Plasma in Early Diets Improves Profitability in Broilers

Learn how spray-dried plasma in early broiler diets improves efficiency and body weight while providing functional proteins that impact the immune system.

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Introduction

Early nutrition of the broiler chicken is becoming more important as we gain increased knowledge about the positive correlation between early growth rate and market weight, and also uniformity of carcass weight and breast muscle growth. All of these factors become even more critical within Antibiotic Free (ABF) production systems. While ABF can mean many different scenarios, it is obvious that removal of growth promoters together with all classes of anticoccidial represent the greatest challenge at the farm level. Optimizing early digestion is often the key to a successful farm program, since this gives the best chance of preventing dysbacteriosis, coccidiosis and necrotic enteritis. Spray-dried plasma represents a source of highly digestible amino acids for all neonate animals, but more importantly it provides a unique contribution of functional proteins that impact the animals immune system.

Plasma composition

Plasma is collected during the slaughter of pigs and ruminants, and separated from red blood cells by centrifugation. The major difference between plasma products and blood meal is the less harsh temperature and time used during spray drying of plasma. The resultant spray dried plasma is a free flowing meal containing around 70-80% crude protein depending on the filtration system used (reverse osmosis or nano/UF filtration), minerals and about 8% residual water. Some 95% of the proteins are albumins and globulins. Porcine and bovine plasma have very similar amino acid profiles (Table 1).

Table 1. Nutrient content of spray dried plasma.

	Digestible amino acid (%)
Lysine	6.5
Methionine	0.7
TSAA	3.5
Threonine	4.8
Valine	5.2
Isoleucine	2.9
Leucine	7.8
Tryptophan	1.4
Arginine	4.7
AMEn	3830kcal/kg
CP	78%

Role of functional proteins

The fact that both swine and bovine-sourced SDP work well with early-weaned pigs indicates that species specificity is not too critical. The IgG molecule cannot be absorbed intact and 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 1) suggest that globulins are ultimately digested, yet their functional properties are also very obvious in piglets and other neonates. It seems possible that they may play both roles consecutively?

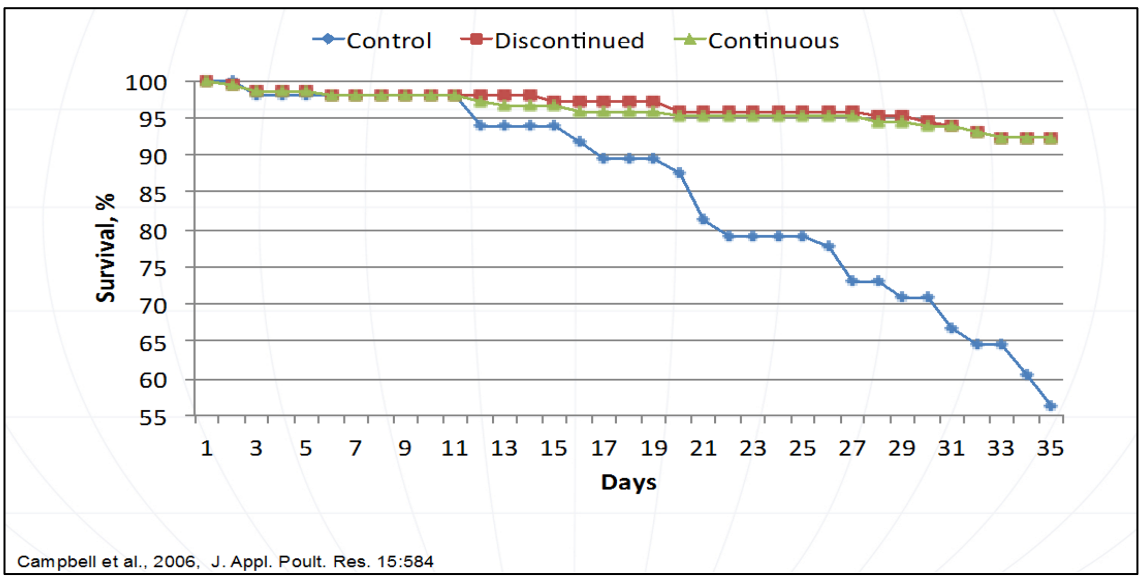
Globulins and other functional proteins reach the small intestine intact and bind to bacteria and viruses and in piglets and have been shown to increase the clearance rate of certain respiratory viruses. There is improved intestinal barrier function, reduced cellular inflammation and less diarrhea and indigestion. There are also some glycoproteins in SDP that possess binding sites for the fimbriae of E. coli. They also encourage the proliferation of lactobacilli species, so overall they promote a more advantageous microbiota. 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 reduced production of pro-inflammatory cytokines, the converse of which is a very energy demanding process. One final impact of SDP on overall nutrient capture is the observation of reduced amino acid catabolism by the intestinal micobiota.

