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Genetic analysis of royal jelly production and behavioural traits in *Apis mellifera*.

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The French association of royal jelly producers implemented a breeding scheme at a national scale to improve a honey bee population for traits of economic interest for royal jelly production. This contribution aims to estimate genetic parameters for those traits because selective breeding requires knowledge of heritability and genetic correlations between the relevant traits. Data from 1,006 colonies were collected from 2011 to 2017 in 37 apiaries. Queens of those colonies were produced by 97 inseminated dam queens. Quantity of royal jelly of the first two harvests in the production season were collected for the 1,006 colonies and the average performance was the production trait studied (PROD). Three functional traits were recorded for 642 to 752 of those colonies at the beginning of the harvest season: a sanitary score (SANI) and two behavioral scores : gentleness (GENT) and calmness (CALM). They were assessed by subjective scoring on a 4-mark scale, with the mark 4 being the most favorable one. Genetic parameters were estimated with a multiple trait animal model considering the performance of the colony as a trait of the queen. The bee genetic (male haploidy) and reproductive (polyandry) specificities were accounted for in the derivation of the relationship matrix. Estimates of genetic parameters were dependent on the numbers of mating drones (d) and drone-producing queens (q). In the range of likely values for d and q, heritability estimates for PROD and GENT were moderate (20-30%) and heritability estimates for CALM and SANI were lower (5-15%). Estimates of genetic correlations between traits were more sensitive to d and q values than heritability estimates. In any cases, GENT and CALM were genetically strongly correlated. While CALM was also favourably correlated to PROD, GENT was weakly associated with PROD. In addition, a tendency toward unfavorable genetic association between GENT and SANI was observed. These preliminary results have to be confirmed by a future analysis on a larger dataset. In conclusion, genetic improvement for bee gentleness and royal jelly production is possible by selective breeding but attention should be paid not to deteriorate the sanitary status of the colonies.