Older layer breeders: lowering the temperature in later incubation

The potential characteristics of laying hens includes not only the egg production of commercials but also the egg production of the parents. Productivity of both generations has been accelerated after applying extended lay and genomic selection techniques in the layer breeding industry.

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Fertility increases dramatically in young flocks and is maintained until the end of production, as seen from recent actual data (Fig. 1).

Consequently, incubation management for hatching eggs from long-lived breeders is necessary to respond to genetic improvement.

Bigger fertile eggs radiate more heat energy

If fertility in the larger eggs from older flocks is still high, total metabolic heat is expected to be higher than in batches of younger flocks. Moreover, larger eggs can obstruct the passage of airflow within the setters.

Little metabolic heat is produced in the early phase of embryonic development, but it increases dramatically along with the rapid growth of the embryo from the beginning of the second half of incubation. Therefore, bigger eggs from older flocks which maintain high fertility need to utilise lower temperature in the second half of incubation than smaller eggs from younger flocks.

The temperature of the embryo is completely different from the air temperature of the setter, especially during the second half of incubation when there is higher heat radiation. Chick quality is closely associated with the temperature to which the embryo is exposed.

With the same profile, the temperature that the embryo experiences can be different depending on breeder age, fertility, egg weight and eggshell thickness. In other words, it is important to keep the temperature that the embryo experiences constant regardless of these factors.

Influence of the overheated hatching egg

Unlike most mammals, avian species contain every nutrient required in their eggs that the progeny will use during embryonic development. This is why the amount of nutrients and the efficiency of nutrient use for embryonic development may determine the differences in hatchability and chick quality.

High eggshell temperature during the second half of incubation will affect embryo development in a negative way. In general, there will be an imbalance in the usage of egg yolk and albumen with this suboptimal condition, and consequently this will negatively affect the hatchability and chick quality.

In the normal condition of embryonic development, fat and carbohydrate are the main energy sources and protein becomes part of the embryonic tissues.

In the case of high embryo temperature in the latter phase of incubation, this induces high metabolic rate and the availability of O_2, which is a requirement for yolk fatty acid oxidation, would be lower than the demand. In these circumstances, the embryo might use protein for producing energy not for growth and development.

Another reason for abnormal embryonic development with a high eggshell temperature is the shorter incubation time, which accelerates the physiological development and reduces the opportunity for the egg contents to provide nutrients to the embryo. In other words, the timetable of physiology and embryology gradually differentiate.

Research has been focusing on the effects of different eggshell temperatures on chick quality and it was demonstrated that an eggshell temperature around 100°F is optimal for the best chick quality. An eggshell temperature exceeding 102°F, especially in the latter part of incubation, decreases chick quality and hatchability, and is often indicated by a swollen abdomen, a shorter chick length, a redness of hock joints, poor navel quality or excessive urates in the residual contents.

In summary, embryos incubated at high eggshell temperatures are less developed at hatch.

Checking the egg weight loss when modifying the temperature profile

The egg weight loss as well as incubation temperature is highly correlated with chick quality. When lowering the temperature profile for older layer breeder hatching eggs, egg weight loss needs to be considered.

There might be insufficient egg weight loss when lowering the temperature profile without altering the humidity set points, because evaporating water from the egg might decrease as a result of the low internal temperature.

As mentioned, poor navel quality along with the big yolk residues inside the abdomen can be caused by suboptimal embryo temperature.

However, insufficient water loss during incubation can cause similar symptoms as well.

The absorption of yolk residues

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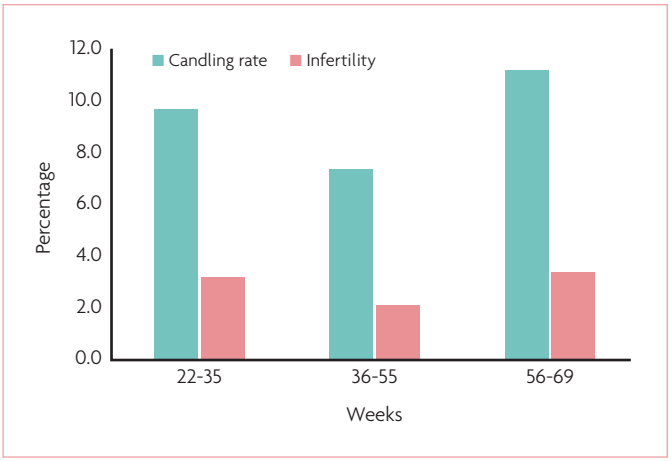
Fig. 1. Candling rate at 18 days of incubation and infertility (n=447).



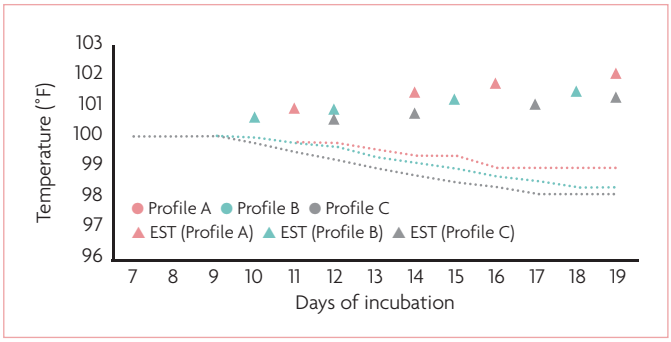


Fig. 2. Temperature set points (dash line) of the different profiles and actual egg shell temperature (triangle).

