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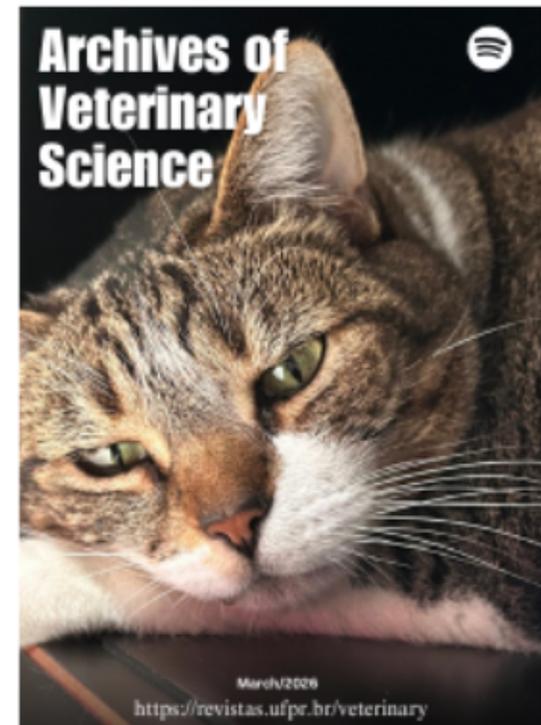
### Integrative effects of long-acting progesterone and micronutrient-amino acid complex on pregnancy maintenance in *Bos indicus* females under field conditions

Geraldo Francisco dos Santos Júnior  
Wallyson Rafael Machado Santos  
Mayra Silvestre  
Natália Santana Siqueira de Lara  
Rafael Augusto Satrapa  
Luciane Maria Laskoski  
Luiz Ernandes Kozicki  
Pedro Henrique Lomba de Lima  
Fernando Andrade Souza

AUTHOR FOR CORRESPONDENCE

**Fernando Andrade Souza**  
fernando.andrade@ufpr.br

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### Integrative effects of long-acting progesterone and micronutrient-amino acid complex on pregnancy maintenance in *Bos indicus* females under field conditions

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Geraldo Francisco dos Santos Júnior<sup>1</sup>; Wallyson Rafael Machado Santos<sup>1</sup>; Mayra Silvestre<sup>2</sup>; Natália Santana Siqueira de Lara<sup>3</sup>; Rafael Augusto Satrapa<sup>1</sup>; Luciane Maria Laskoski<sup>4</sup>; Luiz Ernandes Kozicki<sup>3</sup>; Pedro Henrique Lomba de Lima<sup>3</sup>; Fernando Andrade Souza<sup>2</sup>

<sup>1</sup>Universidade Federal do Acre, Rio Branco, Acre, Brazil, 0000-0002-2865-892 0000-0002-7637-6300, 0000-0002-0827-7501

<sup>2</sup>Universidade Federal do Paraná, Curitiba, Paraná, Brazil, 0000-0003-0246-8742, 0000-0001-8977-9740, 0000-0003-0335-769X, 0000-0002-9474-9404

<sup>3</sup>Pontifícia Universidade Católica – Programa de Pós-graduação em Ciência Animal, Curitiba, Paraná, Brazil, 0000-0002-3700-1811, 0009000793422489

Author for correspondence: Fernando Andrade Souza – [fernando.andrade@ufpr.br](mailto:fernando.andrade@ufpr.br)

**Abstract:** The present study aimed to evaluate the pregnancy rate following fixed-time artificial insemination (FTAI) in Nelore cattle supplemented with either long-acting progesterone (Experiment 1) or an injectable nutritional complex (Experiment 2). In Experiment 1, multiparous cows underwent estrus synchronization and were inseminated on day D10 (D0 = first day of synchronization). On D15, animals were assigned to a control group (n=166), which received an intramuscular injection of 0.5 mL of 0.9% NaCl solution, or to a treated group (n=147), which received 0.5 mL of long-acting progesterone (150 mg). In Experiment 2, heifers were divided into a control group (n=108), which received no treatment, and a treated group (n=99), which received an intramuscular injection of a nutritional supplement on D0 of synchronization. After 7 days of FTAI, all cows and heifers were maintained with bulls for natural mating (20 females per bull) for the following 45 days. Pregnancy diagnosis was performed 70 days after FTAI. The pregnancy rate was higher in the treated groups for both experiments (53.1% vs. 42.8% in Experiment 1, and 53.7% vs. 38.8% in Experiment 2), although differences were not statistically significant ( $p > 0.05$ ). In animals that did not conceive, ovarian cyclicity was not suppressed, indicating that the use of long-acting progesterone or nutritional supplementation did not interfere with the return to estrus. In conclusion, supplementation with long-acting progesterone or an injectable nutritional complex tended to improve pregnancy rates in Nelore cattle subjected to FTAI, without residual inhibitory effects on subsequent ovarian activity.

