STUDY OF RELATIONSHIP BETWEEN DRY WEIGHT GAIN (G) VS. OXYGEN CONSUMPTION i.e. BETWEEN GROWTH / PRODUCTION VS. METABOLISM / RESPIRATION OF *HETEROPNEUSTES FOSSILIS* (BLOCH).

Dr. Pritam kumar
(Guest Teacher)
Dept. of Zoology, H.R. College Mairwa, Siwan. J.P. University, (Bihar)

Abstract

With unit increases in dry weight (g) the oxygen consumption (K.J/fish/day) increased by a fractional power of 0.3927. The correlation coefficient has been calculated to be 0.90002 (P>0.001) which indicates high degree of correlation between these two parameters.

With unit increase in protein weight (g) the oxygen consumption KJ/fish/day) increased by a fractional power of 0.5942. The correlation coefficient (r) has been calculated to be 0.9728 which indicates very high degree of correlation between these two parameters.

Keyword : Oxygen consumption, Heteropneusteus fassilis, Growth, Metabolism respiration.

Introduction

Heteropneustes fossilis (Bloch), belonging to family. Heteropneustidae (or Saccobranctridae), order-Cypriniformes of the class-Teleostami are found in estuaries and fresh waters of India, Pakistan, Ceylon, Burma and China.The growth and energy requirements of several fishes have been worked out by a number of workers **(Winberg, 1956; Mann, 1965; Weatherly, 1966; Warren & Davis, 1967, Singh, 1977)**. The energy lost in equation can be measured directly but the energy used in metabolism can be determined indirectly by respirrometry. It is well known fact that the metabolism of Poikilothermous animals such as fish is dependent on temperature, activity, oxygen and carbondioxide concentration of water, but weight, maturity environmental conditions and also the time of the year.

A number of studies carried out under laboratory condition have shown that there is a linear relationship between feeding rates and metabolic expenditure, leading to a close relationship between metabolism & growth (Brett, 1976; Vivekanandan and Pandian, 1977; Hogendoorn, 1983). Our information regarding relationship between food consumption and growth, dry weight gain Vs. oxygen consumption i.e. between growth/production Vs. Metabolism/Respiration and protein gain Vs. oxygen consumption in fishes is inadequate. The basis of any study of energetic and growth is a precise estimation of food intake. The high protein diets have been suggested (Jobling et al., 1991) to promote good rates of growth and feed utilization without causing excessive acimulation of lipid in the liver.

MATERIAL AND METHODS

Live specimens of different size and weight of *Hereropneustes fossilis* were collected from local fisher men of Gaya. The fishes were transported to the laboratory in plastic container where they were treated with potassium permanganate for few minutes and then transferred to glass aquarium. Unhealthy and injured fishes were rejected. The fishes were fed daily with pieces of goat liver. Experiments were performed after a minimum acclimatization period of seven days in the laboratory.

Measurement of Oxygen Consumption

The concentration of dissolve O_2 content in the water was estimated by Winklers volumetric method (Welch, 1948). Oxygen consumption from air was calculated from the range of imbalance of the level of the manoetric fluid in the manometer and by the use of combined gas law equation and vapour pressure (Dejours, 1975). The calculation was made by the following formula :-

$$\text{at N.T.P.} = \frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

or

$$V1 = \frac{P_2V_2.T_1}{P_2.T_2}$$

Where,

P_1 = Normal atm. pressure (i.e. 760mm)

T_1 = absolute temp. or Kelvin Temp. (i.e. 27.3°C)

P_2 = Atm pressure – vapour pressure of water

V_2 = Volume of Oxygen consumed (as read by the Manometer) and

T_2 = Temperature of air + Kelvin Tem.. (i.e. 27.3°C)

Mean values of O_2 consumption of a series of observation in each weight group at standard Temp. and pressure dry (STPD) was calculated. pH of the water was measured by an electronic pH meters.

Statistical Methods

Characteristic of the regression lines relating to dry weight and protein weight Vs. Oxygen consumption were calculated by the method of least square using a Moscal (DCM) electronic calculator. The relationship between above parameters were established by the following formula :

$$Y = a + b.\ x$$

Where,

Y = dependent variable (Oxygen consumption)

X = independent variable (Dry wt;. or protein Wt.)

a = intercept and

b = regression coefficient (Slope)

The correlation coefficient 'r' has also been calculated.

DISCUSSION AND RESULT

In the present investigation in *Heteropneustes fossilis* exponent value "b" relating to oxygen consumption to body weight has been found to be 0.769 (Table-5) which is very close to that reported by **Winberg (1956), Palaheimo and Dickie (1965), Hakim et al. (1978) and Munshi et al. (1979)** in a number of teleostean species.

In the present study in *Heteropneustes fossilis* the conversion efficiency (on the basis of instantaneous energy budgeting to estimate growth) ranged from 36.0% (in 104.0g) to 37.7% (in 16.3g, Table-4) which is close to that reported by a number of investigators.

In the present study in *Heteropneustes fossils* a positive & significant correlation (r = 0.9902; P>0.001) between dry wt. gain Vs. VO_2 was also obtained. However the value of slope of the regression line was slightly lower (b=0.3927) than the value reported above by Hogendroon (1983).

In the present study in *Heteropneustes fossils* a positive & significant correlation (r = 0.9728; P>0.001 Table - 5) between protein gain Vs. Oxygen consumption was obtained. The slope of the regression line gave a value of 0.5942. Thus, my finding is very close to reported by Hogendroon (1983).

