Feed Safety-A European perspective

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Brief Curriculum

- In 1981 Jon Ratcliff, an honours graduate from Reading University, joined national UK feed company J Bibby Agriculture as a poultry nutritionist. During his fifteen years with Bibby, and latterly ABN, he undertook various management responsibilities culminating in his appointment as General Manager in 1990 and Commercial Manager in 1994, with responsibility for five feed mills and a combined annual output of 400k tonnes.
- In 1996 he left to set up his own consultancy business, Food & Agriculture Consultancy Services (F.A.C.S.). As well as providing a core nutritional, formulation and purchasing function for pig and poultry operations, F.A.C.S. specialises in the implementation of HACCP based Food Safety Programmes from farm through to slaughter. Against the background of increasing concern about global food scares and a more demanding customer base, activity in this area has increased dramatically. During the past five years, F.A.C.S has been consulting for the UKs largest supermarket, Tesco, on matters relating to animal feed and animal feed production. Issues addressed include the removal of antibiotic growth promoters and animal by-products, the segregation of non-genetically modified raw materials and implementation of HACCP within the animal feed and raw material supply industry.

(Translator)

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Brief Curriculum

- 1970~1976 Nutritionist, Feed Plant Manager, Korea-Cargill Co. Ltd., Suwon, Korea
- 1973~1976 Graduate Studies, Seoul National University (M. Sc. in Animal Nutrition)
- 1976~1980 Graduate Studies, University of Alberta, Canada (Ph. D. in Poultry Nutrition)
- 1980~1981 Research Associate, Department of Animal Science, University of Alberta, Canada
- 1981~1982 Assistant Professor, Department of Animal Science, University of Manitoba, Canada
- 1984~2002 Professor, Department of Animal Science
  Major in Animal Nutrition and Feed Technology
- 1994~1995 Visiting Professor, Department of Animal Science, University of British Columbia, Canada
- 1982~1984 Nutritionist, Feed Mill, Surrey Co-op Assoc. Abbotsford, BC, Canada
- 1999~2001 Honorary President, Korean Society of Animal Nutrition and Feedstuffs

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INTRODUCTION

In just a few years the European Feed industry has gone from one that held essentially no interest for consumers to one that is now perhaps the highest profile component of the food chain. During the past ten years consumer confidence in the European feed manufacturing and livestock industries has all but collapsed due to a series of high profile food scares which have included bovine spongiform encephalopathy (BSE), dioxin contamination, outbreaks of food borne pathogens and drug and chemical residues. Most of these scares have occurred despite the widespread implementation of quality systems such as ISO and GMP and have only served to highlight the ineffectiveness of self regulation and strengthen the deep distrust felt by most European consumers towards political efforts to regulate food safety. European supermarkets have recognised that food safety is the number one ingredient within the food chain and the majority of their consumers now perceive the supermarkets as the enforcers of food safety. This paper will focus on the recent measures to enhance food safety within the animal feed industry in Europe.

BACKGROUND

Animal feeding systems in Western Europe are highly developed. Poultry and pig production units have become almost exclusively intensive in large units and dairying and beef has followed a similar trend. Diets have to be formulated with high quality protein to

sustain efficient growth and feed conversion. Although these may be derived of vegetable origin (soyabean, rapemeal etc), they require supplementation with amino acids and the best sources from a nutritional perspective are animal and fish meals. Up until the late 1980s most consumers in Europe were ignorant of the animal feed industry and the animal by-product rendering industry. Most farmers were also ignorant of the industry in terms of the range and quality of raw materials incorporated in animal feed. Two events in the UK were to change that ignorance forever; BSE and the Salmonella enteriditis scare in eggs. Although unrelated, both were directly associated with the inclusion of animal by-products in feed for farm animals. In the case of BSE, at issue was the practice of feeding re-cycled animal protein back to ruminants whereas in the case of the salmonella scare the issue was contaminated feed being fed to layer hens and breeders, particularly from higher risk materials such as meat and bone meal. In both cases the message portrayed by the media was an industry using "unsafe" materials in the quest to maximise profits. Far from learning from these disastrous events, the feed industry continued to supply the media with a catalogue of food scares throughout the 1990s including antibiotic resistance, dioxins, heavy metals, genetically modified ingredients, pesticide residues, mycotoxins, used cooking oils and sewage waste. Not surprisingly, consumer opinion on the animal feed industry is extremely negative in Europe and most of the initiatives to restore confidence have been retailer driven.

