Advance Journal of Food Science and Technology 6(11): 1201-1204, 2014
DOI:10.19026/ajfst.6.185
ISSN: 2042-4868; e-ISSN: 2042-4876

Submitted: May 24, 2014 Accepted: June 20, 2014 Published: November 10, 2014

Research Article

A Comparative Study of the Influence of Energy Level in the Fillet and Food Intake of Economically Important Marine-and-Freshwater Fish Species from Saudi Arabia

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Abstract: Energy content interms of calories/ gram dry weight in the fillet as well as in the food as the dietary ratio of some economically important fishes from different habitat (Marine and freshwater) were determined by two methods; The Organic Carbon and The Karzinkin Tarkovaskaya. The energy value of the nutrients in the fillet/food was determined by these two methods which were highly significant ($p<0.001$) and in order [*Rastrillegar kanagurta* (988.50/8251.66 and 12088.28/8694.46 Joules gm-1); *Lethrinus lentjan* (7274.80/ 5544.50 and 9237.30/ 5978.26 Joules gm-1); *Aphareus rutilans* (6891.56/ 4813.56 and 9092 58/ 5136.78 Joules gm-1) and *Chanos chanos* (6681.50/ 5120.56 and 8841.48/ 5520.54 Joules gm-1)] in Marine water fishes. As compare to other environment of freshwater, the order was as such, *Clarius gariepinus* (7888.61/6613.83 and 8779.25/7290.40 Joules gm-1) *Oreochromis niloticus* (6103.00/4778.69 and 6896.20/5584.16 Joules gm-1); *Cyprinus carpio* (5639.38/4276.49 and 6370.41/4942.18 Joules gm-1) and *Gara tibanica* (4353. 22/3300.45 and 3882.73/2680.53 Joules gm-1) respectively. The moisture content and the ratio of energetic values of fillet/food were also determined and tabulated. Consistency of the results obtained indicate the reliability of the method used and to explain the validity of conversion factor from weight to energy which will be useful for general estimation of energy contents and energy flow in aquatic ecosystem.

Keywords: Bioenergetics, fillet/food calorie ratio, marine and freshwater fishes

INTRODUCTION

The energy transferred into organism from its natural environment in the form of food is of fundamental interest in ecological studies of terrestrial, limnic, marine and global ecosystem (Odum, 1971; Brey *et al*., 1988; Al-Akel and Shamsi, 1995; Bowen *et al*., 1995). The daily ration of certain size group of fishes can be estimated using 24 hours samples of their stomach contents (Sainsbury, 1986; Jarre, 1990). This estimated ration can potentially be energetic (Al-Akel and Shamsi, 1995). The energy flow studies and the calorie content of any organism are the important parameters and used for converting the total biomass of the population into units of energy (Vijayraghavan *et al*., 1975; Marais and Kissil, 1979; Jafri and Shamsi, 1983). Similarly, energy budget and balances for other ecological parameters can be computed interms of calories, which is generally becoming an ecological unit since it gives a better comparison of energetic processes, predicted the amount of energy available for metabolism and growth. This approach can be applied for the determination of the organic carbon of ingested food which is expressed interms of energy unit in its natural environment. These informations of growth can be correlated by several other workers in the past (Salmon and Bradfield, 1972) in *Perca fluvescens*; Niimi and Beamish (1974) in *Micropterus solmoid*; Elliot (1976A, B) in *Salmo trutta* and Al-Akel and Shamsi (1995) in some marine water fish species.

The values of energy contents vary seasonally, taxonomic texture, reproductive stage and the nature of food in take (Qasim *et al*., 1975; Griffith, 1977; Jana and Pal, 1980; Norrbin and Bamstedt, 1984). Studies on the calorie content of aquatic organisms from different environment have so far been limited (Qasim and Jacob, 1972; Vijayraghavan *et al*., 1975; Foltz and Norden, 1977; Jafri and Shamsi, 1983; Pauly, 1986; Al-Akel and Shamsi, 1995). The aim of the present study is to obtain a valid conversion factor from weight-to-energy which might be useful for general estimation of energy content and energy flow in aquatic ecosystem. Here, the author have estimated the energy value of muscles and stomach contents and expressed the biomass interms of energy which are useful in expressing the energy assimilation and conversion efficiency.

MATERIALS AND METHODS

Healthy fishes, *Rastrilllegar kanagurta* (Scombridae), *Lithrinus lentjan* (Lithridae); *Aphareus rutilens* (Lutjanidae) and *Chanos* chanos (Chanidae) as marinewater and *Clarias gariepinus* (Claridae); *Oreochromis niloticsu* (Cichlidae); *Cyprinus carpio*

(Cyprinidae) *and Gara tibanii* (Cyprinida*e*) as freshwater were collected and their stomach content were removed and emptied carefully in a bowl and lumped together for analysis. The mouth and structure of oesophagus were examined for signs of regurgitation of stomach content. The food items present in the gut were examined for each fish separately and were macerated in an electric grinder and then dried in an oven at 90°C for 24 h. The dried sample was homogenized into fine powder using pestle and mortar and kept in a desiccator in properly stopped specimen tube for analysing the energy level in the form of carbon. The dry operation of the moist (Fillet) was undertaken in an oven which was kept at 90°C and the difference of wet and dry weights, the percentage of moisture was calculated. The calorie values of both the samples (Fillet/Food) were estimated by the method of Organic Carbon (Qasim and Jacob, 1972; Qasim *et al*., 1975; Karzinkin and Tarkovaskaya, 1964). These methods were also utilized earlier by Jafri and Shamsi (1983) in freshwater fishes from India and later by Al-Akel and Shamsi (1995) in marinewater fishes from Saudi Atabia. All the analysis were intriplicate to keep the consistency of the results.

