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Title: How Endogenous Retroviruses Shaped the Evolution of the Bovine Placenta

Background and Purpose: Viruses are often perceived solely as harmful agents. However, just as there are beneficial bacteria, some viruses have played essential roles in the evolution of life. One remarkable example is the evolution of placental mammals, which was partly driven by ancient viral infections. The placenta — key to sustaining pregnancy in mammals — exhibits diverse forms among species, yet its evolutionary origins remain unclear. This study aims to elucidate how endogenous retroviruses (ERVs), viral genes embedded in the host genome, have contributed to the unique development and function of the bovine placenta at the molecular level.

Research Outline: We analyzed the bovine genome and identified approximately 7,624 ERV-derived genes. Among them, 284 genes — including BERV-K1, BERV-K2, BERV-K3, BERV-P and Syncytin-Rum1 — are actively expressed in the placenta. These ERVs appear to mediate critical functions such as cell fusion between placental cells and suppression of maternal immune responses, both vital for placental formation. Our findings support the hypothesis that ERVs contribute to species-specific placental structures, offering new insights into evolutionary biology and developmental science. This research may also help improve livestock reproductive efficiency and guide the development of safer artificial reproduction technologies in animal husbandry.

Future Prospects: Further investigation is needed to clarify how specific ERVs like BERV-K1 and Syncytin-Rum1 regulate cell fusion and immune modulation at the cellular and molecular levels. Comparative studies in other ruminants and mammals with differing placental structures will enhance our understanding of ERV-mediated mechanisms. This knowledge could pave the way for creating artificial placental models, improving fertilization and implantation success rates, and advancing livestock breeding technologies.

Reference

Progressive Exaptation of Endogenous Retroviruses in Placental Evolution in Cattle.
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