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A COMPARATIVE STUDY ON DISTRIBUTION, MORPHOLOGY, AND SOME CHEMICAL CONSTITUENTS OF SEMINAL VESICLES IN CATFISHES

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SUMMARY :

Seminal vesicles (SV) are present in all catfishes collected in this study : *Clarias batrachus* (Linnaeus), *Wallago attu* (Bloch and Schneider), *Ompok siluroides* (Lecepede), *Rita rita* (Hamilton), *Mystus tengara* (Hamilton), *Mystus vittatus* (Bloch), *Pangassius pangassius* (Hamilton), *Heteropneustes fossilis* (Bloch) and absent in species other than catfishes. The number of SV lobes ranged from a single pair in *H. fossilis* to several pairs in *P. pangassius* with significant morphological variations. Total proteins, fructose, hexosamines and sialic acid were estimated in the testes and SV. Compared to testes, total proteins were higher in the SV of *W. attu*, *O. siluroides* and *H. fossilis*, fructose levels were higher in the SV of *O. siluroides* and *C. batrachus*, hexosamine contents were higher in the SV of *W. attu, M. tengara* and *H. fossilis*, and sialic acid levels in the SV of *W. attu, O. siluroides, R. rita, M. vittatus* and *P. pangassius*. Sialic acid was not detected in the testes of *R. rita* and *H. fossilis*. The SV may be an adaptive modification of the reproductive system for temporary storage of spermatozoa in a protein-sugar-rich nutrient medium.

Keywords : Catfishes; Fructose; Hexosamine; Seminal vesicles; Sialic acid; Teleosts; Testis.

INTRODUCTION

Seminal vesicles (SV) are glandular outgrowths of the common sperm duct in certain male fishes : *Gobius niger* (L), *Bathygobius soporator* (Cuvier and Valenciennes), *Cobitis fossilis* (L), *Mullus barbatus* (Russell), *Esox lucius* (Gmelin), *Gillichthys mirabilis* (Cooper), *Glossogobius giuris* (Hamilton), *Opsanus tau* (L) and catfishes, *Lctalurus furcatus* (Cuvier and Valenciennes), *I. catus* (L), *I. nebulosus* (LeSueur), *Trachycorystes striatulus* (Steindachner), *H. fossilis, Clarias gariepinus* (Burchell), *C. batrachus* (L), and *M. tengara* (H) (1-15). Among the Indian species, only a few catfishes (*H. fossilis, C. batrachus, M. tengara*) and a gobiid fish (*G. giuris*) were studied for SV. There is a lack of information on the distribution of this organ in

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other species. The SV of catfish is unique in that it is both an exocrine gland secreting a carbohydrate - lipid - protein rich material in the lobular lumen in which spermatozoa are stored temporarily and a steroidogenic organ, like the testis, synthesizing androgens and androgen glucuronides (12, 16, 17). Biochemical analyses show that the SV contains proteins, fructose, hexosamines, silaic acid, phospholipids, free fatty acids, and free and esterified cholesterol, the concentrations of which show significant seasonal variations correlated with testicular maturation (17). The SV secretion has been suggested to serve different functions such as promoting sperm aggregation and survival, thereby improving fertilization, pheromonal function, etc. (12, 17). In view of its structural and functional uniqueness, the present study was undertaken to study the SV distribution in some common fresh water fishes in Varanasi and its chemical constituents. Since both the testis and SV of catfish are suggested to have a common developmental origin from the genital ridge (12, 15), the testis is included for comparison.

MATERIALS AND METHODS

Collection of fishes and tissues :

Adult male fishes of different species except *Wallago* and *Pangassius* were collected in and around Varanasi from the 25th June to 25th July, 1992 (prespawning-spawning phase). They were brought to the laboratory and kept in running water for 1 hr, weighed, and sacrificed for examination of the male reproductive system. Viscera of *Wallago* and *Pangassius*, which were freshly caught, was collected during the same period from fish markets and brought to the laboratory under ice. The identification of fishes was made using keys from Munshi and Srivastava (18). The weight of the fish specimens was also recorded. The reproductive system of 2-3 males of each species was carefully dissected out and fishes were categorized into those with, and without the SV. The SV lobes were counted. The entire reproductive system or the SV alone was photographed. The SV and testes were stored at -20°C for biochemical estimations of total proteins, fructose, hexosamines and sialic acid.

Biochemical Study :

Concentrations of total proteins, fructose, hexosamines and sialic acid in the SV and testis were assayed colorimetrically according to the methods of Lowry et al (19), Mann (20), Elson and Morgan (21), as modified by Davidson (22) and Warren (23), respectively. Readings were noted from standard curves prepared from serial concentrations of bovine serum albumin, fructose, and a mixture of glucosamine and galactosamine, respectively. Sialic acid levels were calculated from Warren's formula II. For all the biochemical estimations, a minimum of 5 replicates were used. Data were expressed as means +SEM. The data were analysed by Student's test.

