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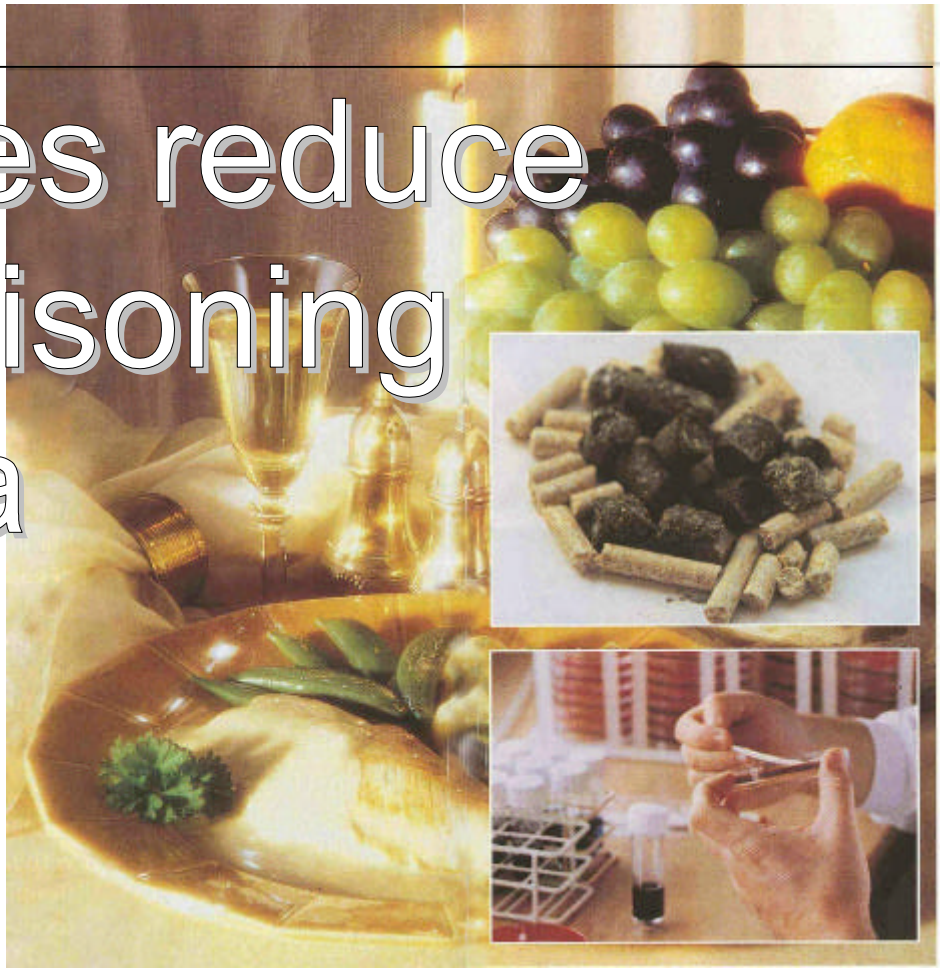
Enzymes reduce food poisoning bacteria



Two enzyme products used widely in the poultry industry to improve the digestibility of wheat and maize-based diets have been found to have additional effects on the numbers of bacteria in the gut of broilers that can cause food poisoning in humans.

From feed to food. Enzymes can play a valuable role in preventing food poisoning from poultry meat.

By Milan Hruby

Some enzymes that are commonly used to improve performance in broilers have also been found to reduce the numbers of the food poisoning bacteria *Salmonella* and *Campylobacter*. These additional enzyme effects are brought about through an increase in the rate of diet of digestibility, which significantly changes both the substrate quality and quantity available to the bacteria in the bird's gut.

The two combinations of enzymes: xylanase and protease (Avizyme 1300, Danisco Animal Nutrition, recommended for wheat-based diets) and amylase, xylanase and protease (Avizyme 1500, recommended for maize-based diets), both used by poultry integrators and feed manufacturers to improve feed efficiency, have been shown to have effects further to those for which they are currently used. Trials at the University of Bristol's department of clinical veterinary science in the UK have shown that when these enzyme combinations are used at their recommended commercial rates, they also promote an environment in the intestine that is unfavourable for *Campylobacter jejuni* and *Salmonella enteritidis*. This may be good news for poultry producers who are looking to incorporate additional practical measures into existing management programmes to minimise the risk of *Campylobacter* and *Salmonella* in production systems.

