INTENSIFICATION OF COMMON CARP CULTURE IN RURAL AREAS OF NORTHERN VIETNAM BY PLANT-BASED FEEDS WITH PROTEIN SOURCES OF DIFFERENT QUALITIES

JOHANNES PUCHER[1], ULFERT FOCKEN[2]
[1]*University of Hohenheim, Life Science Center, Wollgrasweg 43, 70599 Stuttgart, Germany, johannes.pucher@daad-alumni.de*
[2]*Thünen Institute of Fisheries Ecology, Wulfsdorfer Weg 204, 22926 Ahrensburg, ulfert.focken@ti.bund.de*

INTENZIVIRANJE PROCESA GAJENJA ŠARANA U RURALNIM OBLASTIMA SEVERNOG VIJETNAMA KORIŠĆENJEM BILJNE HRANE SA IZVOROM PROTEINA RAZLIČITOG KVALITETA

Apstrakt

U planinskom severnom Vijetnamu, ribnjačka akvakultura je važan deo tradicionalnog integrisanog sistema gajenja koji doprinosi proizvodnji proteina kao i finansijskoj dobiti. Akvakultura u Vijetnamu se najčešće zasniva na polikulturi belog amura sa belim tolstolobikom, sivim tolstolobikom, šaranom i nilskom tilapijom kao sekundarnim vrstama. Ova polikultura se odlikuje niskom produktivnošću od 1.5 t ribe po ha^{-1} a^{-1}. Glavni razlozi za nizak stepen proizvodnje ribe u ovom region su: korišćenje hrane za ribe niskog kvaliteta (lišće, trava, nusproizvodi gajenja), nepoznata bolest sa visokom stopom smrtnosti belog amura i nekontrolisani protok vode kroz jezera što prouzrokuje zamućenost vode i gubitak mineralnih hranljivih materija za primarnu produkciju. Polu intenzivan system proizvodnje kao i promena načina nasađivanja u kome bi šaran bio najvažnija vrsta u sistemu polikulture može da doprinese većoj produktivnosti i profitabilnosti akvakulture ribnjaka u planinskom delu Vijetnama. Ove promene koje vode ka polu intenzivnoj polikulturi čija je glavna gajena vrsta šaran zahtevaju promenu u izvorima hrane kao i u proizvodnji hrane. Dok je hrana sa visokom energetskom vrednošću naširoko dostupna u region, izvori hrane bogate proteinima su ograničeni. Zbog toga je obavljeno istraživanje da bi se ustanovilo koji su lokalni izvori bogati proteinom najpogodniji da se koriste kao sastojci u dopunskoj ishrani šarana.

Obavljena su ispitivanja u mrežnim kavezima u ribnjaku koji je bio nasađen sa tradicionalnim ribljim vrstama, sa gustinom nasada od 1.5 ribe po m^2 i šaranom kao glavnom