RESULTS

Morphology :

The seminal vesicles were found in 8 species of catfishes belonging to families Siluridae, Bagridae, Pangasiidae, Saccobranchidae (Heteropneustidae) and Clariidae (Table 1, Figs. 1-8). The SV shows considerable morphological variations : In *H. fossilis*, only a single pair of lobe is present (Fig. 7), while in *P. pangassius*, numerous lobes are present developing from the lateral and ventral sides of the sperm duct (Fig. 6). In other species the number of SV-lobes varied : in *Wallago attu*, 7-11. *O. siluroides*, 7-10, *R. rita* , 9-11; *M. tengara* , 10-13, *M. vittatus*,

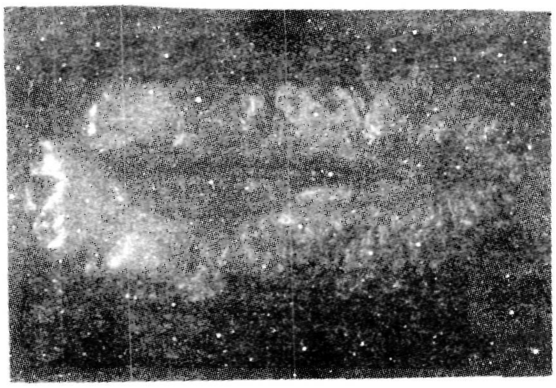

Fig. 1 : The SV and testis (T) of *Wallago attu*. The SV lobes are long, finger-like and tapering distally. X 0.8

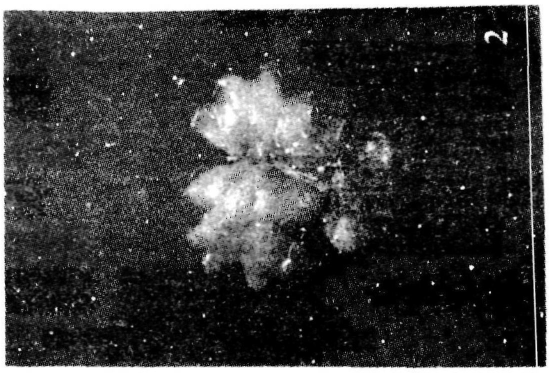

Fig. 2 : The SV of *Ompok siluroides*. The lobes are short, pear-shaped and swollen. X 2.4

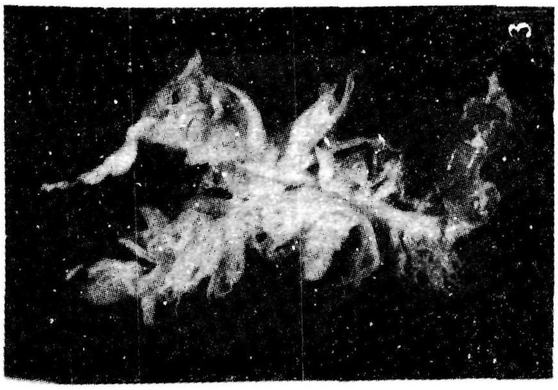

Fig. 3 : The SV and testis of *Rita rita*. The testis is finger-like branched and the SV long, finger-like and tapering distally. X 0.9

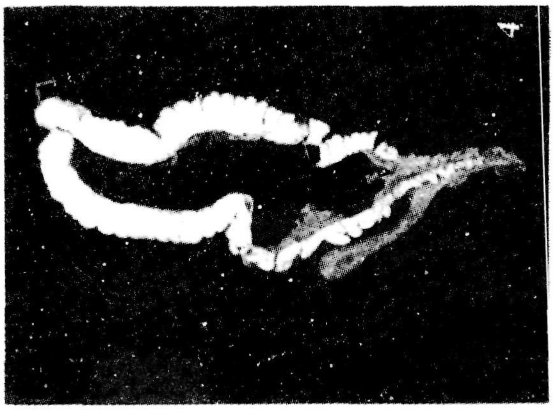

Fig. 4 : The SV and testis of Mystus tengara. The testis is long and serrated. The SV lobes are separate and they are short and swollen. X 0.91

Fig. 5 : The SV and testis of *Mystus vittatus*. The testis is oblong with serrated margin. The SV lobes are long, finger- like and tapering distally. X 1.4

