The Management of Animal Effluents on Brucellosis Affected Farms

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Introduction

The persistence of brucellosis in some cattle herds emphasises the need for greater attention to farm management and husbandry practices, including the management of effluents, in order to control this disease. *Brucella abortus* present in fluids which are excreted by aborting cows can contaminate slurry tanks and bedding in cattle sheds and survive there for a considerable time. The land application of slurry contaminated with *Brucella* organisms can present a risk to cows through inhalation of aerosols or the contamination of grass and water supplies. Aerosols which can drift downwind for considerable distances are produced during the land-application of slurry, particularly in breezy weather conditions. Consequently, slurry management is a factor in the control of brucellosis in some herds.

Animal Effluents and *Brucella abortus*

The isolation of *Brucella abortus* in cattle slurry has been reported by Plommet (1976) and others. Barger and Hayes (1924) detected *Brucella* organisms in the faeces of calves fed on contaminated milk. The reported survival of *B. abortus* in slurry ranges from 77 days (Rankin and Taylor, 1969) to 240 days (Verger, 1981), while Cameron (1932) reported that *B. abortus* survived for 100 days in faeces. Kuzdas and Morse (1954) recorded survival for 29, 385, 121 and 670 days in cattle faeces at temperatures of 25°C, 8°C, -3°C and -40°C, respectively. King (1957) reported that this micro-organism survived for only 4 hours in solid manure at 77°C. However, Gilman (1951) found that *B. abortus* survived for 4 days in dry soil, 66 days in damp soil, 100 days in faeces but for only 4.5 hours in a culture medium when exposed to direct sunlight. Kerimov and Ataev (1980) reported that solid manure was free of *Brucella* organisms after 15 days storage in summer and 120 days in winter. Cameron (1932) reported the survival of *B. abortus* for 4.5 hours in a suspension (not manure) when exposed to direct sunlight.

The survival of bacteria in slurry is usually enhanced by low temperatures as occur in winter and is limited by high temperatures and direct sunlight. On plants, bacterial survival can be affected by temperature and extent of cover by organic matter which may influence exposure to sunlight. The survival of *B. abortus* in tap water for 77 days has been recorded by Cameron (1932), while Kuzdas and Morse (1954) reported survival in lake water for 10 days at 25°C and 57 days at 8°C.

The recorded distances for dispersal of bacteria in slurry include 274 metres (Evenden, 1972), 400 metres (Tamasi, 1983) 350 metres (Boutin et al., 1988) and 800 metres (Hahesy et al., 1996). Evidence that contaminated manure is implicated in the transmission of brucellosis is limited. However, Hoflund (1961) reported that cattle became infected with *Brucella abortus* after the water supply was contaminated by other infected cattle. Transmission *via* stream water was proposed as a likely explanation for some brucellosis outbreaks in France by Plommet (1977). However, Jones (1980) considered that slurry played a relatively small role in
the transmission of *B. abortus* compared with that of aborted material.

A number of measures have been used to inactivate bacterial pathogens in slurry. These include long term storage, aeration, microwave treatment, heat treatment, gamma radiation and the addition of chemicals. To date most of these methods have been used in laboratory experiments only, while a small number have been applied at farm level including aeration and treatment with chemicals. The veterinary regulations in Ireland prohibit the land application of *Brucella abortus* contaminated manures and slurries on grazing land. All other manures and slurries on controlled premises must be stored for at least two months before land-spreading, subject to the approval of the attending veterinary officer (Collins and Kelly, 1984).

The management of contaminated solid manure and slurry in order to minimise the risk of spreading brucellosis

The principal measures which can be applied at farm level in order to minimise the risk of spreading animal disease with manure are outlined below:

- **Storage for a period to allow pathogens to die-off before land-application.** A storage period of at least six months after cattle leave the shed is advisable where brucellosis occurs in a herd. Slurry tank capacity is not adequate on some farms to permit prolonged storage. Long term storage of solid manure is not normally a problem when it is fenced off to prevent access to stock and is sited so as to avoid water pollution.

