UNIVERSITY OF AGRICULTURAL SCIENCES AND VETERINARY MEDICINE CLUJ-NAPOCA
FACULTY OF VETERINARY MEDICINE
DOCTORAL SCHOOL

SUMMARY OF THE DOCTORAL THESIS

# Reproductive Management and Economic Implications in Aberdeen Angus Beef Cattle Through the Implementation of Artificial Insemination and Embryo Transfer

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# CONTENT

# INTRODUCTION

The doctoral thesis titled “Reproductive Management and Economic Implications in Aberdeen Angus Beef Cattle Through the Implementation of Artificial Insemination and Embryo Transfer” represents a significant contribution to the field of cattle breeding, particularly regarding the optimization of reproductive processes in Aberdeen Angus beef cattle. This work was conducted by doctoral candidate Geanina Diana Bitica under the scientific supervision of Prof. Liviu Marian Bogdan at the University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca.

The general context of the thesis highlights the increasing importance of beef cattle in modern agriculture, where economic efficiency and genetic quality become essential priorities for farmers. In this context, the thesis aims to explore ways to optimize reproduction in Aberdeen Angus cattle, a breed known for its adaptability and superior meat qualities.

The thesis is well-structured, covering fundamental aspects of cattle reproduction, from the anatomy of the reproductive system to reproductive pathology. Additionally, it addresses the challenges and methods associated with artificial insemination and embryo transfer in beef cattle, two techniques with the potential to significantly improve reproductive success rates and reduce calving intervals.

An innovative aspect of the thesis is the approach to reproductive management through the implementation of advanced technologies such as artificial insemination and embryo transfer. These technologies not only allow for rapid genetic improvement of the herds but also provide efficient solutions for increasing productivity and economic profitability of beef cattle farms. The thesis also examines the impact of these technologies on animal health and the biological processes involved in reproduction, highlighting both the benefits and challenges associated with them.

Geanina Diana Bitica’s research includes detailed studies on reproductive pathology in Aberdeen Angus cattle, focusing on identifying and treating ovarian and uterine conditions that can negatively affect the reproduction process.

The structure of the thesis includes a series of specific studies, each focusing on a distinct aspect of reproductive management in Aberdeen Angus cattle. The results of these studies provide a solid foundation for practical recommendations aimed at farmers and specialists, with the goal of improving reproductive performance and, consequently, farm profitability.

The thesis “Reproductive Management and Economic Implications in Aberdeen Angus Beef Cattle Through the Implementation of Artificial Insemination and Embryo Transfer” makes a valuable contribution to the field of beef cattle breeding by addressing current issues and proposing innovative solutions. The research results demonstrate the potential of these modern technologies to transform traditional reproductive practices and contribute to the sustainable development of the livestock sector.

The primary goal of this research is to optimize reproductive management in Aberdeen Angus beef cattle to maximize economic profitability for farms. This involves identifying, analyzing, and implementing the most effective reproductive practices to achieve higher calving rates, improved calf health, and enhanced meat quality, while

reducing operating costs and maximizing profit, all achievable through positive genetic progress.

# THESIS STRUCTURE

The doctoral thesis titled "Reproductive Management and Economic Implications in Aberdeen Angus Beef Cattle Through the Implementation of Artificial Insemination and Embryo Transfer" is structured into two major sections, spanning over 120 pages.

**The first part** is dedicated to the current state of knowledge and comprises five chapters. This section includes:

- **General Concepts on Beef Cattle Farming Worldwide and Nationally:** This chapter provides a global and national perspective on the beef cattle industry, highlighting current trends and challenges.
- **Presentation of the Aberdeen Angus Breed:** This chapter describes in detail the breed's characteristics, its adaptability, and its economic significance within modern agriculture.
- **Anatomy and Physiology of the Reproductive System in Cattle:** This chapter explores the structure and function of the reproductive system in beef cattle, focusing on aspects relevant to assisted reproduction.
- **Reproductive Pathologies in Beef Cattle:** This chapter offers an analysis of major reproductive disorders that can negatively impact fertility, detailing risk factors and their consequences.
- **Assisted Reproduction Techniques in Cattle:** The final chapter of this section addresses modern assisted reproduction strategies, with a particular focus on artificial insemination and embryo transfer, providing a theoretical foundation for the subsequent research.

