Plant extract application for controlling respiratory diseases in turkeys

Respiratory diseases of turkeys are currently the most commonly diagnosed group of health disorders in intensive animal farming. They often occur as polyetiological disease entities developing due to viral, fungal and bacterial factors alike. What is more, not unimportant in the course of complex disease syndromes are elements of production technology, which are sometimes capable of inducing or aggravating the course of the disease.

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Currently reported field 'multi-infections' of turkeys pose a huge challenge for veterinarians taking care of these animals. Isolation of highly resistant strains of bacteria, lack of new effective pharmacological resources, antibiotic residues in drinking lines, animal tissues, prolonged withdrawal periods, legal regulations and public opinion pressing in favour of food production without the use of antibiotics pose further challenges for veterinarians and specialists in poultry diseases.

To meet these expectations and restrictions we should seek more and more effective tools which could be introduced into everyday use. One of them is the use of natural plant extracts showing antibacterial properties.

The avian respiratory system

The avian respiratory system is exceptional in terms of anatomy and its functions. It is composed of the nasal cavity, anterior larynx, trachea and syrinx, a vocal organ, which is comprised of the last tracheal rings and first sections of the respiratory tract.

The next element are the lungs, in the flesh of which the primary bronchus enters, branching off into secondary dorsal and ventral bronchi. These, in turn, are interconnected by parabronchi, which are the proper respiratory component of the lung parenchyma.

Another vital and unique element of the respiratory tract are air sacs. They are thin-walled, membranous protrusions of the primary bronchi. Their functions are manifold, but the most important ones involve being part of an effective gas exchange, bone pneumatisation and thermoregulation. This last role is crucial when extremely high temperatures prevail, as birds having no sweat glands primarily exhale the excess heat through the respiratory system.

Conversely, during low temperatures the air sacs constitute an insulating air blanket for important internal organs. In addition, they reduce the specific weight of the birds' body (for flying and diving), facilitate defecation, enhance their sound strength and help in laying eggs.

On the other hand, the above anatomical structure of the respiratory system of birds makes these animals more prone to develop a number of health disorders. High humidity, optimal temperature and high oxygen content within the respiratory tract are perfect conditions for the development of pathogens.

Strong congestion of the trachea mucous membrane in a nine-week-old turkey.

Fibrinous inflammation of the dorsal air sacs in an eight-week-old turkey.

Colibacillosis of the respiratory system

Colibacillosis is caused by one of the most commonly isolated Gram-negative ciliated bacteria of the Escherichia coli genus. Due to the cosmopolitan nature of the bacteria, large variety of its pathogenic serotypes, ability to produce toxins, mobility, diverse routes of infection, easiness of mucosal colonisation and very rapid multiplication of the bacteria (logarithmic increase every 18 minutes), it currently plays the most important role in the pathology of the respiratory bacterial diseases.

As with other bacterial respiratory infections of turkeys, inducing factors are an essential part in the development of colibacillosis.

Typically, the clinical form of the disease occurs as a chronic respiratory disease (CRD). More and more frequently recorded are infections caused by highly resistant strains of Escherichia coli (APEC), which pose a huge challenge when starting an antimicrobial therapy directed against these pathogens.

In the case of turkeys for fattening, in the course of CRD, the utmost importance is ascribed to isolates which are members of O1, O1, O78 serogroups. In the course of the disease the following occur: cough, crackles, sneezing, a series of non-specific symptoms and increased mortality in the flock.

The anatomopathological changes regarding the respiratory system include fibrinous-purulent inflammation of air sacs, hyperaemia, swelling and hypertrophy of lung tissue. Clinically manifested disease is usually diagnosed after 3-4 weeks of life, the intensity of the disease and the percentage of daily falls depends on the occurrence of predisposing factors and associated infections.

Pasteurellosis

Pasteurellosis is a disease caused by infection of a Gram-negative, non-motile Pasteurella multocida bacillus (serotype 1 P. multocida subsp.

