Use of exogenous amylase in early weaned piglets – an update on its importance

by David González and J. Ignacio Fernández, MyA, Pintaluba Group, Spain.

Amylase is the enzyme that catalyses the breakdown of starch into sugars, therefore making them a direct and efficient energy source to be absorbed at the level of the small intestine. Starch is considered as the main store of carbohydrate and the main energy source in piglet diets, representing more than 50% of the total metabolic energy. Therefore its digestibility will be of crucial importance in diets for early weaned piglets where an adaptation of the whole endogenous enzyme system is required.

There are two differentiated factors affecting the overall starch digestibility in early weaned piglets: one related to the starch itself (the source, physical and chemical structure of the starch) and another one related to the piglet's physiology (endogenous amylase production of the piglet).

What is starch?

Starch molecules form semi-crystalline granules in the plant and each plant species has a unique granular size. There are different types of starch based on its granule crystallinity – grains, tuberculous and high amylose corn and legumes.

Grains contain smaller starch granules but with high size variability, while tubercules are bigger and homogeneous with legumes in intermediate position. Smaller granules are digested quicker than larger.

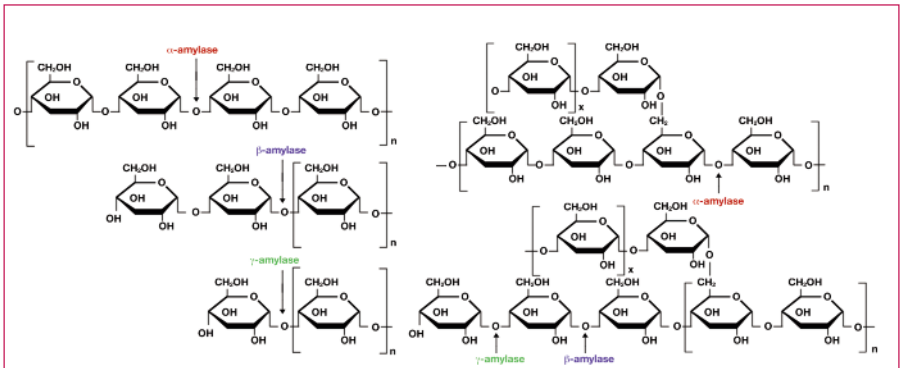


Fig. 2. The different forms of amylase (α, β and γ) ensure the complete break down of the starch molecule.

Chemically speaking, starch consists of a mix of two very similar polysaccharides: amylose and amylopectin. Amylose is a polymer of high molecular weight of linear and helical chains of glucose units (200-250) joined together by glycosidic bonds α(1-4).

Amylopectin is a polymer of highly branched chains of glucose units joined together by glycosidic bonds α(1-4) in the linear way and α(1-6) in branched points (every 15-30 units of glucose).

Depending on the plant, starch generally contains 20-25% of amylose and 75-80% of amylopectin. Due to its tightly packed structure, amylose is more resistant to digestion compared to amylopectin.

The amylose/amylopectin ratio of the variety of grains used in piglet feeding will therefore determine the overall starch digestibility of the postweaning diets, where the higher ratio varieties will need a higher amylase action because of its worse digestibility.

As previously stated, the starch content in the cereal grains is the primary source of energy for the piglet, and its digestibility will be affected by the accessibility of either endogenous and exogenous amylases.

Non-starch polysaccharides will act as a physical barrier which resists the access of enzymes to nutrients encapsulated within the cell. Therefore a predigestion of these

Continued on page 13

Fig. 1. Relationship between the total activity of amylase (AA) in the pancreatic tissue and body weight in piglets.

