Rendering hygiene

- AS 5008–2007 requires rendering plants to test for Salmonella; if it is detected, prompt corrective action must be taken.
- This Update discusses appropriate corrective actions, drawing on information in the MLA Salmonella problem-solving guide.

In Australia, meat and bone meal and other animal protein meals are part of the feed chain. They are important ingredients in pig and poultry rations. As such, there are hygiene issues associated with rendered products that could affect livestock health, and could even affect human health through the transfer of health hazards from feed to people via meat or eggs.

The main hazards associated with rendered products that could be transferred to people are BSE infective agent and Salmonella. Other hazards such as Clostridium perfringens, biogenic amines and physical contaminants could affect livestock health, but are not usually transferred from animal feed to people via food.

Health hazards associated with rendered products have caused considerable disruption to the use of animal protein meals in feed. The principal example is the exclusion of meat meal from feeds in many countries due to the risk of the spread of BSE. Concerns about Salmonella also disrupt trade and the utilisation of meat meal. Many countries insist that imported meal must be Salmonella-free and, if contaminated meal is detected, it could be rejected. On the domestic market, feed producers expect to buy Salmonella-free meal. Producers with a poor record of Salmonella contamination will not be on preferred-supplier lists and may lose all access to some customers.

One of the aims of the Australian Standard for Hygienic Rendering of Animal Products, revised in 2007 (AS 5008–2007), is the production of Salmonella-free animal protein meals. The standard requires that all rendering plants test samples of their products for Salmonella. The standard now requires that if Salmonella is detected, there must be an immediate review of hygienic practices, corrective action taken, and further testing carried out to confirm the effectiveness of corrective action.

Figure 1: There are a number of corrective actions that can be taken to minimise the growth of Salmonella. An Inverted V cover on a cake screw (shown above) better ventilates the screw and allows condensation to run down the outside of the screw casing.

This MTU discusses the corrective actions that can be taken in order to comply with the requirements of the Australian Standard for Hygienic Rendering of Animal Products. It draws on information from an MLA project which investigated possible sources of Salmonella in rendered products.

Salmonella serovars

There are over 2500 serovars (serological types) of Salmonella. The serovars that are isolated from animal protein meals are generally not the serovars that are associated with livestock and human salmonellosis. A particular exception is S. Infantis which is isolated from meat meal, poultry and humans. The major serovars in meat meal—according to reports of the National Enteric Pathogens Surveillance Scheme (NEPSS)—are shown in Table 1. The table also shows the major serovars that are isolated from poultry and humans.

The most commonly isolated serovars from cattle are S. Typhimurium, S. Dublin, S. Bovismorbificans and S. Zanzibar.

The range and frequency of serovars isolated from meat meal probably relates to their ecology and the ability of the different ones to occupy particular habitats rather than to transmission pathways. The difference between the serovars in meat meal
and those found commonly in livestock and meat suggests that cross-contamination of rendered product with raw material is not a major source of contamination of meat meal. The serovars found in meat meal are probably the ones that are best suited to the conditions found in rendering plant equipment.

Contamination of rendered product

It is almost certain that any *Salmonella* in raw material for rendering will be eliminated in the rendering process. Tests have shown that even the so-called low-temperature rendering systems reliably kill *Salmonella*. This means that if rendered product is contaminated by *Salmonella*, the contamination must have occurred after the completion of the heat treatments. It is convenient to classify post-rendering contamination as either casual or endemic. Casual contamination is intermittent. It can introduce *Salmonella* into equipment or product, but the number of *Salmonella* cells introduced by most sources of casual contamination is probably not detectable by standard tests. Endemic contamination is regular or even continuous contamination that occurs when *Salmonella* grow at sites within equipment, and *Salmonella* from these sites regularly feed into product. These sites can introduce detectable levels of *Salmonella* into product.

