Study on External Egg Quality Parameters and Hatchability of Sakini Breed in Swine and Avian Research Program, Lalitpur, Nepal

M. Dahal [1], N. Yadav [2] and P. Tamang[2]*

[1] Swine and Avian Research Program, Nepal Agricultural Research Council, Khumaltar Lalitpur
[2] Himalayan College of Agricultural Sciences and Technology, Kirtipur, Kathmandu

*Corresponding author: dr.maheshwardahal@gmail.com

ABSTRACT

Eggs are an important and convenient source of protein for those living in rural regions. In addition, eggs from local hens are popular and traded for a fair price. As a result, the primary goal of this study was to evaluate egg laying and egg quality parameters in Sakini (Gallus gallus domesticus) from Nepal in order to better understand the chicken's reproductive fitness and the relationship between the parameters. For this, a total of 120 eggs from different weeks (30 from each week) weretaken as a sample. The egg sample was collected from the birds of different ages i.e. 43rd, 48th, 56th, and 57th weeks. These chickens were raised in the same environment and management conditions at Swine and Avian Research Program (SARP), Khumaltar. Eggs were candled during incubation, i.e., on the 18th day. A strong light was held under the eggs to observe their fertility during candling of eggs. External egg quality parameters like Egg weight, Egg length, Egg breadth, Shape index and Egg color weremeasured. Fertility and hatchability percentages were calculated. The findings have shown that the highest fertility rate was observed for the 48.47 ±0.71 gm egg weight groupi.e., 80 %. However, the highest overall hatchability was observed in the 48.73±0.68 gm egg weight group which is 70 %. On the basis of their shape index, there is significantly highest (P<0.01) fertility rate was observed in the 67.26 ± 0.56 group that is 70 %.

Keywords: *Sakini, Egg weight, Fertility, Hatchability, Shape index*

INTRODUCTION

Nepal's most significant economic sector is agriculture. As a result, the agricultural sector's development is essential to the nation's economic progress. Agriculture is the main product, and it feeds over 65 percent of the population (Kattel, 2016). Agriculture is incomplete without livestock, which includes poultry. Around the world, poultry farming is a large and diverse element of agriculture (Neupane *et al.*, 2019) One of Nepal's fastest-growing animal businesses is poultry raising. It contributes significantly

to the contemporary Nepalese economy, contributing for 9% of the country's agricultural GDP and 17.4% of total meat production (DLS, 2018). The poultry industry is separated into two sub-sectors: modern and traditional. Each has its unique characteristics that distinguish them in terms of their contribution to national food security (Ekue *et al.*, 2002). The percentage of backyard chicken (indigenous) production in overall poultry output is around 50%, and this tendency is expected to continue (DLS, 2018). Indigenous chicken has a major socio-economic purpose in rural areas by supplying animal protein, additional financial earnings, and religious concerns. The Sakini chicken is Nepal's main indigenous breed. It may be found in all agro-ecological zones and is widely dispersed across the country.

Sakini chickens are well-known as a good backyard poultry breed for resource-poor environments where they are grown using a traditional scavenging management style (Sapkota *et al.*, 2020). They are dual- purpose breeds with a small body size, colorful plumage and a reputation for exceptional meat and egg production.(Gorkhali *et al.*, 2021). Because of their flavor, taste, and nutrition, consumers prefer local chicken products (Markos, Belay and Astatkie, 2017).Most importantly, they are renowned for their exceptional adaptability in terms of disease resistance and other difficult climatic circumstances. Local chickens, on the other hand, do poorly in terms of development rate (and hence meat output) and egg production. When compared to enhanced commercial broiler or layer birds, most of them are modest adult size and produce little eggs, yet they are appreciated for their broodiness and mothering skills.(Sapkota *et al.*, 2017) Despite their important responsibilities, their poor egg and meat production masks their importance to improving their owners' living conditions and contributing to rural development (Markos, Belay and Astatkie, 2017). The significance of egg shell quality has been widely known, since the challenges associated with egg processing and marketing demand that it be taken seriously. Hence, the present study was designed to improve the external and internal egg qualitytraits of different age of Sakini chicken.

