collected and acclimated for a week in the laboratory in glass troughs filled with moist soil. For each group of 10 unanaesthetized worms, insulin (conc. 40 I.U./ml), acetylcholine, adrenaline, allaxon and 5-hydroxytryptamine were injected separately using an aqueous vehicle. Each worm of the particular test group thus received an injection of 0.1 ml of either 4 I.U. insulin or 0.00001 % (w/v) acetylcholine and adrenaline or 0.05 % (w/v) of allaxon or 0.00001 % (w/v) of 5-HT into the preclitellar region. The animals were fixed in aqueous Bouin's *in toto* 90 min after the injections. Mallory's triple stain was used in histological studies.

The results of the histological observations are given in table 1, which shows that insulin injection presumably induced an increase in the rate of axonal transport and decline in the release of NSM of B cells of subpharyngeal ganglion. As a result, neurosecretory granules are found aggregated in the axonal endings. Again there is no change in the nuclear dimensions of B cells which indicates no enhancement in the rate of synthesis as compared to the normal.

Allaxon is a drug that selectively destroys pancreatic B cells, which are the source of insulin in fishes[2] and higher vertebrates[3]. The atrophy of B cells of subpharyngeal ganglion following the administration of allaxon suggests that these cells are the source of insulin like hypoglycemic endocrine principals.

Amines like dopamine, nor-adrenaline and 5-hydroxytryptamine play a role in neurosecretion in polychaetes and oligochaetes[4]. In Octochaetoides, injected acetylcholine probably interferes with the axonal transport of NSM thereby ensuring the recorded pile-up of neurosecretory granules in the perikarya and anterior half and distal tips of the axons of A cells of lateral group from the brain.

After the administration of adrenaline there was a drastic reduction in neurosecretion from perikarya and axons of A cells of lateral cell group from subpharyngeal ganglion, which may mean adrenaline accelerates synthesis, transport and release of neurosecretory granules in these NSC. Increased nuclear dimensions of nuclei of A cells, present an additional evidence for this assumption. Interestingly enough, 5-HT exerts similar influence on the B cells of subpharyngeal ganglion. The action of 5-HT on A cells (both from brain and subpharyngeal ganglion) probably shuts off or slows down the axonal transport and release but not the synthesis of NSM as their nuclear dimensions were enhanced and NSM was restricted within perikarya.

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PRELIMINARY OBSERVATIONS ON THE USE OF WATER HYACINTH (*EICHHORNIA CRASSIPES*) LEAF MEAL AS PROTEIN SOURCE IN FISH FEED

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EFFORTS have been made by several workers in the past to utilize proteins of plant origin, in various forms, in fish feeds[1-5]. A review of the literature indicates that, although the nutritive value of water hyacinth (*Eichhornia crassipes*) and its use as an ingredient for farm animals has been extensively investigated, the utilization of this weed as fish feed ingredient is much less explored[6].

The present communication reports results of some preliminary observations on the use of water hyacinth leaf meal as a protein source in formulated fish feed. Such a study incorporating low-cost plant protein source in fish feed is significant in view of the rapidly increasing cost of animal protein components.

For the preparation of the leaf meal, fresh water hyacinth, obtained from a sewage-fed pond, was washed, the leaves air-dried and powdered. The leaf meal was assessed for its proximate composition using standard techniques[7]. The meal in dried form at 8 % moisture level contained 25% crude protein and 14693 J/g gross energy.

Soft pellets, containing water hyacinth leaf meal (50 %), low-quality minced meat (37 %) and commercial fish oil (3 %), were prepared by extrusion using a 3 mm die. Carboxymethyl cellulose was used as a binder. The efficacy of the formulated feed was tested through a short-term feeding trial on a siluroid, *Heteropneustes fossilis*. No supplementation with minerals or vitamins was made in the feed. The fish (average weight 10.5 g and average total length 88 mm) were acclimatized to

Table 1 *Growth, feed intake and conversion efficiency of fish fed formulated feed*

	Feed	
	Control	Experimental
Percentage increase in live weight	7.51 ±1.08	19.93 ±1.25
Gain in live weight/day/fish (g)	0.06 ±0.01	0.14 ±0.01
Food consumed/day/fish (g)	0.35 ±0.04	0.31 ±0.04
Food conversion factor	5.82 ±0.23	2.23 ±0.16
Gross growth efficiency	0.17 ±0.00	0.45 ±0.03

± Standard deviation of mean.

laboratory conditions. They were fed *ad libitum* at 17:00 hr. A control group was like-wise fed soft pellets in which the water hyacinth portion was replaced with minced meat. The treatments were carried out in three replicate groups of 10 fish each in 40 l glass aquaria. Fecal material and unused food were siphoned off from the aquaria every day while proper cleaning of the aquaria was carried out at the time of weekly measurement. Average water temperature during the period of the feeding trial was 24 ± 1°C.

