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A STUDY OF THE INFLUENCE OF ENVIRONMENTAL FACTORS AND THE PREVALENCE OF PASTEURELLOSIS IN RABBITS

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Abstract

We studied the influence of environmental factors on the prevalence and clinical manifestations of pasteurellosis in rabbits of the California and New Zealand breeds over a period of one year. It was found that the minimum temperatures in winter and the maximum in summer were out of the optimal values: 4-7 and 16-18^{O}C, respectively. The relative humidity during most of the year was out of the recommended levels / 60-70% /, both at the average and at the maximum measured values. The concentration of ammonia exceeded the average values by about 16 mg / m³, and the maximum values by about 30 mg / m³. The dust content varied from 0.9 to 6 mg / m³ with average values of 3.6 mg / m³. The total number of isolated microflora in m³ air was 6.83 x 10³ (6.5-7.3 x 10³).Dominant in the biological material and washes / from cages, walls and inventory / were the representatives of Salmonella, Staphylococcus, Streptococcus, Pasteurella and Colibacteria; and from the molds Aspergillus flavus, A. fumigatus, Penicillium, Alternaria and Mucor. Antibodies against Pasteurella multocida were found in 60% of the population. Exacerbation of the disease and higher mortality was observed during pregnancy and during the suckling period. The main complications were - respiratory disorders (51%) followed by inflammation of the conjunctiva. About a quarter of the affected animals (26.4%) suffered from the mixed form of the disease. We found that Inflammation of the ears was extremely rare (0.2%). A relationship has been established between the number of environmental factors and the incidence of respiratory diseases. We can conclude that environmental factors are actively involved in the development, form and severity of pasteurellosis in rabbits.

***Key words**: environmental factors, pasteurellosis, rabbit.*

INTRODUCTION

Rabbits are considered competitors to the other farm animals due to their rapid economic maturity, high fertility and meat of high dietary qualities (Zdanovich et al., 2020; Trubchaninova & Kapustin, 2014). The hygiene has a key role in the successful breeding of rabbits indoors, especially in the case of the intensive technologies.

According to Kumar et al. (2008) the rabbit buildings design is based on the behavioral features of the animals and their reactions to the environmental parameters. The relationships between the temperature, the air velocity and the relative humidity in the premises are the major microclimatic factors which have an influence on the rabbits. (Ogunjimi et al., 2008).

The air pollutants originate from the animals themselves as well as from their feces, feeds and bedding. The process of urine and feces degradation is accelerated at high temperatures (van Praag et al., 2010), and this permeates the air with NH3 and H2S.

Pathogenic bacteria, viruses and fungi are found in the air very often and this leads to health risks for both the animals and the staff (El-Raffa, 2004). The author proposes a hygiene program for breeding of rabbits to be elaborated and implemented, which could be an effective solution ensuring the protection of their health and productivity.

Another problem experienced in rabbit breeding is the prevention of the conditionally pathogenic infections. Their most common representative is *P. multicida* which exhibits a marked tropism towards the respiratory, nervous and reproductive systems (Kluger & Vaughn, 1978) and causes rhinitis, otitis, enzootic pneumonia, conjunctivitis, pyometra, orchitis, subcutaneous abscesses, septicaemias (Flatt, 1974). Data of Morisse (1981), Dincheva & Hristev (1983) show that the agent is isolated in the upper respiratory tract of 46-72% of the rabbits examined. According to Morisse (1981), the respiratory disorders are directly or indirectly responsible for 70% of the economic losses in a herd of meat rabbits. The bad

rearing conditions are the main reason for the contraction and the spread of the disease. The air features which play a key role are the temperature regime, the air humidity, airflow, lighting and the toxic gasses concentration. In general, the rabbits adapt well to the different factors of the barn environment and retain their normal physiological functions.
The aim of the present study is to examine the extent to which the barn environment conditions are responsible for the spread and the clinical manifestation of pasteurellosis in a rabbit farm inhabited by rabbits of the California and New Zealand breeds.

MATERIALS AND METHODS

Subject to the present study were two brick buildings (5 x 9 m) with 50 metal cages each, which were placed in two rows on two levels. The windows were installed on one of the side walls and had a total area of 8.4 m². The number of the animals controlled in the course of one year was 1150. The cages on the first level were at a height of 0.8 m above the floor. The feeding was with a ready-mixed standard feeds. The floor cleaning was dry, 1-2 times a week. The ventilation was natural. The natural light coefficient for the cages on level one was 3, and on level 2-4%.
The tests were carried out once a month around 10-11 o'clock on the level of the cages. Subject to controlling activities were the following: the air temperature- with a manual multi-functional Compact infrared thermometer 105518 with a scope from 50 to + 550ºC and a resolution of 0.1ºC, the relative humidity- with an aspiration psychrometer by Assmann, the air velocity (m/s)- with a catathermometer, the lighting level- with a lux meter PU 150 PRAHA, the ammonia- by means of the titrimetric method with sulfuric acid, and the carbon dioxide- with 'Higitest' test tubes. The air samples were collected following the Matusevich method, and the microflora was differentiated by means of different selective culture media. The dust was evaluated through the Koch's sedimentation method (Hristev, 2008). Apart from air samples, washes and biological material were also used for the bacteriological tests. Immunodiffusion reaction was used for the detection of antibodies in the blood serums. The reaction antigens were provided by NDRVMI Sofia. The blood samples were obtained from the ear vein. The results were processed variationally.

