, Haugh Unit and yolk albumen ratio. However, there is no significant variation on albumen height, yolk weight, yolk height, yolk color, yolk diameter and yolk index. It can be concluded that Sasso chicken produce heavier eggs than indigenous chicken. Yolk related parameters are similar for indigenous and Sasso chicken eggs produced at traditional management system.

Keywords: Aleta wondo, Egg quality, Indigenous chicken, Sasso chicken, Traditional management.

Research Paper

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INTRODUCTION

Indigenous chicken are dominant poultry type that accounts major part of sector especially in rural areas of Ethiopia (Melesse and Negessie, 2011). This is due to indigenous chickens are disease resistant, good scavengers, adaptable to harsh environment and produce high quality products. Nowadays, different chicken breeds are being distributed in the country through different organizations to develop chicken productivity mainly egg production. Sasso chicken breed is one mostly distributing in the region by government and non-government organizations.

Besides weight and physical appearance of live birds, the quality of their products affects marketability of chicken and acceptability of products to potential purchasers (Demissu, 2020). Egg quality is one of most important economic factor in poultry industry for both hatching and table eggs (Kocevski *et al.*, 2011). Quality of eggs and preserving that quality is a function of physical structure and chemical composition. Egg weight is also one of the important phenotypic trait that affects egg quality and reproductive fitness of the chicken (Islam *et al.*, 2001). Other internal and external traits like shell thickness, shell color, shape, albumen height, yolk volume and yolk color are major determinants of egg quality.

In the market egg consumers prefer indigenous chicken's eggs over eggs from exotic chicken. The market value of eggs from indigenous chicken is higher even if its size is smaller than exotic chicken's eggs. Regarding this variability there is lack research based answer that aims on what makes difference between the quality of eggs produced from indigenous and exotic chickens. This research was designed to assess the quality of indigenous and Sasso chicken eggs produced under traditional management condition. Sasso chicken was selected due to its high distribution in the region through governmental and non-governmental organizations as well as youth cooperatives.

MATERIALS AND METHODS

Description of study area

Present study was conducted at Aleta Wondo district of Sidama Region. Aleta Wondo is situated in

Sidama Region at distance of about 64 km South to Hawassa and 339 km south to Addis Ababa, capital city of Ethiopia. Aleta Wondo is situated in the coordinates of 60 35′ to 60 40′ north latitude and 380 25′ to 380 30′ east longitudes. Mean annual temperature ranging from 10^0c to 24^0c. Its elevation ranges from 1700 to 2500 *masl*. The average annual rainfall of the district ranges from 900 mm to 1400 mm (Aleta Wondo District report, 2013/14).

Laboratory analysis of eggs

Laboratory work was conducted at Hawassa University, College of Agriculture Poultry laboratory. One hundred eggs of each chicken type were collected from Aleta Wondo district and transported to Hawassa University. Eggs collected from households who own indigenous and Sasso chicken. Laboratory analysis was carried out as soon as eggs reached to the laboratory.

External egg quality traits

Egg weight and shell weight were measured using a digital balance (gm). Egg length, egg width and shell thickness were measured using a digital caliper (mm). Shell weight was measured after it was dried in an oven for 24 hours (Khatkar *et al.,* 1994). The shell thickness was measured using digital calipers at different points (center, broad and narrow ends), and the calculated average value was used for analysis (Mohammed *et al*., 2005). In addition, the eggshell ratio and egg shape index were computed using the following formula.

$$\text{Shell weight (\%)} = \frac{\text{Dry shell Weight}}{\text{Egg Weight}} * 100$$

$$\text{Egg shape index (\%)} = \frac{\text{Width of egg}}{\text{Length of egg}} * 100$$ (Van den Brand *et al.,* 2004).

$$\text{Surface area} = 3.9782 * EW^{0.7506}$$

Internal Egg Quality

For the internal quality traits, the eggs were broken into a flat surface. Thick albumen and yolk heights were measured using a tripod micrometer. 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 at the center part of yolk. The yolk was carefully separated from the albumen. Albumen and yolk weights were determined by weighing with an electronic sensitive balance separately (gm). The yolk color was determined using the Roche Color Fan (Roach scale), which contains 15 scales with a standard colorimetric system. Individual Haugh units (HU) were 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 millimeters, and EW= egg weight in grams.

