BRITISH SUPERMARKETS: FORGING CHANGES IN POULTRY NUTRITION

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Summary

The pro-active response of British supermarkets to the potential risk of the transfer of antibiotic resistant micro-organisms from animals to humans has resulted in the removal of antibiotic growth promoters (AGPs) from most broiler feeds within the UK. It is likely that AGPs will be banned from all poultry during 2000. Their removal has resulted in the search for “natural” and safe alternatives. Alternatives to AGPs need to be properly evaluated and due consideration given to the quality, safety and efficacy of each product. It is unlikely that a single product will emerge as a direct replacement for the registered effect of AGPs. It is more likely that a combination of products may be considered together with a review of the various stress factors that may affect performance and disease, including nutrition, environment and management practices.

I. INTRODUCTION

The influence of the British supermarkets on poultry nutrition dates from the late eighties with the collapse in confidence in the UK feed industry resulting from the Salmonella and Bovine Spongiform Encephalopathy crises. Since that time animal feed has hardly been out of the press throughout Europe, thanks to a continuous stream of consumer sensitive issues ranging from genetically modified raw materials and antibiotic resistance to Dioxin and sewage waste.

A number of the more influential British supermarkets decided that animal feed production was unaccountable in terms of food safety and did not provide adequate traceability and due diligence. Subsequently the supermarkets started to impose their own restrictions on the range of feed ingredients and additives that could be included in animal feed as well as specific production requirements, such as the implementation of HACCP and the heat treatment of poultry feed.

The leading supermarkets continue to monitor consumer attitudes to sensitive issues and take any steps necessary to maintain the confidence in the quality and safety of their products. It is for this reason that the UK’s largest supermarket recently announced the removal of antibiotic growth promoter (AGPs) from broiler feed. At the same time they have challenged pig and poultry producers to review their systems of production to reduce stress and prevent an increase in the therapeutic prescription of antibiotics, such as occurred in 1986 when Sweden imposed a ban on AGPs (Best, 1996).

The response of supermarkets to these issues tends to precede any political legislation. The EU ban on avoparcin in 1997 was a clear signal that politicians were beginning to take the consumer issue seriously despite the conclusions of the SCAN report (SCAN, 1996), which found no evidence of a build-up of antibiotic resistance in humans as a direct result of the use of antibiotic growth promoters in animal feeds. The ban was extended by the EU in 1998 to include tylosin phosphate, zinc bacitracin, spiramycin and virginiamycin, leaving only avilamycin and flavomycin as the two growth promoters registered for use in poultry.

At present two of the antibiotic substances listed by the EU are also approved as coccidiostats (salinomycin and monensin sodium). Any move to add these two substances to the banned list would have serious consequences for the poultry industry both in terms of coccidiosis and clostridial control.

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Although the EU commissioner for consumer affairs, David Byrne, has repeated his concern about the usage of AGPs, and signalled their likely ban within Europe in two years, the British supermarkets have taken their own lead. This came on the back of a number of significant developments within Europe.

Firstly, in 1996, Denmark implemented a voluntary ban. Their experience has been well documented (Jenson, personal communication) and demonstrated that the impact of the ban on animal performance and health has been less than expected. Their strategy not only focused on alternative products but the type of in-feed coccidiostat used (ionophore or chemical), stocking density, ventilation, hygiene standards, chick quality and feed composition.

Secondly, in October 1999, the UK’s largest poultry company, Grampian Country Food Group, announced the removal of AGPs from all its broiler and breeder feed. This decision came on the back of extensive trials with alternative products, under commercial conditions, over a two year period in conjunction with a review of management practices. Significantly, there were no detrimental effects with regard to bird health, suggesting that there would be no need for greater use of therapeutic antibiotics to treat flocks. This is particularly important, because there would be a considerable backlash if it were established that the net effect of removing AGPs was an increase in the use of therapeutic antibiotics. The supermarkets, for obvious reasons, are closely monitoring this issue.

II. ANTIBIOTIC RESPONSE

The growth promoting effects of sub therapeutic dietary levels of antibiotics were discovered in the late 1940’s when a fermentation extract of Streptomyces aureofaciens was included in chicken diets. A very strong body of data on the subsequent use of AGPs has since been accumulated. A recent review of the literature indicates that in 12,153 trials, the addition of AGPs to animal diets increased production 72% of the time (Rosen, 1996).

AGPs are active in the bird’s intestine where they create favourable conditions for beneficial bacteria and disadvantage harmful bacteria. This improvement in gut health allows more efficient absorption of nutrients resulting in improvements in growth rate and feed conversion. In addition AGPs are associated with bodyweight uniformity and control of specific disease conditions such as necrotic enteritis. It is the effect on mortality and disease control, particularly necrotic enteritis, that poses the greatest challenge for alternative products (Pritchard, personal communication).