OBSERVATION

The data showing dry weight gain (g) Vs. Oxygen consumption (K.J/day/fish) in *Heteropneustes fossilis* are summarized in Table – 5. The oxygen consumption (K.J/fish/day) increases with the increase in dry weight gain in different weight group of *Heteropneustes fossils.* The value of oxygen consumption (KJ/fish/day) ranged from 1.10 to 10.68 KJ/fish/day within the dry weight gain range 3.98 to 26.35g (Table -4). A straight line was observed when mean values of oxygen consumption were plotted against the mean values of dry wt. (of respective weight group) on ordinary graph and the observed scores were fitted by least square regression method. The relationship between dry weight gain (g) and oxygen consumption (K.J/fish/day) was represented by :-

$$Y = a + bx.$$

Where Y = Oxygen consumption (dependent variable), X = dry weight gain (independent variable), 'a' = intercept and 'b' is the slope of regression line or regression coefficient. The value of 'a' & 'b' were calculated to be -0.3562 & 0.3927 (Table -5) respectively. By substituting the value of 'a' & 'b' in the above question in becomes.

$$Y = -0.3562 + 0.3927. X$$

or

$$Y = 0.3927 .x – 0.3562$$

A perusal of above equation indicates that with unit increase in dry weight oxygen consumption (KJ/fish/day) increase by a fractional power of 0.3927. The correlation coefficient has been calculated to be 0.9002 (p>0.001, Table -5) which indicates high degree of correlation between these two parameters.

Relationship between protein weight gain (g) Vs. Oxygen consumption (K.J/fish/day)

The oxygen consumption (K.J/fish/day) increase with the increase in protein weight (g) in different weight group of *Heteropneustes fossils.* The mean value of oxygen. The relationship between protein weight gain (g) and oxygen consumption (K.J/fish/day) was established the general equation :-

$$Y = a + bx$$

Where Y – Oxygen consumption (dependant variable), X = protein weight gain (Independent variable) 'a' = intercept and 'b' slope of regression line. The value of 'a' and 'b' have been calculated to be -0.9477 and 0.5942 (Table -5) respectively. By substituting the value of 'a' and 'b' in the above equation it becomes :-

$$Y = -0.9477 + 0.5942.x$$

or

$$Y = 0.5942.x - 0.9477$$

A perusal of above equation indicates that with unit increase in protein weight (g) the oxygen consumption (K.J/fish/day) increases by a fractional power of 0.5942. The correlation coefficient (r) has been calculated to be 0.9728 (Table-5) which indicates high degree of correlation between these two parameters.

Table - 4

Showing mean values of dry weight, protein and oxygen consumption in different weight groups of *Heteropneustes fossilis* (Bloch) at 31.5 1.0°C

Body Weight (g)	Dry Weight (g)	Protein Weight (g)	Oxygen consumption K.J/day/fish
16.3	3.98	3.21	1.10
21.4	5.38	4.17	1.59
34.5	8.77	6.55	2.66
42.3	10.93	7.95	3.32
56.5	14.35	10.45	4.90
64.5	14.51	11.80	5.70
72.2	18.34	13.0	6.78
82.3	20.90	14.81	7.99
95.5	23.86	17.0	9.59
104.0	26.35	18.41	10.68

Table - 5

Showing relationship between dry weight and protein weight Vs. Oxygen consumption (KJ) in different weight group of *Heteropneustes fossilis* (bloch).

S.N.	Parameters	Equation y = a + bx	Correlation coefficient (r)
1	Dry weight (g) Vs Oxygen consumptioin (K.J)	Y = -0.3562+0.3927.X or $Y = 0.3927X^{-0.3562}$	0.9002 P>0.001
2	Protein weight (g) Vs. Oxygen consumption (K.J)	Y =-0.9477+0.5942.X or $Y = 0.5942X^{-0.9477}$	0.9728 P>0.001
3	Body weight Vs. Oxygen consumption (KJ/Fish/day)	Y = -0.376+0.769 logw or $Y = 0.420W^{0.769}$	0.970 P<0.001

References :-

Wealtherley, A.H. (1966). The ecology of fish growth, Nature London. 219 : 1321-1324

Warren, C.E. and G.E. Davies (1967). Laborratory studies on the feeding bioenergetics and growth of fishes. In : Gerking, S.D. (eds.). The biological basis for freshwater Fish Production. pp. 175-214. Oxford, Blackwell.

Mann, K.H. (1965). Energy transformation by a population of fish in the river Thames. *J. Anim. Ecol. 34 :* 253-75

Winberg, G.G. (1956). Rate of metabolism and food requirements of fish. Fish. Res. Bd. Can. Translation series No. 194, 1960; pp. 1-253 (from Intslvnost obena pischevye petrebrostirub, Nauchnye, trudy Belerusskovo Gosudarstennovo Universitetaimeni. V.I. Lenina minsk).

Brett. J. R. (1976). Feeding metabolic rates of young sockeye salmon, *Oncorhychus nerka,* in relation to ration level and temperature. *Fish. Mar. Serv. Rs. Dev. Tech. Rep.* 675pp 43.

Vivekanandan and T.J. Pandian (1977). Surfacing activity and food utilization in a topical air breathing fish. exposed to different temperature. *Hydrobiologia* 54 : 145-160.

Hogendoorn, H. (1983). Growth and production of African catfish, *Clarias lazera* (C & V) III Bioenergetics relation of body weight and feeding level. *Aquaculture* 35 : 1.

Munshi, J.S.D.' B.N. Pandey (1978). Oxygen uptake through gill and skin in relation to body weight of an air breathing siluroid fish, saccobranchus (*Heteropneustes fassilis*) J. Zool. Lond. 184 : 171-180