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Use of rice protein concentrate in rainbow trout feeding: preliminary results

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RIASSUNTO – Impiego di un concentrato proteico di riso nell'alimentazione della trota iridea: risultati preliminari. *E' stato valutato l'effetto di un concentrato proteico di riso (RPC) in parziale sostituzione alla farina di pesce sulle prestazioni zootecniche di trota iridea. Dopo 94 giorni di alimentazione sono stati rilevati i parametri produttivi e gli indici somatici. Alla fine della prova sono emerse differenze significative per quanto attiene l'incremento in peso, l'indice di conversione alimentare, il tasso di accrescimento specifico e l'efficienza proteica. Relativamente agli indici somatici, si sono evidenziate differenze statisticamente significative a carico dell'indice viscerosomatico e del coefficiente di adiposità.*

Key words: rainbow trout, fish meal substitution, rice protein concentrate.

INTRODUCTION – During the past decades, the fishery industry has excessively used the world fish captures to produce fishmeal and fish oil in order to prepare feed for aquaculture diets. This has led to a drastic reduction of several fish populations (Hardy, 1999; FAO, 1999). At present 70% of the oil and 34% of fishmeal obtained from captures are used for aquaculture industry and, if the aquaculture production will continue to increase as predicted, in a short time it will absorb the entire world oil and fish meal production. Moreover, since fish meal still constitutes an important part of the feed formula for cultivated fish and since a further increase of fish meal availability will not be possible (Hardy, 2001), its price is expected to continue to increase (Tacon, 1998). This has forced nutritionists and feed manufacturers to find alternative and renewable sources of protein for use in fish diets. In this sense, partial or total replacement of fish meal by plant protein has been accomplished in many carnivorous cultured fishes with good results in performances traits and fish quality (Fournier *et al.*, 2004). The aim of this research was to evaluate the use of a rice protein concentrate (RPC) meal as potential substitute for fish meal in diets for rainbow trout.

MATERIAL AND METHODS – 360 juvenile rainbow trout (initial individual weight 62.42±0.25 g) were stocked randomly in twelve fibreglass tanks (1x3x0.5 m). Four isonitrogenous (CP 47%) and isoenergetic (22 MJ kg^{-1} DM) diets were formulated with an increasing levels of a Rice Protein Concentrate (C, RPC20%, RPC35% and RPC53%) imported by CBH Company Limited (China). The composition and the proximate analysis of the RPC and of the diets obtained following AOAC (2000) methods are reported in table 1. Each treatment was tested in triplicate. Fish were fed 1.5% of body weight and the feed was supplied 6 days per week, twice a day. All the fish were weighed in bulk every 15 days in order to adjust the feeding quantities. The trial lasted 94 days and at the end survival rate percentage, final individual weight (FIW), feed conversion rate (FCR), feeding rate (FR), protein efficiency ratio (PER) and specific growth rate (SGR) were calculated. Moreover, hepatosomatic [HSI=(liver/body weight)*100], viscerosomatic [VSI=(viscera/body weight)*100] and fat coefficient [CF=(perivisceral fat/body weight)*100] indexes were calculated for each tank on five individuals slaughtered and eviscerated. All data were analysed by GLM Procedure (SPSS, 1999). Differences were considered significant at level of $P<0.05$.

Table 1. Composition, proximate analysis, gross energy and amino acid composition of RPC of experimental diets.

	RPC	C	RPC20	RPC35	RPC53
Ingredient (%)					
Fish meal		57.00	36.00	20.50	2.00
RPC meal		0	20.00	35.00	53.00
Corn meal		9.00	9.00	9.00	9.00
Dehulled barley meal		23.50	24.50	25.00	25.50
Fish oil		6.00	6.00	6.00	6.00
Brewer's yeast		2.00	2.00	2.00	2.00
Lignumsulphyt		1.50	1.50	1.50	1.50
Mineral mixture[1]		0.50	0.50	0.50	
Vitamin mixture[2]		0.50	0.50	0.50	
Proximate analysis (% DM)					

