

A summary on the recent publication by Campbell et al., 2019 on how Spray-Dried Plasma modulates the immune system in chickens improving health and performance

Based on: Campbell, M. J., J. D. Crenshaw, R González-Esquerra, J Polo. Impact of Spray-Dried Plasma on Intestinal Health and Broiler Performance. *Microorganisms* 2019, 7, 219; doi:10.3390/microorganisms7080219

Campbell et al., 2019 provides information for the poultry industry's need for nutritional strategies that support the immune system, promote intestinal integrity and functionality, and increase tolerance to stress and disease challenges. This further supports the industry due to the accelerating trend of reducing the dependence on the use of antibiotics in poultry production.

Despite the vast amount of research published on the use of spray-dried plasma (SDP), and its extensive use in pig and ruminant nutrition, the use of this functional ingredient has not been frequently utilized by the poultry industry. Campbell et al., 2019 reviewed the current understanding on the modes of action of SDP in animals discussing it in the context of the published literature available in poultry. In this sense, the feeding of SDP has been associated with an increased efficiency in the immune response as suggested by various trials conducted in rats, mice, and pigs. In these animals, induced inflammation either by stress or pathogen challenge was significantly reduced by SDP supplementation regardless of whether the primary sites affected were the gastrointestinal, respiratory or the reproductive tracts. The data available suggests that SDP supports immune efficiency which, from a nutritional point of view, is a high energy response; thus, using SDP directs more nutrients to growth and productivity.

The capacity of plasma to reduce gut permeability, improve nutrient uptake and structural integrity when leaky gut is induced, was discussed in the paper. These responses were likely mediated by a reduction in the expression of pro-inflammatory cytokines, and by an elevation in the expression of anti-inflammatory cytokines, along with an increased expression of defensins. Data showing a reduction in lymphocyte activation and infiltration, lessening of edema, and changes in the gut microbiota, were also presented.

Altogether, these changes suggested an immune modulation effect of SDP and an increased restoration of mucosal homeostasis. Campbell et al., 2019 showed that similar effects have been reported in other mucosal systems like the respiratory and reproductive, indicating that the effects of feeding SDP are not limited to the gastrointestinal tract.

The review did not explore the benefits related to its proteins high nutritional value and its high amino acid digestibility focusing primarily on its effects related to the immune response. However, Parsons, et al., reports an average ileal digestibility of 95 and 96% in 10 and 21 days-old chickens respectively, indicating that SDP is highly digestible to young chickens. A new report (Polo, J. et al., 2019) reports higher dry matter, organic matter and crude protein digestibility of the complete diet in 7 days-old chickens. These effects could be long lasting as suggested by Beski et al., 2017 who reported higher intestinal sucrase, maltase and alkaline phosphatase activities in 24d old broilers fed 2% plasma for the first 5 or 10 days of life.

Data reviewed on poultry by Campbell et al., 2019 indicated that feeding SDP to poultry improved overall health, stress tolerance and economically important parameters such as gain, feed efficiency and livability, likely through mechanisms related to the ones mentioned before.

The authors mentioned performance and livability benefits reported in birds fed SDP and subjected to disease challenges such as necrotic enteritis, Salmonellosis, *E. coli* and *Streptococcus* in broilers, and *Pasteurella multocida* in turkeys. Likewise, broilers under high stocking density, environmental stress, and field conditions, benefited by SDP supplementation. Performance benefits were also reported in broilers fed antibiotic growth promoters showing an additive SDP effect. In several trials reviewed by Campbell, et al. 2019, the reductions in mortality after feeding SDP were highly significant. For example, in a natural necrotic enteritis outbreak, control broilers showed 44% vs 10% mortality in SDP-fed chickens. In a broiler trial conducted in pens within a commercial barn whereby an inadvertently high mortality was observed, and *E coli* and *Streptococcus* were isolated, the control group had 83.9% vs a gradual reduction in mortality when fed increasing levels of SDP during the starter period only, down to 14.1% for the group fed 6g of SDP per bird, the highest SDP level tested. In agreement with this report, the data reviewed by the authors showed significant benefits when SDP was only added to the starter diet.

Overall, Campbell et al., 2019 introduced the use of SDP in the feed as a viable nutritional strategy to increase the tolerance of poultry to unspecific stressors and disease challenges, to improve performance and to reduce mortality mainly due to SDP's immune modulatory effect while the improved gut functionality observed in young chickens should be considered a contributing factor.