POTENTIAL HAZARDS ASSOCIATED WITH ANIMAL FEEDS

BSE

In 1988, following the epidemic proportions of BSE within the UK dairy industry and the quantity of evidence linking the feeding of meat and bone meal and BSE, the UK

government outlawed the feeding of mammalian protein to ruminants. British government officials had assumed that by banning meat and bone meal in ruminant diets the epidemic would start to subside. What they had overlooked was the scope for both intentional and unintentional contamination. Apart from specific poultry integrator feed mills, most UK feed mills back in 1988 were multi species. No consideration was given to the fact that multi species mills would continue to use meat and bone meal in pig and poultry rations. Tests have shown that unless completely separate lines are installed it is almost impossible to prevent cross contamination of meat and bone meal within a multi species feed mill because of the common intakes, elevators, conveyors, mixers etc. Rather than declining post 1988, the number of diagnoses of BSE continued increasing until a peak in 1993 when nearly 40,000 cases were confirmed. The emergence, in 1991, of the first born-after-the-ban cases of BSE should have triggered a complete challenge to the ruminant feed ban. The failure at that time to undertake any risk assessment resulted in an escalation of the disease as well as extended risk to the British consumers. Finally, in 1996, once the link between BSE and new variant Creuzfeld-Jacob Disease (vCJD) was admitted, the UK government implemented a ban on all mammalian meat and bone meal being fed to all species. Certain British supermarkets had already banned the material in pig and poultry rations, along with tallow, feather meal and blood meal since 1994. Against this backdrop it seems somewhat surprising that it was only in January 2001 that meat and bone meal was banned throughout the EU to all species of livestock. Since 1994 when the ruminant ban was implemented in the EU, feed plants (as was the case in Britain earlier) continued to use meat and bone meal at multi species feed mills. In addition large tonnages of meat and bone meal were still exported to more than 70 countries, including most European countries, Japan, Thailand, Philippines and Indonesia up until 1996.

The absence of meat and bone meal and other mammalian by-product materials has led to the necessity to re-evaluate the nutrient values of raw materials particularly in relation to amino acid digestibility. This has led to a corresponding increase in the use of synthetic

amino acids. Most feed companies now formulate according to digestible amino acids rather than crude protein. It is recommended that synthetic amino acids comprise no more than 25% of the total digestible amino acids. We have also seen the development of blended combinations of extruded, full fat protein sources, such as peas and canola or beans and canola, which improve digestibility in comparison to the individual ingredients. One of the key developments which have helped overcome some of the problems associated with vegetable based diets has been the widespread use of enzymes.

Antibiotic growth promoters

The discovery that microbes are highly effective at combating new antibiotics through resistance mechanisms, has led the EU to take what are considered excessive measures in relation to the use of antibiotic growth promoters in animal feed. Following the ban on the use of in-feed antibiotic growth promoters (AGPs) by Sweden, in 1986 and Denmark in 1996, the EU has come under intense pressure to remove all growth promoters. Despite scientific committee advice, politicians have already banned popular growth promoters such as virginiamycin and zinc bacitracin such that apart from ionophore coccidiostats, only avilamycin and flavomycin remain licensed for use in animal feeds. The issue causing concern is potential antibiotic resistance in humans and animals. The DANMAP report from Denmark concluded that, since the ban, *Enterococccus faecium* resistance to avoparcin and virginiamycin decreased significantly in pigs and broilers. The EU is now committed to banning the remaining two growth promoters within the next three years. A ban on all growth promoters would also threaten the use of ionophore coccidiostats which would have serious implications for the poultry industry. Certain UK supermarkets have pre-empted the EU by already implementing a ban on all growth promoters in poultry. They are keen to extend the ban to pigs and ruminants but are waiting to see how the poultry industry copes in terms of therapeutic antibiotic usage. In Europe the poultry industry is reliant on wheat

based formulations which are associated with a higher incidence of necrotic enteritis. Certain gram positive antibiotic growth promoters are very effective at helping control clostridia perfringens which are the group of bacteria that produce the toxins associated with necrotic enteritis. The removal of antibiotic growth promoters has led to an increase in the incidence of necrotic enteritis and a subsequent rise in the use of therapeutic antibiotics. Concern about the rise in therapeutic antibiotics has led the UK supermarkets to very recently allow the limited use of avilamycin within the broiler production cycle. It remains to be seen whether this action will reverse the trend in therapeutic antibiotic usage.

The poultry industry has responded to these changes by exploring the efficacy of a wide range of "alternative" in-feed additives that claim to provide similar benefits in terms of performance and health. The most common types of alternative additive are organic acids, herb and essential oil extracts and mannan oligosaccharide. Due to the nature of some of these products, particularly herb extracts, active ingredient levels are not declared and therefore dose response data is limited. The EU has also implemented a rigorous scrutiny of producer strains of feed enzymes and micro organisms used as probiotic feed additives with a view to eliminating any possibility of the transference of antibiotic resistant genes. Pig and poultry producers report varying levels of success compared with antibiotic growth promoters. It is however clear that to add no replacement results in longer term increases in mortality and dependence on antibiotics. In conjunction with strategic changes in management and nutrition, certain pig and poultry producers have been able to maintain, and in some cases improve, performance relative to growth promoters using alternative products.

