# SmartBunker:

# Investigation into feed hygiene during storage –

## *Repeat of mould and yeast testing due to contamination of original feed*

## I.N.I. Innovation Voucher No.: 0213180

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**Overall project aim:** Greenans Products Ltd developed a new style of animal feed storage container (SmartBunker). Traditionally, feed stored within storage containers is accessed via a lid, meaning the feed closest to the top of the container is used first. Feed hygiene can be compromised when new feed is added to the container before the entire previous batch is used, or when storage containers are not cleaned out before new feed is added to the container. The SmartBunker was developed to dispense feed from the bottom, resulting in the oldest feed being used first and any fresh feed added into the container being used last. The funnelled base shape of the SmartBunker container combined with the downward movement of feed also reduces the likelihood of feed becoming lodged in corners which can become stale and reduce feed hygiene.

An initial project (I.N.I. voucher number 0213180) comparing the dry matter (DM) of feed stored in the SmartBunker with that of feed stored in feed bags only (method 1) and metal dustbins with lids (method 2) successfully found that feed stored in the SmartBunker retained a higher DM compared to the two other storage methods. High DM content is associated with greater feed quality due to reduced mould, yeast and mycotoxin growth. The initial project also measured and compared the growth of moulds and yeasts for each of the storage methods. Contamination of feed prior to the start of the project may have affected results gained therefore a repeat of the mould and yeast analysis was performed using the same three month study design but excluding DM testing. Consequently, the aim of this project was to determine if the SmartBunker storage system maintained horse feed hygiene (moulds and yeasts) over a period of three months, and to compare its effectiveness in maintaining this measure with other common methods of horse feed storage 1) feed bag and 2) metal dustbin with lid.

**Project Deliverables:**

1. **Investigate the hygienic status of an equine feedstuff stored in SmartBunker containers over a period of three months and compare with feedstuff stored using two alternative storage methods 1) feed bag and 2) metal dustbin with lid.**

Three SmartBunker storage containers were used in the project. SmartBunker 1 was a newer model than SmartBunkers 2 and 3 and contained an additional seal between the top and bottom sections. The seal was developed with the aim of making the container airtight to aid in maintaining feed quality. The client was keen to compare the effectiveness of the SmartBunker containers in maintaining feed hygiene, to other feed storage methods commonly used within the Northern Ireland equine industry. Two commonly used methods for the storage of equine feedstuffs were identified, these were 1) keeping the feed within the feed bag but not in any additional container and 2) metal dustbins with metal lid. Three feed bags and three metal dustbins were used for the comparison.

Nine bags of the same commercially available equine feedstuff (coarse mix) were sampled prior to the start of the project to detect levels of moulds and yeasts present. Low levels (<1000cfu/ml) of moulds and yeasts were present in all nine bags, although fungi *Mucor* sp. was the only species identified. *Mucor* sp. is a fungus that is found in soil, plants and decaying vegetative matter however it is not pathogenic to horses. A lack of published data on the frequency and level of mould and yeast contamination in commercially available horse

feeds made it difficult to determine if testing more bags of horse feed would provide completely mould and yeast free feed therefore it was decided that the nine bags sampled would be used in the project, with the starting levels used as reference values to compare contamination level throughout the project.

One bag of feed was placed in each storage container with the same feedstuff remaining in the each container throughout the project. Feed was sampled after week 1, 2, 3, 4, 8 and 12 of the project and pooled on container type (SmartBunker, feed bag and metal dustbin).

**Results:**

Results of the mould and yeast analysis for each of the feed storage containers are shown in table 1. There was a general trend for lower levels of moulds compared to yeasts in all storage container types throughout the project. There was also a trend for the level of mould and yeast contamination to decrease from the start of the project to the end.

Comparison of contamination levels on a storage container basis showed that feed samples were generally contaminated with either moulds or yeasts at any one time and not both types of micro-organism. Feed samples from the SmartBunker containers contained only yeasts throughout the project except in week 12, when they were replaced by a low level of moulds (3,000 cfu/g, *Penicillium* sp.). The level of yeast contamination increased sharply in week 2 (30,000 cfu/g) but then decreased steadily until reaching zero in week 12. Moulds were not found in samples from the SmartBunker until week 12 indicating a slow growing mould may have been present or that the environment within the SmartBunker changed to favour mould growth. Moulds are able to survive with less water compared to yeasts therefore the moisture level of the feed within the SmartBunker may have gradually reduced throughout the project. The ability to retain low moisture levels would be advantageous in maintaining feed quality and hygiene by reducing the likelihood of mycotoxin producing moulds from developing.