Leeson Poultry Video 2019 Transcription

Dr. Steve Leeson, Professor Emeritus at University of Guelph, Ontario, Canada

1) What is a good start in the context of immunity development and gut health in broilers?

There are three main factors influencing early immune status and gut health in broilers. The first of these is the chick itself and the fact that it comes from breeders that are well protected with respect to vaccines and general hygiene and husbandry at the farm. The second is biosecurity at the broiler farm itself, obviously this is becoming more and more critical. The third is the role that nutrition can play in supporting the immune system and supporting early development of the gut and limiting the potential incubation of pathogens in the gut.

2) How did you get interested in the use of plasma in pre-starter broiler diets?

It was about 15-16 years ago a graduate student came to me who was actually in swine nutrition and they wanted to test what was the equivalent of an early weaning diet in pigs for young chicks which really has become known as specialized prestarters today. As part of that diet there was quite a large dose of blood plasma and the results were quite dramatic and since then I've always had an interest in looking at the role of blood plasma in early nutrition and overall economics of brighter and poultry production.

3) What is your opinion on the effect of plasma as an immune modulator in broilers?

Definitely seems to be an immune modulator, which is a very difficult thing to measure. At the farm level see that in terms of feed efficiency, so there is a very practical way of indirectly measuring it. Whenever we see plasma we see an improvement of around 5 points of feed conversion and that I'm quite convinced is reduction in immune status of the bird - or not over stimulating the immune responsiveness of the bird to pathogens or to vaccines. Today we see a big range of feed efficiency out in the field across different global regions and a lot of that is due to immune status and the bird having to raise antibodies to various challenges. So it seems that plasma can help reduce that energy cost and it's really a net energy cost of maintenance for immune competence. So as I say, very difficult to measure in direct terms but the outward sign of that is 5 points of feed conversion or more than that, which the industry obviously is very interested in.

4) In your view, what value can plasma bring to broiler nutrition beyond being a highly digestible source of protein?

It is a highly digestible source of protein and amino acids, so it plays a minor role in replacing soybean meal in birds under 10 days of age, which is an important factor today. The response you see to plasma goes way beyond being a simple improvement in digestible amino acids. So it is this – it's the functional proteins that are in the plasma that are giving the underlying response that we see. Even though we're only feeding plasma from between four and ten or maybe four to fourteen days, the response is seen throughout the life of the bird. That's where the savings in maintenance energy comes in.

5) Which production parameters do you think could be impacted in broilers when fed plasma in the first few days of life?

Well the main one in generally healthy birds is going to be feed efficiency. In all birds it will be feed efficiency, but in birds that are generally healthy and have good immune status and generally good gut health, then we still see the response in terms of feed conversion. If you have a major disease challenge – and this is where plasma becomes really interesting – because the results are quite dramatic in terms of reducing the mortality that birds face with either bacterial challenges or viral challenges. So dramatic results when there is a natural disease challenge, but all the time there is that underlying saving in feed efficiency, which I think the industry is most interested in.

6) How well established is the use of plasma in animal nutrition?

It's very well established in animal nutrition. If you feed cats and dogs, you're buying cat and dog food and especially cat food, there's likely to be plasma in there. It's a highly digestible protein for pet foods, that's one of the main areas. Of course, it was picked up by the swine industry about 20 to 25 years ago and I would suspect that 90 to 95% of the baby pigs in the world are fed plasma as soon as they're taken off the mother and given solid feed. So it is well established in the animal industry per se. It's a relatively new technique or a new idea for poultry and the industry is relatively conservative in general terms, so it takes a few years for new ideas to be accepted. But we're seeing acceptance now and so I think there's a role moving forward especially as we rely less and less on antibiotics and other pharmacological agents used to support health, that we have used to support health, in broilers

7) In your view, how can plasma be used in broilers as a tool to reduce antibiotic dependence?

I don't think it's a total replacement. It's not that there will ever be a single factor that replaces antibiotics. It will obviously be a multifaceted approach. I think plasma, you know for the first 10 days, has quite dramatic effects on gut health, but it's along with other factors and it's interesting that they are synergistic. So, using probiotics for example or essential oils or betaine, butyric acid – they're all synergistic to using plasma. So, it won't be the replacement factor but it'll be certainly an important tool in our arsenal for replacing antibiotics.