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Review Article

# Growing Role of Fungi in Mycotic Abortion of Domestic Animal

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**Abstract**

Infectious abortion, caused by diverse types of microbes, is of a great economic and public health significance. Among various etiologic agents, bacteria, fungi, and viruses are implicated in 50 to 62%, 22 to 25 %, and 15 to 25 % of cases, respectively. Mycotic abortion is an important reproductive problem of dairy cattle all over the world. The disease has been reported from many countries, including Australia, India, New Zealand, and USA. It is caused by a number of different fungi, which are mostly distributed in the environment. Among the fungi, *Aspergillus fumigatus* is associated with most cases of abortions followed by zygomyectes. Fungal abortions in cattle have been recorded usually between 6 to 8 months of gestation. Aborted animals usually suffer from retention of the placenta. Moldy fodder or silage, and confinement of pregnant animals in humid, hot, old and unhygienic houses are recognized, as predisposing factors for mycotic abortion. The transmission and epidemiology of disease are still considered inadequately studied. Direct microscopy and cultural isolation of the fungal agent in the clinical specimen still considered as the main stay of diagnosis. Prognosis of case is usually good but very rarely, cows may develop pneumonia or endometritis after few weeks of abortion. Currently, no treatment has been evolved for mycotic abortion. Avoidance of moldy feed and the provision of hygienic shed to pregnant animals will certainly reduce the incidence of disease. It is emphasized that future studies on the pathogenesis and epidemiology of disease will be rewarding. Furthermore, application of molecular techniques for quick diagnosis of mycotic abortion in domestic animals should be attempted.

**Keywords:** Abortion; *Aspergillus fumigates*; Cattle; Fungi; Mouldy fooder; Zygomyectes

## Introduction

Infectious abortion, which involves multiple etiologic agents such as viruses, bacteria, fungi, actinomycetes, *Rickettsia*, mollicutes, and protozoa, is of worldwide distribution [1-3]. Disease in dairy animals is of great economic importance due to direct loss of young one, reduced milk production, expenditure on drugs and veterinary aids, expenditure on keeping such unproductive animals, and delayed conception [3]. Brucellosis is one of the leading causes of abortion in dairy animals in India as well as other countries. Annual economic loss due to brucellosis in India is estimated Rs.240 millions equal to 5.5 million US Dollar. The late term abortions have been estimated to cost between USD 500 to 900 per animal [4]. The common squeal of abortion includes retention of placenta, endometritis, pyometra, sterility, infertility, and anoestrus. Some of the infectious agents responsible for abortions in animals have public health significance [1,3].

Mycotic abortion (fungal abortion, mycotic placentitis), caused by many fungi, is a cosmopolitan, infectious, sporadic, infection of genital tract of animals, particularly the cows [2]. Rarely, outbreaks of mycotic abortions are recorded. The global prevalence of fungal abortions including India is recorded from 1 to 25% [5]. Knudtson and Kirkbride [6] examined 6,858 cases of abortions and stillbirths in dairy cows, and confirmed the etiology of fungal abortions in 6.8%. Among the fungi, *Aspergillus fumigatus* is identified as the cause of bovine abortion in over 60% of the cases. The exact mode of transmission of infection is not known. The fungus can be isolated from fetal stomach contents, and fetal internal organs on mycological media [7]. The isolation of the fungal agent from the clinical specimens, and its direct demonstration under microscope remains the gold standard for an unequivocal diagnosis of mycotic disease [2]. Presently, no chemotherapeutic agent is recommended for the treatment of mycotic abortion in domestic livestock. The management of fungal abortion depends on avoiding the feeding of moldy feed to the pregnant animals, and keeping them in hygienic well ventilated houses. The present communication delineates an overview on the growing role of fungi in abortions of domestic animals with main emphasis on etiology, and diagnosis.

## Etiology

Smith Theobold is credited to report for the first time the association of the fungus with abortion in 1920 [8], who isolated *Rhizopus rhizopodiformis* from the bovine placental membrane. Since then, a large number of mycotic agents are involved in the etiology of abortion in many species of animals [2,5,7,9-14]. These organisms may affect the fetus or its placenta or both. A wide variety of fungi including filamentous moulds and unicellular yeasts are implicated with mycotic abortions of domestic animals Table 1. Most


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**Table 1:** Mycotic agents involve in etiology of abortion in domestic animals.

| Moulds | Yeasts |
|---|---|
| *Absidia corymbifera*<br>*Aspergillus flavus*<br>*A. fumigatus*<br>*A. niger*<br>*A. terreus*<br>*A. wentii*<br>*Curvularia geniculata*<br>*Emericella nidulans*<br>*E. rugulosa*<br>*Exophila jeanselmei*<br>*Fusarium* species<br>*Lecythosphora hoffmannii*<br>*Mortierella wolfii*<br>*Mucor* species<br>*Paecilomyces* species<br>*Penicillium* species<br>*Pseudoallescheria boydii*<br>*Rhizomucor pusillus*<br>*Rhizopus arrhizus*<br>*R. rhizoopodiformis*<br>*Wangiella dermatitidis* | *Candida albicans*<br>*C. Kefyr*<br>*C. krusei*<br>*C. lusitaniae*<br>*C. tropicalis*<br>*Cryptococus neoformans*<br>*C. laurentii*<br>*Geotrichum candidum*<br>*Torulopsis glabrata* |

