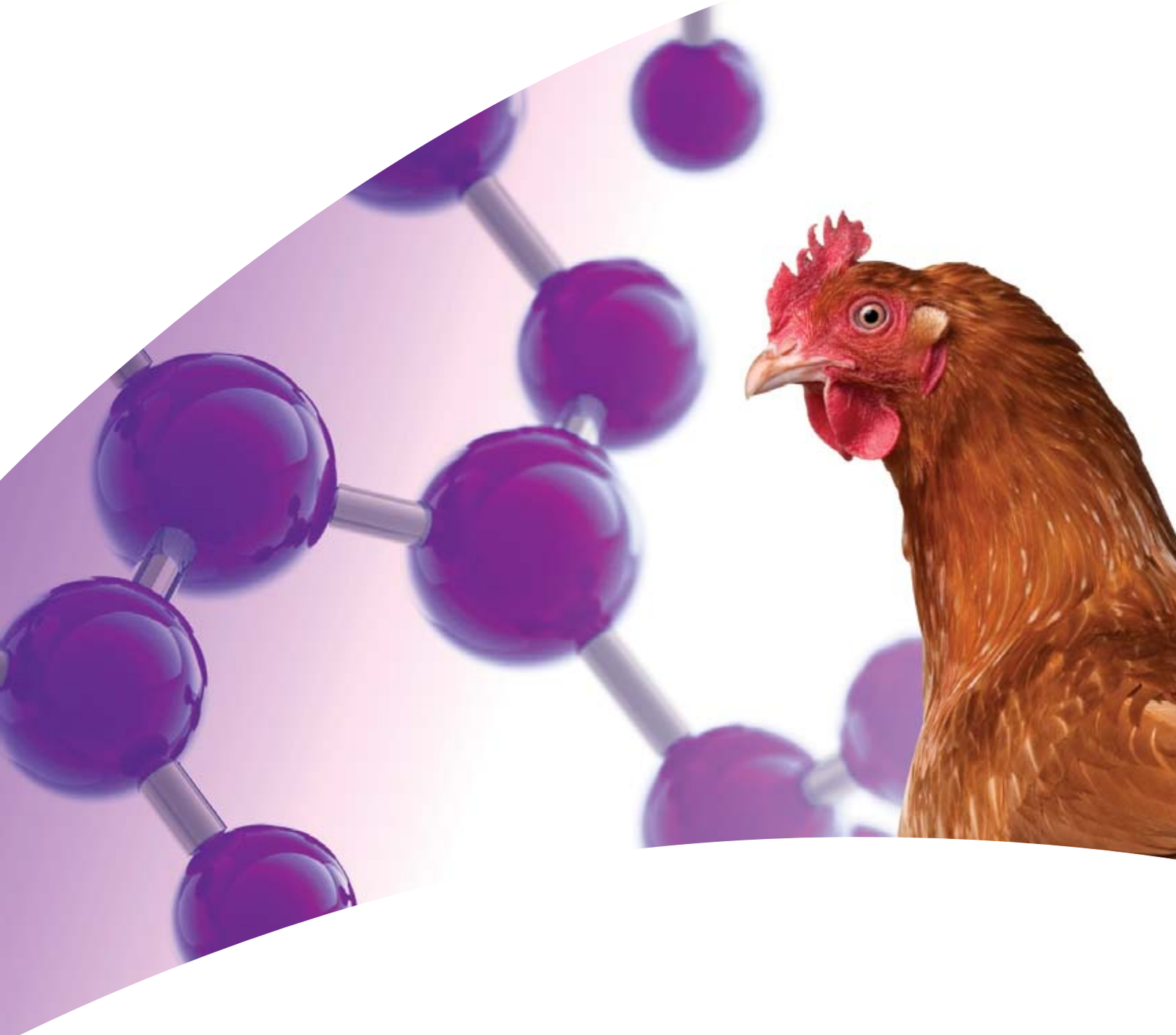
Feedzyme

For protection, health and growth



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Performance in aquaculture&agriculture