vrstom. Korišćeno je 16 mrežnih kaveza (veličine 2 x 2 x 2 m). Svaki kavez je nasađen sa po 5 primeraka mlađi šarana. Stajnjak preživara kao tradicionalno đubrivo stimulisala je dostupnost prirodne hrane. U tri mrežna kaveza, kao dodatna hrana za šarana korišćene su četiri izo-azotne hranljive smeše pripremljene sa lokalno dostupnim sastojcima sa visokim nivoom proteina (obrok od ribljeg brašna i soje, komercijalni koncentrat hrane za svinje, komercijalna hrana za mlađ ribe i ostaci od soje/tofu) i energije (obrok od kukuruza i obrok od manioke). Dnevna doza iznosila je 3% telesne mase riba. Tri mrežna kaveza nisu dobijala dodatnu hranu. 3 mrezna kaveza nisu dodatno hranjena i sluzila su kao kontrola. Na svakih 20 dana ribe u mrežnim kavezima su merene i količina hrane je usklađivana sa njihovom težinom; šarani iz šesnaestog mrežnog kaveza su izlovljeni radi analize crevinih sadržaja i zatim su ponovo nasađeni. U istom ritmu su praćeni parametri za merenje kvaliteta vode. Na isti način je praćena abundanca zooplanktona i zoobentosa. Uzorci ribe uzeti pre i posle testiranja su analizirani radi ustanovljavanja hemijskog sastava ribe. Hrana je takođe analizirana radi ustanovljavanja hemijskog sastava i sastava amino kiselina. Tradicionalni način đubrenja je stvarao životnu sredinu sa niskom ali vrlo promenljivom dostpupnošću zooplanktona (83 ± 49 mg m^{-2}) i zoobentosa kao hrane (6.5 ± 7.5 mg m^{-2}). Glavni izvor konzumirane prirodne hrane bio je zooplankton čija je veličina tela bila veća od 1mm. Pošto je gustina zooplanktona bila promenjiva, specifična stopa rasta šarana u određenim vremenskim intervalima u različitim tretmanima se mogla porediti sa dostupnošću prirodne hrane. Pozitivna korelacija između dostupne prirodne hrane i performansi rasta utvrđena je u svim slučajevima. Ipak, dostupnost prirodne hrane pod ovim režimom fertilizacije nije bio dovoljan da omogući neto rast šarana bez dodavanja hrane. Dodatno hranjnje je takođe bilo neophodno da bi se održala proizvodnja.

Kada je reč o različitim vrstama dodavane hrane, ona bazirana na ostacima soje/tofu je bila najmanje efikasna. Sa ekonomske tačke gledišta, komercijalna hrana za životinje sa visokim nivoom proteina (komercijalna hrana za svinje i ribe) poboljšana lokalno proizvedenim sastojcima pokazala je bolju neto dobit nego hrana u čijem su sastavu kombinovani čisti sastojci (obrok od ribljeg brašna i zagrejane soje) s obzirom da su oni manje prisutni na lokalnom tržištu. Ipak, sva dodatna hrana nije imala dovoljnu količinu i kvalitet proteina da bi sama zadovoljila nivo proteina i esencijalnih amino kiselina koje su potrebne za šarana.

Ovi rezultati navode na zaključak da pod dominantnim lokalnim uslovima, dodatna hrana lokalno napravljena od komercijalnih koncentrata hrane za životinja, sastojci bogati energijom mogu da dovedu do povećane proizvodnje ribe ukoliko se kombinuju sa prirodnom hranom koja je stalno dostupna. Ovo će omogućiti da se poveća udeo akvakulture u zaradi kao i u obezbeđenju hrane u domaćinstvima.

Ključne reči: poluintezivna ishrana, šaran, alternativni sastojci hrane, dostupnost prirodne hrane

Keywords: Semi-intensive feeding; Common carp; Alternative feed ingredients; natural food availability

INTRODUCTION

In mountainous Northern Vietnam, pond aquaculture is an important part of the traditional integrated farming system contributing to protein supply and cash income. Typically, this is a polyculture of grass carp with silver carp, bighead carp, common carp

and Nile tilapia as secondary species, which has a low productivity of 1.5 t fish ha^{-1} a^{-1} (Steinbronn 2009). The use of low quality feed items (leaves, grass, farming by-products), an unknown disease with high mortalities only of grass carp, and an uncontrolled flow of water through the ponds causing high turbidity and loss of mineral nutrients for primary production are seen as the major reasons for the low fish production of the region. Semi-intensive pond management practices and the adjustment of stocking regime towards the common carp as main species of the polyculture system could result in a higher productivity and profitability of pond aquaculture in the uplands of Vietnam. These modifications towards the common carp based, semi-intensive polyculture necessitate a change in feed resources applied as well as feed production. Whereas energy-rich feed resources are widely available in the region, protein-rich feed resources are limited (Tuan 2010). Therefore it was investigated which of the locally available protein-rich feed resources are most suitable to be used as ingredient in supplemental feeds for common carp.

