Additives by Ajay Awati

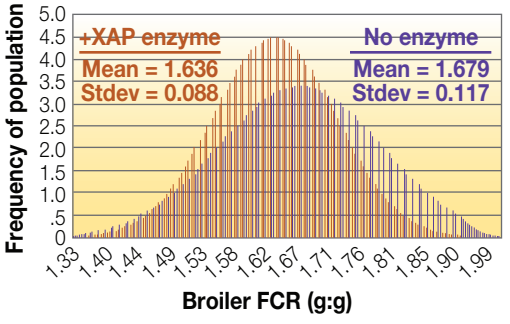
Combined enzyme and probiotic solution unlocks full feed potential

Technologies allow poultry producers to achieve commercial sustainability, meet growing global demand for protein now and in the future.

As we look to feed a growing world population, it is critical for the feed industry to find ways to increase the efficiency by which animals convert feed into protein while shortening the cycle time of production. World meat consumption is expected to double by 2050; and, in the developing world, the increases in animal protein consumption are even more dramatic, mainly due to a new, wealthier middle class. Estimates to 2020 showed that 70 to 75 percent of meat demand will come from Asia and Brazil; 75 percent of the demand for eggs will come from Asia; and 60 percent of dairy demand will be from India, Pakistan and China. It has also been anticipated that these markets will face similar cost-control challenges to "emerged markets," such as Europe and the United States.

Globally, getting better value from feed and delivering high-quality protein will be the biggest challenges that producers face in the future, and multiple strategies will

Figure 1: Influence of corn nutrient variability on feed conversion ratio



Sources:
1. Choct, 2006, Mirzaie et al., 2012
2. Gracia et al., 2003; Barletta, 2010
3. Yu et al., 2007; Cowieson and Adeola, 2005
4. Caine et al., 1998

This graphic demonstrates how the variability of corn impacts the feed conversion ratio (FCR) without enzymes and, in contrast, with the use of an amylase, xylanase and protease enzyme combination (XAP). It shows a benefit of around four points in FCR (2.6 percent) and a reduction in FCR variance of approximately 23 percent. The study used 56 corn samples.

- Xylanase targets NSPs in the fiber fraction of the grain to release captured nutrients.
- Amylase increases the hydrolysis of starch, improving its digestibility, complementing the secretion of endogenous amylases by the bird and resulting in more energy being released to fuel growth.
- Protease improves the accessibility of starch via degradation of the endosperm matrix.
- It also targets other ANFs in the diet, ex: trypsin inhibitors and lectins in soybean meal.

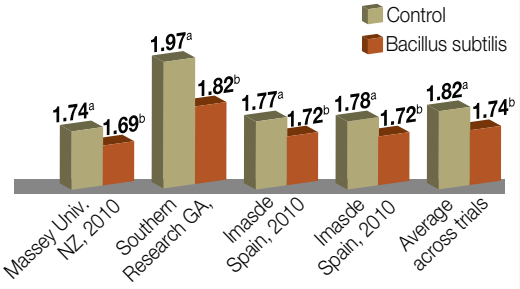
be required to meet this growing demand. From 1961 to 2007, FAO reports global meat production increased from 71 million metric tons to 284 million metric tons due to improved animal genetics and nutrition. New generations of healthy nutrition solutions, including combinations of feed technologies, will need to deliver sustained or increased levels of profitability through enhanced animal performance and livability to ensure a consistent supply of protein at an affordable cost.

Reducing the impact of variance in feeding value

Dealing with variability in feed digestibility and feed cost are two of the main challenges facing animal producers. Feed enzyme technology has an important role to play in this area. It is generally acknowledged that the lower and more variable the feeding value of individual raw materials, the greater the potential for feed enzyme response. Appropriate combinations of feed enzymes are therefore particularly valuable in diets containing cheaper, high-fiber ingredients, which contain higher levels of anti-nutritional factors (ANFs), such as non-starch polysaccharides (NSPs) and phytate.

