Incubation Research Update

Poultry Research Centre | Factsheet #1 | October 23, 2006

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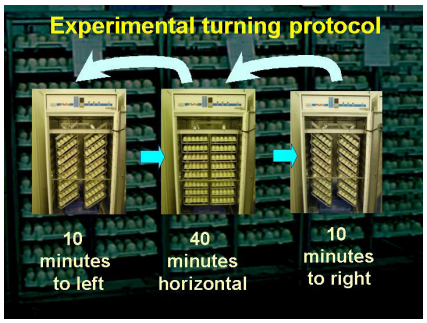
Investigating Alternative Egg Turning Protocols

- The multistage incubators currently in use in most commercial hatcheries pack eggs very tightly together in order to maximize the number of eggs that can be incubated while minimizing the space required. However, embryos from some high yield broiler strains are producing more heat, resulting in difficulty in removing heat from incubators during the later stages of incubation.
- Static pressure in large commercial incubators is reduced when egg trays are horizontal rather than turned, improving airflow and making it easier to remove excess heat. If egg turning can be modified so that eggs can be held on the horizontal for a period of time without negatively affecting hatchability, it would make management of incubator temperatures easier. In some cases, hatchability may even improve due to reduced heat stress on embryos.
- Taking the approach of modifying the egg turning protocol, as opposed to modifying incubator design, would also allow hatcheries to deal with the problem of increased heat production without the need to invest in costly new equipment.

Starting Out - The First Protocol



Experimental Approach: Two trials (at 48 and 53 weeks of breeder flock age) were carried out. Each trial used 600 hatching eggs from a Ross 308 breeder flock. The eggs were exposed to one of two turning protocols: control (eggs turned at a 45 angle to the left for 1 hour, then at a 45 angle to the right for one hour), and 10-40-10 (eggs turned at a 45 angle to the left for 10 minutes, then resting horizontally for 40 minutes, then turned at a 45 angle to the right for 10 minutes, then back on the horizontal for 40 minutes). Each turning protocol was repeated continuously throughout the first 18 d of incubation.

Treatment	Hatch of Fertile (%)	Early Mortality (%)	Mid Mortality (%)	Late Mortality (%)
Control	88.9 [a]	2.5 [b]	0.9	4.1 [b]
10-40-10	75.3 [b]	5.1 [a]	1.1	11.6 [a]

In the above table and all other tables in this report, values with the letter "a" are statistically different than values in the same column with the letter "b".

Results: The 10-40-10 treatment resulted in a lower hatchability of fertile eggs, and higher early and late embryonic mortality than the control treatment (see table on left).

Ongoing Research Projects:

The influence of genetics on embryo metabolism
Managing genetic strains for differences in embryo growth and heat production.

Chick quality and egg size
Is it flock age or simply egg size that affects chick quality?

Using infrared thermograpy to assess chick quality
Testing a new and innovative method for detecting navel infections at hatch.

Rooster age influence on chick quality
Investigating the role of the broiler breeder male in broiler hatchability and chick quality.

In the trial at 48 wk of breeder flock age, the hatch window of the 10-40-10 eggs lagged behind the control eggs. However, this trend was not observed at 53 wk of breeder flock age (data not shown).

Treatment	Chick Weight (g)	Chicks Culled at Hatch (%)
Control	44.5 [b]	4.9 [b]
10-40-10	45.0 [a]	9.7 [a]

There was also an increased percentage of culled chicks from the 10-40-10 protocol compared to the control protocol. The chicks hatched from control eggs were lighter than those from 10-40-10 eggs, (see table above) however the difference is so small that it is unlikely that it would have any influence on final broiler weights.

The Next Step: Due to the negative impact of the 10-40-10 protocol on hatchability and embryo mortality, it would not be feasible for use in industry, and a less severe protocol is necessary.

Making Progress – A Protocol With Promise

Experimental Approach: One trial was conducted using 600 Ross 308 hatching eggs. The control turning protocol remained the same, but the experimental turning protocol was altered so that eggs were turned at a 45 angle to the left for 20 min, held on the horizontal for 20 min, turned at a 45 angle to the right for 20 min, then returned to the horizontal for 20 min (20-20-20 protocol). As in experiment 1, the turning protocols were repeated continuously throughout the first 18 d of incubation.

