was located in these amino compounds. Bidwell and coworkers[6] found out that in wheat leaves, when radioactive glucose was supplied, alanine became much more radioactive in light than in darkness. This was attributed to blockage of the carbohydrate respiration. It was possible for them to reverse blockage by the application of amino acids intrusion. The observation of more radioactivity in darkness is similar to that of Bidwell *et al.*[6]. However, whether it is respiration blockade cannot be ascertained with the present data.

Bidwell and Ghosh[2] have found that uniformly labelled glucose ^{14}C is utilized by *F. vesiculosus*. They have indicated several pathways of glucose utilization involving carboxylation and decarboxylation reaction. They notice that organic acids are better substrates for alginic acid than glucose. These authors also did not record any activity in mannitol but recorded it in fucose. From Table I, it is clear that activity in fucose fraction is higher at 6 hours than at half an hour. It is of interest to record the highest activity in citrate as noted by Bidwell and Ghosh[2]. However no explanation for this can be given with the present data. From Table I, it is also clear that alginic acid synthesis starts much later. This observation indicates that in *Sargassum* alginic acid biosynthesis starts later and it is possibly from sugar phosphates as proposed by Lin and Hassid[3].

In the present investigation, it is of interest to record an appreciably high label in aspartate and no label in malate. This, in the light of recent work of Karekar and Joshi[7], indicates that *S. ilicifolium* belongs to a group of C_4 plants of aspartate formers and possibly aspartate is a key compound from which many other metabolic products are formed.

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PRELIMINARY OBSERVATIONS ON THE USE OF MARINE CATFISH PITUITARY GLANDS FOR INDUCED SPAWNING OF THE INDIAN MAJOR CARPS

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ABSTRACT

Major carps are not available in adequate numbers, especially along the coastal regions of the country, for collection of pituitary glands for large scale induced spawning of these species. Therefore, attempts were made to utilise the pituitary of marine catfish, which are landed in good numbers along the coastal areas, for induced spawning of the major carps. Two species of the major carps, namely, *Labeo rohita* and *Cirrhina mrigala*, were successfully spawned during July, 1973 by administering intramuscular injections of pituitary extract of two species of marine catfish, *Tachysurus thalassinus* and *T. jella*. Sixtyfour per cent of the treated carps spawned successfully when injected with 30 mg and 20 mg of marine catfish pituitary per kg body weight of female and male fish respectively.

INTRODUCTION

THE Indian major carps were successfully induced to breed by the administration of fish pituitary hormones in 1957 (Chaudhuri and Alikunhi, 1957; Alikunhi *et al.*, 1960; Chaudhuri, 1960). Since then, the induced breeding technique has been vastly improved and its use as a dependable method of pure fish seed production has spread widely to all States of India. However, the quantity of fish seed produced in the country through this method in 1964–65 was only 1·57% of the total annual production (Anon., 1966). One of the reasons for this low percentage of fish seed produced through hypophysation technique is the shortage of carp pituitary glands, especially along the coastal areas. With a view to overcome this limitation, studies on the use of marine catfish pituitary glands for induced breeding of freshwater fishes were initiated at the College of Fisheries, Mangalore, in

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1972, when a freshwater catfish, *Clarias batrachus*, was spawned successfully by injection of pituitary extracts from a marine catfish, *Tachysurus* sp. (Devaraj *et al.*, 1972). Experiments were conducted to induce breeding in the major carps, *Cirrhina mrigala* and *Labeo rohita*, with injections of pituitary extracts from two species of marine catfish during July, 1973 and the results thereof are reported in this communication.

Materials and Methods

The pituitary glands used for the experiments were collected from the marine catfish, *Tachysurus thalassinus* and *T. jella* caught off the South Kanara Coast. The glands were collected during the period 30–1–1973 to 2–2–1973, from specimens ranging in weight from 1·0 kg to 9·75 kg. About 97% of the donor catfish were in the I or II stages of sexual maturity. The glands were preserved in absolute alcohol and stored in a refrigerator.

The induced breeding experiments were conducted in the fish farm of the Tungabhadra Board (Karnataka State) during July 1973. The major carp brood fish used for the experiments were all farm-reared and belonged to the age groups of II to IV. The methods followed for the preparation of pituitary extract and administration of hormone were the same as usually practised for the breeding of major carps.

The water temperature during the experimental period ranged from 25·3° C to 27·7° C. The weather was mostly cloudy, with one or two showers during most of the days.

