Research Article

EVALUATION OF EGG LAYING AND EGG QUALITY PARAMETERS OF LOCAL CHICKEN SAKINI (*Gallus gallus domesticus*) OF NEPAL

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ABSTRACT

Eggs are the important and easy sources of protein for the people of rural areas. Moreover, eggs from local chickens are popular and fetch good value. Therefore, this study mainly aimed at evaluating egg laying and egg quality parameters of Sakini (*Gallus gallus domesticus*) of Nepal to understand the reproductive fitness of the chicken and correlation among the parameters. For this, a total of 30 eggs (10 each) collected from the chickens of three agro-ecological zones (AEZs), representing terai, mid-hill and high-hill and of similar age groups after one month of egg laying. These chickens were raised in same environment and management condition at Swine and Avian Research Program(SARP), Khumaltar. Egg laying per hen per year was calculated for the chicken from each AEZs and was found highest for high hills (140). Egg weight (EW), Egg Length (EL), Egg Breadth (EB), Yolk weight (YW), Shell Thickness (ST), Dry Shell weight (DSW), Albumen weight (AW) were the parameters recorded. With this, Least square means and Standard Errors (LSM±SE) for Egg volume (EV), Surface Area (SA), Shape Index (SI) and Breaking Strength (BS) were calculated. In all cases, the eggs from the Sakini from high hills were better in terms of EW(47.45g), YW(13.6g) and AW (29.28g). Similarly, EV (42.02 cm^3), SA(73.06 cm^2), SI(0.75) and BS(1718.74g) were also higher for the eggs from high hill chickens. This result showed that the Sakini from high hills can be selected and their genetic potentiality of egg laying and egg parameters can be explored to improve the native Sakini breeds in the other regions, of Nepal.

Key words: egg, native, breed, quality, value

INTRODUCTION

Local chickens are kept in many parts of the world irrespectively of the climate, traditions, life standard, or religious taboos relating to consumption of eggs and meat (Tadelle, 2003). To the poor majority in rural areas, local chickens serve as an immediate source of protein (as egg and meat) and income when money is needed for urgent family needs (Ekue et al., 2002). It constitutes a significant contribution to human livelihood and contributes significantly to food security (Gondwe, 2004). The local chickens are known for various merits. They are cheaply reared as scavenging flocks by feeding household leftovers, they need a small house or shelter to spend their night while free ranging during the day, and their meat and egg tastes are preferred over those of exotic chickens (Bhurtel, 1998; Roberts, 1999; Dessie and Ogle, 2001). Most important, they are known for their adaptation superiority in terms of their resistance to endemic diseases and other harsh environmental conditions. However, local chickens are poor performers in terms of growth rate (hence meat production) and egg production. Most of them are of small adult size and lay small sized eggs when

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compared to improved commercial broiler or layer birds, respectively (Pedersen, 2002; Gondwe, 2004) but are popular for good broodiness and mothering ability (Bhurtel, 1998; Pokharel et al., 2012). In contrary, commercial chickens were mainly raised for income i.e. broiler, layers and dual purpose breeds as they give higher quantity of meat and larger number of eggs.

The importance of egg shell quality has been greatly realized, as the problems arising from handling and marketing of eggs warrant their serious considerations. Results of various studies shown that shell thickness, shape, size of eggs affect its strength (Curtis et al., 1985; Janson et al., 1987). Also, the quality traits of an egg are those that affect its acceptability to the consumer. Hence, to maintain superiority in the overall quality of an egg, continuous genetic evaluation of different egg quality traits has become essential in today's production oriented market (Sreenivas et al., 2013). In addition to this, information on egg shell quality of local breeds (Sakini) is very limited. Therefore, this investigation was carried out to estimate different egg quality parameters of local chicken (Sakini) of Nepal maintained at Swine and Avian Research Programme (SARP), Khumal complex, Khumaltar and to understand the reproductive fitness of chicken and correlation of parameters of eggs from chickens of three agro-ecological zones.

MATERIALS AND METHODS

Source of chickens and sample size

Local chickens were collected from different agro-ecological zones (AEZ) of Nepal. For Terai, western part of Chitwan (an altitude of 150-250 m) where mainly ethnic community (Darai, Tharu etc) resides, local chickens were selected and procured to SARP, Khumaltar. For Mid hills, northern hills of Nawalparasi with an altitude of around 1000-1500 m were selected where mainly Magar community resides and for High hills, lower part of Rasuwa district (altitude of around 2200-2500m) where mainly Tamang community resides was selected as the collection center. While collecting chickens, it was considered that they were from true to type Sakini breed and were unrelated up to two generations. These chickens were raised at SARP, NARC, Khumal complex under same environment and management. The eggs from all these chicken brought from different agro-ecological zones were collected after a month of egg laying to measure different egg quality parameters.

