

Use of enzymes to optimise performance

by Ulrich Altemueller and Arne Korsbak, DSM Nutritional Products, Bldg. 241/836, Wurmisweg 576, Ch-4303 Kaiseraugst, Switzerland.

The productivity of swine production depends highly on feed costs but it is not the price per ton of feed which is the determining factor; it is the performance of the pigs expressed in daily weight gain (DWG) and feed conversion ratio (FCR). Carcase quality is an additional factor where price per kg dress weight heavily influences profitability.

Knowing that the high performance potential of modern swine genotypes is not yet reached at the farm level, farm management is challenged to apply the correct diet for the different phases of pig production to reach maximum potential.

Feed additives such as enzymes can help to achieve this goal by increasing the digestibility of feed ingredients and optimise the environment and the health status of the pig.

As antibiotic growth promoters (AGP) have been banned in the European Union since January 2006, experience has been gained in the use of alternative substances.

Although enzymes cannot fully replace AGPs, in fact their mode of action is totally

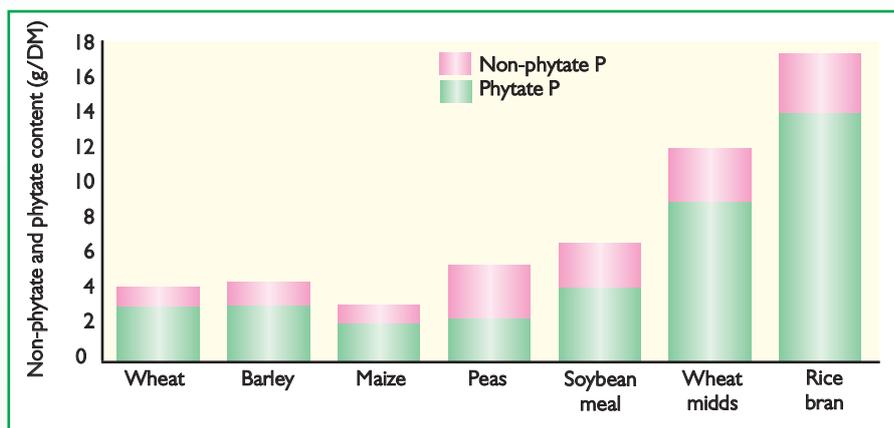


Fig. 1. P-content of selected raw materials used in feed.

different, they have proven to be useful additives in helping to improve performance in nurseries and fattening pens throughout the world.

Increasing prices for classical raw materials, due to the rising demand for corn and other cereals for the biofuel industry, has

led to new diets with products often higher in fibre content.

Feed enzymes

Today the supplementation of monogastric diets with exogenous feed enzymes is a common practice to improve the nutritive value of feed for piglets and pigs.

Two types of enzymes are currently playing a major role in feed enzyme supplementation:

- Phytases which free up phytate bound phosphorous contained in cereals and oilseeds for use by the animal. In addition, other minerals such as calcium, magnesium, trace minerals and amino acids bound to the phytic acid are released for absorption.
- NSP-degrading enzymes break down complex molecules of non-starch polysaccharides (NSPs) present in all cereal grains and oilseed meals and, therefore, release nutrients for absorption.

Phytase

Phytase is now well established in all pig diets to utilise the phytate bound phosphorous in raw materials of plant origin such as cereals and oilseed meals (Fig. 1).

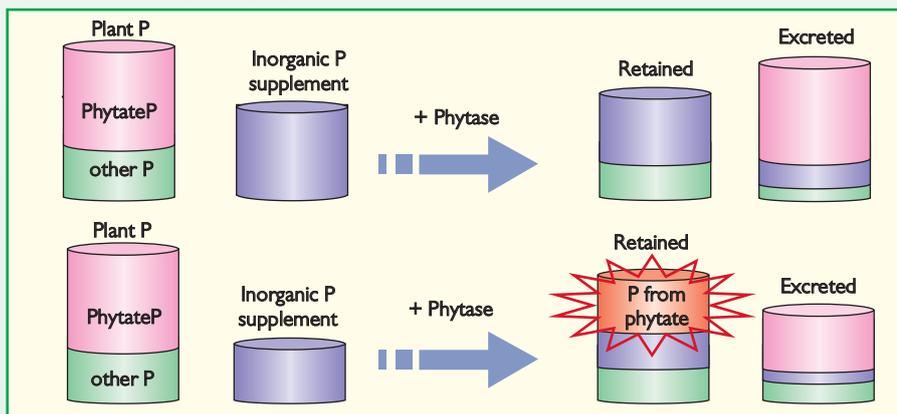
Due to the lack of endogenous phytase, pigs cannot utilise the phytate bound phosphorous and this valuable source of phos-

Continued on page 12

Raw material	Enzyme	Dose (g/ml)	Energy upgrade (%)	Protein upgrade (%)
Wheat	Ronozyme WX	200/310	2.0	2.5
Barley	Ronozyme WX	200/310	4.0	3.5
Rye	Ronozyme WX	200/310	3.0	1.5
Triticale	Ronozyme WX	200/310	3.0	2.0
Oats	Ronozyme WX	200/310	3.0	2.0
Corn	Ronozyme WX	200/310	1.5	1.5
Wheat bran	Ronozyme WX	200/310	3.3	1.5

Table 1. DIF values of selected feedstuffs for Ronozyme WX and Roxazyme G2 for growing-finishing pigs.

