

Ozone Therapy in Equines

Daniel Rodrigues Silva, Adriano Leite Guimarães, Athos Menezes Ramalho Araújo Vieira, Eduardo Dias Duarte, Ellyan Martins Almeida, Heitor Abreu Maximiano, Thiago Dos Santos Viana, Wanessa Soares Luiz Silva

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Abstract— *Ozone therapy, known for its antimicrobial and anti-inflammatory properties, has been explored in veterinary medicine as a less invasive alternative for treating horses. Studies show that this therapy can speed up the wound healing process, reduce pain and swelling, and stimulate the animals' immune system. Ozone therapy has also shown potential in the treatment of orthopedic and dermatological conditions in horses, providing symptom relief and improving the quality of life of these animals. This therapy can be applied in different ways, such as ozonized autohemotherapy, the instillation of ozone gas in cavities and the topical application of ozone. Each method has specific advantages and can be indicated for different conditions, making ozone therapy a versatile tool in the treatment of horses. Problem: What are the real benefits of ozone therapy for the health and well-being of horses? Justification: The search for effective and less invasive methods for animal care encourages the evaluation of new therapeutic approaches. Objectives: This study aims to prove the effectiveness of ozone therapy, analyze application protocols and define safety issues associated with the treatment. Methodology: A literature review was carried out, analyzing existing studies on the application of ozone in veterinary treatments, focusing on the benefits, limitations and safety of the technique.*

I. INTRODUCTION

In recent years, the search for therapeutic methods that promote the well-being and rapid and safe recovery of horses has led researchers and professionals to consider less invasive approaches with high potential for effectiveness. Among these approaches, ozone therapy has aroused interest in the field of veterinary medicine, particularly due to its antioxidant, antimicrobial and regenerative properties. This technique, based on the application of medicinal ozone, is used in several species, including horses, to treat a range of health conditions, from joint injuries to infections and inflammatory processes (SOUZA et al., 2021, TONIN et al, 2024) .

Given this scenario, the central question of this study is: What are the real benefits of ozone therapy for the health and well-being of horses?

The purpose of this work is to analyze the results achieved to date with the use of medicinal ozone in veterinary treatments, considering both its effectiveness and safety for the animal.

The justification for choosing this topic is the growing demand for treatment methods that are simultaneously effective and minimally invasive, factors that contribute significantly to the rapid and trauma-free recovery of animals. Ozone therapy is a technique that can potentially fill this gap, promoting therapeutic benefits with a low risk of adverse effects and a reduced need for drug intervention (CASTRO et al., 2024).

The objectives of this article are, therefore, multiple: firstly, it aims to prove the effectiveness of ozone therapy in the veterinary context, specifically in horses. In addition, this study will seek to analyze the protocols for the

application of ozone in different clinical conditions, as well as to delimit safety issues in the treatment.

The methodology applied in the work was the review of scientific literature, based on the analysis of research on the use of ozone therapy in horses, available on official websites and platforms such as Scielo, PubVet and Google Scholar.

II. DEVELOPMENT

2.1 Introduction to Veterinary Ozone Therapy

Ozone therapy is an integrative therapy that uses a mixture of ozone gas (O₃) and oxygen (O₂) for therapeutic purposes in various medical conditions, being especially recognized for its anti-inflammatory, antibacterial and antifungal properties, in addition to promoting tissue oxygenation and aiding in wound healing.

Its administration can be administered in several ways, such as topically, subcutaneous injections or through ozonated oils, depending on the type of treatment required, and is currently considered a promising approach in veterinary medicine, especially in the treatment of wounds in horses (Flamia and Wilmsen, 2021).

The introduction of ozone therapy into medicine was initially used in human medicine before expanding to the treatment of animals. Discovered in the 19th century by the German chemist Christian Friedrich Schönbein, ozone was identified by the characteristic odor it produced when an electric discharge passed through oxygen. This gas, known for its antimicrobial and anti-inflammatory properties, began to be used on soldiers' wounds during the First World War due to its effectiveness in reducing infections (FARIA et al., 2024).

