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The Morphometrics and the Proximate Composition of the Edible Fresh Water Mussel *Lamellidens Lamellatus* (Lea) from Bathalagoda Tank, A Man Made Reservoir in Sri Lanka

By

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ABSTRACT

Morphometric characteristics of *Lamellidens lamellatus* (Lea) were studied using a random sample of 138 individuals collected from Bathalagoda reservoir in Kurunegala district. The largest number of individuals in the collection was between 40–50 mm. in length. They had a body weight between 60–80 gm.

The most abundant bio-chemical component in the adductor and in the foot was protein. Carbohydrate and lipid quantities were almost equal while ash showed the least value. The total protein content ranged from 48.8% to 73.4%; the carbohydrate content from 12.64% to 23.8%; and lipid content from 12.0% to 28.1% of their dry weight. It was found that there were significant relationships between the length and the body weight; and between length and volume. There were no significant relationships of the total muscle weight with the bio-chemical components in both the adductor and in the foot.

Introduction

There are two families of bivalves with four genera found in the fresh waters of Sri Lanka. Of these bivalves, *Lamellidens Lamellatus* (Lea) is found both in the lotic and in the lentic environments and is widespread, occurring some times in large numbers, in the man made reservoirs of the Hambantota, Polonnaruwa, Anuradhapura, Kurunegala and the Puttalam districts (Costa, 1981; unpublished).

Lamellidens lamellatus is an edible bivalve mollusc sometimes eaten by people living in the immediate vicinity of the reservoirs. However this habit is not widespread. With the present accent on aquaculture in Sri Lanka, it appeared to us that, because of its abundance, the flesh of this bivalve could also be used as a supplementary item of food for culturing of fresh water fish and shell fish.

L. Lamellatus is rather thin shelled. The shell is irregular, egg shaped and ventricose, anteriorly narrow and rounded while posteriorly the margin is nearly straight. The shell surface is smooth. The umbo is weak and covered with wrinkles. The shell is of a brownish colour with yellow stripes and with several growth rings.

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Already, some data on the morphometry, although worked out only for a few specimens, are available for two fresh water molluscs of Sri Lanka, namely, *L. lamellatus* and *Parreysia corrugata* Hadl (1974). The biochemical characterisation of *Parreysia corrugata* has been worked out in India by Nagabushanam and Lomte (1971). However, there appears to be no information whatsoever on the bio-chemical characterities of the common fresh water bivalve *L. lamellatus* which is very common in Sri Lanka, Work carried out so far on fresh water mussels (Willber and Young, 1966; Giese, 1969; Nagabushanam, and Lomte, 1971) indicate that like the marine bivalves, the bio-chemical components vary seasonally with the gonadal development.

Materials and Methods

Very large numbers of *L. lamellatus* of all sizes were collected at random from Bathalagoda tank in the Kurunegala District and were brought alive to the laboratory in fresh water. Their total body weight, (flesh + shell), total muscle weight (flesh), weight of the posterior adductor muscle, weight of the foot, length, breadth, height and the volume of the shell cavity were measured in the laboratory. The volume of the shell cavity was measured by the displacement method (Galtsoff, 1964). Subsequently the animals were opened up and their posterior adductor muscles and feet were carefully dissected out and the fresh (wet) weights of these were obtained. These were then transferred to an oven maintained at 80°C. After about two days (when the weights showed a constant value) the muscles and the feet were ground separately and were kept in a dessicator until these were analysed.

The protein content was determined using Biuret reagent (Rayment, 1964) and the total carbohydrate content was obtained using the colorimetric method according to Dubois (1956). The total lipids were extracted using chloroform-methaol mixture and the lipid content was determined gravimetrically (Floch et al, 1957). The ash content was obtained by placing a weighed quantity of meat powder in a Muffle furnace for two days at 600°C (Giese, 1967). The water content was obtained by determining the difference in weight between the wet muscle and the dried muscle.

L. lamellatus specimens were grouped into six classes on length-basis and five classes on wet weight-basis for this study.

Results

The size frequency of the population of *L. lamellatus* was obtained as length frequency and as body weight frequency and the distribution pattern is shown graphically in Fig. 1 and Fig. 2, respectively. They show that the largest number of individuals were between 40–50 mm. in length and between 60–80 gm. in weight (Table 1).

The body component indices (as % wet weight) are given in Fig. 3. Relatively, the largest body component is the shell. The foot has the smallest index.

The relationship between the length and the body weight is curvilinear (Fig. 4). Relationships of total muscle weight with the weight of the adductor and with the weight of the foot are shown in Fig. 5 together with their regression equations. Regression equations, correlation coefficients, slopes and the significance of relationships of length with total muscle weight and with the volume are shown in Table 2. The relationships of the volume with body weight and total muscle weight are shown in Table 3.

