Nutritional programming of hepatic metabolism in mule ducks

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The effects of maternal nutrition on offspring phenotypes have been mainly documented over the past years in mammals, and are now studied in poultry as well. We investigated the effects of a reduced level of dietary Methionine (Met) on laying performances of female common ducks (*Anas platyrhynchos*) and their impacts on the phenotype of their mule ducklings, obtained from an inter-generic crossbreeding with Muscovy drakes (*Cairina moschata*).

A total of 60 female laying ducks were divided into 2 dietary treatments at 10 weeks of age. The restricted group received Met-restricted diets (R group) containing 0.25% of Met whereas the control group received control diets (C group) containing 0.40% of Met. The restriction was applied during the growing and laying periods, from 10 to 51 weeks of age. Neither the growth, nor the egg laying curve were affected by the methionine restriction. The fertility and hatching rates were also not affected. On the contrary, the total weight ($P < 0.001$), the albumen weight ($P < 0.001$) and the albumen percentage of dry matter ($P < 0.01$) were decreased for eggs laid by female breeders from the R group. Both male and female ducklings from the R group showed a reduced body weight at hatching ($P < 0.001$) and a tendency to an increased proportional liver weight ($P = 0.07$). Moreover, the maternal Met restriction modified plasma parameters in newborn ducklings regardless of sex: the alkaline phosphatase (ALP) and the alanine transaminase (ALT) activities were reduced ($P = 0.07$ and $P = 0.002$ respectively), the levels of glucose ($P = 0.03$) and triglycerides ($P = 0.01$) were higher whereas the level of free fatty acids decreased ($P = 0.01$). At the hepatic level, a study targeted on 170 genes of interest identified 51 differentially expressed genes (DEG). At 12 weeks of age, the animals from the R group showed decreased liver lipid level and abdominal fat weight ($P = 0.005$ and $P < 0.04$ respectively). Finally, at 14 weeks of age and after forced-feeding, the fatty liver weight was reduced in the R group ($P < 0.001$).

In conclusion, the dietary restriction applied during gamete production, and the impoverished nutritional environment during embryonic development, may be involved in the changes observed in the hepatic and lipid metabolisms in ducklings. Finally, the impact of the nutritional programming is still observed at 14 weeks of age, after 12 days of force-feeding.