Veterinary Laboratories Agency

Veterinary Risk Assessment: Exposure of cattle to fungi and yeasts arising from green waste composting units; mycotic abortion and mycotic mastitis

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When assessing the risks arising from environmental contamination by fungi and yeasts cattle are "sensitive receptors" as mycotic abortion and mycotic mastitis are endemic diseases in the UK. This document reviews the incidence, causes and uncertainties in the pathogenesis of mycotic abortion and mycotic mastitis in relation to probable exposure arising from a green waste composting unit.

Disease incidence.

The number of VLA VIDA-recorded incidents of mycotic abortion in England and Wales is recorded in the attached table.

VIDA: Abortion in Cattle due to Fungi of any Species

YEAR	1998	1999	2000	2001	2002	2003	2004	2005	2006
CASES	80	70	66	38	47	54	59	57	44

This data underestimates the actual incidence as it only records incidents reported to and investigated by VLA. Furthermore, although by law all bovine abortions should be reported, only in a small proportion are samples submitted and tests requested for the diagnosis of mycotic abortion.

The typical incidence of abortion is around 5-10%, with an estimated 7% of these due to fungal infection (Andrews *et al*, 2004; Kirkbride, 1992). Therefore the overall incidence of mycotic abortion is probably very low.

Fungal mastitis has most commonly been associated with yeasts but *Aspergillus* mastitis is also diagnosed occasionally. The recorded incidence of mycotic mastitis is very low. Mycotic mastitis is rarely diagnosed but only a very small, and unknown proportion of mastitis incidents are reported and thoroughly investigated. So the background incidence of mycotic mastitis is uncertain.

Distribution of the hazard.

Fungal spores of types that have been associated with mycotic abortion, such as *Mucor* and *Aspergillus* species, are distributed ubiquitously in UK farmyards. The levels are especially high in mouldy bedding, poorly preserved hay and ensiled feed which has undergone aerobic fermentation.

Exposure assessment.

Exposure is ubiquitous. All cattle are exposed to fungal spores in respired air and in feed. All bedding should be assumed to be contaminated.

Contamination of the exterior of the udder and teats is unavoidable. Exposure is greatly increased if the bedding or feed is mouldy.

If there is a 250m separation zone between a composting unit and the "sensitive receptor" a risk assessment is not required. This zone is intended to be sufficient for environmental contamination to decline to background levels. The Environment Agency have data that support the efficacy of this separation zone that take into account possible variations in the production and release of yeasts and fungal spores such as may result from variation in the substrates composted, the environmental conditions and the activities on the composting unit such as turning the composting material. VLA have no independent data which would support or contradict the efficacy of this separation zone.

Consequence assessment; Infection and pathogenesis.

The distribution of yeasts and fungi in the environment is ubiquitous and at potentially high levels of contamination in farm environments yet the incidence of fungal disease is comparatively low. This can be interpreted as good evidence that mycotic abortion and mycotic mastitis are opportunistic infections so factors other than environmental contamination with fungi and yeasts usually determine the risk of disease. However, there may be an ultimate level of environmental contamination that would always overwhelm cows natural defenses, resulting in mycotic disease. To determine such a threshold would require dose response studies, which have not been and are unlikely to be conducted.

Mycotic abortion usually occurs between the 3rd and 8th month of gestation. After haematogenous spread the spores become established in the placenta and cause a placentitis, which results in abortion. The route of entry of fungal spores is by inhalation (which could also result in the subsequent development of a focus of infection in the lung), or by ingestion followed by penetration of gastro-intestinal mucosa. The risk of acquisition of infection by the oral route is greater if there is concurrent gastro-intestinal disease (for example ulceration) or malfunction (for example, increased abomasal pH or oral antimicrobial administration). Placental infection has been induced by intravenous injection of spores during pregnancy. In addition, in *Mucor* infections, it is thought that preputial infection of the bull can transmit infection at service.

In mycotic mastitis, the probable route of infection is ascending infection via the teat but mastitis may also arise via haematogenous spread following ingestion or inhalation of spores. Damage to the teat end caused by poor practice at milking predisposes to ascending infection. Antibiotic therapy could predispose to fungal infection due to introduction of spores when administering intramammary antibiotic therapies. In addition, *Candida* infections can arise due to the prolonged use of antibiotics creating an enhanced environment for their growth (Blood *et al*, 2007).

Risk Factors affecting development of infection

Mycotic abortion should be regarded as opportunistic and not related solely to the presence of the organism in the environment. Undoubtedly, the degree of exposure is one factor in determining risk of infection. However, if the amounts of contamination that occur in typical UK farmyards were at levels that necessarily caused infection, the incidence of mycotic abortion and mastitis would be much higher than the recorded and estimated incidences.

