

Effects of oleoresin capsicum on horses used in public security

Page 1 a 9

[*Efeitos do Oleoresin Capsicum sobre equinos empregados na segurança pública*]

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ABSTRACT

The effects of the Oleoresin Capsicum (OC) spray used by police forces to control civil disturbances are widely known and extensively described in numerous scientific articles regarding humans. However, with the advent of animal welfare concepts, the question arises as to whether horses exposed to OC in such events would experience the same effects described in humans. The objective of this study was to determine if Mounted Police horses exposed to OC exhibit the same symptoms described in humans. In this study, 18 healthy horses from the Military Police of Paraná, without a history of respiratory disease, were led through a cloud of gas created using six pepper spray dispensers. Physiological parameters including respiratory rate, heart rate, rectal temperature, and conjunctival color were evaluated 24 hours before exposure, 30 minutes, and 24 hours after exposure. Blood samples were collected for a complete blood count and blood gas analysis, and samples of the ocular mucosa were obtained using sterile swabs. Analysis of these parameters did not reveal effects analogous to those described in humans. The absence of ocular changes is directly correlated with the primary decontamination method in humans, which involves running with open eyes to allow the air to act against them. In the case of horses, the movement of their eyes while walking at an average speed of 6km/h in a walk and 18km/h in a trot generates airflow throughout the entire body of the animal. Additionally, pieces of tack and parts of the rider's body form a barrier against the action of the OC agent by reducing the contact area. After 30 minutes and 24 hours post-exposure, no aggressive effects like those found in humans in the airways and ocular mucosa were observed.

Keywords: horse, mounted police, oleoresin capsicum, tear gas

RESUMO

Os efeitos sobre seres humanos do spray Oleoresin Capsicum (OC) utilizado pelas forças policiais no controle de distúrbios civis são amplamente conhecidos e largamente descritos em numerosos artigos científicos. No entanto, com o advento dos conceitos de bem-estar animal, levanta-se a questão se equinos expostos ao OC em tais eventos sofreriam os mesmos efeitos descritos em seres humanos. O objetivo deste estudo foi determinar se cavalos da Polícia Montada expostos ao OC apresentam os mesmos sintomas descritos em seres humanos. Neste estudo, 18 cavalos da Polícia Militar do Paraná, saudáveis e sem histórico de doença do trato respiratório, foram conduzidos por uma nuvem de gás criada a partir do uso de seis espargidores de spray pimenta. Os parâmetros fisiológicos de frequência respiratória, frequência cardíaca, temperatura retal e coloração das mucosas foram avaliados 24 horas antes da exposição, 30 min e 24 horas após a exposição. Amostras de sangue foram coletadas para realização de hemograma completo e hemogasometria, e amostras da mucosa ocular foram obtidas por meio de swabs estéreis. A análise desses parâmetros não revelou efeitos análogos aos descritos em seres humanos. A não manifestação de alterações oculares está diretamente correlacionada com a forma primária de descontaminação em seres humanos, que é correr com os olhos abertos a fim de permitir a ação do ar contra os olhos. No caso dos equinos, o deslocamento deles, no andamento ao passo, em uma velocidade média de 6km/h, e ao trote, em uma velocidade média de 18km/h, gera um fluxo de ar em todas as partes do corpo do animal; além disso, peças de selaria e partes do corpo do cavaleiro formam

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uma barreira contra a ação do agente OC, diminuindo, dessa forma, a área de contato. Após 30 minutos e 24 horas depois da exposição, também não foram observados efeitos agressores análogos aos encontrados nas vias aérea e conjuntivas oculares em seres humanos.

Palavras-chave: cavalo, policia montada, oleoresin capsicum, gas lacrimal

INTRODUCTION

Humanity and horses have a long-standing relationship since the early domestication of animals (Primo, 2013), with horses playing a significant role in major historical achievements (Mattosinho, 2017).

