Stock Feed Manufacturers' Council of Australia
Stock Feed Manufacturers' Council of Australia Inc.
ABN 84 816 063 155
PO Box 151 Curtin ACT 2605
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8.1.3. Setting Use-by Dates for Finished Product

Standard

Is there a system to define how to set use by date periods for finished products?

Purpose

To ensure a formal system of setting use by date periods is implemented.

Reason

There are various factors that influence the quality and specification of a finished product, and these are typically product specific. Operators should be aware of the factors influencing their feed and validate their best before/use by date.

What is Acceptable?

Operators shall be aware of the factors influencing feed as these present feed safety risks to the stockfeed.

Moisture

Moisture content is a major factor affecting shelf life. When the moisture content of feed or a part of a feed exceeds 12.5%, there is an increased risk of feed deterioration. An average of 12.5% means that some samples will have higher than 12.5% moisture, presenting a greater risk. Moisture content can be measured by loss on drying (LOD), or by titration (Karl Fisher titration), as well as use of NIR technology for rapid analysis. Caution needs to be taken with use of raw materials containing higher moisture levels. Operators shall discuss with their laboratory representative the appropriate method for their finished product. If onsite testing is being performed, then equipment calibrations (Fact Sheet 2.2.4 to 2.2.7) and personnel training (Fact Sheet 3.2) will be in place.

Water Activity

Water activity (aW) quantifies the amount of free or unbound water and has been recognised as having greater significance with mould growth than moisture content. To measure water activity, laboratories use an electronic device to measure vapour pressure. Typically, as the temperature increases, aW increases. Water activity levels can range from 0.0 to 1.0. The higher the activity rate, the more quickly bacteria and mould grow.

The addition of water to feed through ingredient addition or application of steam during pelleting increases the water activity. Inadequate cooling post pelleting can result in higher water activity and potential for higher rates of feed deterioration.

Stock feed typically has aW levels below 0.6. Mould growth will occur when aW is above 0.6 and 0.8 for bacterial growth.

Raw Materials

Raw materials in use can make feeds more prone to deterioration. Particularly the inclusion of higher levels of molasses increases aW and moisture content. Attention needs to be given to the use of raw materials from other milling processes such as millmix/millrun where the flour mills utilise water in wheat conditioning. Raw materials should be monitored to ensure they do not contain excessive levels of moisture, sorghum can at times exceed the maximum 13.5% moisture receival standard.

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Bagged Feed Packaging

The material used can impact on the ability of the feed to "breathe" during storage. As many manufacturers have moved to either tighter woven poly bags or more solid plastic bags, there is reduced capacity for air circulation and potential sweating of bags. A critical factor when looking at changing packaging materials is to complete feed deterioration studies to ensure there are no unexpected problems following the change. With the introduction of recycled packaging requirements, new packaging shall be tested for "breathability" and how this effects shelf-life.

Feed Cooling

Inadequate airflow through the cooling process post pelleting, steam flaking or steam rolling is seen to limit the capacity to reduce moisture content to acceptable levels. The manufacture of larger diameter cubes is also known to present greater risk as longer cooling times are required to reduce feed temperature and moisture content. Operating coolers through high humidity periods presents greater challenges in reducing moisture content. Bulk feed inadequately cooled and delivered in bulk silos can result in sweating and condensation within the silo, with an increased risk of mould growth.

Storage Climatic Conditions

The conditions directly impact on the feed's shelf life. This especially applies in tropical conditions, experiencing both higher humidity and temperatures. Feeds that show no physical deterioration in dry climatic conditions can be prone to mould growth when supplied into tropical areas. Feeds that are exported and pass through tropical areas in shipping containers are significantly more prone to deterioration.

Storage Silo Condition

Silo ventilation and/or leaking silos can result in poor feed storage and reduced shelf life. At the mill, finished product silos and bins need to be regularly inspected and repaired as required. On farm storage conditions can often be less than desired. Delivery drivers should be trained to identify problems when delivering feed and alerting both the farm manager and feed company. Both at the mill and on farm, silos and bins should be completely emptied and cleaned out on a regular basis.

Sunlight Exposure

Direct sunlight has a detrimental effect on feed active constituents such as vitamins and feed additives. Bagged feeds should not be stored where there is direct sunlight. Resellers shall be notified of appropriate storage conditions and avoid storage of bagged feed in direct sunlight.

Mill Hygiene

Hygiene in removing spilt feed, broken bags, old stock, dust, cobwebs and vermin control is required. This should include regular storage area inspections looking for weevil or other insect presence and actions to reduce infestation. For many mills and retail outlets lemon mite has been a recurring problem that requires vigilant hygiene controls. Vermin control is an essential requirement to stop feed damage and bacterial contamination from rats and mice faecal material.

What goes wrong?

Mould is the most common observation of feed deterioration either on or in the feed. This can result in feed clumping, impaired feed flow through silos and bins, reduced feed acceptability to livestock, and the potential for mycotoxin production. The following table provides an indication of the levels of mould count that are considered unacceptable for different livestock species, with pigs and poultry known to be more susceptible than ruminants to mould presence. Mould counts can be completed by commercial testing laboratories.

Table 1. Guidance on the acceptable level of TMC in various species.

