Feed and organic matter

Organic waste from fish production is conventionally measured as BOD5 (biological oxygen demand measured during 5 days) and COD (chemical oxygen demand (includes BOD5)). Organic waste is of particular concern for several reasons. The easily degradable part (BOD5) may have an immediate, negative impact on the receiving water body by reducing dissolved oxygen concentrations and increasing sedimentation. Within aquaculture systems, a high organic load may affect fish health and performance directly (e.g., gill disease) as well as indirectly (proliferation of pathogenic bacteria and parasites, reduction of dissolved oxygen concentrations, etc.). In recirculating aquaculture systems (RAS), a high organic load caused by limited water exchange may affect biofilter performance by favouring heterotrophic bacteria at the expense of autotrophic, nitrifying bacteria. Organic waste in RAS primarily originates from undigested feed, but also metabolic losses, mucus, dead tissue, feed waste and intake water may contribute. The nutrient composition of the feed affects the quantity and composition of the organic (undigested) waste, and including for example plant protein ingredients may affect the distribution between particulate and unsedimented (suspended and dissolved) organic waste. Quantifying aquaculture waste, including organic matter, nitrogen (N) and phosphorus (P), into different waste fractions (particulate and unsedimented) is essential for optimising the design of different treatment setups with specific cleaning objectives. A series of studies were carried out to measure the solid and unsedimented waste from juvenile rainbow trout (Oncorhynchus mykiss) fed three commonly applied commercial diets (Dalsgaard and Pedersen, 2011). Furthermore, it was hypothesized that particulate COD can be calculated from undigested nutrients. There were only minor differences between the diets. Generally, 48% of ingested N was recovered in the water and 7% in the solids. For phosphorus, 1% was recovered in the water and 43% in the solids. More COD was recovered as solids than as unsedimented waste, while it was opposite for BOD5. A BOD5/COD ratio of 0.5 was derived, indicating that unsedimented organic waste is characterized by easily degradable organic matter. In comparison, a solid BOD5/COD ratio of 0.2 indicated that this waste fraction contains high amounts of hard-to-degrade organic matter. The study confirmed that solid COD can be quite accurately calculated from the composition of undigested nutrients.