



ASOCIACIÓN DE MÉDICOS VETERINARIOS ESPECIALISTAS EN AVES

Conferencia:	Efecto de la temperatura de incubación en el desarrollo corporal de los polos de carne y su influencia en los parámetros productivos.
Fecha:	Miércoles 11 de Mayo
Hora:	15.30 – 16.30 p.m.
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Introduction

Hatchability is a process that has several critical points that can be monitored and controlled to consistently produce healthy and mature hatchlings. The hatchery audit process necessary to produce quality poults includes assessing hatching egg fertility, egg storage and care, evaluation of hatch residue, poult processing, sanitation, and poult health and viability (Hulet, 2007).

Clean Hatching Eggs.

The process of producing quality poults all starts with clean hatching eggs from clean nests (no floor eggs) and control of egg sanitation. Cleanliness of nests and concentration of the cleaning solution is especially critical as breeder flocks get older. As the production season progresses, the eggs increase in size but the amount of shell deposited doesn't change greatly. This means that the shell thickness decreases as egg size increases and the opportunity for bacteria to go from outside the shell to the embryo increases. Bacteria can enter the egg pores within the first fifteen minutes until the shell dries and makes a clean nest environment essential to egg sanitation. Some producers or hatcheries use black lights to monitor proper sanitation of eggs on the farm. Maintaining temperature and cleanliness of the egg storage room is also important. The eggs must be free from foreign matter as well as molds and fungi. Taking environmental swabs of clean eggs and storage room walls on a regular basis is a good verification practice to check for bacterial and fungal load.





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Embryo Temperature / Chick Quality

Optimum hatchability and subsequent bird performance has been obtained with shell-temperatures of 100 – 100.5 F during the incubation period for development and maturation of the embryo into a quality chick (Hulet et al., 2007). Shell temperatures lower or higher than this contributed to reduced hatchability and embryo development. Multi-stage incubation tends to provide lower than optimum embryonic temperatures during the early incubation stages and higher than optimum during the latter stages (Hulet, 2007). Embryos are quite sensitive to high temperatures. The effects of high temperatures are increased yolk sac and smaller poults. When the poults don't consume a majority of the yolk sac, they exhibit reduced immune capability, the stomach is extended, and exiting the egg is more difficult and results in red hocks and unhealed navels (Barri, et al., 2011). Lack of uniformity of leg length can also contribute to imbalanced birds (Oviedo-Rondon, et al. 2009).

Recent research by Molenaar et al., 2011 has shown a direct relationship between incubation temperature and the incidence of metabolic disease (ascites). Genetic selection for efficiency and growth rates of broiler chickens have increased in the past 40 years and decreased the market age significantly (Wolanski et al., 2004; Hulet, 2007; Baghbanzadeh and Decuypere, 2008). Therefore, the incubation period has become a larger part of the total life span (Havenstein et al., 2003; Wolanski et al., 2004). The 21 day incubation period should deserve greater emphasis on optimizing development and maturity during incubation in order to take advantage of the shorter growout period (Hulet, 2007). Incubation temperature is one of the most important environmental factors during incubation (Decuypere and Michels, 1992). It is found that eggshell temperature (**EST**) increases at the end of the incubation process due to higher heat production of the embryos (Lourens et al., 2005) and cooling and air velocity in the incubators is more critical for successful hatch (French, 1997; Elibol and Brake, 2008). High EST ($\geq 38.9^{\circ}\text{C}$), as compared to normal EST (37.8°C), during the second half of incubation reduces hatchling quality; Overheated embryos will result in a lower yolk-free body mass (**YFBM**), shorter chick length, and open navels (Lourens et al., 2005, 2007; Hulet et al., 2007; Leksrisonpong et al., 2007). Other effects of high EST are seen in organ weights of hatchlings, especially reduced heart weights (Wineland et al., 2000; Leksrisonpong et al., 2007; Lourens et al., 2007; Molenaar et al., 2009).



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Molenaar et al., 2011 has proposed that the reduced heart weights at hatching that are due to a high EST may increase the susceptibility to and the incidence of metabolic disorders related to cardiovascular development, such as ascites (Leksrisompong et al., 2007). Because of an insufficient pulmonary vascular capacity, which might be more depressed in chickens that are incubated at a high EST, birds are unable to keep up with the increased metabolic demands for O₂, and ascites may develop (Lubritz and McPherson, 1994). The increase in the intravascular pressure results in fluid accumulation in the abdominal cavity and pericardium (Julian, 1993; Decuypere et al., 2000), and the birds eventually die from these lesions.

As stated our modern broiler chickens are more sensitive to metabolic disorders such as ascites because of the genetic selection for rapid growth, low feed conversion ratio (**FCR**), and high meat yield (Scheele et al., 1991; Decuypere et al., 2000; Balog, 2003; Arce-Menocal et al., 2009). While genetic selection against ascites has been implemented by broiler breeder companies (Wideman and French, 2000; Pakdel et al., 2005; Pavlidis et al., 2007; Arce-Menocal et al., 2009; Hassanzadeh et al., 2010), ascites is still a major cause of mortality in modern broiler production (5.0 to 8.0%; Balog, 2003; Pavlidis et al., 2007). Therefore, a study investigated the effect of EST (high and normal) on chick quality, performance, and mortality, with particular attention given to the incidence of ascites with a cold growout temperature to induce ascites (Balog, 2003). The total mortality was 4.1% higher in the high compared with the normal EST treatment. The mortality associated with the ascites was 3.8% higher in the high compared with the normal EST. The ratio between the right and the total ventricle was 1.1% higher in the high compared with the normal EST treatment at the slaughter age. In conclusion, a high EST from day 7 of incubation onward decreased the hatchling quality and growth performance, but increased the breast meat yield. Other studies by Hulet et al., 2007, have shown that birds reared under high EST during the last five days of incubation can result in decreased post hatch growth efficiency at 42 days of age.

