18. Exploring the internal carbon potential for nutrient removal in recirculating aquaculture systems

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Recirculating aquaculture systems (RAS) have been recently applied for sustainable fish farming since effluent can be treated before discharge. Such control upon the waste stream creates possibilities for nutrient removal where farm sludge can be used to facilitate biological water treatment. Denitrification is a biofiltration process which converts harmful nitrogen species originating from fish excretions to nitrogen gas. This process requires high organic carbon which is typically supplied with external bioavailable carbon sources that increase farm operational costs. Thus, fish faecal excretions have been suggested to be used alternatively as an internal carbon source for denitrification. However, both faecal quantity and quality depend originally on diet composition and its digestibility potential. Lately numerous alternative ingredients with different nutritional profiles and increased indigestible fractions have been used in aquafeeds. As such, faeces capacity to act as an internal carbon source for denitrification may vary. In that respect, the present study aimed to explore the effect of dietary carbon on the quantity and bioavailability of faeces produced by European seabass (*Dicentrarchus labrax*) fed six experimental diets. The latter consisted of an identical basal mixture at 85% and of a test ingredient (shrimp shell meal; SSM, feather meal, insect meal, seaweed, bacterial meal, dried distillers grain with solubles; DDGS) at 15% inclusion. Organic matter digestibility was higher for feather and insect meal which consequently resulted in a lower faecal waste production. As such, despite the high faecal recovery observed for the above diets, more faeces per kg of feed were collected for bacterial meal due to the combinational effect of digestibility and recovery efficiency. Nonetheless, carbon bioavailability, expressed as degree of carbon solubilization and fermentation, was higher for faecal material originating from SSM when faeces were microbially processed with fermentation under isocarbonic conditions. In addition to the higher amount of readily available carbon, SSM faeces yielded a potentially more favourable profile of volatile fatty acids for denitrification with high abundances of acetate and propionate. Considering both the total amount of faecal carbon produced as well as its further fermentation potential, we will be able to determine the feed producing the highest quantity of bioavailable carbon, which is likely the more suitable carbon source for denitrification in RAS.

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