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Irritants of the respiratory airways in a rabbit: gaseous ammonia and ozone

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Air pollutants such as ammonium fumes and ozone irritate the respiratory airways of rabbits. They can lead to breathing difficulties, eye irritation, and a long recovery after exercise.

Summer weather may become a source of many problems. High temperatures and humidity favor the growth of parasites that can transmit serious diseases to animals and humans. Luckily, these unwanted guests can be effectively controlled nowadays by treating farm animals and pets. The return of summer temperatures is also

Figure 1: Pollution alert !!! Yara, a female rabbit aged 7 years, coughs and produces a nasal discharge as soon as air concentrations of ozone are elevated.

Figure 2: Brachycephalous animals are particularly sensitive to air pollutants. Here, Iden, a female French bulldog aged 1.5 years old.

accompanied by an increase of air pollutants, ozone, gaseous ammonia, and ammonium nitrate, produced by the contact of the previous two. All three affect the health of human beings, but are also responsible for the health deterioration of animal and plants. Animals suffering from cardiac or respiratory problems, which are brachycephalous (shortheaded) or older animals are particularly affected (Figures 2, 3). Typical clinical signs include increased rates of respiration during exercise, difficult or noisy breathing sometimes accompanied by cyanosis of mucous membranes, or a runny nose. Recovery after a physical effort can take a long time.

Gaseous ammonia

Gaseous ammonia (NH_3) is a toxic and dangerous - even deadly, gas. As it is heavy, it spreads at ground level. Ammonia is produced by bacteria present in the hay litter; they decompose urea contained in the urine. Urea derives from protein degradation. Thus, the higher the levels of proteins in the food, the higher will be the excess of nitrogen and amino acids. Both will be converted into urea in the liver and, to a lesser extent, in the kidneys prior its excretion with the urine. The amount of urea that will be eliminated by the body is proportional to the amount of water that a rabbit will drink: higher urea concentration lead to increased drinking and to the production of higher volume of urine. Evaporation of the water contained in the urine contributes to an increase of the ambient humidity. Thus, when urine contains a lot of urea, the percentage of air humidity will increase, which contributes to an increase in the rate of gaseous ammonia in the ambient air.

Ammonia intoxications are more frequent during the summer than in winter.

Figure 3: Short nosed cats, here Larousse, a cat of Persian breed, may also suffer from respiratory problems related to air pollutants

Ammonia is transformed into ammonium nitrate in the presence of ozone. This molecule has strong oxidizing properties and, thus, is a strong irritant of the respiratory airways.

Clinical manifestations

Clinical signs depend on the concentration of NH_3 gas in the air and the length of exposure. They include headache, loss of appetite and respiratory problems in humans. In rabbits, the first signs include:

- Irritation of the cornea, inflamed eyelids and tearing,
- Sneezing, snoring and nasal discharge,
- Fever.

If the problem is not treated, the mucous membranes of the pharynx, trachea and bronchi will become irritated and severe diseases of the lower respiratory tract (rhinitis, pneumonia) may develop. Indeed, NH_3 is quickly absorbed by the mucosa and the cells lining the respiratory system, after which they are transformed into molecules with harmful alkaline properties. The destruction of the respiratory mucociliary barrier, which protects the lungs against pathogen invasions, helps colonization by bacteria such as *Pasteurella multocida* or *Bordetella bronchiseptica*. At this stage, rabbits may develop an acute form of the disease, with breathing difficulties and occasional coughing. They become anorexic, depressed and present shortness of breath, dyspnea or mouth breathing, and cyanosis (discoloration of the tongue, gums due to lack of oxygen in the blood), fever and may be hypothermic. At this stage, the disease is difficult to treat and often becomes chronic even when the rabbits are transferred to a clean and well ventilated environment.

Neutralization of the gaseous ammonia

In addition to a good aeration without draft and a good hygiene, different methods help prevent or reduce the amount of gaseous ammonia in the rabbit's living environment:

- Wheat straw and kenaf fibers (*Hibiscus cannabinus*) are litters with high absorbency properties. Diatomaceous earth or clinoptilolite based products mixed to straw litter furthermore increases the absorbency capacities of the litter. Moisture is reduced, limiting bacterial growth and, thereby, the production of gaseous ammonia.
- Wet and dirty manure must be regularly removed from hutches and litter boxes of pet rabbits should be regularly cleaned.
- Sources of humidity should be eliminated, e.g. leaking drinking bottles, or pits filled with liquids.

