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Incubation of Modern Broiler Hatching Eggs: Part 2 – Cobb 500

Fact Sheet #7
May 28, 2009

Incubation Challenges

Many modern commercial hatcheries use multistage incubators. In multistage incubation, eggs are placed sequentially in the incubator so that continuous hatching occurs. After the chicken embryo has incubated 18 days, the eggs are transferred to a hatcher for an additional 3 days. Research has shown that within the same genetic strain embryonic mortality is high during the early days of incubation in young parent flocks, while embryo mortality tends to be higher during the final days of incubation from older parent flocks. Some hatchery personnel have noticed that embryos from modern broiler genetic strains produce more heat at the end of incubation compared to strains that are not as highly selected for growth.

How Embryos Breathe

While the egg is incubating the growing embryo must "breathe" in oxygen (O_2) and expel carbon dioxide (CO_2) and H_2O. This exchange of gases is completed by a special membrane surrounding the inside surface of the eggshell called the chorioallantoic membrane. The gases pass through tiny openings in the eggshell called pores.

Figure 1. Chicken embryo in amniotic sac

The O_2 is used to metabolize yolk nutrients to produce energy for growth and CO_2 and H_2O are produced as by-products. The process of breaking down the yolk nutrients to release energy is called embryonic metabolism. Embryonic metabolism can be measured by the amount of embryonic heat produced. There is a mathematical relationship which shows that embryos that consume more O_2 and produce more CO_2 will have higher heat production. But it is not clear if higher late incubation embryo mortality in embryos produced by older parent flocks is due to higher embryonic metabolism and heat production. This project was carried out to see if there are any differences in embryo heat production between eggs collected from Cobb 500 flocks at six different parent flock ages.

What We Did

Ten eggs produced from each of six parent flock ages were individually incubated in small metabolic chambers at six different times. The chambers were housed inside a small incubator (Figure 2). Daily O_2 consumption and CO_2 production were measured for each embryo and used to calculate daily embryonic heat production.

What we found: Embryonic heat production was significantly different between parent flock ages for all days of incubation except on incubation days 8 and 12 (data not shown). The daily embryonic heat production increased as the parent flock age increased. Compared to embryos from mature, post peak, peak and young parent flock ages embryonic heat production was highest in embryos from the very old parent flock followed by the old parent flock from 18 to 20 days of incubation (Figure 3).

In This Issue

- The challenges of incubating eggs from a modern broiler strain
- Effects of parent flock age on embryonic heat production
- Possible ways to prevent excessive embryonic heat production during incubation
- How this knowledge can benefit the poultry industry

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Figure 2. Individual eggs were inside metabolic chambers housed in an incubator. The O_2 and CO_2 concentrations in the chambers were measured everyday and used to calculate daily embryonic heat production.

This period of incubation is also the same period during which high late incubation embryonic mortality occurs. Since embryos from older parent flock ages have higher metabolism during this incubation period where high mortality occurs, there may be a link between high metabolism, high heat production and embryo death. In multistage incubators if embryos from eggs that have been incubating for 16-18 days are overheating, the temperature of the incubator cannot simply be turned down as this will affect the growth of embryos in eggs that have just been placed into the incubator. The results of this experiment confirm that embryos from modern broiler genetic strains produced by different flock ages produce different amounts of metabolic heat.

What Does This Study Mean For The Poultry Industry?

While this research shows that embryos from different Cobb 500 parent flock ages are different in terms of heat production, further research is needed to establish temperature profiles for all parent flock ages to determine the optimal temperatures for peak embryo performance.
This will provide hatchery managers with specific temperatures that can be used to achieve optimum hatchability and chick quality for each parent flock age. If eggs from each parent flock age are incubated at the right temperature, hatchability will increase and there will be less culled chicks before they are placed and grown into broilers.

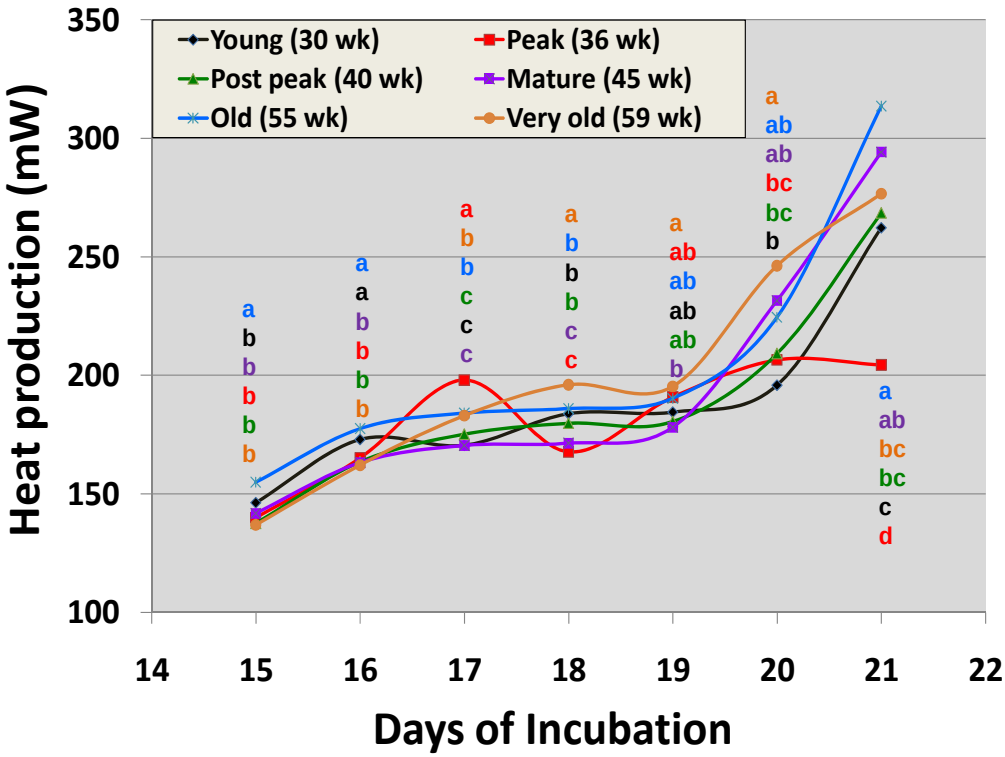

Figure 3. Effect of parent flock age on embryonic metabolism. Flock ages with different letters assigned to them on the same day of incubation are statistically different from each other.

Quick Facts

- Embryos from older parent flock ages produce more heat than embryos from younger flocks.
- Establishing heat production profiles for embryos from the different parent ages could lead to a change in the way eggs are incubated.

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