**Keywords:** cow, estrus-synchronization, heifer, FTAI, Nelore.

#### 1. Introduction

Nutritional status is a critical determinant of reproductive efficiency in beef cattle, influencing follicular development, luteal function, oocyte competence, and early embryonic survival. In tropical production systems, cows frequently experience mineral and vitamin deficiencies due to the seasonal variation in forage quality and high metabolic demands during lactation. These nutritional imbalances impair ovarian function and endocrine signaling, leading to suboptimal responses to synchronization and fixed-time artificial insemination (FTAI) protocols (Diskin & Kenny, 2014; Rizzo et al., 2019).

Beyond the correction of macronutrient deficits, targeted supplementation with nutraceuticals—bioactive compounds such as trace minerals, vitamins, and amino acids—has emerged as a promising strategy to enhance reproductive outcomes. Micronutrients including zinc, copper, manganese, and selenium act as essential cofactors for antioxidant enzymes such as superoxide dismutase and glutathione peroxidase, protecting follicular cells from oxidative stress and improving steroidogenic activity (Arechiga et al., 1998; Bian et al., 2007). Vitamins A and E, along with  $\beta$ -carotene, contribute to follicular vascularization, luteal function, and conceptus development through retinoid and antioxidant mechanisms (Völker & Ludwig, 1995; Boxmeer et al., 2009). In mares, targeted nutritional supplementation with these compounds has been associated with improved follicular dynamics and higher embryo recovery rates, suggesting conserved physiological mechanisms across species (Aurich et al., 2018, 2019; Del Prete et al., 2024).

Injectable formulations of minerals and amino acids offer a rapid and bioavailable route to correct subclinical deficiencies, bypassing limitations of oral intake, ruminal degradation, and variable absorption. The metabolic support provided by such supplements may directly influence folliculogenesis and oocyte maturation, as well as modulate uterine receptivity through improved systemic oxidative balance. However, despite extensive studies on dietary supplementation, the reproductive effects of injectable nutraceutical complexes under field FTAI conditions remain poorly characterized.

Furthermore, hormonal modulation through exogenous progesterone administration represents another approach to optimize the endocrine environment during the peri-ovulatory period. Long-acting progesterone formulations may enhance luteal support and stabilize cyclicity in animals failing to conceive after FTAI, potentially sustaining ovarian activity and minimizing the anestrous period (Torres et al., 2021; Bó et al., 2023). When combined with targeted nutraceutical interventions, such strategies may synergistically improve follicular quality and pregnancy outcomes.

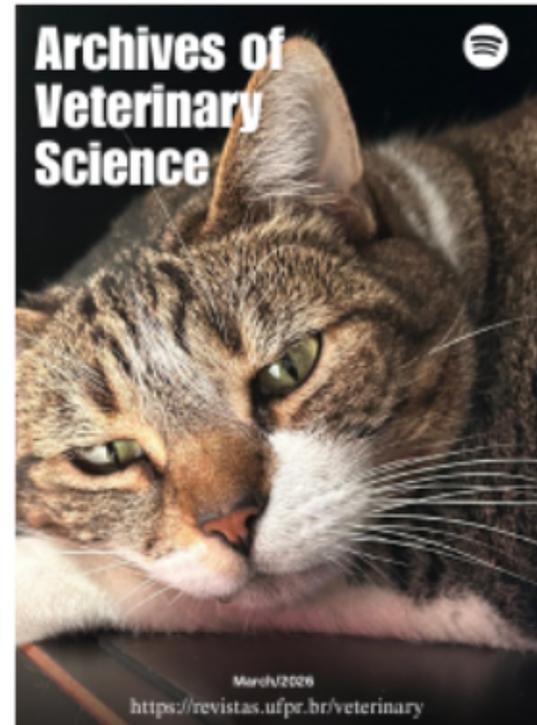
Therefore, this study was designed to test the hypothesis that injectable nutraceutical supplementation (trace minerals and amino acids) and long-acting progesterone administration can enhance reproductive performance in beef cows submitted to FTAI by improving ovarian function, luteal activity, and systemic metabolic balance.

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1



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