

Seasonal changes in biochemical composition of *Holothuria leucospilota* (Echinodermata)

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Biochemical composition of body wall and gonads of *H. leucospilota* was analysed for protein, carbohydrate, lipid, ash, dry weight and calorific values and was discussed in relation to its spawning activities. Lipids constituted the major storage part (2.5 to 30.55%) followed by proteins (1.08 to 3.74%) and carbohydrates (0.00006 to 0.00041%) in the body wall, but in gonads, the lipids, proteins and carbohydrates were 1.8 to 6.1%, 1.06 to 2.6% and 0.00001 to 0.00009% respectively.

In the Indo-Pacific region, dried sea cucumbers form a major trade commodity and are considered to be highly nutritious. The most favoured species are *Thelephora ananas*, *Holothuria nobilis*, *H. scabra*, *H. argus*, *H. edulis*, *Actinopyga mauritiana*, *A. echinitis*, *Stichopus variegatus* and *S. japonicus*. In spite of their commercial and pharmacological importance information on the nutritive status is scanty¹. Studies on the biochemical composition of gonads in relation to reproductive cycle have been made in molluscs and Echinoderms²⁻⁵. In the present study *Holothuria leucospilota* (Brandt) was chosen for evaluating the seasonal variations in its biochemical constituents in relation to its spawning activities. Body wall and gonads have been analysed for their biochemical constituents because the body wall is considered to be the most significant organ for storing the nutrient reserves⁵.

H. leucospilota specimens (20-25) were collected from Anjuna beach, (lat. 15°34'45"N, long. 73°44'20"E) Goa at monthly intervals during August 1985 to October 1986. Five holothurians of 29.25 cm average length were used in the analysis. The specimens were washed thoroughly with fresh water to remove sand and salt, and dissected to separate body wall and gonads. The two organs were dried in the oven at 40°C, weighed and homogenized in an electric grinder. Water content was determined by weighing wet mince tissue and again after drying in a desiccator to constant weight. Lipids⁶, carbohydrates⁷, proteins⁸, ash⁹ and organic carbon¹⁰ were determined. Caloric values were obtained using a Bomb calorimeter (Model 1241, ADIABATIC, Oxygen Bomb calorimeter, Parr).

In the body wall of *H. leucospilota* proteins and

lipids represented the major constituents followed by the carbohydrates (Tables 1,2). The body wall of *H. leucospilota*, dry weight was maximum from January to March. This could be attributed to an increase in the availability of food during December to May¹¹. The dry weight of gonads decreased during August, November, June '85 and August '86. The decrease in the gonad dry weight in this species could be due to spawning and food scarcity as was also reported for *Luidia clathrata* an asteroid^{12,13}. It was also reported that the diet has a major influence on biochemical composition of *Sclerasterias mollis*¹⁴.

The trends of variation in the ash content of body wall and gonads were more or less similar during the study period. Organic carbon are low for this species which could be due to low levels of metabolism in holothurians^{1,15}.

Low values of carbohydrates obtained in the present study are consistent with the observation made earlier^{16,17}. The low carbohydrate values could be due to the fact that glycogen, the usual storage carbohydrate in many marine animals, does not contribute much to the reserves in the body of the holothurians^{18,19}. Fall in the protein values recorded during October 1985 and May-Aug. 1986 in *H. leucospilota* could be related to the post spawning period. The lipid content was quite high in the body wall. It appears that for this species lipids could be an important storage material than proteins and carbohydrates in the body wall and gonads. It also has been reported that the chemical composition may be affected by the difference in availability of nutrients at different times during the year^{14,20}. High levels of lipids in body wall and low levels of lipids in gonads were recorded during August, October and

Table 1—Levels of proteins, carbohydrates, lipids, ash, calorific value, organic carbon in the body wall of *Holothuria leucospilota*