However, there has been relatively little research on the evaluation of indigenous chicken egg quality features. This research will help to assure increased chicken production, long-term usage, and protection of indigenous chicken genetic resources in order to meet the growing demand for chickenproducts. The main objectives of this study were to determine the egg production and egg qualityof Sakini chicken, to determine the weekly age-wise hatchability and also to know theinfluence of external egg quality traits such as egg weight, egg color, shape index and surface area on hatching performance. Certain limitations were there like internal egg quality traits such as yolk weight, yolk height, yolk diameter, albumen weight, albumenheight, albumen diameter couldn't be measured. The egg quality protein which plays important role in provision of nutrient for the developing embryo could not be estimatedalso due to the disease outbreak, the age wise data could not be collected.Sapkota *et al.*, (2020) conducted an experiment to improve the genetic

potential in the egg quality traits of indigenous Sakini chicken by different generation of selection andreported that the egg quality traits of Sakini chickens vary significantly ($p<0.001$) withthe generation of selection.

The differences in the egg length and weight were not significant for different generations. Shape index was significantly differed with respectto the generation of selection. Baskota *et al.*, (2021) studied egg quality in different lines of New Hampshire and Giriraja chicken and the results of this investigation revealed that genotype and respective lines had a substantial impact on egg fertility and hatchability. For genotypes, there was substantial ($P<0.05$) variance in fertility but no significant variation in hatchability. However, there were substantial differences across lines in terms of fecundity and hatchability. In the instance of egg weight, no significant ($P<0.05$) variation was found for genotype, while substantial variance was found for lines comparison. For analyzing the genotypeand line influence, several external egg qualities were measured such as egg length, eggdiameter, shape index, and shell thickness were evaluated. Both genotype and bird lines had a significant ($P<0.05$) influence on all of these exterior egg quality measures.

MATERIALS AND METHODS

Study period and site

The study was carried out under Swine and Avian Research Program (SARP) divisionat NARC, Lalitpur, Nepal during the month of April-May 2021. The poultry unit at SARP lies at a mean elevation of about 1350 masl. Yearly average temperature in the Khumaltar is 15-20°C and receives yearly average rainfall of 2000-2400 mm.

Experimental birds and their management

Indigenous sakini chicken was reared in deep litter pens and fed conventional starter, grower and layer ration. A lighting schedule of 16 h/day was applied during laying period. Standard procedure with respect to preventive vaccination and medication were followed during the study period. Altogether 120 eggs were evaluated and the eggs of 43,48,56 and 57 weeks were taken as sample.

Measurement of external egg parameters

The individual egg was weighed using digital balance to the nearest of 0.00 gm accuracy. The length (L) and breadth (B) of egg were measured with the help of digital Vernier calipers (Figure 78) and shape index was calculated as the ratio of breadth to length times 100 as suggested by (Anderson *et al.*, 2004).

Calculation of Fertility & Hatchability

Candling of egg were done in a dark room by holding a strong light above the egg to observe the embryo (Figure 79) and the fertile eggs were set in an automated incubator for

hatching (Figure 80).Hatchability was calculated as a percentage of total eggs set and as a percentage of fertile eggs as given by (Peebles And Brake, 1987).
Fertility % = (Number of fertile eggs / Total numbers of eggs set incubation) X 100
Hatchability % = Number of egg hatched/ Total number of eggs set X 100

Statistical Analysis
All the egg quality data were managed using SPPS version 20.

RESULTS AND DISCUSSION

Egg parameter was done at Swine and Avian Research Program, Nepal Agricultural Research Council, Khumaltar Lalitpur farm. Different age of hens eggs wascollected from the shed. A total number of 120 eggs, 30 eggs from each 43rd, 48th ,56th and 57th weeks of eggs were collected and analyzed.

Egg Weight
Total 120 eggs from different age group of hens were collected and measured with an electronic balance. In 43,48,56 and 57 weeks, the egg weight of 47.2±0.68, 48.73±0.68, 44.04 ±0.95 and 48.47 ±0.71 gram revealed 60%, 70%, 60% and 75% fertilityrespectively. In 43, 48, 56 and 57 weeks, the egg weight of 47.2±0.68, 48.73±0.68, 44.04 ±0.95 and 48.47 ±0.71 gram revealed 50%, 70%, 50% and 60% hatchability respectively as shown in Table no.1). The overall mean of egg weight was 47.39 ± 0.40gram. However, the highest fertility was observed in 57th weeks of egg weight 48.47 ±0.71 gram and the highest hatchability was observed in 48th weeks of egg weight 48.73±0.68 gram.