Urine stains on wood or rugs can be eliminated by absorbing the excess urine with paper towels. Vinegar is then poured on the stained spot. After 10 minutes, the excess liquid is absorbed with paper towels and the stain is sprinkled with baking soda. After another 15 minutes, the powder is removed with a vacuum cleaner. The odor should have gone after this treatment.

Impact of ozone pollution

Ozone (O_3) is a form of gaseous oxygen with highly oxidizing properties. Its production in the highest atmosphere layers is the result of sunlight. Here, ozone plays a protective role of life, filtering ultraviolet rays (UV). In the lower layers of the atmosphere (troposphere), ozone is the main pollutant of summer smog and is harmful to living beings. The formation of ozone is the result of the ionizing action of sunlight on other precursor pollutants:

- Nitrogen oxides resulting from heavy industry, power plants and motor vehicles.
- Hydrocarbons - from industrial activities, petroleum reservoirs and cars.

In the Northern Hemisphere, ozone is present in growing concentrations in the lower layers of the atmosphere between May and September. This is the consequence of elevated air temperatures, strong sunlight and stagnant weather conditions. Therefore, ozone in the air is stagnant and its concentration increases in both urban and rural areas.

Ozone is an aggressive and irritating gas when it is into contact with tissues of living organisms - plants and mammals. High atmospheric ozone concentrations lead to oxidation reactions, tissue necrosis and impaired growth in plants. In animals, ozone travels deep into the respiratory system. It causes inflammation of the respiratory mucosa and lungs, a decrease in gas exchanges as well as the destruction of the mucociliary barrier, which protects against pathogens, toxic molecules or inhaled allergens. Excessive secretion of fluids will protect tissues damaged by ozone in the respiratory tract. Ozone also affects respiratory muscles that control the passage of air through the airways and respiration. They become sensitive to changes in humidity, air temperature, the presence of dust and, as a result, they contract. Fluid secretion and muscular contraction can lead to a reduction of the lung capacity in laboratory animals and humans up to 30%, hence temporary respiratory difficulties. Susceptibility to asthma and increased susceptibility to bacterial infections and diseases such as pneumonia or bronchitis are common.

Clinical manifestations

Clinical manifestations observed after a short-term exposure to high concentrations of ozone are difficult breathing, wheezing, dry cough, chest pain during deep inhalations and, rarely, nausea. Some sensitive rabbits develop a transient rhino-sinusitis with purulent nasal discharge (Figures 1, 4).

People or animals suffering from chronic respiratory diseases (bronchitis, asthma, emphysema) that reduce their breathing capacity are particularly sensitive to high levels of atmospheric ozone.

A prolonged exposure to ozone leads to the irreversible loss of lung function and premature aging of lungs. Lung structural changes, decreased capacity of the lungs to fight inhaled pathogens and modifications of immune mechanisms have been observed in animals. The ability of the immune system to fight bacterial respiratory tract infections is decreased. Susceptibility to asthma and bacterial infections by *Pasteurella multocida*

Figure 4: Details of the nose with unilateral serous and mucous nasal discharge that appears as soon as the atmospheric levels of ozone are high.

or *Bordetella bronchiseptica* is increased and diseases such as pneumonia or bronchitis are common

The perverse effect of ozone is that damages of the respiratory system may remain asymptomatic, whereas tissue lesions are well present.

Numerous studies hint that rabbits are also sensitive to ozone pollution and develop identical clinical signs than man. Sensitive rabbits start to sneeze and cough as soon as air levels of ozone increase, then develop a transient rhino-sinusitis accompanied by serous and/or mucous nasal discharge as long as the pollution level remains high.

References

Boucher S, Nouaille L. Maladies des Lapins. Manual pratique. Editions France Agricole. 2002. pp 182-183

Kruckenberg SM, Cook JE, Feldman BF. Clinical toxicities of pet and caged rodents and rabbits. Vet Clin North Am. 1975;5(4):675-84.

Makarenko ON, Skorik LV, Mel'nichuk DA. The characteristics of nitrogen metabolism in the tissues of rabbits with ammonium toxicosis. Ukr Biokhim Zh. 1992; 64(6):105-9.