MATERIALS AND METHODS

A net cage trial was conducted in a farmer's pond stocked with the traditional fish species with 1.5 fish m^{-2} and common carp as main species. Each of the 16 net cages (2x2x2m) were stocked with 5 common carp fingerlings (19.7±4.7 g, 10.7±0.8 cm total body length, N=90). Traditional fertilization with 700 kg ha^{-1} $month^{-1}$ fresh ruminant manure stimulated the natural food availability. In three net cages each, four iso-nitrogenous and iso-energetic feeds (CP: 26 % DM, GE: 19.3 MJ/kg DM) based on locally available high-protein ingredients (fish meal + soybean meal, commercial pig feed concentrate, commercial fish fry feed and tofu residue) and energy ingredients (corn meal and cassava meal) (see Table 1) were fed to the common carp as supplemental feed at a daily rate of 3% of fish body mass. Three net cages were not fed additionally as control. The trial lasted for 82 days. Every 20 days, fish in the net cages were weight and feed amounts were adjusted; common carps from the 16th net cage were harvested for gut content analysis and restocked. In the same rhythm, water quality parameters and abundance of zooplankton and zoobenthos were monitored.

Table 1. Composition of trial feeds in percentage. [1]: Pig feed concentrate EH-150S (46% crude protein); [2]: Cargill Aquaxcel; 7414 (40% crude protein)

Feed	Fish meal	Pig feed[1]	Fish feed[2]	Tofu residue	Soy bean	Corn meal	Cassa-va meal	Rice bran	Mine-rals	Vita-mins	Sunf. oil
A	10	-	-	-	43	35	7	3.3	1	0.5	0.2
B	-	41	-	-	-	40.7	7	3.3	1	0.5	6.5
C	-	-	48.6	-	-	33.1	7	3.3	1	0.5	6.5
D	13.5	-	-	79	-	-	-	-	1	0.5	6

Samples of fish carcasses and feeds were analysed for dry matter and crude ash according the AOAC (1990). Crude protein was determined using a C/N analyser (Vario MAX CN, Elementar Analysensysteme GmbH, Germany, N x 6.25). Gross energy (GE) was determined with bomb calorimeter (IKA C 7000, Janke & Kunkel IKA-Analysentechnik, Germany) using a benzoic acid standard. Feeds were analysed for essential amino acid composition. ANOVAs and regressions were used for statistical analysis.

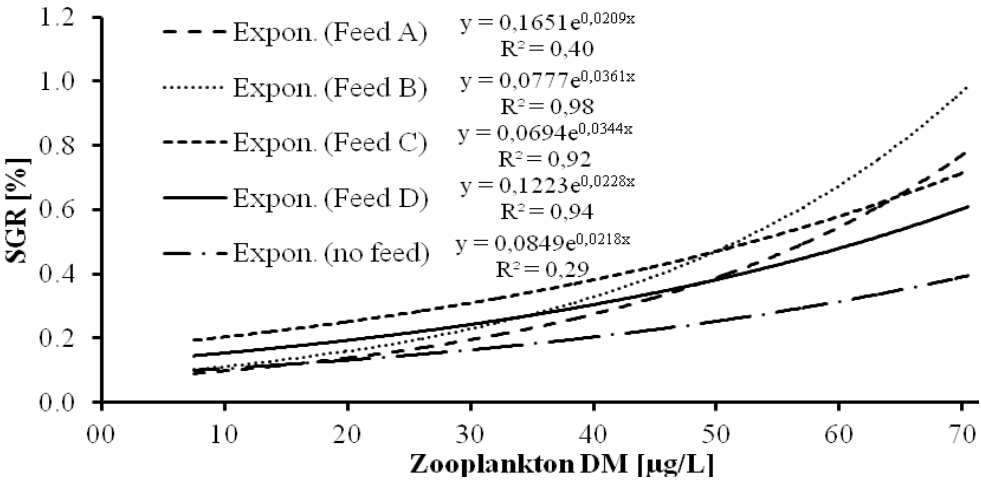

Figure 1. Exponential regression of specific growth rates (SGR) of common carp fingerlings vs. zooplankton DM for the four test feeds and without any additional feeding.