Hatch Residue Analysis

During the hatchery season for a flock, analysis of hatch residue can help identify problems in the incubation process and improve hatchability. While analysis of the data is not always clear, developing a system to collect data is fairly simple. Usually, a hatch residue sample from four to six trays per flock is used to routinely diagnosis a flock (sample should be within one percent of the total hatch for the flock). After counting the hatchlings, the remaining un-hatched eggs in the tray are counted and stage of embryonic development determined.





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The un-hatched eggs are divided into the following categories: infertile eggs, early dead membrane (1 – 2 day of development), early dead blood (3 – 5 days of development), mid dead (6 – 14 days of development), late dead (15 – 21 days of development), pipped, cull or dead chick, contaminated egg, and cracked – at transfer and/or setting.

An infertile egg has a white, solid spot on the surface of the yolk that is called the blastodisc. When that blastodisc is fertilized, it develops an opaque center and has a “donut” appearance that is apparent even when the egg is not incubated. When the embryo dies in the early dead membrane stage, the presence of concentric white membranes emanating out from the blastodisc are visible, but there is no blood present. The next stage, early dead blood, has the presence of blood with the embryo and is differentiated from the next stage by the presence of embryo with small eyes, but not yet large, pigmented eyes. The mid dead embryo stage starts with the presence of an embryo with large pigmented eyes until the presence of feathers. The late dead stage is from the presence of feathers until external pipping of the shell by the embryo. The last embryonic stage is external pipping. Cracked at setting and transfer are the two last categories. The difference between cracked at setting or at transfer has to do with the degree of dehydration – the egg cracked at setting will be completely dried up. Determination of when the embryo died can help focus attention in the review of the hatchery process to equipment or critical times that need to be controlled to prevent embryonic mortality.

Troubleshooting hatchery problems are sometimes difficult because the origin of the problem is not always in the hatchery – it might have occurred in the feed mill, breeder flock, breeder house, egg storage, or egg truck. Sometimes the problem originates in one machine and is not an overall hatchery management problem. Sanitation problems can sometime mask potential hatchability, that is, embryos do not hatch because of bacterial contamination even though incubators are well managed.

An evaluation of the hatch residue can help a hatchery manager decide how to improve hatchability or chick quality. Problems are determined by finding when hatch values exceed accepted norms for the different embryonic mortality categories. Values of fertility are best for hatchability when they are between 95 – 97 %. When fertility is low, it can affect other categories because of the lack of uniformity of embryo temperature inside the egg set (not as much heat provided by the developing embryos).



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Normal values for the early dead membranes, early dead blood, mid dead, late dead and pipped embryos are: 1.7, 1.3, 0.5, and 3.0 %, respectively. Contaminated and cracked shells are usually less than 0.5 %.

Values of early dead membrane over 1.7% are usually accompanied by unfavorable conditions prior to setting of the eggs – transport, handling, storage, cleaning, sanitation, etc. High early dead blood values would cause managers to look at factors that occur during the first few days of incubation – variation in temperature (up and down), improper turning, fumigation, and prolonged storage time that would cause embryonic mortality.

Mid dead embryos are not common and are normally quite low (0.5 % or less) since this is just a period of embryo growth. When greater mid dead embryo values are found, they are usually associated with contamination, low storage temperature, or with a high early dead blood category that is carried over into the mid stage.

Greater late dead embryo and pipped embryos are usually caused by high temperature either in the setter (last few days) or the hatcher, poor nutrition of the breeder flock, small chicks, increased yolk sac size, red hocks, navel buttons and strings, and head over wing malposition. Other factors common for mortality at this stage of development are inadequate vitamins and minerals in the diet, contamination, mycotoxins, low temperature (late hatch, mushy chicks), eggs chilled at transfer, or improper room ventilation system. Late dead embryos with either multiple limbs or exposed brain are usually associated with high heat early in the incubation process (Wineland, et. al., 2000; Hulet, et. al., 2007; Molenaar, et. al., 2009).

Contaminated eggs are caused by dirty nests, dirty/floor eggs, condensation, poor shells, improper sanitation, or dirty/low temperature wash water. Contamination is associated with increased cull poult, unhealed navels, lethargic poult, and odorous/mushy poult. Transfer and setting cracks are caused by rough handling, poor nest setup, thin shells, older breeder flocks (larger egg size), or poorly maintained setter/hatcher trays.

By taking the time to consistently evaluate flock hatchability, a hatchery manager can tell what is normal for his operation and notice flock hatchability problems as soon as they occur.



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Hatch residue analysis and hatchery audits do not always tell you what the problem is, but generally gives you clues in order to troubleshoot problem origins and help monitor the hatchery process to maintain consistent, healthy, mature poults.



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In Conclusion

The concept of the importance of temperature is not new. It was described and explained by Romanoff (1936, 1960). However, it is just as important now as then to start right, monitor embryo egg shell temperature at each stage of incubation, and be vigilant in management of our hatchery facilities. If we fail at any portion of our hatchery management plan, we will pay for it not only in losses in hatchability but in flock performance losses.



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