Feedzyme

There are a number of benefits to the use of enzymes as feed additives:

one	Boosting the enzyme activity in the immature gut of young animals
two	Supplementing existing digestive enzymes to promote a more thorough digestion of a given feed
three	Enabling the incorporation of less digestible feed raw materials, usually of cereal origin - including low grade raw materials such as DDGS (Dried Distillers Grain with Solubles), without compromising performance

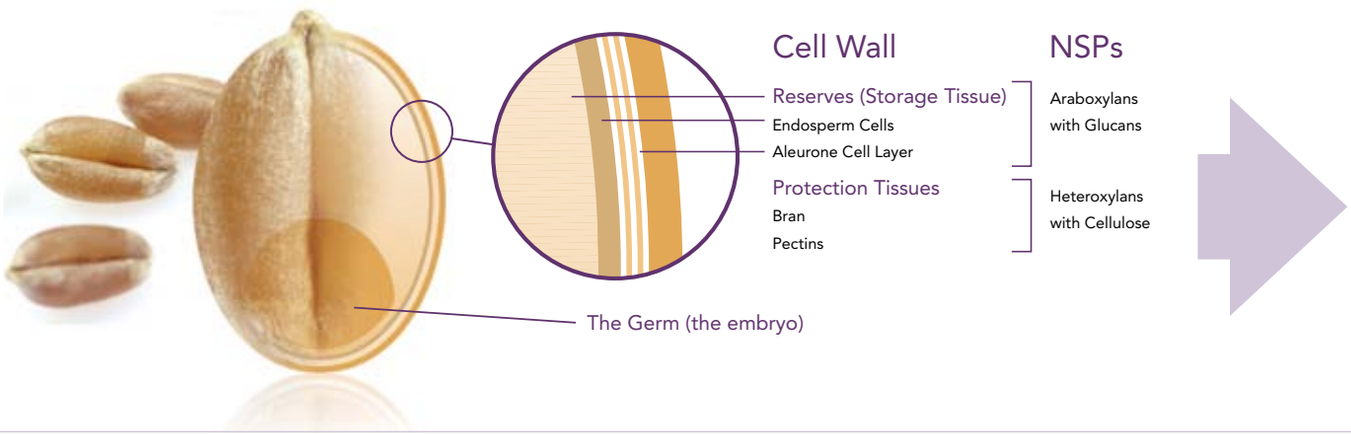
Most cereals contain nutrients that remain unavailable because the animal does not naturally produce the enzymes required for the breakdown of these components. These are the non-starch polysaccharides (NSP's) such as cellulose, glucans and xylans which are excreted, undigested. These undigested components can increase intestinal viscosity and slow down endogenous enzyme penetration of the gut contents. This can increase the risk of nutritional scours as a result of more partially digested material remaining available for pathogen colonisation.

The addition of xylanase in Feedzyme enzymes to degrade xylans not only provides more energy to the animal but also converts the more complex polysaccharides to fermentable energy sources for use by cellulolytic and hindgut fermenting bacteria. Apart from providing more energy to the animal this hindgut fermentation helps to maintain a lower pH, which helps exclude potential enteropathogens such as Salmonellae. The presence of additional energy in the hindgut reduces the dominance of Clostridia and reduces the threat of necrotic enteritis.

The Feedzyme enzymes offer a range that cover the majority of feeding situations:

Feedzyme-TS	A new thermally stable enzyme catering for the modern trend to increase pelleting temperatures for greater feed biosecurity, and for feed storage in hotter climates.
Feedzyme	A multi-enzyme complex with high levels of xylanase, making it suitable for all rations.
Feedzyme-Multi	A synergistic combination of NSP enzymes including xylanase and beta-glucanase with phytase.
Feedzyme-Multi TS	A combination of NSP enzymes with phytase that are thermally stable.

“Feedzyme enzymes offer a unique, environmentally friendly means of improving the digestion of feed, resulting in healthier animals with improved feed conversion and litter quality.”