Casual contamination

Raw material is a possible source of casual contamination of product and equipment. *Salmonella* could be transferred from raw material to cooked product by aerosols, splashes, on equipment or on people; however, as pointed out above, the types of *Salmonella* that commonly occur in cattle and other livestock are not commonly isolated from meat meal. This suggests that direct contamination of cooked product by raw material is not a major cause of salmonella detections in meat meal. Other possible sources of casual contamination are:

- boots, clothing and hands of people;
- condensation dripping from ceilings;
- dust particles;
- rain through roof leaks;
- grease from gear boxes;
- spilled meal or cake.

To prevent contamination from these sources equipment should be enclosed; however, there is anecdotal evidence that rendering plants that have open equipment have less risk of contamination of meat meal by *Salmonella* than plants with closed equipment. This is because the open equipment can ventilate and dry. It is less likely to develop *Salmonella* growth niches where there is sufficient moisture to support microbial growth.

Whether equipment is open or closed is often dictated by OH&S and EPA requirements. It may not be possible to eliminate *Salmonella* growth niches by opening up equipment. The alternative is to make sure equipment is adequately ventilated to remove vapour from the hot product before it condenses.

Endemic contamination

It is more likely that detectable levels of contamination of meat meal occur because particular serovars of *Salmonella* become established in equipment. Conditions in rendering equipment after the heat treatment are generally dry and warm to hot. *Salmonella* should not become established in these conditions, but niches are known to occur in equipment where it is a little cooler and there is sufficient moisture available to support microbial growth. Control of *Salmonella* depends on being able to identify these niches and eliminate them by engineering them out or by keeping them clean.

It is sometimes possible to identify potential niches by sampling suspicious sites with sponge swabs or by taking residue scrapings.
and testing for *Salmonella*; however, a study by MLA has shown that where there are endemic sources of *Salmonella* within equipment, the *Salmonella* tend to be spread far and wide making it difficult to pinpoint the original site or sites of contamination.

Examples of typical *Salmonella* growth niches in rendering plants, and the corrective action to eliminate them are shown in Table 2.

**Extent of contamination**

If sites of endemic contamination, such as those listed below, exist in a rendering plant, *Salmonella* may spread throughout the equipment. If the sites of endemic contamination are identified and cleaned, it is possible to prevent the contamination reaching detectable levels. If they are not recognised and eliminated, *Salmonella* can build up to detectable levels.

There could be light, moderate or heavy contamination depending on the extent to which *Salmonella* spread from sites of endemic contamination. Tests have shown that where there is light contamination, characterised by occasional detections of *Salmonella*, the level of contamination is about 10 cells per 100 grams. In cases of moderate contamination—characterised by frequent, but not constant or persistent detections of *Salmonella*—the level of contamination is less than 100 cells per 100 grams. In cases of heavy contamination where detections are regular and persistent, the level of contamination in the meal is about 300 cells or more per 100 grams.

It has also been shown that in cases of light contamination, *Salmonella* may not be detectable at any sites within equipment. In cases of...