Corn is the most common feed grain used globally. However, its feeding value can also be very variable due to growing and harvest conditions, which can be improved with the addition of appropriate enzyme combinations. Broiler trials have shown that variability in feed conversion ratio, caused by variability in corn and its digestibility, can be improved by a combination of xylanase, amylase and protease enzymes (Figure 1), with each enzyme having a specific contribution to the response seen in the bird.

Figure 2: Live body weight gain through addition of multi-strain Bacillus



FCRc: corrected 3 points per 100g of liveweight difference
[ab]Shows significance at P<0.05 in the individual trials
Source: Danisco trials, 2010

This table shows the improvements in broiler FCRc (feed conversion ratio - bodyweight converted) after a three-strain B. subtilis *addition to the diet.*

It is also increasingly recognized that the anti-nutritive effects of dietary phytate are highly influential on amino acid and energy digestibility, raising the value of phytase to the end-user beyond being just a contributor to phosphorus and calcium nutrition. Gaining a better understanding of the effects of adding varying doses of phytase together with other exogenous enzymes (and other feed additives) will be extremely important in reducing the impact of volatility in the feed industry and in creating future value for producers. New developments in phytase technology offering phytase sources with enhanced bio-efficacy and consequent improved nutrient release (e.g. new *Buttiauxella spp.* phytase versus *E.coli* phytases) which will help producers improve performance while enjoying additional feed cost savings.

RELATED CONTENT
How to select the best phytase for your feed formulation,
www.WATTAgNet.com/165247.html

Achieving optimum feed efficiency

Dr. Mingan Choct's review, "Managing gut health through nutrition," notes: "Formulating a

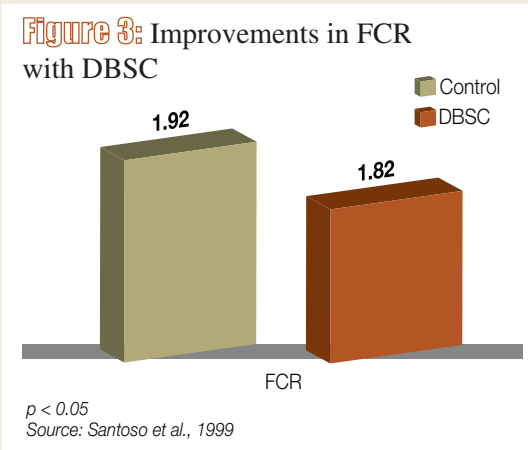
diet for its effects on gut health is fast becoming a reality in the monogastric animal industries. This is because the maintenance or enhancement of gut health is essential for the welfare and productivity of animals when antibiotics are not allowed in feed" (Choct *et al.*, 2009). Against this global background of gradual reductions in sub-therapeutic antibiotic use, it is essential to understand the important interactions between the diet, diet digestibility and the consequent effects on gut microbiota balance.

Undigested nutrients flowing to the hind gut not only impact growth performance, but also directly contribute to undesirable shifts in the gut microbiota, negatively affecting feed conversion ratio (FCR) and bird health. Long before any signs of disease are observed, microbial imbalances can negatively affect performance.

Enzymes can positively affect the gut microbiota through improved digestibility, for example, xylanases showed benefits in wheat-based diets for poultry in a *Campylobacter jejuni* challenge model (Fernandez *et al.*, 2000). It was also noted that indigestible NSPs and trypsin inhibitors (TIs) both appeared to induce necrotic enteritis (NE) linked to *Clostridium perfringens* proliferation in chickens (Shojadoost *et al.*, 2012). Both NSPs and TIs are well-known substrates for xylanase/beta-glucanase and protease enzymes, respectively. Studies have also shown how protease addition improved the performance of chickens challenged with *Eimeria spp.* and *Eimeria*, one of the pre-disposing factors in NE (Peek *et al.*, 2009).