Typical Grain Composition

Most cereals contain nutrients that remain unavailable because the animal does not naturally produce the enzymes required to break down these components.

These are the non-starch polysaccharides (NSPs). The structure of NSP's is complex and endogenous enzymes secreted by monogastrics in their digestive tract are unable to break them down adequately, resulting in poorly digested dietary fibre. NSPs are either water soluble or water insoluble with water insoluble forms more difficult to digest. The variation within different cereals is illustrated (below).

The grain's NSP components in more detail

Raw materials differ in the nature of their main non-starch polysaccharides - cellulose, ß-glucans and pentosans- and whether their NSP content is water soluble or insoluble.

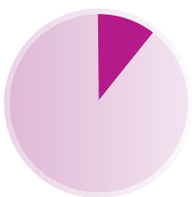
Barley and oats contain undesirable gel forming glucans which are mainly soluble but poorly digested, depressing the potential energy value of these cereals as well as the nutritional quality of the whole diet.

Corn does not contain ß-glucans, either soluble or insoluble, while its pentosans are mainly insoluble.

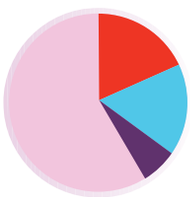
Wheat and rye are characterised by an endosperm wall in which pentosans occur, largely in the form of insoluble araboxylans, which impede digestion by increasing the water holding capacity and reducing the availability of otherwise highly digestible nutrients.

Soya has a high level of NSPs of which 30% are pectins, largely insoluble.

Wheat Typical Grain composition expressed as % Dry Matter

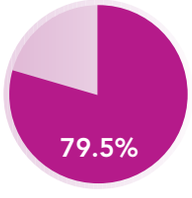


11% Non Starch Polysaccharides



Composition of the NSP content

18.5%	Cellulose
0%	Soluble ß-Glucans
16.7%	Soluble Pentosans
6.5%	Insoluble ß-Glucans
58.3%	Insoluble Pentosans
0%	Insoluble Pectins



Total Insolubles as a % of non cellulose NSPs

Non Starch Polysaccharides in more detail

Water Soluble NSPs

- Higher anti-nutritional properties.
- Mainly Consist of ß-Glucans and Pentosans:

araboxylans ◄·····►

arabinogalactans ◄·····►

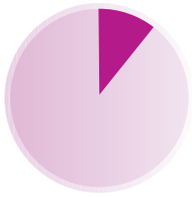
·····► heteroxylans

Water Insoluble NSPs

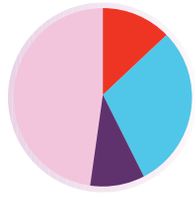
- More difficult to digest.
- Consist mainly of cellulose and hemi-celluloses.
- Includes Heteroxylans

Rye

Typical Grain composition expressed as % Dry Matter

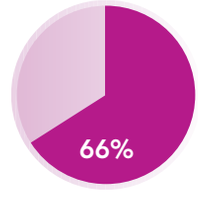


11% Non Starch Polysaccharides



Composition of the NSP content

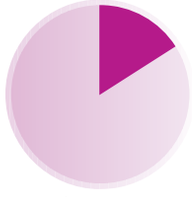
13%	Cellulose
0%	Soluble ß-Glucans
29.6%	Soluble Pentosans
9.6%	Insoluble ß-Glucans
47.8%	Insoluble Pentosans
0%	Insoluble Pectins



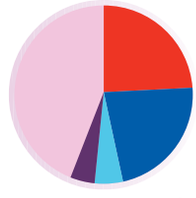
Total Insolubles as a % of non cellulose NSPs

Barley

Typical Grain composition expressed as % Dry Matter

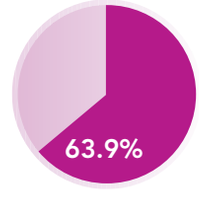


16% Non Starch Polysaccharides



Composition of the NSP content

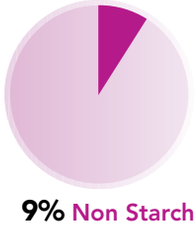
24.2%	Cellulose
22.4%	Soluble ß-Glucans
5%	Soluble Pentosans
4.3%	Insoluble ß-Glucans
44.1%	Insoluble Pentosans
0%	Insoluble Pectins