Estimate YR and AR were used the following formula:

$$YR = \frac{Yolk\ weight}{egg\ weight} * 100$$

$$AR = \frac{Albumen\ weight}{Egg\ weight} * 100$$

$$\text{Yolk index} = \frac{\text{Yolk Height (mm)}}{\text{Yolk Diameter(mm)}} * 100$$

$$\text{Albumen yolk ratio} = \frac{\text{Yolk weight (g)}}{\text{Albumen weight(g)}} * 100$$

Statistical analysis

Data was analyzed using the general linear model (GLM) procedure of SAS (Version 9.0). Mean comparisons were conducted using Duncan's multiple range test. Values were considered significant at the 5% level of significance.

RESULT AND DISCUSSIONS

External egg quality parameters

External egg quality traits are presented in Table 1. Result indicated that there is high variation between egg weight of Indigenous and Sasso chicken reared under farmer's condition. Egg weight of Sasso chicken is significantly higher than that of indigenous chicken's eggs ($p<0.0001$). Egg weight value of present study is much more than the value presented by Welelaw *et al.,* (2018) who reported average egg weight of indigenous chicken 43.9 gram at different areas of Southern Ethiopia. In line with current study, Yonas *et al.*, (2019) presented statistically higher egg weight value of Sasso over indigenous chicken in Hawassa and Yirgalem districts of Sidama region. The reason for this variation might be genetic variation of both chickens. Sasso chicken breed is higher in weight than local chickens; this might cause variation on egg weight as egg weight and body weight of birds are positively correlated traits (Zita *et al*., 2009).

Regarding egg length, egg width, shell weight and surface area there are significant difference between eggs of Indigenous and Sasso chickens. Eggs collected from Sasso chicken breed showed statistically higher value than eggs collected from indigenous chickens. This superiority is connected with higher egg weight of Sasso over indigenous ones. Egg weight positively affects egg length, egg width, shell weight and surface area of chicken eggs. This is due to that egg weight is positively and strongly correlated with egg length, egg width, shell weight and surface area (Legesse and Kefyalew, 2023; Bertha 2015; Sezai *et al*., 2015). Higher egg length but lower egg width was reported for indigenous chicken by Serkalem *et al*., (2019), whereas similar result was given by similar authors on egg length and egg width of Sasso chicken breed with current result. Nearly similar value unimproved Horro chicken egg (52.73 egg length and 37.06 mm) was found by Demissu (2020).

Shell thickness showed statistically significant variation between Sasso and indigenous chickens in the

study areas (p<0.0001). Shell thickness is very important parameter of egg quality, that it prevents the entrance of egg contaminating agents in to the eggs. Thick shells are acceptable as egg with firm interior parts that is better recognized for successful hatching (Nushurin and Romanov 2002). Shell thickness is affected by quality and quantity of feed, by genetic factor, calcium and phosphorus availability and metabolism in the birds (Pelicia *et al.*, 2009). Higher value of shell thickness recorded from eggs collected from Sasso chicken during the present study might be due to one of above factors. Halima (2007) recorded too higher shell thickness (0.68-0.77 mm) of eggs from different indigenous chicken ecotypes than the value of present study.

