SALMONELLA IN LIVESTOCK FEED

K-STATE Research and Extension

Feed hazards are classified as either chemical, biological, or physical in nature. Of the biological hazards of concern to the Food and Drug Administration, *Salmonella* spp. is the only one prevalent in livestock feed. In the livestock industry, *Salmonella* can be found in both unprocessed ingredients[1,2] and processed feed[3] — leading to potential contamination in all stages of the production system. While *Salmonella* presence in feed can negatively impact the health of the animals themselves, the impact of *Salmonella* on consumers is the major concern.

Salmonella contaminated meats and animal by-products increase the risk of foodborne illness and may contribute to antibiotic resistance depending on the strain present. To reduce risks to consumers, the feed industry has taken steps to detect *Salmonella* within feed mills to prevent contaminated feed products from leaving feed mills.

The FDA defines certain strains of *Salmonella* as adulterants, which can cause disease in animals consuming the feed if not killed during feed manufacturing.[4] Table 1 shows adulterant *Salmonella* strains most likely to cause disease in each animal species.

While adulterant strains of *Salmonella* are the only ones that require recall of a product, periodic sampling of mills can be used to better understand feed mill biosecurity. The objective of this publication is to identify areas where *Salmonella* is prevalent in mills and to present ways to control *Salmonella* in this environment.

Sampling sites

Because *Salmonella* can be introduced via feed ingredients, people, vehicles, and dust, sampling various sites around a feed mill help evaluate any biosecurity issues within the mill. Testing should occur regularly in areas that accept incoming ingredients, receiving areas for unprocessed ingredients, incoming and outgoing trucks, and areas with high foot traffic. Testing is important in areas with high foot traffic because *Salmonella* spreads easily on dust tracked on the bottom of boots. Tracking throughout the mill can result in widespread contamination of the facility. Monitoring high-risk areas provides better understanding of where *Salmonella* enters the facility and how to prevent its spread.

Table 1. *Salmonella* serotypes that cause disease in animal species.

Animal species	*Salmonella* serotype*
Poultry	*Salmonella* Pullorum, *Salmonella* Galinarum, *Salmonella* Enteritidis
Swine	*Salmonella* Cholerasuis
Sheep	*Salmonella* Abortusovis
Equine	*Salmonella* Abortusequi
Dairy and Beef Cattle	*Salmonella* Newport, *Salmonella* Dublin

*Considered an adulterant species under section 402(a)(1) of the FD&C Act (21 U.S.C. 342(a)(1))

Suggested sampling sites include, but are not limited to:

- Ingredient trucks, including tires, steering wheel, foot pedals, and floor mats
- Receiving area for raw ingredients and pit grate
- Control room
- Worker shoes
- Areas with high foot traffic
- Areas with a lot of truck traffic
- Pellet mill or conditioner – both feed contact surfaces (inside the mixer and cooler) and non-feed contact surfaces where dust can accumulate (cyclones above mixer and cooler)
- Cooling and storage bins
- Discharge (areas where dust can accumulate)
- Feed transportation truck, including tires, steering wheel, foot pedals, and floor mats

Swabbing procedure

Many times the environment, such as the floor and equipment, is a better indicator of bacterial contamination than the finished contaminated products. Environmental swabs are therefore performed by trained personnel, preferably the same worker each time to ensure consistency. Unfortunately, the environment is full of bacteria, both good and bad, in order to minimize contamination from factors other than the sample, an aseptic technique is used. Aseptic technique should be used when collecting the samples using a sterile sponge with buffered peptone water. For the following samples, aseptic technique entails not touching the inside of the bag, not grabbing swabs directly from the bag, keeping bags closed as much as possible, and changing gloves between each swab taken.

Steps in swabbing:

1. Wear proper personal protective equipment (PPE) such as steel-toed boots, hard hat, goggles, and latex or nitrile gloves. Clothing should be changed before entering the facility.
2. Open the bag containing the sponge using the plastic pull-tabs. Push the sponge handle out of the bag without reaching your hand inside (Figure 1).
3. In a uniform motion, swab the area while holding the sponge horizontally. Flip the sponge over to the unused side and swab in a vertical direction (Figure 2). Follow standard protocol, swabbing an area greater than 100 cm^2 (approximately 16 square inches or about the size of a drink coaster).
4. Place only the sponge portion of the swab inside the bag with the handle remaining outside.
5. While holding onto the sponge through the outside of the bag, twist off the sponge handle and dispose of it properly.
6. Label the bag with the location, date, and the name of the person collecting the sample.
7. Keep bags refrigerated at 32-40°F during storage and transportation to the laboratory for analysis.

Figure 1. Aseptic technique for swabbing sponge bag handling. Open the bag containing the sponge using the plastic pull-tabs. Push the sponge handle out of the bag without putting your hand inside. Place the sponge back in the bag but only the sponge portion, leave the handle out. Close the bag with the sponge portion inside by removing the excess of air, folding the top of the bag and twisting the wire flaps.