Maintaining gut microbiota balance

Probiotics have been defined as combinations of beneficial bacteria that maintain the gut microflora and assist with natural defenses against pathogens (Patterson and Burkholder, 2009). Used in healthy human nutrition solutions for decades, their potential benefits in supporting animal gut microbiota balance are well recognized. *Bacillus* probiotics are favored for inclusion in animal feed due to their stability during steam conditioning and pelleting; their resistance to enzymatic digestion; and stomach acidity, which ensures delivery to the lower intestinal tract, as well as their effective colonization of the gut wall.



Feed conversion ratio improvements in broilers after the addition of dried Bacillus subtilis culture (DBSC) to the diet.

Benefits claimed for *Bacillus* include supporting optimum gut microbiota in young animals, counteracting stress, transportation, climatic change, mixing animals of different origin and overuse of therapeutics. In addition, they have been shown to help protect growing animals from colonization by coliforms and promote villi development in the gut lining, enhancing the animal's ability to absorb nutrients (Lee et al, 2010). This is important, as gut metabolism in chickens accounts for 20 to 36 percent of daily energy expenditure (Cant *et al.,* 1996).

Trials with combined strains of *B. subtilis* have shown 4 to 5 percent improvements in FCR (Figures 2 and 3) and in an NE challenge model (Santosa *et al.* 1999) broilers maintained good performance during the period of challenge when probiotics were added to their feed.

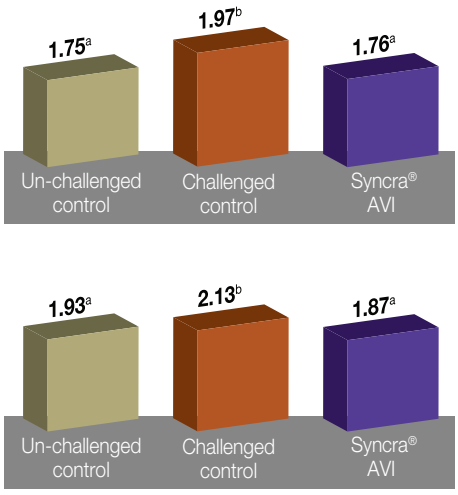
The demand for more protein doesn't only equate to meat, as eggs are a major protein source

in many countries. After adding dried *B. subtilis* culture to layer diets, layer trials exhibited the following performance improvements: 2.8 percent in number of eggs/hen/day; 1.2 percent in egg weight; and 2.4 percent in egg mass/hen/day (Xu *et al.*, 2006).

The same studies showed that egg shell strength was improved by 10.6 percent, protein levels in eggs by 3.1 percent, while yolk cholesterol was decreased by 12.2 percent. Also, 5.9 percent less feed was required to produce 1 kg of egg.

Meta-analysis of two studies with NE challenge model, showing combination of mixed enzyme (xylanase, amylase and protease) and Bacillus *three strain probiotic (Syncra AVI) maintained feed conversion ratio similar to unchallenged control under NE challenge.*

Figure 4: Combining multi-enzymes and Bacillus to unlock the full potential of feed



Source: Mathis et al., 2013

Achieving the optimum healthy nutrition solution

Multi-enzyme combinations of xylanase, amylase and protease can help producers improve performance while also supporting gut health. *Bacillus* DFMs have also been shown to provide healthy performance benefits. The logical conclusion would be that combining *Bacillus* probiotics and selected enzymes should unlock even more value by combining these benefits and helping producers supply high-quality protein more quickly and profitably.

Recent trials have been conducted to quantify the benefits of combining three strains of *Bacillus* together with xylanase, amylase and protease enzymes under "low challenge" and "challenged" conditions. In a meta-analysis of six broiler trials run under "low challenge" conditions, average improvements in body weight corrected FCR of 2.4 percent were seen, bringing a net benefit of around three-to-one in terms of return on investment.

In two studies using an NE challenge model with *Clostridium perfringens*, the same combination of *Bacillus* three-strain probiotic and xylanase, amylase and protease enzymes showed equivalent FCR to the unchallenged control (Figure 4).

As the pressure grows on poultry producers to reduce production costs without compromising bird performance or gut health, this combination appears to offer good opportunities to fully unlock the potential of feed. ◀

Full references available on request from monica.hart@dupont.com.

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