Veterinary Drugs

Veterinary drugs may be administered in animal feeds for livestock and aquaculture. If good manufacturing practices (GMP) are employed then Maximum Residue Levels (MRLs) should not be exceeded. However, from the reported cases of residues in foods of animal

origin, it is clear that GMP is not being applied effectively. The most common cause of residues is cross contamination occurring within the feed mill and / or the failure to implement the appropriate withdrawal period prior to slaughter. To combat the cross contamination issue, many feed companies are either refusing to incorporate veterinary drugs in the feed or are limiting their use to specific manufacturing sites. The screening of imported food products is being stepped up by the EU following the finding of the banned antibiotics, chloramphenicol and nitrofuran residues in fish and poultry products imported from China, Brazil and Thailand.

Agricultural and other chemicals

The dioxin scandal in Belgium has not surprisingly led to further regulation in Europe in an attempt to protect consumers from undesirable substances such as polychlorinated biphenyls (PCBs), dioxins, mycotoxins, pesticides, fungicides and heavy metals such as mercury, lead and cadmium. Dioxins and PCBs are ubiquitously present as contaminants in the environment and dietary intake of foods of animal origin represents the most common route of human exposure. Animal feeds can be an important source of contamination for livestock. Contaminated fats and oils added either intentionally (as in the case of Belgium) or unintentionally are a potential source of contamination of dioxin and PCBs to animal feeds. The EU has now implemented a complete ban on the use of Used Cooking Oils (UCOs) which are derived from recycled restaurant fats etc, in an attempt to limit the threat of dioxin contamination. The recent scandal involving hormone contaminated molasses highlights the threat posed to the feed industry by environmental pollutants. Once again testing of imported raw materials and animal products has been increased following the discovery in Germany of organic wheat contaminated with a banned pesticide imported from Ukraine.

Zoonoses

Incidents of food poisoning receive widespread publicity and the animal feed industry has had to respond positively to demonstrate its responsibility in controlling zoonoses derived from animal feed. Codes of Practice are focusing on the hygiene status within feed mills and treatment of raw materials to reduce or eliminate pathogens such as salmonella. The standards we now strive for are food standards not feed standards. Significant improvements have been made in the Europe in the reduction of salmonella contamination in poultry meat. Much of this success has been the result of the efforts within the feed industry through measures such as heat treatment and treatment of the raw materials and finished feed with bacteriocides. Measures to control E. Coli and campylobacter contamination have been less successful and further legislation is anticipated. Disease outbreaks such as Avian Flu, Foot and Mouth disease and Swine Fever, serve to highlight the importance of biosecurity procedures. Foot and Mouth in the UK has led to the banning of catering waste and in particular swill feeding of pigs. Biosecurity is only as good as the weakest link in the chain. The feed industry must make sure it applies appropriate measures that will include bacterial status of the feed, vehicle cleanliness, procedures at arrival at the farm such as wheel sprays and clothing and transport scheduling.

Mycotoxins

Mycotoxins are a diverse range of molecules that are harmful to animals and humans. They are produced as secondary metabolites by moulds or fungi growing on agricultural products ("field toxins": fusarium) before or after harvest during transport and storage ("storage toxins : aflatoxins, ochratoxins"). Of the 200,000 known species of moulds and fungi most are beneficial to man in the production of bread, cheese, antibiotics etc. However, there are more than 300 which are known to have harmful effects on animals and

humans. The mycotoxins are produced by the moulds or fungi as they metabolise the nutrients present in the feeds and feed ingredients, thus contaminating the feed. Mycotoxins are metabolised in the liver and the kidneys and also by micro organisms in the digestive tract. Therefore, often the chemical structure and the associated toxicity of mycotoxin residues excreted by animals or found in their tissues are different to the parent molecule. Some of these mycotoxins have greater significant impact on economic returns and have varied species susceptibility. They have a range of toxic, carcinogenic, mutagenic and teratogenic effects in animals and humans. No region of the world escapes the problem of mycotoxins and according to the United Nations Food and Agriculture Organization approximately 25% of the worlds grain supply is contaminated. These toxins are mainly produced by the fungi genera of Aspergillus, Fusarium, Penicillia and Claviceps. Whether grain is produced in temperate, sub tropical or tropical climates, if rainfall and humidity are experienced in the harvest season, infection of the grain by mould or fungi is likely. Where there is mould growth the likelihood of mycotoxins is significant although the presence of mould does not necessarily imply that mycotoxins can be found. Conversely, the absence of mould does not necessarily mean the absence of mycotoxins. Mycotoxins in combination appear to exert greater negative impact on the health and productivity of livestock in comparison to their individual effects. This is important when considering analysis of feed materials in terms of interpretation of the levels found and the mycotoxins to be tested. Mycotoxins are regularly found in feed ingredients such as maize, sorghum, barley, wheat, rice meal, cottonseed meal, groundnuts and other legumes. Most are relatively stable compounds and are not destroyed by processing of feed. Due to the global import and export of raw materials, no country can be considered not to be at risk from mycotoxins. Mycotoxins, or their metabolites, can be detected in meat, visceral organs, milk and eggs. Limits on aflatoxin levels in milk and animal feed already exist in the EU and new legislation is being implement governing maximum levels for ochratoxin, zearalenone and DON in both human foods and animal feeds. The response from feed suppliers is a much