RESULTS AND DISCUSSIONS

Disturbances of the microclimate such as excess or lack of heat, excess humidity, increase of the harmful gases and microorganisms in the air are all reasons for reduction of the resistance which in turn leads to rapid spread of different infections.
According to Regulation 44 (2006), temperature values between 16 and 25°C and humidity between 65 and 70% are considered optimal with reference to rabbits. The average temperatures during our studies (Table 1) were within the accepted range. However, the minimum temperatures, mainly in winter, as well as the maximum ones during the summer exceeded these reference values by 4-7°C, on average. If we consider that the optimal temperature for rabbit breeding is 16-18°C (Pomytko, 1982; Morisse, 1981), then the difference between it and the maximum values reported increases up to 11-12°C. These differences increased mainly during the summer and, according to Dermendzhieva et al. (2017), Ogunjimi et al. (2008), the rabbits were under the conditions of temperature stress.
The heat stress during the summer affects negatively the development of the growing rabbits, their reproductive functions and reduces their resistance to diseases (Marai et al., 2002). The heat stress affects the fertility of the female rabbits as well as the embryonic development and the weight of the embryos. The milk secretion of the mothers is reduced while the mortality in newborns is increased. It is possible that a temporary coital and fertile impotence be observed in male rabbits (Kumar et al., 2008). The construction materials of the renovated conventional building in which the rabbits controlled by us were reared were, in all likelihood, with good heat technology qualities and, therefore, neither very low or below-zero centigrades during the winter, nor very hot ones during the summer were registered.
The relative humidity during most of the year was beyond the recommended references values- 60-70% both with reference to the average and the maximum values reported. If

we consider the reference values of 60-80% cited by Kumar et al. (2008) as the norm, then it could be concluded that the humidity was more often within the accepted parameters than not. The relative humidity exceeded the recommended reference values especially during the winter period and partly during the spring and the autumn. The lack of artificial ventilation impeded the air circulation during the cold days which led to trapping of the excess humidity and a lower temperature. The highest humidity and, at the same time, the lowest air velocity (0.17 m/s) were measured from the end of the working day until the morning of the following day.

Harmful and toxic gases are accumulated as a result of the life activity as well as the feces and urine decomposition processes. Similar conclusion was also reached by Calvet et al. (2011), Da Borso (2016), who also add the absent or misfunctioning ventilation system.

All these set the conditions for the development of intoxication of various degrees as well as decrease of the immunological protection of the rabbits.

During the early morning hours, the ammonia concentration usually exceeded the average values by 16 mg/m³ and the maximum ones- by 30 mg/m³. During our tests, no presence of hydrogen sulfide was ascertained.

The carbon dioxide emitted by the rabbits during breathing as well as a small fraction released during the urine and feces decomposition were within the reference value norms and did not exceed 0.25% even in the maximum values reported.

In older publications it is acceptable that the recommended air velocity in the rabbit buildings exceed the optimal one by 1-2 m/s. However, according to Regulation 44, it must not exceed 0.2 m/s, and the cooling quantity- 5-8 mcal/cm²/s. Kumar et al. (2008) recommend values of 0.3-0.4 m/s at air temperatures from 22 to 25^{O}C. According to Dermendzhieva et al. (2017), the dry cleaning and the high temperatures, especially during the summer, are the main reason for the rapid organic waste decomposition during which the ammonia, accompanied by the hydrogen sulfide, exceed the recommended hygiene norms. The dust content varies in quite wide ranges: from 0.9 to 6 mg/m³ at average values of 3.6 mg/m³. If we take the acceptable indicative dust content in the buildings for most types of animals (0.5-4 mg/m³) into account, then it was within the hygiene norms.

The total number of the microflora isolated in a m³ of air was 6.83 x 10³ (6.5-7.3 x 10³); 6-7 thousand of them were microorganisms and the rest were molds. The representatives of *Salmonella*, *Staphylococcus*, *Streptococcus*, *Pasteurella*, coliform were dominant in the biological material and the washes (from cages, walls and inventory), and the *Aspergillus* (*flavus*, *fumigatus*), *Penicillium*, *Alternaria* and *Mucor* in the molds. Presence of antibodies against *Pasteurella multocida* was detected in 60% of the population.