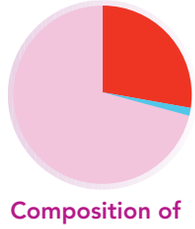
Total Insolubles as a % of non cellulose NSPs

Corn

Typical Grain composition expressed as % Dry Matter

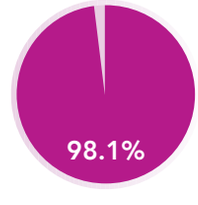


9% Non Starch Polysaccharides



Composition of the NSP content

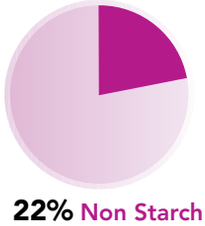
27.8%	Cellulose
0%	Soluble ß-Glucans
1.4%	Soluble Pentosans
0%	Insoluble ß-Glucans
70.8%	Insoluble Pentosans
0%	Insoluble Pectins



Total Insolubles as a % of non cellulose NSPs

Soya

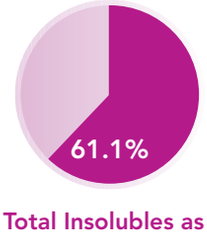
Typical Grain composition expressed as % Dry Matter



22% Non Starch Polysaccharides

Composition of the NSP content

28%	Cellulose
0%	Soluble ß-Glucans
17%	Soluble Pentosans
11%	Soluble Pectins
0%	Insoluble ß-Glucans
24%	Insoluble Pentosans
20%	Insoluble Pectins