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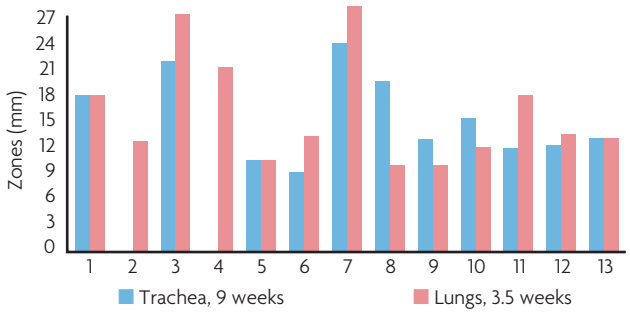
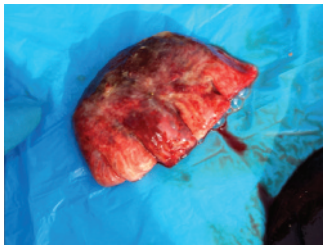


Fig. 1. Susceptibility zones of E. coli to a given active substance.



Fibrinonecrotic pneumonia in a 10-week-old turkey.

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multocida). This bacterium is regarded as a commensal colonising the mucous membranes of the upper respiratory tract and rostral cavity and its clinical significance is most often reflected as a consequence of viral diseases or chronic immunosuppression.

The clinical form of the disease is diagnosed in turkeys usually between 8- 14 weeks of life and its intensity depends on a number of factors ranging from the environmental conditions, the concentration of birds, vitamin deficiencies, technological stress caused by the presence of vectors (rodents), ending with the immunological status of the animals.

The course of the infection depends on the virulence of the pathogen, although farmed animals are in most cases diagnosed with peracute and acute form of pasteurellosis.

In the first case, despite the rapid course of the disease and the high mortality rate of the birds, there are no prodromal symptoms and the only characteristic change discovered during autopsy are petechial and ecchymotic haemorrhages on the cardiac muscle and pancreas.

The clinical picture for the acute form is non-specific and includes apathy, dejection of birds, lowering of the wings, drop in food consumption, ruffled feathers, increased thirst, sometimes rapid breathing, gasping or slight diarrhoea. Due to the septicaemic nature of the disease in the two above forms, during the diagnostic section strong inflammatory lesions of the pulmonary tissue can be observed, called fibrinonecrotic pneumonia.

Ornithobacteriosis – respiratory form

The aetiological agent of ornithobacteriosis are pleomorphic, non-motile, Gram-negative Ornithobacterium rhinotracheale bacilli comprising 18 serotypes (A-R). Beside Escherichia coli, it is now one of the most commonly isolated bacteria in the course of chronic infections of the respiratory tract of turkeys.

Due to the possibility of infection of birds by both the vertical and horizontal way, and in particular by aerosols and through direct contact of birds, the disease has been classified as one of the most infectious bacterial diseases of the respiratory tract of turkeys.

As with previously described types of diseases, an important factor in the development and course of ornithobacteriosis is the presence of predisposing factors (for example inadequate production technology, deficient diet, concurrent bacterial, viral, fungal co-infections).

The disease affects birds of all ages and is manifested mainly by disorders in the functioning of the respiratory system. These include coughing, crackles, shortness of breath, serous nasal discharge. In addition, there has been a swelling of the infraorbital sinuses, apathy, dejection, sudden decrease in appetite and water consumption.

During diagnostic section, unilateral or bilateral serous-fibrinous or fibrinous-purulent pneumonia and air sacs inflammation come to the fore.

Additionally, swelling and congestion of the lung tissue, severe fibrosis of the dorsal surface of the lungs and the presence of exudate the texture and colour of yoghurt can be observed. The mortality of birds in the farming environment depends on the occurrence of predisposing factors and associated infections and most often it fluctuates between 5-30%.

Bordetellosis

Bordetellosis is a highly contagious disease of the upper respiratory tract of turkeys caused by Gram-negative aerobic bacterium Bordetella avium.

Distinguishing features of this bacterium are: high tropism for ciliated epithelium of the respiratory tract, the capacity of production of toxins (osteotoxin, dermonecrotic toxin, cytotoxin, endotoxin) and immunosuppressive activity.

In young turkeys (2-4 weeks old), the disease is highly contagious and significant lesions developing in the upper respiratory tract quickly spread throughout the flock.

