

Egg Storage, how to improve embryo survival



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Introduction

For **fertile eggs to reach their hatching potential**, they need to be handled carefully, with the aim of avoiding unnecessary embryo development during dormancy, keeping the albumin and yolk membranes in good condition, allowing sufficient movement (turning) to keep the egg contents oxygenated and prevent them sticking to the shell membranes and, always, keeping levels of bacterial contamination as *low as possible*.

Hatchability naturally drops as eggs age.

Kept in reasonable conditions, eggs can be stored for **just over a week** without major problems.



However, **eggs that are to be stored for longer than 10 days need greater care with storage conditions**, and can sometimes benefit from additional treatments. Thus, if market conditions are such that egg age is likely to drift above 10 days, then *it will be worth dropping egg storage temperatures throughout the cold chain* (farm store to truck to hatchery store), turning the eggs in the hatchery egg store and using short periods of incubation during egg storage (**SPIDES**) to boost resilience.



Storage temperatures which are too high, or temperatures which fluctuate are associated with a much faster rate of hatchability decline than cooler, absolutely constant ones.



It is notable that the speed of decline in hatchability after 14 days storage will vary substantially depending on the adequacy of the storage conditions offered.

Controlling Contamination

Eggs that are laid into wet, dirty conditions have very little protection in the first few minutes after lay, while the cuticle cures.

- ▶ Keeping nests and collection belts clean, while discarding floor and dirty eggs is *good practice* in any hatching operation, but **is particularly important if egg age is above 7 days**. It is helpful to monitor rots and bangers when the eggs are candled and transferred, referring back to the farm if levels are high, or start to rise.

- ▶ Clean nests, careful avoidance of conditions likely to cause condensation on the egg surface, and effective fumigation using formalin on arrival at the hatchery will all help to keep contamination rates down.



Storage Temperatures and Embryo Development

When the fertile egg is laid, the blastoderm will be at EGK (*Eyal Giladi and Kochav 1976*) **stage X**. These embryos are capable of a complete pause in development until the eggs are set, although it is common to see **slow development** in conditions above 15°C, with **'normal' development** starting around 30°C.

Comparing the impact of temperatures fluctuating by 1-3°C around normal holding temperature (normally harmful) with those achieved using SPIDES (beneficial as long as time above 32°C does not exceed 12 hours) shows that measures taken to control egg store temperature at around 15°C (12°C if storage is longer than 14 days to preserve albumin quality) will almost certainly be beneficial – making sure that the cooler capacity is sufficient to cope with extremes of heat and cold, insulating the ceiling walls and floor to slow temperature changes down and keeping the door closed except when in use are all sensible precautions.



If egg storage exceeds 14 days, physical changes to egg quality start to be of concern. The thick albumin thins and spreads, so that it **is no longer as effective a cushion for the embryo.** Antimicrobial proteins become less effective. **Storage temperatures below 15°C will help to maintain albumin quality.**

If mottling of the vitelline membranes surrounding the yolk is present, the membrane strength will deteriorate rapidly, making the yolks more fragile, and the surface they provide for the embryo less hospitable.



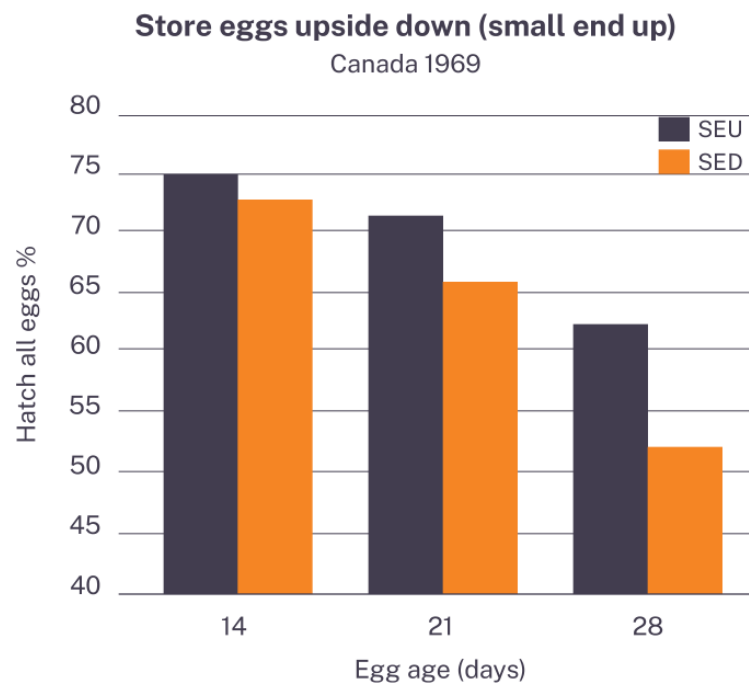
The **best strategy for dealing with yolk mottling** is prevention, avoiding known causes. Certainly if a flock has had mottling for any reason, it is better to set the eggs within 10 days of oviposition.