TABLE 1

SIZE DISTRIBUTION OF L. *LAMELLATUS*. (n= 138)

	Length group (mm.)	Number of individuals	Total body weight (gm.)
(1)	10–19	4	20
(2)	20–29	20	20–39
(3)	30–39	34	40–59
(4)	40–49	58	60–79
(5)	50–59	20	80–99
(6)	60–70	2	100–120

TABLE 2

REGRESSION EQUATIONS, CORRELATION COEFFICIENTS, SLOPES AND THE SIGNIFICANCE OF RELATIONSHIP OF LENGTH WITH VOLUME AND MUSCLE WEIGHT

Relationship	Correlation coefficient	slope	Regression equation	Significance
1. Length and total muscle weight	0.445	1.658	y=1.65x—6.14	NS
2. Length and volume	0.761	7.705	y=7.71x—8.72	S

TABLE 3

REGRESSION EQUATIONS, CORRELATION COEFFICIENTS, SLOPES AND THE SIGNIFICANCE OF RELATIONSHIPS OF VOLUME WITH BODY WEIGHT AND TOTAL MUSCLE WEIGHT

Relationship	Correlation coefficient	slope	Regression equation	Significance
1. Volume and body weight	0.513	1.978	y=0.51x +8.86	NS
2. Volume and total muscle weight	0.462	0.201	y=0.20 x +8.23	NS

Proximate composition

The bio-chemical composition of the adductor muscle and the muscle of the foot of each size group of L. *lamellatus* is given in Table 4. The mean of the bio-chemical components of each size group and the grand mean as a whole, are also indicated in the table.

The correlation coefficients, slopes, regression equations and the significance of the relationships of the total muscle weight protein, carbohydarte, lipid, ash and water content are given in Figs. 6,7,8,9 and 10 respectively. The relationship of protein in the adductor muscle and in the foot with water is shown in Fig. 11.

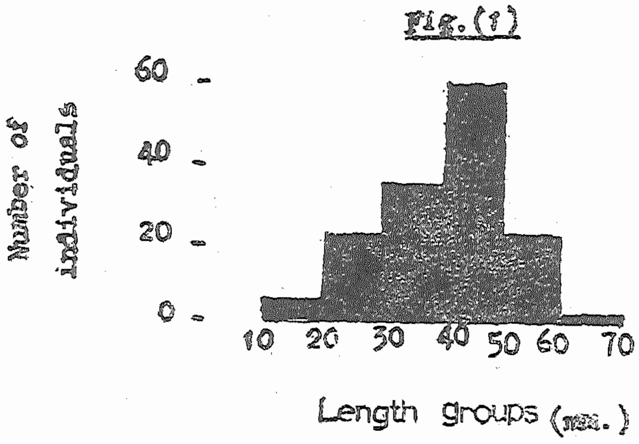

Fig. 1 — Distribution pattern of length groups.

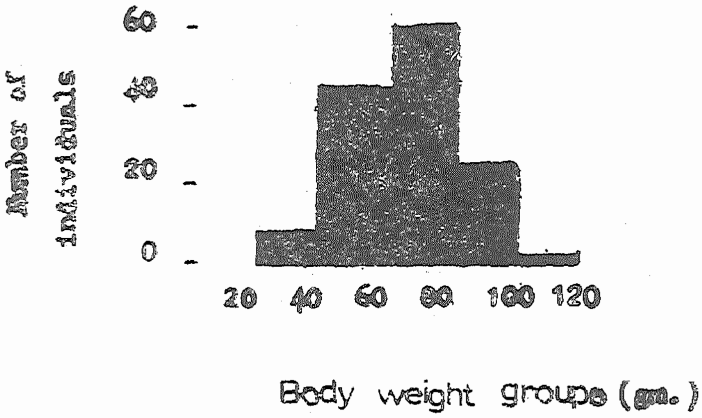

Fig. 2 — Distribution pattern of weight groups.

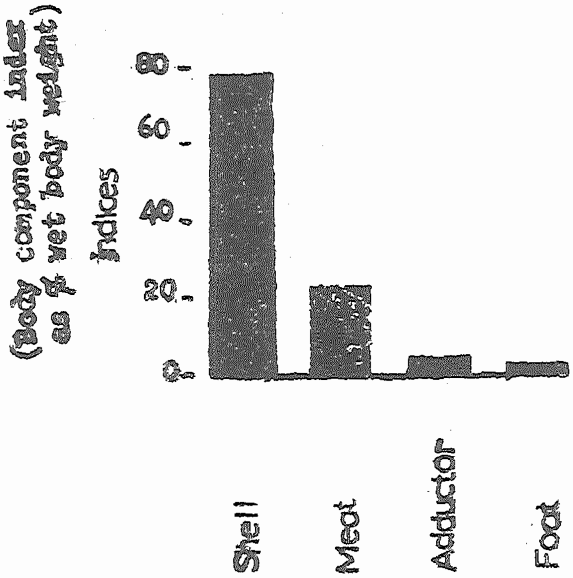

Fig. 3 — The component indices.

