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Selection for increased robustness in broiler chicken

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Conciliating economic performance and animal welfare by enhancing robustness through breeding selection processes

European broiler farming primarily relies on fast-growing genotypes (Fig. 1) raised in standard and confined systems. While economically advantageous, this farming model raises concerns regarding animal health and welfare. It is now recognized that rapid growth negatively affects broiler mobility and can lead to an increased prevalence of lameness due to accelerated ossification, as well as a higher incidence of footpad dermatitis. One of the top challenges for breeders is therefore to reconcile economic performance with animal welfare. Breeders have been addressing this issue for several years through various strategies aimed at improving the robustness of the strains they offer. Robustness can be defined by a strain's resistance and resilience abilities (overall ability to recover from stress/infection, …)

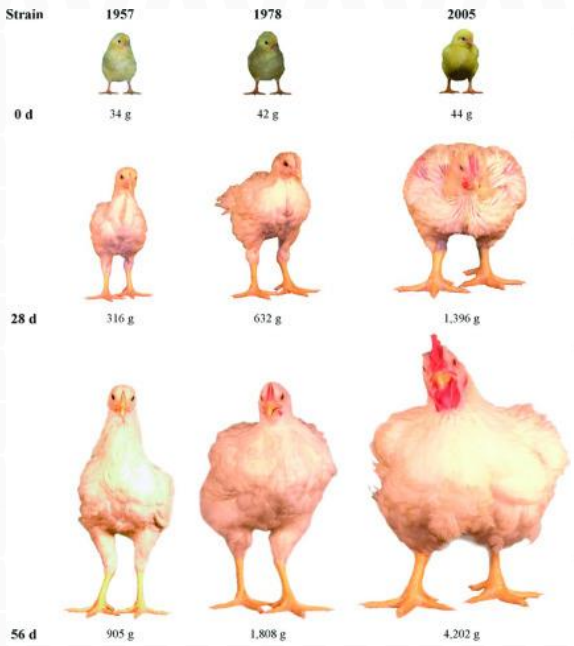

Figure 1 : Weight evolution of broiler chickens from 1957 to 2005 at hatching, 28 days, and 56 days (Zuidhof et al., 2014).

Enhancement of robustness

Various tests are conducted by breeders to improve the robustness of the strains they offer for sale (examples are presented in the following section).

However, to achieve an objective assessment of robustness, breeders rely more on data from the farming scale and repetitions of the batches raised in different countries with diverse climates and environments, as selection is global.

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Examples of strategies used by breeders to enhance the robustness of their crossbreeds

- Experimentally exposing animals from different lines to various types of stress (e.g., density, temperature, light intensity, photoperiod) to assess their genetic 'value' and determine their integration into the selection scheme. The following variables are monitored: activity, exploration, time spent mobile/immobile, perch usage, gait score, digestive health, bone quality, and technical performance such as growth.
- Performances measurement of relatives (siblings of selected lines): selected animals are kept under optimal (non-degraded) conditions, while their relatives are raised under degraded conditions (permanent litter, multi-age groups, less secure feed) to identify robust and high-performing families and eliminate high-performing but non-robust families.
- Selection for the continuous improvement of skeletal quality and gait enhancement. The gait score is crucial and more informative compared to assessing skeletal defects alone (Fig. 2) for predicting gait quality.
- Antibiotic consumption is an interesting, albeit indirect, indicator of a strain's robustness (see AVINED annual survey; Fig. 3), though it is not yet a selection criterion in France.

Figure 3 : **Antibiotic use in broilers in the Netherlands**

Year	# days of antibiotic exposure/year		% flocks of slow(er) growing flocks
	Conventional	Slow(er) Growth*	
2014	17.8	4.9	8.4%
2015	15.6	3.6	15.5%
2016	13.1	4.0	33.4%
2017	13.4	4.7	41.1%
2018	13.5	3.8	40.7%
2019	13.8	2.3	41.3%
2020	14.1	2.4	46.3%
2021	11.5	1.7	53.5%
2022	11.6	1.2	55.4%

*: Kip van Morgen en Beter Leven 1 ster

Percentage of flocks not treated with antibiotics (2022):
- ✓ **Conventional:** 72% of all flocks
- ✓ **Slow(er) growing:** 97% of all flocks

Source: AVINED (2023)

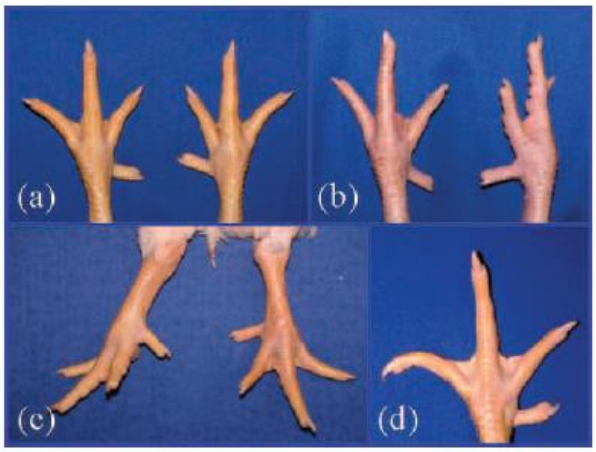

Figure 2 : Illustrations of (a) healthy legs (score 0) compared to (b) and (c) long bone deformities (score 100) and (d) crooked toes (score 100) (Kapell et al., 2012).

Points of attention

- The integration of lines that have demonstrated their ability to withstand various types of stress does not necessarily maximize all performance criteria (growth, feed conversion ratio, yield) through their robustness. Breeders therefore prioritize a balanced selection approach.
- According to breeders, mortality rates and internal culls (in experimental stations) are not reliable indicators of the genetic value of the tested line, due to the diverse environments and rearing conditions. These indicators are thus continuously monitored in the field to obtain contrasting results.
- Highly heritable selection criteria, such as zootechnical performance, are easily observed, but less so for those related to the environment and health.
- It takes approximately four years to achieve improved performance and welfare in broiler chickens at the Pedigree level, resulting in healthier animals.

References:
Zuidhof M.J., B.L. Schneider, V.L. Carney, D.R. Korver and F.E. Robinson. 2014. Growth, efficiency, and yield of commercial broilers from 1957, 1978 and 2005. Poultry Science. 93 (12):2970-2982. doi: 10.3382/ps.2014-04291
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