Turning During Storage



The first publication showing a benefit to turning during storage was Funk and Forward (1951), the improvement only being seen in eggs stored more than 7 days. Proudfoot (1966) stored eggs laid by White Leghorn layers for 14 to 28 days, with half of the eggs held level and the other half held at 50°, and turned through 180° once a day.

Later (Proudfoot 1969) compared eggs stored small end up with eggs held blunt end up, checking hatchability at 7, 14, 21, and 28 days of storage. After 7 days, **the eggs held upside-down hatched worse than the controls, but for all longer storage periods the small end up orientation was beneficial.**



Proudfoot 1969

Becker *et al* (1969) compared turning angles of 180° with 90°, finding that the smaller turning angle, which is consistent with the turning angle in the setter, gave *better results*.

More recently, Elibol *et al* (2002) looked again at turning during storage, looking at turning 4 or 24 times a day for eggs stored 3, 7 or 14 days. They showed a **consistent advantage to turning 4 times a day in eggs stored for 14 days**, which was biggest in eggs laid by older hens. **Turning more often was less beneficial**. Later, Elibol and Brake (2008) looked at storing eggs upside-down, showing *very similar effects* to those reported by Proudfoot in 1969 for eggs stored for 14 days.



Elibol and Brake 2008

Storing eggs upside-down in modern hatcheries is not easy, but it works well in systems where the eggs are stored on cardboard flats in boxes, which can be inverted regularly while the eggs are stored.

Modified egg stores, with the same turning mechanism as that used in the setters, are fairly common in higher generation hatcheries and work well. Interestingly, **turning eggs during storage as well as giving SPIDES treatments shows a benefit to both** (the effects are additive), **suggesting that the two systems act on different component causes of the hatch drop seen in stored eggs** (Ozlu et al 2021).



SPIDES

Using *short heat treatments* during longer periods of egg storage is a method that first appeared in the scientific literature more than 100 years ago (Jackson, 1912, who placed eggs under broody hens to deliver the heat treatment). Most of the experiments seemed to work, but *commercial hatcheries rarely seemed to be able to deliver consistent results* working from the experimental reports.



In 2011, **Aviagen** started to investigate the process, **trying to develop robust advice as to how to use heat treatments effectively**. Details of the trials concerned are given in Nicholson *et al* (2013). The series of trials showed that heating speed was not important, and egg shell temperatures could be quite variable, depending on their placement.

What was important was that the eggs spent no longer than 12 hours above 32°C through the whole storage period, so multiple treatments needed to be short. The timing of the first treatment should ideally be during the first week, although eggs treated for the first time 10 days after lay still responded well.

Ideally the total treatment will deliver a mean EGK stage of XII.

- The heat treatments can be delivered using the corridor of multistage setters,
- By filling alternate tray spaces in single stage setters or
- By using one of the many modified setters produced by the incubator manufacturers.

All work well, but it is **advisable to track the egg shell temperature during heating and cooling to ensure that the eggs are not over treated**. Never put the heated eggs straight back into the cold store after treatment. Use the setter pre-heat treatment to cool the eggs down to around 24°C first. When incubating the eggs, plan the set time as if the eggs are fresh, not their full egg age.



Conclusions



Difficult market conditions and uneven order sizes can both force planners to run an egg bank with a longer than ideal egg age.

If good practices of egg hygiene and storage temperature are followed as routine, and temperatures are changed appropriately if egg age starts to drift, and the hatchery is able to turn eggs during storage and use SPIDES treatments weekly during long egg holds, then much of the hatchability that would normally be lost can be rescued and chick quality will be good as well. Continual attention to the detail of egg storage times and storage temperatures is key to achieving the best results.



Thank you!

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