**The second part of the thesis is dedicated to the author's personal contributions and is structured into six chapters:**

- **Research Hypothesis and Objectives:** This chapter presents the scientific premise of the research and the specific objectives proposed by the author, which guide the entire experimental effort.
- **Characteristics of the Natural and Artificial Environments in Which Experiments Took Place:** This chapter describes the specific details of the experimental environments, including aspects related to location, environmental conditions, and how these were controlled or varied during the experiments.
- **Materials and Methods:** This chapter provides a detailed description of the methodology used in the research, including the tools and techniques applied for data collection and analysis.
- **Results and Discussion:** This section presents the detailed results obtained from the experiments, followed by a comprehensive discussion of the significance of these results in the context of existing literature and the thesis objectives.
- **General Conclusions and Recommendations:** This chapter offers a synthesis of the main conclusions of the research and proposes practical recommendations for farmers and specialists based on the data obtained.
- **Originality and Innovative Contributions:** The final chapter of this section highlights the originality of the thesis and the innovations introduced in the field of reproductive management in beef cattle.
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# RESERCH OBJECTIVES

The primary objective of this study was to develop protocols aimed at improving reproductive function during the postpartum period through primarily preventive measures, thereby minimizing economic losses associated with this period.

**The specific objectives of this study were:**

- **Monitoring cattle for the diagnosis of existing pathologies:** This involves observing and assessing the health status of the cattle to identify any reproductive disorders that may affect their fertility and overall reproductive performance.
- **Treatment of primary pathologies and identification of the most effective therapeutic protocols:** This objective focuses on addressing the main reproductive pathologies identified in the cattle and finding the most effective treatment protocols to manage these conditions and improve reproductive outcomes.
- **Comparing different types of prostaglandins and their effectiveness in luteal tissue lysis:** This involves evaluating the efficacy of various prostaglandin types in inducing luteal tissue lysis, which is crucial for synchronizing estrus and improving reproductive efficiency.
- **Monitoring success and proposing methods to enhance biotechnical practices in beef cattle reproduction:** This includes assessing the success rates of implemented reproductive protocols and suggesting improvements in biotechnical approaches to optimize reproductive performance in beef cattle.

# RESEARCH RESULTS

### Incidence of Reproductive Pathologies in Aberdeen Angus Cows (Study 1)

Study 1 revealed significant seasonal differences in reproductive health among Aberdeen Angus cows. During the winter, 45% of the 140 examined cows were confirmed pregnant, compared to only 30% of the 314 cows examined in the summer, a statistically significant difference ($p<0.05$). Ovarian hypofunction was more prevalent in summer, with an incidence rate of 43% compared to 20% in winter. Overall, ovarian hypofunction was observed in 50.22% of cases. Ovarian cysts had a constant prevalence of 8% in both winter and summer. The incidence of corpus luteum without pregnancy was 15% in winter and 10% in summer. These results indicate significant seasonal variations in reproductive health, highlighting the impact of heat stress and other environmental factors on ovarian function and overall fertility.

### Management of Ovarian Inactivity in Beef Cattle (Study 2)

Study 2 evaluated the effectiveness of Dexidroxiprogesterone and PRID Delta treatments in managing ovarian inactivity in cows, compared to an untreated control group. In the Dexidroxiprogesterone-treated group of 123 animals, 60.16% were confirmed pregnant, and 20.33% showed corpus luteum, indicating ovulation, although not all confirmed pregnancy. In the PRID Delta-treated group of 122 animals, 59.84% were pregnant, and 19.67% had corpus luteum. In contrast, the untreated control group of 56 animals had a significantly lower pregnancy rate of 14.29%, with only 10.71% showing corpus luteum. This control group exhibited a high level of ovarian inactivity, with 75% of animals showing no signs of reproductive activity. The

results underscore the importance of progesterone treatments in improving fertility, highlighting the positive impact of hormonal intervention on reproductive success compared to no treatment.

**Study on the Treatment of Luteal Tissue in Angus Cows with Natural and Synthetic Prostaglandin Analogs (Study 3)**

Study 3 investigated the effects of administering natural and synthetic prostaglandins to Angus cows with existing luteal tissue, evaluating their responses in terms of estrus synchronization and subsequent pregnancy rates. Cows were treated with either synthetic prostaglandin (Group 1) or natural prostaglandin (Group 2) and monitored until estrus onset. The average interval until estrus onset was 55.72 hours for Group 1 and 56.87 hours for Group 2, with more pronounced estrus signs observed in Group 1. The average duration of estrus was similar between groups, around 22 hours. The proportion of cows detected in estrus was 81.48% in Group 1 and 85.18% in Group 2. Following artificial insemination, 71.11% of cows were confirmed pregnant, with pregnancy rates of 72.72% in Group 1 and 69.56% in Group 2. These results suggest that both types of prostaglandins are effective in inducing estrus and achieving high pregnancy rates, with no significant differences between the two treatments.

