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Short Communications

Evaluation of embryonic malformations in pure strains of White Leghorn and their reciprocal crosses

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The capability of chicks to hatch successfully is biologically a complex process. Embryonic viability is influenced by a number of factors such as genetical background (Abudabos 2010), the age, strain, strain by age interaction (Suarez *et al.* 1997), nutrition and health of stock, the qualitative attributes of eggs, climate, season, egg handling, hatching technology etc. Failure to hatch may be due to infertility or alternatively death of zygote at a specific stage of incubation or embryonic malpositions or sporadic development malformations that may also affect the growth of the embryo and ultimately it's hatching.

Skeletal defects are one of the most important issues in commercial poultry breeding because of their economical consequences. However, it is known that reasons for skeletal defects in chicken are multiple and hereditary (Mercer and Hill 1984). The most important inherited skeletal defects are abnormalities of the axial skeleton, including mutations affecting the beak, head, neck and body/ cerebral hernia, hereditary exencephaly. Crossed beak, short mandible, short upper/lower beak, supernumerary ribs, kyphosoliosis and spondylolisthesis have been reported in poultry populations (Somes 1990). The present study was undertaken to critically examine the reproductive ability affected by embryonic mortality and malformations of two long-term selected strains of White Leghorn and their reciprocal crosses over 8 consecutive generations.

The study was conducted on 2 selected strains (PL1 and PL2) of Single Comb White Leghorns and their contemporarily reared reciprocal crosses over 8 consecutive generations. The 2 strains had an altogether different genetic background as PL1 was originally derived from a reputed commercial inbred cross imported from USA and PL2 from the well-known purebred 'Mount Hope' stock of USA which in India was commonly referred to as 'Mychick' strain.

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Selection in both the strains was based primarily on part-year egg production on the basis of combination index (Osborne 1957). Mild selection had also been practiced for egg weight throughout the course of selection. Other traits which were considered for mild selection in different generations included liveability, fertility and hatchability. The study was undertaken on a total of 1 96,239 eggs. Eggs in each hatch were stored at 55° F for 10 days before setting these in the incubators. All the 22nd day unhatched eggs were included in the studies and each dead embryo was observed for malformations if any. A total of 13726 dead or unhatched eggs were broken-open for recording the gross defects of beak, head, eyes, wings, legs and other imperfections which were recorded for each dead and unhatched embryo.

The incidence of terata for various genetic groups pooled over generations is given in Fig.1. The incidence of terata observed in the present study is lower than most of the earlier studies; however, the incidence reported herein matches favorably with those observed by William *et al.* (1969) in chickens, and by Cherms (1981) in turkeys. The lower incidence of terata reported in the present study as compared to the earlier studies may be due to the effect of continued natural selection which operates against such defects. The embryos carrying such anomalies contribute very little, if any, to the successive generations. Butcher and Nilipour (2009) observed that a loss of 1.2 to 1.8% of total hatch due

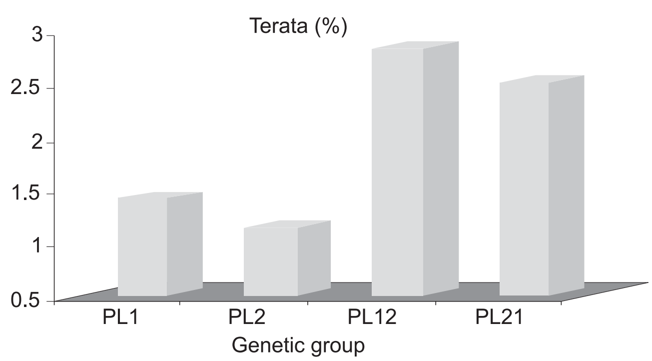


Fig. 1. Incidence of terata for various genetic groups.

Table 1. Incidence of embryonic malformations in purebred and reciprocal crosses of White Leghorn strain