III. ALTERNATIVES TO ANTIBIOTICS

EU legislation requires AGPs, which are termed zootechnical additives, to undergo a registration process that satisfies strict requirements for safety, quality and efficacy. The alternatives to AGPs are registered in other categories, and unfortunately, therefore, many of these additives have not been through the same rigorous registration process and thus tend to be backed by less scientific data. Consumer and retailer requirements will demand that alternative products are safe to animals, consumers and the environment. There are specific concerns with some of the alternatives with particular reference to pharmacological and/or systemic effects, residues and microbial resistance to the product (Ward, J. 1999).
(a) Probiotics

Probiotics are cultures of living organisms designed to manipulate and maintain a beneficial microflora in the gut. They include competitive exclusion, probiotics, bioregulators and pre-biotics.

(i) Competitive excluders

Competitive exclusion products are a culture of multi species non-pathogenic microflora, which may be administered as a spray direct on to chicks at day old, applied in the drinking water or a top dressing on feed. Providing young birds with their normal intestinal flora helps prevent colonization of the gut by potentially harmful and pathogenic bacteria. Significant reductions in salmonella have been demonstrated from their use and some effects against clostridial challenge have also been observed. These products have been widely used as a once-only oral dose in broiler breeders.

(ii) Probiotics

Probiotics are a culture of specific living organisms (primarily Lactobacillus) that colonise the gut and provide a healthy environment for the establishment of an intestinal population of beneficial organisms, thereby inhibiting the multiplication of pathogenic bacteria. Administration is continuous in the feed or in some cases via the drinking water. The lactobacilli must be host specific for effective colonization to take place. Unfortunately many probiotic preparations are marketed as multi species products. In addition, Lactobacilli are heat sensitive and do not survive standard pelleting temperatures.

(iii) Bioregulators

Bioregulators are single Bacillus species products in the form of spores that are heat resistant and sporulate inside the bird releasing beneficial bacteria in the gut. These bacteria are not host specific but their proliferation produces a probiotic effect. Data on poultry is limited. Administration is continuous in the starter feed.

(iv) Pre-biotics

Pre-biotics are fermentable sugars that promote the growth of beneficial organisms in the gut of the bird. Administration is continuous in the feed or drinking water. Data on poultry is limited.

(b) Nucleotides

Nucleotides are biological mixtures of nucleotides, RNA and yeast which, it is claimed, have a probiotic effect as well as stimulating the immune response and enhancing the effectiveness of vaccines. They have been used in breeders using continuous administration via the feed.

(c) Oligosaccharides

Oligosaccharides are sugars which are not capable of being broken down by digestive enzymes and which occur naturally in many feed ingredients. There are two main types of
oligosaccharide product, fructo-oligosaccharides (FOS) and mannan-oligosaccharides (MOS). Administration of both products is continuous in the feed.

FOS products claim to feed the beneficial bacteria at the expense of the harmful ones. Whilst there is evidence they do this, there is also data showing that FOS promotes clostridial proliferation (Kaldhusdal, 1999).

MOS is prepared from the yeast cell wall of Saccharomyces cerevisiae. Not all cell preparations are the same. The efficacy of the product is dependent upon the process of phosphorylation to produce phosphorylated gluco-mannans. MOS modifies the microbial ecosystem of the intestine by not allowing pathogens to attach on to the intestinal tract. Bacteria have lectins on the cell surface that recognize specific sugars and allow the cell to attach to that sugar. These sugars can be found on the epithelial cell surface. Many enteric pathogens, including Salmonella typhimurium, Salmonella enteriditis and Escherichia coli, use type-1-fimbriae, which bind to D-mannose bearing lectins (Finucane et al., 1999). Because digestive enzymes do not degrade MOS, it passes through the tract with the pathogens attached, thereby preventing colonization.

Further work suggests phosphorylated gluco-mannans stimulate immune response and macrophage activity (Savage et al., 1996). There is an increasing amount of poultry data being published which endorses the efficacy of MOS compared with other additives (Peterson et al., 1999).

(d) Acidification

Organic acids are registered as preservatives in feed legislation and are widely used in the UK for the control/inhibition of salmonella in both raw materials and finished feed. Mixtures based on propionic/formic acids or salts reduce bacterial and mould counts in feed, limiting the stress associated with introduction of these pathogens to the bird. The pH effect of organic acids in the feed potentially encourages a beneficial microbial flora in the upper intestine whilst at the same time reducing the growth rate of pathogenic bacteria, although the effect in poultry has not been as pronounced as in pigs (Huygebaert, et al., 1999). Organic acids can be applied either within the feed or drinking water.

Formic acid has been shown to be particularly effective against enteric bacteria such as E. coli, but there are health and safety problems associated with using straight acid. Salts of the acids are easily handled and release formic acid in the crop of the bird.

Formaldehyde based products have been shown to be very effective at reducing Salmonella and Enterobacteriaceae in raw materials, feed and birds. There is some commercial evidence that the cleaner feed results in performance benefits, particularly mortality levels in poultry.