In the decades that followed, ozone therapy began to be incorporated into medical treatments and, more recently, also into veterinary practices. With the publication of Hans H. Wolff's 1979 book "Medicinal Ozone", ozone therapy gained popularity as a preventive and curative therapeutic approach in Germany, and its use became consolidated globally, including in Brazil, where the practice began to develop in the 1970s with physician Heinz Konrad and spread to Santa Catarina in the 1990s through Dr. Edison de Cezar Philippi. Today, ozone therapy is widely accepted and increasingly studied, particularly in horses, due to its low cost, practicality and effectiveness in the treatment of inflammatory, respiratory and wound healing conditions (ABOZ, online¹).

For horses, potential benefits include improved injury recovery and increased circulation, providing relief to animals that frequently suffer from musculoskeletal injuries and respiratory problems, common in sports and heavy work activities. Its application is especially recognized for its antimicrobial, anti-inflammatory and analgesic properties, and its use is associated with a faster and more efficient healing process, without the formation of exuberant granulation tissue, which is a common problem in equine wounds (SOUZA et al., 2021, TONIN et al., 2024).

Among the main effects of the application of ozone therapy are the anti-inflammatory effect, reducing inflammation in wounds, promoting faster healing and reducing the animal's discomfort, effective antimicrobial action against a wide range of bacteria and fungi, action in controlling pain and reducing edema, providing greater comfort for the animal during the healing process, which can be especially useful in deep or chronic wounds, increased tissue oxygenation, leading to improved tissue oxygenation, stimulation of tissue regeneration, accelerating the regeneration of damaged tissues and increased levels of fibrinogen, an essential protein for the healing process, promoting the formation of clots and helping to protect the wound from infections (SOUZA et al., 2021, TONIN et al., 2024).

These benefits make ozone therapy an effective and cost-effective alternative in the treatment of wounds in horses, although technical knowledge is essential for its correct application, in order to maximize results and avoid complications (CASTRO et al., 2024).

2.2 Applications of Ozone Therapy in Horses

Ozone therapy in horses has been a therapeutic alternative used especially in treatments for respiratory diseases, recovery from muscle injuries and healing of chronic wounds. Its application helps in oxygenation and reduces inflammation in the respiratory tract, providing relief and facilitating breathing. This is because ozone improves oxygen circulation and reduces lung inflammation, benefiting the performance of horses, especially those that participate in intense activities. By improving blood circulation and promoting tissue regeneration, ozone reduces healing time and minimizes pain associated with injuries. This effect is particularly useful for competition and work horses, which are often subject to physical wear and tear and need a quick and safe return to activities (BASILE & BACCARIN, 2022).

¹ABOZ. **Ozionize-se**: History of ozone therapy. Online. Brazilian Association of Ozone Therapy. Available at: [https://www.aboz.org.br/ozonize-se/historia-da-](https://www.aboz.org.br/ozonize-se/historia-da-ozonioterapia/#:~:text=Em%201979,One%20Year%20Earlier,Preventive%20and%20Authentic%20Therapy%20of%20Ozone.)

[ozonioterapia/#:~:text=Em%201979, One Year Earlier, Preventive and Authentic Therapy of Ozone.](https://www.aboz.org.br/ozonize-se/historia-da-ozonioterapia/#:~:text=Em%201979,One%20Year%20Earlier,Preventive%20and%20Authentic%20Therapy%20of%20Ozone.) Accessed October 15, 2024.

Due to the antimicrobial properties of ozone, it is effective against bacteria, fungi and viruses present in wounds. In addition, ozone therapy improves tissue regeneration and promotes healing, preventing open wounds from turning into even more serious injuries. This is particularly valuable for horses, which are susceptible to infections in stable or pasture environments (PRATO, 2022; SOARES et al., 2019)

Ozone acts on animal organisms mainly due to its ability to generate a cellular response through the transient increase of reactive oxygen species (ROS), leading to metabolic adaptations that stimulate the organism to respond with an increase in natural antioxidants, generating a response to inflammation and strengthening the immune system. In controlled doses, it stimulates the organism to produce antioxidant enzymes, such as glutathione peroxidase and superoxide dismutase, essential for neutralizing free radicals, also leading to a reduction in pro-inflammatory mediators such as tumor necrosis factor (TNF-alpha) and interleukins, protecting tissues against oxidative stress generated by intense exercise and inflammatory conditions (JARAMILLO et al., 2020).