Potential for use of plasma in broiler pre-starter diets

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 15-20d of age, the underlying cause may well start with indigestion in the first few days of age. The concept behind using SDP in diets for weanling piglets provide an interesting analogy to the issues seen with the neonate chick and provide an interesting platform for developing new dietary initiatives for ABF broiler management systems.

The most dramatic benefits from using SDP in broiler diets are seen when broilers are naturally or artificially infected with various pathogens. Campbell et al. (2006) evaluated SDP in broilers that had a veterinary-confirmed natural occurrence of severe necrotic enteritis. Birds were either fed continuously with SDP at 1% from 1-14d, 0.5% from 15-28d and 0.25% from 29-35d, or discontinuously with just 1% SDP in the starter from 1-14d. Feeding SDP had a dramatic effect on mortality due to necrotic enteritis. Interestingly the birds in the discontinuous group were protected after 14d even though they consumed unsuplemented broiler grower diet at this time (Figure 1).

Figure 1. Survival of broilers fed plasma during a natural Necrotic Enteritis outbreak.



The most consistent effect from using plasma is observable improvement in feed efficiency. In part this improved efficiency is related to using a highly digestible source of amino acids, and to improved gut villi structure. However, the major effect is undoubtedly the result of functional proteins tempering the immune system. Sustaining the immune system represents a major component of maintenance energy requirements. Table 2 outlines performance of Ross 308 broilers grown in three regions representing major differences in local disease challenge and so the need to support immune responses with variable vaccination programs. Broilers in all regions were fed diets with comparable levels of nutrient density in terms of AME and available amino acids. While weight-for-age is likely to be unaffected by sustaining the immune system, there will be major differences in maintenance nutrient needs and so feed efficiency. In this example the range is an astounding 30 points of feed conversion, some of which will be captured by feeding spray-dried plasma.

Table 2. Cost of sustaining the immune response in broilers is 30 points of feed conversion.

	Mexico	USA/Canada	New Zealand
Health status	Major disease challenge	Moderate disease challenge	Minimal disease challenge
Vaccination	Hatchery and farm	Hatchery	None (?)
Feed:Gain for 2.3kg Ross 308 broilers fed comparable diets	1.80	1.63	1.50

APC, Inc., the world's leading producer of SDP has been involved with numerous studies around the world involving the use of plasma in pre-starter diets for broilers. Table 3 summarizes 13 studies conducted by independent broiler institutes around the world. Because each company has their own standards for using pre-starter diets, then the inclusion level, time of feeding the pre-starter with SDP and of course market age, are all variables. Overall, there is 5 points improvement in feed conversion and 75g improvement in growth. In most economic evaluations, feeding SDP at 2% for 10d is paid for by 1 point improvement in feed conversion together with just 10g increase in body weight

Table 3. Summary from 13 Broiler research/field studies with spray-dried plasma (2008-2014).

Trial #	Plasma Level	Days fed	Final BW Control, g	Final BW SDP, g	Diff BW, g	FCR Control	FCR SDP	Diff FCR
1	2.5	4	2,446	2,666	+220	-	-	-
2	1.5	7	2,010	2,048	+38	1.890	1.840	-0.050
3	1	7	3,267	3,290	+23	1.805	1.756	-0.049
4	1	7	3,293	3,336	+43	1.803	1.773	-0.030
5	1	7	3,280	3,313	+33	1.804	1.764	-0.040
6	1.5	8	2,208	2,262	+54	1.785	1.809	+-0.024
7	1.5	7	3,008	3,034	+26	1.709	1.684	-0.025
8	3	7	3,008	3,006	-2	1.709	1.681	-0.028
9	1	10	2,419	2,514	+95	1.580	1.470	-0.110
10	0.5	10	2,419	2,542	+123	1.580	1.480	-0.100
11	1	10	2,419	2,480	+61	1.580	1.440	-0.140
12	0.5	10	2,419	2,456	+37	1.580	1.470	-0.110
13	1	14	2,664	2,883	+219	1.682	1.724	-0.041
Average Improvement					**+75**			**-0.051**

