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Cytokines in Reproduction & Neuro–Immuno–Endocrine Responses of Cattle & Buffalo

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INTRODUCTION

In both cattle and buffalo, reproduction is a complex process influenced by intricate interactions among the nervous, immune, and endocrine systems. Cytokines, a diverse group of small proteins, serve as key mediators in these interconnected pathways, orchestrating cellular communication, immune responses, and tissue homeostasis. Beyond their traditional roles in inflammation and immune defense, cytokines exert profound effects on reproductive functions such as follicular development, embryo implantation, placental development, and parturition. Moreover, they participate in neuroendocrine regulation, influencing hormone secretion and physiological responses crucial for successful reproduction.

Role of Cytokines in Reproduction

1. Ovarian Function: Cytokines modulate ovarian function by regulating follicular growth, steroidogenesis, and ovulation. Pro-inflammatory cytokines like interleukin (IL)-1β and tumor necrosis factor-alpha (TNF-α) influence granulosa cell function and follicular maturation, whereas anti-inflammatory cytokines such as IL-10 contribute to follicular development and maintenance of ovarian health.

2. Pregnancy and Parturition: During pregnancy, cytokines play critical roles in implantation, placentation, and fetal development. They regulate immune tolerance at the maternal-fetal interface and coordinate the inflammatory processes necessary for parturition. Dysregulation of cytokine balance can lead to pregnancy complications such as miscarriage, preterm birth, or maternal-fetal immune rejection.

Neuro-Immuno-Endocrine Responses

1. Neuroendocrine Regulation: Cytokines interact with the hypothalamic-pituitary-gonadal (HPG) axis and other neuroendocrine pathways to influence reproductive hormone secretion, gonadal function, and sexual behavior. IL-1β, for instance, acts centrally to stimulate the release of gonadotropin-releasing hormone (GnRH), thereby affecting the timing of ovulation and reproductive cycles.

2. Immune Modulation: The immune system and neuroendocrine system are tightly interconnected through cytokine signaling. Cytokines regulate immune responses in reproductive tissues, ensuring proper immune tolerance during pregnancy and preventing infections that could compromise reproductive health.

CONCLUSION

Cytokines represent crucial mediators in the intricate network linking reproduction with neuro-immuno-endocrine responses in cattle and buffalo. Their roles span from modulating ovarian function and pregnancy maintenance to influencing neuroendocrine regulation and immune responses critical for reproductive success. Advances in understanding cytokine dynamics offer promising avenues for improving fertility management, developing novel reproductive therapies, and enhancing animal welfare in livestock production. Future research should continue to unravel the complexities of cytokine actions in reproductive physiology, paving the way for innovative approaches to optimize reproductive outcomes in cattle and buffalo.

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