Spray-dried plasma assessed

Use of dietary plasma in pre-starters for broilers may improve growth and health.

By **STEVE LEESON***

EARLY nutrition of the broiler chicken is becoming more important as more knowledge is gained about the positive correlation between early growth rate and market weight and also the impact early growth and development have on the uniformity of carcass weight and composition.

All of these factors become even more critical within antibiotic-free (ABF) production systems. While ABF can apply to many different scenarios, it is obvious that removal of growth promoters and all classes of anticoccidials represents the greatest challenge at the farm level.

As detailed in the first article on this topic (*Feedstuffs,* July 27), optimizing early digestion is so often the key to a successful farm program, since this offers the best chance of preventing dysbacteriosis, coccidiosis and necrotic enteritis.

The early-weaned piglet faces many similar challenges, and especially so in swine ABF production systems. One key ingredient now used almost universally in the diets of weanling pigs is spray-dried blood plasma, which is a source of highly digestible amino acids and, more importantly, a source of functional proteins.

There is no doubt that the growth and health of the newly weaned piglet is greatly enhanced by the use of dietary plasma, so the question arises as to the potential usefulness of plasma in pre-starter diets for ABF broiler chicks.

Plasma composition

Plasma is collected during the slaughter of pigs and ruminants and is usually separated from red blood cells by centrifugation. The major difference between plasma products and blood meal is the separation of plasma from red cells and the less-harsh temperature and time used during spray drying of plasma.

The resultant spray-dried plasma (SDP) is a free-flowing meal composed of around 75-80% crude protein and minerals and about 8% residual water. Some 95% of the proteins are albumins and globulins (Tumbleson et al., 1986). Porcine and bovine plasmas have very similar amino acid profiles (Table).

Essential amino acids represent around 40% of the total protein. The main deficiencies of amino acids relative to lysine content are the total sulfur amino acids and isoleucine. Although this amino acid profile is economically meaningful during formulation, the amino acid contribution alone cannot explain the positive effect seen in piglets when substituting SDP for, say, fish meal.

The benefit of SDP for neonates is more likely the fact that these amino acids are part of functional proteins that impart the major advantages to the newly weaned pig and, perhaps, the young chick. The constituent immunoglobulins in SDP can be separated into fractions with high, medium and low molecular weight that correspond to globulins, albumins and fibrin, respectively.

The globulins are one of the most beneficial components of SDP in that the same response in pigs is seen with SDP or just 25% of the same inclusion level as extracted globulins. Consequently, the globulin content of SDP is one useful measure of quality.

Functional proteins

The fact that both swine- and bovine-sourced SDPs work well with early-weaned pigs indicates that species specificity of the globulins is not critical. The immunoglobulin G molecule cannot be absorbed intact, so it is assumed that the beneficial effects of these globulins occur in the small intestine. Globulins certainly reach the small intestine intact, although there is little information available on their ultimate fate.

Studies measuring amino acid digestibility (Table) suggest that globulins are digested, yet their functional properties are also very obvious in piglets. It seems possible that they may play both roles consecutively?

Globulins reach the small intestine intact and bind to bacteria and viruses, and in piglets, they have been shown to increase the clearance rate of certain intestinal and respiratory viruses. There is improved intestinal barrier function, reduced cellular inflammation and less diarrhea and indigestion.

Some glycoproteins in SDP possess binding sites for the fimbriae of *Escherichia coli.* They also encourage the proliferation of lactobacilli species and, thus, promote a more advantageous microbiota overall.

The critical health benefits seen in early-weaned pigs fed SDP are ascribed to increased microvillus growth relative to crypt depth, which is analogous to the effects seen with antibiotics and butyric acid.

The most important health and production benefits accrue due to the reduced production of pro-inflammatory cytokines, the converse of which is a very energy-demanding process. Feeding SDP, therefore, probably has a greater effect on net energy than apparent metabolizable energy (AME), although the latter will be improved if for no other reason than that gut development is improved with the absence of diarrhea.

One final effect of SDP on overall nutrient capture is the observation of reduced amino acid catabolism by the intestinal microbiota.

ABF chick vs. early-weaned pig

There are interesting similarities between the challenges of feeding the newly weaned pig and the neonate chick, especially in ABF systems. Both animals are faced with a sudden change in nutrient supply, they are challenged with population mixing, processing and transportation stress and the supply of maternal antibodies is minimal in relation to the field challenge from microbes and feed enterotoxins.

While the chick's weight can vary up to 10-15%, the weight of newly born pigs can vary by 50-80%. Feeding SDP to sows reduces such drastic variation, so it would be interesting to feed SDP to broiler breeders and record the variance in broiler performance.

