researchers can continuously record livestock growth, health, and behavioral patterns. Through cloud databases and data-mining algorithms, precise dynamic phenotypic models can be built to enable individual tracking and group performance prediction. This digital monitoring approach not only improves the objectivity and timeliness of data collection but also supports large-scale breeding and health management with intelligent tools.

Artificial intelligence (AI) and machine learning algorithms will play an increasingly important role in genetic and phenotypic evaluation. AI can automatically identify key factors affecting genetic stability and trait expression from large-scale omics and phenotypic datasets, constructing predictive models. For example, deep neural networks can perform pattern recognition on phenotypic outcomes associated with different editing sites, assisting in selecting optimal insertion sites and gene constructs. In the future, AI will be deeply integrated with bioinformatics platforms to form a Smart Breeding System, enabling integrated decision support for gene design, phenotypic evaluation, environmental monitoring, and risk prediction.

Overall, future research on transgenic livestock will move toward precision, safety, intelligence, and sustainability. Through the coordinated advancement of technological innovation, ethical governance, and intelligent evaluation, transgenic livestock are expected to make forward-looking contributions to global food security, medical health, and agricultural modernization, while ensuring animal welfare and ecological safety.

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