How to improve the efficiency of corn-soy poultry diets

New research has shown positive effects on broiler performance when a wide range of NSP-degrading enzymes are included in the diet.

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Non-starch polysaccharides (NSPs) are the main constituents of plant cell walls and play a role in the encapsulation of nutrients including amino acids, starch and lipids. It is well-known that NSPs negatively affect access of endogenously secreted enzymes to their substrates, reducing digestibility.

Plant feed ingredients commonly used in poultry diets contain between 7 and 19 percent of NSPs. Cereals like wheat and barley and protein sources like soy contain a higher proportion of NSPs compared with corn. However, the total NSP content of corn and wheat are not so different, close to 90 grams per kilogram. The major difference between corn and wheat NSPs is the kind of arabinoxylan structures present in each.

Arabinoxylans from corn have a much more complex structure than arabinoxylans from wheat. They are highly branched with multiple arabinose residue substitutions in corn. A recent study showed that the arabinose:xylose ratio (A:X) obtained for a corn-based diet was higher than that obtained for a wheat-based diet (0.73 vs. 0.65). This demonstrates a higher degree of substitution in corn arabinoxylan chains (AX), compared with those in wheat.

BY ADDRESSING A WIDE range of chemical bonds present in corn NSPs, the feedase concept has demonstrated significant benefits on energy uplift and the release of other nutrients.

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NSP content of cereals and protein sources commonly used in monogastric diets

		Ingredients used in poultry diets (% dry matter)				
Composition	Carbohydrates	Corn	Barley	Wheat	Rye	Soybean meal
Cellulose	Glucose	2.2	4.3	2.0	1.6	12.3
Arabinoxylans	Arbinose	2.2	2.8	2.9	3.6	3.1
	Xylose	3.0	5.6	4.7	6.1	5.1
Beta-glucans		0.1	4.2	0.8	1.6	-
Pectins	Mannose	0.3	0.4	0.3	0.5	1.2
	Rhamnose	-	-	-	-	0.4
	Galactose	0.5	0.3	0.4	0.5	1.3
	Uronic acids	0.7	-	0.4	0.4	6.7
Total NSPs		**9.9**	**18.7**	**11.9**	**15.3**	**31.5**

Source: Bach-Knudsen, 1997

Barley and rye contain a higher proportion of NSPs compared with corn and wheat.

Formulation of experimental diets

Treatment	Diet	Enzyme addition	Energy kcal/kg	Energy MJ/kg	dAA** Reformulation
T1	Positive control	-	-	-	-
T2	Negative control (NC) 1	-	-80	-0.33	-3%
T3	NC2	-	-80	-0.33	-6%
T4	NC3	-	-120	-0.50	-3%
T5	NC4	-	-120	-0.50	-6%
T6	NC1+	a feedase*	-80	-0.33	-3%
T7	NC2+	a feedase*	-80	-0.33	-6%
T8	NC3+	a feedase*	-120	-0.50	-3%
T9	NC4+	a feedase*	-120	-0.50	-6%

*Rovabio Advance T-Flex at 50 grams/ton
**Digestible amino acids
Source: Rios et al., 2017

Eight diets were formulated to have reduced AME and digestible amino acid levels compared with the positive control — feedase was added to four of them.

Improving digestibility and nutrient release

There is still knowledge to be acquired on the impact of indigestible components within many feed ingredients, including corn and soy. By understanding the complex nature of the NSP content in these major feed ingredients, there is also the potential to improve the digestibility of feed. By quantifying their NSP content, along with any other important anti-nutritional factors present, it is possible to estimate the indigestible fraction of a feed that is available to enzymes.

Not all carbohydrases act similarly on the NSP components, because they are a variable substrate. That is why, by adding different carbohydrases in the same basal diet, different effects are seen in animals.

In the previously mentioned study, the dry matter digestibility (dig DM) of wheat- and corn-based diets were assessed. This was carried out without enzyme addition, in the presence of xylanase alone, or xylanase plus arabinofuranosidase (ABF). Compared with dig DM of wheat, the 11 percent lower degree of substitutions in wheat, decreased the dig DM by 31 percent compared to corn. More than that, xylanase alone increased wheat dig DM by 4 percent versus the control, but had no significant effect on corn dig DM in this study. However, the combination of xylanase and ABF had a significant effect on dig DM in corn-based diets.

The feedase effect

The ability of efficient multi-enzyme solutions to improve global feed digestibility is known as the feedase effect. By reducing the indigestible fraction of feed, as well as anti-nutritional factors, more nutrients are released. This is due to the inclusion of a wide range of NSP-degrading enzymes, including xylanases and ABFs.