**Implementation of Artificial Insemination in Beef Cows (Study 4)**

The implementation of artificial insemination in beef cattle operations can be optimized using estrus synchronization protocols, which significantly enhance pregnancy rates. In this study, three different protocols were tested. Group 1 used PGF Veyx Forte for luteolysis, followed by artificial insemination at 76 hours. This protocol achieved a pregnancy rate of 68%, with a total cost per cow of 93.2 Ron and a cost per pregnancy of 137.06 Ron, making it the most economically efficient. Group 2 followed the Ovsync protocol, which included administration of GnRH and PGF Veyx Forte, resulting in a lower pregnancy rate of 35%. Despite similar total costs per cow (133.2 Ron), the cost per pregnancy was significantly higher at 380.57 Ron, making this protocol less economically viable. Group 3 incorporated a PRID Delta device into the Ovsync protocol, achieving a pregnancy rate of 48%. Although the total cost per cow was higher (178.2 Ron), the cost per pregnancy decreased to 371.25 Ron compared to Group 2. This protocol provides a balance between reproductive efficiency and cost, offering a viable option for improving pregnancy rates in beef cattle operations.

**Implementation of Embryo Transfer in Beef Cattle (Study 5)**

Study 5 analyzed the cost-effectiveness of embryo transfer in beef cattle, comparing two groups treated with prostaglandin PGF2α during fall and spring. In Group I, 23 females were treated, 14 showed estrus, and 8 were selected for embryo transfer, resulting in 3 pregnancies and a success rate of 37.50%. In Group II, 24 females were treated, 13 showed estrus, and 9 were selected for embryo transfer, resulting in 4 pregnancies and a success rate of 44.44%. Financially, Group I had a total cost per animal of 3007.50 lei, while Group II had a lower cost of 2997.78 lei per animal. Despite Group I being more economical with a total cost of 28,760 lei compared to

37,380 lei for Group II, the latter demonstrated higher efficiency in selecting females for embryo transfer and maintaining a higher success rate of pregnancies. Group II had higher transfer success and estrus rates, suggesting that spring is a preferable period for embryo transfer, despite the lack of statistically significant differences.

# GENERAL CONCLUSIONS

Based on the research conducted, the following general conclusions can be drawn:

**Ovarian Hypotrophy – The Primary Reproductive Pathology**: Ovarian hypotrophy is the most common reproductive pathology encountered in beef cattle, closely linked to feeding and management practices. Nutritional deficiencies, heat stress, and improper environmental management significantly contribute to the development of this condition, which is characterized by the absence of normal follicular activity and leads to anestrus and temporary infertility. Therefore, ensuring optimal feeding conditions and hygiene is essential for maintaining reproductive health and preventing this condition.

**Ultrasound Examination and Targeted Treatments**: Ultrasound examination of the reproductive tract enables the application of targeted treatments, such as administering prostaglandin in the presence of luteal tissue. This approach allows for accurate diagnosis of reproductive issues and the application of precise treatments that enhance reproductive success. Prostaglandin treatments have proven effective in inducing luteolysis and synchronizing estrus, resulting in good pregnancy rates at a reduced cost.

**Effectiveness and Cost-Effectiveness of Prostaglandin Synchronization**: Estrus synchronization using prostaglandin, followed by artificial insemination at a predetermined time, has been demonstrated to be an efficient and cost-effective method for increasing pregnancy rates. This strategy is particularly valuable in beef cattle operations, where reproductive efficiency is crucial for economic success. Compared to more complex and costly protocols, the use of prostaglandin provides an excellent balance between cost and reproductive outcomes.

**Cost and Benefits of Embryo Transfer**: Obtaining a calf through embryo transfer involves a significant cost, exceeding 10,000 lei per animal; however, this cost is justified by the long-term benefits of superior genetics. Investment in embryo transfer can be recouped through improved genetic quality of the herd, leading to enhanced productive and reproductive performance of the resulting calves. Although initial costs may seem high, the superior genetic value of the offspring provides a competitive advantage in the market, offsetting the initial investment.

# ORIGINALITY AND INNOVATIVE CONTRIBUTIONS

The thesis stands out for its originality through a detailed comparison of various estrus synchronization protocols and their economic impact, analyzing both pregnancy rates and the associated costs per cow and per pregnancy. The integration of ultrasound as a selection method for embryo transfer, based on the presence of a compact and functional corpus luteum, adds an innovative approach to the reproductive management of beef cattle. This method, combined with the economic analysis of embryo transfer costs, offers a new perspective on the profitability of this technique, demonstrating that investment in embryo transfer is justified by the genetic and economic benefits obtained.

The thesis integrates the results obtained with data from the specialized literature, thereby validating the research and providing new insights into reproductive practices in beef cattle. Additionally, the research is distinguished by its practical recommendations, which can be directly applied in beef farms, based on concrete data and rigorous observations. This practical and well-founded approach contributes to optimizing reproductive management on farms, ensuring a balance between reproductive efficiency and economic viability.