

FOOD CONVERSION IN THE FISH *ETROPLUS SURATENSIS**

SUMITRA-VIJAYARAGHAVAN, M. V. M. WAFAR and JOSEPH P. ROYAN

National Institute of Oceanography, Dona Paula-403 004, Goa.

ABSTRACT

Food conversion efficiency in the fish *Eetroplus suratensis* was studied using four types of diets. A comparison of assimilation efficiency, gross growth efficiency (K_1) and net growth efficiency (K_2) obtained in this study indicated a higher conversion efficiency with the food compounded from purified ingredients, followed by processed foods. Lowest conversion rate was obtained with the unprocessed natural food. The diets containing 60 to 87% protein were found to give higher conversion efficiencies.

Use of compounded feeds in fish culture has already gained some recognition in India (Lakshmanan, Murty, Pillai and Banerjee, 1967; Singh and Bhanot, 1970; Singh and Singh, 1975 and Jayachandran and Paulraj, *in press*). The studies of the last two authors mentioned above have shown that the weight gain in fishes using compounded feeds is much higher than that of fishes fed on natural feeds. The advantages of using dry pelleted feeds in such studies have been indicated by Cowey and Sargent (1972). The present study which forms a part of the aquaculture programme, was undertaken to find out the food conversion efficiencies in the fish *Eetroplus suratensis* using four types of pelleted feeds. Of the four feeds chosen, three were compounded and one unprocessed natural food.

Eetroplus suratensis (4-7 g) were collected from the Goa State Fisheries Farm and sorted into 4 groups of twenty each. These fishes were kept in glass aquaria (40 × 20 × 30 cm) with 7 l seawater of salinity 15‰ at room temperature (28°C ± 1°C). Fishes were adapted to the experimental diets for a week and the experiments were run for a period of 25 days.

The diets used and their composition are given in Table I. The fishes were fed *ad libitum* and the amount of food consumed throughout the experimental period was recorded. The faecal matter was collected every morning from each tank and its dry weight was recorded.

At the beginning of the experiment, five fishes were taken at random from each tank and sacrificed to determine the initial wet weight ratio and caloric content. At the end of the experiment, all the fishes were sacrificed for the determination of final dry wt and caloric values. The caloric content was determined using Parr 1200 adiabatic microbomb calorimeter. The calculation of energy values was made according to the instructions given in the Parr Manual 1241. Food conversion efficiency was

* Paper presented at the National Colloquium on Biochemistry of Fish, Chidambaram, Annamalai University, 17-19 September, 1977.

Table I Composition of test diets used in the feeding experiments with *Eitroplus suratensis*.

Japanese formula 10		Tamil Nadu Agricultural University (TNAU) pellet 7		White Fish Meal		Acetes sp.	
Vitamin free casein	54%	Silk worm pupae	25%	White fish meal	87%	Protein	74.92%
Cod liver oil	6%	Groundnut oil cake	25%	Cod liver oil	2%	Lipid	3.87%
Glycogen	6%	Rice bran	25%	Vitamin premix	2.8%	Carbohydrate	5.73%
Cellulose powder	19.8%	Tapioca flour	25%	Mineral mix	3%	Ash	15.48%
Other ingredients	14.2%	In addition, salt, mineral and vitamins have been added		Binder	5%		

Table II. Dry wt. balance of *Eitroplus suratensis* fed on different diets. The values are in dry wt (g) per animal. Experimental period was 25 days.

Expt. No. and food given	No. of animals	Initial wt. W ₁	Final wt. W ₂	Mean wt. $\frac{W}{5}$	Production P = W ₂ - W ₁	Food consumption C	Faecal output F	Relative growth rate $\frac{P}{\frac{W}{25}}$	Assimilation A	Food conversion ratio
1. Japanese formula 10	15	1.6128	1.9141	1.7635	0.3013	2.9858	0.3646	0.0068	2.6212	
2. TNAU pellet 7	15	1.4393	1.6676	1.5535	0.2283	4.3467	1.0273	0.0059	3.3194	
3. White fish meal	15	1.6090	1.8315	1.7203	0.2225	2.7467	0.3294	0.0052	2.4173	
4. Acetes sp.	15	1.60.9	1.6784	1.6437	0.0695	2.2587	0.1384	0.0017	2.1203	

Food conversion in the fish Etroplus suratensis

Table III. Energy balances of *Etroplus suratensis* fed on different diets. The values are in kcal per animal. Experimental period was 25 days.