Results

The results of the induced spawning experiments are presented in Table I. Seven females and eleven males of *mrigal* were treated with pituitary extract of the marine catfish. In all cases, except in one set, the female and male fish received a total of 30 mg/kg and 20 mg/kg body weight of pituitary glands respectively. In experiment No. 4, one set of *mrigal* was injected at a lower dose of 20 mg/kg and 15 mg/kg pituitary for the female and male fish respectively. Of the six *mrigal* which received the higher dose of pituitary, five spawned successfully, yielding over 20 lakhs of eggs with normal rates of fertilisation. The *mrigal* treated at a dose of 20 mg/kg did not spawn. During these experiments, it was seen, that pituitary extract prepared and kept in a refrigerator for 24 hours could also be successfully used. Along with the fish injected with the marine catfish pituitary, six females and eleven males of *mrigal* were also treated with carp pituitary extract in order to compare the results. Of these, four spawned successfully yielding a total of 16,28,000 eggs.

From Table I it is seen that all *rohu* females and males, except one set in experiment No. 7, received 30 mg/kg and 20 mg/kg body weight of catfish pituitary respectively. One set of *rohu*, in experiment No. 7, was injected at a lower dose of 20 mg/kg and 15 mm/kg body weight of pituitary for female and male fish respectively. Of the five *rohu* treated at the higher dose, two spawned successfully yielding 7,54,600 eggs, while that injected with the lower dose did not spawn. Along with this, four *rohu* administered carp pituitary hormones also spawned.

Discussion

The present experiments clearly demonstrate that it is possible to use the pituitary of the marine catfish *T. thalassinus* and *T. jella*, for induced spawning of the Indian major carps. From Table I, it is clear that seven out of eleven females treated with the marine catfish pituitary extract at a dose of 30 mg/kg spawned. Two female fish, one *rohu* and one *mrigal*, injected at a lower dose of 20 mg/kg of pituitary, did not spawn. Among the ten control fish treated with carp pituitary, eight spawned, accounting for 80% of positive results.

Normally doses of 6 to 10 mg/kg for female and 4 to 6 mg/kg body weight for male fish are used for induced spawning of the Indian major carps, when pituitary extracts from mature carps are injected. The dosage of pituitary required to spawn major carps when the donor carps are immature is not known. During the present experiments it was not possible to work out the minimum threshold dose of pituitary of the marine catfish required for spawning of major carps. A higher dose of pituitary of the marine catfish was used deliberately in view of the immature condition of the donor fish and the phylogenic and habitat differences between the donor and recipient species. Though it is reported that there is no great phylogenic specificity between the pituitary hormones of different species of fishes (Pickford and Atz, 1957), some of the heteroplastic injections have failed to yield positive results. For instance, Clemens and Sneed (1962) have reported that extremely high doses of carpsucker (*Carpiodes carpio*) pituitaries were required to ovulate female goldfish. The Indian major carps could not be spawned by pituitaries of grey mullets (*Mugil cephalus* and *Liza troschelli*) and *Tilapia mossambica* (Anon., 1970). In view of the fact that the donor catfish in our experiments were mostly immature, it should be possible to spawn the major carps with a much lower dose by employing pituitaries of mature marine catfish.

On an average, the catfish, mainly represented by various species of *Tachysurus*, accounts for

TABLE I

Dosage and response of brood fish injected with the marine catfish or carp pituitary glands