Type of anomaly	Percent dead embryos with malformations of the total eggs set				
	PL1	PL2	PL12	Pl 21	Pooled
Beak defects					
Total	1.25	0.79	4.12	2.44	2.15
Crossed upper to the left	0.30 (24.0)	0.26 (32.9)	0.95 (23.1)	0.63 (25.8)	0.535 (24.9)
Crossed upper to the right	0.22 (17.6)41.6*	0.10 (12.6)45.5*	0.63 (15.3)38.4*	0.87 (35.6)61.4*	0.455 (21.2)46.1*
Parrot	0.12 (9.6)	0.05 (6.3)	0.32 (7.7)	0.00 (–)	0.122 (5.7)
Upper short	0.41 (32.8)	0.21 (26.6)	1.26 (30.6)	0.63 (25.8)	0.63 (29.3)
Lower short	0.00 (–)	0.00	0.32 (7.7)	0.00	0.08 (3.8)
Upper absent	0.05 (4.0)	0.14 (17.7)	0.32 (7.7)	0.31 (12.3)	0.205 (9.5)
Both absent	0.00 (–)	0.01 (1.3)	0.32 (7.7)	0.00 (–)	0.08 (3.8)
Upper bifurcated	0.09 (4.2)	0.00 (–)	0.00 (–)	0.00 (–)	0.022 (1.0)
Both elongated	0.03 (2.4)	0.00 (–)	0.00 (–)	0.00 (–)	0.007 (0.3)
Lower elongated	0.03 (2.4)	0.00 (–)	0.00 (–)	0.00 (–)	0.007 (0.3)
Both shortened	0.00 (–)	0.01 (1.3)	0.00 (–)	0.00 (–)	0.002 (0.09)
Additional upper beak	0.00 (–)	0.01 (1.3)	0.00 (–)	0.00 (–)	0.002 (0.09)
Eye defects					
Total	0.51	0.39	1.27	0.62	0.69
Left eye absent	0.07 (13.7)	0.12 (30.8)	0.95 (74.8)	0.31 (50.0)	0.36 (52.2)
Right eye absent	0.08 (15.7)	0.12 (30.8)	0.32 (25.2)	0.31 (50.0)	0.21 (30.4)
Both eyes absent	0.16 (31.3)	0.07 (17.9)	0.00 (–)	0.00 (–)	0.06 (8.6)
Right eye small	0.04 ((7.8)	0.02 (5.1)	0.00 (–)	0.00 (–)	0.015 (2.2)
Both eyes small	0.04 (7.8)	0.00 (–)	0.00 (–)	0.00 (–)	0.01 (1.4)
Eyes fused medially	0.06 (11.8)	0.02 (5.1)	0.00 (–)	0.00 (–)	0.02 (2.8)
One eye bulged out	0.06 (11.8)	0.04 (10.2)	0.00 (–)	0.00 (–)	0.025 (3.6)
Hernia					
Total	1.09	0.80	1.58	0.94	1.10
Hernia of brain	0.65 (59.6)	0.59 (73.7)	1.26 (79.7)	0.94 (100)	0.86 (78.2)
Hernia of viscera	0.44 (40.4)	0.21 (26.3)	0.32 (20.3)	0.00 (–)	0.024 (21.8)
Other defects					
Total	0.25	0.11	0.63	0.07	0.26
Limb defects	0.11 (44.0)	0.00 (–)	0.00 (–)	0.00 (–)	0.026 (10.0)
Headless	0.05 (20.0)	0.01 (9.1)	0.63 (100)	0.007 (100)	0.19 (73.1)
Hood on head	0.02 (8.0)	0.00 (–)	0.00 (–)	0.00 (–)	0.005 (1.9)
Twin embryos	0.02 (8.0)	0.03 (27.3)	0.00 (–)	0.00 (–)	0.013 (5.0)
Four legged winged monster	0.05 (8.0)	0.07 (63.6)	0.00 (–)	0.00 (–)	0.026 (10.0)

Figures in parenthesis indicate percentage of various malformations of the total major defects.
*Total crossed beak malformations (%)

to malpositions and deformities can be anticipated.

The incidence of individual types of malformations is given in Table 1. It is to be noted that most of the malformed embryos exhibited more than one type of the malformation, and were, therefore, recorded more than once in the calculation of incidence of individual malformations. The incidence of malformations was higher in PL1 as compared to PL2. The incidence was even higher in the crosses. These results were consistent with those reported by Suarez *et al.* (1997) and (Deeming and Van Middlekoop 1999) who observed significant effects of strain and strain × age interaction on embryonic malformation. Genetic factors can be responsible for the appearance of embryonic loss occurring in the first week of the incubation (Liptoi and Hidas 2006). They opined that disposition of early embryonic mortality can be inherited and it can accumulate in a stock, which will finally deteriorate its fertility indices.

Beak abnormalities: The incidence of beak defects, expressed on the basis of total eggs set varied between 0.79 and 4.12% in the different genetic groups (Table 1). Of all the malformed embryos, beak abnormalities were most abundant (37.8 to 60%) being highest in PL 21 and lowest in PL1 (Fig. 2). The incidence of beak defects observed was, in general, in agreement with the findings of William *et al.*

