RESEARCHBRIEF

Spray Dried Porcine Plasma (SDPP) Promotes the Association Between Metabolic and Immunological Processes at Transcriptional Level in Gilthead Sea Bream Gut

AQUA

In fish, the intestine is a complex multifunctional organ with key physiological roles, including water and electrolyte homeostasis, endocrine modulation, metabolism and immune regulation, and commensal microbiota balance. Importantly, the intestine is one of the main portals of pathogen entry into the organism. Accordingly, the intestine has a mucus layer that acts as physical and chemical barrier, thus, protecting the gut epithelium by defense mechanisms that help for maintaining the tissue homeostasis.

Spray dried plasma (SDP) is a complex mixture of functional components including immunoglobulins, transferrin, growth factors, bioactive peptides, enzymes, hormones, and amino acids, therefore, SDP is a high protein ingredient with excellent amino acid profile and a digestibility close to 99%. SDP is commonly used in feed for young animals including pigs, calves, and poultry. Several studies in livestock have shown that SDP has positive effects on productive as well as on physiological parameters, immunity, and gut health in pigs and poultry. In addition, its beneficial effect has been also reported in commercial aquatic species such as, rainbow trout, gilt-head seabream, salmon and Nile tilapia. In these fish species, SDP has shown a repertoire of beneficial attributes on the host, including an improvement in somatic growth performance, digestibility, feed intake, feed efficiency, immunity and improved antioxidant system capacity. Furthermore, the use of SDP and other blood derivatives has environmental benefits for the sustainability and circular economy associated with animal production because it helps to provide added value to the industry and has less carbon footprint compared with plant protein sources that may be used in aquafeeds.

The aim of this study was to unveil the biological mechanisms modulated in response to the dietary administration of porcine SDP in the gilthead sea bream gut. To achieve this goal, a microarrays-based transcriptomic approach in gut samples from gilthead sea bream fed with SDPP-supplemented diet for 95 days was used. As control diet, we used a protein-rich commercial feed (51% crude protein, 17% crude fat and 20.6 MJ/kg gross energy), that was supplemented with 3% porcine SDP at the expense of LT70 fishmeal.

Performance results indicated that final body weight (BWf) and specific growth rate (SGR) were 6.2 and 4.1% higher in fish fed the SDP diet compared to control group ($P<0.05$), respectively. In addition, feed conversion rate (FCR) values were lower in fish fed the SDP diet in comparison with those fed the control diet ($P<0.05$). No significant differences were found in terms of standard length (SL) and conditions factor (K) (Table 1). The improvement of results in terms of somatic growth and feed efficiency are of interest, since both diets were formulated with high levels of fish meal (FM LT70 and FM 60 = 49.4%) and low levels of plant protein sources (22.3%), which indicates that even with high quality protein sources, the use of SDPP (3%) has remarkable benefits in terms of production performance.

Table 1. Somatic growth and feed efficiency in gilthead sea bream (Sparus aurata) fed diets containing Spray-Dried Porcine Plasma (SDPP).

	CONTROL DIET	SDPP DIET (3.0%)
Initial Body Weight (BWi) (g)	10.6 ± 0.1	10.6 ± 0.1
Final Body Weight (BWf) (g)	82.7 ± 3.2 b	88.2 ± 1.6 a
Standard Length (SL) (cm)	14.6 ± 0.2	14.8 ± 0.1
Fulton's Condition Factor (K)	2.66 ± 0.6	2.72 ± 0.3
Specific Growth Rate (SGR) (% BW/day)	1.63 ± 0.03 b	1.70 ± 0.04 a
Feed Conversion Ratio (FCR)	1.21 ± 0.05 a	1.09 ±0.07 b

RESEARCH BRIEF

We used a microarray for understanding the effect of the diet on the gut transcriptome, since the transcriptomic signature of a tissue is a useful approach for providing insight into the tissue-specific responses to the diet composition. The microarray analyses showed a total of 803 (468 up- and 335 down-regulated) differential expressed genes (DEGs) (Figure 1).

