Monitoring hatchery performance to ensure turkey poult quality

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In order to ensure good hatchability and poult quality it is necessary to meet several biological targets during incubation. This article will describe how to monitor, measure and incorporate these into a routine hatchery performance program.

From nest to hatchery

After the eggs are laid it is necessary to ensure that the collection, disinfection and the storage in the farm is appropriate.

It has been reported that in turkey eggs; in order to totally stop embryo development during storage the room temperature should be below 15°C. The early embryo mortality increases (four days = 6.45% versus 14 days = 8.23%) as storage time lengthens.

The pre incubation (37.5°C) for 12 hours prior to storage permits the embryo development to reach the relatively inactive hypoblast stage increasing its survival during storage.

The longer pre incubation time required for turkey eggs compared to broilers can be explained by the fact that turkey eggs are laid at an earlier stage of embryonic development than chicken eggs.

The majority of embryos from turkey eggs at time of lay are undergoing or just completing the formation of the area pellucida, in contrast to chicken embryos that have completed formation of the area pellucida by the time of oviposition.

The beneficial results on hatchability of the pre incubation are only significant when the eggs are going to be stored for long periods (14 versus four days).

Pre incubation prior to storage not only provides extra incubation time for the embryos to hatch; when eggs are incubated for a longer time before storage, hatchability drastically dropped. The pre-incubation can also contribute to a better hatch window.

Incubation temperature

For many years the optimal temperature was assuming to be between 37-38°C (98.6-100.4°F), assessed on the environmental air. Does the temperature reported in one spot in the machine reflect the temperature that the embryo is facing?

The answer is no, the temperature of the embryo during its development does not always match the air temperature of the incubators, especially in the last two thirds of the incubation period.

Embryonic temperature during incubation is considered to be the most important physical factor for successful commercial poultry incubation.

That is a crucial biological target that needs to be monitored frequently. Breakouts demonstrated that embryos can become overheated during incubation, especially in multi-stage incubators.

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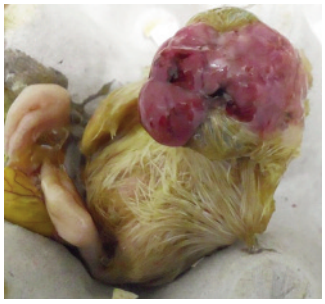

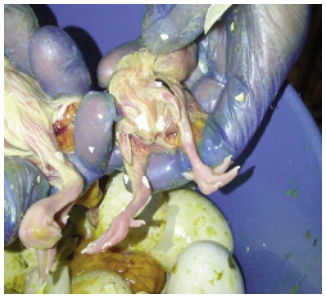

Careful monitoring of egg shell temperature.

Signs of overheating either in the setter or hatcher include the following: exposed brain, leg alterations: (asymmetry between limbs, crooked toes, splayed legs), decreased yolk-free poult weight, decreased heart size, red bruised hocks; enlarged yolk masses; unhealed navels or scabs; increased late embryo mortality; malpositions with head over the top of the wing or with head in the small end, and white feathers.

Embryo temperature

Embryo temperature can be measured by direct assessment (internal thermometer and egg shell temperature) and by indirect assessments (incubation time and moisture loss).

- **Egg shell temperature:**

Direct measurement of embryo temperature is difficult in a commercial operation, as it requires inserting a thermocouple inside the egg.

However, similar results can be obtained by using an infrared thermometer which has been allowed to equilibrate for 15 minutes inside the incubator. The procedure is simple, fast and can be accomplished when the machines are in operation.

Select 10 eggs in different positions on the rack and hold the infrared thermometer under the end of the air cell and record the reading. It is important to remember that the dead embryos will show a lower reading.

For optimal poult quality, the temperature profile used must take into consideration the age of the breeder flock and days of storage. This is more easily accomplished in single stage incubators than multi-stage.

High temperatures have a stronger deleterious effect on the embryo than lower temperatures. Keep in mind that large eggs will produce more heat and have more difficulty to lose this heat.

Moisture loss at transfer

During the formation of the embryo, metabolic water is produced. The moisture loss is determined by relative humidity, temperature and shell conductance.

Very high moisture loss will produce dehydration of the embryo sticking to the shell membrane.

A minimum amount of this water needs to be lost to generate a sufficient air cell for the embryo to breathe after internal pipping. Very high moisture loss will produce dehydration of the embryo sticking to the shell membrane.

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Our research and external studies have shown that the highest hatchability can be achieved when the eggs are subject to the correct temperature and when the eggs lose between 10-12% of the fresh egg weight by day 25 of incubation.

How to measure moisture loss at transfer?

- Weigh in a balance with a readability of at least 5g, one by one, the same six trays of eggs that are going to be used later for poult yield and breakout.
- Mark each tray.
- Weigh an empty setter tray and record it.
- Calculate the initial egg weight, which equals the complete tray weight minus the empty tray weight) divided by the number of eggs on they tray.
- At day 25 weigh the marked trays and from the original egg weight subtract the new weight and then divide back into the original egg weight.