Expt. No. and food	No. of animals	Initial calories	Final calories	Production	Food consumption	Faecal output
		I_1	I_2	$P = I_2 - I_1$	C	F
1	2	3	4	5	6	7
1. Japanese formula 10	15	8.243	10.292	2.049	11.398	1.021
2. TNAU pellet 7	15	7.356	8.779	1.423	17.226	2.867
3. White fish meal	15	8.224	9.699	1.475	10.458	0.693
4. <i>Acetus</i> sp.	15	8.223	8.742	0.513	10.093	0.363

Assimilation A	Metabolism K	Assimilation efficiency A/C %	Gross growth efficiency K_1 or $P/C\%$	Net growth efficiency K_2 or $P/A\%$
$C - F$	$A - P$	%		
8	9	10	11	12
10.377	8.329	91.04	17.97	19.74
14.359	12.935	83.36	8.26	9.91
9.765	8.290	93.38	14.10	15.10
9.730	9.210	96.41	5.15	5.34

determined both on dry wt and caloric basis. Equations used in the calculation were those of Crisp (1971).

Table II gives the dry wt balance and Table III gives the energy balance of *Etroplus suratensis*. The groups of fishes fed on the diets of Japanese formula 10 and on white fish meal, showed that although their consumption per unit weight was nearly the same, the K_1 and K_2 values of the fishes fed with the former were higher than that of the latter. In fact, of all the groups, the fishes fed on Japanese formula 10 gave the maximum conversion efficiencies (K_1 and K_2) with a high relative growth rate. The fishes fed on TNAU pellet 7 consumed more food than the other groups but gave lowest assimilation efficiency. However, K_1 and K_2 values were found to be next to that of the white fish meal showing thereby whatever food they assimilated has been effectively converted into body tissue, thus resulting in higher relative growth rate than the white fish meal. In group 4, where *Acetes* was used as food, assimilation efficiency was high, but K_1 and K_2 values, relative growth rate and consumption/unit wt were low, thereby showing that the food was in readily assimilable form but the fishes ate a small quantity and converted little of it into body tissue.

A review of the literature shows that K_2 values range from 8% in the adult carp fed on detritus and algae (Kevern, 1966) to 44% in the young *Ophiocephalus striatus* fed on young fishes and prawns (Pandian, 1967). Average conversion efficiency for flat-fishes lies between 19.92 to 38% (DeSilva and Balbontin, 1974). *Tilapia mosambica* when fed on different proportions of *Spirogyra* and liver (Mathavan, Vivekanandan and

Pandian, *in press*) gave 15.8 to 26.0% (100% liver gave 30% K₂; tadpole gave K₂-25.9%). In the present study K₂ values range from 3.3 to 11.5% on dry wt basis and from 5.3 to 19% on caloric basis.

The food conversion ratios (FCR), defined as the ratio of the amount of dry food consumed to live wt gain, in the present study for the four diets were 4.02, 8.02, 3.92 and 5.69 respectively (Table II). Of the four test diets used the white fish meal showed the lowest FCR. Jayachandran and Paulraj (*in press*) reported 3 to 11.6 FCR in the common carp *Cyprinus carpio*. The FCR of 8.02 obtained in the second group of fishes fed on TNAU pellet 7 in the present study was similar to that of pellet 2 used by Jayachandran and Paulraj (*in press*).

Dietary protein requirement of fishes varies from species to species. Thus Delong, Halver and Mertz (1958) reported 40 to 55% as optimum protein requirement for chinook salmon. Works of Nail (1962), Simco and Cross (1966) and Deyoe and Tiemeier (1969) showed that dietary protein requirement for the optimum growth is 25% and above in the channel catfish. However, Dupree and Sneed (1966) obtained optimum growth rate in channel catfish on 40% protein contained in a dry diet. Ogino and Saito (1970) reported 38% as optimum protein level requirement for the young carp. Cowey, Adron, Blair and Pope (1970) showed that the conversion rate in 0-group plaice was high on the diets containing 50 to 70% protein. In the present study, higher food conversion efficiency was obtained with the diets containing 60 to 87% protein.