Likewise, mycotic mastitis should also be regarded as opportunistic and not related solely to the presence of the organism in the environment. It is possible that very heavy environmental contamination may ultimately cause mastitis but it is likely that other factors usually precipitate disease especially intramammary antibiotic administration, and damage to the teat end, such as may be caused by over-milking or milking machine malfunction.

Although environmental contamination is not the only risk factor, it is clearly a necessary risk factor for fungal infections to occur. The lack of dose response data and full understanding of the interactions between environmental contamination and other risk factors means the actual risk arising from an independent composting unit cannot be directly assessed. There should be no increased risk if the resulting environmental contamination is no greater and of no longer duration than that experienced by cows on the farm, arising from the farm environment.

Composting is a usual activity in and around farmyards. Conditions such as humidity, temperature and the nature of the material being composted may affect the type and amount of contamination with potentially pathogenic organisms. Cattle are commonly housed on composting material, such as deep litter bedding. The risks of abortion and mastitis arising from these direct contacts with composting material are generally regarded as acceptable.

Additional risk arising from a composting facility close to a farm could probably be assessed by comparing the amounts of environmental contamination around the composting facility with the amounts that occur in typical farmyards. This would assess only the risk component attributable to the presence and level of the hazard, whereas it is likely the major determinants of risk are other factors (referred to above). The exposure of cows turned out to pasture in the summer may usually decrease whereas if there is a composting facility, including on farm composting activities, close to the pasture, exposure may be maintained at a comparatively high level for cows at pasture.

The environmental conditions and the nature of the material being composted may affect the levels of environmental contamination. To assess the worst case contamination arising from a particular unit it would be necessary to collect representative samples over a period that included the substrates and environmental conditions likely to cause the highest levels of environmental contamination. To assess the generic comparative risk, it would be necessary to collect a large number of repeated samples from different composting

facilities and different farmyards for these to be truly representative of the range of possible scenarios.

To assess the consequences of particular exposure requires data on rates of mycotic abortion and mastitis for farms exposed to the full range of exposure levels. Sufficient farms and samples should be taken to ensure that the statistical analysis has enough power to determine whether there is additional risk associated with composting activity, either on the farms or nearby green waste composting facilities. Such investigations are unlikely to be practical.

To assess if there is any increased risk of abortion or mastitis on a particular farm, a farmer must investigate the aetiology of all incidents of abortion and mastitis. If there is a significantly increased risk the incidence of these conditions will be higher than expected background incidence. If there is an increased risk of fungal disease, one possibility is that exposure to the hazard / organism is unusually high. But in the case of mycotic abortion or mastitis, even if the disease incidence is unusually high it cannot be assumed that the cause is increased exposure as there appear to be other necessary risk factors that determine when disease occurs.

Conclusions.

Based on available surveillance data, the incidence of mycotic abortion is approximately 0.35 - 0.7% of pregnancies. This confirms that cattle are "sensitive receptors" and mycotic disease causes significant economic loss to the cattle industry and to each farm affected with abortions. Where a farm experiences higher levels of mycotic abortion, losses to that farm are potentially much higher.

There may be an ultimate level of environmental contamination that would inevitably cause mycotic abortion or mastitis but mycotic abortion and mastitis usually appear to be opportunistic infections. This means that although the presence of fungi or yeasts in the environment is a necessary factor for them to cause disease, it is not possible to identify a specific level of environmental contamination that inevitably causes abortion or mastitis because other critical risk factors apparently usually determine the development of disease. For example relatively high levels of exposure to fungi and yeasts in cattle kept on deep litter bedding are apparently tolerated by most cows because factors in addition to the presence of the organism determine the risk of infection and disease.

To assess the risk of abortion and mastitis on a farm it is essential to investigate and record all incidents, including comprehensive laboratory investigation. An increased incidence of mycotic abortion or mastitis over expected background incidence confirms increased risk of disease but does not necessarily indicate the cause is increased exposure to yeasts or fungi.

To attribute a possible increased risk of these diseases due to a green waste composting facility, it would be necessary to show that environmental contamination arising from the waste composting facility was higher or more persistent than expected environmental contamination exposure arising in a farm yard. Even this information would not confirm that an increased incidence of mycotic abortion or mastitis was necessarily caused by the environmental contamination as the other risk factors responsible for precipitating mycotic abortion or mastitis may still be of greater significance.

A farmer with a mycotic disease problem may choose to reduce environmental contamination as part of a disease control program. This could be the only practical method of risk reduction on a particular farm but it may be unsuccessful if other risk factors remain and continue to predispose cattle to fungal disease, even at reduced levels of environmental contamination and cattle exposure.

References

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