Drs. Swick and Iji at the University of New England in Armidale, Australia have conducted a number of independent research trials that generally confirm the research results indicate above. Feeding just 5kg or 10kg/metric ton in the pre-starter the first 10d improved growth to 35d by just over 70g and improved efficiency by around 10 points of feed conversion. (Table 4)

Table 4. Effect of feeding bovine or porcine plasma from 1- 10d on broiler performance (Swick, 2015a).

	Body weight (g)		Feed:Gain	
	10d	**35d**	**0-35d**	**0-35d, adjusted**
Control	305	2420	1.58	1.58a
5kg/t porcine plasma	303	2540	1.50	1.48b
10kg/t porcine plasma	315	2500	1.48	1.47b
5kg/t bovine plasma	305	2480	1.44	1.44b
10kg/t bovine plasma	298	2460	1.47	1.47b

In another study (Table 5), Swick (2015b) clearly showed that bird response to SDP is dependent on both time of feeding and inclusion level. As expected, response in feed efficiency is increased with prolonged feeding of higher levels of SDP. With 20kg/metric ton to 10d, early efficiency is improved by over 10 points of feed conversion. At the same research center, Iji (2016) show comparable improvements in feed efficiency, although in this trial, maximum response was seen with feeding just 10kg SDP/metric ton for the first 10d of growth.

Table 5. Effect of feeding spray-dried plasma for 5 or 10d (Swick,2015b).

Plasma	Days fed	10d body weight (g)	1-10d Feed:gain
0		327	1.14
10kg/t	5d	332	1.09
20kg/t	5d	331	1.06
10kg/t	10d	329	1.04
20kg/t	10d	344	1.01

Table 6. Effect of feeding Spray Dried Plasma for 10d on broiler performance (Iji,2016).

		0	5kg/t	10kg/t	20kg/t
Body wt (g)	**10d**	321b	332ab	341a	346a
	35d	2609ab	2544b	2629b	2677a
Feed:gain	**1-10d**	1.20a	1.13b	1.10b	1.09b
	1-35d	1.61a	1.58ab	1.52b	1.53b

A broiler integrator in Europe recently ran two cycles of broilers using SDP in the starter. Body weight was increased by around 60g and feed conversion improved by between 6 and 9 points over the two cycles. With concomitantly reduced mortality, there was 2-3c€ reduction in feed cost per kg live weight. The improved feed efficiency and increased weight gain offset the increased price of the pre-starter by yielding 7c€ increased profit per bird.

Table 7. Commercial farm results from a European broiler integrator (2016).

	Cycle 1			Cycle 2			Overall
	Control	**Plasma**	**Diff.**	**Control**	**Plasma**	**Diff.**	**Diff.**
Final Wt., g	2168	2243	+75	2242	2289	+47	+60
FCR (kg feed/kg LW)	1.65	1.59	-0.06	1.60	1.51	-0.09	-0.075
Feed Costs/kg LWt €	0.54	0.52	-0.02	0.52	0.50	-0.03	-0.025
Mortality, %	4.24	2.94	-1.30	4.11	3.39	-0.72	-1.01
Kg per m^2	43.03	44.88	+1.85	46.01	45.87	-0.14	+1.71
Profit per bird placed €	0.01	0.09	+0.08	0.12	0.18	+0.06	+0.07

Results from an extensive commercial study in the USA are shown in Table 8. Broilers were fed 20kg of SDP per metric ton of starter, that also included an antibiotic growth promoter, for the first 10d with broilers grown to just over 3kg live weight. Once again there was 70g improvement in live weight accompanied by 3 points improvement in feed efficiency. Income minus feed cost was improved by 2.3% although the greatest economic return in this study accrued from improved carcass yield and increased proportion of white meat.

Table 8. 100,000 bird commercial field study from broiler integrator in the USA.