Egg measurements and quality parameters

All eggs for incubation were sorted against cracks, morphological deformities, and dirty (soiled) before acquiring egg weight, egg length, egg breadth, and egg volume. Eggs were weighed (in grams) on digital scale while egg length and egg breadth were measured using a Vernier calipers. The values of the egg length (L) and egg breadth (B) were used to determine the egg volume (V) (cm^3) using Hoyt's (1979) equation ($V=Kv*LB^2$) where the estimated volume coefficient (Kv=0.507) is applicable to all eggs which are not very pointed.

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(1979) equation **($V=Kv*LB^2$)** where the estimated volume coefficient (Kv=0.507) is applicable to all eggs which are not very pointed. Shape Index (SI) for an egg was computed as the ratio between its B and L.

Statistical analysis:

Data on EW, SI, ST, SA and BS of local chicken and commercial dual purpose poultry breeds in Nepal were entered in Ms Excel and respective formulae were used to calculate values for each parameter studied. Statistical tools used were GenStat for windows 10th edition for the analysis of Mean and Standard Errors and other simple statistics.

Parameters' description:

Egg weight (EW, g): The Egg Weight (EW) was measured with an electronic balance to the nearest 0.01 g.

Shape Index (SI): The shape index was calculated using the following formula given by Anderson et al., 2004.

SI = B/L X 100 (where B=Breadth of egg; L = Length of egg)

Shell Thickness (ST, mm): Thickness was measured after removing the internal membranes of the eggshell. A precision micrometer was used to the nearest 0.01mm. Average shell thickness of each egg was computed as the average of the three measurements of egg shell thickness.

Surface Area (SA, cm^2): Surface area of the egg was computed from L, B and EW using Carter formula (1975).

Surface Area (SA), $cm^2=4.5118*L^{0.289}*B\text{^}0.3164*EW\text{^}0.4882$

Breaking Strength (BS, g): The expected egg shell Breaking strength (BS, g) of each egg was computed from its Egg Weight (EW) using the formula as suggested below (Arad and Marder 1982).

Breaking Strength (BS)=50.86*EW^0.915

RESULTS

Egg laying

The overall average egg laying per hen per year from Sakini chickens of different AEZ at optimum management condition at Khumal complex under intensive system was 112 against the total egg laid under backyard farming (60-70) (Neopane, 2004). This showed that management system and feeding increases the egg laying of Sakini chicken. The egg laying for the Sakini chicken from high altitude had more average eggs per hen per year (140) compared with Terai (99.9) and mid hills (95.8). The results obtained is presented in Table (1) which is really encouraging and need to be verified under different locations.

Table 1. Egg laying (egg per hen per year) from Sakini chickens of different AEZ under optimum management condition at Khumal complex under intensive system

AEZ	Average egg/hen/yr	Std Deviation
Overall	111.9	24.4
Terai	99.9	23.4
Mid Hill	95.8	27.2
High Hill	140.0	35.3

Egg parameters

When egg weight, length, breadth, and volume were compared for local Sakini chickens across different AEZ (Table 2), significant differences ($p<0.05$) were found among the breeds. All eggs from high hills were heavier and longer than those from Terai and mid hill. Other measurements such as egg length and egg breadth were also recorded for the calculation of Egg Volume for different breeds of chicken. Egg volume was highest for eggs from chicken of High hill (42.02 cm^3) followed by Terai (39.51 cm^3) and lowest for mid hills (38.92 cm^3).

Table 2. Mean Egg Weight, Length, Breadth and Volume of local chicken from different AEZs

AEZ	No.	Egg weight (g)	Egg Length (cm)	Egg Breadth (cm)	Egg Vol (cm^3)
Terai	10	42.69±0.65	4.97±0.03	3.96±0.02	39.51±0.40
Mid-hills	10	43.55±0.88	5.18±0.03	3.85±0.04	38.92±0.41
High-hills	10	47.45±0.68	5.34±0.04	3.94±0.02	42.02±0.57
Overall	30	44.564±0.70	5.159±0.03	3.914±0.02	40.068±0.53

No. refers to the number of eggs taken for observation

Table 3. Comparison of means and standard Error (SE) of yolk weight, albumen weight and shell weight (dry & wet) in different chicken breeds (g)

AEZ	No.	**Mean** ± SE				
		fresh shell wt (g)	oven dry shell wt (g)	Shell Thickness (mm)	yolk wt (g)	Albumen wt (g)
Terai	10	5.11±0.08	3.85±0.06	0.35±0.02	12.40±0.20	23.80±0.24
Mid-hills	10	5.23±0.09	4.11±0.09	0.59±0.04	12.66±0.20	26.78±0.59
High-hills	10	5.39±0.21	4.56±0.09	0.48±0.03	13.60±0.21	29.28±0.38
Overall	10	5.24±0.09	4.17±0.08	0.43±0.01	12.87±0.29	26.52±0.53

No. refers to the number of eggs taken for observation

Along with above parameters measured, means and SE for other egg parameters such as Fresh shell weight, oven dry shell weight, yolk weight (g) were measured and albumen weight (g) were calculated for all the eggs from different AEZ. Also shell thickness (mm) was measured the

highest value was found for mid hill. In deed for all the egg parameter measured, highest value was found for the eggs from high hills (Table 3).

