CALORIFIC VALUES AS FUNCTIONS OF MAIN BODY CONSTITUENTS IN SOME FRESHWATER TELEOSTS

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ABSTRACT

Energy values of groups of small, medium and large size fishes of some commercially important freshwater fishes have been determined using wet-oxidation method. The calorific values per unit of dry weight was significantly different ($P < 0.001$) among three size groups of each species tested. The species-specificity of caloric content was invariably observed ($P < 0.001$) in all the fishes of small, medium and large size. Low and high calorific values were obtained in small and large size fishes respectively. As the organic carbon, organic matter and total nitrogen of the fish body increased with age, the energy content of the fishes also increased and was described by equations of least square method.

The biomass of animals can be expressed in energy units if their caloric contents are known. Similarly, energy budgets and balances for other ecological parameters can be computed in terms of calories. Thus the calorie is becoming a generally accepted ecological unit since it gives a better comparison of energetic processes than number or biomass. The information on the energy content
of commercially important freshwater fishes of India are extremely meagre but the calorific values of some Indian marine fishes and the food ingested by them are reported by Qunsim et al. (1973). The present study reports the energy values of some freshwater fishes of various size groups.

Different size groups of fishes viz., Clarias batrachus, Heteropneustes fossilis, Channa punctatus, C. striatus, Belone cancila, Mastacembelus pancerus, Wallago attu and Barbus stigma were obtained from local fish farms. On the basis of weight the former six species were grouped into small (1 to 18g) medium (60 to 250 g) and large (20 g to 1 kg) while only small (1 to 800 g) and medium (12 g to 12 kg) size groups of Wallago and Barbus were obtained because of non-availability of medium-size group. The body muscles were taken from various parts of the body which were then heated in a hot-air oven at 80°C until constant weights were obtained. Calorific values of dry somatic tissue were determined according to the wet oxidation method as described by Winberg (1971). The results were compared later with a Bomb Calorimeter the values of which exceeded within 5%. Organic carbon, organic matter and total nitrogen of the body were obtained following standard methods.

As can be seen in Table 1, calorific values varied greatly between small, medium and large size groups of all the test fishes. \( F_{2,9} \geq 10.19; P < 0.001 \). The caloric values were distinctly low in the small-sized fishes but increased gradually with higher weights so that energy content was heaviest in the large-sized fish. The species-specificity of caloric content was invariably observed in all the fishes of small \( F_{7,14} = 16.18; P < 0.001 \), medium \( F_{5,18} = 4.10; P < 0.01 \) and large size \( F_{7,24} = 19.84; P < 0.001 \). For example, Clarias contained the greatest values among all the species of three size groups investigated while the minimal values were obtained in Belone in all but medium size.

**Table 1. Calorific values of dry tissue (kcal g\(^{-1}\)) in different freshwater teleosts.**
group. In the latter size, Belone, Channa striatus, C. punctatus, Heteropneustes and Mastacembelus showed almost similar calorific values ($P > 0.05$); the energy values of Clarias was as large as at least 1.24 fold from any of the other fishes tested ($P < 0.05$). Among the larger fishes, the lowest values were obtained in Belone which did not differ much ($P > 0.05$) from the Barbus. The next higher but approaching similar ($P > 0.05$) values were found in Channa punctatus, Wallago, Heteropneustes, C. striatus and Mastacembelus. By contrast, the content in Clarias exceeded about twice and one and half the Belone-group and Channa-group respectively. Among the smaller fishes the caloric content in Wallago was significantly higher ($> 1.30$ fold) than the values found in any of Heteropneustes, Belone, Mastacembelus and Clarias.

Calorific values of a fish is certainly the consequence of the main constituents of the body. Fish undergoes energy changes of its soma in different stages of maturity because there is a considerable drain on the energy reserves due to sexual maturation and it is the female where this drain is heaviest (Craig 1977). As already obtained in certain species of Indian and exotic major carps (Jana and Pal 1980), here, in Fig. 1, it has been shown that the caloric value of fish body, irrespective of species, tended to rise with increase in each of the body constituents.

**FIG. 1.** Relation between calorific values and main body constituents in some freshwater teleosts.
constituents of organic carbon \( (r' = 0.958) \), organic matter \( (r = 0.728) \) and total nitrogen \( (r = 0.959) \) in the body. The best fit equations for predication of calorific values \( (\hat{Y}) \) from these three components are linear as follows:

\[
\begin{align*}
\hat{Y} &= -0.4235 + 21.9664X \quad (1) \\
\hat{Y} &= -0.4722 + 12.8689X \quad (2) \\
\hat{Y} &= -0.4670 + 257.7423X \quad (3)
\end{align*}
\]

The y-intercepts in all, are negative and do not vary much as compared to the values of slope suggesting the greatest importance of total nitrogen (equation 3) in caloric content of fish body. Parallely, Slobodkin and Richman (1961), Ostapenya and Sergeev (1953) and Salonen et al (1976) found a linear relationship between body constituents and energy value in a number of organisms.

This investigation was supported by an award of the UGC Teachers' fellowship to G.P.P. We are thankful to Mr. Tapan Kumar Bhattacharyya of the Department of Applied Chemistry, University of Calcutta, for kindly analyzing the samples in the Bomb Calorimeter.

**References**