While horses have primarily been used as a means of transportation for many centuries, they have also found their way into other areas, including leisure activities, various sports disciplines, and even therapy for patients with disabilities or limitations (Leschonski *et al.*, 2008). Another area where horses have been employed for a long time is in public security, where these animals possess unique characteristics such as great mobility across diverse terrains (Bondaruk, 2005). Given this demand, it is increasingly necessary to develop actions that ensure these animals are maintained in a perfect state of health. When a horse is in good health, it responds better to commands from the professionals in public security who handle them, and studying the effects of certain products on horses allows for a better understanding and approach focused on animal welfare. It also improves safety aspects for the police officers responsible for the horses during real situations. Any identified harmful effects can be further studied with the goal of minimizing them.

To prevent acts of vandalism and ensure the free right to peaceful expression of public opinion, security forces employ various instruments, including horses, primarily for discouraging violent actions and dispersing crowds, rather than for detention or confinement. However, horses are occasionally exposed to another instrument of civil disturbance control known as chemical vaporizers.

These chemical agents are vaporized into the air through special processes and cause a range of instantaneous and non-permanent psychophysiological effects in humans. The non-lethal component technically known as Oleoresin

Capsicum (OC), popularly referred to as pepper spray, is commonly used (Viala, 2005).

Oleoresin Capsicum (OC) is a toxic derivative extracted from chili peppers, and a synthetic variant known as Pelargonic Acid Vanillylamide (PAVA) has been produced.

Pepper spray is a type of tear gas and inflammatory agent that causes irritation to the eyes in humans, sometimes leading to temporary blindness. It primarily affects the oral, nasal, and ocular mucous membranes, eliciting physiological responses such as temporary blindness, tearing, disorientation, shortness of breath, and asphyxia (Razuk and Renata, 2020). Due to its low aggressiveness, OC-based pepper spray, used for self-defense, was the only product authorized for unrestricted trade in the United States, specifically in the state of New York, following relevant legislation (Recer *et al.*, 2002).

The main objective of pepper spray is to temporarily incapacitate humans with minimal harm. This effect is achieved because capsinoids cause pain by stimulating the vanilloid receptor, a molecular integrator of potentially harmful stimuli (Razuk and Renata, 2020).

Capsaicin causes intense pain and neurogenic inflammation when exposed to human skin and eyes (Omega, 2000). Additionally, when the spray reaches the eyes, it causes changes in the conjunctiva and cornea, along with punctate epithelial erosions that can be caused by both the solvents present in the spray and capsaicin itself (Vesaluoma, 2000).

The effects of chemical agents on humans are reasonably well-known, particularly regarding ocular and oral mucosa, as well as the upper respiratory tract (Sidell *et al.*, 2008). These effects are attributed to the muscarinic effects acting on the parasympathetic system and the nicotinic effects acting on the somatic and

sympathetic systems (Colasso and Azevedo, 2012)

The responsibility for the well-being of equines employed in Public Security lies with the ethical posture expected from the police officers, from minimal exposure to possible chemical agents to the actions to be taken until veterinary professionals arrive with specific protocols. From this perspective, public agents are responsible for the welfare of the animals and, for deontological reasons (Valla, 1998), should preserve the integrity of the animals involved in policing activities, aligning with the concept of animal welfare that is currently prevalent. When evaluating animal welfare, individual variations in responding to the adversities caused by these effects on animals must be considered (Valla, 1998).

This study aims to determine if the effects observed in humans from the chemical agent known as pepper spray also occur in horses.

This study was approved by the Ethic OC Committee for Animal Use of the College Gospel of Paraná (protocol n°. 004476/2012).

MATERIALS AND METHODS

In this experiment, 16 horses and 2 mares with an average weight of 455 kilograms and an average age of 7.5, belonging to the Brazilian Show Jumping (BH) and Mixed Breed (SRD) breeds, from the horse herd of the Mounted Police Regiment "Coronel Dulcídio" (RPMon), were used for mounted policing activities. These animals undergo training from the moment they are acquired by the Military Police of Paraná for activities related to law enforcement and public order restoration.

