Superior chick quality is the result of optimal incubation conditions

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Delivering perfect day-old chicks is a hatchery's key aim. Chick quality is expressed in various ways, like 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 the post hatch environment are the most important drivers of embryo development. These drivers are directly related to chick quality and subsequent performance. In this article, all of these factors are discussed as well as how they depend on incubator design.

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 chickens (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 and cooling capacity to maintain the right temperature. Air velocity should be uniform, to reduce variation in heat transfer capacity and, thereby, ESTs. Thanks to the laminar airflow concept, the air velocity in HatchTech's incubators is perfectly uniform.

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 12% of its weight at day 18 of incubation to maximise hatchability. Therefore, the balance between heat transfer capacity created by relative humidity and egg weight loss control is essential. The laminar airflow concept and HatchTech's humidity control guarantee this balance. To obtain superior chick quality

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ESTs should always be close to 37.8°C or below 37.8°C after day 19 of incubation.

CO_2 concentrations

CO_2 concentrations become crucial during the hatching phase. In practice, some hatchery managers try to reduce the hatch window by reducing the inlet of fresh air into the hatcher, increasing CO_2 concentrations in the hatcher above 0.8%. This triggers the embryo to hatch earlier than if the maximum CO_2 concentration is below 0.35%. However, Maatjens et al. (2014) found lower navel quality at 12 hours post hatch for chicks exposed to 1.0% CO_2 from day 19 of incubation onward compared to chicks exposed to 0.2% CO_2.

This emphasises the importance of maintaining CO_2 concentrations at a lower level to guarantee superior chick quality.

A combination of high EST and a high CO_2 concentration during the hatching process is even more detrimental for chick quality. In some commercial incubators, the cooling capacity of the incubator partly depends on the inlet of fresh air.

Reducing ventilation rate to increase the CO_2 concentration then also results in too high ESTs. The combination of high EST and a high CO_2 concentration during the hatching negatively affects stomach development. High ESTs and increased CO_2 concentrations should never be used to shorten the hatch window. The reduction of the hatch window will never counterbalance the negative effect on chick quality.

Post hatch environment

From the moment of hatch until delivery at the farm, rectal temperatures of chickens have to be maintained between 40.0 and 40.6°C.

At temperatures higher than 41.0°C, chickens start panting to cool their body by evaporation. Panting can result in dehydrated chickens when they have no access to feed and water.

Overheating post hatch has a major effect on subsequent growth performance and mortality. The design of hatchers, chick handling rooms, chick storage rooms, and trucks is, therefore, crucial in achieving the correct environment for every single chicken from hatch until delivery at the farm.

Providing chicks with early access to feed and water not only prevents dehydration. It also allows the chicks to continue their development and use the valuable residual yolk nutrients for immunity and maturation.

Traditionally, chicks spend up to 48 (or, in cases of long travel or an overnight stay at the hatchery, 72) hours without access to feed and water. With HatchCare – the hatcher with light, feed and water, chicks continue to be fed and hydrated until delivery at the farm. This results in heavier, better developed and superior day-old chicks.

Conclusions

Providing maximum chick quality is largely dependent on incubator design. An incubator should provide the right circumstances for optimal, uniform ESTs, allow embryonic respiration, and continue post hatch development by early feeding and maintaining correct body temperatures. ■

References are available from the author on request