Metabolomic analysis of nutrient sources in the embryonic egg of two divergent lines for meat ultimate pH

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Divergent selection on the ultimate pH (pHu) of the breast muscle has allowed the creation of the pHu+ and pHu- lines, which represent a unique model to study the genetic and physiological control of energy stores and meat quality in chicken. Indeed, pHu+ and pHu- chicks (presenting low and high-energy status, respectively) exhibit different nutrient and hormone response capacities at hatch.

The avian egg forms a natural chamber that contains all the elements that are necessary for the survival and development of the embryo. During the first two weeks of development, nutrients are mainly provided by the lipids and proteins contained in the yolk. In the last third of development, embryo will use other nutrients present in the egg white and amniotic fluid. We hypothesized that a variation in these nutrient sources could contribute to metabolic and developmental differences that are present at hatch between the pHu+ and pHu- lines. To address this question, we analyzed the physical and chemical characteristics of the yolk and performed some metabolomic analyses (1H-nuclear magnetic resonance, NMR) at E0 (the first day of incubation) and E10 (after 10 days of incubation) for yolk and at E10 for amniotic fluid.

Metabolomic analysis evidenced changes in yolk composition between E0 and E10 stages. However, no difference in metabolomic profile was found between the two lines. In contrast, chemical analysis revealed a higher lipid percentage at E0 in the pHu+ line (32,9%) that appeared particularly low in the pHu- line (27,7%). On the other hand, analysis by 1H-NMR spectroscopy of the E10 amniotic fluid showed a different metabolic signature between the lines with leucine, isoleucine, oxoisocaproate, citrate and β-glucose being superabundant in pHu+ line while choline and inosine being superabundant in pHu- line.

These results highlight quantitative and qualitative differences in the nutrients potentially available to developing embryos, which could explain metabolic and developmental differences between the pHu+ and pHu- lines. The molecular characterization of the different compartments of the egg will help in understanding the metabolic orientation of the embryos (according to their nutrient sources and genetics) and could contribute to identify biomarkers reflecting the animal's energy status *in ovo*.