Aspergillosis: an ever present threat?

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Fungi belong to seven different classes. Aspergillus sp. belong to the Ascomycota, which are so called Eumycota, real fungi. Other veterinary medicine relevant pathogens are members of the families Candida, Coccidioides, Microsporum, Trichophyton, Penicillium and Sporothoirix.

Real fungi have cell walls containing chitin. Distinction is made between filamentous multi-cellular fungi and mono-and dimorph yeasts. A fungal colony with filamentous fungi consist of hyphae (forming a myce-lium) and, on the other hand, spores.

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Vegetative hyphae grow into a substrate, reproductive hyphae grow into the surrounding air. The hyphae that grow in the air will contain the spores, which can be organised individually alongside the hyphae or in fruit bodies. The way spores are formed, their morphology and their position are important features for identification of fungi.

Yeasts are single organisms that multiply by forming daughter cells growing from a porus in the cell wall. If this is the only way of multiplying, yeasts are called monomorph, if they can also multiply into a form containing hyphae, they are called dimorph.

Fungi disease

In poultry, important effects on performance can be due to a mycotoxicosis caused by intake of mycotoxins produced by fungi. Mycoses, on the other hand, are diseases caused by the growth of the fungi in an animal. Systemic mycosis are usually caused by dimorph yeasts. Examples are coccidioidomycosis, histoplasmosis and blastomycosis. The condition is localised in the internal organs or skeleton of the animal. Subcutaneous and intermediate mycoses are localised in subcutis, digestive and respiratory tract, mouth and nasal cavity and sinuses.

Aspergillosis and candidiasis are members of this family of disease, relevant for poultry. Superficial mycoses such as caused by Microsporum and Trichophyton are found on skin, nails and in the feathers or hair.

Definition and etiology

Aspergillosis is a fungal disease of chickens, turkeys and other birds. There are about 600 species in the genus Aspergillus.

Nodules in the respiratory organs are typical and help in diagnosing the condition. There are basically two forms. The acute form, most typically in very young birds, is characterised by a high morbidity and high mortality. The term 'brooder pneumonia' is a synonym for aspergillosis in young birds.

Chronic aspergillosis occurs in older birds, such as layers and breeders of both chicken and turkeys. Other terms used for aspergillosis are fungal or mycotic pneumonia, pneumomycosis, bronchomycosis, 'asper' or 'air sac'. Sometimes aspergillosis is not confined to the respiratory system, and infections of eye, brain, skin, joints and viscera might occur.

The principal aetiological agent is A. fumigatus, in much lesser extent A. flavus is isolated. In other rare occasions, A. terreus, A. glaucus, A. nidulans, A. niger, A. amstelodami and A. nigrescens are isolated. A. fumigatus and A. flavus lack sexual reproduction.

A. fumigatus grows rapidly on culture (Sabaroud dextrose) and reaches a diameter of 3-4cm in seven days, A. flavus even faster, 6-7cm in 10 days on Sabaroud at 25°C. Differences between colour of mycelium and conidia help in identification.

Aspergillus sp. are ubiquitous, but growth is optimal at about 40°C. The organism is thermo-tolerant and growth can occur at temperatures as high as 55°C, but also at 9°C. Oxygen levels as low as 0.5% will support growth and conidiation.

Aspergillus sp. are mycotoxigenic fungi. Some authors claim these toxins play a role in the severity of the disease. The fact that Aspergillus sp. are ubiquitous aids its role as an accidental non contagious pathogen causing aspergillosis in birds. Indeed, aspergillosis in birds is a dead-end infection.

The conidia are only 2-3µm, small enough to pass through the upper respiratory tract and allow deposit in the deep pulmonary system. The growth of Aspergillus sp. in vitro is enhanced by the presence of hydro-cortisone, the equivalent of stress induced hormone cortisol. This explains why the occurrence of aspergillosis is both function of the inhaled dose of conidia and the susceptibility of the host. The immune status of the host, as seen in immuno-deficient people, might play a very important role in the severity of the disease.

