Sample Sizes for Surveillance and Suspected Contamination Sampling

Surveillance is the routine collection of information used to characterize risk with clearly established intervention points used to monitor and maintain animal health. Surveillance also uses thresholds to dictate further action either through sampling, implementing mitigation strategies, or a combination of both. If surveillance thresholds have been met or exceeded, it is time to transition to suspected contamination sampling. Pre-determined samples sizes for surveillance sampling with thresholds (Table 1) and suspected contamination sampling with return to surveillance sampling thresholds can be found at the end of this resource (Table 2). This resource will detail how to interpret those pre-determined sample sizes for surveillance and suspected contamination. To calculate sample sizes yourself, refer to "Calculating Sample Sizes and Thresholds" or to coordinate the transition to suspected contamination sampling, refer to "Transitioning from Surveillance Sampling to Suspected Contamination Sampling."

The pre-determined sample sizes depend on two factors, 1) the probability of feed serving as a source for pathogen of interest and 2) the severity of the pathogen in regards to species of interest. There are spectrums within these two factors that will determine sample size.

Probability of feed serving as a source for pathogen of interest

The probability of feed serving as a source for pathogen of interest takes in account the potential feed ingredients and mitigation strategies already implemented at the feed mill.

- **High probability**
  - High probability indicates that there is immediate danger that the hazard will occur.
  - If there are no mitigation techniques in place at a feed mill, then this is the proper designation.
- **Medium probability**
  - Medium probability indicates that the hazard will probably occur if not controlled.
  - If a feed mill utilizes only point-in-time mitigation techniques, this is the appropriate designation.
    - Examples of point-in-time mitigation techniques include quarantining or holding ingredients, thermally processing feed, implementing feed batch sequencing, or implementing flushes after manufacturing certain diets.
    - These techniques can only guarantee that infectivity of the pathogen has been reduced, but doesn't prevent recontamination.
  - If a feed mill has or utilizes rendered ingredients for diets, this is the appropriate designation.
    - Rendered ingredients are manufactured at a temperature range of 240-290°F for at least 40-90 minutes which reduces pathogen contamination (Hamilton, 2006). However, this temperature range does not prevent recontamination during further feed manufacturing or delivery.
    - Transportation of these ingredients from rendering facilities is also a risk of pathogen introduction to a feed mill (Lowe et al., 2014) as these types of ingredients have been shown to better support pathogen survival when compared to plant based ingredients (Dee et al., 2018)
- **Low probability**
  - Low probability indicates that it's possible for hazard to occur if not controlled.
  - If a feed mill utilizes a chemical feed additive as a means to reduce pathogen contamination or infectivity, this is the appropriate designation.
    - Chemical feed additives reduce pathogens in feed at time of application and remain active throughout the feed supply chain (Stewart et al., 2020).

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- **Very low probability**
  - Very low probability indicates that it's unlikely for the hazard to occur and an assumption that the hazard will not occur is warranted.
  - If a feed mill utilizes point-in-time mitigation techniques in combination with a chemical feed additive, this is the appropriate designation.

Severity of the pathogen of interest in regards to species of interest

The severity of the pathogen of interest in regards to species of interest is based on the short and long term consequences if it were to be introduced. The type of production system served by the feed mill and the production system's definition of mortality and morbidity will influence the designated severity.

- **High severity**
  - Pathogen of interest would cause high mortality and high morbidity if introduced into the production system.
- **Medium severity**
  - Pathogen of interest would cause high mortality and low morbidity if introduced into the production system.
- **Low severity**
  - Pathogen of interest would cause low mortality and high morbidity if introduced into the production system.
- **Very low severity**
  - Pathogen of interest would cause low mortality and low morbidity if introduced into the production system.

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Table 1: Recommendations for surveillance sample size and thresholds based on severity of pathogen of interest and probability of pathogen being introduced through feed.

Severity / Probability	**HIGH** Pathogen of interest would cause high mortality and high morbidity	**MEDIUM** Pathogen of interest would cause high mortality and low morbidity	**LOW** Pathogen of interest would cause low mortality and high morbidity	**VERY LOW** Pathogen of interest would cause low mortality and low morbidity
HIGH Immediate danger that the hazard will occur.	75 samples/week: 10 feed samples 65 environmental samples **Threshold = 1 positive**	75 samples/week: 10 feed samples 65 environmental samples **Threshold = 1 positive**	15 samples/week: 5 feed samples 10 environmental samples **Threshold = 1 positive**	5 samples/week: 1 feed sample 4 environmental samples **Threshold = 1 positive**
MEDIUM Hazard will probably occur if not controlled.	75 samples/week: 5 feed samples 70 environmental samples **Threshold = 1 positive**	15 samples/week: 2 feed samples 13 environmental samples **Threshold = 2 positives**	8 samples/week: 2 feed samples 6 environmental samples **Threshold = 2 positives**	5 samples/week: 0 feed samples 5 environmental samples **Threshold = 2 positives**
LOW It's possible for hazard to occur if not controlled.	25 samples/week: 1 feed sample 24 environmental samples **Threshold = 1 positive**	15 samples/week: 1 feed sample 14 environmental samples **Threshold = 2 positives**	8 samples/week: 1 feed sample 7 environmental samples **Threshold = 3 positives**	4 samples/week: 0 feed samples 4 environmental samples **Threshold = 2 positives**
VERY LOW It's unlikely for the hazard to occur and can assume that hazard will not occur.	25 samples/week: 0 feed samples 25 environmental samples **Threshold = 1 positive**	15 samples/week: 0 feed samples 15 environmental samples **Threshold = 2 positives**	8 samples/week: 0 feed samples 8 environmental samples **Threshold = 3 positives**	3 samples/week: 0 feed samples 3 environmental samples **Threshold = 2 positives**

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Table 2: Recommendations for suspected contamination sample size and when to return to surveillance sampling based on severity of pathogen of interest and probability of pathogen of interest introduced through feed.

<table>
<tr><th>Severity
Probability</th><th>HIGH
Pathogen of interest would cause high mortality and high morbidity</th><th>MEDIUM
Pathogen of interest would cause high mortality and low morbidity</th><th>LOW
Pathogen of interest would cause low mortality and high morbidity</th><th>VERY LOW
Pathogen of interest would cause low mortality and low morbidity</th></tr>
<tr><td>HIGH
Immediate danger that the hazard will occur.</td><td colspan="2" rowspan="2">300 samples:
102 feed samples
198 environmental samples
Return to surveillance: no more than 3 positive samples</td><td colspan="2" rowspan="2">100 samples:
25 feed samples
75 environmental samples
Return to surveillance: no more than 3 positive sample</td></tr>
<tr><td>MEDIUM
Hazard will probably occur if not controlled.</td></tr>
<tr><td>LOW
It’s possible for hazard to occur if not controlled.</td><td colspan="2" rowspan="2">100 samples:
15 feed sample
85 environmental samples
Return to surveillance: no more than 3 positive sample</td><td colspan="2" rowspan="2">60 samples:
5 feed samples
55 environmental samples
Return to surveillance: no more than 3 positive sample</td></tr>
<tr><td>VERY LOW
It’s unlikely for the hazard to occur and can assume that hazard will not occur.</td></tr>
</table>

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