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A comparative evaluation of fertility, hatchability and embryonic mortality of indigenous Siruvidai chicken ecotype with Indian chicken breeds

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Abstract
Siruvidai chicken is one of indigenous chicken ecotype reared as a backyard poultry in Tamil Nadu state of India. The hens of this chicken are known for their broodiness instinct and mothering ability among the farmers. Hence a comparative evaluation was carried out to assess the fertility and hatchability of indigenous Siruvidai chicken hatching egg with Nicobari black and TANUVAS Aseel eggs under artificial incubation conditions. A total of 4,646 Siruvidai, 5,428 Nicobari black and 5,999 TANUVAS Aseel hatching eggs collected from farm were artificially incubated and the fertility and hatchability were recorded. The eggs that failed to hatch out were subjected to egg break-open studies at the end of incubation period to determine the stage of embryonic mortality. The results revealed that the mean fertility rate was significantly (p<0.01) higher in Nicobari black (89.20±0.12%) compared to Siruvidai (85.87±0.49%) and TANUVAS Aseel (87.48±0.04%). The hatchability on total egg set in Nicobari black (83.69±0.05) was significantly (p<0.01) higher than TANUVAS Aseel (82.43±0.02) and Siruvidai (80.25±0.61). On the other hand, the hatchability on fertile egg set was significantly (p<0.05) higher in TANUVAS Aseel (94.24±0.08%) compared to Siruvidai (93.47±0.23%) and Nicobari black (93.86±0.17%). The breakopen study of unhatched eggs revealed that the early embryonic mortality was significantly higher in TANUVAS Aseel (3.84±0.07%) compared to Siruvidai (3.51±0.03%) and Nicobari black (3.36±0.10). The mid embryonic mortality was 0.68±0.25, 0.88±0.45 and 0.50±0.33% in Siruvidai, Nicobari black and TANUVAS Aseel respectively and no significant (p>0.05) difference existed among the genetic groups. The late embryonic mortality and total embryonic mortality was significantly (p<0.01)) higher in Siruvidai (2.34±0.40 and 6.53±0.23%) followed by Nicobari black (1.90±0.14 and 6.14±0.24%) and TANUVAS Aseel (1.42±0.05 and 5.76±0.08%). Hence the results indicated that the fertility and hatchability rate and early embryonic mortality was lower in Siruvidai compared to Nicobari black and TANUVAS Aseel but the late and total embryonic mortality was higher in Siruvidai eggs compared to other genetic groups under artificial incubation conditions.

Keywords: Fertility, hatchability, embryonic mortality, Siruvidai

Introduction
Indigenous chicken breeds are of great importance in the rural sector of most of the developing and underdeveloped countries. According to the twentieth Indian livestock census (DAHD, 2019) [1], the total backyard poultry in the country was 317.07 million in 2019 and has increased 45.8% over the previous census. The market for indigenous chicken products is increasing tremendously owing to the preference of their meat and eggs by majority of rural and urban communities. However, the major glitch in the large-scale flourishing of indigenous chicken breeds is their poor productive performance as indigenous chicken breeds are generally poor layers and slow growers. But these birds are also known for their adaptive superiority in terms of their resistance to endemic diseases and other harsh environmental conditions. Of late, more focus has been bestowed on native chicken populations as significant genetic resources and efforts are being taken to characterize and conserve many lesser known or non-descript germplasm. The indigenous Siruvidai chicken is one such chicken ecotype reared as a backyard poultry in Tamil Nadu state of India. The hens of this chicken are known for their broodiness instinct and mothering ability for self-propagation among the farmers. In recent years many small- scale farmers are largely involved in breeding of this germplasm in Tamil Nadu. Fertility and hatchability play an important role in determining the profitability of the enterprise for small and medium-scale farmers. Unfortunately, poor fertility and hatchability rates of native chicken breeds are one among the major threat for large scale

expansion. Hence this study was aimed to carry out a comparative evaluation of fertility, hatchability and embryonic mortality in indigenous Siruvidai chicken along with well-known breeds namely Nicobari black and TANUVAS Aseel eggs under artificial incubation conditions.

