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# Interactions of feed enzymes and antibiotic growth promoters on broiler performance

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**SUMMARY –** Addition of enzymes to broiler feed, particularly those containing high levels of wheat and fat, have given useful benefits even in the presence of antibiotic growth promoters. Enzyme supplementation frequently gives improved litter conditions and better overall growth performance. Some of these benefits come from improvement in fat digestibility which is frequently observed in feeds treated with enzymes. However the microflora of the gastrointestinal tract is unlikely to be modified by feed enzymes in a similar manner to that achieved with antibiotic growth promoters. Combinations of acidifiers and enzymes give very cost-effective broiler production in the absence of antibiotic growth promoters.

**Key words:** Antibiotics, enzymes, fat, acidifers.

***RESUME –*** *"Interactions des enzymes alimentaires et des promoteurs de croissance antibiotiques sur les performances des broilers". L'addition d'enzymes dans les aliments pour broilers, en particulier ceux qui contiennent de hauts niveaux de blé et de matières grasses, ont apporté des avantages d'utilité même en présence de promoteurs de croissance antibiotiques. La supplémentation en enzymes permet fréquemment de meilleures conditions de litière et de meilleures performances globales de croissance. Certains de ces bénéfices proviennent de l'amélioration de la digestibilité des matières grasses, ce que l'on observe fréquemment pour les aliments traités aux enzymes. Cependant la microflore du tractus gastro-intestinal n'est pas susceptible d'être modifiée par les enzymes alimentaires de façon similaire à ce que l'on obtient avec les promoteurs de croissance antibiotiques. Des combinaisons d'acidifiants et d'enzymes permettent une production rentable de broilers en l'absence de promoteurs de croissance antibiotiques.*

***Mots-clés :*** *Antibiotiques, enzymes, matières grasses, acidifiants.*

Efficient modern broiler production requires the use of high-energy feeds. In many European countries some of this energy is supplied as wheat or barley depending upon market prices and local conditions. To achieve suitably high energy levels significant amounts of fat are also usually formulated into the diet. It is quite common to add 4-6% extra fat to give final total fat contents of 8-12%. It has long been recognised that broiler diets based on wheat or barley and high fat contents present a difficult challenge for the digestive system of the broiler. This was frequently manifested as wet litter syndrome that in turn resulted in increased ammonia production in broiler houses and increased the incidence of breast blisters and hock burns on broilers.

These problems were not solved by the use of antibiotic growth promoters but in recent years they were overcome by the addition of feed enzymes. Indeed major improvements in broiler performance and litter conditions could be demonstrated by the incorporation of feed enzymes into broiler diets that already contained antibiotic growth promoters. An example of these benefits of feed enzymes is illustrated in Table 1. In the presence of an antibiotic growth promoter liveweight, feed conversion ratio (FCR) and litter moisture were all improved by supplementation of the feed with a multi-enzyme system KEMZYME W.

Table 1. Effect of KEMZYME W on broiler performance in the UK with feed containing an antibiotic growth promoter

| Production characteristics | KEMZYME W treatment | |
|---|---|---|
| | Control | 1 kg/t |
| Liveweight (kg) | 2.37a | 2.41b |
| Feed conversion ratio | 1.79a | 1.75b |
| Litter moisture (%) | 45.9a | 43.0b |

[a,b]Values with different letters are significantly different at P = 0.01.

One of the effects of using either wheat or barley in broiler feeds was clearly to increase the viscosity of contents of the gastrointestinal tract. Both wheat and barley are well known sources of non-starch polysaccharides that are unable to be digested by poultry and which can form viscous gels in an aqueous environment such as is found in the gastrointestinal tract.

It is relatively easy to show that suspensions of wheat or barley form high-viscosity gels. However it was also observed that the viscosity of the contents of the gastrointestinal tract when broilers were fed a wheat based diet was much greater than that due to the wheat alone (Table 2). In this trial conducted in Holland the viscosity in the gastrointestinal tract was considerably higher than that generated by wheat alone. Clearly there must be some other interactions here to give this high viscosity. Langhout (1998) showed that the microflora of the gastrointestinal tract seemed to play an important role in the production of this high viscosity. Gnobiotic or "germ-free" broilers did not generate such high intestinal viscosity even when fed on wheat-based diets.

Table 2. Effect of KEMZYME W on the viscosity of a wheat suspension and on digesta viscosity

| Enzyme | Wheat suspension (mPas) | Digesta viscosity | |
|---|---|---|---|
| | | Fore gut (mPas) | Hind gut (mPas) |
| None (control) | 5.5 | 6.2 | 12.0 |
| KEMZYME W | 4.6 | 4.0 | 5.8 |

Another problem often observed with wheat-based diets was a reduction in fat digestibility. Van der Klis *et al.* (1995b) observed a relationship between the ileal viscosity and fat digestibility in broilers. Wheat in effect seems to reduce the apparent metabolizable energy (AME) value of fats and oils in a feed (Van der Klis *et al.*, 1995a), and this can be improved by adding endoxylanase enzymes to the feed.

Scheele *et al.* (1997) demonstrated an increase in the AME of dietary fat in four different wheat-based broiler feeds when a xylanase enzyme was added (Table 3). The four different wheat varieties gave different levels of ileal viscosity and fat digestibility in the absence of an enzyme. In the presence of the xylanase however the AME values of the fat were significantly increased and were more uniform.

