

Campden BRI
Station Road
Chipping Campden
Gloucestershire
GL55 6LD, UK



Tel: +44 (0)1386 842000
Fax: +44 (0)1386 842100
www.campdenbri.co.uk

Animal Feed Safety and Quality

Assuring food safety at all stages of the feed chain – including on farm – is crucial to the assurance of the safety of food and drink products in the food supply chain. Safety control measures are typically integrated into good practice measures (e.g. GAP – Good Agricultural Practice; GMP – Good Manufacturing Practice; GHP – Good Hygiene Practice). Concomitant with assuring safety is maximising quality – the procedures and measures undertaken to assure safety also impinge on quality and can be used to optimise it.

This white paper looks, in general terms, at the factors that affect feed safety and quality. It addresses how these issues arise and are controlled, highlighting the similarities and differences from food safety and quality.

We offer a range of services to the food and drink sectors that are equally applicable to the animal feed sector. Specifically, we can help with operational support – HACCP, risk assessment, hygiene and legislation issues, and traceability systems – and with supplier approval systems. We can also help with practical processing and production issues and such things as pesticide residue, mycotoxin and heavy metal analysis, particle shape and size studies, and foreign body identification. For details on how we can help you, please contact:

Simon Penson
+44(0)1386 842280
Simon.penson@campdenbri.co.uk

Chris Knight
+44(0)1386 842012
Chris.knight@campdenbri.co.uk

Introduction

Animal feed safety and quality have come to the forefront in recent years, and the feed sector now finds that it needs to be applying food safety and quality measures, which are common practice in human food sector.

Feed must be safe for consumption by the animal. For example, it must be free from mycotoxins and any other chemicals that would be harmful to the animal, and it must not introduce pathogenic microorganisms to the animal. The resulting meat, milk or eggs must also be safe for human consumption. Things to consider here include, for example, the accumulation of pesticides, heavy metals and other toxins with long half-lives in meat and other animal products – things that might not be of concern to the animal itself, but which might be harmful to human health when consumed over time.

The quality and performance of animal feed is also receiving much more attention. High commodity costs continue to put pressure on margins. In order to maximise performance, a deeper understanding of raw material quality in relation to cost and performance is required. There is a need to ensure most cost effective formulations per unit of productivity (e.g. weight gain per kg of feed) – a factor that does not have to be considered in human food production. For example, there is a lack of fundamental understanding of why some varieties of wheat and maize may perform better in feed formulations than others; this is related to protein, carbohydrate and lipid compositions and interactions. There is also a need to ensure maximum return on investment from formulation costs (e.g. enzymes and other supplementary ingredients).

Safety issues are best controlled by a hazard analysis approach – identifying the realistic potential problems and putting measures in place either to prevent their occurrence or reduce the level of a hazard or the likelihood of its occurrence to acceptable levels. Much of this can be done by standard good hygiene and good manufacturing practices. The sector is actively adapting best practices from the food and medical sectors into animal feed production, and more prescriptive standards are now being formulated and adopted. In addition, legislation surrounding feed safety is now more closely mirroring that which controls food and drink.

The control of quality issues is more commercially based – deciding on which of a multitude of options is appropriate for the particular situation, taking into account the imperative for safety. This would include, for example, feed particle size, and the addition of nutritional supplements or enzymes into the mixture.

Who and what is involved?

Two specific groups of people are involved in maintaining feed safety and quality: the manufacturers of the individual ingredients (both the basic grain raw material and the nutritional supplements and formulation enhancers), and the compounders and feed manufacturers.

In essence, they are looking to assure feed safety, including the minimisation of contamination, control the cost of raw materials, and optimise their quality.

Safety issues

Three main factors drive the feed safety agenda:

- Legislation, which lays down minimum feed hygiene requirements
- Customer demands and expectations, which are monitored through auditing to check feed business compliance
 - Technical standards
 - Good Hygiene Practice
- Business requirements – industry is duty-bound to maintain the safety and quality of their products
 - Safe, quality and legal products
 - Environmental, social and economic sustainability

Legislation

In the European Union, much of feed safety is regulated by three areas of legislation:

- EU Regulation 178/2002 on the general principles of food (and feed) law
- EU Feed Hygiene Regulation (183/2005)
- National regulations implementing the above

The feed-related Articles of 178/2002 impose a number of responsibilities on feed business operators; e.g. Article 15 states that.... *“feed must not be unsafe, i.e. it must not have an adverse effect on human or animal health, or make animal products (milk, meat and eggs) unsafe for human consumption”*.

The more specific Feed Hygiene Regulation (183/2005) lays down general rules on feed hygiene, and came into force across the whole of the EU on 1 Jan 2006; its principal objective is to ensure a high level of consumer protection with regard to food and feed safety. Primary responsibility for feed safety rests with the feed business operator, and there is a need to ensure feed safety throughout the food chain – from primary production to the feeding of feed to food-producing animals.

Article 6 on Hazard Analysis and Critical Control Points states that: *“Feed business operators ... shall put in place, implement and maintain a permanent procedure or procedures based on the HACCP principles.”*

It stops short of requiring a full documented HACCP system, but the requirement applies to feed business operators and some farms, such as those that add additives and premixes to

home mixed feeds. The HACCP principles are described in the legislation, and are essentially the same as those implemented in food safety control: identifying hazards and critical control points; establishing critical limits; monitoring at the critical control points; establishing corrective actions to be taken when necessary; and verifying, documenting and reviewing the system.

