Technical information

The influence of Incubation Conditions on Chick Quality

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Chick quality

Besides optimizing hatchability, an important aim of a hatchery is to deliver perfect day-old chickens. Chick quality is expressed in many ways, most important of which are 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. In the current article, all of these factors are discussed as well as how they depend on incubator design.

Eggshell temperatures affect chick quality

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 5 mm smaller). Molenaar et al. (2011) showed that an EST of 38.9°C from day 7 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 3 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 0.65 g 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 and eggshell temperatures

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 9 of incubation) and cooling (after day 9, 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 maximize 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.

CO_2 concentrations affect chick quality

In commercial hatcheries, the CO_2 concentration is often maintained below a maximum level to supply enough fresh air to the developing embryos. Early on in life, CO_2 concentration does not seem to have a large impact on chick quality. De Smit et al. (2006) showed that a gradual increase of CO_2 to a concentration above 1% during the first 10 days of incubation had a positive effect on relative growth during the first week of life, but did not result in higher body weights at slaughter age. Everaert et al. (2007) demonstrated that chicken embryos can tolerate high CO_2 concentrations (4%) between day 10 and 18 of incubation without an effect on chick quality.

CO_2 concentrations become more crucial in the hatching phase. In practice, some hatchery managers try to reduce the hatch window (time between the first and last chicken hatched) 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 emphasizes 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 might be 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 negative effect of too high ESTs on chick quality is larger than the negative effect of high CO_2 concentrations (results shown earlier in this article), however the combination of 1% CO_2 and an EST of 38.9°C from day 19 of incubation onward had a negative effect on stomach development 12 hours post hatch when compared with 0.2% CO_2 and an EST of 38.9°C (Maatjens et al., 2014). High ESTs and increased CO_2 concentrations should never be used to shorten the hatch window. The reduction of the hatch window will never counter balance the negative effect on chick quality.

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Post hatch environment affects chick quality

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. 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 feeding and water access 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 HatchTech's new hatching system, called HatchCare, chicks are provided with feed and water immediately post hatch and continue to be fed and hydrated until delivery at the farm. This results in heavier, better developed day old chicks of higher quality.

Conclusions

Realizing 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

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