PERIPHYTON AS PARTIAL REPLACEMENT OF COMMERCIAL FEEDS IN THE CULTURE OF ORGANIC TILAPIA IN ISRAEL

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PERIFITON KAO DELIMIČNA ZAMENA KOMERCIJALNE HRANE U ORGANSKOM GAJENJU TILAPIJE U IZRAELU

Abstrakt

Cena hrane čini jednu od najvećih stavki u tekućim troškovima proizvodnje u akvakulturi. Usled potrebe za korišćenjem samo organskih sastojaka, cena koncentrovane hrane za uzgoj organske ribe je izuzetno visoka. Tokom petogodišnjeg perioda rađeni su eksperimenti kako bi se ispitala mogućnost upotrebe različitih supstrata za indukciju rasta perifitona koji bi služio kao prirodna hrana za tilapiju različite veličine, od mlađi do naprednih uzrasnih stadijuma. Kao supstrat, procenjivan je različit poljoprivredni otpad - plastične cevi, najloni i mreže. Različiti supstrati dali su različite prinose perifitona u zavisnosti od njihove površine (glatka ili hrapava) i boje. Rezultati rasta pokazali su da je ušteda hrane od 40% u naprednim fazama rasta dovela do svega 10% redukcije stope rasta tilapije u odnosu na kontrolna jezera, dok je u mladičnjaku moguće smanjiti količinu koncentrovane hrane do 50% bez ograničenja rasta riba. Ovo smanjenje količine hrane od 30-40% dovelo je do poboljšanja koeficijenta konverzije hrane (FCR) od barem 30% u jezerima sa perifitonom (45% u mladičnjacima).

Zaključak: upotreba supstrata hrapavih površina za indukciju rasta perifitona može pomoći u recikliranju otpadnih materijala i značajno redukovati troškove hrane u organskoj akvakulturi.

Ključne reči: *akvakultura, perifiton, tilapija*

INTRODUCTION

This is even more so in organic aquaculture due to the specific requirements to use only organic certified ingredients. Thus, the cost of organic pelleted feeds is almost double the cost of regular feeds used in aquaculture, hampering economic viability. To cope with this problem, a series of experiments aimed at improving natural food production for tilapia in the ponds while reducing added feed amounts were performed. Different hard surfaces were introduced in the water column of earthen fish ponds to induce the growth of periphyton on them and thus improve natural productivity of the water body. This presentation summarizes the results obtained over 5 years of research conducted under field tests in earthen ponds stocked with tilapia fish at stocking densities similar to those used in organic fish culture (1-1.5 fish per m^2.

MATERIAL AND METHODS

Tilapia culture experiments:

Five experiments were carried out in 6 earthen ponds of 300 m^2 area and 1 m depth at the Fish and Aquaculture Research Station Dor. The different experiments tested tilapia performance in 'periphyton+reduced feed' ponds (Periphyton) in relation to conventional ponds (Control), for tilapias of different stocking size and different substrates for periphyton. In all experiments 3 ponds were allocated to each treatment or control. The treatments consisted of the addition of underwater surfaces equivalent to 30-50 percent of the pond surface area with a simultaneous reduction by 30-40 percent in the amount of pelleted feed supplied to the fish. The substrates used and their location in the water column varied in each experiment. In the control ponds no underwater substrates were added and the full amounts of organic certified floating feed pellets were supplied. In each experiment the initial stocking weight of the tilapias was different (from fingerlings to advanced juveniles of 330g) but the fish in all ponds in the same experiment had the same initial weight and density. Experiments lasted 3-5 months and were conducted during the warm season of the year when the temperatures were optimal for fish growth.

Substrate experiments:

Three experiments were carried out in 1 m^3 cages placed within fish ponds of the tilapia culture experiments, to test growth of periphyton on materials with different characteristics. Strips of substrates were vertically placed in the epilimnion, and sub-sets of substrates were removed at sampling time to analyze chlorophyll and dry and organic matter attached on them. Measurements were all standardized on a cm^{-2} basis.

In the first experiment, periphyton growth on eight substrates with different textures was tested, including plastic smooth surface sheets and agricultural nets of different mesh and type of threads as rough substrates. In the second experiment the effect of the color of the substrate on periphyton development on it was tested using nets of the same type, differing only in their color (white, black or blue). In the third experiment the growth rate of periphyton development on a white rigid rough plastic substrate was measured through sampling at a several days intervals during a 3 week period.

RESULTS

Tilapia culture experiments:

In each of the experiments performed survival was similar in both treatments. In the periphyton ponds, reduction of 40% in the feed input did not negatively affect fingerling performance in the nursery. In early juveniles grow-out from 90g to 350g (exp. 1) and advanced growout from 320g to 520g, 40% feed saving led to a reduction of only 10% in tilapia's growth rate in relation to the control ponds. This growth rate reduction did not result in significant differences between treatments in tilapia harvesting weight and biomass when the culture period was short (87 days), while a 10% reduction in tilapia harvesting weight and biomass in periphyton ponds took effect when the culture period was longer (135 days). When feed saving in periphyton ponds was reduced to 34% and 30%, even after a long culture period tilapia growth rate was not reduced and the performance was similar in Periphyton and Control ponds. This occurred when tilapia density was both lower than expected (~50% survival) and higher than expected (large amounts of wild spawning appearing in the ponds). In all the experiments the similar or just 10% reduced tilapia performance together with the 30%-40% decreased feed amounts supplied to the Periphyton ponds led to at least 30% improved feed conversion ratio (FCR) in the periphyton ponds (45% in the nursery).

Substrate experiments:

Results of the substrate experiment, which tested periphyton growth on 8 substrates of different texture, and color showed a marked difference in the periphyton among the different substrates. The amount of periphytic matter (measured as dry matter, DM, and ash free dry matter, AFDM) on fine nets, more than doubled that on coarse nets, and was about 4 fold increase over smooth plastic substrates. Chlorophyll was 60% higher in the fine mesh cylindrical thread net substrate than in the coarse mesh flat thread net and the white flexible smooth surface plastic sheets. Other rough and smooth substrates were intermediate and not significantly different from either. The color of the substrate did not affect the chlorophyll content of periphyton but did affect its dry and organic matter content. The white substrate had 40% more DM and 50% more AFDM than the blue and black substrates. Linear growth of periphyton on a white rigid rough plastic net substrate during 22 days was observed. The regression equations of the chlorophyll, DM and AFDM on time (number of days submerged) showed that periphyton increased daily by 3 mg chlorophyll, 2 g DM and 0.3 g AFDM per square meter of substrate.

CONCLUSIONS

The use of submerged substrates to allow periphyton development on these surfaces as a method to increase natural food resources for tilapia is an appropriate technology for organic tilapia culture that allows a decrease in feed inputs and reduction of costs.