Table 1: Influence of different classes egg weight on fertility and hatchability

Age (week)	No. of observation	Mean ± SE (gm)	P-value	No. of fertile eggs	Fertility (%)	No. of hatchable eggs	Hatchability (%)
43	30	47.2±0.68	<0.001	18	60	15	83
48	30	48.73±0.68		21	70	19	90
56	30	44.04 ±0.95		18	60	15	83
57	30	48.47 ±0.71		24	80	18	75
Overall	120	47.39 ± 0.40					

Shape index
In 43,48, 56 and 57 weeks, the shape index of 66.10±0.69, 67.26 ± 0.56, 74.03 ±0.91 and 74.26± 0.74 revealed 60%, 70%, 60% and 60% respectively. In 43, 48, 56 and 57 weeks, the shape index of 66.10±0.69, 67.26 ± 0.56, 74.03 ±0.91 and 74.26± 0.74 revealed 50%, 70%, 50% and 60% hatchability respectively as shown in Table 2. The overall mean shape index was 70.08±0.50. However, the highest fertility and hatchability was seen in 48 weeks of shape index 67.26 ± 0.56 indicating that normal oval and slightly round

shaped eggs have higher fertility rates than those of cylindricaleggs.

Table 2: Influence of shape index of egg on fertility and hatchability

Age (weeks)	No	Mean ±SE(%)	P- val ue	No. offertile eggs	Fertility (%)	No. of hatched eggs	Hatchability (%)
43	30	66.10±0.69	0.0	18	60	15	83
48	30	67.26 ± 0.56	00	21	70	19	90
56	30	74.03 ±0.91		18	60	15	83
57	30	74.26± 0.74		18	60	14	77
Overall	120	70.08±0.50					

Note: **Significant at 0.5% level

Egg Length

In 43, 48, 56, and 57 weeks, the egg length of 41.36±0.35, 41.96± 0.35, 52.40 ±0.50, 53.96± 0.51 revealed 60%, 70%, 60% and 60% fertility respectively. In 43, 48, 56 and 57 weeks, the egg length of 41.36±0.35, 41.96± 0.35, 52.40 ±0.50 and 53.96± 0.51 revealed 50%, 70%, 50% and 60% hatchability respectively as shown in table no 3. The overall mean of egg length was 46.80 ± 0.61. However, the highest fertility and hatchability was seen in 48 weeks of egg length of 41.96± 0.35.

Table 3: Influence of egg length on fertility and hatchability

Age (weeks)	No.	Mean ±SE(mm)	P value	Level of significance	No. of Fertile eggs	Fertilityty (%)	No. of hatchedd eggs	Hatchab ility (%)
43	30	41.36±0.35	0.0	**	18	60	15	83
48	30	41.96± 0.35	00		21	70	19	90
56	30	52.40 ±0.50			18	60	15	83
57	30	53.96± 0.51			18	60	14	77
Overall	120	46.80 ± 0.61						

Note: ** Significant at 0.5% level

Egg breadth

In 43, 48, 56, and 57 weeks, the egg breadth of 27.30±0.23, 27.80 ± 0.24, 38.74 ±0.35 and 39.97± 0.21 revealed 60%, 70%, 60% and 60% fertility respectively. In 43, 48, 56 and 57 weeks, the egg breadth of 27.30±0.23, 27.80 ± 0.24, 38.74 ±0.35 and 39.97± 0.21 revealed 50%, 70%, 50% and 60% hatchability respectively as shown in table no 4. The overall mean of egg breadth was 32.97 ±o.58. However, the highest fertility and hatchability was seen in 48 weeks of egg length of 41.96± 0.35.

Table 4: Influence of egg breadth on fertility and hatchability

Age (week)	No	Mean ±SE (mm)	P value	No. of Fertile eggs	Fertility (%)	No.of Hatched eggs	Hatchability (%)
43	30	27.30±0.23	0.000	18	60	15	83
48	30	27.80 ± 0.24		21	70	19	90
56	30	38.74 ±0.35		18	60	15	83
57	30	39.97± 0.21		18	60	14	77
Overall	120	32.97 ±o.58					

Note: **Significant at 0.5% level

Eggshell Color

Fertility and hatchability for eggs classified by shell color are presented in Table 5.The highest fertility and hatchability were seen in light brown colored eggshell.