Results: There was no difference in hatchability of fertile eggs or embryo mortality between the control and 20-20-20 treatments, indicating that the 20-20-20 protocol had no negative impact on hatchability. The 20-20-20 protocol also had no negative effect on the percentage of culled chicks, or chick weight at hatch (see table below).

Treatment	Hatch of Fertile (%)	Early Mortality (%)	Mid Mortality (%)	Late Mortality (%)	Chick Weight (g)	Chicks Culled at Hatch (%)
Control	89.0	3.8	1.9	2.4	45.4	0.7
20-20-20	86.3	5.4	1.4	3.6	45.5	0.0

The Next Step: The 20-20-20 protocol showed promise, so the decision was made to proceed with a larger scale experiment to confirm the findings with a larger number of eggs, as well as track chicks throughout broiler grow out to see any potential effects of the 20-20-20 protocol on broiler performance.

Stepping It Up – A Large Scale Test

Experimental Approach: Two trials were conducted (at 43 and 58 wks of breeder flock age), each using 1800 hatching eggs. Cobb 500 eggs were used, since this is a strain that hatchery managers have reported to produce more heat than other strains. The control and 20-20-20 protocols remained the same as in the previous experiment. At hatching, all chicks were weighed. In addition, 60 chicks per treatment had their length measured, and were then culled and the yolk sac removed and weighed. Seven hundred saleable chicks from each treatment were then selected for the broiler grow out part of the trials. Broilers were weighed at 3 and 6 wk of age, and feed consumption and mortality were recorded on a weekly basis.

Research Sponsors:

- Jamesway Incubator Company, Inc.
- Lilydale Inc., Edmonton Hatchery
- Maple Leaf Poultry, Wetaskiwin Hatchery

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Treatment	Hatch of Fertile (%)	Early Mortality (%)	Mid Mortality (%)	Late Mortality (%)	Chicks Culled at Hatch (%)
Control	83.7 [b]	5.0 [a]	0.8	3.1	2.9
20-20-20	87.9 [a]	3.1 [b]	0.9	2.8	1.9

Results: In this larger scale experiment, the 20-20-20 protocol resulted in higher hatchability of fertile eggs than the control protocol. The 20-20-20 protocol also had lower early embryo mortality than the control protocol eggs (see table above). No difference in the incubation time required to hatch or the hatch window was observed between treatments (data not shown). There were no differences in the percentage of culled chicks between protocols. Chick length, yolk sac weight, or percentage of dry matter in the yolk sac also did not differ between protocols (data not shown).

There were no differences in chick weight, or broiler BW at 3 or 6 wk of age between broilers from the control and 20-20-20 protocols (see table on left). Broiler mortality throughout the production period was also not affected by egg turning protocol (see table below).

Treatment	Chick BW (g)	Wk 3 BW (g)	Wk 6 BW (g)
Control	46.2	849	2473
20-20-20	46.2	854	2495

Treatment	Cumulative Broiler Mortality					
	Wk 1 (%)	Wk 2 (%)	Wk 3 (%)	Wk 4 (%)	Wk 5 (%)	Wk 6 (%)
Control	0.3	1.0	2.8	4.4	6.1	7.5
20-20-20	0.6	1.0	2.0	3.1	4.6	6.5

Looking to the Future – Industry Implications

Based on the promising results obtained with the 20-20-20 turning protocol, further testing will be done in commercial multi-stage incubators. This would confirm the effects of the 20-20-20 protocol in an environment where heat dissipation would be a limiting factor to embryo development. It is in a commercial setting where any potential improvements in hatchability or ease of management would likely be most visible.

The 20-20-20 turning protocol has the potential to improve efficiency in commercial hatchery operations by facilitating the dissipation of heat from embryos of high yield genetic strains, making incubator temperature management easier and improving hatchability.

This research is part of a continuing embryology and chick quality research program at the University of Alberta.

This report has been produced in keeping with our goal to connect with industry on a continuous manner, both in the receiving of input and the transferring of knowledge.

This report was prepared by E. O'Dea