Shape index of indigenous and Sasso chicken eggs show statistically similar values. Shape index value recorded in present study on both types of chicken is higher than the value presented by Markos *et al.*, (2017) on three indigenous ecotypes of Ethiopian chicken. However, much higher shape index value was reported by Berta (2015), who reported average shape index of 77.59% on Cobb-500 broiler hatching eggs. In agreement with present study 72.2% shape index was reported on eggs collected from indigenous chicken in South Sheko, Bench and North Bench districts of Southern Ethiopia (Welelaw *et al.*, 2018). Egg shape index recorded during present study on both chicken lines is categorized under normal shape group. Egg shape index is important to characterize species of birds, to determine egg quality, for better hatchability and chick survival and important in commercial system due to eggs out of normal shape are likely to be broken during shipment (Song *et al*., 2000; Mueller *et al*., 1960; Lundberg and Vaisanen, 1979; Sarica and Erensayin, 2009). According to this above explanation eggs produced from indigenous and Sasso chicken in the study area are acceptable as better quality eggs.

Table 1: External egg quality parameters of Indigenous and Sasso chicken in the study area

Egg quality Parameters	Breeds		Overall	p-value
	Indigenous (Mean±SD)	Sasso (Mean±SD)		
Egg weight (g)	49.41±445	55.21±5.657	51.68	<0.0001
Egg length (mm)	53.33±2.87	55.11±3.13	54.03	0.0004
Egg width (mm)	38.64±1.51	40.71±1.52	39.45	<0.0001
Shell weight (g)	4.35±0.60	4.71±0.73	4.51	0.0021
Shell thickness (mm)	0.23±0.07	0.31±0.03	0.26	<0.0001
Shape index (%)	72.66±4.95	74.04±3.94	73.2	0.0650
Shell percentage (%)	8.92±1.45	8.54±1.01	8.77	0.0725
Surface area (mm^2)	74.25±5.01	80.69±6.24	76.77	<0.0001

Vales presented in table are measured in gram.

Internal egg quality parameters

Internal egg quality parameters evaluation of indigenous and Sasso chicken in the study district is presented in Table 2. Result of the present study shows that eggs collected from Sasso chicken showed statistically higher Albumen weight than indigenous chicken's eggs (P<0.0001). Albumen weight record of Sasso during present study is much lower than the report of Fanu *et al.*, (2019) on Sasso chicken eggs, who reported 40.56 gram, 34.47 gram and 33.41 gram of albumen weight in different districts of North Shewa Zone, Ethiopia. Albumen weight measurement value on indigenous chicken during present study is higher than the values reported by Welelaw *et al.*, (2018) and Markos (2017) but in agreement with report of Ahmedin and Mangistu, (2016) who reported 25.05 gram on indigenous chicken ecotypes. Variation attributed between chicken types might be due to genetic based, because higher egg from Sasso chicken may contain higher albumen weight than indigenous chicken ecotype's eggs. This is due to positive correlation between egg weight and albumen weight of eggs (Sezai *et al*., 2014; Legesse and Kefyalew, 2023; Alipanah et al, 2013; Markos, 2017).

There is no significant difference on albumen height of eggs collected from indigenous and Sasso chickens. Albumen height recorded during present study is lower than the values reported by Markos (2017) on different indigenous ecotypes and also lower than report of Fanu *et al.*, (2019) on Sasso chicken reared under traditional management in different districts of Northern Shewa Zone. Numerically higher Haugh unit is seen on the eggs collected from indigenous chicken eggs than Sasso's eggs. In consistence with present study Yonas *et al.*, (2019) found higher Haugh unit value on both indigenous and Sasso chickens. Similarly, Fanu *et al.*, (2019) reported much higher Haugh unit on Sasso chicken than present result. Haugh unit is better indication of freshness of eggs so that eggs with high value of Haugh unit are fresher and less deteriorated than eggs with lower Haugh unit value. Haugh unit is also dependent on management system of birds, quality and quantity of feed, production environment and also storage condition of the eggs (Aberra *et al.*, 2012).

