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# Incubation of Modern Broiler Hatching Eggs: Part 1 – Ross 308

## Incubation Challenges

Currently, modern hatcheries incubate eggs in one of two ways. In single stage incubation, all eggs start incubation at the same time and finish at the same time. In multistage incubation, eggs of different embryonic ages are present in the incubator at the same time. Information from some hatcheries in Alberta has indicated that some modern strains are producing more heat at the end of incubation compared to other strains. Similarly, embryos from eggs produced by older parent flocks also seem to produce more heat than embryos from younger parent breeder flocks. Since eggs from older parent flocks are bigger, the embryos produced are also bigger than those from younger parent flocks. The principle of multistage incubation is that the heat produced by older embryos is used to warm embryos of eggs that have just been placed in the same machine. However, with some modern genetic strains there is concern that during the final few days in the incubator the embryos may be getting too hot. This overheating may cause more late incubation embryo deaths (Figure 1) or weaker chicks at hatching.

## How Embryos “Breathe”

During incubation, the embryo “breathes” oxygen (O<sub>2</sub>) and produces carbon dioxide (CO<sub>2</sub>) and water (H<sub>2</sub>O) using a special membrane surrounding the inside of the egg shell (the chorioallantoic membrane). The gases pass in and out of the egg through tiny holes (pores) in the eggshell.

## Why Embryos Produce Heat

Heat is produced when the embryo uses O<sub>2</sub> to break down fat in the yolk to get energy for growth and maintenance of body tissues.

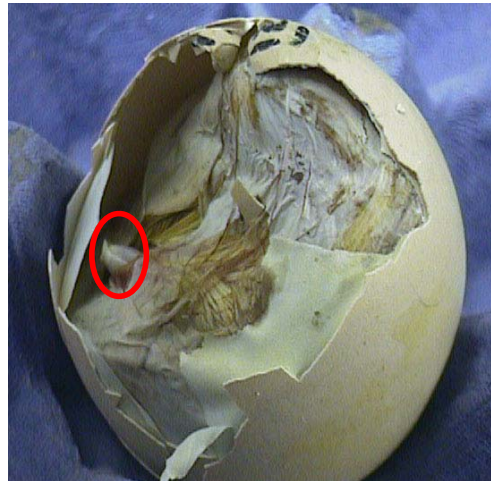


Figure 1. Chicken embryo that died during the hatching process. The red circle shows where the beak has poked into the air cell (internal pipping).

This process is called embryonic metabolism. The O<sub>2</sub> consumed and the CO<sub>2</sub> and H<sub>2</sub>O produced by the embryo have a direct effect on the heat that the embryo produces. So the amount of heat that an embryo produces indicates the embryo's metabolic activity. The current experiment was conducted to see if embryos from eggs produced by different parent flock ages have different metabolic rates. We wanted to determine if embryos from Ross 308 older parent flocks produce more metabolic heat.

**What we did:** The eggs from the six parent flock ages were incubated at six different times. Each individual egg was placed into a small metabolic chamber housed inside a small single stage incubator (Figure 2). The O<sub>2</sub> consumed and the CO<sub>2</sub> produced by each embryo were measured every day for 21 days. The daily O<sub>2</sub> and CO<sub>2</sub> measurements were used to calculate heat produced by the embryo at each day of incubation.

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May 28, 2009

## In This Issue

- The challenges of incubating eggs from current broiler breeder strains
- Effects of parent flock age on embryonic heat production
- How can this information help the hatching egg industry



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Figure 2. Equipment used to measure embryonic metabolism of individual eggs throughout the entire incubation period. A sample of air is taken from each chamber and assessed for O<sub>2</sub> and CO<sub>2</sub> concentrations. The amount of O<sub>2</sub> consumed and CO<sub>2</sub> produced by the embryo are used to calculate heat production.

