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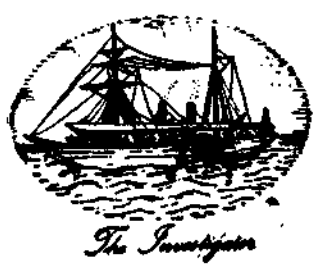

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BIOCHEMICAL STUDIES ON 'SOFT' PRAWNS : 1. PROTEIN NITROGEN AND NON-PROTEIN NITROGEN CONTENTS IN *PENAEUS INDICUS*

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ABSTRACT

The tail portion of both the healthy and 'soft' prawns (*Penaeus indicus*) collected from experimental ponds, was analysed for Protein nitrogen (PN) and Non-protein nitrogen (NPN) to find out to what extent the two fractions of the total nitrogen (TN) vary under these two conditions. The analysis reveals that the NPN fraction is considerably higher in the case of 'soft' prawns as compared to that of the healthy prawns. It is assumed that the increase of NPN content in 'soft' prawns may be due to endogenous protein metabolism caused by changes in the ecosystem during the period of extreme ecological conditions.

INTRODUCTION

PRAWNS are known to become 'soft' in brackishwater culture ponds during the period of adverse ecological conditions like low salinity, high temperature, over crowding, etc. This is one of the major problems in intensive prawn culture operations, as heavy mortality is noticed following such 'soft' condition. The causative factors that lead to the 'soft' condition have not been thoroughly studied. The present investigation was aimed at finding out the possible causative factors for such a condition through biochemical and physiological studies.

It is well known that proteins are ubiquitous components of all living tissues and serve indispensable functions in cellular architecture and are intimately concerned with virtually all physiological events (Mahler and Cordes, 1968). Therefore, any change in the physiology of the organism as a result of adverse ecological conditions is bound to affect the protein content of the tissues qualitatively as well as quantitatively.

Hence, the first part of the investigation deals with the quantity of protein nitrogen (PN) and non-protein nitrogen (NPN) present in the tissues of the 'soft' prawn *Penaeus indicus* and reports on the possibility of protein starvation as the causative factor for softness in prawns based on experiments carried out in the laboratory.

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MATERIAL AND METHODS

The prawn *P. indicus* were collected from experimental ponds at Narakkal during the period of southwest monsoon when the salinity of the pond water was low (range : 1.61 to 2.25‰). The tail portion was

separated after measuring the total length and noting the sex of the prawn. The exoskeleton was removed and the flesh was weighed after removing the adhering water with a blotting paper. After drying at a temperature of 85°C, the flesh was weighed to find out the percentage water content in the flesh. The dried material was ground into a fine homogenous powder and was packed in injection vials and preserved. Aliquots were taken from the sample for the estimation of TN and NPN.

TN was estimated by Micro-Kjeldahl method (Vogel, 1971) with the distillate collected in a 2% boric acid solution. NPN was estimated after separating the protein in 10% Trichloroacetic acid (Jacobs, 1951). All samples were analysed in duplicate. PN was computed by subtracting NPN from TN. Protein was calculated by multiplying PN with 6.25 (Love, 1957).

Also, feeding experiments were carried out in the laboratory on 'soft' prawns (*P. indicus*) collected from experimental ponds to find out to what extent the quality of the food consumed affects the 'condition' of the prawn. The prawns were divided into two groups. One group was fed with a carbohydrate rich food (boiled rice) whereas the other group was fed with a protein rich food (prawn meat). The experiment was repeated three times with different sets of individuals and was carried out in 3' dia. plastic pool with a water depth of about 50 cm. During the period of experiment the ambient salinity ranged from 2.45 to 2.48‰ and the ambient temperature from 25 to 28°C. The food was supplied *ad libitum* in both cases. The changes in the condition of the prawn was examined by feeling the prawns with the fingers. The experiments was run for periods ranging from 5 to 20 days.

Results

The amount of TN present in the tail was more or less similar in both 'soft' and healthy prawns. It ranged from 13.39 to 15.17% (mean ± SD = 14.61 ± 0.52%) and from 13.53 to 15.57% (mean ± SD = 14.82 ± 0.62%) of the dry weight in 'soft' and healthy prawns respectively. On the other hand, both the PN and NPN contents showed considerable difference between 'soft' and healthy prawns. The amount of PN ranged from 9.87 to 11.99% (mean ± SD = 10.88 ± 0.76%) in the former, whereas in the latter it ranged from 11.12 to 12.33% (mean ± SD = 12.1 ± 0.46%) (Fig. 1 a).