At least a 20% additional increase in the growth of piglets in the first 7-14 days

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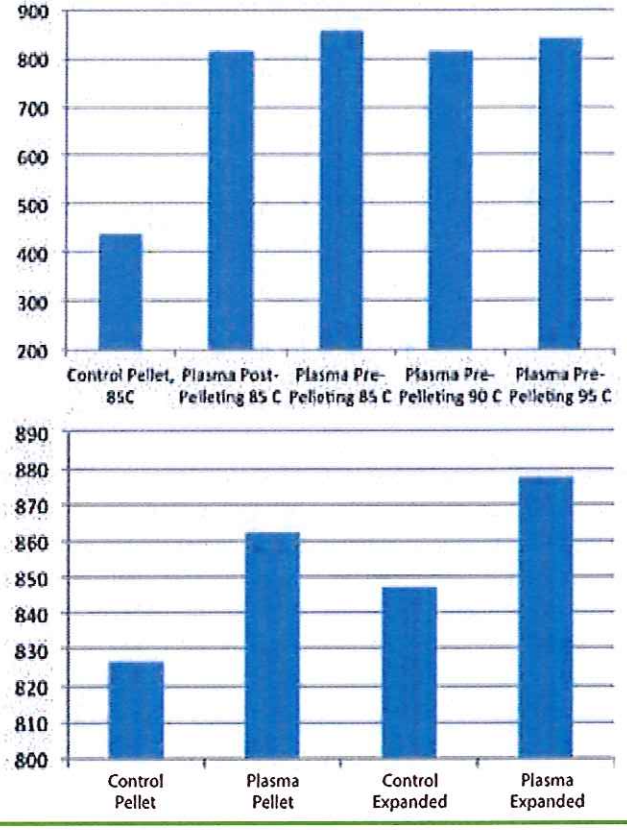
Nutrient content of spray-dried plasma

	Digestible amino acid (%)
Lysine	6.2
Methionine	0.5
Total sulfur amino acids	2.9
Threonine	3.8
Valine	4.2
Isoleucine	2.5
Leucine	6.5
Tryptophan	1.2
Arginine	4.0
AMEn, kcal/kg	3,000
Crude protein, %	75

1. Bodyweight (g) of broilers fed diets containing plasma within feed processed at a high temperature



for antibiotic-free chicks

after weaning generally can be expected when the piglets are fed moderate amounts of SDP, even though these specialized diets normally contain quality animal proteins like milk and fish meals.

One of the major challenges in both swine and broiler production today is variability in final bodyweight. While many feeding options and/or additives can influence the average performance of the herd or flock, there is often little observed effect on variance. It is becoming obvious that such variance in the weight of 100 kg pigs or 2-4 kg broilers is perhaps most affected by early development.

With pigs, genetic selection has resulted in increased litter size, but with perhaps more variance in piglet weight at birth. Likewise, with broiler breeders, ever-increasing egg production is associated with more variation in both egg weight and chick weight leaving the hatchery.

Studies with pigs show that bodyweight immediately postweaning accounts for 30% of the variation in 110 kg bodyweight. SDP seems to reduce such variance in weight 14 days postweaning.

Since each gram of a broiler's bodyweight at seven days of age equates to roughly a 10 g difference in weight at 40 days, there is great potential for studies with SDP in pre-starter diets to both standardize and improve the overall broiler growth rate. It has been suggested that such variation in early bodyweight may be due to transient (12- to 24-hour) anorexia in the newly weaned pig and, likewise, failure of some chicks to eat in the first 24-36 hours in the broiler house.

Compensatory gorging invariably follows such anorexia, and unfortunately, this situation corresponds to a time of quiescent endogenous enzyme production. The resultant indigestion can fuel microbial overgrowth, so there is a need for products such as SDP that underpin intestinal health and the immune response.

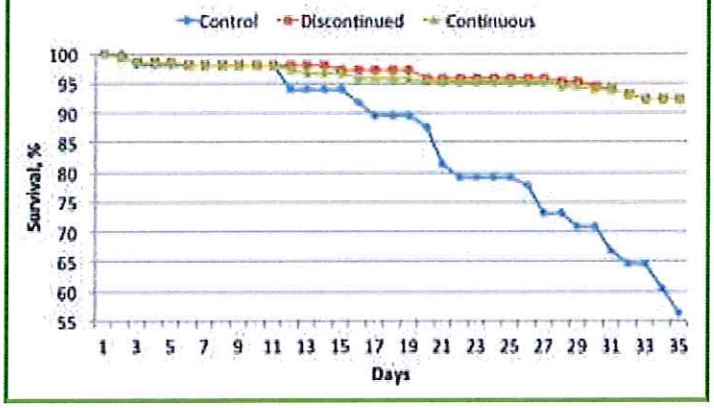
The magnitude of response to SDP may be influenced by inherent ingredient usage in the diet. When SDP replaces a significant amount of vegetable protein in piglet diets, the result is around double that seen when it replaces ingredients such as fish meal. Likewise, the response to SDP in piglets is much greater with the usual on-farm microbial challenge and much less in a sterile environment.