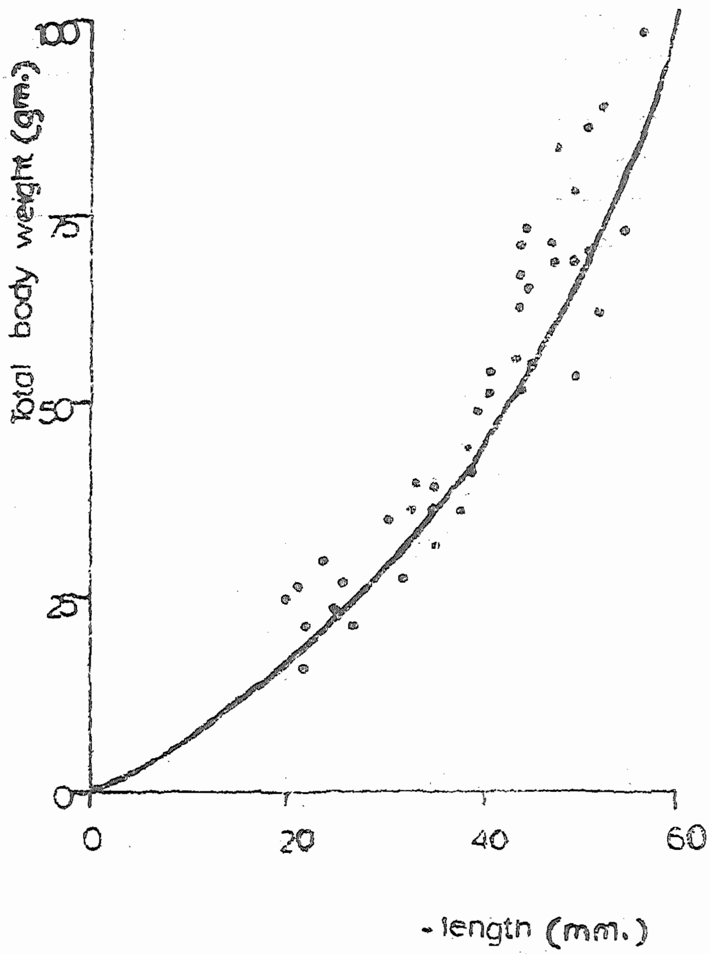

Fig. 4 — Relationship between total body weight and length

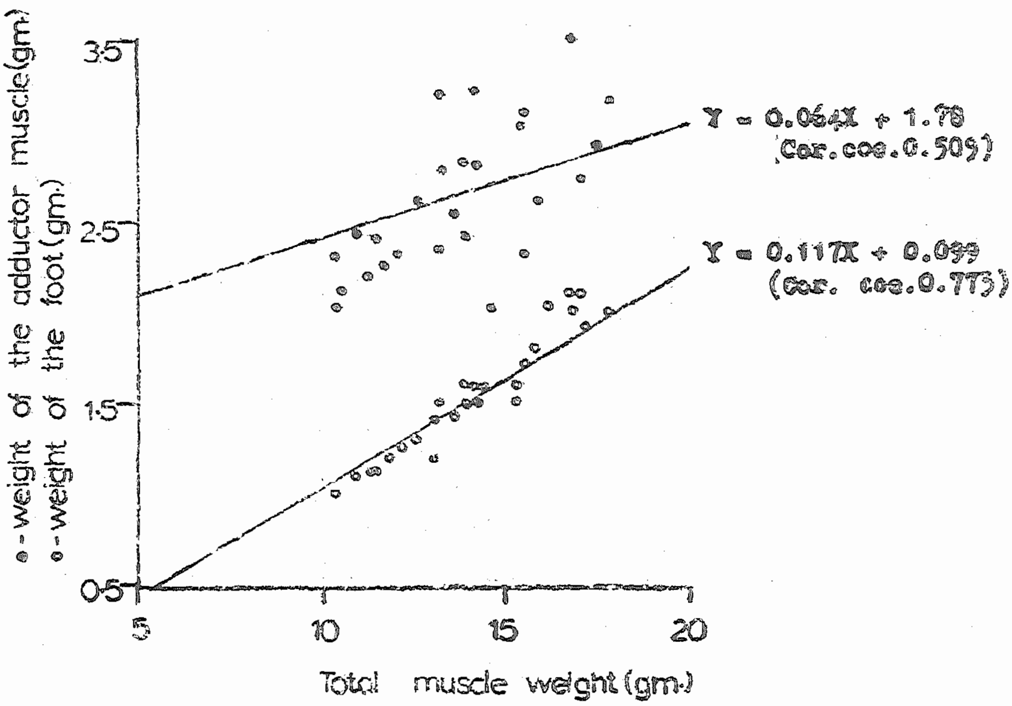

Fig. 5 — Relationships between weight of the adductor muscle and the foot with total muscle weight

