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Incubation traits and embryo development

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Selection for meat traits has been accompanied by significant physiological changes, such as those observed in reproductive performance and embryo development. Impact of a divergent selection on the breast meat ultimate pH, which reflects the level of glycogen reserves, is under study.

Incubation traits and embryonic development were evaluated in the high pH line (pHu+, representing the lower energy status) and low pH line (pHu-, representing the higher energy status) after 11 generations of divergent selection from a base population corresponding to a commercial grandparent female broiler line.

Eighty females for the pHu+ and pHu- lines were housed in controlled environment from 20-40 weeks of age. Artificial insemination was performed twice a week from 28 weeks of age. For each line three batches of a minimum of 300 eggs each, laid between 30 and 34 weeks of age, were incubated in a semi-commercial incubator and hatcher.

On day seven of incubation, eggs were candled and all undeveloped eggs were removed and were opened to evaluate true fertility and determine the age of death of embryos in order to record the early embryonic mortality; the middle and late mortality were evaluated with the same procedure at day 14 of incubation and on the unhatched eggs, respectively.

Hatchability was recorded at the end of each incubation. The embryonic development was evaluated on eggs from the 30th week of age in dedicated incubation, by recording the embryos' wet body weight from day 4 to day 21 of incubation. From these data, the embryonic growth pattern of the two lines was estimated using the Gompertz model. The goodness of fit of the models were assessed using R2adj and differences between the two lines established in terms of inflection points of estimated maximum daily weight gain of the embryos. High true fertility (TF) values were measured in both lines. The mean TF value was 86.90% for pHu+ and 89.40% for pHu-. Mean hatchability showed a difference of 3.61% between the two lines.

Embryo mortality occurred mainly between 24 hours and day 4 of incubation and during the hatch period, from day 18 to 21. Differences in embryo mortality profiles were observed: a higher early mortality was registered in pHu+ line, whereas a higher late mortality was observed in pHu- line. In the embryonic growth models, differences were observed in terms of inflection points and in the estimated maximum daily body weight gain of the embryos from the two different lines.

In conclusion, pHu- line, which represents the higher energy status, had the best reproductive and incubation traits compared to pHu+ line, confirming that divergent selection on the meat ultimate pH has determined physiological changes in the reproductive performance, embryo development and viability between the two lines.

These observations pave the way for future physiological and genetic studies to evaluate the contribution of energy status in terms of improving reproductive traits. ■

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Isolating and staging embryonic development

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Staging entails the classification of the normal sequence of embryonic development from the first cleavages of the fertilised germinal disc to the day of hatch. Individual stages are based on the morphological characteristics of the embryo when examined and not the number of hours post-oviposition or hours or days incubated.

Staging should be used when a precise, objective, and repeatable assessment of embryonic development is necessary.

Hamburger and Hamilton (HH, 1951) published the most widely used 'normal table' for domestic fowl describing embryonic development from oviposition (Stage 1) to the day of hatch (Stage 45).

However, embryonic development actually begins about seven hours after fertilisation and continues through oviposition. It was Eyal-Giladi and Kochav (EGK, 1975) that published a normal table describing embryonic development from the first cleavage division (Stage I) through oviposition (Stage X) into the onset of pre-primitive streak formation (Stage XIV) during the initial hours of incubation.

Staging procedures continue to be used by developmental biologists in describing the origin and development of the initial germ layers through the morphogenesis of the complete chick embryo. With the advent of molecular biology, biologists use staging to define stage-specific gene expression associated with morphogenetic events.

In the past decade staging embryos has found a niche in the fine tuning of hatchery egg storage techniques prior to incubation. By subjecting broiler eggs to SPIDES (short periods of incubation during egg storage) the hatchability of stored eggs is significantly increased.

This is most likely due to the embryo (the blastoderm) advancing from Stage X (EGK) to Stage XIII (EGK), thus rendering the blastoderm more resistant to the stress of egg storage.

SPIDES treatments that push embryonic development into early primitive streak formation [Stage 2 (HH)] will increase embryo mortality upon incubation. Staging embryos is not a routine task but it is a quality control measure that should be done if the hatchability of eggs following SPIDES treatment is not reaching target goals.

Preparation of the blastoderm for staging involves two steps: first, the blastoderm and its associated yolk are isolated from the surface of the ovum (yolk) and transferred to a Petri dish; and second, the blastoderm is exposed by removing the yolk masking its ventral surface. The first step is the same procedure used to isolate the perivitelline layer (PL) overlying the blastoderm for PL sperm-hole counts.

