

Evaluating success through the assessment of unhatched eggs

Effective hatchery management requires an understanding of incubation practices and paying attention to the details that make a hatchery operate at its peak. Knowing the incubation equipment and how to make it work properly is one of the first steps for success and much of this information can be found in the provided incubation manuals. Secondly, an understanding of embryology and how the incubation equipment can promote proper embryo growth will lead to the production of quality chicks.

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Duplicating successes obtained from other successful hatcheries can yield positive results. Additionally, learning from incubation failures can also greatly contribute to management and improvements desired in the hatchery. This information can be obtained through conducting routine embryo diagnosis, or hatch residue analysis.

Three to four hatcher trays should be selected from near the top, middle and bottom of the incubator racks and all unhatched eggs in those trays should be opened and examined to determine the time of embryo loss, and then recorded.

This should be done for each flock on a routine and scheduled basis so 'normal' embryo loss can be established. For the results to be beneficial to improve the hatchery operations, it is necessary to make sure this is done correctly, and unhatched eggs are properly categorised as to the time of death. In the event of the inevitable infertile eggs, these must also be distinguished as infertile and not early dead. To effectively use the data from the embryo losses to adjust and improve hatchery performance, it is imperative that embryo losses be categorised properly.

Egg production and fertilisation

Embryo development begins with syngamy or the union of the male and female gametes at the time of fertilisation.

Approximately 20 minutes after oviposition (egg-laying), the next ovum (or yolk) is ovulated and must be fertilised within the hen in the first five minutes following ovulation.

If the ovum is not fertilised at this time, fertilisation cannot occur as the egg albumen is immediately deposited to surround the entire yolk and contains an enzyme inhibitor that prohibits fertilisation from occurring. As the fertilised ovum moves down the reproductive tract, the complete contents of the egg itself is formed. This entire egg formation process requires approximately 24-26 hours to



Fig. 1. Infertile egg (left) showing no cellular growth of the germinal disc. Fertile egg on the right showing the doughnut shaped pattern representing cellular development and embryo growth.

complete (in the domestic hen) and is occurring within the hen's body with a temperature of between 40 and 41.1°C.

The hen's body temperature is sufficient to allow for embryonic development to take place during egg formation and before oviposition.

During egg formation, the chicken embryo is viable and growing and will be composed of approximately 40,000-60,000 cells at the time of lay. This early cellular development of the embryo, which occurs in the oviduct, can often be seen with the naked eye in a freshly laid egg (Fig. 1).

Fertility levels in the breeder flock continue to be the largest single causative factor to hatchery success. Poor fertility will not only reduce the overall hatchability potential of eggs, but poor fertility is also known to affect embryo viability and therefore, chick quality.

Egg storage and handling

After the fertilised eggs are laid by the hen, they are then collected and subjected to storage and transportation from the farm to the hatchery. Egg storage refers to the entire period from the time the egg is laid until they are placed in the incubator.

The egg storage and transportation conditions can vary greatly in terms of the time of storage, temperature, humidity as well as the physical transportation to the hatchery.

Each of these variables can affect hatchability of the eggs with losses in hatch primarily occurring in the first few days of

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Table 1. Categories to determine losses and record development.

Stage of loss	Age (days)	Stage of development
Infertile	–	No signs of development at the germinal disc area
Early dead (1st week)	0-3	Any development at the germinal disc. May include visible blood formation
	4-7	Eye pigmentation becomes prominent on 4th day of development
Middle dead (2nd week)	8-14	Egg tooth on beak becomes prominent on 8th day of development
Late dead (3rd week)	15-18	Chick down covering prominent on 15th day of development
	19-21	Egg yolk mostly withdrawn into body cavity on 19th day of development

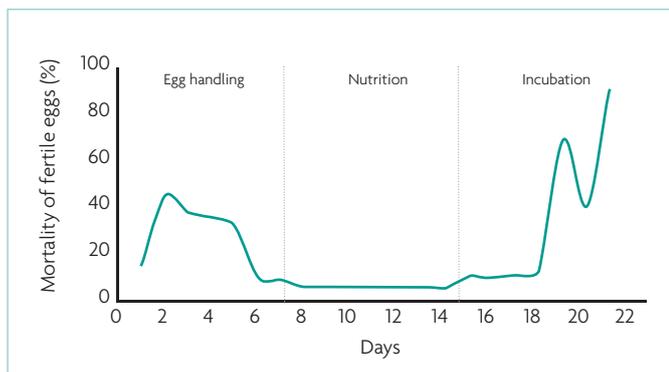


Fig. 2. The likely causative factors associated with elevated embryo losses found during incubation.