Table 1. Minimum, average and maximum values of the environmental factors examined

Environmental factors	Minimum	Average	Maximum
Temperature, °C	9.1	20.5±3.6	29.2
Relative humidity, %	62	78.3±8.5	91
Air velocity, m/s	0.17	0.56±0.3	1.8
Cooling value, mj/cm²/s	6.25	9.3±1.2	14.3
Ammonia, mg/m³	32	36.2±2.8	50
Carbon dioxide, vol. %	0.05	0.11±0.04	0.18
Microflora, thousand/m³	6.5 x 10³	6.83±0.5	7.3 x 10³
Dust, mg/m³	0.9	3.6±0.7	6

Having analyzed all data available, we consider that the barn environment factors on one hand, and the age, physiological condition and the overall resistance of the animals, on the other, determine the contraction and the form of display of the pasteurellosis (Table 2). Exacerbation of the disease and a higher mortality rate was observed during pregnancy and the suckling period. The respiratory disorders had the biggest share (51%) followed by inflammation of the conjunctiva. A quarter of the animals affected (26.4%) suffered from the mixed form. The ear inflammation was the rarest condition (0.2%).

Table 2. Clinical forms of pasteurellosis manifestation

Form of manifestation	n	%
Respiratory disorders with clinical manifestation, number	586	51
Pneumonia	103	17.6
Conjunctivitis	224	38.2
inflammation of the ears	1	0.2
Subcutaneous abscesses	103	17.6
Mixed form	155	26.4

Note: n - Number of animals

The constructive and technological shortcomings of the reconstructed building were the reason for the dynamics in the temperature-humidity regime.
The random opening or closing of the door and the windows led to non-rhythmic circulation and velocity of the air (Figure 1).
The air flow was the most active from the side of the open windows and it gradually dwindled towards the opposite side of the building i.e. there were both 'turbulence' and 'dead' zones at hand.

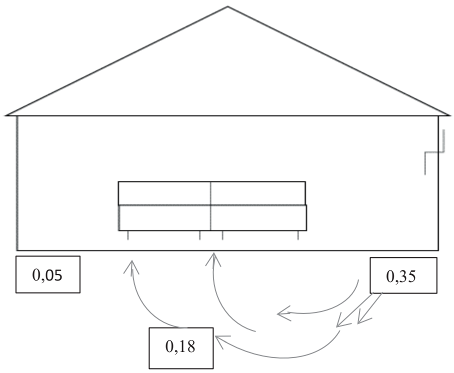

Figure 1. Cross-section of the air flow

This led to periods of increase of the toxic gases concentration. During an experiment exposing rabbits to ammonia, Morisse (1987) ascertains that the mucosa of their respiratory tracts becomes vulnerable and easily penetrable by the *Pasteurella* and other microorganisms on it. In another study (1981), the author proves that the air velocity is another environmental element involved in the contraction of the respiratory syndrome.
The more elements of the barn environment are beyond their acceptable optimum, the more often a respiratory pathology is registered (Table 3).

Table 3. Relative share of the rabbits which contracted pasteurellosis, depending on the involvement of major factors of the barn environment

Influencing factor	Relative share of sick animals, %
1, 2	20.7
2, 4	26.4
2, 3, 4	34.1
1, 2, 4	38.0
1, 2, 3, 4	51.0

Legend: 1 - ammonia; 2 - relative humidity of the air; 3 - air flow; 4 - temperature.

Taking all these into account, we can conclude that the contraction, form of manifestation and severity of the pasteurellosis in rabbits is largely dependent on the factors of the environment.

CONCLUSIONS

The minimum temperatures in the winter and the maximum ones during the summer in the buildings for rabbits studied by us were beyond the optimal values by 4-7 and 16-18^{O}C respectively. The relative humidity during most of the year exceeded the recommended hygiene norms (60-70%) both for the average and the maximum values reported. The concentration of ammonia exceeded the average values by around 16 mg/ m^3 and the maximum ones- by 30 mg/m^3. The content of dust varied from 0.9 to 6 mg/m^3 at average values of 3.6 mg/m^3. The total number of the microflora isolated in m^3 of air was 6.83 x 10^3 (6.5-7.3 x 10^3). *Salmonella*, *Staphylococcus*, *Streptococcus*, *Pasteurella* and coliform as well as the molds *Aspergillus* (*flavus*, *fumigatus*), *Penicillium*, *Alternaria* and

Mucor were isolated in the biological material and the washes (from cages, walls and inventory). Antibodies against *Pasteurella multocida* were detected in 60% of the population. Exacerbation of the disease and higher mortality were observed during pregnancy and the suckling period. The respiratory disorders took up 51%, followed by inflammation of the conjunctiva. Slightly more than a quarter of the animals affected (26.4%) contracted the mixed form. Inflammation of the ears was extremely rare (0.2%). A relationship has been established between number of the non-optimal environmental factors and the incidence of pasteurellosis. A complex of ecological factors such as the concentration of ammonia, the air flow, humidity and temperature in the production premises played an active role in the contraction of the disease, the form of manifestation and its severity as well as in the pasteurellosis carriage in rabbits. The dust and the composition of the microflora in the air may be supplementary but not major etiological factors for the contraction of the disease.

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