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# EVALUATION OF THE EFFECTS OF CONVENTIONAL RESTRAINT AND ELECTROMAGNETIC IMMOBILIZATION ON STRESS AND WELL-BEING OF CATTLE

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**ABSTRACT**

Objective: To evaluate the effects of conventional physical restraint and electromagnetic immobilization on cattle handling, focusing on stress and physiological parameters related to animal welfare. Cattle handling, essential for diagnosis and treatment, can result in considerable stress, manifested by changes in heart rate, cortisol levels, and other biochemical indicators. Conventional restraint techniques, such as the use of ropes and chains, have often been associated with physiological stress reactions, such as increased heart rate and cortisol, which can harm animal welfare and affect productivity. In contrast, electromagnetic immobilization emerges as an alternative, less invasive approach, using electromagnetic waves to keep cattle immobilized more gently. Studies indicate that electromagnetic immobilization can significantly reduce the increase in cortisol levels and decrease adverse reactions to stress, such as increased heart and respiratory rates. In addition, this technique has shown positive results in terms of preserving meat quality and increasing production efficiency, with less metabolic impact. Although electromagnetic immobilization shows promise, the definition of the ideal dose and the proportion of parameters required for its application still require further investigation. The combination of conventional methods with alternative techniques, such as electromagnetic immobilization, may contribute to a more effective approach to cattle management, providing more effective stress control and improved animal welfare.

**Keywords:** Stress. Cattle Management. Electromagnetic Immobilization. Animal Welfare.

## INTRODUCTION

Animal welfare has received increasing attention, both in the scientific context and from a social perspective, due to the direct effect that management practices have on the health and productive efficiency of animals. In cattle, physical restraint practices are commonly necessary for diagnostics, treatments, and surgeries. However, they can lead to considerable stress, causing physiological, metabolic, and behavioral changes that harm the animals' welfare (Moberg, 1996; Grandin, 1997). Conventional physical restraint techniques, such as the use of ropes and chains, are widely used. However, they are often criticized for favoring excessive handling and the risk of harm to animals, in addition to contributing to physiological stress reactions, such as increased heart rate, elevated blood cortisol levels, and changes in blood pressure (Stöber, 1990; Sneddon & Gentle, 2001). If not properly implemented, these practices can result in financial problems, such as weight loss, growth delays, and poor meat quality (Paranhos da Costa et al., 2002).

The implementation of alternative techniques, such as electromagnetic restraint devices, represents progress in animal management. These devices use low-intensity electromagnetic waves to keep cattle immobilized in a less invasive manner, promising a considerable reduction in stress and pain. Initial research suggests that this strategy may provide advantages for both animal welfare and the protection of caretakers (Korth-RFID, 2009; Rosa et al., 2009).

Considering the relevance of practices that favor welfare and the need to critically evaluate the effectiveness of new techniques, this study aims to assess the effect of conventional and electromagnetic restraint methods on physiological and biochemical parameters linked to stress in cattle. The assessment included measurements of heart rate, respiration, mean arterial pressure, and blood cortisol levels, parameters commonly used as indicators of stress in laboratory animal research (Graf & Seen, 1999; Fantoni & Mastrocinque, 2002).

## METHODOLOGY

The methodology used in this comparative study and literature review involved a critical and systematic evaluation of scientific articles, books, and other relevant resources on the effect of physical restraint practices on cattle welfare, contrasting them with alternative methods, such as electromagnetic restraint. The study was conducted through a search of academic databases, such as Google Scholar, PubMed, Scopus, and

Web of Science, with the aim of including publications from the last 30 years that discuss the impacts of stress caused by physical restraint and management options.

The research chosen focused mainly on traditional restraint techniques, such as the use of ropes and chains, as well as on more recent techniques, such as electromagnetic restraint. The focus was on the analysis of physiological and behavioral parameters linked to stress, such as cortisol levels, heart rate, blood pressure, and respiratory rate. The effects of physical stress on beef production and quality were also taken into account.

The inclusion criteria took into account peer-reviewed articles, theses, and technical reports that discuss the physiological impacts of stress on cattle and the benefits of alternative management methods. Articles that did not directly address the effects of stress or that did not have the full text were removed.

The evaluation of the studies was done qualitatively, aligning the information with the main topics of the review, such as the physiological impacts of stress, the comparison between restraint techniques, and the advantages of alternative techniques. The discussion included the analysis of the findings in the literature, highlighting the similarities and discrepancies between the studies and providing a critical perspective on the consequences of cattle management.