The animals were exposed to OC within the premises of RPMon, specifically in the training arena. The area was delimited by a 10-meter-wide by 15-meter-long quadrilateral indicated by cones at the corners, connected by striped bands used to isolate crime scenes. This formed the corridor through which the animals were led. The weather conditions were favorable, with a sunny day in winter, starting at a temperature of 18°C and reaching 20.2°C by the end of the experiment, with no precipitation before or after the experiment. The animals were led through

the OC cloud as soon as the spray devices were activated, walking at an average speed of 6km/h in a walk, and immediately after passing through the cloud, they were led back through it at a trot.

The clinical parameters of the animals were evaluated 24 hours before exposure, and venous blood samples were collected for complete blood count, arterial blood samples for blood gas analysis, and conjunctival samples using sterile swabs. The same protocol was repeated 30 minutes and 24 hours after exposure.

The 30-minute time point was chosen to avoid accidents during the collection of ocular samples with swabs and to allow for a greater cumulative effect of the product on the animals.

The experiment used pepper spray dispersers, popularly known as pepper sprays, manufactured by Condor Non-Lethal Technologies, model PR-125 PROFESSIONAL1, with Oleoresin Capsicum (OC) as the active ingredient. The sprays were activated in an open outdoor space as recommended by the manufacturer.

The experiment took place in the training arena of the Mounted Police Regiment "Coronel Dulcídio" of the Military Police of Paraná. A rectangular space measuring 10 meters wide by 15 meters long was delimited. Police officers with pepper sprays were positioned every 5 meters on both sides of the arena, starting from where the dispersers were activated. This formed a cloud, and the animals were mounted through the cloud in the first pass at a walk and then returned at a trot, simulating a real-life deployment situation.

After sample collection, the horses were evaluated for signs of irritation in the oral, nasal, and ocular mucous membranes, as well as changes in respiration, heart rate, and the presence or absence of skin irritation on the face, forelimbs, neck, and trunk.

Statistical analysis of the data was performed using the PAST 4.03 software, with Shapiro-Wilk test for normality, Turkey's test, and a significance level of 0.05. The results did not show significant changes between the evaluated time points.

The clinical examination included evaluation of heart rate, respiratory rate, capillary refill time, rectal temperature, skin turgor, evaluation of abdominal quadrants, and coloration of ocular and oral mucosa (Speirs, 1999).

For complete blood count analysis, venous blood samples were analyzed using the Celldyn 1400² equipment.

Arterial blood samples for blood gas analysis (Speirs, 1999) were collected in heparinized syringes (Procedures..., 2004). Immediately after collection, the samples were placed in a support rack inside a styrofoam box measuring 22 centimeters in length, 14.5 centimeters in width, and 16 centimeters in height, with 1.5-centimeter-thick walls. The box was filled with cold water to a height of 4 centimeters, and ice cubes were added on the inside to preserve the samples. After the samples were properly stored, they were sent to the laboratory located in the Veterinary Center of the Military Police of Paraná, where the RapidLab 348³ equipment was used. The blood samples for blood gas analysis and complete blood count were sent in groups of six, allowing for the entry of samples into the laboratory every fifteen minutes. Gasometry samples were analyzed before the samples for the complete blood count.

Samples of ocular mucosa were collected using sterile swabs moistened with physiological solution.

After collection, smears were made on slides and left to dry at room temperature. They were then fixed with methanol and stained using the May-Grunwald-Giemsa (MGG) method. After this step, the slides were subjected to microscopic analysis to search for allergic effects (presence of eosinophils) resulting from exposure to OC. More than 10 homogeneous and non-overlapping fields were counted during the microscopic analysis.

The findings included mucus filaments, keratinocytes, cocciform cells, the presence of neutrophils, and cellular debris. No microorganisms or eosinophils were found.