Fig. 2. The principle of phytase addition.



Continued from page 11
phorous is excreted into the environment where it acts as a pollutant.

To meet the phosphorous requirements for pigs, the addition of inorganic phosphorous sources such as monocalcium or dicalciumphosphate is needed. By adding phytase to the diet plant phosphorous can be better utilised and the addition of inorganic phosphorous can be reduced. As a consequence feeding costs are reduced and the amount of excreted phosphorous is minimised by more than 30%. The principle of the phytase addition to feed is illustrated in Fig. 2.

Besides phosphorous, phytase releases

many more nutrients. Increased digestibility of calcium, magnesium, amino acids and some trace elements is observed. Matrix values of phytase for least cost feed formulations demonstrate the economic advantage of phytase during the feed formulation process.

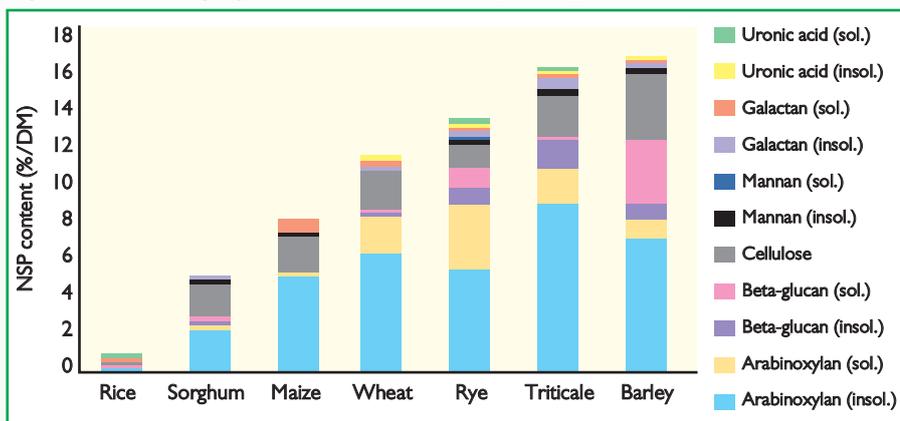
The reduction of total phosphorous and calcium by using phytase in the diets of weaning piglets helps to prevent post weaning disorders in the intestines. Disorders at this development stage often cause severe health problems in piglets. Poor performance or losses is a result of ill prepared and unbalanced diets during this critical period.

In order to overcome the effect of insufficient production of hydrochloride acid in young piglets, especially shortly after weaning, carefully selected feed ingredients may help to decrease the acid binding capacity of feed for piglets and enhance the digestion of protein in the stomach.

The use of phytase reduces the total amount of inorganic calcium and phosphorous sources such as limestone and dicalcium phosphate.

These two feed ingredients have high acid binding capacity values and, therefore, a reduction of these ingredients is crucial to optimise protein digestion in the stomach and prevent intestinal disorders.

Fig. 3. Non-starch polysaccharides in selected feedstuffs.



NSP degrading enzymes

Non-starch polysaccharides are found mainly in cereal grains such as wheat, rye and barley and even more in cereal byproducts like wheat bran and rice bran (Fig. 3).

Pigs do not secrete endogenous enzymes to break down the non-starch polysaccharides (NSP) and, therefore, the addition of NSP degrading enzymes in the feed can help to make more nutrients available for absorption in the small intestine rather than being less effectively fermented in the large intestine or even excreted unused.

Nutrients such as proteins, starch and fats are enclosed within the plant cell wall and

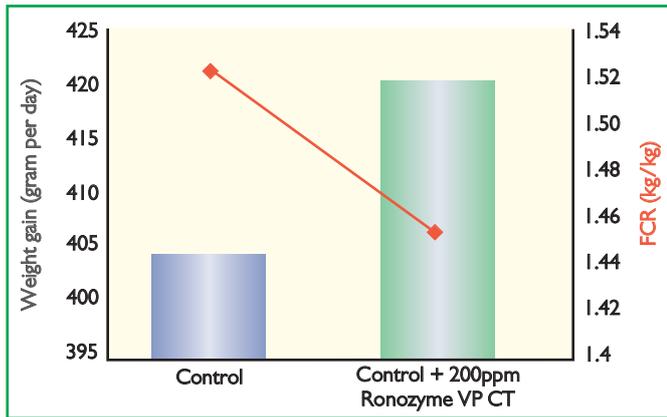


Fig. 4. NSP feed enzymes on performance of piglets.