Among the different supplemental feeds, the one based on tofu residue was performing worst by showing the poorest content of essential amino acids (Table 2) as well as proximate common carp compositions similar to the unfed group and significantly different from the three other supplemental feeds (Table 3).

Table 2. Requirements of essential amino acids (EAA) and trial feed content in % of crude protein (CP); grey cells mark lower content than required. Arg: Arginine; His: Histidine; Ile: Isoleucine; Leu: Leucine; Lys: Lysine; Met: Methionine; Phe: Phenylalanine; Thr: Threonine; Trp: Tryptophan; Val: Valine. * (NRC 2011)

EAA		Thr	Val	Met	Ile	Leu	Phe	His	Lys	Arg	Trp
Requirement*		4.7	4.4	2.2	3.1	4.4	4.1	1.6	6.9	5.3	0.9
Feed	**A**	4.1	4.6	1.5	4.2	8.1	5	2.4	3.8	6.1	1.2
Feed	**B**	3.7	4.2	1.7	3.6	3.6	4.1	1.8	4.3	5.5	0.8
Feed	**C**	4.2	5.5	1.8	3.7	8.8	5.1	2.7	4.3	5.9	1.1
Feed	**D**	3.5	3.9	1.4	3.3	3.3	3.8	2	4.1	4.1	0.9

Table 3. Proximate composition of common carp under different feeding treatments.

CA: crude ash; CL: crude lipid; CP: crude protein; DM: dry matter; GE: gross energy.

	No feeding	Feed A	Feed B	Feed C	Feed D
DM [% of FM]	22.4±0.4	28.3±1.8	28.8±2.3	27.5±1.1	25.5±2.1
CA [% of DM]	16.6±0.8 [a]	11.9±0.9[b]	11.7±0.5[b]	11.2±0.4[b]	15.3±1.0 [a]
CP [% of DM]	72.9±1.7[a]	63.6±5.6[b]	62.7±3.1[b]	61.8±0.3[b]	71.4±3.6[a]
CL [% of DM]	7.0±1.0[b]	21.5±5.4[a]	21.8±2.7[a]	22.1±2.6[a]	11.6±4.2[b]
GE [MJ kg-1]	21.0±0.2[b]	24.8±1.2[a]	24.9±0.7[a]	24.9±0.8[a]	22.5±0.9[b]

Feeds A, B and C resulted in similar growth and proximate composition of common carp (Table 3). From an economical point of view, commercial animal feeds with high protein level (commercial pig and fish feeds) stretched with locally produced feed ingredients showed a better net benefit than feeds combining pure feed ingredients (fish meal + heated soybean meal) as they are less established on the local markets and have less controlled quality and higher prices. However, all supplemental feeds were insufficient in protein quantity and quality to solely fulfil the protein and essential amino acid requirements of common carp (Table 2) but were resulting in growth at sufficient availability of natural food resources. Due to the high protein content (Hepher 1988) and nutritional quality of natural food resources (Ventura and Catalan 2010), the CP content as well as content of essential amino acids in supplemental feeds do not need to fulfil all requirements of the cultured fish (De Silva 1995), which increases the profitability due to lower protein ingredient costs.

CONCLUSION

These results lead to the conclusion that under the prevailing local conditions, supplemental feeds made of commercial animal feed concentrates and locally produced, energy-rich ingredients may result in increased fish production if combined with continuously high natural food availability. Further adjustments on interaction of supplemental feed formulation and natural food quantity and quality may be beneficial to increase the production as well as the benefit out aquaculture. This will increase the contribution of aquaculture to household food security and income generation.

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