TABLE 4

BIO-CHEMICAL COMPOSITION OF THE ADDUCTOR MUSCLE AND THE FOOT

Size group (mm.)	*length (mm.)*	*bio-chemical composition (as% dry weight)*							
		Protein		*Carbohydrate*		*Lipid*		*Ash*	
		adduc.	*foot*	*adduc.*	*foot*	*adduc.*	*foot*	*adduc.*	*foot*
30—40	32	68.31	58.51	16.80	20.60	13.70	20.50	2.11	3.91
	40	66.19	59.21	15.58	19.31	18.59	22.30	3.63	2.32
	40	52.14	55.50	19.39	20.50	24.57	24.30	4.53	2.80
Mean		62.11	56.07	16.79	20.13	18.95	22.36	3.43	3.01
40—49	41	67.85	50.31	17.50	20.31	14.20	23.51	2.65	4.51
	42	63.44	55.41	16.48	22.31	15.00	20.41	5.60	3.51
	42	70.12	50.21	17.45	20.60	16.89	28.10	1.82	2.30
	45	55.72	59.31	20.15	21.50	23.93	21.30	4.84	1.90
	45	59.10	55.40	16.61	21.50	23.37	19.81	1.03	3.81
	45	70.57	50.21	13.65	19.50	19.59	24.51	1.43	4.01
	45	61.29	56.61	16.23	21.21	16.01	18.90	3.26	3.41
	45	66.08	56.40	20.44	20.21	15.01	23.10	1.72	1.32
	46	64.43	55.30	23.80	21.60	13.01	22.11	2.96	5.11
	46	58.58	53.51	19.29	20.20	12.12	22.70	5.35	3.41
	48	56.85	55.40	20.29	20.30	20.52	23.51	3.47	4.80
	48	66.27	58.20	17.99	22.50	13.50	14.60	0.16	5.20
	48	64.56	57.70	23.37	22.30	14.01	20.61	1.55	2.40
	49	71.75	58.40	15.91	20.80	12.00	20.20	2.08	1.81
Mean		64.18	55.16	18.22	22.12	16.36	21.66	2.70	13.39
50—59	50	73.41	58.40	12.64	21.80	16.12	20.70	1.59	1.81
	50	53.49	48.80	23.01	20.41	18.00	22.20	2.71	1.72
	52	68.89	60.71	15.64	20.70	17.09	21.20	0.43	3.00
	52	71.46	52.80	16.35	19.21	13.79	25.40	4.49	4.81
	53	69.58	59.20	16.88	21.31	15.79	20.81	0.63	5.30
	53	61.29	55.80	14.84	20.40	18.60	20.10	3.20	2.31
	56	61.07	53.20	18.89	22.40	15.01	15.20	1.81	4.30
	56	62.50	60.11	20.48	21.51	14.96	15.41	4.76	1.82
Mean		65.21	56.12	17.34	20.96	16.18	22.62	2.45	3.13
Grand mean		63.83	55.78	17.52	20.77	17.16	22.22	2.86	3.17