The NPN content was in the range of 3.18 to 4.18% (mean ± SD = 3.73 ± 0.50%) in 'soft' prawns as against 2.41 to 3.10% (mean ± SD = 2.72 ± 0.23%) in healthy prawns. The data were analysed by using student's *t*—test and it was found that the amount of NPN present was significantly higher in 'soft' prawns ($P < 0.001$). NPN when expressed as a percentage of TN ranged from 20.96 to 30.72% (mean ± SD = 25.57 ± 3.61%) in 'soft' prawns and from 17.38 to 20.37% (mean ± SD = 18.3 ± 1.00%) in healthy prawns (Fig. 1 b). Both PN and NPN were found to be independent of length. Consequent to a decreased PN value in 'soft' prawns the protein content was found to be less ranging from 61.13 to 74.94% (mean ± SD = 67.92 ± 4.84%) whereas in the healthy prawns it ranged from 69.5 to 78.94% (mean ± SD = 75.65 ± 2.85%) (Fig. 2 a).

Apart from the above-mentioned differences in the quantity of PN and NPN present in 'soft' and healthy prawns in terms of percentage of the dry matter, there was considerable difference in the quantity of dry matter itself between 'soft' and healthy flesh when it is related to the wet weight of the flesh. The dry matter content ranged from 14.53 to 20.74% (mean ± SC = 18 ± 2.30%) in the case of 'soft' prawns whereas in the case of healthy prawns it ranged from 19.61 to 26.91% (mean ± SD = 23.12 ± 2.61%) (Fig. 2 b).

The prawns (*P. indicus*) collected from experimental ponds were found to recover even at a low salinity of 2.45 to 2.48‰ when fed with a protein rich food (prawn meat). But, when fed with a carbohydrate rich food (boiled rice) the control prawns did not recover from their 'soft' condition. The time taken for recovery ranged from 5 to 20 days. In two cases the prawns moulted two times before recovery. The inter-moult period was 10 days in the case of a prawn measuring a total length of 102 mm (♀) and 14 days in the case of a prawn with a total length of 115 mm (♂) (Table 1).

from Fig. 1 a, b that the tissues of 'soft' prawns contain more percentage of NPN that the healthy prawns. This difference in the NPN fraction of TN between the tissues of 'soft' prawns and healthy prawns could be due to the mobilization of tissue protein in 'soft' prawns.

It is interesting to note that in the tissues of *P. indicus* the quantity of TN remained more or less at the same level in both the 'soft' and healthy prawns (Fig. 1 a). In other words, the quantity of PN and hence tissue protein was reduced in 'soft' prawns indicating that the

TABLE 1. *Time taken to recover from the 'soft' condition by the prawns* Penaeus indicus *kept in low saline water (2.45 to 2.48‰) and fed with a protein rich food*

Length (mm)	Sex	Time taken for recovery in days	No of times moulted	Inter Mult Period
92	♀	5	—	—
95	♀	5	—	—
96	♀	10	1	—
102	♀	17	2	10 days
115	♂	20	2	14 days
129	♀	8	1	—

DISCUSSION

The quantity of NPN present in the tissues of fishes has been studied fairly well (Shewan, 1951; Gerking, 1955; Niimi, 1972). On the other hand, little information is available on the amount of NPN present in the tissues of crustaceans.

A knowledge of the quantity of PN and NPN present in an animal tissue is important from the point of the physiological condition of the animal and also from the point of the relative value of its protein content. It can be seen

body protein has been catabolized (endogenous protein metabolism) for cellular activities. This could have resulted only under the following circumstances :

(*a*) inadequate availability of protein food in the ecosystem or

(*b*) due to some set-back in protein synthesis. Both the above-mentioned probabilities, which might have resulted due to environmental changes could have affected the anabolic activities of the prawns leading to the 'soft' condition. That the anabolic acti-