greater awareness of the use of mycotoxin binders and a noticeable shift away from aluminosilicate and clay binders to natural low inclusion binders, such as esterified gluccomannan extracts from yeast cell wall, that exhibit strong binding capacity across a wide range of toxins.

Genetic Modification

The reliance on soya and other vegetable proteins is further complicated by the trend in Europe away from genetically modified (GM) raw materials for animal feed. Most of the major supermarkets in Europe have banned genetically modified macro ingredients such as soya and maize. The demand for non-GM raw materials has increased significantly this year resulting in a two-tier market for soya. At present the supply chain has absorbed the differential but as demand increases the differential may well widen and consumers might then begin to see the difference in food costs. The feed industry has had to implement HACCP risk assessment to identify and control cross contamination within the supply chain. Supermarkets have insisted on the use of certified non-GM raw materials and some have set up their own audit trails to verify traceability from the supermarket shelf back to the individual farms in the country of supply. The EU is still debating regulations relating to the labeling of animal feeds that contain GM ingredients. At the time of writing, there appears little sign in Europe of consumer resistance to genetic modification declining.

CONTROL OF FEEDBORNE HAZARDS

Given the direct link between feed safety and foods of animal origin it is essential that feed production is considered in the same way as food production in terms of quality assurance, and food safety systems based on Hazard Analysis Critical Control Point

(HACCP). As well as dictating animal production methods and feed ingredients, a number of the larger UK supermarkets have produced Codes of Practice regulating the production of animal feed. Until the early 1990s the feed industry was mainly self-regulated although most companies had taken on ISO or GMP certification. However it is significant that all the major food scares that have originated from the animal feed industry during the past decade occurred despite the implementation of ISO and GMP. These quality systems provide good documentation and traceability procedures but do not address the fundamental issue of risk assessment and control. HACCP has been adopted from the food processing industry and applied to the rest of the food chain, including the production of animal feed, as a direct result of pressure from the UK's major supermarkets. HACCP provides the means of analysing the potential hazards within the production, transport and storage process and identifying how effectively each hazard is controlled and the appropriate corrective actions required in the event of a non-conformance. The HACCP system is now mandatory within the UK and more recently throughout the EU and independent certification is provided under the audit standard EN45011. HACCP is a proactive system and if implemented correctly will drive the day-to-day feed production process. However, HACCP does not eliminate risk and regular review of the system is required particularly as new hazards become defined such as industrial chemicals and genetically modified raw materials. The feed industry bodies in the UK (UKASTA) and Europe (FEFAC) have now introduced an independently audited code of practice for its members covering raw material supply, transport, feed manufacture and supply. Both the supermarket codes and the industry codes are based upon HACCP principles.

In 2001 the EU Commission established a European Food Safety Authority which will be responsible for evaluating all aspects of food and feed safety from farm to fork, incorporating risk analysis, risk assessment and risk management. One area that will come under further scrutiny is feed additive evaluation and approval. New legislation will encompass all feed additives, including herbs, spices, natural extracts, neutraceuticals etc to evaluate standards of safety, quality and efficacy.

CONCLUSION

The European animal feed industry is at last recognizing that its customers are not just the farmers who purchase the feed but the consumers and retailers who sell and consume the animal products. They also recognize that food safety is not negotiable. The last decade has demonstrated only too well that certain chemical substances and biological agents incorporated into feed, either intentionally or unintentionally, can result in hazards in food of animal origin and may enter feed at any stage of production up to the point of feeding. Where foodbourne hazards originate in feed, the hazard must be adequately controlled. HACCP enables feed manufacturers to identify the risks and control the hazards in a proactive manner. To operate quality control on a reactive basis is no longer acceptable. A long term viable global feed industry depends on a long term and viable global food industry and that can only be maintained if consumers are confident about the products they consume. Looking forward, the feed industry must strive to overturn any negative perception that exists at the consumer level, even if that means at times, making certain decisions that are not necessarily to the benefit of the farmers. It also involves reviewing some of the more traditional practices within the industry and assessing "safe" and "natural" alternative products and strategies that bioscience technology is now able to provide and which will find favour with the consumer.

(* 이 자료는 ㈜ 올텍바이오코리아의 협조로 제공, 발표되었습니다.)