Superior chick quality: where and how should we hatch our chicks?

Incubating day-old chicks is a wonderful process, but how do you optimise the incubation process to guarantee superior chick quality?

by Dr Inge van Roovert-Reijrink and Carla van der Pol, HatchTech BV, The Netherlands. hatchtechgroup.com

Chick quality is expressed in many ways, most important of which are the number of second grades, hatchling yolk-free body mass, chick length, navel quality, and first week growth and mortality.

During the incubation process, eggshell temperature, carbon dioxide concentration, and post hatch environment are the most important drivers of embryo development and, therefore, chick quality and subsequent performance.

Eggshell temperatures

Several studies aimed to determine the optimal eggshell temperature (EST). Lourens et al. (2005) showed that an EST lower than 37.8°C (100°F) during the first week of incubation or higher than 37.8°C during the third week of incubation resulted in a higher percentage of second grade chicks (up to 5% more) and shorter chick length (up to 5mm smaller). Molenaar et al. (2011) showed that an EST of 38.9°C from day seven of incubation onwards increased the incidence of ascites in later life in comparison to an EST of 37.8°C.

EST in the hatcher phase also has a large impact on chick quality. Maatjens et al. (2014) applied three ESTs from day 19 of incubation onward and found higher relative heart weights at hatch for 36.7 and 37.8°C than for 38.9°C (0.69% and 0.66% vs. 0.58%, respectively).

These results suggest that it may be even better to incubate at a temperature slightly below 37.8°C than above it; yolk-free body mass of the 36.7°C incubated chicks was 0.65g higher at hatch than that of 38.9°C incubated chicks.

All these studies show the relevance of an optimal EST during incubation to obtain superior chick quality.

Incubator design

EST is influenced by embryonic heat production and heat transfer capacity of the air, which depends on air temperature, air velocity, and relative humidity. All of these are greatly dependent on incubator design.

The machine needs to have enough heating (prior to about day nine of incubation) and cooling (after day nine, when embryonic heat production increases) capacity to maintain the right temperature.

Air velocity should be uniform,

like in HatchTech's incubators with the laminar concept, to reduce variation in heat transfer capacity and, thereby, ESTs.

Relative humidity affects the air's heat transfer capacity because humid air transfers heat better than dry air. To maintain optimal ESTs throughout incubation, it would be ideal to maintain a high relative humidity during the whole incubation process.

However, this is impossible because an egg needs to lose at least 10%, but preferably around 12%, of its weight at day 18 of incubation to maximise hatchability.

Therefore, a balance must be found between heat transfer capacity created by relative humidity (to maintain uniform ESTs) and egg weight loss control.

When the design of an incubator and all its settings are correct, EST should always be close to 37.8°C or below 37.8°C after day 19 of incubation to obtain superior chick quality.

Hatcher and hatch window

Around day 18 of incubation eggs are transferred from the setter to the hatcher, so that the chicks can hatch in the hatcher baskets. It is well known that chicks do not hatch at the same time.

The time period in between the first and last hatched chick is called the hatch window and can vary between 24 and 36 hours.

Every factor that increases the variation in embryo development before or during incubation also affects the length of the hatch window. Two factors that have a large influence on the hatch window in commercial incubation are the mix of egg batches that is made by the hatchery personnel (mix of storage durations or breeder flock ages etc), and incubator design, incubator operation, and incubation profiles or in other words: how uniform the air temperature is inside the incubator.

Nowadays, incubators become larger to reduce the cost price per egg. When incubators increase in size, the chance that batches of eggs of different breeder flock ages or storage durations are mixed increases. In addition, the design of the incubator becomes more crucial to provide uniform incubation conditions to all eggs. Due to the mix of egg batches and non-uniform incubation conditions the length of the hatch window in larger incubators can increase. An important question is: why should we be concerned about the hatch window?

In practice this question can be answered in two ways.

- A hatchery has planning for chick handling and transport. It is important to ensure that all chicks are

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hatched and dry when they are taken from the hatcher. A predictable and short hatch window makes it easier to take the chicks from the hatcher at the right time to have maximal hatchability.

- For the chicks, a large hatch window is detrimental because it can take up to 72 hours before chicks are placed at the farm and finally have access to feed and water. Research has shown that no access to feed and water between hatch and placement at the farm negatively affects subsequent performance.

To ensure that chicks are hatched in time to meet the hatchery planning, actions can be taken in the hatcher to shorten the hatch window. Used methods are:

- Transfer patterns in which eggs are moved from the relative cold spots in the setter to the relative warmer spots in the hatcher or vice versa.
- Increase hatcher air temperature.
- Increase hatcher CO_2 level.

Chick quality is negatively affected by these actions and the moment of first intake of feed and water is still postponed until the chicks are placed at the farm. Therefore, these actions are not beneficial for the chicks, but only for the hatchery personnel in the short term.