The morbidity can reach 100% of birds, and the mortality fluctuates below 5%. Watery mucous and mucous-fibrous discharge from nares and conjunctival sac, submandibular oedema, dyspnoea, crackles, coughing and eye rubbing can be observed in the infected birds.

Macroscopic lesions include the dorsal-ventral flattening of the tracheal rings, congestion of the trachea mucous membrane, distortion of turbinates and the accumulation of large amounts of mucus with fragments of shed epithelium and fibrin within the above organs.

Other bacterial infections

Clinically, infections with bacteria of the Mycoplasma spp. genus also have a very important role in the health of the respiratory tract of turkeys. A broad immunotherapy of parental flocks and the elimination of seropositive flocks led to an extremely rare occurrence of mycoplasma in turkey flocks for fattening.

In addition to the bacteria showing a direct predilection for the respiratory tract of birds, in the course of poly-aetiological disease syndromes, also isolated are additional bacteria of the Staphylococcus, Streptococcus and Klebsiella genus.

They belong to the saprophytic microflora of birds, although with

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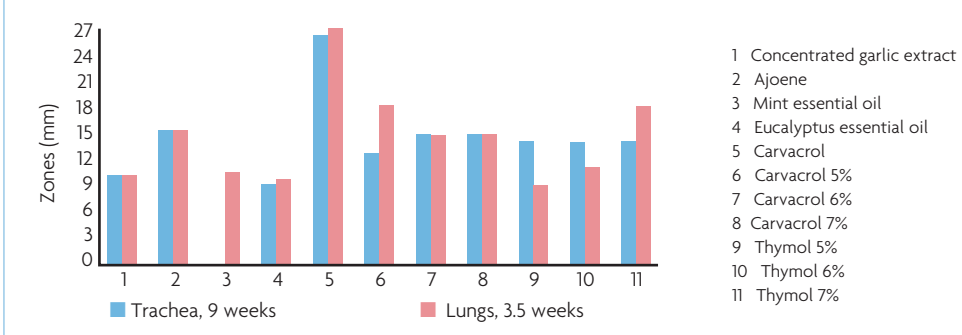
Petechial haemorrhages myocardium in a 10-week-old turkey.

Fig. 2. Susceptibility zones of Klebsiella spp to a given active substance.



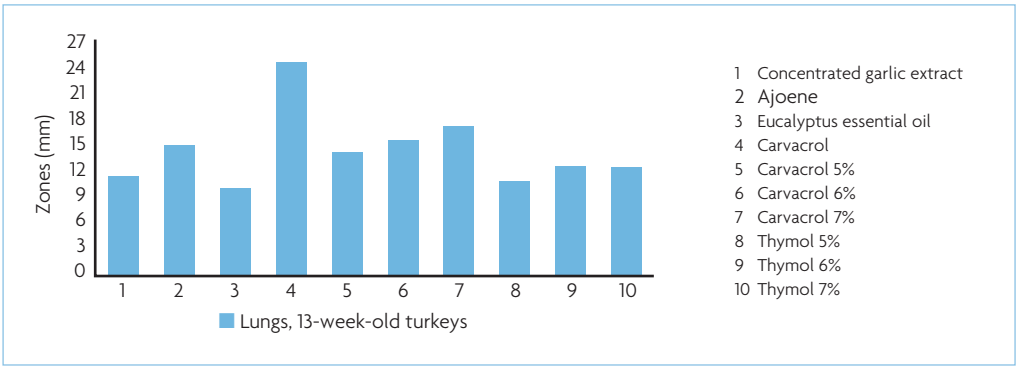


Fig. 3. Susceptibility zones of Enterococcus spp to a given active substance.