Table 1 – Trial diets

Ingredients (kg/tonne)	Wheat diet	Maize diet
Wheat	546.3 – 547.3	-
Corn	-	541.5 – 542.5
Soybean meal 48%	348.9	376.7
Soy oil	42.6	17.5
Tallow	20.0	20.0
Salt	3.8	4.1
DL Methionine	1.7	1.5
Limestone	12.2	12.2
Dicalcium phosphate	13.5	15.5
Vitamin/Mineral premix	10.0	10.0
Enzyme mixture	1	1
Calculated analysis		
ME, kcal/kg (MJ/kg)	3050(12.78)	3050(12.78)
Crude protein, %	22.50	22.50
Lysine, %	1.20	1.31
Methionine, %	0.50	0.50

Campylobacter reduced

The need for such integrated programmes has been highlighted by the results of tests carried out by health experts in many countries that show that poultry carcasses can test positive for these harmful bacteria. For example, an independent investigation in the UK (Lister, 2002) found that 50% of all broiler carcasses tested positive for *Campylobacter* and in a recent survey in the USA (Zhao *et al*., 2001), 71 % of chicken raw meat retail samples were contaminated with *Campylobacter* species.

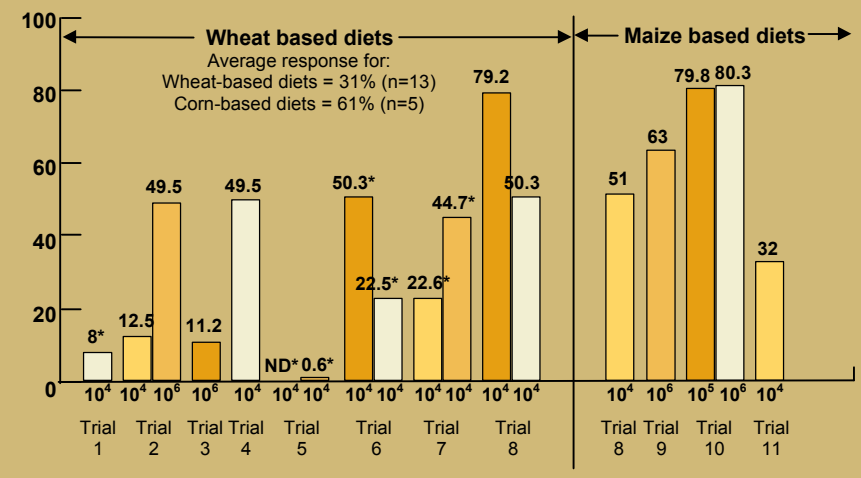
The Ross birds used in the project were fed on commercial diets based on either wheat or corn, plus the standard recommended dose rates of the appropriate enzyme combination (both

wheat and maize-based diets were used), but excluding antibiotic growth promoters or coccidiostats (*Table 1*).

In the trials investigating *Campylobacter jejuni,* broiler chicks were challenged orally with a dose of 10^4 or 10^6 of the bacterium at four or five days of age, and population numbers in different parts of the intestinal tract were measured between 12 and 33 days of age.

In the eight wheat-based trials, there was, on average, a 66% reduction in the numbers of *Campylobacter* found in birds fed the diet supplemented with enzymes, and in the maize-based trials there was a reduction of over 33% in birds fed the enzyme supplemented diet, compared with the controls *(Figure 1*).

