Assessing Poult Quality at the Hatchery and at Placement

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Why measure poult quality? Compared to feed, poult expense has minimal economic value. Nonetheless, poult quality can have dramatic effects on other economically important traits. Current research has confirmed that poor poult quality can have long term detrimental effects. Long term effects of poult quality have been shown for thermoregulation, immunity, intestinal function, leg problems, and development of the heat stress response as well as other physiological systems which impact the economics of feed utilization and growth.

Additionally, the establishment of a system of poult grading may improve company relationships with contract growers. It is common for growers to blame poor performance on poor poults. Thus, good poults precede good grower relationships. The same is also true for the business relationships between the hatchery and live production personnel.

Concept of Conductance Constant

Because the respiration of incubating cleidoic eggs has been shown to follow Fick's First Law of Diffusion, we know that at least three factors may affect the growth and/viability of embryos as well as the ability of the hatchling to survive and thrive. The factors determine the maturity at hatching of all species examined in the world. The concept includes avian species those that require greater amounts of maternal care at hatching. Those three factors are: 1. The rate of flow of oxygen to the developing embryo, 2. The length of the developmental period, and 3. the weight of the egg that the hen produces. We need to consider each of these factors when we examine poult quality. These three factors are interrelated so if one of them changes within a species, then the remaining two factors must adjust accordingly to create offspring that are characteristic of the species.

Domestic turkeys are unique among modern-day poultry species because of the unusual variation in egg sizes and egg functional qualities. It is common to observe hens at the initiation of lay producing eggs weighing 75 grams while at the end of a reproduction cycle, they may produce eggs weighing over 100 grams. Increases in egg weight as hens age must be accompanied by equally large changes in eggshell permeability or in the length of the incubation period because of the codependency of these factors. Additionally, at the time of oviposition, the turkey embryo is less well developed than other domestic species like the chick or duckling.

Research has shown that as egg size increases in selected turkey breeder hens, the resulting changes in eggshell permeability and length of the incubation period are not allometric. Thus, the embryo must adjust metabolically to the changes in the egg to survive. These metabolic adjustments may result in one or more physiological systems in the hatchling being immature. The systems that probably are affected most are the intestine, the cardiovascular system and immunity. The poult embryo intestine matures relatively late in development. Thus, its maturity may be delayed without affecting embryonic survival. Under ideal conditions nutrients are being absorbed from the embryo intestine (the yolk sac membrane), but for optimal growth and survival posthatching, the poult intestine must mature within a 48 hour period immediately following hatching.

Early Poult Livability

It is very difficult to manage something that we cannot measure. Although early poult livability has been a common problem for the turkey industry for many years, empirical data describing the problem are limited. Furthermore, the information is outdated. Infectious agents (e.g. infected navels) have been shown with certainty to lead to significant decreases in livability, but there are also numerous non-infectious agents that contribute to poult viability. Under normal brooding conditions, the greatest percentage of poult mortality occurs at three to five days following placement into the brooder house. For poult quality measurements to have validity and assist in survival or growth, a reliable method to predict what happens prior to three to five days is needed that accurately and precisely describes the poult. Preemptive actions can then be used to improve poult livability.

Behavior of Weak Poults

Weak poults display characteristic behaviors that enable us to cull them at the hatchery. Poults display these behaviors because they don't feel well or are immature. We all like also to see poults arrive at the brooder barn standing and looking around but not crowded into the corners of the delivery boxes. Poults that are gasping for air or are unable to orient themselves ("flip-overs") are obviously compromised. Hatchery and poult placement workers are trained and identify these behaviors and cull poults. Unfortunately, the knowledge is lacking to help workers identify nonbehavioral characteristics that are correlated with poult livability in the brooder.

Hatchery Empirical Data

Recent research suggests that two measurable and observable hatchery measurements are related to poult quality. These two characteristics are Poult Yield and Hatch Window. Data will be shown that indicate the relationships with each measurable characteristic with poult quality as measured by the 7 day livability of approximately 200 flocks.

As Poult Yield increases above 66%, the probability of survival of poults improves. It is difficult to recommend the utility of yields greater than 66% because yields of 68 or 69% are probably not practical. These poults would be very "green" or altricial at the time of removal from the incubator and probably result in reduced hatchability and poorer quality hatchlings.

Eggs that hatch in a short time frame according to the conductance constant also yield better poult livability when placed in brooder houses. This has led to the concept of Hatch Window. The conductance constant predicts that poults that hatch at the same time live better. This may be due to asynchrony between the actual hatch time and the time of removal from the incubator. Poults struggle to survive when hatching earlier or later than the predicted time determined by the conductance constant struggle. Late hatching poults seem to be particularly affected.

Other Factors Contributing to Poult Quality:

Hatchery Processing

"Stressors", are typically imposed by industry and can include a number of factors, such as variability, vaccination, sexing, toe trimming, desnooding, beak trimming and prolonged transport time to far flung growers. At hatching, the poult is nearly deplete of liver glycogen and has a body composition containing nearly 25 to 30% lipid (dry matter basis). The poult is in a gluconeogenic state (deriving energy from body reserves) and will remain so until it consumes exogenous nutrients. The hatchery processing steps, combined with metabolic changes associated with acclimation to external nutrient sources, may contribute to peaks of early poult mortality beginning at approximately 4 days of age.

Time of Placement

Despite poults being placed in a timely manner, some poults persistently fail to learn to eat and drink even in the presence of other poults that are eating and drinking. It would be useful to know measurable traits at the time of placement so this failure could be predicted and remedied by the use of supplements. Delaying placement is a subject of some controversies. Some growers favor placement on the day of removal from the incubator while others contend that poult quality is improved in a controlled environment in the hatchery to recover better from the trauma of removal and servicing. Research suggests that a "rest" period allows poults to recover and reestablish glycogen reserves to maximize alertness to improve poult viability.

Holding time prior to placement can have prolonged detrimental effects on the status and quality of poults. For example, when water and feed are withheld for 48 hours, poults continue to have higher plasma glucose concentrations than those fed immediately after hatching. The failure of held poults can still be noted 4 days after feeding commenced, but the effects are finally gone 7 days after feeding. Holding times can also have prolonged effects on overall growth. Part of this reduction in growth may be partly due to prolonged effects on intestinal structure. Delayed access to feed is followed by microvilli clumping and delayed jejuna mucosal development and crypt structure up to 9 days after hatching.

Poult Weight at Placement

Poult weight at the time of placement is a factor that affects the livability of poults. Heavier poults have a much better chance of surviving. The prediction equations suggest that poults arriving at the brooder barn weighing greater than 53 grams have a better chance of surviving at a 98% rate or greater.

Poult Vent Temperature

After a poult has been off feed for 48 hours, the body temperature begins to decline then as starvation progresses the body temperature continues to decrease. The decline in body temperature is probably due to a lack of metabolism. The deep body temperature of adult turkeys is 106-107 degrees. Poults arriving at the brooder with vent temperatures between 103 and 104 degrees have a better than 99% chance of survival.

Crossbar Shell Temperatures

Set point temperatures in the hypothalamus around which thermoregulation occurs may be established in embryonic poults by what are called "cross bar temperatures". Recent data suggest that exposure to optimal temperatures (*ca*. 98 to 99 degrees F) for hatching at 24 days of incubation can result in a poult that is more comfortable and better able to handle changes in environmental temperatures than those not exposed to optimal “cross bar temperatures”.

In Summary – Each company should have its own poult quality index. Examples of factors to be included in an assessment form for defining quality will be illustrated.