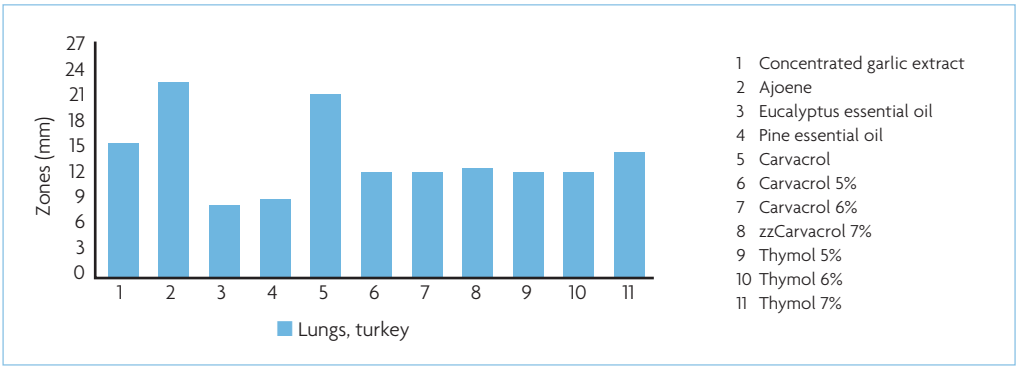


Fig. 4. Susceptibility zones of Staphylococcus aureus to a given active substance.

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persistent inappropriate technological conditions in the breeding facilities, the lack of proper hygiene or non-compliance with the rules of biosafety, the abovementioned groups of bacteria may pose an additional threat to the respiratory system of birds.

In case of complex bacterial infections, the infected flock most often shows symptoms of dyspnoea, coughing, sneezing, discharge from nose and conjunctival sac, swollen infraorbital sinuses and apathy.

Post-mortem lesions include most often serous-fibrinous inflammation of the air sacs, lung congestion and oedema and catarrhal inflammation of the trachea mucous membrane.

The occurrence of opportunistic infections enforces medical treatments exhibiting a broad spectrum of activity, which in the long term, results in the emergence of bacteria resistant to commonly used antibiotics.

The in vitro effects of natural herb extracts

'Multi-infections' that occur under field conditions are extremely difficult to control with the use of antibiotics or chemotherapeutic agents and, therefore, alternative methods to facilitate the fight against common bacteria are searched for. Great emphasis is put on the insulation and the use of active substances contained in plants. Subject to intense research are garlic, oregano, common thyme, field mint and eucalyptus globulus, from which dozens of active substances exhibiting antibacterial effect can be isolated.

For example, garlic (allium sativum) has in its composition dozens of chemical compounds which, when properly acquired, can prove to be extremely effective in fighting pathogens present on farms. Some of the compounds (Allicin, Ajoene, diallyl disulphide and their derivatives) are determinants for antimicrobial properties.

These compounds have the ability to easily penetrate cell membranes of micro-organisms. Inside the cell, they merge with cellular enzymes which results in the blockage of the latter.

The inhibition of the enzymatic processes results in disruption of the cell membrane function and basic metabolic pathways and eventually in the death of the bacterial cell.

Considering the defined framework, the results presented in Figs 1-4 include only selected studies done in the biggest number of repetitions. All published results were obtained in the course of the author's own tests and are his property.

The tested active substances were obtained in laboratory conditions while maintaining strict parameters and control processes involving proper temperature adjusted in the course of the extraction process; proper mixing speed adapted to the type of raw material; the use of adequate solvents for a variety of extraction processes; matching time intervals in the process of activity assessment; building equipment which enabled the recovery of the maximum amount of active substance, and a packaging process to ensure product stability.

The pathogens used in the tests were the bacteria isolated during the course of field diseases, in particular, the bacteria which show low susceptibility to antibiotics and chemotherapeutic agents. In view of obtaining promising results of the in vitro tests, tests with the use of natural extracts of herbs, essential oils, pure active substances and mixtures of the above are continued.

Currently, work is being carried out on the possibility of multiplying the concentration of the active substance in the test samples.

In the interpretation of the presented results we should consider the fact that the raw material is a mixture of natural ingredients extracted from plants, thus the accumulating mechanisms of action are not fully known and repeatability of results may vary, depending on the type and characteristics of the tested pathogen.

Apart from this, every new tool which helps to maintain the health of the birds at an appropriate level, to support drug therapy or reduce the number of antibiotics used becomes extremely valuable.

In the near future, phytobiotics, while used in an appropriate manner, may prove to be one of the key elements in the control of bacterial infections in poultry production. ■

Different stages of unilateral fibrinous-purulent pneumonia in 11-week-old turkeys.