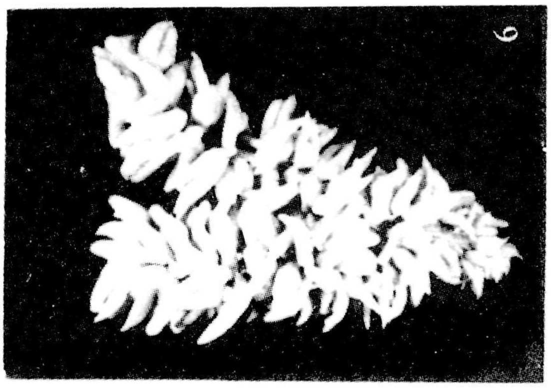

Fig. 6 : The SV of *Pangassius pangassius*. The lobes are numerous, long, finger-like and tapering distally. X 0.42

Fig. 7 : The SV and testis of *Heteropneustes fossilis*. The testis is lobed and the SV long and club-shaped. X 1.2

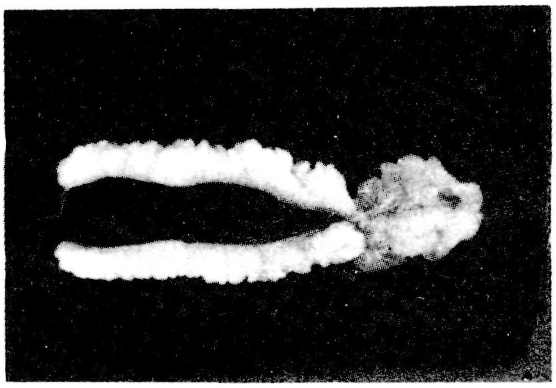

Fig. 8 : The SV and testis of Clarias batrachus. The testis is lobed and serrated and the SV short and swollen. X 1.2

13-17 and in *C. batrachus*, 5-8. The lobes are elongate, finger-like and tapering into filamentous processes in *W. attu* (Fig. 1), *R. rita* (Fig. 3), *M. vittatus* (Fig. 5) and *P. pangassius* (Fig. 6), short and swollen in *O. siluroides* (Fig. 2), *M. tengara* (Fig. 4) and *C. batrachus* (Fig. 8), and club-shaped in *H. fossilis* (Fig. 7). The testis also revealed considerable differences in the size and shape in the catfishes studied (Figs. 1-8).

Biochemical parameters (Table 2) :

The concentration of total proteins was significantly higher in the SV than in the testis of *W. attu, O. siluroides* and *H. fossilis* but was higher in the testis than SV in *M. tengara*. It

Table 1. Species list studied for seminal vesicles (SV) in males of freshwater catfishes collected in Varanasi during late prespawning to spawning phase (25 June to 25 July, 1992).

Species	Wt. of fish	Seminal vesicle	No. of SV lobes (In Pairs)	Family
Wallago attu (Bloch and Schneider)	2.1 kg,	+	7-11	Siluridae
Ompok siluroides (Lecepede)	40 g	+	7-10	Siluridae
Rita rita (Bleeker)	500 g	+	9-11	Bagridae
Mystus tengara (Hamilton)	900 g	+	10-13	Bagridae
Mystus vittatus (Bloch)	50 g	+	13-17	Bagridae
Pangassius pangassius (Hamilton)	6.8 kg	+	Numerous	Pangasiidae
Heteropneustes fossilis (Bloch)	100 g	+	1	Saccobranchidae or Heteropneustidae
Clarias batrachus (L)	56 g	+	5-8	Clariidae

+ Present

Table 2. Total proteins, fructose, hexosamines, and sialic acid in seminal vesicles (SV) and testes of freshwater catfishes collected in Varanasi during late prespawning to spawning phase (25 June to 25 July 1992).