SDP also has more of a positive effect in piglets fed diets with mycotoxins (200 parts per billion of aflatoxin plus nine parts per million of fumonisin). Overall, the dietary management or production concerns that allow SDP to express beneficial effects in piglets are mirrored in ABF broiler production.

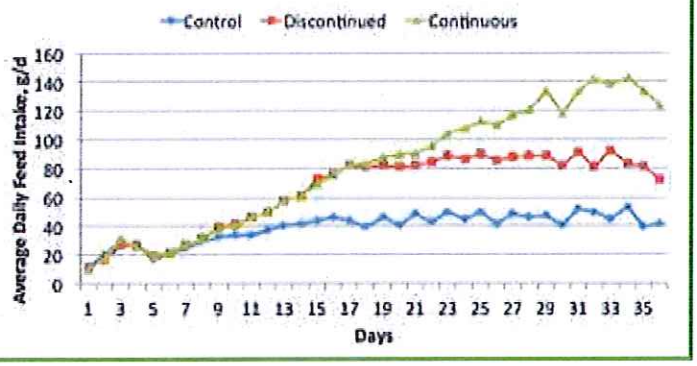
Plasma potential

The main challenges with ABF production are intestinal dysbacteriosis, coccidiosis and, subsequently, necrotic enteritis. While this cascade of events culminates in observable bird distress anywhere from 15 to 20 days of age, the underlying cause may well start with indigestion in the first few days of age.

2. Survival of broilers fed plasma during natural necrotic enteritis outbreak



3. Feed intake of broilers fed plasma during natural necrotic enteritis outbreak



The concept behind using SDP in weanling piglet diets provides an interesting analogy to the issues seen with the neonate chick and provides a possible platform for developing new dietary initiatives for ABF broiler management systems.

Research studies conducted some 10 years ago indicated that using 1.5% SDP in the starter diet and just 0.375% in the finisher diet improved the growth and feed efficiency of broilers and that the response was greater when broilers were housed in a higher antigen-challenge environment (Campbell et al., 2003; Bregendahl et al., 2005).

The summary of results from a number of broiler studies suggests that improvements in the pre-starter period are around 4% in average daily gain and 2.6% in feed:gain. These effects for gain are maintained or even improved through 42 days, while the improvement in feed:gain diminishes to around 1% for the overall 42-day growout.

Since plasma functional proteins are thought to be more susceptible to heat processing than intact proteins are, there is always a question about the efficacy of SDP using modern feed milling processes.

Campbell et al. (2006) showed the resilience of SDP under varying pelleting conditions and even when expanding to 149°C (Figure 1).

The most dramatic benefits in using SDP in broiler diets have been seen when broilers are naturally or artificially infected with various pathogens. Campbell et al. (2006) evaluated functional SDP in broilers that had a veterinary-confirmed natural occurrence of severe necrotic enteritis. Birds were fed SDP either continuously — 1% from days 1 to 14, 0.5% from days 15 to 28 and 0.25% from days 29 to 35 — or discontinuously with just 1% SDP in the starter from days 1 to 14.

Feeding SDP had a dramatic effect on mortality due to necrotic enteritis. Interestingly, the birds in the discontinuous SDP group were protected after 14 days, even though they consumed a non-supplemented broiler grower diet at this time (Figures 2 and 3).

Not only did SDP affect survival, but these birds also consumed significantly more feed. The effect of SDP may well have been through sustaining a better gut villi structure, along with the ability of SDP to combat pathogens as previously described.

Conclusions

The widely accepted practice of including SDP in diets for weanling piglets is based on the product's role in supplying functional proteins that enhance growth and efficiency by normalizing or improving gut function. Piglets fed plasma are invariably healthier and, with limited diarrhea, are better able to utilize the entire spectrum of nutrients within the diet.

Perhaps poultry nutritionists can learn from this application of SDP for use in broiler pre-starters, particularly when birds are grown with minimal pharmacological support. The research to date shows an encouraging response of broilers to SDP, and it likely warrants a future role in the arsenal of so-called "antibiotic alternatives."

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