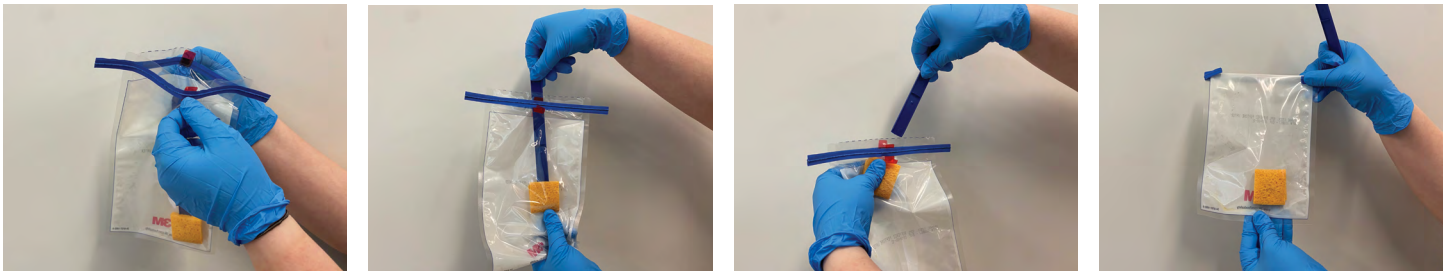
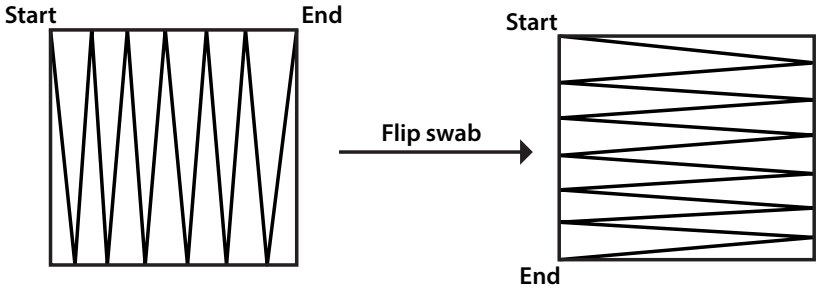


Figure 2. Swabbing pattern for environmental sponges. Begin swabbing in one direction. Flip the sponge over to the unused side and swab at a 90° angle.



LeBlanc, Destin A. V*alidated cleaning technologies for pharmaceutical manufacturing.* CRC Press, 2000.

After samples have been collected from areas that may have been exposed, swabs should be kept refrigerated and sent to an accredited analytical laboratory for *Salmonella* diagnosis if testing is not done on site. Commercial laboratories with these capabilities include Midwest Laboratories, Eurofins, Alliance Analytical Labs, and others. A microbial panel for *Salmonella* should be requested. Serotyping, or identifying the species of *Salmonella*, should be considered if a more complete analysis is desired or to determine if the serotype is an adulterant.

A sample that tests positive for a *Salmonella* serotype not mentioned in Table 1, should prompt a review of the hazard analysis and risk assessment plans. Feed mill personnel should determine the location of contamination and implement appropriate corrective measures. If a feed sample tests positive for an adulterant serotype, the mill must consider a recall plan.

Feed sample collection

Samples should be representative of the finished feed product manufactured. Use a sterile bag (Whirl-Pak type) to collect feed samples, while maintaining the aseptic technique, the technique described above to limit sample contamination. Sample the feed at set intervals, collecting a sample totaling at least 0.05% of the total bulk volume.[5]

Prevention and mitigation techniques

Environmental sampling can be used as a risk assessment to identify areas of concern throughout the mill. Once areas at risk of *Salmonella* contamination have been identified, use the following methods to reduce the spread of *Salmonella* or to eliminate *Salmonella* from the mill.

- Measures should be taken to ensure that when raw ingredients enter the mill, they do not come into contact with both common contact surfaces and finished products to avoid cross contamination.
- Prevent entry of birds and other pests.
- Receiving pits should remain covered until truck is parked and ready to unload – tires can carry dirt and other contaminants that fall into the pits and can contaminate feedstuffs. Ask that drivers remain in their vehicles and get out only when absolutely necessary. If the driver must exit the truck, request them to wear clean boot covers and clothes that have not had previous animal contact.[6]
- Dust is a vehicle for *Salmonella* and can contaminate feedstuffs when swept back into the receiving pit during cleaning. Therefore, disposing of dust and any spilled feed can reduce the spread of *Salmonella* throughout the mill. Likewise using clean air during cooling can limit the chance of recontamination following pelleting and conditioning.[7]
- Limiting traffic between dirty and clean areas or locations can reduce the chance of recontamination via *Salmonella* tracked though the mill on boots.

Conclusions

Currently, there are no regulations in the swine industry for mandated environmental sampling for *Salmonella*; however, similar to what is already seen in poultry, the swine industry may demand more

emphasis placed on controlling *Salmonella* at all levels of production.

Because *Salmonella* outbreaks are more common in poultry than in swine, the poultry industry has implemented sampling in feed mills to reduce the spread of *Salmonella*, especially in feed delivered to laying hens and breeding stock. Adherence to these protocols allows the poultry industry to evaluate its own biosecurity and avoid external intervention unless it becomes necessary.

While the swine industry does not face as many animal health concerns related to *Salmonella* as the poultry industry, the continuing rise of pork-related *Salmonella* cases may lead industry leaders and researchers to look deeper into the safety of the entire food and feed production chain.

Controlling *Salmonella* in feed mills is a complex matter, and although *Salmonella* cannot be easily eliminated, there are strategies to aid mills in decreasing the spread of *Salmonella*. Environmental sampling helps determine areas at greatest risk of infection within the mill, leading to the implementation of techniques to prevent or reduce the spread of *Salmonella*.

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