Species	Total proteins (μ g/100 mg tissue wt)		Fructose (μ g/100 mg tissue wt)		Hexosamines (μ g/100 mg tissue wt)		Sialic acid (μ moles /100 mg tissue wt)	
	SV	Testis	SV	Testis	SV	Testis	SV	Testis
Wallago attu	1230.62 ± 223.74	570.71 c ± 11.36	149.89 + 4.30	144.74 NS + 8.43	729.13 + 22.03	349.27 c + 18.70	0.126 + 0.003	0.04916 c 0.007
Ompok siluroides	2118.70 + 261.66	608.22 c + 80.4	312.10 + 10.17	200.17 NS + 12.13	399.71 + 19.97	403.34 NS + 38.19	0.121 + 0.006	0.0230 c + 0.0003
Rita rita (Bleeker)	607.13 + 72.11	511.79 NS + 12.97	200.33 + 19.13	199.10 NS + 32.18	790.13 + 33.10	1542.76 b + 191.87	0.039 + 0.001	ND ND
Mystus tengara	905.49 + 98.69	2381.29 c + 258.28	133.02 + 18.34	114.02 NS + 25.79	1564.28 + 121.93	1187.85 a + 52.88	0.063 + 0.006	0.006 c + 0.0003
Mystus vittatus	1411.77 + 111.23	2187.27 NS + 517.62	213.17 + 15.11	167.24 NS + 20.30	1392.98 + 391.03	2235.57 NS + 276.65	0.0819 + 0.003	0.031 c + 0.001
Pangassius pangassius	5178.11 + 112.34	6113.17 NS + 413.17	439.35 + 55.13	500.18 NS + 32.74	2110.13 + 155.53	3721.73 c + 217.19	0.0917 + 0.001	0.0113 c + 0.0001
Heteropneustes fossilis	6368.93 + 304.31	4242.32 c + 149.14	453.81 + 16.40	651.65 c + 15.28	650.37 + 21.61	355.71 c + 20.51	0.046 + 0.002	ND ND
Clarias batrachus	4810.03 + 354.34	4838.24 NS + 189.66	560.60 + 10.43	497.84 c + 5.10	2017.08 + 124.19	2125.77 NS + 38.74	0.0669 + 0.001	0.0973 b + 0.007

Values are mean ± mean SEM, n=5
ND = Not Detectable, NS = Not Significant, a=p<0.05, b=p<0.01, c=p<0.001 seminal vesicles vs. testis.

is not significantly different in *C. batrachus, R. rita, M. vittatus* and *P. pangassius*. Fructose contents are significantly higher in the SV of *C. batrachus* and in the testis of *H. fossilis*. Hexosamine contents are higher in the SV of *W. attu, M. tengara, H. fossilis* and in the testis of *R. rita, M. vittatus*, and *P. pangassius*. Sialic acid contents are significantly higher in the SV of all species except *C. batrachus* (July value), and were not detectable in the testis of *R. rita* and *H. fossilis*.

DISCUSSION

The present study demonstrates that the SV is present in all catfishes (*C. batrachus, H. fossilis* and *M. tengara, M. vittatus, W. attu, O. siluroides, R. rita* and *P. pangassius* belonging to various Families (Table 1). The SV is not present in species belonging to the Families, Cyprinidae, Sciaenidae, Centropomidae, Anabantidae and Mastacembelidae. Although the present data strengthen the view that the SV seems to be a common feature of catfish reproductive system, it was not reported in the European catfish, *Silurus glanis* (L) (24). The present observations indicate further that the male reproductive system shows considerable morphological variations. The SV of different species showed morphological variations with regard to the number, size and shape of the lobes. In *H. fossilis*, only a pair of vesicle is present, and sometimes the lobes showed bifurcations distally (3, 25). A large number of lobes were found in *P. pangassius*. In other species, the number of lobes varied between these ranges. The size and shape of the SV also varied : they are elongate, finger- like, round and swollen or club-shaped. In *W. attu* and *R. rita*, the lobes tapered to filamentous processes. Based on these differences, the following trends can be adduced from the distribution and morphology of the SV in catfishes: (a) the SV shows great variations in the number of lobes; (b) variations in shape which may be a function of secretory activity of the organ, and (c) presence of sterile filamentous processes.

The biochemical data show that both SV and testis contain proteins, fructose, hexosamines and sialic acid. Further, there is considerable variation regarding the relative concentrations of these correlates in the two organs and the species studied. No reason can be provided at present for these variations. Seasonal variation is not likely as the fish were collected in the spawning phase. It may be that the total tissue mass/exocrine activity is a contributing factor. The variation in the sperm content may be another possibility. However, the high sperm content in the testis does not explain low concentrations of certain parameters or the absence of sialic acid in *H. fossilis* and *R. rita*. As constituents of SV and testicular secretions, they may play an important role in the maintenance and survival of spermatozoa. Presence of spermatozoa has been reported in the SV of *M. tengara* (9), *C. gariepinus* (12, 15), *C. batrachus* (17), *H. fossilis* (26) and in *P. pangassius* (our histological observation). The protein- carbohydrate-lipid rich seminal secretions of the SV and testis serves as a storage and nutrient medium for spermatozoa in the reproductive system. When the sperm is released into water, the viscous nature of the secretions help to keep sperm together and increase their motility ensuring better fertilization efficiency (12, 15, 17). Catfishes are mudstrainers and burrowers by habit and during summer their habitats, ponds, rivulets, lakes, etc.) dry up often. Under such harsh conditions, the fish survive in moist burrows. The SV, as a temporary storage organ, helps the fish to protect sperm till the monsoon rain arrives and flood the habitat prior to spawning. The presence of SV in catfishes may be an adaptive modification towards better reproductive success.

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