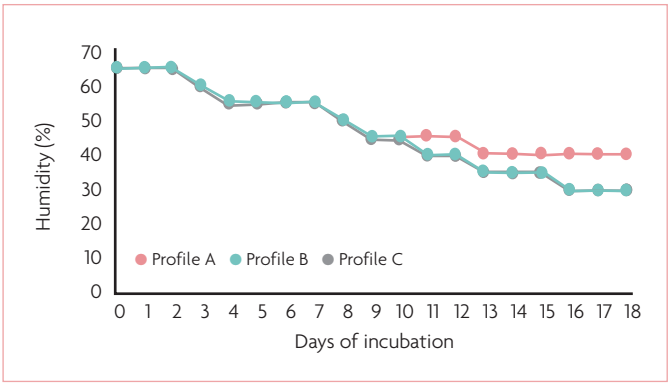


Fig. 3. Different humidity set points with different temperature profiles.

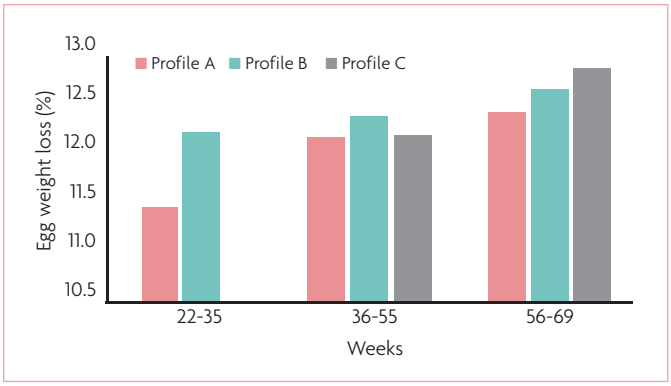


Fig. 4. Egg weight loss trends depending on the different profiles (n=447).

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into the body cavity begins on day 17, and the adequate closure of the navel on day 20 requires an optimal amount of yolk residues.

If it remains heavy until the end of its absorption into the body cavity, the closure of the navel will be interfered with and can be a potential cause of omphalitis.

Therefore, if the moisture loss gets out of optimal range with lowering the temperature profile, lower the humidity set point accordingly (see Fig. 3).

Residual yolk and hock joint condition

In practice, three temperature and humidity profiles have been applied to eggs from a variety of ages of breeders in the commercial layer hatchery from June 2017 to February 2020 with 17 different parent flocks (Figs. 2, 3 and 4).

Profile A is the highest temperature profile and is applied to the batches from 22-61 weeks of age, eggshell temperature increased gradually and reached 102°F at 19 days, and egg weight loss was less than 12% until 50 weeks.

Applying Profile B to the wider range of breeder ages, eggshell temperature was around 101-102°F and egg weight loss was between 12-13%. Applying Profile C, which is lowest temperature to the batches from older than 36 weeks of age, eggshell temperature was close to 101°F and egg weight loss was between 12.5-13.5%.

From the random sample in the practical hatchery circumstances, chick quality assessment was done by Pasgar scoring method for three kinds of different profiles (Fig. 5).

Pasgar score is one of the visual chick quality scoring methods which can be applied in practical chick production sites.

This method puts the subjective visual assessment into accurate and measurable evaluation by checking the chick viability, residual yolk amount, firmness of the legs, navel and beak integrity individually.

Using Pasgar score, the chick quality of Profile B was reasonable from the younger to prime flocks in navel condition, hock joint integrity and the amount of yolk residues, but it was not for the older flocks.

The navel condition, hock joint integrity and the amount of yolk residue scores of Profile C for prime flocks was as good as for the older flocks.

Summary

Since genomic-based selection programmes have been employed in the layer breeding industry over the past decade, the fertility of layer breeders has been rapidly progressed, maintaining high levels until the end of production. In accordance with this improvement, practical changes should be made in the hatchery to accommodate eggs from older breeders from metabolic heat impacting adjacent embryos.

With this in-field trial of the commercial layer hatchery for the last three years, the trends of egg weight loss were monitored and the residual yolk and hock joint condition of the day old chicks was evaluated in the different temperature and humidity profiles depending on the age of the parent stocks. Profile B, which has lower temperature and humidity profiles than Profile A, maintains good chick quality until the age of around 50 weeks. Profile C has lower temperature than Profile B, while maintaining the same humidity set points shows good quality results for not only older aged flocks but also the prime flocks.

Therefore, to see better developed chicks with the latest laying hen genetics, lowering the temperature set point for the second half of incubation in coordination with the optimal range of egg weight loss will help older breeding flocks produce the same high quality chicks as prime flocks. ■

Fig. 5. Pasgar scores from the different profiles by the age of the breeders.