Total Insolubles as a % of non cellulose NSPs

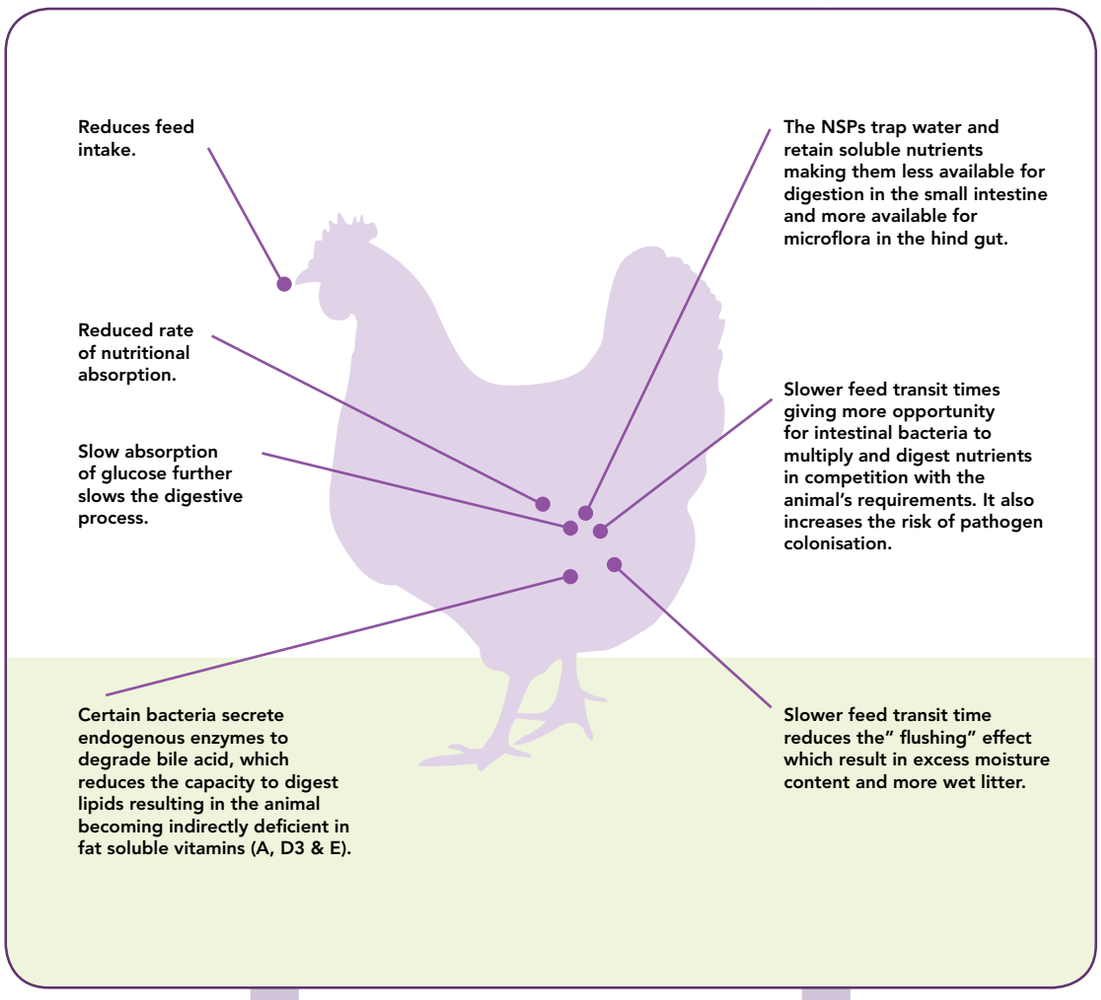
Enzyme Requirement

Exogenous enzymes are required to supplement the lack of naturally produced enzymes to cover two main problem NSPs.

1

Beta Glucans	Xylans
Largely arises from the use of barley & oats	Xylans derived from wheat in animal feed produce high viscosity digesta.
A problem particularly for poultry and young animals	This can be especially important in pigs where xylans can be removed by hind gut fermentation.
The shortage results in increased viscosity of the intestinal content leading to:	This also applies to fibre in the cell wall, particularly xylans and araboxylans, which are also responsible for impeding digestion by causing a more viscous environment in the intestine leading to:

2



3

Beta Glucanase	Xylanase
ß-Glucanase enzymes break down ß-Glucans from the feed to reduce viscosity, increase water absorption and restore digestive function.	The use of xylanase enzymes will reduce digesta viscosity and release otherwise non-metabolisable energy.

All enzymes operate best under certain optimised conditions, primarily pH and temperature. Ideally, enzymes should give maximal activity at the same pH as the intestinal tract, which would mean within a range from pH 2.0 in the stomach to 7.5 in the large intestine. In practise, excluding acidophilic proteases, feed enzymes need to operate primarily in conditions between pH 4 and 7.5.

The longer degradation time for the aleurone cell wall, prevalent in wheat co-products and other cereals such as barley, compared with the starch-rich endosperm means there is a need for a longer incubation time with enzymes for them to be ruptured.

By reaching maximal activity at a neutral pH Feedzyme works optimally in the small intestine where the feed resides for most of the time. This gives these multi-enzyme products more time to act on the target substrates.

Since all biological systems are affected by temperature, enzyme activity at different temperatures is also a consideration. To benefit the animal, an in-feed enzyme system must have good activity at the internal body temperature, typically 37°C to 41°C. Enzymes with low optimal temperature of activity are associated with low thermal tolerance, important when considering the survival of the active enzyme when exposed to pelleting temperatures over 80°C. In these cases established enzyme products have had to be supplied in liquid form that are applied post pelleting, requiring specialised spraying equipment and separate holding tanks for storage. Feedzyme-TS provides a powder enzyme with good thermotolerance while Feedzyme benefits when exposed to mild heat in the conditioner and pellet press. This initiates the activity of ß-Glucanase giving optimum enzymatic activity at temperatures far higher than body temperature whilst still retaining significant hydrolysis capability at the body temperature of a bird.