Materials and Methods

The artificial incubation study was carried out for a period of five months period from 32 weeks onwards in Siruvidai, Nicobari black and TANUVAS Aseel. The Nicobari black and TANUVAS Aseel flock were maintained in the farm for more than 3 generations whereas the Siruvidai cocks and hens used in the study were of first generation under farm conditions. The selected cocks and all the hens were trained for artificial insemination and the layers were inseminated twice a week to obtain hatching eggs. All settable eggs collected during seven days period were incubated together. The total number of Siruvidai, Nicobari black and TANUVAS Aseel eggs incubated in 20 settings put together were 4,646, 5,428 and 5,999 respectively. On hatching, the number of chicks hatched was recorded from each setting. All the unhatched eggs were subjected to break -open studies and number of infertile eggs, embryonic mortality at early (0 - 7 days), mid (8 - 14 days) and late (15 -21 days) periods of incubation were recorded. The fertile unhatched eggs were then examined in detail to identify the stage of embryonic mortality and recorded. The results gathered were analyzed and the average fertility, hatchability on total eggs set (HTE), and hatchability on fertile eggs set (HFE), embryonic mortality during early, mid and late incubation periods were calculated. The data of fertility, hatchability and embryonic mortality were subjected to a one-way analysis of variance as per Snedecor and Cochran (1989) [2].

Results and Discussion

The artificial incubation study data showed that there was significant (p<0.01) difference in fertility (%) among the three genetic groups (Table 1). The fertility of eggs in Siruvidai, Nicobari black and TANUVAS Aseel were 85.87±0.49, 89.20±0.12 and 87.48±0.04% and the values ranged from 81.34 to 88.98, 87.50 to 90.73 and 86.54 to 88.97% respectively. The fertility (%) of Nicobari black (89.20%) was significantly (p<0.01) higher than Siruvidai (85.87%) and TANUVAS Aseel (87.48%) chickens. The fertility (%) of TANUVAS Aseel and Nicobari black recorded in this study was higher than those reported earlier for Aseel (Mohan *et al.*, 2008) [3]and Nicobari (Vijh *et al.*, 2006) [4]; whereas, lower than those reported in Siruvidai (Jamima *et al.*, 2020) [5] and indigenous chickens of other regions (Kalita *et al.*, 2012; Sankhyan and Thakur, 2016) [6, 7]. The fertility rate reported in the present study was comparatively better in Siruvidai chicken than that of previously reported values of 76.33% in indigenous chicken of Assam (Kalita *et al*., 2012) [6]. The difference in fertility in the three genetic groups might be due to genetic disposition or adaptability of the birds to artificial insemination which needs to be further explored.

In the present study the mean hatchability on total egg set (TES) in Siruvidai, Nicobari black and TANUVAS Aseel were 80.25±0.61, 83.69±0.05 and 82.43±0.02% and the values ranged from 75.00 to 83.72, 82.16 to 85.53 and 81.49 to 83.63% respectively. Similarly, the mean hatchability on fertile egg set (FES) in Siruvidai, Nicobari black and TANUVAS Aseel eggs were 93.47±0.23, 93.86±0.17 and 94.24±0.08% respectively and the values ranged from 91.95 to 95.41% in Siruvidai, 92.43 to 95.60% in Nicobari black and 93.19 to 95.22% in TANUVAS Aseel.

The data showed that the hatchability (%) on total egg set (HTES) was significantly (p<0.01) higher in Nicobari black (83.69) compared to Siruvidai (80.25) and TANUVAS Aseel (82.43); whereas, the hatchability (%) on fertile egg set (HFES) was significantly (p<0.05) higher in TANUVAS Aseel (94.24) when compared to Nicobari black (93.86) and Siruvidai (93.47). The HTES and HFES reported in the present study for Siruvidai, Nicobari black and TANUVAS Aseel were higher than those reported earlier for Aseel (Mohan *et al.*, 2008) [3] and Nicobari (Vijh *et al.*, 2006) [4] and indigenous chickens of other regions (Kalita *et al.*, 2012; Sankhyan and Thakur, 2016) [6, 7] under artificial incubation which might be due to better plane of nutrition and managemental practices. However, higher HTES (84.19) and HFES (84.19) values were reported by Jamima *et al.* (2020) [5] in Siruvidai chicken under artificial incubation.

The data on embryonic mortality showed that significant (p<0.01) difference existed in early, late and total embryonic mortalities but not in mid embryonic mortality among the genetic groups.