Dry matter	92.00	95.76	95.13	95.13	94.78
Crude protein	68.86	48.06	47.11	46.87	46.95
Ether extract	10.19	14.34	13.72	13.47	13.62
Crude fiber	2.78	1.98	2.33	2.93	3.09
NFE	14.25	25.50	28.76	30.33	30.58
Ash	3.92	10.12	8.08	6.40	5.76
Gross energy ($MJkg^{-1}$ DM)[3]	21.38	21.52	21.87	21.98	22.45
Amino acid composition (% diet)					
Cys	1.43	0.90	0.63	0.84	0.76
Met	2.11	n.d	0.61	0.75	0.77
Tyr	3.19	1.12	1.46	1.78	2.00
Phe	3.69	2.02	2.27	2.55	2.60
Lys	2.66	3.56	2.83	2.35	1.67
Leu	7.35	3.71	3.85	4,09	4.00
Ileu	3.44	2.34	2.25	2.39	2.27
Thre	2.79	1.69	1.56	1.62	1.41
Try	n.d.	n.d.	n.d.	n.d.	n.d.
Val	4.78	3.17	2.73	2.92	2.92

[1] Mineral mixture (g or mg/kg diet): bicalcium phosphate 500 g, calcium carbonate 215 g, sodium salt 40 g, potassium chloride 90 g, magnesium hydroxide 124 g, iron sulphate 20 g, zinc sulphate 4 g, copper sulphate 3 g, potassium iodide 4 mg, cobalt sulphate 20 mg, manganese sulphate 3 g, sodium fluoride 1g.
[2] Vitamin mixture (IU or mg/kg diet): DL-a tocopherol acetate, 60 IU; sodium menadione bisulphate, 5 mg; retinyl acetate, 15000 IU; DL-cholecalciferol, 3000 IU; thiamin, 15 mg; riboflavin, 30 mg; pyridoxine, 15 mg; B12, 0.05 mg; nicotinic acid, 175 mg; folic acid, 500 mg; inositol, 1000 mg; biotin, 2.5 mg; calcium panthotenate, 50 mg; choline chloride, 2000 mg.
[3] Determination with adiabatic calorimetric bomb (IKA 700).

RESULTS AND CONCLUSIONS – The survival was higher than 96% for all treatments. The results concerning performances traits are shown in table 2. Final individual weight (FIW) of the fish fed diets C and RPC20 were significantly higher than those of the other dietary groups. Concerning feeding rate, no significant differences appeared between the diets. Feed conversion rate (FCR) resulted significantly higher in diet containing the higher level of RPC while the lowest FCR is recorded in diet 2. Protein efficiency ratio (PER) was significantly higher in diets C and RPC20 compared with the others.

Table 2. Performances traits (mean±s.d.).

	C	RPC20	RPC35	RPC53
FIW g	170.91 ± 2.86a	172.66 ± 1.53a	143.05 ± 5.23b	134.92 ± 11.39b
FR %	1.20 ± 0.04	1.17 ± 0.01	1.19 ± 0.01	1.19 ± 0.04
SGR %	1.07 ± 0.02 a	1.08 ± 0.01a	0.88 ± 0.04b	0.82 ± 0.09b
FCR	1.07 ± 0.03bc	1.04 ± 0.02c	1.30 ± 0.05ab	1.43 ± 0.18a
PER	1.85 ± 0.05a	1.94 ± 0.04a	1.56 ± 0.06b	1.43 ± 0.18b

Means in the same row with different letters are significantly different ($P \leq 0.05$)

SGR showed a similar trend of PER and resulted significantly more favorable in C and RPC20 diets.The somatic indices are reported in table 3. No differences appeared concerning hepatosomatic index while viscerosomatic index (VSI) and visceral fat ratio (CF) were significantly higher in fish fed higher dose of RPC leading to a lower dressing percentage.

Table 3. Somatic indices (mean ± s.d.).

	C	RPC20	RPC35	RPC53
HSI	1.85 ± 0.12	1.86 ± 0.25	2.09 ± 0.37	1.83 ± 0.1