The data of clinical exams, CBC, blood gas and ocular mucosa were subjected to a statistical

analysis using PAST 4.03, with Shapiro-Wilk test for normality and a significance level of 0.05. The multi-level comparison of TUKEY's was used to compare the moments.

CASUISTRY

In the present study, no clinical signs were observed in horses similar to the symptoms observed in humans exposed to *Oleoresin Capsicum* under conditions simulating real application, such as chest pain, signs of discomfort or stress, skin and mucous membrane irritation, lignification, tearing of the eyes, temporary blindness, epiphora, blepharospasm, photophobia, nasal discharge, burning sensation, edema, disorientation, shortness of breath, asphyxia, difficulty breathing, coughing, and diarrhea.

RESULTS

The results of the complete blood count (Table 1), blood gas analysis (Table 2), and ocular mucosa (Table 3) did not show statistically significant alterations in the pre-exposure, 30 minutes, and 24 hours post-exposure periods.

In humans exposed to OC, aggression to the eyes and respiratory system are observed. Eye-related symptoms include pain, blepharospasm, photophobia, conjunctivitis, diffuse conjunctivitis, periorbital edema, eyelid erythema, tearing, hyphema, uveitis, necrotizing keratitis, symblepharon, secondary glaucoma, cataract, traumatic optic neuropathy, and vision loss. In the upper and lower respiratory tract, humans may experience a burning sensation in the nose, chest pain, throat irritation, sporadic breathing, dyspnea, coughing, sneezing, and difficulty breathing (Schep *et al.*, 2015). However, such manifestations in the studied systems were not observed in horses exposed to the product.

Regarding hematological and blood gas data, no statistical differences were found indicating changes in the three sample collection moments. The statistical results for the cellularity of the ocular mucosa did not show significant changes in the three evaluated time points.

Table 1. Mean, standard deviation, and variance of blood counts of horses subjected to OC exposure

Parameter	Control	30 minutes	24 hours after
Erythrocytes	7.83±1.05 ^a	7.06±1.14 ^a	6.97±1.13 ^a
Hematocrit	38.45±4.79 ^a	34.57±5.33 ^a	32.98±5.32 ^a
Hemoglobin	15.13±2.19 ^a	13.83±2.18 ^a	13.27±2.20 ^a
MCV	48.33±1.86 ^a	48.50±1.76 ^a	47.33±1.86 ^a
MCH	18.85±0.67 ^a	19.42±0.43 ^a	19.02±0.47 ^b
MCHC	35.78±8.18 ^a	40.02±0.83 ^a	40.22±0.92 ^a
Leukocytes	11066.67±1009.29 ^a	11200.00±613.19 ^a	10233.33±937.37 ^a
Segmented	64.00±8.99 ^a	60.00±8.85 ^a	61.00±6.03 ^a
Lymphocytes	30.17±10.93 ^a	30.33±10.61 ^a	32.67±7.76 ^a
Monocytes	1.33±1.21 ^a	4.00±3.10 ^a	1.67±0.82 ^a
Eosinophils	3.67±2.34 ^a	4.67±3.93 ^a	4.67±3.01 ^a
Basophils	0.83±1.17 ^a	1.00±1.67 ^a	1.00±0.00 ^a
Platelets	280166.67±51378.66 ^a	221500.00±57204.02 ^a	220500.00±47911.38 ^a

Table 2. Mean, standard deviation, and variance of the Blood Gas Analysis of horses subjected to OC exposure

PARAMETER	CONTROL	30 MIN.	24 HOURS
Ph	7.52±0.03 ^a	7.48±0.09 ^a	7.51±0.03 ^a
pCO ₂ (mmhg)	42.13±4.21 ^a	40.65±11.11 ^a	41.12±1.93 ^a
pO ₂ (mmhg)	103.77±17.35 ^a	92.50±30.75 ^b	100.45±17.01 ^a
HCO ₃ (mmol/L)	33.60±2.82 ^a	29.43±9.50 ^a	32.12±1.82 ^a
O ₂ %	97.97±0.94 ^a	96.42±2.64 ^a	98.30±0.85 ^a
CO ₂ CT(mmol/L)	34.87±2.89 ^a	30.58±9.72 ^a	33.38±1.81 ^a