(e) Essential oils, herbs and spices

These products are associated with homeopathy and are therefore considered natural and acceptable to the consumer. Commercial results appear to show some of them to be effective but possibly less predictable in terms of performance response, particularly over a sustained period of time (Francesch et al., 1999). Specific essential oils, such as oregano, are known to be antimicrobial and have been associated with enhanced gut function through the development of a beneficial gut flora. Herbs and spices are believed to be antipathogenic and stimulate digestive function. Unfortunately, in many cases, the manufacturers market the product as a mixture and do not specify the active ingredient, making measurement difficult. The objective should be to identify and isolate specific activities.
(f) **Plant extracts**

A number of products have been used in feed that may indirectly promote the development of a beneficial gut flora. Yucca products have been successfully used to control ammonia emissions in pigs and poultry. Extracts of sanguinaria and garlic have been associated with antimicrobial effect. Commercial evaluations in poultry however have been disappointing.

(g) **Gut conditioners**

(i) **Enzymes**

Enzymes are now widely used in the poultry industry to overcome the anti-nutritive effect of non-starch polysaccharides (associated with increased gut content viscosity and poor digestibility) and phytin phosphorous. Enzyme preparations containing proteases and lipases are also becoming more widespread. It may be possible to develop specific enzyme preparations that enhance the gut microflora.

(ii) **Betaine**

Work on betaine suggests that protection can be given to the structure of the epithelial cells in the gut, improving nutrient absorption and fluid retention, particularly under stress conditions. At levels in excess of 1kg/tonne its beneficial effect on coccidiosis control is well accepted. It is also very effective for flushing turkeys when scouring is a problem. Unfortunately commercial levels are generally less than 500g/tonne.

(iii) **Particle size**

Physical properties of the feed affect gut function. The use of whole wheat in commercial broiler and turkey diets has been shown to improve gut morphology and function. In addition, it has been shown that coarser particle size in broiler feed pellets can improve physical performance and reduce the incidence of necrotic enteritis.

(iv) **Feed ingredients**

The non-starch polysaccharide fraction of cereals is known to influence the utilization of nutrients in the diet in the bird. The incorporation of carbohydrate hydrolases in diets containing either wheat, barley, oats or rye can significantly improve bird performance and litter quality (Riddell and Kong, 1992). Due to its viscosity characteristics, maize has been known to reduce the incidence of necrotic enteritis when included in the diet at levels in excess of 20% (Branton et al., 1997). In Denmark up to 30% of the wheat content in starter and grower rations for broilers has been substituted with maize, in the absence of AGPs.

Other feed ingredients that are associated with gut condition and necrotic enteritis are animal protein sources, (fishmeal and meat meal), and fat type.

(h) **Mineral growth promoters**

The possibility of using copper and zinc are limited in the inorganic form because of the UK feeding stuff regulations for poultry diets. “Organic” or “chelated” minerals provide a means of increasing the availability of trace elements at the same inclusion level as the
inorganic salts. Studies with broilers at Missouri University have shown a comparable response to organic copper at 50 ppm compared to copper in the form of copper sulphate at 175 ppm (Carlson personal communication).

(i) **Immunity enhancers**

Vitamin E, at levels significantly higher than those recommended has been shown to improve the immune status of poultry with subsequent implications for disease control and day old viability. The interaction of selenium and vitamin E is well documented (Combs, 1999). Organic selenium has been shown to significantly improve parameters such as meat quality and feathering compared with sodium selenite (Mahan, 1999). More recently, studies have shown an improvement in the immune status of day old chicks, as well as a vitamin E sparing effect, resulting from the supply of organic selenium in broiler breeder diets (Surai et al., 1999).

**IV. CONCLUSION**

One of the first alternatives to consider is removal of AGPs without any substitute or replacement strategy. Where this has been tried commercially for broilers, initial results have been comparable to those in AGP treated birds but subsequent batches of birds have shown a steady decline in performance. In addition, certain of the alternatives to AGPs show significant benefits to the physical product and to financial returns compared with untreated birds.

Measuring the effect of any specific product is not easy, particularly when trying to determine the potential changes in gut microflora given that the most important beneficial species of microflora are not yet fully identified. The validity of microbe plate cultures must be questionable. Hopefully, advanced DNA evaluation techniques will help in the future in assessing the effects on gut microflora population. Products that consist of unspecified mixtures should be challenged to identify and isolate specific activities.

Evaluation of products should be carried out in fully controlled and replicated trials. However it should be noted that, if the trials are carried out under hygienic conditions and low levels of stress, the ability to measure the response to some of those products that work through inhibition of harmful bacteria may be significantly reduced. Commercial farm trials are useful but account must be taken of variation associated with differences in sites, houses, environment, chicks, feed and management. Particular care must be taken in the evaluation of data relating to mortality and disease. At the commercial level, results should be assessed over a continuous period, not just for a single batch of birds.

At present, the practical approach may involve targeting different areas of the gut. To reduce the bacterial load in the upper intestine, acidification, either in water or feed, or competitive exclusion products, may be considered. In the small intestine, attention should be given to those factors that can affect the gut condition such as enzymes, raw materials and particle size. To promote and maintain a beneficial bacterial population in the hindgut the use of phosphorylated mannan oligosaccharides (MOS) or essential oils may prove most effective.

The choice of product(s) must be made in conjunction with an appropriate coccidiostat programme and an assessment of stress factors associated with nutrition, environment and management. Evidence from Scandinavia and now the UK suggests that, through appropriate management, it is possible to limit the effect of the total withdrawal of AGPs.
REFERENCES