If the results are different from expected, the temperature, the humidity and ventilation profile should be revised.

Hatch window

The hatch window is the time that it takes the poult to hatch, coming out of the eggs. It is also called the 'spread of hatch'.

Hatch window is a powerful tool in the hatchery to access the distribution of the heat in the incubators and to adjust the pulling time.

The duration of the hatch window is principally influenced by two factors:

- The stage of development of the embryos at the beginning of incubation.
- The temperature and ventilation in the setters or incubators.

When the temperature during the incubation period is uniform the poults will hatch together in a short period of time (Fig. 1).

If the eggs are hatching too early the poults are susceptible to dehydration leading to an increase in first week mortality on the farms and poor performance. If they are hatching too late it generates low hatchability, low quality poults, an increase in pipped eggs and live embryos in unhatched eggs.

If the temperature, humidity and ventilation were appropriate in the incubators you should expect to see:

- 36 hours before hatch: 1% of the poults hatched.
- 24 hours before hatch: 15% of the poults hatched.
- 12 hours before hatch: 95% of the poults hatched

How to measure the hatch window?

- At transfer (day 24 or 25), select a hatcher for monitoring and record how many eggs have been transferred to that particular machine.
- Identify when the projected pull time is for that hatcher.
- Calculate 36 hours prior to the identified pull time. This should now be regarded as your ideal hatch window.
- At the 36th hour before pull, open the hatcher and physically count how many birds are out of their shells in each tray. The goal should be less than 1% hatched 36 hours prior to the identified pull time.

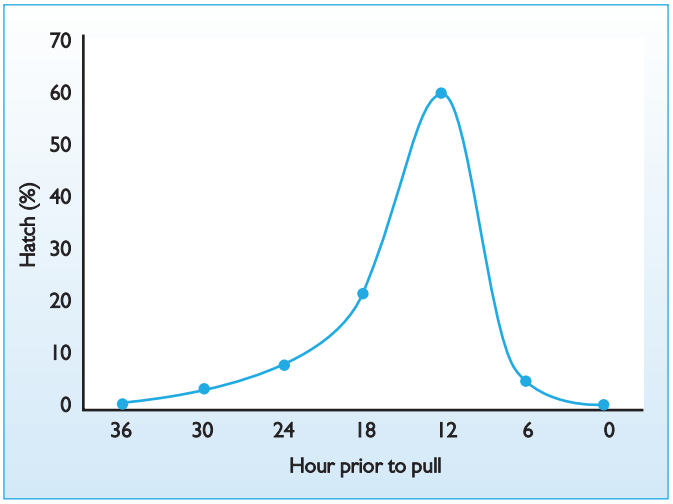


Fig. 1. Chart showing a 36 hour hatch window (reflective of a 69-70% poult yield).

Poult yield

Monitoring the weight of the poults at hatch time and their relationship with the weight of the eggs (poult yield) is also very useful to measure incubation temperature and humidity.

How to measure the poult yield?

- The same label trays that were weighed before setting and then monitored at transfer should be used.
- At pulling time weigh the birds and calculate the ratio poult to original egg weight.

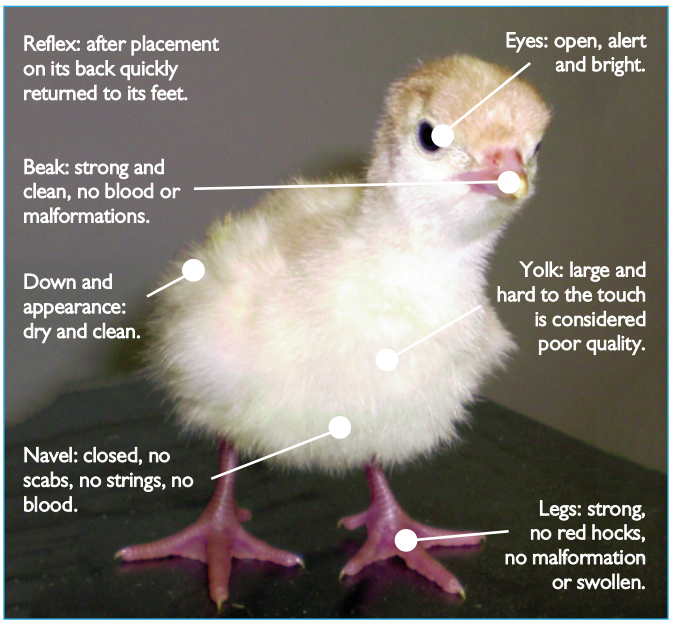
It is recommended that birds at hatch time that are going to have a long journey before placement (more than six hours) should lose 30-31% of the original egg weight.

If at transfer time the moisture lost was correct but at hatch time the poult yield is lower than 66% of the weight of the eggs, it indicates that the incubation period was too long or in some cases the hatcher temperature was too high or the humidity too low.

If the yield was 72 -73% the poults are not ready, the birds will have problems on the farm, will be lazy and will not eat and drink at placement. It is as a result of a short period of incubation, low incubation temperature or high humidity levels.