Feedzyme-TS

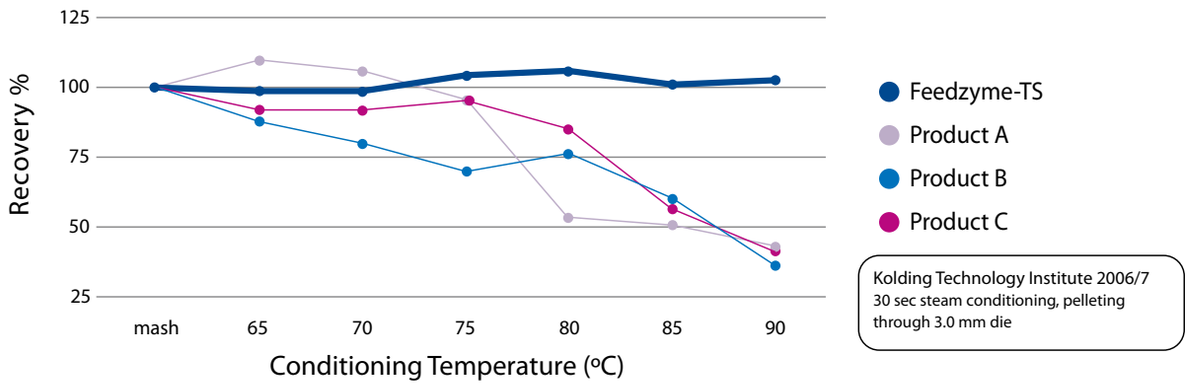
Feedzyme-TS is an intrinsically heat stable product capable of withstanding pelleting temperatures of upto 95°C. The protection is brought about due to the small size of the enzyme and its dense structure. This density does not allow moisture to penetrate the molecule easily. Moisture entering the enzymes structure and then being turned to steam by the pelleting process is the major cause of enzyme destruction in feed. This method of protection is far superior to coating in that it is ready to start working immediately it encounters its substrate. Coated products must first have their coat broken down in order to allow the substrate to reach the enzymes active site and be broken down. This reduces the effective working time of the enzyme and will ultimately reduce the amount of digestible nutrients that it can produce in the time that the feed is present in the small intestine.

Although Feedzyme-TS reaches its highest efficiency in rations with a high wheat and wheat co-product inclusion it has an important effect on improving the digestibility of other cereals such as barley, corn, rice, rye and sorghum. It can be considered an all purpose enzyme.