Expt. No.	Species	Injected with marine catfish pituitary			Injected with carp pituitary (controls)		
		Wt. of brood fish (kg)	Dosage (mg/kg)	Response (Remarks)	Wt. of brood fish (kg)	Dosage (mg/kg)	Response (Remarks)
1.	*Mrigal*	F 2·00	30	+	F 2·00	4·5	+
		M 1·00 M 0·70	20		M 0·50 M 0·50 M 0·50	4·0	
2.	*Mrigal* ..	F 1·50 F 1·00 F 0·50	30	+ + Smaller ♀ got – 'plugged'	F 3·00 F 1·50 F 2·00	6·0	+ – The ♀ which + did not spawn got 'plugged'
		M 0·75 M 0·50 M 0·50 M 0·50	20		M 2·50 M 1·00 M 0·50 M 2·00	4·0	
3.	*Mrigal* ..	F 3·00	30	+	F 3·00	7·5	–
		M 2·50 M 2·00	20		M 2·50 M 2·00	5·0	
4.	*Mrigal* ..	F 4·00	30	+	F 4·50	5·5	+
		F 4·00 M 2·00	20 15	–	M 1·00 M 1·00	4·0	
		M 2·00 M 1·00	20				
5.	*Rohu*	F 1·00		+	F 2·00	7·5	+
		F 0·50 F 0·50	30	– One ♀ got – 'plugged'. Third one jumped out of the breeding hapa	M 1·00 M 1·00 M 0·50	5·0	
		M 0·50 M 0·50 M 0·50 M 0·50	20				
6.	*Rohu*	F 4·00	30	+	F 4·00	7·5	+
		M 2·00 M 1·00	20		M 2·00 M 1·50	5·0	
7.	*Rohu* ..	F 2·50	30	–	F 5·00	7·5	+
		F 4·00	20	–	F 4·00		+
		M 3·00	15		M 2·50		
		M 2·50 M 2·00	20		M 2·50 M 2·50	5·0	

F = Female; + = Positive response.
M = Male; – = Negative response.

about 5% of the total marine fish landings of India. As the bulk of the catfish landed are used for sun-drying, for which the fish are split open, the fishermen may not object if the scalp is cut for the collection of pituitary glands. The cost of a major carp pituitary gland works out to about 50 paise, while it is only 10 paise in the case of marine catfish gland. Moreover, the major carps are scarce along most of the coastal areas. In this context, the present finding should help not only in reducing the cost of fish breeding work, but also to solve the problem of shortage of carp pituitary at fish seed production centres.

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RECENT TRENDS IN ELECTROCHEMICAL SCIENCE AND TECHNOLOGY

THE Society for Advancement of Electrochemical Science and Technology (SAEST) is a professional scientific body which was founded in 1965 at Karaikudi. It was started with a view to disseminating knowledge on Electrochemical Science and Technology. It publishes two journals, one quarterly Journal titled *Transactions of SAEST* and the other monthly *Current Titles in Electrochemistry*. In addition, the SAEST arranges joint symposia in collaboration with Electrochemical Industries, and these are held at the premises of the sponsoring industries. It also organizes Technical sessions every year on topics of current interest in the field of electrochemical science. To mark the completion of 10 years of its useful service, the Society observed its Decennary Celebrations on 26–27th November 1974 at Karaikudi.

A technical session on 'Recent Trends in Electrochemical Science and Technology' was got up for this occasion and it was primarily devoted to survey the status of Electrochemical Industries and their future prospects with particular reference to India. The recent developments in the field of Electrochemical Technology in India were also included in the scope of the session. The subjects covered were Chlor-alkali, Batteries, Electro-metallurgy, Electro-thermal products, electro-organic and inorganic chemicals, Metal finishing, and Anti-corrosion products. The venue for this seminar was Central Electrochemical Research Institute, Karaikudi, where the headquarters of the SAEST is located.

The symposium was organized under five sessions. In the first session on "Electro-organic and inorganic products", articles on 'Chloralkali Industry in India, 'Titanium Substrate Insoluble Anode for Chlor-alkali Cells', 'Inorganic Electrochemicals in India' and 'Electro-organic Products' were presented. The second session was devoted to 'Electrometallurgy' papers covering Lead, Zinc, Copper and Nickel. The third session on 'Electrothermics and fused salts' presented discussions on a number of electro-thermal products. During the fourth session, an account of the technology, production and growth of the Indian battery industry was presented. During the last session, the present Status and Modern Trends in Phosphating, a prepainting stage in the treatment for metals were discussed.

Three special lectures also formed part of the technical session. Prof. S. Ramaseshan gave a talk on 'Electrochemical Machining' describing the work currently carried out at the National Aeronautical Laboratory, Bangalore.

Prof. S. K. Rangarajan of National Aeronautical Laboratory, Bangalore, in his lecture on 'Perspectives in Fundamental Investigations' presented the basic approaches for evaluating typical problems of technological importance such as dendritic growth of zinc, optimization of cell design in electrochemical reactors. Finally Prof. K. S. G. Doss, the Founder President and former Director of Central Electrochemical Research Institute lectured on the principles of metal corrosion.

The session was attended by well over 230 delegates from all over the country including a number of representatives from industries and Governmental bodies and brought to focus the recent developments, existing problems and future projections relating to electrochemical industries in India.