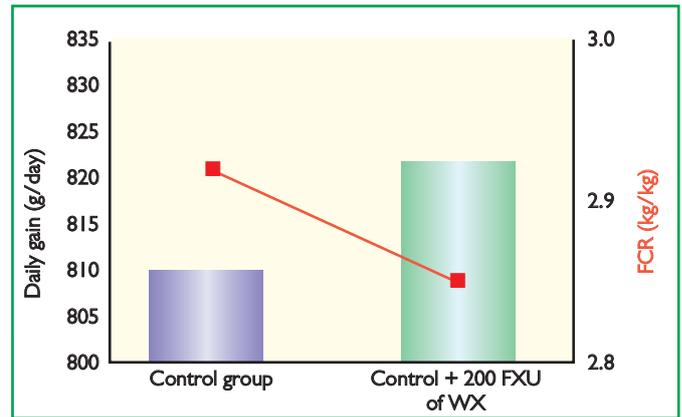


Fig. 5. NSP feed enzymes on growing finishing pigs.

not affected by the pig's own digestive enzymes.

Breaking down the NSP component of the cell wall by NSP degrading enzymes allows the unlocking of encapsulated nutrients and makes them available for the endogenous digestive enzymes. The increased digestibil-

Raw material	Dose (g/ml)	Energy upgrade (%)	Protein upgrade (%)
Wheat			
Ronozyme WX	200/310	6	4
Roxazyme G2	100/100	6	4
Corn			
Ronozyme WX	200/310	3	2.5
Roxazyme G2	100/100	3	2.5
Ronozyme VP	200/83	5	3
Barley			
Ronozyme WX	200/310	8	4.5
Roxazyme G2	100/100	8	4.5
Rye			
Ronozyme WX	200/310	5	3
Roxazyme G2	100/100	5	3
Triticale			
Ronozyme WX	200/310	6	3
Roxazyme G2	100/100	6	3
Oats			
Ronozyme WX	200/310	8	4
Roxazyme G2	100/100	8	4
Wheat bran			
Ronozyme WX	200/310	8	4.5
Roxazyme G2	100/100	8	4.5
Soya meal 44%			
Ronozyme VP	200/83	5	8
Rapeseed meal			
Ronozyme VP	200/83	5	6
Sunflower meal			
Ronozyme VP	200/83	5	8

Table 2. DIF values of selected feed-stuffs for Ronozyme WX, Ronozyme VP and Roxazyme G2 for piglets (7-30kg).

ity as a result of the addition of certain enzymes to the diet can be expressed in digestibility improvement factors (DIF) and related to the matrix values of raw materials for the lowest cost feed formulations (Tables 1 and 2).

Weaning piglets are challenged by a new environment and a different diet. Sows' milk containing a high percentage of fat, milk protein and lactose is replaced by a solid diet containing complex carbohydrates and proteins from cereal grains and oilseed meals.

Different enzymes are necessary to convert the new feedstuffs into usable nutrients. How feed enzymes help to maximise performance in terms of growth and feed efficiency is proven in numerous trials (Fig. 4).

Recently the use of NSP degrading enzymes has become more common in feed for growing-finishing pigs as well. The increasing cost of raw materials due to the industrial use of feedstuffs in the biofuel industry and the search for byproducts to be used in diets for growing-finishing pigs makes the use of feed enzymes more attractive.

Especially in diets with a high content of arabinoxylans and β -glucans (for example, wheat and barley based diets) the added feed enzymes have a xylanase and/or a glucanase activity. Although the NSP content in maize and sorghum is low, even these studies show an increase of performance in growing-finishing pigs by adding certain feed enzyme combinations. Response to enzyme treatments on the performance of grow-finish pigs is shown in Fig. 5.

Properties of feed enzymes

In addition to the mode of action described above, feed enzymes need additional properties to fulfil the criteria of easy and safe handling during the mixing process of feed.

Enzymes are proteins that have specific and complex structures. This structure is

essential for the activity of the enzyme and its stability to withstand the sometimes harsh conditions of feed processing (for example, pelleting) and guarantee the full potential of the added enzyme in the feed. Differences between the products on the market are often obvious just by looking at their physical appearance. Stability during the process of feed production needs internal investigation to find out whether the desired products fulfil the criteria needed (see Fig. 6).

Conclusion

Both phytase and NSP degrading feed enzymes are nowadays common additives in diets for piglets and growing-finishing pigs. The different mode of action of these enzymes allows combining them in one diet.

The special functionality of phytase and NSP degrading enzyme, especially during the weaning phase to minimise intestinal disorders, enables the swine producers throughout the world to optimise performance in the nursery pen.

The benefits in terms of growth and feed efficiency and the reduction of the negative impact of intensive swine production on the environment are obvious. Although declared activities of enzymes seems to be very similar, their efficacy as well as handling, mixing and stability properties of different products are very different. ■

Fig. 6. Stability of enzymes during pelleting.