	Conventional	2% SDP 10d	Difference
7d Body weight (g)	150	160	+6.7%
Final body weight (g)	3250	3320	+2.2%
Adjusted F:G	1.723	1.693	-1.7%
Mortality (%)	3.04	3.57	+18.0%
Income-Feed cost			+2.3%
Carcass yield			+0.7%
White meat yield			+3.6%

A smaller scale study from Canada showed no improvement in growth rate, but 4 points improvement in feed efficiency and a dramatic 50% reduction in processing plant carcasses condemnations (Table 9)

Table 9. 2016 Canadian commercial farm study involving paired 45,000 bird houses, with two successive flocks fed 20kg SDP/tonne from 0-10d.

	Control	SDP starter	Difference
31d body weight	1792g	1778g	-0.8%
Feed:Gain	1.66	1.60	-4.0%
Mortality	4.23%	3.26%	-23%
Plant condemnations	2.42%	1.17%	-51%

The most recent commercial study was conducted by one of the larger broiler integrators in central Brazil. Broilers were fed 20kg SDP/tonne pre-starter through 10d of age and birds grown to just over 2.7kg live weight. In cycle #1, birds were smaller when fed plasma and only showed two points improvement in feed conversion. In the next cycle, on the same farms, birds were 100g heavier and had an amazing 18 points better feed conversion. Over the two cycles, the economic advantage was 0.3R$ per bird, representing a 7:1 return on investment of the SDP.

Table 10. Commercial field trial from Brazilian broiler integrator: Paired houses, modern farm, very warm summer conditions.

	Cycle 1		Cycle 2		Difference
	Control	Plasma	Control	Plasma	
Final BW, g	2,730	2,661	2,718	2,814	+13g
Feed:gain	1.70	1.68	1.77	1.59	-0.10
Mortality, %	3.0	2.4	3.3	2.9	-0.55

Economic Simulation for 100,000 Birds							
	Final BW	Feed Intake	Price Bird/kg	Price Feed/kg	Income R$	Cost R$	Profit R$
Control	2,724	4.56	R$ 4.00	R$ 1.284	1,057,021	567,570	489,450
Plasma	2,738	4.35	R$ 4.00	R$ 1.294	1,066,311	548,241	518,069

Tables 11-15 outline suggested levels of SDP for inclusion in diets of broilers, breeders and commercial layers. Different scenarios relate to different disease challenge expected in various regions of the world and hence the differential potential for SDP to counteract the negative impact of an active immune system.

Table 11. Suggested levels of S.D. Plasma in diets for broilers fed growth promoters and ionophore anticoccidials and with good gut health (April 2017 pricing).

	Diet inclusion	Projected cost (cents/broiler)
0-10d	1.50%	1.6c
11-16d	0%	0c
17-28d	0%	0c
28-42d	0%	0c
	Total	**1.6c**

Table 12. Suggested levels of S.D. Plasma in diets for ABF broilers and/or those with poor gut health (April 2017 pricing).

	Diet inclusion	Projected cost (cents/broiler)
0-10d	2.00%	2.2c
11-21d	0.50%	1.7c
22-35d	0%	0c
36-42d	0%	0c
	Total	**3.9c**

Table 13. Suggested levels of S.D. Plasma in diets for broiler breeder hens with regular vaccination programs (Jan 2017 pricing).

	Diet inclusion	Projected cost (cents/breeder)
0-6 weeks	2.00%	11c
7-21 weeks	0.25%	7c
22-24 weeks	1.00%	6c
25-64 weeks	0.20%	30c
	Total	**54c**

Table 14. Suggested levels of S.D. Plasma in diets for growing pullets and layers with minimal disease challenge (Jan 2017 pricing).

	Diet inclusion	Projected cost (cents/layer)
0-6 weeks	1.5%	6c
7-18 weeks	0.20%	3c
19-21 weeks	1.5%	18c
22-80 weeks	0.10%	13c
	Total	**40c**

Table 15. Suggested levels of S.D. Plasma in diets for growing pullets and layers with major viral or other disease challenge (Jan 2017 pricing).

	Diet inclusion	**Projected cost (cents/layer)**
0-6 weeks	2.00%	8c
7-18 weeks	0.50%	11c
19-21 weeks	2.00%	11c
22-80 weeks	0.25%	32c
	Total	**62c**

Further reading

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