Importance and incidence

The financial consequences are relevant in both chicken and turkey production. Estimates based on data from Iowa, USA, indicate losses over $11million due to mortality caused by aspergillosis. Data from France, however, indicate that chronic infections can lead to rejections at the slaughterhouse, indicating an impaired respiratory capacity that suggests subclinical losses of flocks that could be costing the industry a multitude of the losses due to mortality.

In France it is estimated that about 0.25% of the live weight of male flocks is rejected due to aspergillosis.

Factors that play a role are, surprisingly, dynamic ventilation systems, improved drinking water systems and more attention to litter quality. The more dusty conditions combined with the ventilation system cause spores to be airborne more significantly, thus providing more chances for infections.

In chickens, hatcheries are still very important in the epidemiology in tropical climate zones. Often, but not always, low standards of biosecurity are responsible for this crucial role of hatcheries. In moderate climate zones, aspergillosis is nowadays more associated with contaminated litter.

Typically, and compared to infections origi-

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nating from hatcheries, these aspergillosis cases occur in single houses, or farms and not in several farms that get their chicks from the same hatchery.

Feed is another source sometimes mentioned as the cause of aspergillosis, for example, in cases seen with layers in batteries. Finally, the environment (wooden constructions) is one of the possible causes to be considered. It is generally accepted that most strains are equally pathogenic.

Aspergillosis is not a transmissible disease, and infection is always acquired from the environment, for example, from litter. In ovo infections indicate the important role of breeder management (avoiding cracks in eggs).

Young birds appear more susceptible, and hatchery contamination of day old chicks is the origin of the most spectacular form of aspergillosis, brooder pneumonia. The contamination might come from one egg, stuffed with spores, which has exploded, not because of the aspergillus growth, but from contamination with gas forming bacteria.

Pulmonary aspergillosis is caused by inhalation of conidia of aspergillus. The conidia will adhere to epithelial surfaces and smooth muscle cells. After slight swelling, formation of hyphae starts 25 hours after infection, both in and outside host cells. Conidia can translocate from luminal to visceral surface of the air sacs. Necrosis will cause a fulminant inflammatory reaction of the host, with massive numbers of heterophils involved.

Proteases expressed by Aspergillus growth together with the heterophil mediated lysis may be the main cause of the destruction of the pulmonary parenchyma causing the typical aspergillomas. Other types of aspergillosis, such as systemic, ophthalmic and encephalitic forms, could be caused by phagocytosis of macrophages that help the fungi get in the blood stream.

Yellow to white nodules in lungs, trachea, bronchi and air sacs may be found in early infection. In later more advanced stages, a thick cheesy plaque will develop covering the infected tissue. This is especially true in turkeys. The clinical signs and the classical nodules are very suggestive of aspergillosis. However, isolation of the fungus is definitive.

Prevention and control

Use clean eggs free of cracks and fresh litter free of hard wood, dusty rice hulls and peanut hulls. Maintain a clean environment in the hatchery and during brooding.

Treatment is very difficult as soon as the infection has been established, although enilconazole, sprayed in the house, is known to aid in preventing new infection. There is a regulatory issue here, as disinfection of the environment in presence of animals could be illegal in European conditions.

Several disinfectants are used for prevention, but care should be given to the claimed activity and safety in use. Several producers claim a sporocidal activity, but when taking a closer look at the activity, the sporocidal activity is only evident after a very long contact time and/or high concentration.

Fungal spores are extremely difficult to destroy by disinfection. Some of these compounds work on the metabolism, so when spores are not sporulating, they cannot exert their activity. When these compounds are washed away from the spores, they will be able to sporulate again. These compounds should be called anti-sporulant instead of sporocidal.

Conclusion

Aspergillosis is an underestimated condition, mainly in turkey production, where it causes not only mortality, but also rejection at slaughter and where it most probably has a significant impact on performance.

Although in moderate climate and modern hatchery conditions, aspergillosis might occur less than it did in the past, it can still cause devastating losses in chickens.

The fact that it becomes rather rare in European like conditions causes another problem, limited investments by few pharmaceutical companies are done to maintain a preventive or therapeutic product on the market, making aspergillosis another 'orphan disease'.

The few flocks affected cannot be treated, causing problems with welfare as well as economical losses for the poultry farmer. ■