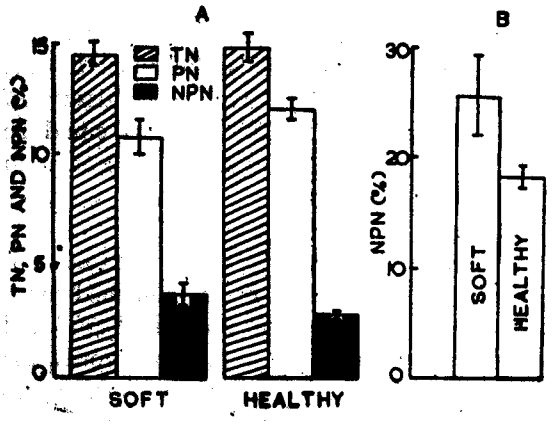


Fig. 1 a. Amount of TN, PN and NPN (expressed as a percentage of dry matter) present in the flesh of 'soft' and healthy prawns (*P. indicus*). The vertical line denotes the standard deviation from the mean values and b. Amount of NPN (expressed as a percentage of TN) present in the flesh of ' soft ' and healthy prawns (*P. indicus*).

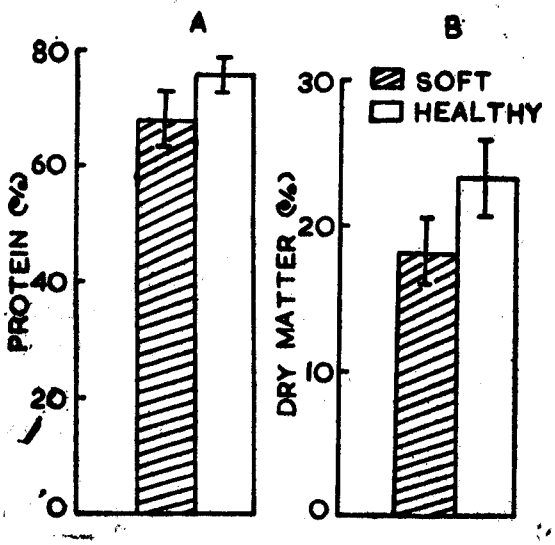


Fig. 2 a. Amount of protein (expressed as a percentage of dry matter) and b. amount of dry matter (expressed as a percentage of wet weight) in the flesh of ' soft ' and healthy prawns (*P. indicus*).

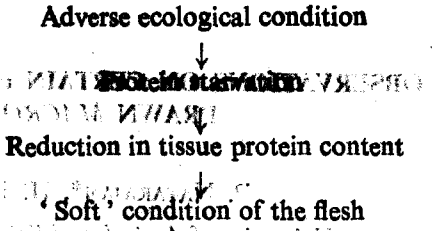
vity has been affected in the ' soft ' prawn is evident from the percentage of dry matter present in the tissues (Fig. 2 b). Apart from the fact that the dry matter is less in the case of ' soft ' prawns when compared to healthy prawns, the protein content in terms of percentage of the dry matter is also considerably less in the former than in the latter (Fig. 2 a). It has been reported by Maynard and Loosli (1969) that during a period of inadequate protein nutrition protoplasm may be broken down to meet certain nitrogenous needs of the body. It is believed that such a thing could have happened in prawns also. This important biochemical fact coupled with a reduction in the quantity of dry matter as a result of physiological set-back following ecological changes in the culture ponds could have rendered the prawns ' soft '.

Experiments carried out in the laboratory has revealed that ' soft ' prawns collected from ponds recover from the ' soft ' condition when fed with protein rich food (Table 1). On the other hand, the control group fed with a carbohydrate rich food did not recover at all. The time taken for recovery ranged from 5 to 20 days. These findings support the assumption that non-availability of protein food in the ecosystem could have been the causative factor for ' softness ' in prawns. However, in the experiment only prawn meat was supplied as protein source and as such it could not be ascertained whether it is simply due to the inadequate quantity of protein food or due to any qualitative or quantitative variation in the amino acid make-up of the food consumed. Further experiments on amino acid levels might throw more light on this.

Though it has been reported by Bell *et al.* (1970) that both synthesis and breakdown are affected by many factors particularly by hormones secreted into the blood by the endocrine glands, the present problem of breakdown of

protein does not seem to be related to any endocrine function as the 'soft' prawns recover to healthy condition when fed with protein rich food.

In the light of the above findings the possible causative factor for 'softness' in prawns is schematically summarized as follows :



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