- **Treatment of slurry with chemicals prior to land-spreading.** Published reports include the treatment of slurry with xylene when contaminated with *B. abortus* (Plommet and Plommet, 1974). However, it is not clear if slurry treated with xylene has an adverse effect on grass yield or quality following land application. Strauch (1981) listed four chemicals which were suitable for treating slurry and which were tolerated by crops. These are calcium hydroxide, “thick lime milk”, calcium cyanamide and formalin. In Germany when brucellosis occurs in cattle, slurry is treated with either (a) “thick lime milk” i.e. a mixture of calcium hydroxide powder and water at a rate equivalent to 24 kg calcium hydroxide/m³ (109 kg hydrated lime/1000 gallons slurry) or (b) formalin at 10 kg/m³.

- **The risk of disease transmission associated with land spreading slurry can be minimised by observing the following guidelines:**
  - spreading slurry on arable land or on grassland which is being closed for a crop of silage,
  - spreading in calm weather conditions, preferably when cattle are not present in adjoining fields.
  - The use of shallow injection and band spread slurry applicators reduce aerosol drift compared with the commonly used high trajectory splash plate method. It is possible that more recent models of low trajectory splash plate spreaders may contribute to a reduction in drift.

Based on the experience of treating slurry with chemicals at farm level and concerns regarding risks to human health when working with formalin, a lime product may be the best option when considering chemical treatment of slurry. “Thick lime milk” is not commercially available in Ireland at present and its preparation at farm level is not normally feasible, due to the large volumes involved. The use of calcium hydroxide powder (also referred to as “hydrated lime”, “slaked lime” and “builders’ lime”) may be the most practical approach.
The treatment of slurry with calcium hydroxide

It is generally necessary to increase the pH in slurry from approximately 7.0 to a level of at least 12 in order to effectively inactivate bacteria by the addition of hydrated lime and to maintain the pH at this level for a minimum of 4 days. This requires the addition of an adequate quantity of calcium hydroxide and thorough mixing throughout the slurry. The guidelines set out below can assist this process.

1. Slurry agitation.
   Slurry must be agitated in advance of lime treatment so that it is as fluid as slurry suitable for land spreading. In long storage tanks this may require agitation at each end and can take some hours to complete. Hydrogen sulphide gas (slurry gas) which can be fatal to humans and livestock is often released from slurry during agitation. It is not advisable to remain inside cattle sheds at this time.

2. Addition of lime to slurry.
   Personal protective equipment including eye goggles and good quality dust masks should be worn when adding hydrated lime to slurry. The addition of lime at a number of points along the tank can assist even distribution in the slurry. Agitation of slurry should cease while lime is being added and it is advisable to have at least two people present to assist in case of mishap. There may be an increase in the level of ammonia gas released when hydrated lime is mixed with slurry.

3. When hydrated lime has been added, the agitation of slurry can be restarted and continued for six hours.
   - Day 2, agitate slurry for 3 hours.
   - Day 3, agitate slurry for 3 hours
   - Day 4, agitate slurry for 3 hours.

4. After Day 4, treated slurry can be spread on farmland.

In the study conducted by the Tuberculosis Investigation Unit, treated slurry was spread on farmland within two weeks of treatment without difficulty. However, Thunegard (1975) reported difficulty in agitating slurry which was left in storage for some months after treatment with lime.

Hahesy et al. (1995) examined the effect of spreading lime treated cattle slurry on grassland which was closed for a crop of silage. The findings showed that (a) silage quality was not affected, but (b) grass yield at silage harvesting stage was reduced by up to 17% (mean 11%).

In order to avoid a reduction in grass yield following the application of lime treated slurry, it may be advisable to increase the application rate of nitrogen fertiliser when closing the grassland for a crop of silage. However, normal management practices, which include a minimum time period between nitrogen application and silage cutting date, must be observed in order to avoid excess nitrate levels in grass when harvesting, which could adversely affect silage preservation.

Summary
The storage of slurry for at least six months before land-application is the most practical method to deal with slurry on farms when brucellosis occurs in a herd. Where slurry capacity is not adequate to permit long term storage, treatment with calcium hydroxide in order to attain pH 12 in slurry for at least four days will inactivate Brucella organisms present. Following treatment, the use of low drift spreaders and the application of slurry to arable land or grassland closed for a crop of silage can also minimise the risk of transmitting Brucella abortus to the home herd and contiguous herds.
References


Rankin, J. D. and Taylor, R. J. (1969). A study of some disease hazards which could be associated with the system of applying cattle slurry to pasture. The Veterinary Record 85: 578-581.