The reality is that there will always be a hatch window. A hatch window is part of nature. The best way to deal with a hatch window is to ensure that the rectal temperature of the hatched and dry chicks is between 40.0 and 40.6°C and to provide them with feed and water.

The benefit of feed and water in the hatcher

During the last few days of incubation, the residual yolk is retracted into the body cavity as an extension of the intestine. Post hatch, the residual yolk is the only nutrient source of the chick until exogenous feed is available.

Chicks can use the residual yolk for maintenance during the first few days post hatch. However, research has shown that development and maturation of the gastrointestinal tract, and important immune related organs is delayed in chicks that have to rely solely on their residual yolk and have no feed and water available between hatch and placement at the farm.

A study of Noy et al. (1996) showed that the residual yolk of chicks with access to feed during 96 hours after hatch reduced more rapidly in size than in fasted birds. This can be caused by increased intestinal activity in fed chicks.

A more rapid reduction in residual yolk size indicates that valuable nutrients are earlier used for important developmental steps.

Geyra et al. (2001) showed that fasting post hatch retarded body weight increase and intestinal growth. The effects of fasting were specific to both time of fasting and the intestinal segment examined (duodenum, jejunum or ileum).

The jejunum appeared to be the most sensitive of the intestinal segments. Fasting between 0 and 48 hours post hatch decreased crypt size, the number of crypts per villus, crypt proliferation, villus area, and the rate of enterocyte (intestinal absorptive cells) migration in the duodenum and jejunum.

Geyra et al. (2001) concluded that early access to feed is important for optimal early intestinal development.

Maiorka et al. (2003) also showed that the development of the gastrointestinal tract was directly linked to feed and water intake.

They showed that relative weight and length of the jejunum and ileum increased when chicks were supplied with feed and water post hatch. In addition, intestinal mucosa development was affected by the availability of feed and water: the number of villi per area decreased because villi size increased.

According to these findings Maiorka et al. (2003) hypothesised that the absence of physical stimuli caused by feed in the intestinal lumen and the specific need for certain nutrients, such as water, may be responsible for negative changes in the morphology of the intestinal mucosa.

Protein in the residual yolk is the source of antibodies from the hen. To be effective, it is important that maternal antibodies move from the residual yolk into the bloodstream but also to sites of vulnerability such as the mucosal surfaces where bacteria and viruses can enter the body.

Dibner et al. (1998) evaluated the effect of early feeding on the development of the immune system in broiler chickens. They showed that providing nutrients immediately post hatch resulted in heavier bursa weight, earlier appearance of biliary IgA and germinal centres (secondary lymphoid organs), and an improved resistance to a disease challenge.

In broiler chickens the first week of life is not only important for further development of the gastrointestinal tract and important immune related organs but is also an important period for muscle production.

Halevy et al. (2000) showed that the length and timing of fasting post hatch affects satellite cell activity.

Short-term fasting can enhance satellite cell number. However, long term fasting almost completely arrests cell mitosis and decreases the number of satellite cells. In the study of Halevy et al., (2000) the chicks that fasted during the first days of life did not regain their body weight or breast muscle weight by day 41, however chicks that fasted between day four and six post hatch had full growth compensation by day 41.

Halevy et al. (2000) concluded that sufficient feed directly post hatch may be critical for later muscle development. A study of Noy and Sklan (1999) also showed that early feeding increased body weight and breast size at marketing age in chickens and poults. They showed that early feeding reduced mortality numerically.

Early feeding seems to have a positive effect on chick performance because development and maturation of important organs is not retarded post hatch, but continues.

HatchCare

To improve the environment and well being of the chicks post hatch, HatchTech developed a new hatcher, HatchCare. In HatchCare, chicks are provided with their first necessities of life; feed, water, light, and fresh air at the correct temperature. This will continue development and maturation of important organs post hatch.

In addition, HatchCare is developed to take away a few large stress moments that are present in the traditional hatching and handling situation. Chicks are used to light, the stress of seeing the first light when the hatcher is opened is taken away.

Chicks do not sit between the eggshells and have room to move around and find the feed and water. Fans produce less noise because, due to the design of HatchCare, high air velocity is not necessary to obtain uniform embryo temperatures.

Chicks will be transported in the HatchCare basket which will take away a lot of handling stress and opens up the opportunity to provide feed from hatch until placement at the farm.

Where and how should we hatch our chicks?

Realising maximum chick quality is largely dependent on incubator design. An incubator should provide the right circumstances for optimal, uniform ESTs, allow for embryonic respiration, and continue post hatch development by providing the chicks with correct body temperatures and feed and water access. When all of these are guaranteed, superior chick will arrive at the broiler farms every day. ■

References are available from the authors on request