Fig. 6

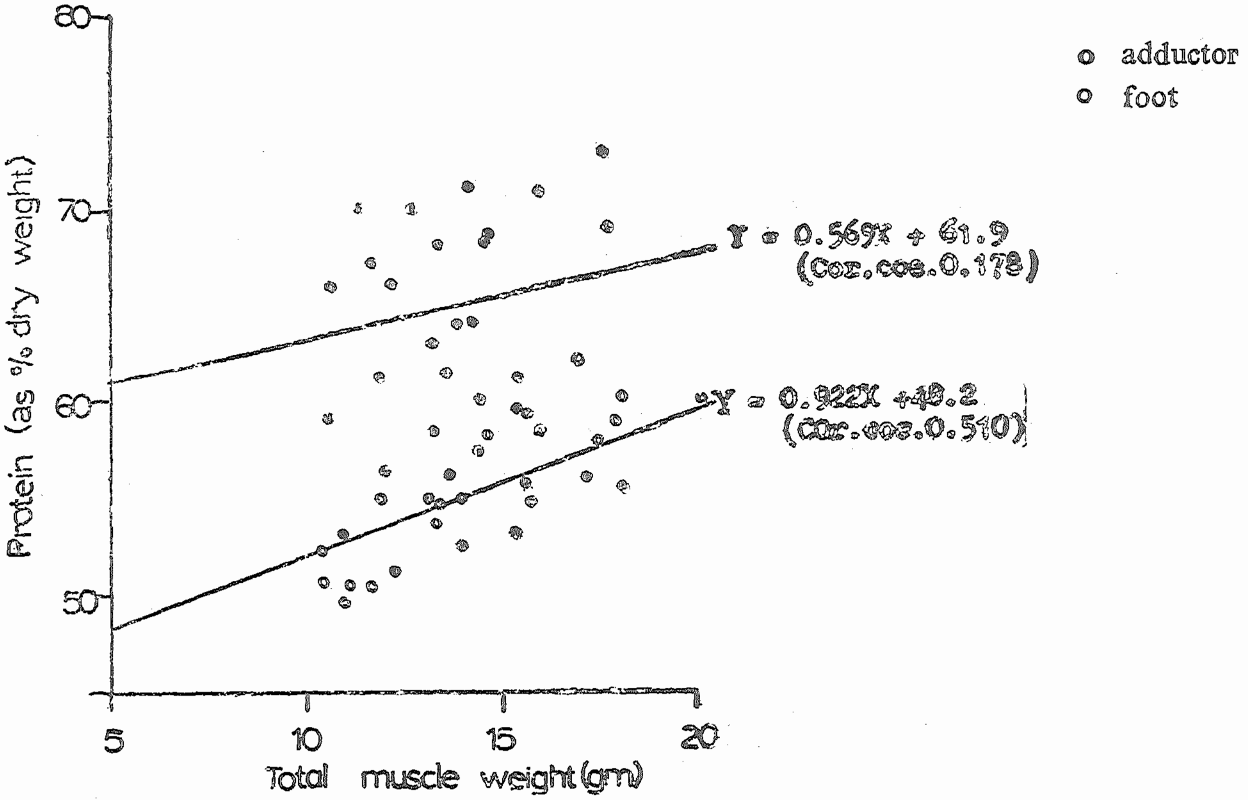

Fig. 7

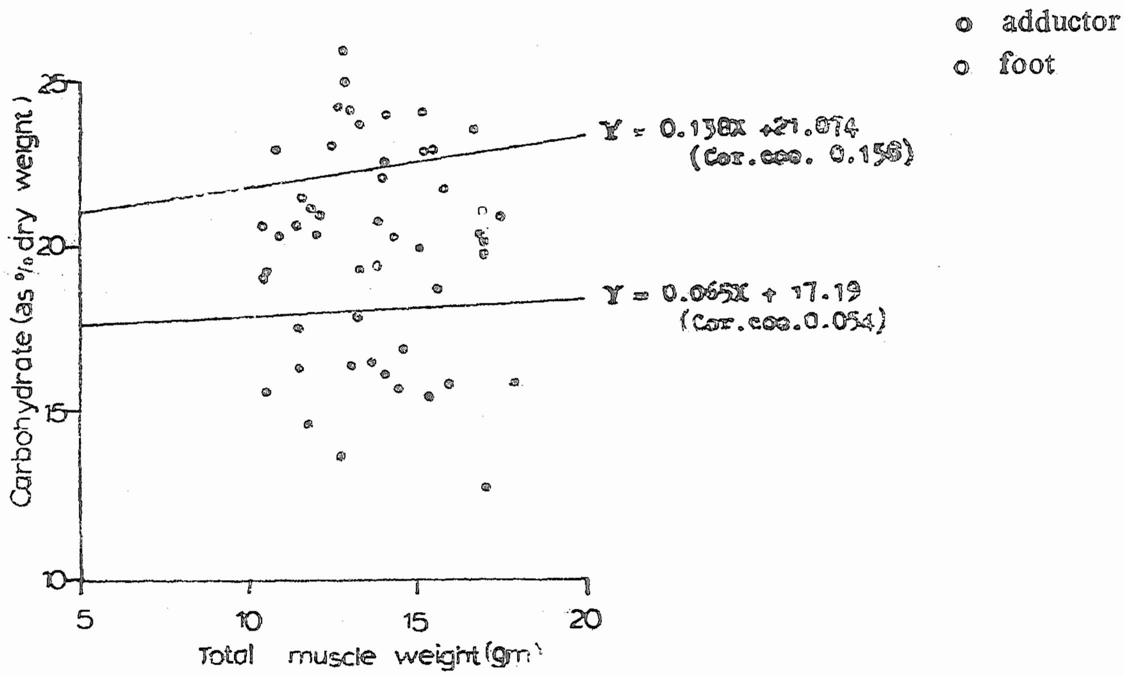

Fig. 6 - Relationship between total muscle weight and protein content.
Fig. 7 - Relationship between total muscle weight and carbohydrate content.