**What we found:** For all flock ages, daily embryonic heat production increased gradually and leveled off around 16 to 19 days of incubation. The heat production stopped increasing during this incubation period because the O<sub>2</sub> available through simple diffusion through the pores of the shell reached a maximum. Since O<sub>2</sub> consumption was its maximum this also affected CO<sub>2</sub> and heat production. Around 19 days of incubation the embryo began the hatching process that enabled it to take in more O<sub>2</sub>

by using its lungs, thereby increasing its O<sub>2</sub> consumption, CO<sub>2</sub>, H<sub>2</sub>O and heat production. Comparisons of daily embryonic heat production showed that from 17 days of incubation onwards the mature, old and very old flocks had higher embryonic heat production than the embryos from young, peak and post peak flock ages. This means that embryos from older parent flocks could be at risk of overheating compared to embryos from the young flocks. The peak flocks had an unusual drop in heat production at 19 days of incubation. The reason for this is unknown.

### Significance of this Study to the Poultry Industry

The results show that embryos produced by parents of different (Ross 308 and other strains) flock ages produce different amounts of heat. Therefore, it may be beneficial to incubate eggs from different parent flock ages separately under different incubator conditions. The knowledge gained from this research may be important for hatchery managers; but more research is needed to fully apply this knowledge. Future research should determine the incubation temperatures that embryos from each parent flock age require in order to prevent overheating and improve embryo survival.



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### Quick Facts

- Embryos from older parent flock ages produce more heat than embryos from younger parent flock ages
- Hatchery managers may need to adjust incubator temperatures depending on the parent flock age that produced the eggs

### Research Team

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### Project Sponsors

- Alberta Livestock Industry Development Fund (ALIDF)
- Aviagen
- Jamesway Incubator Company, Inc.
- Maple Leaf Hatchery
- Poultry Industry Council (PIC)
- Natural Sciences and Engineering Research Council (NSERC)
- Poultry Research Centre (PRC), University of Alberta

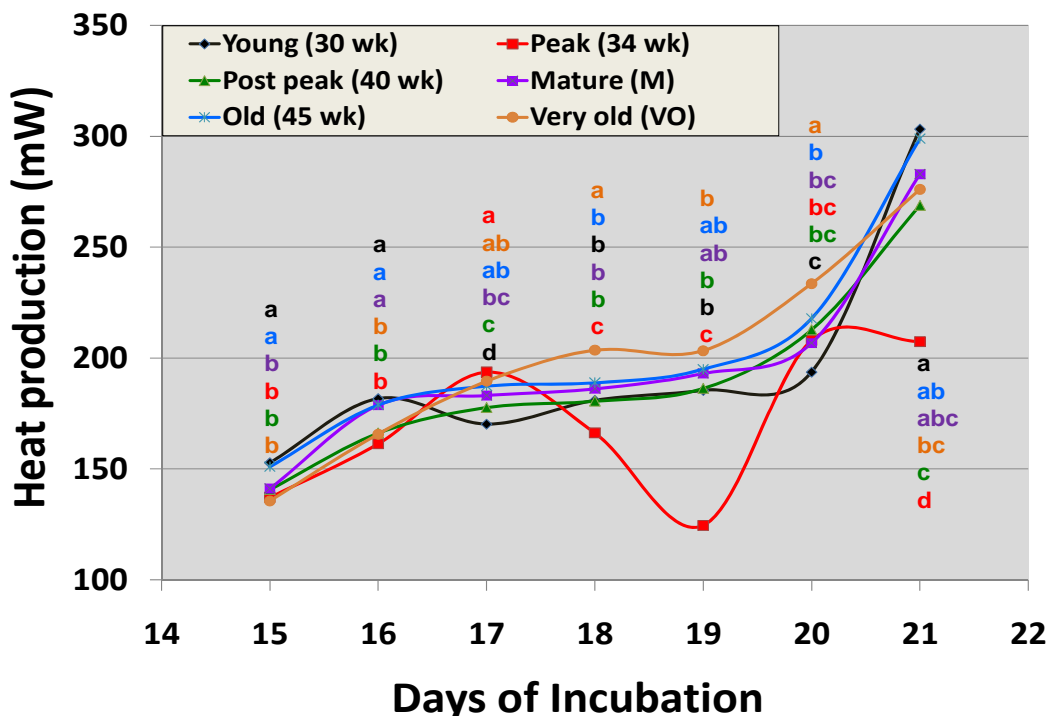


Figure 3. Effect of parent flock age on embryonic metabolism. Flock ages with different letters assigned to them on the same day of incubation are statistically different from each other.