Noldus
Information Technology

Behavior and genetics in fowl: side-effects of selection for production traits

Per Jensen, Karin Schütz and Leif Andersson

Using EthoVision for Animal Behavior Research

Since about 1960, the average production levels of farm animals have increased by about 85% [3]. This may be important for many production-related health problems in modern stocks, for example leg problems in broilers. One biological explanation for increased health problems in highly selected animals may be an altered resource allocation [2]. We have found that laying hens in general tended to use behavior patterns that required less energy compared to their ancestors, red jungle fowl [4].

Behavioral variables and production traits

We decided to perform a so-called QTL analysis (Quantitative Trait Loci) of the behavioral variables and of the production traits that differed between the strains. QTL analysis is a method to map phenotypic traits to specific chromosomal regions, and is thus an important step towards identifying the genes that may be responsible for variations in a certain trait [1]. We used one jungle fowl male and four white leghorn females as parental animals to generate about 800 F2 animals, which were subjected to phenotypic recordings and DNA mapping. We recorded production traits, such as growth, for each individual.

The FS-maze test

A number of different behavioral tests were performed to record the reactions of all animals on an individual level. One of those, the so-called FS-maze ("Foraging and Social behavior test Maze") test, was designed to measure the tendency of each individual to eat food from a food source with hidden food when freely available food was present (i.e. the tendency for so-called contra-free loading) and at the same time measure their tendency to engage in social encounters [5]. Both these traits had been shown to vary between the parental lines. The FS-maze (see photo on the right) consisted of an arena with four arms, each measuring 0.5x0.8 m. Two of the arms contained food mixed with sawdust, and two contained free food. One arm with each food source had a mirror in its end, to simulate social interaction. While in the maze, the animal thus had a choice of feeding from free or hidden food in the perceived presence of other birds or alone.

EthoVision recording

We used EthoVision for automatic video tracking. To increase the recording efficiency, four FS-mazes were used simultaneously, arranged in one single test room, permitting the recording of the behavior of four birds at a time. Four video cameras were attached to the roof, each covering one FS-maze. Using a 4-channel mixer, the video signal was transferred to a computer running the EthoVision software. One issue was to find suitable parameters for EthoVision because the animals differed widely in color and size (color varied from completely black to completely white). To solve this, we used a brown background in the test arenas and lit each arena with four indirect spotlights,

providing a soft and shadow-free lighting. EthoVision was set to detect animals by means of background subtraction, and the parameters of size and contrast were set in pilot tests to optimize object detection.

Results and Discussion

We recorded the time spent in each of the four arms for every individual. In previous studies we had verified that when the animals were in the arms, they were mainly engaged in feeding and interacting with the mirror [5]. The time spent in the arm was therefore used as an approximation for their behavior. The preliminary results indicate a phenotypic correlation between growth and feeding patterns, and perhaps between growth and social tendency. QTL analyses are presently carried out. Preliminary data indicate a genetic influence on the behavior, which may perhaps also throw light on the genetic connection between production traits and observed behavior. The results may be helpful for designing breeding programs which will allow animals to maintain more of their natural behavior while still producing at an efficient level. Our experiments also show that EthoVision can be used successfully to automate behavioral observations in fowl.

References

1. Andersson, L. (2001). Genetic dissection of phenotypic diversity in farm animals. *Nature Reviews/Genetics*, **2**, 130-138.
2. Beilharz, R.G.; Luxford, B.G.; Wilkinson, J.L. (1993). Quantitative genetics and evolution: is our understanding of genetics sufficient to explain evolution? *Journal of Animal Breeding and Genetics*, **110**, 161-170.
3. Rauw, W.M.; Kanis, E.; Noordhuizen-Stassen, E.N.; Grommers, F.J. (1998). Undesirable side-effects of selection for high production efficiency in farm animals: a review. *Livestock Production Science*, **56**, 15-33.
4. Schütz, K.; Jensen, P. (2001). Effects of resource allocation on behavioral strategies: A comparison of red junglefowl (Gallus gallus) and two domesticated breeds of poultry. *Ethology*, **107**, 753-765.
5. Schütz, K.E.; Forkman, B.; Jensen, P. (2001). Domestication effects on foraging strategy, social behavior and different fear responses: a comparison between the red junglefowl (Gallus gallus) and a modern layer strain. *Applied Animal Behavior Science*, **74**, 1-14.

Contact Information

Per Jensen[1], Karin Schütz[1] and Leif Andersson[2]

[1]Department of Animal Environment and Health, Swedish University of Agricultural Sciences, Skara, Sweden

[2]Department of Animal Breeding and Genetics, Swedish University of Agricultural Sciences, Uppsala, Sweden

address

E-mail: Per.Jensen@hmh.slu.se