Table 3. Mean, standard deviation, and variance - ORAL MUCOSA exposed to OC

Parameter	Control	30 minutes	24 hours after
Cellularity	106.00±0.00 ^a	105.83±1.47 ^a	104.50±1.52 ^a
Mucus filaments	106.00±0.00 ^a	107.00±1.67 ^a	105.17±2.48 ^a
Keratinocytes	106.00±0.00 ^a	106.00±0.00 ^a	106.00±0.00 ^a
Neutrophils	106.00±0.00 ^a	106.00±0.00 ^a	106.00±0.00 ^a
Lymphocytes	106.00±0.00 ^a	107.00±1.10 ^a	107.67±0.82 ^a
Monocytes	106.00±0.00 ^a	106.00±0.00 ^a	106.00±0.00 ^a
Eosinophils	106.00±0.00 ^a	106.00±0.00 ^a	106.00±0.00 ^a
Microorganisms	106.00±0.00 ^a	106.00±0.00 ^a	106.50±1.22 ^a
Cellular debris	106.00±0.00 ^a	106.33±3.14 ^a	105.67±2.58 ^a

DISCUSSION

The clinical parameters such as heart rate, respiratory rate, capillary refill time, rectal temperature, skin turgor, coloration of the oral mucosa, coloration of the ocular mucosa, and evaluation of abdominal quadrants did not show any significant changes during the evaluated time periods. Similarly, clinical signs analogous to the symptoms observed in humans were not found in the equines exposed to OC.

In humans exposed to OC, skin irritation and/or lighnification are commonly observed, which was not observed in the horses. The thick coat of hair in horses provides them with strong protection against OC, as compared to humans. This protection is expected to be greater if exposure occurs in winter, as in this climatic season the hair of horses is thicker than normal. Additionally, the use of equestrian equipment such as saddle and bridle provide additional protection, especially on the back region. Furthermore, the body of the mounted police

officer, particularly the legs, acts as a barrier, reducing the contact of the agent with the horse.

One of the ways to mitigate the effects of OC on human eyes is to run against the wind, which allows the contact of the eyes with air and helps remove the chemical agent. In the experiment, the horses moved from a walking pace to a trot, which has an average speed of 18 km/h, creating a significant airflow that reaches all the areas of contact with the product, including the skin, eyes, and nasal and oral mucosa (Colassoa and Torres, 2019; Duarte *et al.*, 2022).

Although the horses did not use Personal Protective Equipment (PPE) such as face guards or face noise and chest guards in this study, horses used for dissuasion purposes in operations of Restoring and Maintaining Public Order (RMPO) should be equipped with such gear (Figure 1). These protective equipment items offer important protection for the skin and eyes of horses, aligning with the fundamental principles of animal welfare and ethical considerations.



Fonte: J.Cacciatore (2023)

Figure 1. Face guard and Chest guard.

Chemical agents can induce ocular allergic reactions in horses (Scarabelli, 2018), but such reactions were not observed in the experiment. This observation is directly correlated with the fact that the horses were in constant motion during the exposure to the product. Additionally, it is important to note that the animals did not make use of PPE during the experiment, which is mandatory for horses in real-life situations and

provides significant protection for the eyes of the animals (Fig. 1). Unfortunately, such equipment is not mandatory in some police corporations.

After leaving the experiment area, the horses did not show any signs of disorientation or lack of coordination in their movements, as evidenced by their ability to walk at a normal pace to the location where the tack (saddle, pad, and bridle)

was removed. Subsequently, they were led without being mounted to the site for sample collection. The horses used in the experiment resumed their police duties only after 48 hours.

No significant variations in eosinophil counts were observed, indicating no allergic manifestation due to OC exposure (Ivester, 2013). The blood count did not show an increase in neutrophils or lymphocytes, indicating no response to stimulation from the exposure to the chemical agent.