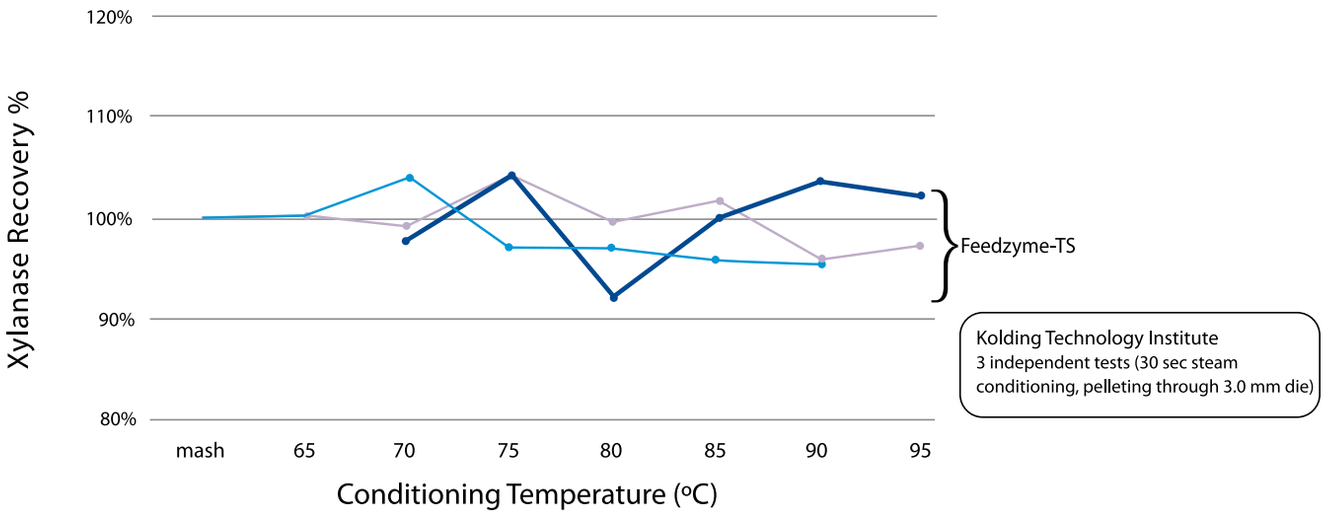
Thermal Stability

Increased safety concerns and salmonella control requirements have increased pelleting temperatures, particularly for poultry diets, over the past decade. This can be a problem for enzymes as generally these start to lose activity after 65°C. The intrinsic protection of Feedzyme-TS ensures stability where pelleting temperatures are above 85°C.

This improved stability can translate into a longer shelf life, especially in countries with hot and humid climates. The table below shows the recovery of enzyme activities in Feedzyme-TS compared to other enzymes at the same pelleting temperatures.



Feedzyme-TS is heat stable up to 95°C under normal pelleting conditions as shown in the tests run by Kolding Technology Institute.



Soluble arabinoxylans are the main NSP's that increase the viscocity of the digestive content in the small intestine. The heating process during pelleting solubilises even more araboxylans, which further increase the viscocity.

The effects include reduced rate of feed passage, increased water consumption and changes in the gut microflora.

Any exogenous xylanase needs to be stable enough under higher pelleting temperatures to maintain its activity and efficacy in the animal.

Feedzyme

Multi-enzyme complexes are particularly suitable for maize based feeds. Feedzyme has enzyme mixtures that help improve the digestibility of vegetable proteins. Glucosidases are able to reduce the released oligosaccharides to their simple forms, a major advantage to young stock.

Cellulases and hemi-cellulases can improve the digestibility of this fraction, increasing the energy value of the ingredients with improvements in animal performance. Feedzyme enzymes can be used with wheat and vegetable by-products such as sunflower, rice bran, copra meal and other high fibre ingredients.

Feedzyme contains ß-glucanase, together with vital side-activities which help reduce viscosity of gut contents and fully convert ß-glucans into glucose, permitting normal digestion to take place.

Feedzyme-Multi

Phytate is the main store of phosphorus in plants. Up to six phosphate molecules from phosphoric acid are bound by esterification to from phytic acid. Major minerals and trace elements are frequently bound to phytic acid forming the phytate salt.

As phytate is largely indigestible by monogastrics and birds the phosphorus is unavailable. The animal's dietary requirement for phosphorus not already supplied by feed inputs has been supplemented from inorganic sources such as DCP and MCP.

The addition of phytase to the diet will break down phytate releasing the phosphorus content and increasing its availability to the animal. In addition other valuable nutrients such as minerals, amino acids and carbohydrates are released as these are frequently bound to, or complexed with, phytate.

Improving the availability of plant phosphorus enables the amount of added inorganic phosphorus to be reduced. This not only reduces the amount excreted which minimises the environmental loading, but saves cost.

Feedzyme-Multi also contains high levels of cellulase, hemicellulase and cellobiase. These are particularly important for the digestion of the fibrous fraction of the animal's diet. This fibrous fraction is able to provide a significant amount of energy that was otherwise unavailable for utilisation by the animal.

Amylases also assist the breakdown of starch into simple sugars such as glucose and maltose. Proteases split protein into amino acids and lipases assist fat digestion. All these factors enhance the effect of the ration on performance.

Feedzyme-MultiTS

As Feedzyme-Multi in a thermally stable formulation.

Usage

Usage	Feedzyme-TS	Feedzyme	Feedzyme-Multi	Feedzyme-MultiTS
Broilers and layers in rear	0.5 kg/t	0.5 kg/t	0.5 kg/t	0.5 kg/t
Layers in production	0.25 kg/t	0.25 kg/t	0.25 kg/t	0.25 kg/t

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