**Table 2: Possible locations of *Salmonella* growth and suggested solutions**

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
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</thead>
<tbody>
<tr>
<td>Extraction ducts from press fume hoods—These ducts act as condensers. They condense moisture from vapours exiting press chokes and temperatures inside ducts can be ideal for <em>Salmonella</em> growth.</td>
<td>Off-set ducts from directly above the choke fume-hood and use a drained T-piece or S-bend to prevent water running back down duct into fume hood. (See Figure 2). Introduce a program for regular cleaning of fume extraction ducts.</td>
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<tr>
<td>Choke fume hoods—Condensation in the fume hood forms patches of wet meal cool enough to support growth, particularly in large fume hoods.</td>
<td>Have sufficient extraction to remove vapour before it condenses. Make fume hood as close fitting as possible around the choke to keep surfaces hot and increase velocity of extracted air. Make fume hoods easy to disassemble and clean them and choke housing regularly.</td>
</tr>
<tr>
<td>Cake screws and covers: 1. Vapour from hot meal cake will condense on screw cover. 2. Dead ends of screws can accumulate moisture and are cooler than that part of screw swept with hot cake.</td>
<td>Covers could be either open mesh with hinged solid-plate covers that fold over during floor cleaning, or inverted V-shape, to better ventilate the screw and allow condensation to run down outside screw casing (see Figure 1). Dead screw ends should be avoided.</td>
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<td>Cake elevators—Head space at top of bucket elevators or tube screws accumulate moisture from the vapour from the hot cake.</td>
<td>Ventilate bucket elevators. Tube screws are very difficult to ventilate, fit access for regular cleaning.</td>
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<tr>
<td>Cake bin—Closed bins have a large surface area that can be moist from condensation. Temperature in enclosed cake bin can be ideal for <em>Salmonella</em> growth.</td>
<td>Ventilate cake bins or leave open. If left open, creates dust problems and exposes the product to casual contamination.</td>
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<tr>
<td>Mill—Friction in the mill generates heat and moist vapour. The vapour may condense in the in-feed and discharge screws. Excessive moisture in the mill discharge screw is a high priority for <em>Salmonella</em> control.</td>
<td>Mill discharge must be well ventilated and extraction system must include dust filtering. Ventilation must be sufficient to extract air drawn into mill by rotation of hammers. Remove any redundant screws attached to mill discharge screw. Have program for regularly cleaning the mill, associated screws and ventilation system.</td>
</tr>
<tr>
<td>Screens/sieves—Screens are covered to control dust. Vapours off hot meal from the mill can condense on screen covers and support <em>Salmonella</em> growth.</td>
<td>Ventilate screens if possible, but a regular cleaning procedure is essential.</td>
</tr>
<tr>
<td>Meal bins—Bins should be enclosed to suppress dust. If meal is transferred direct from mill to meal bin, hot vapour from milled meal can condense in bin.</td>
<td>Screened meal is easier to manage in meal bin because meal cools during screening process. Ventilate meal bins if necessary. Have a regular cleaning program to remove damp residues.</td>
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</tbody>
</table>
moderate contamination there may be several sites within equipment where *Salmonella* is detectable, and in cases of heavy contamination *Salmonella* is detectable at many sites within the equipment.

If *Salmonella* is present at detectable levels in meat meal, it must be assumed that contamination has probably spread through the meal-handling equipment. It may be possible to identify *Salmonella*-growth niches such as those discussed above and, while these points must be corrected, more widespread cleaning of equipment will be necessary.

Conversely, cleaning accessible components of equipment without identifying and eliminating one or more potential sites of endemic contamination could result in an apparent elimination of *Salmonella*, but contaminated meal could be detected within a few weeks as *Salmonella* spreads from the endemic sources of contamination.

**Corrective action**

According to the Australian Standard AS 5008–2007, if *Salmonella* is detected in meat meal, hygienic procedures must be reviewed and corrective action taken. From the comments above, a logical approach to corrective action is to review:

1. possible sources of casual contamination which could introduce contamination from raw material or other sources into equipment;
2. possible sites of endemic contamination. This will require inspections inside equipment. Any signs of moist, damp or smelly meal are an indication of possible endemic contamination;
3. history of contamination. If there have been previous detections of *Salmonella* it could mean that sites of endemic contamination have not been correctly identified and eliminated. It also means that *Salmonella* could be widespread throughout equipment, and extensive cleaning is required.

The MLA Salmonella Problem Solving Guide provides a decision tree to help decide what corrective action should be taken, and a list of check points that can be used to help identify priorities for corrective action.

**Salmonella inhibitors**

There are several commercial brands of inhibitors which help control *Salmonella* in rendering equipment and in meat meal. The active ingredients are generally organic acids such as formic, acetic and propionic acids or their salts. *Salmonella* inhibitors can be applied as a powder or liquid. Renderers have found the powder form is helpful in preventing endemic contamination by *Salmonella* at moist sites in equipment. The liquid form can be applied directly onto meals and animal feeds to eliminate low levels of *Salmonella* contamination. *Salmonella* inhibitors can be useful adjuncts to other corrective actions taken in response to detections of *Salmonella* in meat meal.

**Further reading**
