

Whole-genome ICAR parentage verification certification

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Parentage verification certification in dairy cattle currently relies on the standardized 195-SNP ISAG parentage verification (ISAG PV) panel. In this study, we evaluate and compare the performance of the ISAG panel with a whole-genome SNP-based approach. Specifically, we assess the robustness of the ISAG panel across a wide range of contemporary genotyping scenarios, including diverse SNP platforms and marker densities, and examine the potential benefits of extending parentage verification certification to genome-wide SNP datasets. The objective of this work is to propose a complementary parentage certification methodology, applicable when whole-genome SNP data are available, for potential inclusion in the ICAR guidelines.

Genotypic data representing five dairy breeds available at the Council on Dairy Cattle Breeding (CDCB, USA) were analyzed using large subsets of known parent-offspring pairs and unrelated animal pairs (100,000 comparisons for each dataset). Mendelian inheritance was tested using all available ISAG PV SNPs and all autosomal SNPs only, applying only basic quality control filters to exclude SNP and arrays with known poor genotyping performance (e.g. poor clustering and probe performance). An empirical threshold was determined to identify ACCEPTED, DOUBTFUL and REJECTED samples.

The results demonstrate that whole-genome SNP comparisons provide discriminatory power to accurately identify true parentage relationships, even in datasets combining multiple chip types and marker densities. The findings also show that the current ISAG panel exhibits substantially lower sensitivity and specificity compared with the whole-genome SNP approach. Most importantly, nearly one out of four comparisons in our dataset failed to meet the ICAR minimum call-rate requirements when using the ISAG panel, thereby precluding parentage verification. We conclude that, when available, whole-genome SNP comparisons should be preferred over the ISAG panel and recommend their inclusion in the current ICAR guidelines.