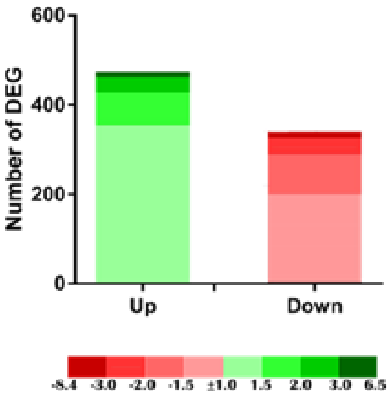
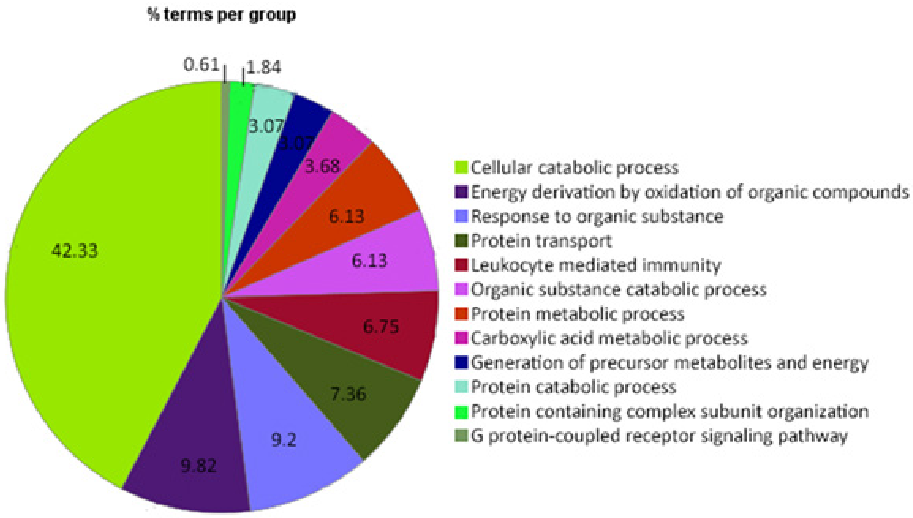


Figure 1. Anterior intestine microarrays-based transcriptomic analysis for gilthead sea bream fed the SDPP diet. Number of total differential expressed genes (DEGs). The green (upregulation) and red (downregulation) color scheme indicates the gene modulation according to its magnitude interval (fold-change).

In order to properly understand the effect of changes in gene expression on the gut, different bioinformatic tools were used in order to identify to which biological processes were these genes involved (Figure 2).

The functional network analysis revealed that dietary inclusion of SDPP induced sustained changes in 120 biological processes, grouped in 12-clusters. Among them, the metabolic-related process (cellular catabolic process, organic substance catabolic process, protein metabolism process), protein transport, and leukocyte mediated immunity were interacting in the main interactome network (Figure 2).

Figure 2. Pie chart distribution of significantly enriched terms based on the biological functions in the anterior intestine of gilthead sea bream fed the SDPP diet. It is represented the percentage of the significantly differentially expressed genes in each principal cluster.



Our team of scientists initiates research

*where we seek to understand how our functional proteins work, resulting in more than **600 published journal articles**.*

RESEARCHBRIEF

Among them, present results indicated that fish fed the SDPP diet had a more active intestinal mucosa as biological processes involved in cellular catabolism, protein metabolic and catabolic processes, and protein transport were indicated. In addition, we saw that SDPP tightly regulates mitochondrial metabolism, which is beneficial in terms of proper cell functioning. The last but not the least, current results showed that SDPP tightly regulated the immune response at innate and cellular levels. In addition, several genes associated with the pro-inflammatory response were also differentially expressed due to the dietary presence of SDPP. This is of special relevance, since inflammation is one of the first strategies that the host has against pathogens, which means that fish fed the diet containing SDPP has an intestinal mucosa more resilient to bacterial infections and more prone to properly respond to pathogens.

It is important to mention that these results were obtained in fish that did not show dysbiosis signs in terms of gut microbiota abundance and diversity nor inflammatory signs in the intestinal villi. Thus, all changes in gene expression profiles reported in this study are just linked to the presence of the ingredient in the diet.

In conclusion, the integrative analysis of gilthead sea bream fed a diet with SDPP supported the better key performance indicators related to growth and feed performances of gilthead sea bream, which are also associated with a balanced immune response and an enhancement of the mucosal health status.

Plasma Performance

Spray Dried Plasma (SDP) is a highly digestible protein with significant benefits to the aquaculture industry. Research demonstrates SDP helps support immune and intestinal health and is especially effective when used during stressful or challenging conditions. SDP works well either with or without antibiotics or other medications and may replace antibiotic growth promoters. SDP is suitable for use in all types of farmed fish environments. SDP helps to support immune and intestinal health, leading to improved production measures.

BOTTOM LINE

- INCREASED TOLERANCE TO STRESS & DISEASE ↑
- WEIGHT GAIN & EFFICIENCY ↑
- GROWTH ↑
- UNIFORMITY ↑
- MORTALITY ↓

For additional information, contact the Sales or Technical Service teams.

Reference:
Vallejos-Vidal et al., 2022 Spray-Dried Plasma Promotes the Association between Metabolic and Immunological Processes at Transctiptional Level in Gilthead Sea Bream (Sprus aurata) Gut. Front. Mar. Sci. 9:814233. doi: 10.3389/fmars.2022.814233.