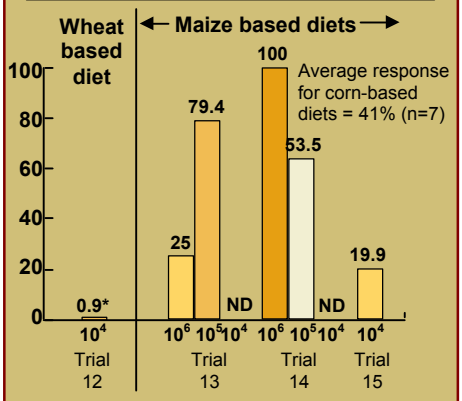
Figure 1 – *Campylobacter jejuni* levels in the caecum of broilers - Enzyme* treatment as a percentage of the controls**



*P<0.05; ND = not detected **2 wheat varieties were evaluated
Different levels of inoculations were used (≤106 cfu) in some trials.

***Avizyme 1300 (wheat) or 1500 (maize,) Danisco Animal Nutrition, UK

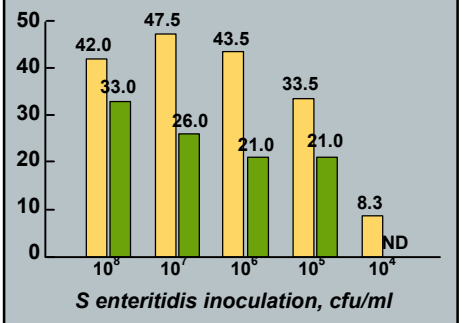
Figure 2 – *Salmonella enteritidis* levels in the caecum of broiler – Enzyme treatment as a percentage of the controls**



*P<0.05; ND = not detected
Different levels of inoculations were used (≤10^6 cfu) in some trials.

**Avizyme 1300 (wheat) or 1500 (maize,) Danisco Animal Nutrition, UK

Figure 3 – *Salmonella enteritidis* positive birds*- Enzyme treatment as a percentage of the controls**



Corn-based diet. Birds inoculated with 10^4-10^8 *S. Enteritidis* at day 1 of age
*Defined as a bird with a >10^5 cfu/g
ND = not detected
***Avizvme 1500. Danisco Animal Nutrition. UK*

Salmonella challenge overcome

In the trials investigating *Salmonella enteritidis,* the chicks were challenged orally with between 10^4 and 10^8 bacteria at one day of age, and population numbers in different parts of the intestinal tract were measured between 14 and 17 days of age.

In the three maize-based trials, there was, on average, a reduction of almost 60% in the numbers of *Salmonella* found in birds fed the enzyme supplemented diet and a significant reduction in the number of *Salmonella* found in birds fed the enzyme-treated wheat-based diet (*Figure 2*).

What this means in commercial practice is that fewer birds are likely to test positive for *Salmonella*. These studies found that significantly fewer birds fed the enzyme supplemented corn-based diets tested positive to *Salmonella*, when compared with the controls. (*Figure 3.)*

Effects explained

These results appear to be linked to the three key modes of action of the enzyme mixtures used, at the level of the gut:

1. A reduction in intestinal viscosity associated with wheat - resulting in increased feed passage rate, which means that there is less substrate available to "feed" the pathogenic bacteria.
2. An increase in nutrients digested by the bird - resulting in fewer nutrients for the growth of the pathogens studied.
3. An altered carbohydrate profile in the intestine resulting in more of the substrate preferred by beneficial species of bacteria, such as *Lactobacillus.*

So, as well as having a positive effect on the growth rate and feed efficiency of the birds, the additional effect is to reduce the amount of substrate available for the development of potentially harmful bacteria in the gut.

According to Dr Fresie Fernandez, who carried out the trials at the University of Bristol, the effect of the enzyme products on bacterial numbers "represents a useful addition to the management practices already available for ensuring food safety".

As a microbiologist, she is keen to emphasise that complete elimination of pathogenic bacteria from the gut is presently unlikely. "However, any reduction is an important step forward," she says. ●

References

Lister, S. (2002) International Poultry Production, 10: 15-19.
Zhao et al. (2001). Appl. Environ. Microbial. Dec;67(12):5431-6.

Key Words: Avizyme 1300, Avizyme 1500, Broiler, Corn, Digesta viscosity, Digestibility, Gut microflora, Microflora, Passage rate, Wheat, AGP, Zoonosis, Food safety, xylanase, amylase, protease, Salmonella, Campylobacter