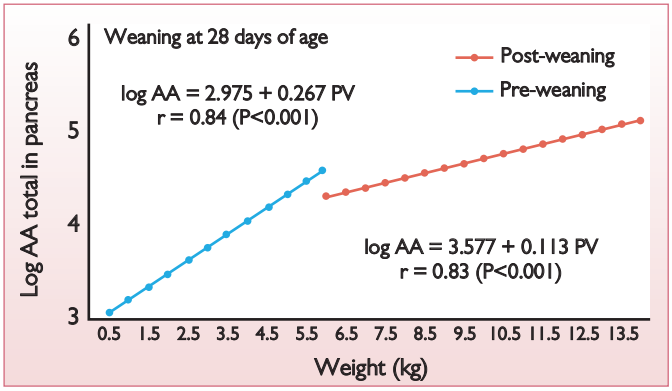
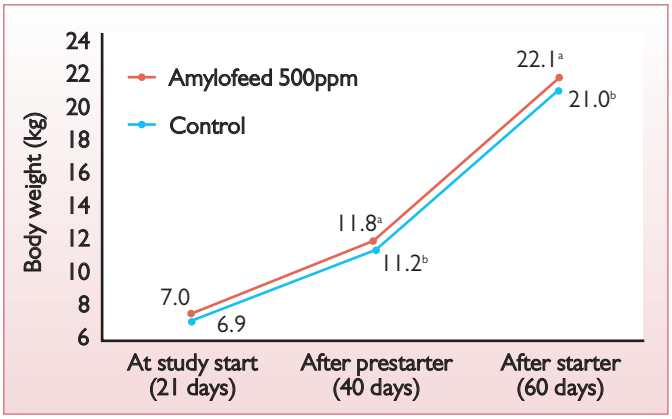


Fig. 3. Body weight data.



Continued from page 11
NSP must occur to facilitate the access of amylases to the starch.

Piglet physiology

The digestive system of the new born piglet has a very limited capacity and corresponds to that which the milk requires for its breakdown and absorption. Starch digestion of baby pigs is limited because amylolytic activity found in the pancreas is almost residual until around three weeks of age and it is not completely developed to digest starch coming from grains and cereal products until a much later stage.

Weaning, together with a change of diet (from milk to vegetable) and the new environment have a marked negative influence on digestive enzyme secretions. Several studies have shown a depression in the pancreatic amylase levels at the time of weaning; taking more than one week to restore preweaning levels (Fig. 1).

This decreased digestion capacity may shift the digestion site of the starch from the small intestine to the large intestine, allowing the non-digested starch to be fermented, therefore producing volatile fatty acids which have been reported to be less effective on energy utilisation compared to direct absorption of glucose from the small intestine (55 vs 75%; NRC, 1998).

Moreover, changing the site of digestion from the small to the large intestine increases the availability of substrates for the pathogenic bacteria in the lower gut. The addition of enzymes to increase the animal's own digestive capacity may prevent such negative effects. This may explain why there are less digestive disorders in piglets following exogenous enzyme supplementation.

Exogenous enzymes

Feed enzymes have historically been one of the most cost effective tools to alleviate the negative effects associated with early weaning of piglets. The right choice of an optimum enzyme combination is therefore crucial to both guarantee an optimum digestion of the complex NSP substrates included in piglet feed (xylans, betaglucans, alpha-galactosides, betagalactomannans) and to cover the post-weaning lack of endogenous amylase production around weaning.

Amylofeed is a multi-enzyme complex, developed and registered in the EU (E 1612) for its use in weaned piglets, containing high amounts of NSP enzymes (betaglucanases and xylanases) and high amounts of amylases. Amylofeed is produced by fermentation of a non-GMO Aspergillus niger and a non-GMO Aspergillus oryzae. Due to this non-GMO fermentation process, the product contains the three forms of amylase (α-amylase, β-amylase and γ-amylase), thus ensuring the complete digestion of starch by providing two forms of amylase not naturally produced by the animal (β-amylase and γ-amylase) (Fig. 2).

Amylofeed is commercialised by Materias y Actividades SL (Pintaluba Group) from Spain. Various practical feeding trials carried out within Europe have demonstrated the economical advantages of using Amylofeed in piglet diets. Data obtained from three different experiments were combined and analysed together in a meta-analysis.

Two experimental treatments were used in each study: control with no exogenous enzymes, and Amylofeed at 500g/tonne of feed in both prestarter and starter phases.

At the end of the trial (60 days of age), in comparison with controls, piglets fed diets supplemented with Amylofeed were significantly heavier (22.1 vs. 21kg) (Fig. 3).

For the overall period (from 21-60 days of age) the piglets fed diets supplemented with Amylofeed grew significantly faster (381 vs. 358g/d) and ate more feed (548 vs. 530 g/d) compared to controls. On the basis of these results, the following conclusions can be drawn. In comparison with controls, piglets fed diets supplemented with Amylofeed need 2.36 days less to gain 14kg and reach 21kg of live weight (14kg/381g/d = 36.75 vs. 14kg/358g/d = 39.11 days). According to this first conclusion, piglets fed diets supplemented with Amylofeed need to eat 589g less feed to gain 14kg and reach 21kg of live weight (548g/d x 36.75d = 20,139 vs. 530g/d x 39.11d = 20,728g). ■