Natural and undisturbed hatching leads to maximum quality day old chicks

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The goal of a hatchery is high hatchability and good chick quality, resulting in optimal performance in later life. To optimise embryo development during incubation and thereby chick quality, incubation conditions need to meet the requirements of the embryo.

Temperature is of major importance for optimal embryo development and growth. Research has indicated that a constant eggshell temperature (EST) of 37.8°C until day 19 of incubation results in the lowest embryo mortality, highest hatchability, optimal embryo development and chick quality, expressed in a longer chick length, and higher yolk free body mass at day of hatch.

Although the optimal EST until day 19 is known, very little is known about the optimal EST during the last three days of incubation. The hatching phase is characterised by physiological and metabolic processes which ensure embryo survival. Therefore, optimal EST during the hatching phase is of major importance to gain good chick quality at day of hatch.

In addition to EST, the effect of carbon dioxide should not be underestimated during the hatching process.

Temperature drives embryonic development and growth and with that it has an impact on chick quality. When development increases, heat production as well as carbon dioxide production increase due to the exchange with oxygen. If ventilation is limited, the carbon dioxide level will increase during the hatching process.

In practice, high carbon dioxide levels (>8,000ppm) can be found in hatchers in an attempt to narrow the hatch window. A high carbon dioxide concentration in the hatcher has an impact on the oxygen availability and with that it also has an impact on chick quality.

Research trials

The effect of temperature and carbon dioxide during the hatching phase was investigated by the research department of HatchTech during an experiment in which 600 first grade eggs of the same Ross 308 broiler breeder flock (41 through to 45 weeks of age) were used. Until day 19, eggs were incubated at an optimal EST of 37.8°C. After day 19, EST was set at 36.7°C (low), 37.8°C (normal), or 38.9°C (high). The carbon dioxide concentrations of 2,000ppm (low) or 10,000ppm (high) were reached by injecting carbon dioxide in a continuous flow.

Effect on chick quality

We found that a high EST of 38.9°C during the hatching phase negatively affected embryo development and subsequent chick quality. The negative effect of high EST compared to low EST (36.7°C) was evidenced by a lower yolk free body mass (YFBM) and lower organ development, expressed by a lower heart and liver weight at hatch. On the other hand, a low EST of 36.7°C compared to a normal EST of 37.8°C during the hatching phase resulted in comparable or even improved embryo development and increased chick quality at hatch.

In the cardiovascular system, the heart plays an essential role. Good heart development is necessary to ensure proper body functions. High EST negatively affected heart weight. A 16% lower relative heart weight was found at high EST compared to

low EST at hatch. A lower relative heart weight may have negative consequences during further development. Earlier studies of the research department of HatchTech have shown that high EST during the second week of incubation increased mortality caused by ascites in later life which may be related to the reduced heart development.

The liver is an important organ to supply energy for the demanding hatching process. Glycogen is stored in the liver and will provide essential energy needed during the hatching process.

High EST negatively affected liver weight. A 4.3% lower relative liver weight was found at high EST compared to low EST at 12 hours after hatch. It might be possible that at a high EST the energy supply from the liver was not sufficient and that the embryo was forced to find another energy source to complete the hatching process successfully.

Protein is a sufficient alternative energy source. When protein is used, less protein will be left for growth and development.

This was confirmed by the 0.65g lower YFBM found at high EST compared to low EST, which indicates that less protein was left for growth and development.

A less developed heart and liver in combination with a lower YFBM can lead to a lower performance during later life. High carbon dioxide negatively affects chicken embryo physiology and chick quality at low EST.

At low EST, high carbon dioxide has a negative effect on physiological processes in the embryo, but due to adaptive mechanisms the body continues functioning. However, at high carbon dioxide in combination with high EST, the negative effect of high EST is too large to compensate for the negative effects of carbon dioxide that appear in the blood.

The combination of high EST and high carbon dioxide results in depleted energy sources during the hatching process, which leads to less development and lower chick quality at hatch.

Conclusions

High EST of 38.9°C during the hatching phase negatively affected organ development and chick quality at day of hatch. This may result in decreased performance during later life. Normal and low EST during the hatching phase resulted in better chick quality at day of hatch compared to high EST.

In practice, carbon dioxide concentrations are sometimes increased during the end of incubation (>8,000ppm) in an attempt to narrow the hatch window. However, this experiment showed that high carbon dioxide levels of 10,000ppm did not affect hatch time and hatch window.

The combination of high EST and high carbon dioxide during the hatching phase indicates that no adaptive mechanisms are able to react, which results in retarded growth and functioning of organs.

To optimise embryo development and to ensure good chick quality at day of hatch, high EST and the combination of high EST and high carbon dioxide should be avoided during the hatching phase. ■

References are available from the author on request