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Studies on the composition of legumes and carob seed germ meal and their effect on physiology and biochemistry of digestion of Mediterranean fish species.

ABSTRACT

A series of experiments were conducted in order to evaluate the effects of feeding sea bream (*Sparus aurata*) and sea bass (*Dicentrarchus labrax*) with diets containing grain legumes crude or processed and carob seed germ meal on the physiology and biochemistry of digestion. The use of plant meals as alternative ingredients in the production of cost-effective aquafeeds has been recongnised worldwide as a need for sustainable aquaculture industry.

The nutritional and antinutritional composition of three varieties of field pea and chickpea in three locations for two years were firstly evaluated in order to obtain information on the effects of genetic and environmental factors. The effects of processing techniques, dehulling and extrusion, on their antinutritional composition were further estimated. The nutritional value of the crude or processed aforementioned legumes was initially evaluated with the determination of the apparent digestibility coefficients for protein, fat and starch in diets for sea bream. Furthermore, digestibility of nutrients, digestive enzyme activities (trypsin, amylase, lipase, maltase), gastric evacuation time, as well as stomach moisture content and pH, of extruded, experimental, semi-purified feeds containing different levels of the grain legumes for sea bass were evaluated. The nutritional value of carob seed germ meal inclusion in diets for sea bream and sea bass was also estimated by digestibility studies and digestive characteristics such as gastric evacuation time, moisture and pH of gastrointestinal segments.

The analysed nutrient and antinutrient composition of field peas and chickpeas indicated that environmental factors dominant on the cultivation areas during the two years had an effect on the protein content of these legumes. Dehulling did not increase the protein composition of chickpeas while extrusion had no effect on the antinutritional factors, tannins and phytic acid in both legumes.

Protein from the plant raw materials was well digested in both sea bream and sea bass and did not differ significantly from the control diets that contained fishmeal and soybeanmeal. Pea protein was more digestible than that of chickpea in sea bass. Lipid digestibility was not affected by the inclusion of plant ingredients and

had high values for all diets. Starch digestibility of the experimental diets that contained crude field peas and chickpeas was significantly lower than the control diets in sea bream, but with extrusion processing digestibility was significantly improved and did not differ form the control diets. In sea bass, the apparent digestibility values of starch were significantly lower for the diets containing field pea and chickpea in relation to the diets containing fishmeal and soybean meal even after extrusion with the exception of the diet containing field pea 15% which indicated slightly lower values.

Comparing the two species, apparent digestibility coefficients for protein and lipids were higher in sea bass than in sea bream, whereas starch was more digestible by sea bream.

Activities of α-amylase and trypsin in the intestinal content of sea bass were highest 2hrs after feeding for all diets and decreased thereafter as the stomach content decreased. However fish fed the diet containing 20% soybean meal retained higher trypsin activity values at 6 and 10hrs after feeding. Concerning digestive enzyme activities in the tissue of all intestinal segments, α-amylase and maltase exhibited highest values in the midgut and lowest in the rectum. Lipase activity was highest in the pyloric caeca and mid gut. Trypsin activity was only a small proportion compared to that found in the digestive fluid.

The addition of carob seed germ meal increased the stomach moisture content in both species, the highest being found in sea bass. No differences were found in the moisture content of the intestinal segments in both species except in the mid gut of sea bass. The moisture content in the rectum of sea bream was higher than that of sea bass.

The values of protein and starch absorption in the stomach of both species had negative values. In sea bass high values of protein absorption were observed from the anterior part of the intestine independent of diet composition whereas in sea bream the highest values were found in the midgut and rectum. Starch absorption was higher in sea bream than in sea bass in all three intestinal segments. At 6 and 8hrs after feeding about half of the digesta was found in the midgut of sea bass as compared to that of sea bream.

Fishmeal exhibited a better buffering capacity than field peas and chickpeas in diets fed to sea bass. Carob seed germ meal inclusion in the diet of the above species reduced the pH values in the stomach content at all post-prandial times in relation to

the control diet, which contained fishmeal. This was not observed in sea bream. The buffering capacity of carob seed germ meal did not differ from that of fishmeal in both species. As the digesta passed from the stomach to the anterior and middle intestine the pH increased and remained constant in the rectum.

The exponential model described best the gastric evacuation in sea bream and sea bass for all diets. Gastric evacuation time for the diets containing 30% field peas and chickpeas was lower than the diets containing fishmeal and soybean meal. Carob seed germ meal inclusion did not affect the gastric evacuation time when compared to the fishmeal diet but was different in each species. In sea bass, gastric emptying was significantly slower than in sea bream for both diets.

In conclusion, the digestive characteristics of sea bream and sea bass differed in their response to the inclusion of plant raw materials showing that the nutritional value of each tested ingredient must be evaluated for every species of interest.