Present study's result indicates that there is no significant difference on yolk weight, yolk height, yolk color and yolk index of eggs collected from indigenous and Sasso chickens in the study areas. Yolk height recorded during present study on indigenous chicken

eggs is in line with findings of Yonas *et al.*, (2019) who reported yolk height of 15.77 mm and 15.90 mm at Hawassa and Yirgalem respectively, however, higher yolk height was reported by the same author on Sasso chicken eggs at Hawassa and Yirgalem districts of Sidama Region. Other important parameter in internal egg quality is yolk color of eggs which determine preference of the products by end users. Present study revealed that there is significant difference on yolk color between eggs collected from indigenous and Sasso chickens. Finding of the present study is in agreement with the repots of Halima (2007), who reported 9.25 and 9.75 R/scale values at Gelila and Guagua districts of Amhara region, and also the report of Yonas *et al.*, (2019) on indigenous and Sasso chicken eggs at Hawassa and Yirgalem. Fanu *et al.*, (2019) reported higher value of R/scale on Sasso chicken eggs. Similarly, Ahmedin and Mangistu (2016) reported 11.48 R/scale value on eggs collected from indigenous chickens at Eastern Hararghe Zone, Ethiopia. Variation attributed between these studies on yolk color might be due to type of ration and management system of the chickens. Zaman *et al.*, (2004) showed that eggs collected from scavenging birds have higher yolk color than intensified chicken's eggs due to scavenging birds can access insects and plants which are rich in xanthophylls. Indigenous chicken eggs have statistically higher yolk to albumen ratio than Sasso chicken eggs (P<0.0001). Berhanu *et al.*, (2022) reported 71.2 yolk albumen ratio on indigenous chicken at different agro-ecologies of Sidama Region. Demissu, (2020) reported 61.15%, 71.14% and 61.96% yolk albumen ratio on unimproved horro chicken at highland, midland and lowland agro-ecologies respectively. His report at highland and lowland agro-ecologies is in agreement with current report of Sasso chicken eggs.

Table 2: Internal egg quality parameters of indigenous and Sasso chicken in the study area

Parameters	Breed		Overall	p-value
	Indigenous (Mean±SD)	Sasso (Mean±SD)		
Albumen weight (g)	25.47±3.39	29.34±3.98	27.18	<0.0001
Albumen height (mm)	4.96±1.19	4.73±1.03	4.87	0.2016
Yolk weight (g)	17.86±1.96	18.73±2.81	18.20	0.0247
Yolk height (mm)	15.69±1.31	15.45±1.00	15.60	0.2106
Yolk diameter (mm)	41.40±1.79	42.31±3.30	41.75	0.0281
R/scale (1-15)	9.46±1.80	9.76±1.97	9.58	0.3266
Albumen ratio (%)	51.48±6.19	53.99±4.05	52.47	0.0053
Yolk ratio (%)	36.17±3.92	33.95±4.15	35.30	0.0008
Yolk index (%)	37.98±3.56	36.74±3.74	37.49	0.0388
Haugh unit (HU)	71.61±9.85	67.05±10.18	69.82	0.0056
Yolk Albumen ratio (%)	71.30±11.81	63.58±11.36	68.27	<0.0001

CONCLUSION

Present study was done on egg quality collected from indigenous and Sasso chickens reared under traditional production system at midland agro-ecology. Eggs collected from Sasso chicken breed showed superiority over indigenous chicken eggs for egg weight, egg length, egg width, shell weight, shell thickness and surface area. So Sasso chicken produces larger eggs than indigenous chicken when both chickens reared under farmer's management condition. Eggs from Sasso chicken weigh higher albumen weight and yolk weight than indigenous chicken eggs due to higher egg weight of Sasso chicken. However, eggs produced by indigenous chickens may have better traits for yolk ratio, yolk index, Haugh unit and yolk albumen ratio. During present study yolk color remains similar to eggs collected from both chicken types; so that we can conclude that yolk color is mainly dependent on feed types and production system of the chicken.

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