However, unlike the PL sperm-hole assay, when staging the blastoderm must remain associated with the PL, thus the need for the second step. Failure to adequately remove all the yolk lining the ventral surface of the blastoderm will hinder one's ability to differentiate the subtle differences that characterise the stages between Stage X (EGK) and the onset of primitive streak formation [Stage 2 (HH)]. ■

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Turkey egg fertility and poult quality at onset of lay

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In poultry, genetic selection helped to improve growing performance with, however, an influence on other metabolic and physiologic parameters, mainly linked to reproduction efficiency. To limit the negative effects of this high body growth, changes in breeding techniques, such as a light or feeding program are often applied.

As all animals do not exhibit the same receptivity and do not respond in the same way, the evolution of body composition must be considered individually. Thus, our objective is to better characterise some morphological criteria using non-invasive tools, to promote greater homogeneity of the flock, as early as possible, and therefore increase production performance.

This study looked at the body composition of breeder turkeys using a CT-scan from 16-28 weeks of age, as well as blood biochemical markers and ovarian development. The CT-scan analysis allowed the estimation of the volumes of tissues such as bones, adipose tissue, whole muscles and viscera.

During the breeding period, body weight was strongly correlated with bone, muscle and viscera and fat volumes ($r>0.75$), and increased to sexual maturity (31 weeks of age). The linear regression of muscle volume and viscera with reproductive age is associated with a r^2 value of 0.63.

The evolution of bone volume was better represented by a quadratic regression ($r^2=0.70$) and was parallel to that of the evolution of plasma calcium levels. The regression of fat volume ($r^2=0.48$) changed inversely with plasma triglyceride levels.

After the initiation of light stimulation, the volume of fat decreased, triglyceride levels in the blood increased along with a constant average body weight, and an intense ovarian development. Egg, yolk, and albumen weights increased with the age of the turkeys, as well as the triglycerides concentration.

The oxidative stress in the plasma was also measured as well as in the yolk to compare it to the embryonic mortality rate. In fact, the latter decreased with the age of the breeders. At the same time, a shell quality approach was also conducted to better characterise the turkey egg.

In conclusion, CT-scan was used to study the body composition of a breeder turkey and to provide new data for genetic selection strategies. In addition, the evolution of adipose tissue volume and changes in bone density, measured over time, could be used to optimise the feeding strategy of the breeders. ■

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Effects of egg handling in tropical climate and SPIDES

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The longer the egg storage interval between lay and setting, the higher the rate of early embryonic mortality (EEM). Short periods of incubation during egg storage (SPIDES) will reduce EEM because the SPIDES advances the stage of embryonic development from Stage X (Eyal-Giladi and Kochav, 1976), the normal stage of development at oviposition, to around Stage XIII a targeted stage of embryo development.

This slight advance renders the embryo more resistant to the stress of prolonged cool egg storage. In tropical climates temperature control is challenging within the hen house, egg storage areas, and during egg transport to a hatchery.

Until eggs are sufficiently cooled (below 22°C) embryo development may advance beyond Stage XII or XIII, and SPIDES would actually increase EEM.

In this study, embryo stages were determined using grand parent (GP) hatching eggs obtained from different field situations in a tropical climate in order to determine the range of embryo stages before and after egg cooling and SPIDES.

A total of 361 Indian River GP hatching eggs were assessed for embryo stage.

They were sourced from first or second collection in three farms (27, 39 or 63 weeks old) and assessed immediately after collection, on arrival at the hatchery and after SPIDES treatment.

House, air and eggshell temperature (EST) during holding, transportation and storage (including during SPIDES treatment) were recorded for each group.

Flock age did not show a clear influence on embryo stage in the fresh eggs. However, the prime flock was a long way from the hatchery, and eggs were held on farm for 31 hours followed by 18 hours in transit, with EST always above 22°C. Conversely, the old flock eggs were cooled to below 22°C within 5.30 hours.

During storage and transport, embryos in the prime flock eggs advanced from Stage 10.3 to Stage 11.7, whereas embryos in eggs from the old flock did not show any further development (Stage 10.5 at both points).

After SPIDES treatment, the embryo stages of both prime and old flock eggs developed to more advanced stages, from Stage 11.7 to Stage 13.1 in prime flock eggs and Stage 10.5 to Stage 12.7 in old flock eggs.

In conclusion, local environmental conditions affected the rate of embryo development during farm storage and transport. Furthermore, SPIDES treatment advanced embryonic development in prime and old flock eggs. ■

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