Genomics meets Precision Livestock Farming: combining omics and sensor-based phenotyping in dairy cattle

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The integration of advanced technologies in livestock farming offers new opportunities to improve animal welfare and productivity. This study, within the NextGenerationEU framework of the ”Next Generation Animal Production” project, explores the combination of thermal imaging, video surveillance, pedometers, and genomic data to monitor dairy cattle behavior and health. The objective is to develop an integrated system using multiple data sources for precision phenotyping, early health detection, and breeding optimization. Thermal cameras and video surveillance capture physiological and locomotion data, while activity sensors track movement patterns. Phenotyping will include 900 Holstein cattle from four Croatian farms. Genotyping with a 700K SNP array will enable analysis of genomic variability linked to analysed traits. In addition to linear models, machine learning will identify key indicators of disease susceptibility and welfare. Preliminary results show significant correlations between genomic markers and behavioral traits, suggesting a genetic basis for activity levels and stress resilience. Certain allele variants are associated with these traits, emphasizing the potential of genomic selection to improve welfare and productivity, while integrating sensor data facilitates early detection of behavioral anomalies. This study highlights the potential of integrating genomics and digital phenotyping in future breeding programs.