In humans, the irritating effects of OC usually begin within 20 to 60 seconds after exposure and disappear within approximately 30 minutes. However, other effects such as rhinorrhea, salivation, photophobia, cough, and respiratory impairment may persist for up to 24 hours (Schep *et al.*, 2015). To verify if such effects would occur in horses, the animals were evaluated at 24 hours before exposure, 30 minutes after exposure, and 24 hours after exposure.

Another piece of evidence supporting the fact that the animals did not develop any allergic processes is the low quantities of mast cells and basophils found at different time points (Wagner, 2016).

Blood gas analysis is the preferred examination for evaluating pulmonary function and respiratory disorders (Day, 2002). In animals exposed to OC, no clinical signs of transient acidemia such as tachycardia and hypoventilation due to pCO₂ alteration (Kowal, 2008) were observed, and there were also no alterations in pH values (Silva, 2013), which remained unchanged during the analyzed exposure periods.

No changes in mast cells and basophils were found in the evaluation of cellularity in the ocular mucosa, demonstrating that the dermatological effects observed in humans do not occur in horses exposed to the product.

Chemical agents can induce ocular allergic reactions in horses (Scarabelli, 2018), but horses exposed to OC did not present ocular alterations in clinical signs analogous to the symptoms observed in humans (Sebastião, 1988).

Other clinical signs such as ocular lesions like epiphora, blepharospasm, photophobia, corneal edema, conjunctival hyperemia, and miosis were also not observed in the exposed horses.

The limitations of the experiment were related to the number of horses due to their large size, despite the valuable data obtained.

Another limiting factor was the impossibility of performing a biopsy on the ocular mucosa, as it would compromise the subsequent evaluations at thirty minutes and twenty-four hours. The biopsy procedure would cause local edema formation. Additionally, the chemical agent was dispersed in an open environment according to the manufacturer's recommendations, simulating a real-life situation, which reduces its concentration.

In addition to the limiting factors mentioned above, the presentation of the product and the manner in which it is designed to be used in directed jets at targets up to 1.5 meters away is a limiting factor. This design does not allow for saturation of the area in the same way as the vaporization effect of a tear gas grenade, specifically o-chlorobenzylidene malononitrile (CS).

After analyzing the results obtained, it can be concluded that horses exposed to OC gas, using Pepper Spray PR-125 model, in an open environment according to the manufacturer's recommendations, and exposed in a situation simulating a potential real-life deployment, such as crossing through a dispersed OC cloud, did not exhibit the effects found in humans. Furthermore, OC exposure was not a stressor for horses trained for public safety.

CONCLUSION

Based on the obtained data, no effects of exposure to Oleoresin Capsicum (OC) in spray presentation were observed in horses when exposed in simulated situations. Furthermore, no signs of discomfort like those observed in humans were observed.

The results did not identify skin aggressions in the animals due to the protection provided by saddlery equipment, the natural barrier formed by their hair, and the thicker skin of horses

compared to humans, which protects against the action of Oleoresin Capsicum.

Regarding the conjunctivae, no changes in their cellularity were observed because the simulated use, forming clouds, did not provide a sufficient concentration or an equivalent distance of the recommended activation of 1.5 meters. It should be noted that in the experiment, the animals were not wearing the mandatory personal protective equipment known as face nose or face guard (Image 1), which provides extra eye protection for horses. This equipment is used in situations of restoring and maintaining public order.

Another contributing factor is the way the product is used, where it should be activated against the target at 1.5 meters in a straight line. Additionally, the spray trajectory descends after reaching 1.5 meters from the target, compromising the product's effectiveness.

Far from exhausting the topic, further experiments can be conducted to investigate the effects of OC on the lower airways through bronchoalveolar lavage. Moreover, the effect of OC on dogs used in public safety can be studied, aiming to provide more ethical and technical guidelines for the application of these animals in public safety within the framework of Animal Welfare.

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Effects of oleoresin...

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