Correct the timing, check the hatch window and adjust the temperature and humidity of the hatchers. Every 1% loss in bird yield is equivalent to about three hours extra in the hatcher.

Fig. 2. Evaluating poults using the Tona or Pasgar score.



Breakouts

Breakouts should be a regular routine in the hatchery (in both bad and good hatches) because it generates information to develop a guideline to help monitor the incubation process.

This allows the hatchery to react much quicker and implement corrective actions when hatch values surpass the accepted range for the different embryonic mortality categories.

A hatch residue sample from six trays per flock is used to routinely monitor a flock (sample should be at least within 1% of the total hatch for the flock). The same trays should be used for egg moisture loss at transfer, and poult yield.

The first steps are counting all the poults and the culls, noting any abnormalities. Of the remaining eggs, the embryonic mortality should be determined.

Divide minimally into the following categories:

- Early dead membrane (1-3 days of development).
- Early dead blood (4-6 days of development).
- Mid dead (7-14 when candling is made or 7-16).
- Late dead (17-28 days of development).
- Pipped.
- Totally developed dead.
- Contaminated.
- Culls.

A normal fertility score should be between 95-97%. When fertility is low, the insemination process is the first factor considered.

Early dead membrane (1-3 days development) over 2% are usually linked to adverse conditions preceding setting of the eggs (farm storage, transportation, handling, storage, disinfection, etc) or a very high initial incubation temperature.

High early dead blood values (over 1.5%) invite a review of the temperature, the turning and the ventilation during the first few days.

Disinfection, transportation and the storage should be also reviewed. This could also be linked to vitamin deficiencies – vitamin E, riboflavin, biotin, pantothenic acid, or linoleic acid.

Mid dead has a high association with contamination, extreme incubation temperature, or high early dead blood embryos that are carried over into the mid stage.

Nutritional deficiencies, such as riboflavin, vitamin B12, biotin, niacin, pyridoxine, pantothenic acid, phosphorus, boron, or linoleic acid, are also linked.

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Contaminated and cracked shells are usually less than 0.5%, late dead and pipped embryos around 3.0%.

Poult quality

Measuring the poult quality is complex because until now there is no perfect test that allows the hatchery manager to predict the on farm performance of the poults.

Poult weight (over 60g from a 90g egg) and poult yield (68-69%) are easily measured but have the disadvantage that the amount of residual yolk sac cannot be measured. They are not very useful to predict first week mortality and especially farm performance.

Yolk Free Body Mass (YFBM) is a better indicator of bird development than body weight. Different studies have shown a positive relation between YFBM and subsequent performance of the bird.

YFBM is calculated by subtracting the residual yolk from the body weight. A higher YFBM indicates a better development of the poult during incubation.

The increase in egg size due to an older breeder flock age must be taken into account in the evaluation. Although this is an accurate method to evaluate poult quality, animals have to be sacrificed and the method is time consuming. The poult length is an interesting test to estimate the performance of turkeys on the farms, but due to the long life of the turkeys, it is very complex to determine the value of it.

Tona and Pasgar are one of the more popular measurement tools that put a visual score by a quality control person, into a measureable and to some extent repeatable number (Fig. 2).

The Tona or Pasgar score evaluates different criteria such as navel, legs, beak, yolk sac, eyes and reflexes or activity which primarily reflect conditions during the last part of incubation. They are good to predict poult livability in the first week post hatch but not production performances. However these tests are useful for the hatchery manager to review the incubations conditions especially if they are done on a routine basis.

Reasons for poults hatching early	Reasons for poults hatching late
Incorrect pre incubation	No egg pre incubation
High incubator and/or hatcher temperatures	Eggs stored for long periods and/or too low temperatures
Setting eggs too early	Low incubator and/or hatcher temperatures
Hot areas in the incubators and/or hatchers	Incorrect setting patterns in multi-stage incubators
Incorrect ventilation. Seasonal temperature	Setting too late or no hours to compensate for flock age and days of storage
Too many fertile eggs (especially multi-stage)	Incorrect ventilation. Seasonal temperature
	Low fertility (especially multi-stage)

Table 1. Identifying the reasons for poults hatching early or late.

Transportation

To ensure their best performance and to lessen the chances of mortality, turkey poults should be given feed and water as soon after hatching as possible. A common practice in the turkey industry is to hold poults in the hatchery overnight prior to placing on feed and water. Poults that are delayed access to feed for 48 hours post hatch show depressed body weights.

It is very important that the birds are in homeostasis during transportation. That is achieved with good ventilation, 50-60% humidity, and proper rectal temperature measurement of the birds (103-104°F). Poult internal temperatures of above 105°F will lead to panting.

Conclusion

Artificial incubation is a process that involves several stages; during each stage the embryo is required to cope with some metabolic targets. Every stage should be monitored in order to collect information, note alterations and make corrections when necessary.

Making these measures an everyday occurrence in the hatchery is important so that we can be sure that on hatch day there are no surprises and that poult quality can be improved. ■

References are available on request from juan.lopez@hendrix-genetics.com