Using high throughput phenotyping of growth and feed intake to improve adaptation of chickens to sustainable diets

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Abstract Title:
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Abstract text:

As feed cost is representing the largest part of production cost in poultry, feed efficiency is since decades one of the most important criterion of selection. Until recently however, this criterion was recorded in conditions that differed from commercial production conditions, as animals had to be reared in individual cages to obtain individual measurement of feed intake. Moreover, while feed intake had to be collected on several consecutive days to be reliable, feed efficiency was calculated only for a limited period of time (usually one or a few weeks). We thus developed an electronic feed station that enables individual and continuous measures of feed intake and body weight of chickens reared on floor and in group. The originality of the design is coming from the fact that i) it can be used from a few days post-hatch to adult age and ii) animals are not restrained nor isolated from each other when feeding, and thus can express more natural feeding and social behaviors together with higher physical activity. Chicks are equipped with a RFID chip at hatch to be detected at every visit to the feed station. One feed station can be used for 100 birds. We used this feed station in two successive experiments. Experiment 1 aimed testing the capacity of adaptation to sustainable diets of slow- and fast-growing chickens (40 birds/genotype/diet). Experiment 2 aimed at deciphering the genetics determinism of daily feed intake in 2 experimental lines of fast-growing chickens divergently selected for ultimate pH of breast meat. In the first experiment, birds were fed either with a corn-soy diet or with a diet containing local feedstuffs (rapeseed, sunflower and field bean) or feedstuffs not in competition with human food (wheat DDGS). Diets were adapted to birds nutritional needs. The alternative diet designed for fast-growing chickens in experiment 1 was also used in experiment 2. Chickens were reared until market weight, i.e. 35 d and 42 d for fast-growing chickens in experiment 1 and 2, respectively, and 84 d for slow-growing chickens in experiment 1. Results of experiment 1 showed that animals have a good capacity to adapt to alternative diets. In both genotypes, growth was similar between diets or even better with the alternative diet, while feed intake was similar or lower with the alternative diet. As a consequence, feed conversion ratio did not differ between diets in standard chickens. In label rouge chickens, feed conversion ratio was even better with the alternative diet until 40 d. Moreover, variability of feed intake and feed efficiency is lower in birds fed with the alternative diet, indicating a better homogeneity of performances with this diet than with the corn-soy diet. Most between-diet differences are observed just before or after dietary transitions, showing that transition ages could be optimized in some cases. Carcass composition was slightly improved with the alternative diet, with a higher thigh percentage in Label Rouge chickens and a lower abdominal fat percentage in standard chickens. Meat quality was moderately affected only in Label Rouge chicken, breast meat being less acidic and less yellow with the alternative diet. Results of experiment 2 showed that profiles of heritability of feed intake and feed efficiency varied strongly with age and with the line. For example, heritability of feed conversion ratio varied with age from 0.08 to 0.63 in the low pH line and from 0.08 to 0.49 in the high pH line. As for the phenotypic study in experiment 1, dietary transitions appeared as critical periods of evolution of the genetic determinism of studied traits. The genetic correlations between final feed efficiency and daily performances highlighted the possibility of using early performances as selection criterion of final performances. The strong differences of genetic correlations between daily or final feed efficiency and meat pH between the two lines confirmed the existence of differences of metabolism already observed between the two lines. Finally, our results showed that improvement of feed efficiency would rely mostly on a decreased feed intake in the high pH line and through a higher weight in the low pH line. This new tool offers large perspectives both for nutrition and genetics. It allows a better modelling of growth and feed efficiency over time and gives access to the flock average and homogeneity. On the other hand, it makes it possible to evaluate feeding behavior which is another important component of the bird's adaptability to dietary changes or other environmental fluctuations.

Keywords:

throughput phenotyping, feed intake, adaptation, sustainable diets

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