The legislation also requires feed business operators to provide the competent authority with evidence of their compliance with the system in the manner that the competent authority requires - taking account of the nature and size of the food business, and ensuring that any documents describing the procedures developed in accordance with the system are up-to-date at all times.

Detailed guidance on how to devise and operate a HACCP plan in feed production and use is given in [HACCP in produce and feed](#) (Campden BRI Guideline 64), as well as in [HACCP: A practical guide](#) (Campden BRI Guideline 42). In feed production, it is recognised that in many scenarios, control is best exercised through good practice, rather than through specific critical limits. The legislation refers to this.

Regulation 183/2005 also requires feed business operators (other than most farms) to comply with detailed standards concerning facilities and equipment, personnel, storage, transport and record-keeping (GHPs). It requires farms, including home mixers, to follow basic hygiene procedures in relation to the feed they use and apply a risk-based approach to ensure hazards are properly controlled (GAP/GHP). Farms that buy in additives and premixtures and add them directly to feeds have to apply the principles of HACCP in a formal way.

In addition, there is specific legislation on the labelling of feeds. In the UK, this is included in the Animal Feed Regulations 2010.

Safety hazards

The hazards encountered in animal feed can be chemical, physical or microbiological. Chemical hazards include mycotoxins, pesticides, veterinary residues, technical additives such as copper, cleaning chemical residues, and environmental contaminants such as dioxins and heavy metals. Physical hazards include glass, metal, wood and other materials, and insects. Microbiological hazards include *Salmonella*, *Escherichia coli*, and other 'vegetative' pathogenic micro-organisms.

Typical hazards and their sources include:

Vegetative pathogens

Presence on raw materials due to contamination at previous stages

Introduction in the factory from

- pests (birds, insects, rodents)
- people (staff, visitors, contractors)
- equipment (unclean storage bins, process equipment, etc.)
- cross contamination in the process (from previous production)
- dust in air used for cooling

Growth due to conducive conditions in storage (moisture and temperature), e.g. feed raw materials

Survival due to under conditioning (low process temperature and/or time)

Mycotoxins

Presence on raw materials due to contamination at previous stages (e.g. crop production, suppliers' storage operations)

Growth due to growth of causal fungi on feed materials due to conducive conditions in storage (moisture and temperature)

Pesticides

Presence on raw materials due to contamination at previous stages (e.g. crop production)

Introduction due to incorrect application in the process (e.g. insecticides in storage)

Veterinary medicines

Introduction due to

- feed incorrectly formulated
- cross contamination in the process (previous production)

Technical additives

Introduction due to

- feed incorrectly formulated
- cross contamination in the process (previous production)

Cleaning chemical residues

Introduction from contaminated equipment (from cleaning operations) in the factory

Undesirable substances (environmental contaminants)

Presence on raw materials due to contamination at previous stages (e.g. crop production)

Glass

Presence on raw materials due to contamination at previous stages

Introduction from the environment (lights, etc.) in the factory

Metal

Presence on raw materials due to contamination at previous stages

Introduction from equipment in the factory

Survival due to failure of magnets and/or metal detector in the process (complete or partial failure)

Previous stages in the supply chain include, for example, crop production, storage and primary process operations at the supplier.

A range of extremely powerful analytical techniques is available both for troubleshooting of problems that have arisen and as a part of a 'due diligence' programme targeted at specific hazards of most relevance (risk) to particular feed materials. These techniques include, for example, mass spectrometry, analytical microscopy, and molecular (DNA) methods (which can be applied to the feed itself or specific contaminants such as microbes) as well as sophisticated particle shape and size analysis and imaging technology.

Quality issues

From a feed manufacturer's perspective, quality relates to the feed having the properties, over and above safety, that the customer requires. This includes the technical/nutritional properties that it needs to fulfil, and specific characteristics, such as suitability for organic production. The combination of these is likely to be specific to an individual feed, but some generic examples include:

- correct balance of micronutrients for the species
- correct performance, e.g. does not cause sticky faeces, adequate weight gain per kg of feed

What do you need to do?

Clearly, feed manufacturers, the users of feed, and those that use products of animal origin (meat and poultry, milk and eggs) need to be clear about what characteristics they are looking for. Food manufacturers need to communicate with the primary producers about this, and the primary producers need to relate this to the ingredients they are buying from the feed manufacturer. The latter need to apply HACCP principles to their production operation, as do the primary producers.

Specific things that could need checking include:

- Mycotoxin levels

- Pesticide residue levels
- Physical contaminants
- Veterinary residue levels
- Heavy metal levels

- Pathogenic microorganisms

- Particle size
- Enzyme activity

- Organic status
- Supplier approval and auditing systems

- Legislation

Traceability

The need for traceability applies as much to the feed chain as it does to the food and drink chain. It is relevant to both safety and quality issues. If you are a feed producer/supplier and your product is out of specification for any reason, you want to know why and to whom it might have already have sent. Similarly, if you are a primary producer, and there is a problem with your product that is feed related, you will want to know which batches of feed are implicated, where the feed originated, and where (if released) your product has been sent.

Conclusion

It is clear that the basic issues surrounding feed production and formulation are similar to those facing producers of food for humans. The product has to be safe and effective (and cost-effective), and sustainable. As well as customer and business requirements acting as drivers, there is also legislation to ensure safety. Again, this is broadly similar to the situation faced by the food industry, and the steps that the feed industry must take are also similar. Many of the services that we offer to the food industry are equally applicable to the feed industry, such as analytical services, HACCP and legislation advice. Please do contact us if you would like to discuss any of these issues further.

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