Table 5: Influence of eggshell color on fertility and hatchability

Color	Observations	No of fertile eggs	Fertility (%)	No of hatchable eggs	Hatchability (%)
Dark Brown	30	18	60	15	83
Light Brown	30	22	70	20	90
White	30	20	70	16	80

DISCUSSION

The overall mean weight of sakini at different weeks was 47.39 ± 0.40 gm, which was slightly less than that of overall mean 49.02±0.87 gm (Sapkota *et al.*, 2020),of three different generations of Sakini breed. The difference might be due to the age of egg samples which was of 40 weeks in (Sapkota *et al.*, 2017). The study conducted by Baskota *et al*., 2021, revealed that the mean egg weight of 51±0.33 of Giriraja breed conducted at Khumaltar had 91% fertility and 76% hatchability. This fertility and hatchability are higher when compared to our present study. This might be due to different breed. This might due to difference in egg weight which indicates that mediumsized eggs have better fertility and hatchability.

Result of the present study reflected that the overall mean shape index of sakini chicken eggs was 70.08±0.50 percent (Table no.2) Shape index gradually increases as the age of the hen increases, shape index is directly proportional to age of hen. (Sapkota *et al.*, 2020) in a study has the shape index 75.06±1.42 percent which is greater than the present study. Similarly, shape index for Bovans Brown, Koekoek, Sasso and local breeds were observed as 74.5, 73.4, 72.7 and 69.8 percent, respectively in a study by (Assefa, Melesse and Banerjee, 2019) which was found higher than the value of shape index in this study. Verma *et al.*, (2018) shows the average shape index of Kadaknath breed is 75.89±0.50 which has fertility of 87.18% and 64.81% hatchability and the average shape index of Assel breed is 75.56±0.39 which has fertility of 80% and 55.7% hatchability. The present findings values are lower compared to the data of (Verma *et al.*, 2018). The difference in values might be the age difference because data were taken during the peak hourof egg laying time and young age (i.e. 42 weeks) whereas the present findings data weremean of four different age weeks (i.e. 43, 48, 56 and 57 weeks).

Findings of this study indicated that overall mean egg length of Sakini chicken was 46.80 ± 0.61 mm (Table no.3) which is less than the findings of (Sapkota *et al.*, 2020) i.e. 53.76±0.51 mm. (Yakubu, Ogah and Barde, 2008) found the egg length of Nigerian normal feathered chicken as 48.7mm which is slightly more than the present data. On the otherhand, (Assefa, Melesse and Banerjee, 2019) reported the egg length of chicken in the range 43.3 mm to 55.6 mm.

The overall average egg breadth of present study was 32.97 ±0.58 mm (Table no.4). The egg breadthof 56th and 57th week (38.74 ±0.35 and 39.97± 0.21) respectively is higher than in 43rdand 48th (27.30±0.23 and 27.80 ± 0.24 respectively. Overall average egg width of Sakinichicken in this study of (Sapkota *et al.*, 2020) was 40.35±1.48 mm which is greater than the present study. This might be due to the different age of birds. The variations in theegg length and width can be associated with the genetics of the birds (Assefa, Melesse and Banerjee, 2019).

Results of the present study was similar with (Mujeer *et al.*, 1988) stated that light brown shell eggs produced better hatchability and fertility than dark brown eggs as shown in (Table 5).

CONCLUSION

The result of this study helps us to suggest that the medium sized eggs have better fertility and hatchability. Shape index do affect the fertility and hatchability. Although,Shape index gradually increases as the age of the hen increases, it would be highest during the peak hour of egg laying time. The egg shell color did not affect the fertility and hatchability but also, light brown shell eggs have higher fertility and hatchability rate. The egg length and

egg breadth would be different at different ages and it affects the fertility and hatchability as well.