Hygiene Standard	Quality Interpretation	PIG	SOW	PIGLET	BROILER	LAYER	BEEF	DAIRY
Total Mould Count TMC (cfu/g)	Good	1,000	1,000	1,000	1,000	1,000	1,000	1,000
	Acceptable	5,000	5,000	5,000	5,000	5,000	10,000	10,000
	Poor	>10,000	>10,000	>10,000	>15,000	>15,000	>50,000	>50,000

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Bacterial growth requires higher levels of aW than mould growth. The presence of bacteria is found at low moisture/aW levels; however, they will not reproduce and increase in number until a desirable aW is reached. For bacterial growth to become a significant risk for end users, the feed will already be displaying high levels of mould growth. Stock feed that has deteriorated to show high levels of mould growth and potential bacterial risk should not be fed to livestock. Such feeds should never be reprocessed or remixed into other feeds (Fact Sheet 8.4.1). When there are concerns over feed moisture levels, and/or higher risk raw materials are in use, or feed storage conditions are less than desirable, inclusion of mould inhibitors should be considered.

Moisture and **warmth** are the two factors favourable for **insect multiplication** in grain. Based on work with grain, temperatures below 15^{0}C help to suppress insect growth. Feed moisture levels above 12% increases the risk of insect infestation. Ensuring raw materials used in feed manufacture do not contain live insects greatly assists in ensuring a lower risk of subsequent insect presence in finished products. The mill hygiene program (Fact Sheet 2.7.1 & 2.7.3) shall focus on regular monitoring and inspection for insect presence, areas of potential multiplication and actions to reduce spilt feed.

Rancidity is the process by which fats and oils are broken down or oxidised in feed. This results in objectionable odour and decreases the palatability of feed. If the formulation contains ingredients that are rich in unsaturated fatty acids, measures to reduce fat oxidation shall be implemented. This is common in feeds formulated for young and sensitive stock. Storage conditions also affect the risk of rancidity. Operators shall mitigate feed that is stored for extended period of time and under hot weather conditions (Fact Sheet 2.3.1).

Measures to mitigate rancidity include designing appropriate storage conditions out of direct sunlight or stored directly on ground. Additionally, the inclusion of antioxidants is recommended to delay the process of oxidation. For monitoring rancidity in feed, operators can measure the Peroxide Value (PV) at a certified laboratory. PV of an oil or fat is a measurement used to detect the extent to which rancidity reactions have occurred during storage. Other methods including measurement of free fatty acid (FFA) are available, however PV is most commonly used.

The inclusion of **vitamins, medication** and **feed additives** should be risk assessed to determine the risk and rate of activity decline. Customers depend on the specification provided for finished feeds, and operators shall ensure their activity level is according to specification. Several factors affect the activity level, such as but not limited to:

- Storage prior to manufacture of feed.
    - Most vitamins, medication and feed additives are sensitive to high temperature, moisture and sunlight.
- Post-manufacture activity decline in storage.
    - This rate is increased when stored under high temperature and humidity.

Stock feed manufacturers and nutritionists need to take account of storage conditions and shelf life when formulating active constituent levels in feed. Many of these materials suffer from oxidation, with inclusion of antioxidants being required under more challenging feed storage conditions. Or, where there will likely be a longer period between manufacture and feed consumption. Feed mills should initially consult with their premix and feed additive supplier to acquire knowledge and data relating to product shelf life. Suppliers may also complete best before studies for clients. Vitamin and medication analysis can become expensive and requires laboratories to have competency in the analysis required. Before initiating sample testing it is important to gain from the laboratory an assessment of their level of accuracy with the relevant assay.

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Use by Date Validation

Stock Feed Manufacturers must validate the use by date that is placed on products supplied to end users. This can be achieved by completing shelf-life tests. Finished feeds are kept at different temperatures over a period of time, a sample is collected and testing conducted. The number of samples collected, and the sampling method are important for accuracy of information. The following tests can be conducted:

Table 2. A general overview of tests carried out for use by date or best before validations.

Microbial Counts	a. *Escherichia coli* (O157:H7) & Coliforms. b. Total Plate Count. c. Yeast & Mould (important for fungal growth). d. Salmonella. e. Listeria.
Vitamin, Minerals, Amino Acids	Detect the degradation over time and whether the levels have slipped below specification.
Fat oxidation	a. Peroxide value (PV), or b. Free fatty acids (FFA). For feeds formulated to contain higher fat levels.
Medication	Study the decline in activity. Note of caution - check with your medication supplier regarding accuracy/ recovery of medication. Some analysis testing can be +/- 20% in accuracy.
Nutritional Profiling	Examples include: a. Energy. b. Crude protein. c. Fat content. d. Sodium. e. NDF. f. Moisture. g. Ash.

With each of these tests it is essential to determine the starting level and compare the change over time. Feeds can be stored under "typical" storage conditions or under more extreme conditions. The methodologies vary and the operator shall discuss with their laboratory representative the most appropriate test. Some methods include, but not limited to:

1. **Direct Method:** Real-time shelf-life testing mimics the actual storage conditions and is an accurate estimation of the time it takes for a product to deteriorate. However, these can be time-consuming.
2. **Challenge Test:** The intentional inclusion of pathogens or microorganisms into the feed product during manufacturing. This test is limited to detecting the effects of pathogens and microorganisms only.
3. **Accelerated Shelf-life:** Manipulating temperature and humidity to accelerate the deterioration of feed. The study is versatile and relatively low cost; however, they do not measure the exact representation of shelf life. VICH guidelines can assist with accelerated trial parameters.

<u>Best Before/Use by Date Recommendations</u>

Recommendations listed below are subject to individual company verification testing to support alternate time-period.

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Table 3. Guideline for recommended best before and/or use by date. Each finished feeds requires validation through testing.

Product Type	Period	Comments
Finished Feed – general	6 – 12 months	Most feeds
Finished Feed – high fat + moisture	3 – 6 months	Products for younger stock containing fats and milk powder, high molasses content
Finished feed – high temperature & humidity in storage	3 – 6 months	Summer, tropical/subtropical climatic conditions
Mineral lick blocks and supplements	12 – 24 months	
Premix & supplements	6 – 12 months	
Liquid feeds	6 – 12 months	