ABFs are debranching enzymes; they improve the enzymatic activity of carbohydrases on the arabinose side chains of arabinoxylans. As a result, xylanases have better access to the xylose backbone for hydrolysis. By working synergistically, NSP breakdown is increased and the anti-nutritional effects are therefore reduced — boosting an overall efficacy of feed energy utilization. At the same time, the release of other nutrients is increased, such as amino acids and lipids. In fact, it is these nutrients that produce the extra metabolizable energy that can be measured.

Digestibility of dry matter (dig DM) of wheat- and corn-based diets*

	Dig DM %		
	Control	Xylanse	Xylanase +ABF
Wheat	72.5[a]	75.4[b]	79.6[c]
Corn	49.8[a]	48.8[a]	52.0[b]

a,b Different letters means significant (P<0.05) differences among treatments
**Without enzyme addition and in the presence of xylanase or xylanase plus arabinofuranosidase*
Source: Cozannet et al. 2017

The combination of xylanase and arabinofuranosidase had a significant effect on dry matter digestibility in corn-based diets.

Beyond the energy uplift

An experiment was conducted to find out the level of nutrients that could be released by the action of a feedase in broiler diets. The positive control diet was based on corn (49 to 72 percent) and soybean meal (23 to 40 percent), being representative of a commercial Brazilian diet. A series of eight diets were formulated to have reduced AME and digestible amino acid levels compared with the positive control. A feedase was added to four of these diets. The diets were fed in three phases: starter, grower and finisher.

It is a common practice to reformulate diets based on energy when adding carbohydrases. However, interest is growing on the use of digestible amino acid (dAA) values in such calculations. The cost of protein in a diet makes up a significant proportion of its price. Therefore, if the amino acid specification can be reduced, without compromising performance, then significant savings could be made. The formula may call for lower inclusions of

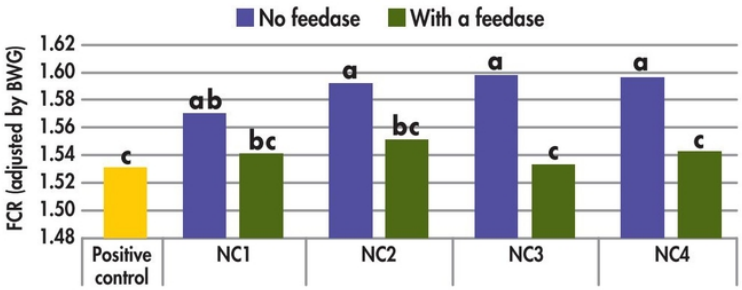
expensive ingredients and alternative or lower-quality raw materials could be used.

Maintaining high-level performance with a reformulated diet

The experimental diets were fed to broilers in a floor pen facility at the Universidade Federal do Rio Grande do Sul in Brazil. A total of 2,016 Cobb 500 male day-old chicks were used in the trial. Feed and water were provided *ad libitum* and a range of performance parameters was recorded at 21-, 35-and 42-days of age.

The four reformulated diets resulted in significant performance losses, as shown by an increase in adjusted FCR. Over the whole period, the addition of a feedase to the reformulated diets, recovered the reduction in FCR degradation seen in the re-formulated diets.

Broilers fed nutritionally adjusted diets, with or without a feedase



a,b,c Different letters mean significant (P<0.05) differences among treatments
Source: Rios et al., 2017

In the trial, FCR was adjusted by body weight gain (0-42 days) of broilers fed nutritionally adjusted diets, with or without a feedase, and compared with the positive control. The addition of a feedase to the reformulated diets, recovered the reduction in FCR degradation seen in the re-formulated diets.

in all feeding phases demonstrating that the feedase was able to increase nutrient release from the diet by reducing the indigestible fraction.

Future implications

This research has increased interest in a global enzyme solution applied with a more complete understanding of the indigestible fractions of different diets. It allows larger energy and dAA uplifts — hence greater feed cost savings. The efficacy of the feedase concept has been demonstrated in corn-soy-based diets and can be explained by the inclusion ABFs, beta-glucanases and cellulases. These work in synergy with a series of eight different xylanases to break down the highly branched NSPs.

The feedase effect improves the release of energy and nutrients, including amino acids, from the feed. These enzyme complexes have been tested and are extensively used "on top" of a phytase inclusion. They act on a different substrate and have additional benefits. Nutritionists can reformulate diets accordingly — reducing feed cost without any negative impact on broiler performance. A re-think is needed regarding the feed cost savings that can be made when a feedase is added to a corn-soy-based diet. ■

What are the major enzymes used in poultry feeds?: www.WATTAgNet.com/articles/31502

The trial highlighted the interest of using this kind of feedase in reformulated diets, bringing performance back to statistically the same level as the positive control, while making feed cost savings. This positive effect was observed

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