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Abstract

The Effect of Hypercapnic Conditions During Early Incubation of Long-Stored Eggs

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Egg storage beyond 7 days has a negative effect on hatchability and chick quality. These negative effects may be caused by a sub-optimal level of albumen pH during early incubation. Gillespie and McHanwell (1987) measured an intra-embryo pH of 7.9 to 8.4 between 26 and 53 hours of incubation.

The albumen pH is around 9.0 within the first day of incubation and declines slowly after approximately 2 days of incubation. During early incubation, the embryo, therefore, has to maintain a barrier between the inside of the embryo (pH 7.9 to 8.4) and its exterior (yolk pH around 6.3 and albumen pH around 9.0). A long-stored embryo may be unable to maintain this barrier due to the negative effects of prolonged egg storage on embryo viability. A high CO_2 concentration in the incubator can reduce albumen pH and this may have a positive effect on embryonic development and hatchability. In the current study, it was investigated whether hypercapnic conditions during the first 5 days of incubation affected albumen pH, embryonic development, and embryonic mortality when eggs were stored for 15 days.

Eggs (n = 2,560) were collected from a Ross (308) broiler breeder flock of 36 weeks of age and stored for 15 days. Eggs were incubated in two seperate setters (HatchTech-4,800) for the first 5 days of incubation. In one setter, CO_2 was injected to maintain CO_2 concentrations between 0.70% and 0.80%. In the other setter, CO_2 increased from 0.05% to 0.20%, due to CO_2 production of the embryos.

In both setters, relative humidity was maintained between 65% and 75%. Average eggshell temperature was maintained at 37.8°C. On day 6 of incubation, all eggs were transferred to one setter (HatchTech-57,600). At 18, 42, 66, and 90 hours of incubation, 20 eggs per treatment were used to determine albumen pH and the stage of embryonic development. On day 6 of incubation, clear eggs were removed. After 520 hours of incubation, all unhatched eggs were collected. Clear eggs and unhatched eggs were opened to determine infertility or the stage of embryonic mortality.

Results showed that between 18 and 90 hours of incubation, albumen pH decreased in both treatments and the CO_2 treatment had a lower albumen pH than the control treatment. The stage of embryonic development was not affected by the CO_2 treatment. The CO_2 treatment had a lower hatchability of fertile eggs than the control treatment (87.9% vs. 91.0%; P = 0.02). This lower hatchability was caused by a higher embryonic mortality on day 3 of incubation (3.5% vs. 2.2%; P = 0.08), between days 4 and 9 of incubation (2.7% vs. 1.6%; P = 0.13), and on day 20 of incubation (0.9% vs. 0.3%; P = 0.01). In addition, more unhatched embryos were malpositioned in the CO_2 treatment than in the control treatment (1.2% vs. 0.4%; P = 0.05). The hypercapnic conditions used in the current study had no affect on embryonic development and increased embryonic mortality. It seems that an albumen pH of 9.0 is not sub-optimal for embryonic development in long-stored eggs.

References

Gillespie, J. I., and S. McHanwell. 1976. *Measurement of intra-embryo pH during early stages of development in the chick embryo.* Cell Tissue Res. 247:445-451.

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