Investigating the impact of the extrusion process conditions and replacement of insect meal on pellet quality

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Recognizing the importance of exploring more sustainable protein sources to substitute fish meal in fish feed production, as the use of fish by-products is not able to sustain the fast-growing aquaculture industry. Extensive research has been conducted on various potential alternative protein sources like plant and insect protein which mostly focused on examining the effects on the nutritional profile of the feed and the fish´s performance with the inclusion of insect meal in the diet. However, only a few studies attempt to address how the insect meal affects the physical quality of the fish feed pellets.
The present study focused on the effects of extrusion process conditions on the physical quality of fish feed pellets at a different level of replacement with unprocessed black soldier fly larvae (BSFL). A three-factorial central composite design with regression analysis and response surface methodology was used. Eight response parameters were measured by varying four factors: screw speed, moisture, temperature, and the amount of added insect meal.
Two models were developed: 1) regression models describing the effects of all variables based on experimental design and 2) empirical models describing the impact of process conditions and composition. Both models describe well the impact on the physical quality parameters. The obtained results showed that water absorption and water stability increased with increasing insect meal level to a maximum value and then decrease at higher values. Samples containing insect meal showed lower hardness values and lower bulk density than pellets without insect meal, suggesting adequate expansion during extrusion. The lubricating effect of the insects was observed due to high-fat content that decreases the viscosity of the melt, which leads to lower heat generated by friction in the extrusion barrel. With established models, optimum replacement levels and process conditions were identified and tested. The results obtained show that BSFL is promising for fish feed improving some of the pellet properties with optimum process conditions.