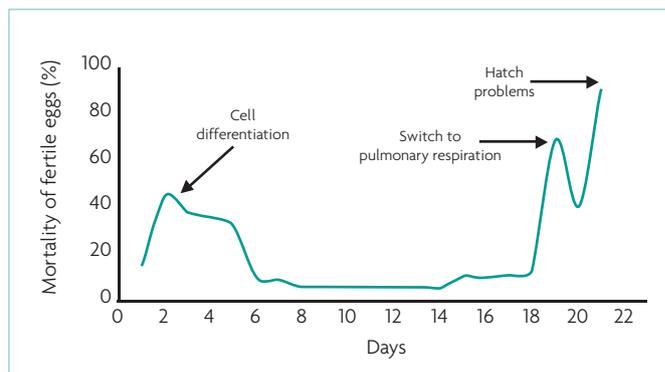


Fig. 3. Normal mortality losses due to problems during physiological development. These can not be avoided.

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the incubation period. Excessive egg storage will cause losses in hatchability at an increasingly reduced rate with each day of storage past seven days.

Additionally, eggs stored longer than seven days will take longer to incubate, with most embryo losses due to storage length occurring in the first few days of incubation.

Too high or too low egg storage temperature or fluctuating egg storage temperatures has also been shown to cause losses in hatchability, with most of the embryo losses occurring in the first week of incubation.

Physically rough handling of the hatch eggs during transport will also cause first week of incubation embryo losses. Proper embryo diagnosis is necessary to be able to categorise the losses correctly in order to identify the probable areas of management to investigate.

Incubation and embryo development

The incubation period of the chicken of 18-19 days in the incubator and 19-21 days in the hatcher encompasses the entire incubation period. While improper incubation and hatcher processes can cause embryo losses at any stage of embryo development, embryo losses due to poor incubation conditions primarily occur in the later stages of incubation.

Middle and late-stage embryo losses will help to identify potential causative factors

The pigmented eye of a four-day-old embryo.



of any poor hatchability. Because the total incubation period can be broken into the 'incubation' stage, and the 'hatcher' stage, the best embryo diagnosis program will also allow for a separation of the late pre-hatcher embryo losses and those that occur in the hatcher.

Effective embryo diagnosis (hatch residue analysis)

As previously mentioned, selecting three to four hatcher trays from each flock with each tray located in the top, middle and bottom areas of the hatcher racks. If 'clear eggs' are usually removed at transfer, the trays to be used for embryo diagnosis should not have the clear eggs removed so that they can be broken out with the other unhatched eggs.

To make the process easier to implement and in order to use the data most effectively, it is recommended to use the category ranges shown in Table 1 to determine losses and record data for the first, second and third weeks of development. Using these categories allows the first, second and third week embryo losses to be separated from each other. Each week represents a different area of hatching egg care that would likely cause any elevated losses, as seen in Fig. 2.

Elevated first-week mortality is primarily caused by egg handling conditions, or any situation that occurs before the eggs are placed in the incubators (hen house, farm, transport trucks, egg storage, etc).

Elevated second-week mortality is primarily caused by poor breeder nutrition but is rarely seen in the industry as hens raised on poor diets will usually quit laying before they lay inferior eggs.

Elevated third-week mortality is usually caused by incubation conditions, which could include many different scenarios. It is also helpful to understand what can be expected for normal mortality, or that which would occur due to physiological issues during development and can not be avoided (Fig. 3).

An expected 4-5% total embryo loss (first, second and third week losses combined) can be attributed to developmental problems

and can not be avoided. Once a baseline, or normal embryonic loss pattern, has been established for each flock and for a hatchery, aberrations found during the embryo diagnosis can be easily identified. When the embryo losses are evaluated and recorded properly, knowing where in the process to look to correct the problems is much easier. The importance of recording data properly can not be overemphasised.

Infertility must be separated from early dead embryos (0-3 or 4-7 days), so it is known whether to troubleshoot in the breeders themselves or in the egg handling process. Likewise, knowing if last week embryo losses in hatch are found primarily in the 15-18 or 19-21 day range will separate our efforts by knowing whether to look directly at the incubator or hatcher conditions.

Conclusion

The most important aspect of properly conducting an embryo diagnosis to evaluate incubation losses is to be willing and able to actually use the data to make a difference in the hatchery operations.

Learning from our incubation failures can be just as powerful a tool to help properly manage a hatchery as trying to mimic good performances.

If improvements are to be made in hatchery operations we must use all the tools available to us to grow and improve – and that includes properly evaluating our hatchery losses. ■

The egg tooth on the end of the beak of an eight-day-old embryo.

