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# THE INFLUENCE OF EGG-WEIGHT ON FREQUENCIES OF EARLY EMBRYONIC MORTALITY AND CHROMOSOMAL ABERRATIONS IN LAYING HENS

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## INTRODUCTION

The influence of egg weight on survival rate of chicken embryos has long been known. An extensive review of these and other effects on the hatchability is given by Landauer (1967). Landauer (1967) showed that hatchability reaches a maximum at an egg weight of around 55 g. Whereas Hagger *et al.* (1986) and Sewalem and Wilhelmson (1999), reported that embryonic mortality increased with increased egg weight.

Thorne *et al.* (1991) reported that chromosome abnormalities were responsible for 4.4 to 28.1 % (average 11.8 %) and 7.4 to 25.0 % (average 13.4 %) of the early embryonic mortality in broiler and layers respectively. The embryonic mortality was caused by chromosomal aberrations to an extend of 25 % (Logde *et al.*,1974) and 50 % (Szalay and Hidas, 1989).

This study attempted to find the relationships between egg weight, frequencies of early embryonic mortality, frequencies, and types of chromosomal aberrations in two pure lines (A and D) of a commercial brown layer breeding programme.

## MATERIAL AND METHODS

Eggs of the two lines (A and D) were collected daily stored for a maximum of 7 days and incubated for 72 h under standard conditions. Sampling was done at three times of laying cycle. The age of hens at the time of sampling varied from 20-24, 26-28 and 61-64 weeks. Eggs were fertilised by artificial insemination. The egg weight were classified into S($< \bar{X}$ - SD g), M($\bar{X} \pm$ SD g) and L($> \bar{X}$ + SD g) classes.

Chromosome preparations were made using a technique adapted from Vagt and Saar (1986). After 72 h incubation, the eggs were opened at the blunt end to examine the contents by stereo microscope. Infertile eggs and early embryo mortality were discarded. Eggs with normal development or abnormally retarded in growth (included abortive development embryo - Thorne *et al*. 1991) embryos were injected with 0.2 ml of a 0.005% colchicine and incubated for 1 h (37.8$^{o}$C). Blastodisc was removed and embryo was washed with Hanks solution (Hanks: Aqua dest = 1:9) and incubated in hypotonic solution (FCS: Aqua dest =1:5; 37.5$^{o}$C; 25 min). Hypotonic solution was removed by Pasteur pipette and 3 ml of fixative (acetic acid : methanol = 1:3, 0$^{o}$C) were added. Samples were kept minimum 45 min prior to making slides. Slides were stained in Giemsa solution for around 12 min.

Slides were scanned carefully on low power and 5 to 20 clear metaphase spreads were then counted at x 1000 magnification. The 8 largest chromosomes were analysed. When

chromosomal aberration were detected more than 20 metaphase were counted. To confirm euploid and aneuploid aberrations, their availability should be proved once and three times, respectively.

Contingency chi-squared test and Fischer exact test were used in the statistical analysis.

## RESULT AND DISCUSSION

**Frequency of chromosomal aberration.**

Chromosomes were successfully analysed in 673 embryos from a total of 705 that had been processed slides. In the lines A and D, chromosomal aberrations were found in 9.7% and 13.5% of the embryos, respectively. This difference between two lines was statistically not significant. Some authors reported, that layer strains had a lower incidence of chromosomal aberrations varying from approximately 1 to 4 % of all embryos (Bloom, 1974; Fechheimer and Jaap, 1978; Thorne *et al.* 1991).

**Relation between egg weight and frequency of early embryonic mortality.** The early embryonic mortality in each egg weight class of the lines A and D are given in Table 1. In both lines A and D were observed that frequencies of early embryonic mortality of small eggs was higher than in medium or large eggs (Table 1). Christensen (2001) reported also that eggs size was positively correlated with early embryonic development.