Due to its ability to spread to tissues, causing vasodilation of the arterioles, there is an increase in blood flow to the tissues and greater availability of nutrients, which causes ozone to react with lipid components of cell membranes, generating peroxide products that trigger a series of biochemical and cellular responses. (OLIVEIRA, 2007)

Regarding its administration, this can be carried out in several ways, with different forms of application depending on the animal's clinical condition, aiming to maximize the therapeutic benefits of ozone, adapting to the specific treatment need and the type of injury or condition (BASILE & BACCARIN, 2022).

One of the application techniques is rectal insufflation, a non-invasive and easy-to-administer technique that allows the absorption of ozone through the intestinal mucosa, where it enters the bloodstream and is distributed throughout the body. This method is effective for systemic conditions, especially for inflammatory diseases and general recovery (BASILE & BACCARIN, 2022).

In the study carried out by JARAMILLO et al. (2020), the effect of transrectal application of O₃ in 16 healthy horses was evaluated, taking into account the parameters of physical and laboratory evaluation, and production of reactive oxygen species (ROS). Some of the animals were assigned to the control group (CG), receiving 1L of oxygen transrectally, and the other group treated with O₃ (GT), treated with 1L of the oxygen and ozone mixture rectally. While the CG showed no changes in the exams, in

the GT an increase in the number of red blood cells, in the hemoglobin concentration, and in the hematocrit values was identified in relation to the basal values and CG. Demonstrating that the use of O₃ led to changes in erythrocyte values and improvement in the rheological properties of the blood, proving to be a safe technique that can indirectly improve oxygenation and metabolism of tissues. (JARAMILLO et al., 2020)

Another study, this time carried out by Alves et al., (2004) on the effects of ozone therapy on intestinal reperfusion injuries in horses, indicated that ozone can play a significant protective role in the initial phase of reperfusion. A reduction in epithelial detachment, neutrophil infiltration and hemorrhage in the mucosa was observed, in addition to a decrease in edema and neutrophil infiltration in the submucosa. The authors point out that this was due to the ability of ozone to modulate antioxidant enzymes and neutralize free radicals formed in the reperfusion phase. Thus, the biochemical action of ozone, possibly linked to its antioxidant capacity, reduces tissue and inflammatory damage associated with oxidative stress during reperfusion.

Another technique is autohemotherapy, where a blood sample is taken from the animal itself and enriched with ozone before being reinfused into the body (BASILE & BACCARIN, 2022). The aim is to stimulate a more effective immune response and increase blood oxygenation, especially benefiting horses that need systemic support to recover from illness or injury. Autohemotherapy has shown potential in reducing inflammatory processes and improving the overall immune response (SILVA et al., 2019).

SILVA et al. (2019) points out that this process can be carried out in two ways:

- Major autohemotherapy: In this method, blood is removed and treated with ozone, and then reinfused into the animal intravenously. This technique is used to enhance tissue oxygenation and stimulate therapeutic responses, such as tissue regeneration and immune response.
- Minor autohemotherapy: Similar to major, but the reinfusion of ozone-treated blood is done intramuscularly instead of intravenously. This approach also aims to improve oxygenation and the body's response.

The next technique applied is the inhalation of ozonated gases, used especially in some cases of respiratory diseases, as it disinfects and reduces the microbial load in the respiratory tract. However, ozone inhalation should be applied with caution, as, in inadequate concentrations, it can

irritate the respiratory tract and worsen local inflammation (BASILE & BACCARIN, 2022) .

There is also the application of ozonated oil, where ozone is dissolved in vegetable oils, forming a solution that is applied directly to the affected areas, such as skin lesions, superficial infections and open or chronic wounds, promoting healing and protecting against bacterial and fungal infections (PETEOACĂ et al, 2020).

The last method is called bagging , because the injured limb or area of the horse is wrapped in a plastic bag, where the ozone is concentrated, so that the gas is in direct contact with the affected area, which allows it to act deeply in the tissue, benefiting localized injuries, such as ulcers and wounds that require antibacterial and healing action (PRADO et al, 2020).