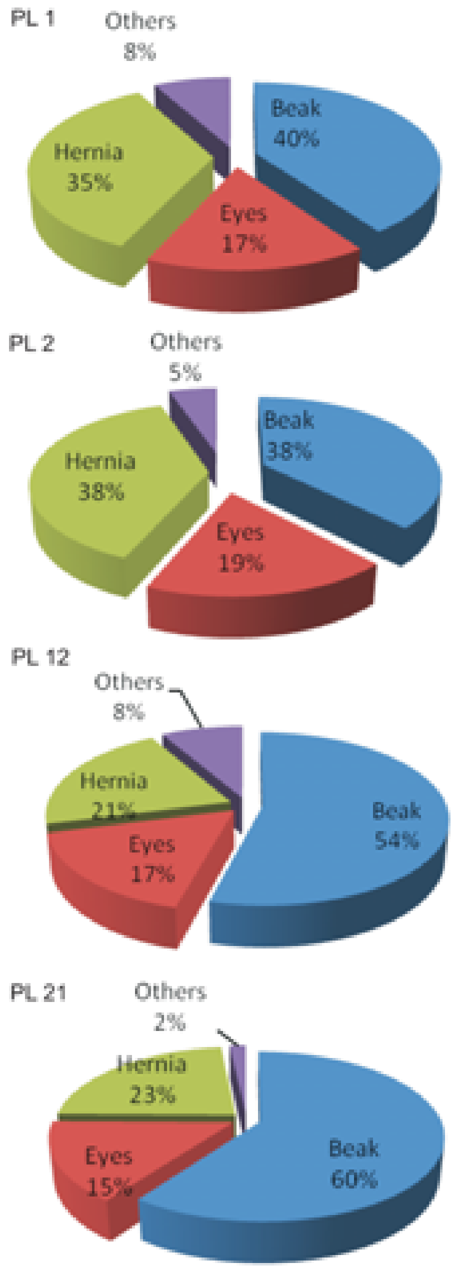


Fig. 2. Distribution of malformations into major types in different genetic groups

(1969) who found 52% of all the malformed embryos exhibited beak defects. However, Jaszczak *et al.* (2006) reported 16% of the malformed embryos had beak defects in broilers while Butcher and Nilipour (2009) reported 35% beak abnormalities.

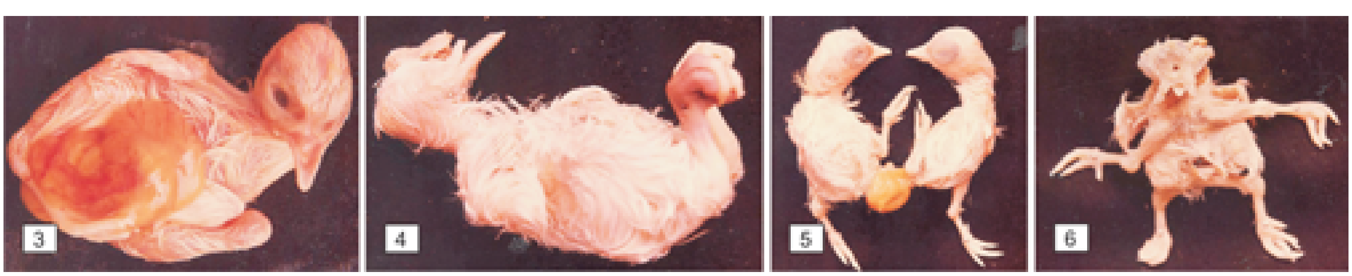
Eye abnormalities: One or the other type of eye defect was encountered in all the genetic groups with the incidence varying between 0.39 and 1.27% of the total hatch. Of all the malformed embryos, 15.2 to 18.7% exhibited eye defects (Fig. 2). William *et al.* (1969) also reported 16% incidence of eye defects. Of the various types of eye abnormalities, absence of one or both the eyes occurred with the highest frequencies.

Hernia of brain and viscera: Incidence of hernia (20.8 to 38.3%) was second highest anomaly after beak defects of the malformed embryos (Fig. 2). Hernia of brain consistently occurred in all the stocks. The proportion of hernia of brain, of the total herniated embryos varied between 59.6 and 100% with an average of 78.2%. The anomaly was invariably associated with some defects of beaks or eyes or both.

Other abnormalities: Other abnormalities which occurred with low frequencies were limb defects, absence of head, hood on head; body edema; twin embryos with common yolk; four legged and winged monster; talpid like syndrome and three legged alive chick (Figs 3–6).

SUMMARY

The incidence of embryonic malformation expressed on the basis of total eggs set varied between 1.14 and 2.84% in different genetic groups. Of all the malformed embryos, the percentage of beak defects, eye defects and brain hernia varied from 37.8 to 60.0; 15.2 to 18.7 and 20.8 to 23.1 respectively. Pooled over genetic groups, the beak defects exhibited the highest anomaly (51.4%) followed by hernia (26.1%). Other anomalies which occurred with low frequencies were limb defects, absence of head, body edema, and twin embryos with common yolk, four legged and four-winged monsters, talpid like syndrome and a three-legged alive chick. It is felt that application of cytogenetical and embryological methods may be of major relevance in studying embryonic mortality vis-a-vis genetic background and improvement of the reproduction traits of poultry species.



Figs 3–6. **3.** Embryo exhibiting missing upper beak. **4.** Embryo with both eyes missing, lower beak elongated while upper turncated and hernia of brain. **5.** Twin embroys united with common yolk. **6.** Four legged and winged monster; upper beak short and bifurcated having perforation in the centre and depicting hernia of brain.

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