**Source:** Pal [2].

**Table 2:** Dual mycotic infections of bovine abortion causative fungi demonstrated in placental tissues.

| | | |
|---|---|---|
| *Aspergillus flavus* | + | *Absidia corymbifera* |
| *Aspergillus fumigatus* | + | *Absidia corymbifera* |
| *Aspergillus fumigatus* | + | *Rhizomucor pusillus* |
| *Aspergillus fumigates* | + | *Rhizopus arrhizus* |
| *Candida albicans* | + | *Mucor* |
| *Emericella nidulans* | + | *Absidia corymbifera* |

**Source:** Pal [2].

of the fungi, which cause abortions in livestock, are prevalent in our environment as saprobe. In majority of cases, only one species of fungi is demonstrated in the etiology of fungal abortion. However, Turner [15] reported simultaneous infection of a bovine fetus by two fungi. The mixed infection due to more than one fungus is demonstrated in about 10 % of mycotic abortions [2]. The dual infection of bovine placenta due to more than fungi is presented in Table 2.

## Host

The mycotic abortion has been diagnosed in buffaloes, cows, goats, mare, sheep, and sows from many counties of the world [2,5,7,10,13,16-22]. However, infection is encountered more commonly in dairy cattle [2,22-25]. The literature scan did not find report of fungal abortion in other domestic animals.

## Transmission

The respiratory tract is considered as the primary portal of entry of airborne conidia of *Aspergillus* [2]. It is believed that the primary infection occurs in the lungs as a result of the inhalation of the organisms from the environment, and the infection may spread to the genital organs by blood stream. The other possible route of infection is through alimentary tract following ingestion of fungal spores in moldy fodder. The use of fungal contaminated semen for artificial insemination can also produce infection aspergillosis, Sarfati and co-workers [22], used DNA sequences to fingerprint *A. fumigatus* isolates from a cow with disseminated aspergillosis, cows with single *Aspergillus* lesions, calves that had aborted due to aspergillosis, mothers of those cows and cattle without aspergillosis. They demonstrated that the portal of entry was gastrointestinal tract and the infection of aborted calves was due to maternally derived isolates that had possibly crossed the placental barrier. Hitherto, the exact mode of transmission is not well defined. Hence, it seems imperative to undertake further studies to elucidate the exact mode of transmission of infection of the genitalia [2]. An experimental study to elucidate the role of *A. fumigatus* and other fungi in the pathogenesis of mycotic abortion indicated that possibly the fungi and their toxins penetrated the uterus and fetus by hematogenous route.

## Epidemiology

Mycotic abortion, an infectious, cosmopolitan disease of livestock, is of a great economic concern to the farmer because it leads to direct loss of young one, reduced milk production, expenditure on drugs and veterinary aids, expenditure on feed by keeping such unproductive animals, development of many complications such as retention of placenta, endometritis, infertility, sterility, pyometra, and delayed conception [3].

The disease is sporadic, and rarely occurs in epidemic form [21,26]. The incidence of global bovine fungal abortion ranges from 2 to 20%. The disease is highly prevalent between November and April in the Northern Hemisphere. The maximum cases are recorded in pregnant cows, which are confined to the sheds/pens, and fed on hay or ensilage. Among the causative agents, *A. fumigatus* is the most common pathogen (62%), followed by zygomyectes, which accounts for 21% of the cases. In New Zealand, maximum cases of bovine abortions are caused by *M. wolfii* [23]. A concomitant pulmonary zygomycosis is observed in 20% when *M. wolfii* is involved [12]. Mycotic abortion in dairy cattle usually occurs in the third trimester of pregnancy. Most cases of abortion in animals are caused by exogenous fungi that exist in nature as saprobes [2]. In Australia, the occurrence of bovine abortions due to *M. wolfii* has been related with the use of silage that had not been properly dried before use [13]. In one study, it has been recorded that about 12 % of a herd of 68 crossbred cows aborted third trimester fetuses after consuming mould peanuts for 4 days [27].The epidemiological investigation conducted by Pal and co-investigators [5] confirmed the presence of *A. fumigatus* in the immediate environment of dairy animals Table 3. It is pertinent to mention that epidemiological studies can help to establish the source of infection. This may be useful to adopt strategies to prevent the exposure of animals from the fungi.

## Clinical Signs

There are no specific clinical signs observed in animals aborting due to fungal infections. However, the affected animal may exhibit vaginal discharge, hyperemia of cervical mucosa, reduced appetite, fever, and retention of placenta [5].The placentas in most of the cases was thickened, necrotic, hemorrhagic, and edematous. The aborted fetus may show discrete, raised lesion on the skin of head and neck, and also pneumonia [2].