Samples taken from feed stored only in feed bags contained the lowest overall yeast and mould contamination of all three storage containers. This is most likely due to the less favourable environment for micro-organisms growth; feed within the bags would have been susceptible to low temperatures and increased moisture but able to dry out quicker compared to that stored in either the SmartBunker or metal dustbins. The trend for decreased levels of yeast contamination throughout the project was also seen in the feed bag samples. Despite these favourable results, it is not recommended to store animal feed in feed bags alone as they are susceptible to vermin contamination and in environments where damp conditions are prolonged, such as temperate autumn and winter seasons, feed may not be able to dry out leading to prolonged high moisture conditions and an ideal environment for moulds and yeasts to proliferate.

Samples taken from the metal dustbins accumulated the highest mould and yeast samples with samples taken in weeks 1 and 2 being the only samples containing both moulds and

yeasts at the same time. The higher level of overall contamination found for the dustbins compared to the other storage methods combined with the presence of moulds and yeasts the same time indicate the bins provided a favourable environment for micro-organisms to grow and for feed hygiene to deteriorate.

**Table 1.** Yeast and mould contamination of an equine feedstuff stored for 12 weeks using three common feed storage methods.

| Storage Method | Sample Week | Contamination Level (cfu/g) | | Mould Species |
|---|---|---|---|---|
| | | Yeasts | Moulds | |
| SmartBunker | 1 | 3,000 | 0 | N/A |
| Feed Bag | | 8,000 | 0 | N/A |
| Metal Dustbin | | 1,000 | 5,000 | *Penicillium* sp. |
| SmartBunker | 2 | 30,000 | 0 | N/A |
| Feed Bag | | 0 | 2,000 | *Mucor* sp. |
| Metal Dustbin | | 6,000 | 2,000 | *Penicillium* sp. |
| SmartBunker | 3 | 9,000 | 0 | N/A |
| Feed Bag | | 5,000 | 0 | N/A |
| Metal Dustbin | | 50,000 | 0 | N/A |
| SmartBunker | 4 | 3,000 | 0 | N/A |
| Feed Bag | | 3,000 | 0 | N/A |
| Metal Dustbin | | 0 | 2,000 | *Penicillium* sp. |
| SmartBunker | 8 | 1,000 | 0 | N/A |
| Feed Bag | | 0 | 0 | N/A |
| Metal Dustbin | | 0 | 0 | N/A |
| SmartBunker | 12 | 0 | 3000 | *Penicillium* sp. |
| Feed Bag | | 0 | 1000 | *Penicillium* sp. |
| Metal Dustbin | | 10,000 | 0 | N/A |

**cfu/g: colony forming units per gram**

**N/A: not applicable due to no moulds present**

**Conclusions**

The nine bags of feed used in the project were purchased direct from the manufacturer and sampled the following day. Sampling the feed soon after purchase provided a reference value from which further analysis could be compared and information on the hygiene of feed available to the average horse owner within the equine industry. The finding that moulds and yeasts were present in feed used in both the present and previous study indicates that low level contamination may be common in horse feeds, but this contamination is not a risk to equine health due to non-pathogenic species being identified.

The finding that contamination levels were generally low and due to either moulds or yeasts and not both at the same time, suggests that the environment within the storage containers was not ideal for micro-organism growth. Micro-organisms that spoil feed require oxygen, moisture and a temperate environment, with moulds growing slower than yeasts. The SmartBunker consistently had no mould growth until week 12 although yeasts were present. As moulds are producers of pathogenic mycotoxins the risk of feed induced health problems was lowest from the feed stored within the SmartBunker. Metal dustbins provided a more suitable environment for mould and yeast growth with contamination with either moulds or yeasts found in every sample except that from week 8.

Results obtained in the project indicate that feed stored in the SmartBunker is likely to maintain a high level of hygiene due to low levels of mould and yeast growth. Storing feed in metal dustbins is not recommended due to the likelihood of condensation (first project) development and an increased moisture content that can promote mould and yeast growth. Storing feed in feed bags with no other protection did not reduce feed hygiene in this study however it is not recommended due to the unstable environment within the bag and the potential for vermin to contaminate feed with faeces and urine.