Table 3. Effect of addition of xylanase to broiler feed on AME values of fat and ileal viscosity

| Diet | AME dietary fat (MJ:kg) | | Ileal viscosity (mPas) | |
|---|---|---|---|---|
| | – Enzyme | + Enzyme | – Enzyme | + Enzyme |
| Wheat 1 | 31.01a | 33.33b | 4.4a | 3.6bd |
| Wheat 2 | 31.07a | 32.97b | 4.2ab | 3.2d |
| Wheat 3 | 29.39c | 33.69b | 4.9a | 3.3d |
| Wheat 4 | 28.95c | 32.97b | 5.8a | 3.1d |

[a,b,c,d]Different letters for the same parameter within the same row and in the same column indicates a significant difference ($P < 0.05$).

In a balance trial conducted at the Rijksstation voor kleinveeteelt, Merelbeke, Belgium, both an antibiotic growth promoter (Virginiamycin) and KEMZYME W individually improved digestibility of fat in a wheat-based broiler feed (Fig. 1).

A combination of both antibiotic growth promoter and KEMZYME W did not improve fat digestibility

compared to the KEMZYME alone. However the fat digestibility with the addition of the enzyme was 70.5% so in this case it may have been difficult to get much more improvement in fat digestibility. In this instance it appears as if feed enzymes may be able to replace antibiotic growth promoters in terms of improving nutrient digestibility.

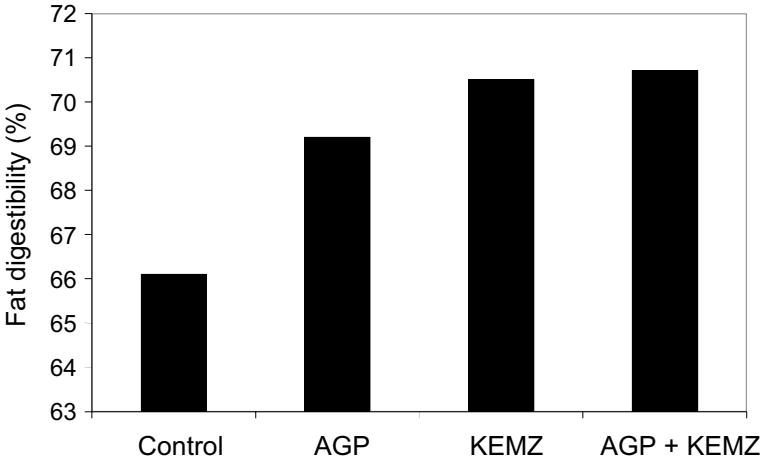


Fig. 1. Effect of antibiotic growth promoter (AGP) and KEMZYME W (KEMZ) on fat digestibility in wheat-based broiler feeds.

Antibiotic growth promoters have also played a very useful role in modifying the microflora in the gastrointestinal tract of poultry, but it is unlikely that feed enzymes alone will exert much influence on the microflora. It is possible that improved feed digestibility brought about by enzymes may reduce the residence time of nutrients in the gastrointestinal tract and so give less opportunity for growth of pathogenic bacteria.

Another strategy that may positively influence the microflora in the gastrointestinal tract and improve nutrient digestibility is to use an acidifier together with an enzyme. Acidifiers have long been used in pig nutrition but not used extensively in broiler nutrition. Some recent trials have been undertaken at a research farm in the UK to investigate this strategy. A positive control with an antibiotic growth promoter (Avilamycin) and a multi-enzyme system, KEMZYME W was used. This is a standard situation for broiler production with high wheat and high fat feeds. Broiler performance and economic returns were compared against this positive control using combinations of a xylanase enzyme and various acidifiers but without any antibiotic growth promoter.

As shown in Table 4 both bodyweights and FCR of broilers were maintained at acceptable levels when an antibiotic growth promoter was replaced by an acidifier and enzyme together. It is clearly possible to obtain good broiler performance without recourse to antibiotic growth promoters.

Table 4. Broiler performance obtained with various combinations of antibiotic growth promoter, enzymes and acidifiers

| Treatment† | Body weight (g) | FCR |
|---|---|---|
| AGP + KEMZYME W | 2517 | 1.76 |
| KEMZYME X + ACID LAC | 2627 | 1.73 |
| KEMZYME X + KemAcid P | 2597 | 1.72 |

†AGP: antibiotic growth promoter; KEMZYME W: multi-enzyme mixture; KEMZYME X: xylanase; ACID LAC: lactic acid-based acidier; KemAcid P: lactic/propionic acids-based acidifer.

An economic analysis of this trial also showed that it was possible to achieve both good

zootechnical results and good production economics by means of acidifiers and enzymes (Table 5). Inclusion of an acidifier and an enzyme will generally increase slightly the cost of feed per tonne. However here both feed cost per kg of meat and gross revenue per broiler were in fact slightly improved by omission of the antibiotic growth promoter and inclusion of an acidifier and an enzyme.

Table 5. Economic analysis of broiler performance shown in Table 4

| Treatment† | Extra cost (£/t of feed) | Feed cost (p)/kg meat | Gross revenue (p)/broiler |
|---|---|---|---|
| AGP + KEMZYME W | 3.00 | 27.0 | 57.9 |
| KEMZYME X + ACID LAC | 3.57 | 26.5 | 61.7 |
| KEMZYME X + KemAcid P | 3.27 | 26.4 | 61.3 |

†AGP: antibiotic growth promoter; KEMZYME W: multi-enzyme mixture; KEMZYME X: xylanase; ACID LAC: lactic acid-based acidier; KemAcid P: lactic/propionic acids-based acidifer.

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