## Diagnosis

The diagnosis of mycotic abortion is confirmed when the fungal elements are observed to be associated with placentitis, fetal pneumonia, or dermatitis. A small portion of fetal skin, placental tissue, fetal internal organs or abomasal contents are examined in

**Table 3:** Prevalence of *Aspergillus fumigatus* in the environment of animal sheds positive for mycotic abortion.

| S.N. | Animal species | Age of Animal | Isolation of *Aspergillus fumigatus* from saprobic environment | | | |
|---|---|---|---|---|---|---|
| | | | Fodder | Animal excreta | Soil | Air |
| 1. | Buffalo | 8 years | 3/*4 | 1/4 | 2/4 | 3/4 |
| 2. | Cow | 8 years | 2/4 | 2/4 | 3/4 | 3/4 |
| 3. | Buffalo | 7 years | 1/4 | 1/4 | 2/4 | 1/4 |
| | | Total | 6/12 | 4/12 | 7/12 | 7/12 |

*Numerator denotes the number of samples positive and denominator indicates the number of samples examined.
**Source:** Pal and co-workers [5].

**Table 4:** Abortion in dairy animals due to *Aspergillus fumigatus*.

| Animal species | Number examined | Number positive | Diagnosis of mycotic abortion by | | |
|---|---|---|---|---|---|
| | | | Direct microscopy | Cultural isolation | Serology by AGID* |
| Buffalo | 31 | 2 (6.4%) | 2 | 2 | 2 |
| Cows | 22 | 1 (4.5%) | 1 | 1 | 1 |
| Goats | 05 | 0 (0.0%) | 0 | 0 | 0 |
| Total | 58 | 3 (5.1%) | 3 | 3 | 3 |

*AGID: Agar Gel Immuno Diffusion Test
**Source:** Pal and others [5].

10% KOH wet mounts for mycotic elements by light microscopy. The cotyledons, caruncles, fetal lung, skin, and abomasal contents should be inoculated onto the surface of plates of Sabouraud dextrose agar supplemented with antibiotics. These should be inoculated at 25 and 37°C. The detailed morphology of the isolates recovered from the clinical materials is done in PHOL (Pal, Hasegawa, Ono, Lee) or Narayan stain for the identification of the pathogen [28,29].

The antibodies against *A. flavus, A. fumigatus, A. niger* and *A. terreus* can be demonstrated in the sera of aborted animals by AGID method [2,5,30]. The diagnosis of fungal abortions in dairy buffaloes and cows by direct microscopy, isolation, and serology was made by Pal and others [2] Table 4. The fungi can also be detected in the histological sections of placental cotyledons, caruncles, fetal skin, and lung with PAS, H and E and GMS techniques. Many fungal elements were seen in association with acute necrotizing placentitis, and vasculitis [2]. Presently, no immunological test is available to diagnose animal abortions caused by zygomyectes. It is pertinent to mention that mycotic abortion should be differentiated from brucellois, campyobacteriosis, chlamydiosis, coxiellosis, leptospirosis, listeriosis, toxoplasmosis, and yersiniosis.

## Management

At present, no antifungal chemotherapeutic agent is recommended for the treatment of mycotic abortion in animal. The feeding of moldy hay, grass, straw, etc. to the pregnant animal should be avoided. The treatment of hay with fungicides during haymaking is essential to prevent the growth of fungi. The animals should be kept in clean, well ventilated, hygienic, and dry sheds/byres/pens as humidity favour the development of many fungal pathogens. The pregnant animals may be fed loose hay in an open barn. The mycological examination of the semen used in artificial insemination is imperative to check the presence of fungi. These measures may help to reduce the incidence of mycotic abortions in domestic animals [2].

## Conclusion

Since the first record of bovine abortion in about 96 years ago, there is an increase incidence of fungal abortions among domestic animals. The global prevalence of mycotic abortion is estimated 1 to 25 %. Mycotic abortion caused by several fungi, is usually a sporadic infectious disease of domestic animals, particularly cows. The disease has economic implications on dairy industry. Most cases are caused by exogenous fungi that occur as saprobe in the environment. *Aspergillus fumigatus* is the predominant filamentous fungus responsible for mycotic abortions in animals. As clinical signs are not pathognomonic, the laboratory help is imperative to confirm the diagnosis of fungal abortion. In the absence of any therapy, disease can be managed by avoiding the moldy feeds to the pregnant animals, and keeping them in good ventilated, clean and dry pens. Mycotic abortion should be included in the differential diagnosis of other infectious diseases. It is recommended that future work on the pathogenesis and epidemiology should be undertaken. As fungi are emerging as an important cause of morbidity and mortality in humans and animals, the growing role of fungi in abortions of different species of livestock should be investigated.

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