

TWO GENES WITH EPISTASIS MAY EXPLAIN THE DIFFERENCE BETWEEN ASCITES-RESISTANT AND ASCITES-SUSCEPTIBLE BROILER LINES

Shelly Druyan and Avigdor Cahaner

The Hebrew University, Faculty of Agriculture, Rehovot, Israel

Genetic control of the tendency of broilers to develop ascites syndrome (AS) was suggested, but research is hindered by low incidence of AS in commercial populations. Therefore divergent selection aimed at developing AS-resistant and AS-susceptible lines was initiated. Progeny of 85 sires (designated as S_0 generation) from a commercial dam-line were evaluated under AS-inducing conditions. Incidence of AS (%AS) per family ranged from 0% to 50% and was highly heritable (about 0.6).

Additional chicks (generation S_1) were produced from the S_0 parents of families with lowest %AS and highest %AS, and were tested under experimental AS-inducing condition. Significant genetic divergence was established between AS-susceptible and AS-resistant lines already by a single cycle of selection. Among S_1 progeny of high-%AS families, 70% of the chicks exhibited AS, in contrast to only 20% among progeny of the low-%AS families. This divergence further increased in the following generations: among the S_2 and S_3 progeny, %AS was over 90% in the AS-susceptible line, and lower than 20% in the AS-resistant line.

Initial pedigree analysis, based on families from the AS-resistant line that segregated into AS birds vs. healthy birds at the 1:1 ratio, suggested that a single dominant gene is responsible for AS resistance. According to this model, AS-resistant birds are homozygous or heterozygous for dominant allele, while AS-susceptible chicks are homozygous for the recessive allele for AS susceptibility. Further evaluation of the genetic control of AS was based on male offspring of the cross between the divergent lines. These heterozygous males were mated to females from the AS-susceptible line. The birds in these progeny-testing families segregated into AS birds vs. healthy birds at the 3:1 ratio, suggesting that the difference between our AS-resistant and AS-susceptible lines can be explained by a model of two major genes with epistasis, where the dominant alleles in both genes are needed to confer resistance to AS.

Resource populations derived from crosses between AS-resistant and AS-susceptible lines may facilitate an efficient genomic search for the AS genes. Once the AS genes are identified and a genotyping tests are developed, breeders will be able to easily detect individual birds carrying the alleles for AS susceptibility, and select against them. Selection may eliminate from the commercial broiler stocks all birds that carry the alleles for AS susceptibility, also in heterozygous state, which is highly relevant for the cross-bred commercial broilers.

Therefore, before applying such selection, it is necessary to study how elimination of alleles for AS susceptibility affects various aspects of performance under a range of environments and management practices. Such studies will be more sensitive, informative and reliable if done with the AS-resistant and AS-susceptible lines and their F_1 hybrid, rather than with standard commercial broilers.

Key words: ascites syndrome; broiler; heterosis; major genes; selection.