Period	Water content (%)	Dry weight (g)	Ash (%)	Org. carbon (%)	Carbo-hydrate (%)	Protein (%)	Lipids (%)	Calorific value (cal.g ⁻¹ dry wt)
Aug. 1985	71.71	26.2882	15.70	2.40	0.00021	2.380	7.81	1016.48
Sept.	68.49	54.2320	12.50	4.32	0.00026	3.140	11.55	329.85
Oct.	70.22	44.9360	10.45	3.63	0.00009	2.740	12.96	536.56
Nov.	52.80	53.1700	10.00	3.03	0.00021	3.620	30.55	478.29
Dec.	61.69	49.7300	14.25	6.03	0.00009	2.620	15.41	479.49
Jan. 1986	69.29	65.6025	8.25	4.83	0.00015	2.780	14.85	374.07
Feb.	58.89	66.5225	18.35	2.82	0.00008	3.080	16.86	434.70
March	66.48	71.4000	10.45	4.98	0.00032	3.740	14.35	354.22
April	66.91	54.5330	13.30	4.92	0.00041	2.960	11.91	817.78
May	68.59	52.1400	16.97	3.69	0.00032	2.200	8.55	473.38
June	76.91	42.2300	18.15	1.35	0.00031	1.080	2.51	541.03
July	71.10	50.0000	10.50	5.61	0.00019	1.842	10.95	143.10
Aug.	72.90	70.0000	14.90	2.10	0.00019	2.600	7.50	986.42
Sept.	69.89	44.6000	13.90	3.94	0.00026	3.620	8.65	291.50
Oct.	70.30	42.52000	11.00	3.60	0.00006	2.600	12.50	512.68

Table 2—Levels of proteins, carbohydrate, lipids, ash, organic carbon in the gonads of *Holothuria leucospilota*

Period	Protein (%)	Carbo-hydrate (%)	Lipid (%)	Ash (%)	Org. carbon (%)	Dry weight (g)
Aug. 1985	1.2	0.00006	2.5	1.4	0.61	0.90
Sept.	1.6	0.00002	4.2	1.7	0.89	1.08
Oct.	1.0	0.00001	2.6	1.0	0.51	1.21
Nov.	2.0	0.00004	3.9	1.5	1.20	1.05
Dec.	1.1	0.00003	4.1	2.2	0.90	1.90
Jan. 1986	1.8	0.00004	2.9	1.6	1.50	1.80
Feb.	1.6	0.00002	4.8	2.6	1.10	2.80
March	1.6	0.00006	4.6	1.9	1.90	0.89
April	1.4	0.00009	6.1	1.4	1.82	0.64
May	1.0	0.00005	9.2	1.8	1.21	1.14
June	0.9	0.00002	2.1	2.4	0.70	1.80
July	0.9	0.00001	1.9	2.2	0.68	2.68
Aug.	1.0	0.00008	1.8	2.0	1.20	1.20
Sept.	2.6	0.00008	1.8	1.2	0.42	2.24
Oct.	1.5	0.00004	2.6	1.5	0.48	1.98

November 1985, January, August and September 1986 respectively due to the spawning activities. Similar results were also reported on *Strongylocentrotus franciscanus* and *Pisaster ochraceus*²¹⁻²³. The present results compare well with some of the earlier reports that the biochemical components change with the gonadal development².

The lipid levels¹⁷ obtained for *Actinopyga mauritiana* (1.5%), *Synaptula hydriformis* (6.2%) and for *Pentacta pigmea* (1.5%) are low compared to

that of *Parastichopus californicus* (7.5%) and *Stichopus japonicus* (9.3%). It was postulated that the lack of heavy calcification in the body wall of the holothurians resulted in higher levels of organic compounds than present in the body walls of other echinoderms¹⁷. The differences found in *H. leucospilota* could also be due to the negligible calcification. The body wall in holothurians may contribute to nutrition by taking in dissolved organic nutrients directly from the environment^{24,25}. It is noteworthy that the linear relationship between lipids and proteins ($r = .6$) indicated that the variation in proteins and lipids were similar during the study periods. The present study suggests that lipids are the main reserves of energy in body wall as well as in gonads of this species.

In *H. leucospilota*, caloric values in the body wall fluctuate seasonally with high caloric content corresponding to high values in gonad index²⁶. High caloric values were recorded during August 1985 and during April and August 1986. Similar trend was also noticed in the biochemical variations of the gonads and body wall. The decrease in the lipid content of gonad observed during October, November 1985 and in June, July 1986 and also in proteins during October 1985, June and July 1986 could be due to the spawning activities of holothurian. The activity to restore reserves of proteins, carbohydrates, lipids and calories may reflect a generally higher level of activity and metabolic rate¹³.

Also there was no significant correlation between the length of the holothurian and the biochemical

composition of the body wall in *H. leucospilota*. This agrees with some earlier results based on the observations on *Benthogone rosea*, *Paelopatides gigantea* and *Psychropotes longicauda*¹⁵. He also suggested that the thickness in the body wall varies greatly among holothurians. *Benthogone rosea* was the smallest in length, but the dry weight was close to that of *Paelopatides gigantea* due to its thicker body wall. *Psychropotes longicauda* also had a thick body wall, although no greater in length its weight was 3 times higher than that of *Paelopatides gigantea*. Presently, *H. leucospilota* has a thick body wall and with an average length of 29.25 cm. It is well reflected in the dry weight of this species.

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