In a study carried out by PRADO et al. (2020) in a horse presenting an infected wound, anti-tetanus treatment and antibiotic therapy (procaine benzylpenicillin) were administered for 5 days, intramuscularly. The wound was treated with the application of ozonated oil daily and once a week, a " bagging " procedure was performed, using a plastic bag wrapped around the wound area and an ozone source (O₃) at a concentration of 60 mcg/ml was inserted for 10 minutes, using an ozone generator, over 5 weeks. After treating the horse with ozone therapy, positive results were observed, including the reduction of granulation tissue and wound healing. The use of ozone therapy as a single therapeutic protocol resulted in rapid and adequate healing, without secondary contamination and with less appearance of exuberant granulation tissue (PRADO et al, 2020)

Ozone therapy protocols vary according to the horse's health problem and the method of application. For respiratory conditions, for example, rectal insufflation is applied once or twice a week, with doses adjusted to the animal's weight. In musculoskeletal injuries, subcutaneous injection is applied in weekly or biweekly sessions, depending on the severity of the injury. For chronic wounds, topical application can be done daily or every other day until complete healing (RODRIGUES, 2022)

It is also observed that these forms of application make the treatment adaptable and effective for different conditions, favoring natural recovery and reducing the need for conventional drug treatments. (PRADO et al, 2020; RODRIGUES, 2022) .

In the treatment of a puncture wound in a horse's hoof by Flamia and Wilmsen (2021), a therapeutic approach was performed that combined systemic and topical interventions over 90 days. Systemic treatment included intramuscular administration of 2% meloxicam (10 mg/kg) daily for seven days to control pain and inflammation, and a single dose of trichlormethiazide and dexamethasone (10

mg/kg), also intramuscularly. In parallel, topical ozone therapy with ozonated sunflower oil was applied.

The authors observed an excellent healing process throughout the period, without the formation of exuberant granulation tissue, an effect that highlights the role of ozone therapy in promoting dynamic and controlled healing, essential for areas of high mobility such as the hoof and heel. Additionally, the combination of ozone therapy methods, such as the use of ozonated oil, the " bagging " method and ozone autohemotherapy, proved to be efficient in avoiding common complications, such as excessive accumulation of granulation. The animal's physiological response to the injury was thus enhanced by the integrated approach between ozone therapy and systemic anti-inflammatories (Flamia and Wilmsen , 2021).

After 9 weeks of treatment, wound remodeling was noted, with healing occurring without the presence of exuberant granulation tissue. Wound evaluation throughout treatment showed the beginning of asymmetric growth at the edges of the lesion, with a pink/reddish coloration, indicating progress in healing. Furthermore, the combination of different ozone therapy techniques demonstrated beneficial effects on wound regeneration, suggesting that these approaches may contribute to the development of new therapeutic protocols for equine wounds (Flamia and Wilmsen , 2021).

Furthermore, despite the positive evidence regarding the use of ozone therapy, some authors cite some necessary precautions that the professional must take in the application process, being indicated especially as a complementary therapy and not just a main therapy, due to the potential associated risks. For TONIM et al., (2024) ozone therapy should be considered as a complementary therapy within a broader treatment protocol.

In the study by Pliego et al. (2023), the use of ozone therapy in the treatment of a mare with cutaneous habronemiasis demonstrated some therapeutic limitations, especially due to excessive ozone applications. The protocol included daily cleaning with ozonated serum, application of ozonated oil and six sessions of intralesional ozone , in addition to ointment with dexamethasone and bandages. Although the objective was to stimulate healing and reduce the lesion, the results showed that, after 30 days, there was no significant reduction in the affected area, and surgical intervention was recommended to remove the compromised tissue. An increase in epithelial desquamation was also observed, which hindered the healing process, possibly due to repeated exposure to ozone, which may have caused excessive irritation of the tissue and aggravated the local inflammatory response.

glutamyltransferase levels and causes a slight decrease in glucose concentration, making it important to monitor blood glucose levels in animals during its administration. These reports show that despite the indications, it is necessary to have well-measured guidelines and protocols for the application of ozone therapy, avoiding the risk of adverse effects that compromise the animal's recovery.

III. FINAL CONSIDERATIONS

As noted in the article, ozone therapy has proven to be a promising alternative in the treatment of horses, both due to its effectiveness and its minimally invasive nature, thus serving as a therapeutic option that prioritizes animal welfare. In the studies analyzed, it was possible to verify that the antimicrobial, antioxidant and anti-inflammatory properties of ozone favor its management in various clinical conditions such as inflammatory problems, wounds, respiratory problems and others.

Thus, this study contributes to a broader understanding of the possibilities and limitations of ozone therapy, indicating that, with additional advances in research and well-established protocols, this technique could consolidate itself as an effective and reliable therapeutic method in equine veterinary medicine.

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