The biological evaluation of the above feed over a 2-week experimental period indicated that the formulated feeds were readily acceptable to the fish with no apparent mortality or other problems. It can be seen from table 1 that, although the difference in the average feed intake per fish per day was negligible in the two fish groups, the fish fed with water hyacinth diet registered around 20% gain in live weight in contrast to the group fed the control diet where this gain was only about 8%. The food conversion ratios for the water hyacinth feed and the control feed over the experimental period were 2.2:1 and 5.8:1, corresponding to gross growth efficiency of 0.45 and 0.17 respectively.

It has earlier been emphasized that herbivorous fish, like the grass carp (*Ctenopharyngodon idella*), could feed directly on water hyacinth[8]. Edwards[9] has discussed various ways by which water hyacinth may be converted into detritus and utilized by certain fish. However, only a few workers have reported the use of water hyacinth as feed and/or ingredient for carnivorous or omnivorous fish. It has been pointed out that dry concentrate prepared from water hyacinth juice can supplement vitamin deficient diets for fingerlings of the channel catfish (*Ictalurus punctatus*) and that it is superior to commercial alfalfa meal[10]. Recently, Hirawant[11] has reported pen culture of carp and tilapia using water hyacinth and rice bran mixture, along with commercial pelleted feed, as supplementary feed. The author has quoted a food conversion value of 1.9 with the above feed combination.

The present study thus revealed that water hyacinth in leaf meal form, could be a possible source of cheap plant protein, and, with appropriate effort and proper processing, could be utilized in developing less expensive feeds for fish. Detailed studies on these lines are in progress.

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HAEMOGLOBIN LEVEL OF THE FISH *HETEROPNEUSTES FOSSILIS* DUE TO TRYPANOSOMA INFECTION

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MANY species of Trypanosomes from fish have been described all over the world, particularly in India where a number of new species were encountered[1-8]. Tandon *et al* initiated work on the physiology of fish blood infected with Trypanosomes and observed the changes in the haemoglobin level. The present study adds further knowledge to the haemoglobin level of the fish infected with *Trypanosoma danilewski* var *saccobronchi*.

T. danilewski var *saccobronchi* was observed in 75% of the fish *Heteropneustes fossilis* collected at Warangal region. The infected fish ranged from 14.3–69.6 g in weight and in length from 12.8–21.7 cm. Normal fish ranged from 16–70 g in weight and 15 cm–22 cm in length. The infection was heavy in all the fishes. The blood was drawn and the haemoglobin content was estimated in normal as well as in the infected fish by Sahli's method. The results were statistically analysed by the students t test. The haemoglobin levels of the infected fish were 9.35 $\pm$0.46 g/100 cc while those of the normal were 12.91 $\pm$0.72 g/100 cc. Decrease in the haemoglobin level was observed in the infected fish compared to the normal fish. In the earlier reports the decrease in *clarius batrachus by Trypanosoma maguri* was 20% and in *Mystus vittatus by Trapanosoma vittati* was 60%[5]. In the present study the percentage of decrease is 30%. Decreased level of haemoglobin is an important factor for the anemia in fish leading to their death. Woo[9] stated that due to the haemoflagellate infection in the blood, the antibody-antigen forms a coating on the RBC and the compliment is induced for the lysis of the RBC. Ultimately the number of RBC's will be reduced and the haemoglobin level decreases. Another important factor now noticed is the host and species specificity. The decrease in the haemoglobin varied from host to host and also due to different species of Trypanosomes, though the infection was heavy in all the hosts. This indicates that the host and species specificity is involved in utilizing the haemoglobin.

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PRELIMINARY OBSERVATIONS ON THE CARDIOPHYSIOLOGY OF *MOINODAPHNIA MACLAYI* (KING).

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THE crustacean heart has been a subject of several investigations[1-3]. However, the main focus has been more on the heart of decapoda and still more so as of the family potamonidae. This situation is understandable since they are larger animals, more often in shallow waters and easy to collect for examination. However there is still a wide gap in the knowledge of comparative properties of freshwater estuarine and marine potamonids[3]. Moreover, although ubiquitous cladocerans have been observed repeatedly under microscope, very scanty information is available on the cardiophysiology of these micro-organisms[4]. The present note hopes to fill in this lacuna by recording the exact cardiac rhythms in these micro-organisms.

The specimens were collected from the ponds and tanks in the vicinity of Poona University. They were