The early embryonic mortality in Siruvidai, Nicobari black and TANUVAS Aseel ranged from 3.06 to 3.98, 3.13 to 3.74 and 3.20 to 4.58% respectively and the highest early embryonic mortality (%) was found in TANUVAS Aseel (3.84±0.07) compared to Siruvidai (3.51±0.03) and Nicobari black (3.36±0.10). There was no significant (P>0.05) difference in mid embryonic mortality among Siruvidai (0.68±0.25%), Nicobari black (0.88±0.45%) and TANUVAS Aseel (0.50±0.33%) and the values ranged from 0.42 to 1.56, 0.39 to 1.64 and 0.37 to 1.16% respectively.

The late embryonic mortality ranged from 1.53 - 3.83, 1.04 - 2.96 and 1.02 - 1.81% in Siruvidai, Nicobari black and TANUVAS Aseel and were significantly (p<0.01) higher in Siruvidai (2.34±0.40) followed by Nicobari black (1.90±0.14) and TANUVAS Aseel (1.42±0.05). The total embryonic mortality in Siruvidai, Nicobari black and TANUVAS Aseel ranged from 4.59 to 8.05, 4.40 to 7.57 and 4.78 to 6.81% and maximum total embryonic mortalities (%) were observed in Siruvidai (6.53±0.23%) followed by Nicobari black (6.14±0.24%) and TANUVAS Aseel (5.76±0.08%).

The early embryonic mortality was relatively higher than mid and late embryonic mortalities in all the genetic groups. The early, late and total embryonic mortalities in the three genetic groups were higher than those reported earlier by Jamima *et al.* (2020) [5] and Sankhyan and Thakur (2016) [7]. However, Jamima *et al.* (2020) [5] reported high incidence of early embryonic mortality (7.71%) compared to late embryonic mortality in Siruvidai chicken which is in disagreement with the findings of the present study in Siruvidai chicken.

Hence the results of the study indicate that fertility and hatchability rates on total and fertile eggs set and early embryonic mortality were lower in Siruvidai whereas late and total embryonic mortality were higher in Siruvidai compared to Nicobari black and TANUVAS Aseel which were subjected to intense selection for higher production under farm conditions. This indicates scope for selection and genetic improvement of Siruvidai ecotype for production and reproductive characters in future generations.

Table 1: Percent fertility and hatchability of eggs and embryonic mortality in indigenous chicken ecotypes / breeds (n=20)

Traits \ Breeds/ ecotypes	Siruvidai	Nicobari black	TANUVAS Aseel	F value
No. of eggs set	4,646	5,428	5,999	
Fertility (%)	$85.87^{c\pm}0.49$ (81.34 - 88.98)	$89.20^{a\pm}0.12$ (87.50 - 90.73)	$87.48^{b\pm}0.04$ (86.54 - 88.97)	29.73**
Hatchability (FES) (%)	$93.47^{c\pm}0.23$ (91.95 - 95.41)	$93.86^{ab\pm}0.17$ (92.43 - 95.60)	$94.24^{a\pm}0.08$ (93.19 - 95.22)	4.11*
Hatchability (TES) (%)	$80.25^{c}\pm0.61$ (75.00 - 83.72)	$83.69^{a}\pm0.05$ (82.16 - 85.53)	$82.43^{b}\pm0.02$ (81.49 - 83.63)	22.63**
Early embryonic mortality (%)	$3.51^{b\pm}0.03$ (3.06 - 3.98)	$3.36^{c\pm}0.10$ (3.13 - 3.74)	$3.84^{a\pm}0.07$ (3.20 - 4.58)	12.87**
Mid embryonic mortality (%)	0.68 ± 0.25 (0.42 - 1.56)	0.88 ± 0.45 (0.39 - 1.64)	$0.50^{\pm}0.33$ (0.37 - 1.16)	1.04^{NS}
Late embryonic mortality (%)	$2.34^{a\pm}0.40$ (1.53 - 3.83)	$1.90^{b\pm}0.14$ (1.04 - 2.96)	$1.42^{c\pm}0.05$ (1.02 - 1.81)	15.31**
Total embryonic mortality (%)	$6.53^{a\pm}0.23$ (4.59 - 8.05)	$6.14^{b\pm}0.24$ (4.40 -7.57)	$5.76^{c\pm}0.08$ (4.78 - 6.81)	5.03**

Values in parenthesis indicates range of values
FES –Fertile Eggs Set, TES- Total Eggs Set
** Significant (p<0.01), * Significant (p<0.05)
^{abc} Means bearing different superscripts within each row differ significantly (p<0.05)

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