Ultimately, the review was conducted respecting the integrity of the studies and the appropriate use of scientific sources, without performing an original study with animals, limiting itself to the analysis of the available literature. The methodology made it possible to collect broad knowledge about the effect of management practices on the welfare of cattle and the influence of management practices on animal health.

## RESULTS AND DISCUSSIONS

Cattle management is a fundamental step that directly impacts animal welfare and productivity rates. Traditional methods of physical restraint, such as ropes and chains, although efficient for immobilization, are often associated with negative consequences for animal welfare. These procedures can cause a variety of reactions negative, such as increased plasma cortisol levels, increased heart rate (HR) and respiratory rate (RR), and significant metabolic changes, such as decreased blood pH (Moberg, 1996; Paranhos da Costa et al., 2002; Rosa et al., 2009).

Increased cortisol, a glucocorticoid hormone released in stressful situations, has been extensively documented as one of the main physiological signs of ineffective handling. Research indicates that restraint techniques involving manual handling and chutes can increase blood cortisol levels by up to 150% compared to baseline levels (Rosa et al., 2009; Grandin, 1997). These increases are linked to activation of the hypothalamic-pituitary-adrenal axis and symbolize an effort by the body to reestablish homeostasis. However, chronically high levels of cortisol can result in negative effects, such as susceptibility to immunosuppression, impaired recovery from injuries, and decreased productivity (Fantoni & Mastrocinque, 2002; Sneddon & Gentle, 2001).

In addition, the stress caused by physical restraint also leads to significant cardiovascular changes. Research such as that carried out by Rosa et al. (2009) suggests that the heart rate in cattle can increase from 64 ± 8 beats per minute (baseline) to 97 ± 23 beats per minute during the conventional restraint method. These increases are directly linked to the release of catecholamines, such as adrenaline and noradrenaline, which enable the body to deal with dangerous situations. There may also be similar changes in respiratory rate, reaching peaks of 33 ± 4.84 movements/minute during the restraint period.

However, alternative approaches, such as electromagnetic immobilization, have shown promise in reducing the effects of handling on animal welfare. This procedure uses low-power electromagnetic waves to immobilize the animal, reducing the demand for intense manual handling and, consequently, the related stress. Rosa et al. (2009) demonstrated that, despite the increase in physiological parameters during the use of the electromagnetic immobilizer, these increases are considerably smaller compared to conventional methods. For example, in groups of some studies that were subjected to electromagnetic immobilization, plasma cortisol levels reached peaks of 4.1 ± 0.6 µg/dL, while in the traditional method, these levels exceeded 5.2 ± 0.9 µg/dL. Hemogasometric parameters also provide important data on the physiological effect of handling. Changes in blood pH, the presence of bicarbonate (HCO3-), and excess bases (BE) were more evident in the traditional method, suggesting greater metabolic disorders. On the other hand, the electromagnetic method proved to be efficient in preserving these parameters within the limits considered normal, indicating a reduced systemic impact (Fantoni & Mastrocinque, 2002).

Another relevant point is the reaction of cattle to painful stimuli during handling. Although all animals subjected to the conventional method respond to painful stimuli immediately after restraint, a considerable portion of animals subjected to electromagnetic immobilization do not respond to the stimulus in the first 30 minutes after the intervention (Rosa et al., 2009). This suggests that the electromagnetic technique can offer greater comfort and reduce the sensation of pain during handling.

From an economic perspective, strategies that reduce stress during management provide concrete advantages. Animals that suffer less stress exhibit higher rates of weight gain, greater feed efficiency, and better quality meat, as demonstrated by the reduction of lesions, hematomas, and high pH levels in meat (Paranhos da Costa et al., 2002; Grandin, 1997). Furthermore, less invasive and more humane methods satisfy the demands of customers, who are increasingly demanding regarding the ethical origin of animal-derived products.

These considerations are in line with the growing market demands for management methods that value animal welfare. International entities, such as the OIE, highlight the importance of reducing stress and pain in production animals, not only for ethical reasons but also for their direct effect on productivity and the quality of final products, such as meat and milk (OIE, 2021).

## FINAL CONSIDERATIONS

Conventional physical restraint practices, such as the use of ropes and chains, are effective but are often associated with stress reactions that negatively affect cattle welfare, resulting in physiological and metabolic changes. Electromagnetic immobilization appears to be a promising alternative, with less impact on stress, preserving physiological parameters within normal limits and reducing the pain response during restraint. In addition to benefits for animal welfare, However, these techniques can contribute to improving the productivity and quality of animal products, aligning with the growing demands for more humane and efficient practices in cattle management.

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