Table 1: Influence of egg weight on frequencies of early embryonic mortality (EEM) in the lines A and D

| Line A | | Line D | |
|---|---|---|---|
| Egg weight | EEM (%) | Egg weight | EEM (%) |
| S (< 52.0 g); n = 75 | 34.7 [(a)] | S (< 50.5 g); n = 74 | 40.5 [(a)] |
| M (52.0 - 67.6 g); n = 293 | 14.3 [(b)] | M (50.5 -62.5 g); n = 287 | 16.3 [(b)] |
| L (> 67.6 g); n = 60 | 5,0 [(c)] | L (> 62.5 g); n = 66 | 4.6 [(c)] |

Differences are not significant between frequencies with same letter (P> 0.05)

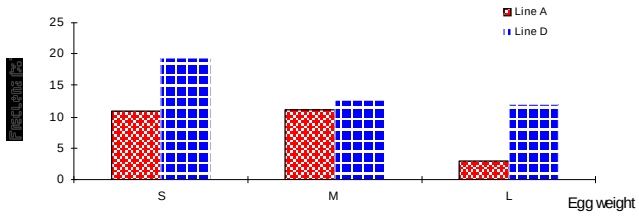
Comment [R1]:

Comment [R2]:

**Relation between egg weight and frequency of chromosomal aberrations.** In the line A chromosomal aberrations were found to be 10.9 % (small eggs), 11.1% (medium eggs) and 2,0 % (large eggs). Whereas, in the line D, chromosomal aberrations were observed with 19.2% (small eggs), 12.5 % (medium eggs) and 11.8 % (large eggs). In both lines A and D there were no significant difference in frequencies of aberrations between egg weight classes (Figure 1).

In the lines A and D, the frequencies of chromosomal aberration of L egg classes were relative low. But Reinhart and Hurnik (1984) reported that large eggs (average 69 g) have higher mortality in a later phase of incubation and delay in development intensity.

Figure 1: Frequencies of chromosomal aberrations within egg weight classes from lines A and D




**Relation between egg weight and types of chromosomal aberrations.**
Pure haploid and triploid, haploid-mosaic, tetraploid mosaic, and aneuploid mosaic (trisomic and monosomic mosaic) were observed in both the lines A and D. These types of aberration were also reported from other authors (Bloom, 1974; Thorne *et al.*, 1991).

The distribution of types of chromosomal aberration in the egg weight classes in the lines A and D were shown in Table 2 and 3. Medium eggs in both lines have more types of chromosomal aberration than in small or large eggs. But the differences are not statistically significant.

Table 2: Frequencies of various types of chromosomal aberrations within egg weight classes from line A

| Various types | Egg weight | | |
|---|---|---|---|
| of chromosomal aberration | **S** (< 52.9 g) | **M** (52.9-68.3 g) | **L** (>68.3 g) |
| Haploid | 1 (1.8 %) | 6 (2.6 %) | 1 (2.0 %) |
| Triploid | 1 (1.8 %) | 2 (0.9 %) | - |
| Haploid-mosaic | 3 (5.5 %) | 12 (5.1 %) | - |
| Tetraploid mosaic | 1 (1.8 %) | - | - |
| Trisomic mosaic | - | 1 (0.4 %) | - |
| Monosomic mosaic | - | 5 (2.1 %) | - |
| **Total** | 6 (10.9 %) [(a)] n = 55 | 26 (11.1 %) [(a)] n = 235 | 1 (2.0 %) [(a)] n = 50 |

Table 3: Frequencies of various types of chromosomal aberrations within egg weight classes from line D

| Various types of chromosomal aberration | Egg weight | | |
|---|---|---|---|
| | **S** (< 51.6 g) | **M** (51.6-63.2 g) | **L** (>63.2 g) |
| Haploid | 1 (1.9 %) | 2 (0.9%) | 2 (3.9 %) |
| Triploid | 1 (1.9 %) | - | - |
| Haploid mosaic | 7 (13.5 %) | 17 (7.4 %) | 1 (2.0 %) |
| Triploid mosaic | 1 (1.9 %) | 1 (0.4 %) | 2 (3.9 %) |
| Tetraploid mosaic | - | 1 (0.4 %) | - |
| Monosomic mosaic | - | 7 (3.0 %) | 1 (2.0 %) |
| Double monosomic haploid mosaic | - | 1 (0.4 %) | - |
| **Total** | 10 (19.2 %) [(a)] n = 52 | 29 (12.5 %) [(a)] n = 230 | 6 (11.8 %) [(a)] n = 51 |

## CONCLUSION

The results of the study indicate a significant influence of the egg weight on the frequency of early embryonic mortality: small eggs have a higher early embryonic mortality than medium or large eggs. There is no clear relationships between egg weight on frequency and type of chromosomal aberration.

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