

THE POTENTIAL OF MICRO ALGAE AS FEED INGREDIENT FOR ATLANTIC SALMON

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MOGUĆNOST KORIŠĆENJA MIKROALGI U HRANI ZA KARNIVORNE VRSTE RIBA

Apstrakt

Potreba za sastojcima visokog kvaliteta u proizvodnji hrane za ribe raste zajedno sa razvojem proizvodnje u akvakulturi u svetu. Riblje brašno i riblje ulje su najčešće birani sastojci za hranu za ribe zbog njihove visoke nutritivne vrednosti i ukusa. Riblje brašno sadrži onu količinu amino kiselina koja je ribi potrebna. Riblje ulje je odličan izvor esencijalnih n-3 masnih kiselina dugog lanca, koje su veoma važne za unapređenje zdravlja, kako kod riba tako i kod onih koji konzumiraju ribu. Riblje brašno i ulje su zamenjivani biljnim sastojcima u proteklih 25 godina. Međutim, biljni sastojci često sadrže širok spektar anti-nutritivnih sastojaka koji imaju negativan uticaj na zdravlje ribe kao i korišćenje hrane za ribe. Ulje biljnog porekla u hrani za ribe menja sastav masnih kiselina u tkivu ribe, umanjuje povoljan profil masnih kiselina pa dominiraju manje pogodne n-6 masne kiseline. Postoji sve veća zainteresovanost za pronalaženjem izvora hrane za ribe u nižim trofičkim nivoima morskih ekosistema, kao što su mikroalge. Morske mikroalge su primarni proizvođači n-3 masnih kiselina i zbog toga su verovatno bolja alternativa za riblje ulje od biljnog. Neke mikroalge imaju odgovarajući sastav proteina kao i profil amino kiselina. Cilj ovog eksperimenta je da istraži nutritivnu svarljivost (ADC) suve materije (DM), proteina i pepela mikroalgi *Nanofrustulum* (C3), *Desmodesmus* (C4) i *Nannochloropsis* (C1) koji su inkorporirani u hranu za Atlantskog lososa, *Salmo salar*.

Dva testa svarljivosti su urađena sa Atlantskim lososom. Cilj prvog eksperimenta (inicijalni test, P, prosečna inicijalna težina ribe 1000g) bio je da istraži svarljivost sastojaka 3 alge tako što je kontrolna hrana bazirana na ribljem brašnu rastvorena sa 30% test sastojka (u odnosu 70:30). Ove tri vrste hrane su proizvedene hladnim procesom peletiranja. Drugi eksperiment (eksperiment provere, V; prosečna inicijalna težina ribe 436g), urađen je da bi potvrdio rezultate C1 i C4 korišćenjem ekstrudirane hrane. Feces je sakupljan metodom ceđenja.

U oba eksperimenta, primećene su značajne razlike u svarljivosti ADC mikroalgi. Sveukupno, najviša ADC za proteine, DM i pepeo ($P < 0.05$) utvrđena je kod hrane C3, dok nije bilo značajnih razlika između C1 i C4. Kada je reč o eksperimentu V, najviša ADC suve materije i proteina utvrđena je za hranu C1 ($P < 0.05$), dok se razlika ADC pepela nije pokazala među različitim tipovima hrane. ADC proteina i suve materije je bio u istom opsegu kao i vrednosti eksperimenta P, dok je ADC pepela bio viši.

Nutritivna svarljivost varira među različitim vrstama mikroalgi. Ona verovatno takođe zavisi od tehnoloških uslova procesuiranja hrane. Zasnovano na ADC vrednostima, iako je C3 pokazala bolji potencijal, njen visok sastav pepela i nizak sastav proteina, mogu biti ograničavajući factor za korišćenje ove mikroalge u ishrani za ribe. Velike razlike nisu pronađene u vrednostima svarljivosti između algi C1 i C4. Ova zapažanja treba dalje potvrditi dugoročnim eksperimentima hranjenja Atlantskog lososa da bi se u potpunosti definisao potencijal sva tri kandidata.

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INTRODUCTION

The demand for high quality ingredients to produce aquafeeds is increasing with the growth in world aquaculture production. Fishmeal and fish oil have been preferred ingredients in aquafeeds because of their high nutritional quality and palatability. The amino acid content in fishmeal matches the requirement of fish. Fish oil is an excellent source of the long-chain essential n-3 fatty acids, which are important to promote good health both for the fish and the consumer of the fish. Fishmeal and oil have been replaced by plant ingredients during the course of the past 25 years. However, plant ingredients often contain a wide range of anti-nutritional factors that have a negative impact on fish health as well as feed utilization. Use of plant oils in aqua diets also changes the fatty acid composition of fish tissue to a less favorable n-6 dominated profile. There is an increasing interest for exploring feed resources from a lower trophic level in the marine ecosystem, such as microalgae, in aqua diets. Marine microalgae are primary producers of n-3 fatty acids and therefore may be a more promising alternative to fish oil compared to plant oils. Some of the microalgae also have a favorable protein content as well as amino acid profile. The aim of the present experiment was to investigate apparent nutrient digestibility (ADC) of dry matter (DM), protein and ash from *Nanofrustulum* (C3), *Desmodesmus* (C4) and *Nannochloropsis* (C1) that were incorporated in feeds for Atlantic salmon, *Salmo salar*.

MATERIALS AND METHODS

Two digestibility trials were carried out with Atlantic salmon. The first experiment (Pre-study, P; initial fish av. wt. 1000 g), aimed to investigate ingredient digestibility of the three algae by diluting a fishmeal based control diet with 30% test ingredient (70:30 ratios). These three feeds were produced by cold pelleting process. The second experiment (verification experiment, V; initial fish av. wt. 436 g), was carried out to confirm the results of C1 and C4 using extruded diets. Stripping method was used to collect the feces.

RESULTS

Significant differences were noted in ADC of the microalgae, in both experiments. Overall, highest ADC for protein, DM and ash ($P < 0.05$) was observed for C3, while no significant differences were noted between C1 and C4. For experiment V, highest ADC of DM and protein was observed for C1 ($P < 0.05$), while ADC of ash showed no differences between the feeds. ADC's of protein and DM were in the same range as values in experiment P, while ADC of ash was higher.

CONCLUSION

The nutrient digestibility varies among different strains of microalgae, perhaps also depending on the feed processing condition. Based on ADC values, though C3 revealed a better potential, its high ash and low protein content, may be a limiting factor in its application as a feed ingredient. No large differences were noted in the digestibility values between the algae C1 and C4. The present observations have to be further confirmed through long-term feeding experiments with Atlantic salmon to fully define the potential of the three candidates.

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