Fig. 8

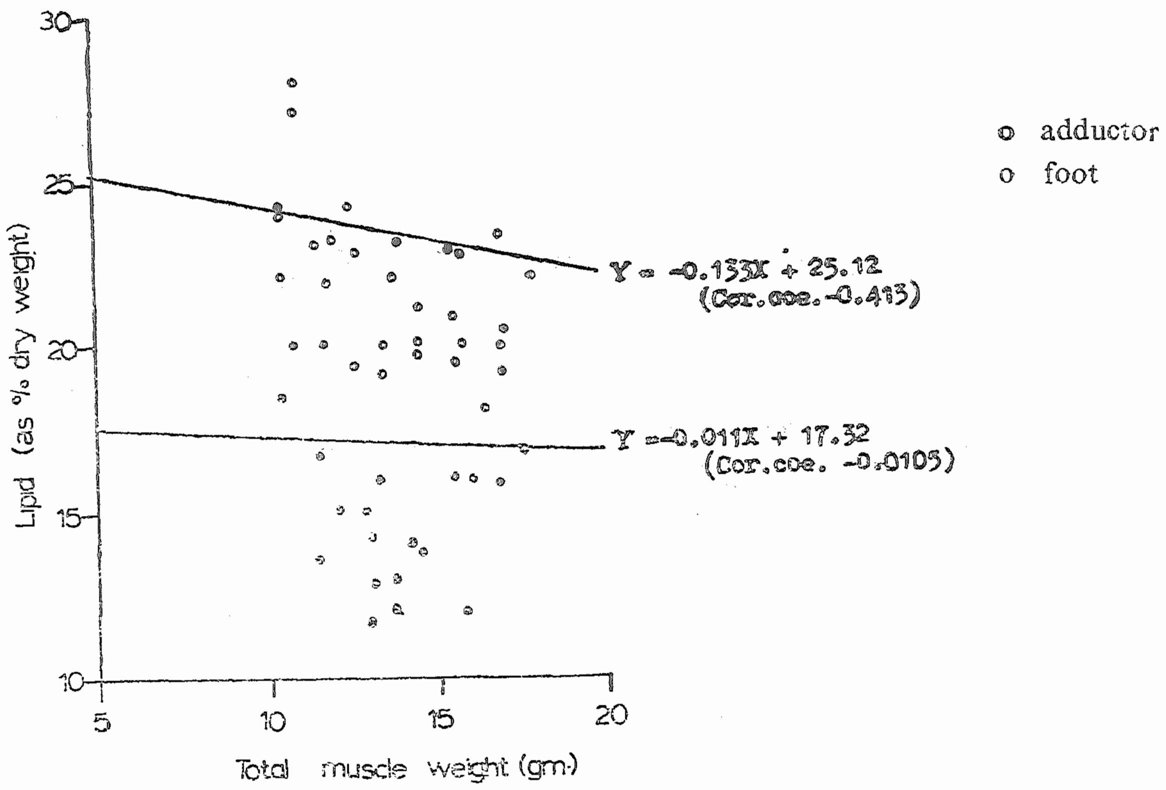

Fig. 9

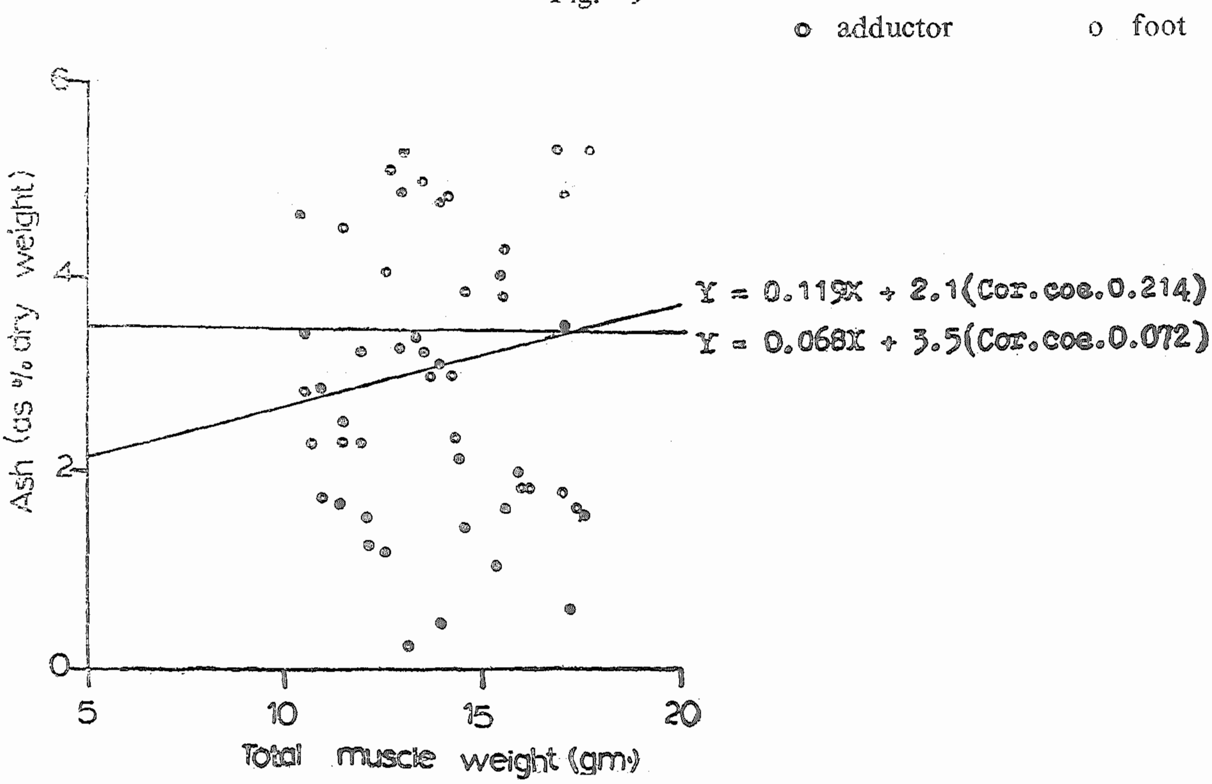

Fig. 8 - Relationship between total muscle weight and lipid content.
Fig. 9 - Relationship between total muscle weight and ash content