ACKNOWLEDGEMENT

We acknowledge with thanks Dr. O. Deshimaru of Japan, Dr. C. B. Cowey of Aberdeen, Dr. M. N. Kutty of Tamilnadu Agricultural University for having generously supplied us with formulated feeds. Our sincere thanks are also due to Dr. S. Z. Qasim, Director, N.I.O., Goa, Dr. S. V. Job and Dr. T. J. Pandian of the Madurai University, Madurai for going through the manuscript and for the suggestions.

REFERENCES

- Cowey, C. B., J. W. Adron, A. Blair and J. Pope, 1970. The growth of 0-group plaice on artificial diets containing different levels of protein. *Helgolander wissenschaftliche Meeresuntersuchungen*, 20: 602-609.
- Cowey, C. B. and J. R. Sargent, 1972. Fish nutrition. In: *Advances in Marine Biology*, Vol. 10, edited by F. S. Russell and C. M. Yonge. Academic Press, London and New York, p. 383-492.
- Crisp, D. J., 1971. Energy flow measurements. In: *Methods for the study of marine benthos* (IBP Handbook No. 16), edited by N. A. Holme and A. D. McIntyre. Blackwell Scientific Publications, Oxford and Edinburgh, pp. 197-297.
- Deyoe, C. W. and O. W. Tiemeier, 1968. Nutritional requirements for channel catfish fingerlings. *Feedstuffs*, 40: 48-49.
- Delong, D. C., J. E. Halver and E. T. Mertz, 1958. Nutrition of salmonoid fishes. VI. Protein requirements of chinook salmon at two water temperatures. *Journal of Nutrition*, 65: 589-599.
- De Silva, S. S. and F. Balbontin, 1974. Laboratory studies on food intake, growth and food conversion of young herring, *Clupea harengus* (L). *Journal of Fish Biology*, 6: 645-658.

Food conversion in the fish Etroplus suratensis

- Dupree, H. K. and K. E. Sneed, 1966. Response of channel catfish fingerlings to different levels of major nutrients and purified diets. *Technical Paper No. 9*, Bureau of Sport Fisheries and Wildlife, U.S. Department of Interior, 21 pp.
- Jayachandran, P. and S. Paulraj. Formulation of pelleted feeds and feeding trials with common carp. (*In press*)
- Kevern, N. R., 1966. Feeding rate of carp estimated by a radio-isotopic method. *Transactions of the American Fisheries Society*, **95**: 363-371.
- Lakshmanan, M. A. V., D. S. Murty, K. K. Pillai and S. C. Banerjee, 1967. On a new artificial feed for carp fry. *F.A.O. Fisheries Reports*, **44**: 373-387.
- Mathavan, S., E. Vivekanandan, and T. J. Pandian. Food utilization in the fish *Tilapia mosambica* fed on plant and animal foods. (*In press*)
- Nail, M. L., 1962. The protein requirement of channel catfish. *Proceedings of the South-eastern Association of Game and Fish Commissioners*, **16**: 307-316.
- Ogino, C. and K. Saito, 1970. Protein nutrition in fish: I. The utilization of dietary protein by young carp. *Bulletin of the Japanese Society of Scientific Fisheries*, **36**: 250-254
- Pandian, T. J., 1967. Food intake, absorption and conversion in the fish *Ophiocephalus striatus*. *Helgolander wissenschaftliche Meeresuntersuchungen*, **15**: 637-647.
- Simco, B. A. and F. B. Cross, 1966. Factors affecting growth and production of channel catfish. *University of Kansas Publications of the Museum of Natural History*, **17**: 191-256.
- Singh, C. S. and K. K. Bhanot, 1970. Nutritive value of algal feeds for common carp. *Journal of the Inland Fisheries Society of India*, **2**: 121-127.
- Singh, C. S. and K. P. Singh, 1975. Feeding experiments on Indian major carps in Tarai ponds. *Journal of the Inland Fisheries Society of India*, **7** : 212-215.