REFERENCE

1. Anderson, K. E. et al. (2004) 'Shell characteristics of eggs from historic strains of single comb white leghorn chickens and the relationship of egg shape to shell strength', International Journal of Poultry Science, 3(1), pp. 17–19. doi: 10.3923/ijps.2004.17.19.
2. Assefa, S., Melesse, A. and Banerjee, S. (2019) 'Egg Production and Egg Quality Traits of Local and Exotic Chicken Breeds Reared in Two Agroecologies under Traditional Management System', Research Journal of Food and Nutrition, 3(1), p. 11. Available at: https://www.sryahwapublications.com/research-journal-of-food-and-nutrition/pdf/v3-i1/3.pdf.
3. Baskota, N. et al. (2021) 'Egg quality in different lines of New Hampshire and Giriraja chicken', Bangladesh Journal of Animal Science, 49(2), pp. 108–118. doi: 10.3329/bjas.v49i2.53219.
4. Curtis, P. A., Gardner, F. A. And Mellor, D. B. (1986) 'A Comparison of Selected Quality and Compositional Characteristics of Brown and White Shell Eggs.', Poultry Science, 65(3), pp. 501–507. doi: 10.3382/ps.0650501.
5. . Ekue, F. N. K. Et Al (2002) 'Survey of the Traditional Poultry Production System in the Bamenda Area, Cameroon', Institute of Agricultural Research for Development (IRAD) Yaounde, Cameroon, Joint FAO/(June), pp. 15–25.
6. Gorkhali, N. et al. (2021) 'Polymorphism of Sakini Chicken Population From Different Locations/ Altitudes of Nepal Using Randomly Amplified Polymorphic Dna Markers', SAARC Journal of Agriculture, 18(2), pp. 115–124. doi: 10.3329/sja.v18i2.51113.
7. Hays, F. A. And Sumbardo, A. H. (1927) 'Physical Characters of Eggs in Relation to Hatchability.', Poultry Science, 6(4), pp. 196–200. doi: 10.3382/ps.0060196.
8. Kattel, P. (2016) 'Socio-Economic Importance of Indigenous Poultry in Nepal', Poultry, Fisheries & Wildlife Sciences, 4(1), pp. 9–11. doi: 10.4172/2375-446x.1000153.
9. Markos, S., Belay, B. and Astatkie, T. (2017) 'Evaluation of egg quality traits of three indigenous chicken ecotypes kept under farmers' management conditions', International Journal of Poultry Science, 16(5), pp. 180–188. doi: 10.3923/ijps.2017.180.188.
10. Mujeer, K. A. et al. (1988) 'Traits influencing the hatching performance of japanese quail eggs', British Poultry Science, 29(1), pp. 101–112. doi: 10.1080/00071668808417031.
11. Neupane, D. et al. (2019) 'Effect of Probiotics on production and egg quality of dual purpose chicken at Kathmundu in Nepal', Bangladesh Journal of Animal Science, 48(1), pp. 29–35. doi: 10.3329/bjas.v48i1.44556.
12. Peebles, E. D. And Brake, J. (1987) 'Eggshell Quality and Hatchability in Broiler Breeder Eggs ', Poultry Science, 66(4), pp. 596–604. doi: 10.3382/ps.0660596.
13. Sapkota, S. et al. (2017) 'Research Article;Evaluation of egg laying and egg quality parameters of local chicken Sakini', 1(September 2019), pp. 181–188.
14. Sapkota, S. et al. (2020) 'Selective Breeding to Improve Productive and Reproductive Performances and Survivability of Indigenous Sakini Chicken', Journal of Nepal Agricultural Research Council, 6(March), pp. 62–69. doi: 10.3126/jnarc.v6i0.28116.
15. Silversides, F. G. and Scott, T. A. (2001) 'Effect of Storage and Layer Age on Quality of Eggs From Two Lines of Hens 1', pp. 1240–1245.
16. Verma, A. K. et al. (2018) 'Comparative Assessment of Fertility and Hatchability of Kadaknath and Aseel Fowls', (7), pp. 1238–1243. doi: 10.13140/RG.2.2.16460.26245.
17. Yakubu, A., Ogah, D. M. and Barde, R. E. (2008) 'Productivity and egg quality characteristics of free range naked neck and normal feathered Nigerian indigenous chickens', International Journal of Poultry Science, 7(6), pp. 579–585. doi: 10.3923/ijps.2008.579.585.