Fig. 10

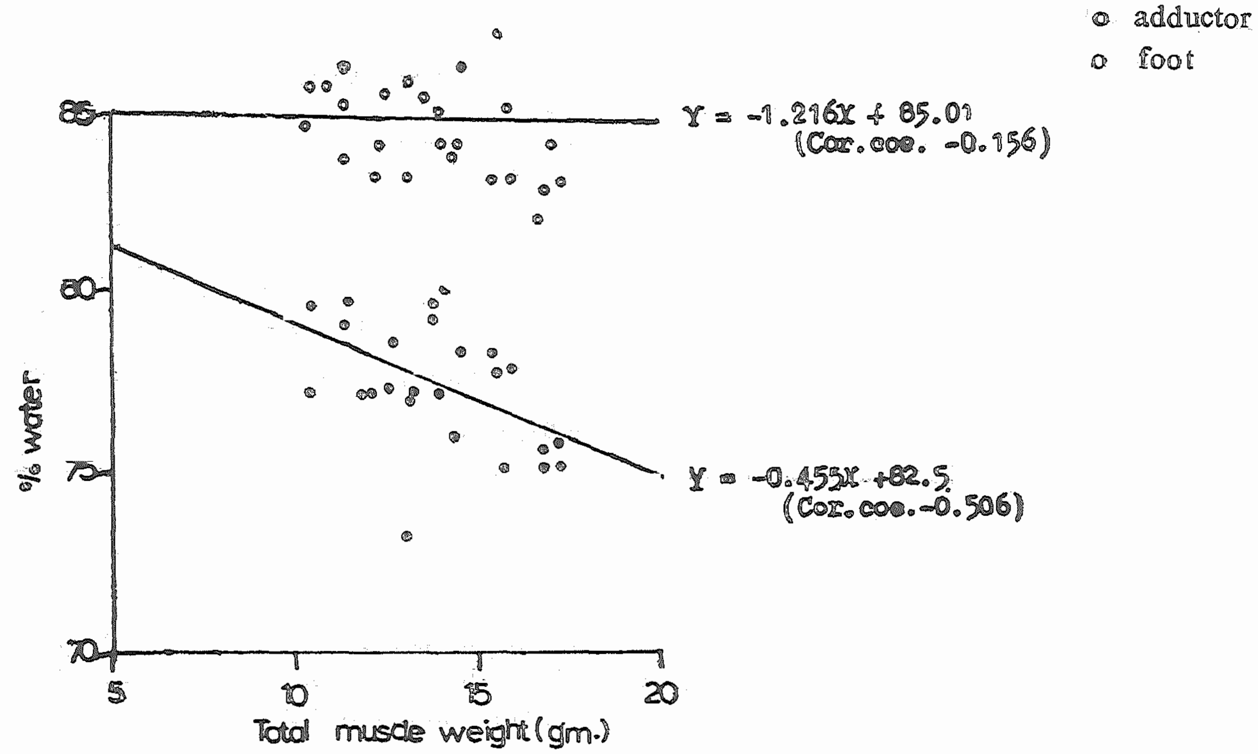

Fig. 11

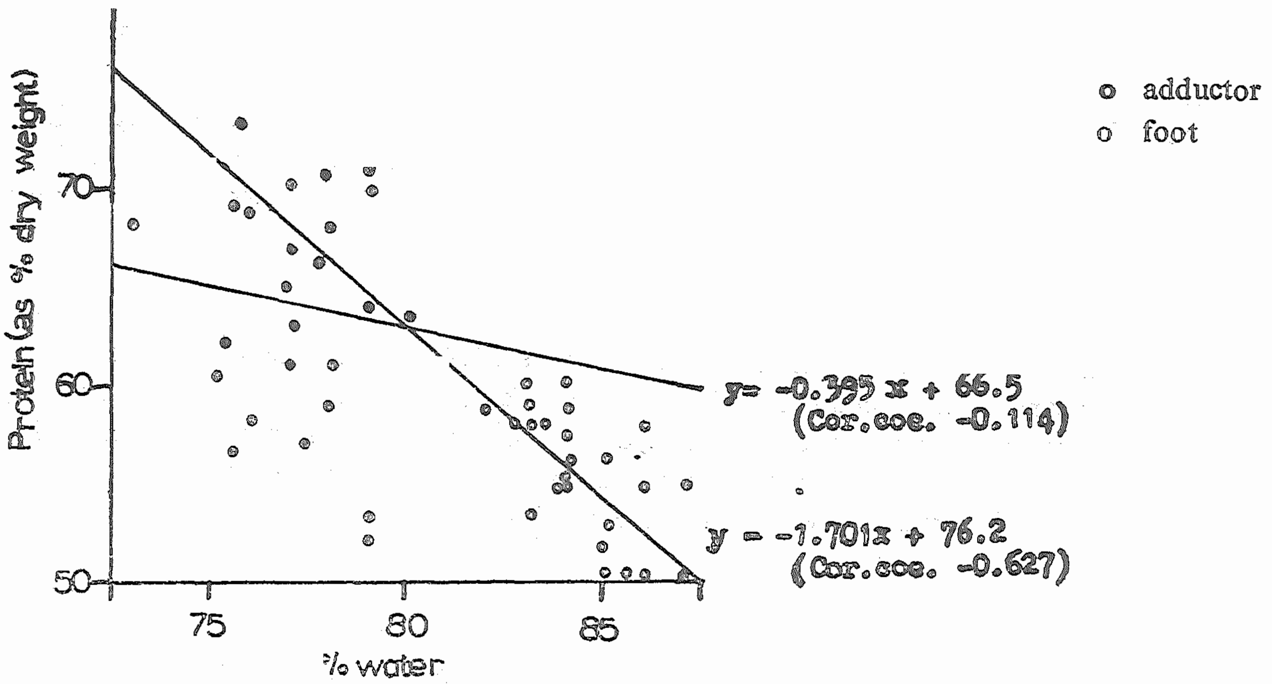

Fig. 10 - Relationship between total muscle weight and water content.
Fig. 11 - Relationship between water content and protein content.