In addition, yolk and albumen weight was found highest for GR chickens (14.6 g and 30.80 g), and the lowest value was for Sakini breed (13.87 g and 26.515 g).

Table 4. Agro-ecological zone wise mean EW, ST, SI, SA and BS of eggs of local chicken

AEZ	No.	SI(B:L)	SA(cm^2)	BS(g)
Mid Hills	10	0.76±0.007	71.51±1.31	1663.43±41.88
Terai	10	0.77±0.008	68.75±1.22	1575.02±41.24
High Hills	10	0.75±0.009	73.06±1.31	1718.74±42.66
Mean	10	0.76±0.005	70.79±0.78	1641.34±25.81

Note: No. refers to the number of observations; EW –Egg weight; ST- Shell Thickness, SI- Shape Index; SA- Shell Surface Area; BS- Shell Breaking Strength

Means for SI- Shape Index, SA- Shell Surface Area and BS- Shell Breaking Strength was calculated along with its standard errors (Table 4). Among the different AEZ, Shape Index (SI) was highest for Terai (0.77) while Surface area (SA) and Breaking strength (BS) was higher for eggs of High hills chickens which were 73.06 cm^2 and 1741.34g, respectively.

Least square means and standard errors (SE) of the different egg shell parameters of different chicken breeds are presented in table (5). While comparing EW, SA and BS among different breeds, GR eggs showed the highest value followed by NH and the value was lowest for Cornish breed (Table 5). The greatest force needed to rupture eggs was related with high SI values. Comparing pure lines, NH, GR and Sa (>76) had high SI value in descending order with low SI for BA and Cor (75).

Table 5. Least square means and standard errors of different egg parameters in indigenous and exotic chickens

Breed	No.	EW(g)	ST (mm)	SI(B:L)	SA(cm^2)	BS(g)
GR	20	50.31±1.03	0.500±0.021	0.77±0.006	76.53±1.09	1834.11±34.48
NH	20	49.34±0.85	0.510±0.018	0.79±0.004	75.53±0.89	1801.46±28.38
BA	20	46.94±0.71	0.525±0.016	0.75±0.006	73.16±0.76	1721.18±23.72
Cor	20	43.91±0.78	0.515±0.033	0.75±0.005	70.66±0.89	1619.09±26.32
Sa	30	44.56±0.77	0.434±0.016	0.76±0.005	70.79±0.78	1641.34±25.81

Note: No. refers to the number of observations; EW –Egg weight; ST- Shell Thickness, SI- Shape Index; SA- Shell Surface Area; BS- Shell Breaking Strength

DISCUSSION

External egg quality traits, particularly egg weight, shell weight, width and length are important parameters to consider during selection for improvement in live weight of the local chicken (Parmar et al., 2006). Higher egg weight (47.45 g), egg volume (42.0cm^3) and surface area (73.06 cm^2) for the egg from high hill chicken influencing its egg quality and reproductive fitness of the chicken as it plays a significant role in the process of embryo development and successful hatching

while the size of the hatching egg influences body weight of chicks up to maturity as suggested by (Islam et al., 2001; Farooq et al., 2001). This result can be linked with growth performances from earlier studies on Sakini chicken suggesting the higher weight of chickens from high hills (from Rasuwa district) raised under intensive system (Sapkota et al. 2013).

Egg weight in local chickens can be predicted using egg width, egg length and shell weight as these factors are significantly correlated (Proudfoot and Hulan, 1981). The egg weight gradually increases as hen's age increases reflecting the positive correlation between egg weights and age of the laying hen (Niranjan et al., 2008). This weight is positively correlated to yolk, albumen and shell that the egg contains and varies with genetic groups of chickens (Pandey et al., 1986) as reflected in our study. Egg yolk accounts for slightly over 30% of total egg weight. However, albumen represents the largest proportion of the egg being estimated to be 58.5% of the total egg of which 88% is water and 12% is protein (Hunton, 1987) thus it is important to consider the weight of yolk and albumen weight which is higher for the eggs from high hill chickens.

CONCLUSIONS

Egg production per hen per year (egg number) and the related egg quality traits such as egg weight, egg volume, surface area, yolk weight, albumen weight and calculated Breaking strength and Shape Index were higher in eggs laid from high-hill chicken suggesting the need to make further efforts on improving the productivity of indigenous chickens through selection and crossbreeding with local chickens of other regions.

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