RESULTS

The results obtained in the present investigation for energetic values interms of Joules gm-1 weight in both marine-and-freshwater fish species with fillet/food calorie ration were given in Table 1 and 2. The specific differences were obtained in the total energetic ration of fillet to food. Data pertaining reveals that the energetic values were comparatively high in the method of Karzinkin and Tarkovaskaya (1964) in comparison to Organic Carbon method. However, the relative effectiveness of both the methods was determined by calculating the correlation coefficient. This correlation coefficient between caloric value of fillet and food in two different methods is given in Table 3 which is significantly high. This indicates that the methods applied were equally efficient and has reasonable accuracy.

The assimilation of energy nutrient in the body and the food intake of the two methods applied are apparently increase in order (*R.kanagurta*> *L. latigens*> *A.rutilens*> *C.chanos*) for marinewater fishes and (*C.gariepinus*> *O.niloticus* >*C.carpio*> and *G.tibanica*) for fresh water fishes, respectively, Table 1 and 2.

DISCUSSION

To know the relationship between the fish growth and the food abundance in the environment, it is necessary to compare the food intake and the bioenergetic of fish which is potentially useful for aquaculture (Mills and Forney, 1901; Al-Akel and Shamsi, 1995; Bowen *et al*., 1995). The total energetic content of an animal depends on the amount of carbohydrate, protein and lipid content in the body, so, the diet has often been shown to have a profound influence on body composition (Brett *et al*., 1969; Pandian and Raghuraman, 1972; Page and Andrews, 1973; Adron *et al*., 1976; Papoutsoglou and Papaparaskeva-Papoutsoglou, 1978; Marais and Kissil, 1979). It seems that protein formation and their growth proceeded at a higher rate in the lower energy

Table 1: Total average energy interms of Joules gm^{-1} dry weight, fillet/food energy ratio and percent of moisture content in marinewater fish species

		Organic Carbon method			Karzinkin Torkovaskaya method			
Species	Number of specimen used	Fillet	Food	Ratio	Fillet	Food	Ratio	Moisture content of fish (%)
Rastrillegar kanagurta	15	9889.50±14.53	8251.66±15.56	1.19	12088.28±69.89	8694.46±7.790	1.39	63.54
Lethrinus lentjan	20	7274.80±13.44	5544.50±15.76	1.31	9237.30±16.81	5978.26±17.67	1.54	68.30
Aphareus rutilans	20	6891.56±17.96	4813.56±9.430	1.43	9092.58±10.25	5136.38±19.32	1.77	70.25
Chanos chanos	20	6681.50±20.99	5120.56±11.70	1.30	8841.48±16.94	5520.54±15.74	1.60	70.62

Table 2: Total average energy interms of Joules gm^{-1} dry weight, fillet/food energy ratio and percent of moisture content in freshwater fish species

		Organic Carbon method			Karzinkin Torkovaskaya method			
Species	Number of specimen used	Fillet	Food	Ratio	Fillet	Food	Ratio	Moisture content of fish (%)
Clarias gariepinus	25	7888.61±45.59	6613.83±35.35	1.19	8779.25±20.47	7290.40±24.80	1.20	70.40
Oreochromis niloticus	25	6103.00±30.62	4778.69±20.64	1.28	6896.20±12.74	5584.16±19.40	1.23	69.45
Cyprinus carpio	25	5639.38±18.60	4276.49±18.88	1.32	6370.41±19.74	4942.18±30.11	1.29	68.20
Garra tibanica	25	4353.22±24.04	3300.45±11.65	1.32	3882.73±23.84	2680.53±19.69	1.45	61.60

Table 3: Correlation coefficient between caloric values of fillet and food in two different method

	Marinewater fishes		Freshwater fishes	
Method used	Value of correlation coefficient	Significance	Value of correlation coefficient	Significance
Organic Carbon	0.9974	p<0.0026	0.9826	p<0.0174
Karzinkin Tarkovaskaya	0.9997	p<0.0003	0.9854	p<0.0346

containing diet not because of differences in the efficiency of feed protein conversion into body protein due to any dietary component but it become voluntary feed intake at higher level. According to Griffith (1977), Norrbin and Bamstedt (1984) and Brey *et al*. (1988), differences in energy content depends on general life strategies and environment. This indicates that the geographically different races or variants may also cause for the disruption in conversion factor from food to fillet. In our compilation, values from wide geographical areas like marine and freshwater were included the differences with values else where, on that basis we can conclude that taxonomic status of different fish species may affect the energetic values. This hypothesis is in concordance with the work of Driver (1981).

However, some variations in the energetic values in two different methods (Karzinkin Tarkovaskaya, 1964) and Organic Carbon assimilation might be due to the complete oxidation of protein moreover, the inorganic material present in the sample interferes with the titration (Hughes, 1969; Qasim *et al*., 1975). Hence, it is quite obvious that the energetic values of the fish were certainly the consequence of the main constituents of its body such as protein, lipid and carbohydrate, which all together determines the energy content per unit weight of body mass excluding the inorganic material (Brey *et al*., 1988), so, the fish undergoes energy changes of its soma in different stages.

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