TABLE 5

THE % RANGE OF BIO-CHEMICAL COMPONENTS IN THE ADDUCTOR AND IN THE FOOT OF *L. LAMELLATUS*

Bio-chemical component	*adductor*		*foot*	
	as % dry weight	*as % wet weight*	*as % dry weight*	*as % wet weight*
1. Protein	53.49%–73.41%	12.30%–16.88%	48.80%–60.70%	8.78%–10.92%
2. Carbohydrate	12.64%–23.80%	2.90%–5.47%	19.20%–22.50%	3.46%–4.05%
3. Lipid	12.00%–24.51%	2.76%–5.63%	14.60%–28.10%	2.63%–5.06%
4. Ash	0.16%–5.60%	0.03%–1.29%	1.30%– 5.30%	0.23%– 0.95%

Relationships of total muscle weight with the protein content in the adductor and in the foot shows a non significant positive relationship. This slight increase in the protein content with the weight may be due to the substitution of intestitia water by amino acids and proteins in the muscle tissues.

There appears to be no significant difference between the two means of carbohydrate contents in the foot and in the adductor. Total carbohydrate content also shows no significant increase with increasing total muscle weight ($\text{cor. coe.}_{ad.} = 0.158$, $\text{cor. coe.}_{ft.} = 0.054$). When compared with fishes, the carbohydrate content in the adductor and in the foot of *L. lamellatus* appear to the much higher than that in the flesh of some fishes. The reason for such a high content of carbohydrate in these tissues is probably due to the fact that *L. lamellatus* is a filter feeder. Giese (1969) indicated that the carbohydrate content in the muscles of carnivorous molluscs is much lower than that of in herbivorous molluscs.

As percentage dry weight, the grand mean of the total lipid content in the adductor shows a lesser value than that of the foot. However there is no statistically significant difference between the two grand means of lipid content in both tissues (Table 6). Although analysis shows that the adductor stores more protein and carbohydrate while the foot stores more lipid, it is probable that these values may vary during spawning times. There is also no significant relationship of the total muscle weight with the total lipid content in the adductor and in the foot.

Ash forms the least quantity among other components in the adductor and in the foot. There is no significant difference between the two means of ash contents in both tissues. When compared with marine molluscs (Giese, 1969), the adductor and the foot of *L. lamellatus* have less amounts of ash.

Discussion

Size frequency diagrams show that the largest number of individuals of *L. lamellatus* in the population collected from Bathalagoda reservoir is between 40–50 mm. Hadl (1974) however indicated that the largest number of individuals in his collection was in the 30–40 mm group. The smallest animals that were collected measured around 10 mm. The majority of individuals in this collection weighed between 60–80 gm. while a small number of individuals weighed around 120 gm. The smallest size group in the population was between 20–40 gm.

The shell forms the largest component of the body. The meat (total muscle) forms about 21% of the body weight. However this proportion could change with the type of food and with the state of gonadal development as was shown by Giese (1969).

The relationship between length and body weight is significant at 5% level of significance, with a correlation coefficient of 0.753. The correlation coefficient of the relationship between length and body weight is somewhat lower than that of the relationship betweeen log-length add log-body weight. Therefore the curvilinear relationship is a better fit for the relationship between body weight and length. Though there is a positive relationship between length and muscle weight, it is not statistically significant.

The relationship between length and volume shows a significant relationship with a correlation coefficient of 0.7608. The reason for this may probably be due to the increase in the volume of the cavity of the shell with the increase in length.

Relationships of the volume with body weight and total muscle weight also show no significance though both these show a positive regression line (Table 3). The total muscle weight actually shows no significant increase with the size of the body perhaps because the weight of the muscle changes with other parameters such as with gonadal development (Giese, 1969).

Fig. 5 shows that the weight of the foot increases significantly with total muscle weight with a correlation coefficient of 0.7737 while the weight of the adductor shows no such significant increase.

It is generally known that the molluscan flesh is made up of amino acids, either free or combined to form macromolecules among which the proteins predominate (Wilber and Young, 1966). The main bio-chemical component of the flesh in both adductor and foot of *L. lamellatus* is protein (Table 5). Although the protein content in the adductor is much higher than that of the foot, there is no significant difference between the two means of the protein content in each tissue (Table 6). Protein content in these tissues shows a wider range than the other bio-chemical components.

TABLE 6

DIFFERENCES BETWEEN THE MEANS OF BIO-CHEMICAL COMPONENTS IN THE ADDUCTOR AND IN THE FOOT OF *L. LAMELLATUS*

Bio-chemical component		*Grand mean (as% dry weight)*		*Variance of the mean*		*Significance of the difference between the two means*
		adductor	*foot*	*adductor*	*foot*	
1. Protein	..	63.83%	55.78%	1.07	0.21	NS
2. Carbohydrate	..	17.52%	20.77%	0.51	0.99	NS
3. Lipid	..	17.16%	22.22%	1.67	0.22	NS
4. Ash	..	2.80%	3.17%	0.13	0.03	NS

Percentage water content in both the fresh (wet) adductor and foot is rather high. The amount of water in the foot may vary from 82.5% to 87.4% while in the adductor the water content may vary from 75.8% to 80.8%. although the percentage water content in the foot is somewhat higher than that of the adductor, statistically there is no significant difference between the two means of water content in both tissues. It is also seen that although the water content in the adductor is lower than that of in the foot, the adductor contains more protein in contrast to the foot.

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