

spermatozoa¹. It has been reported that the epididymis utilizes glucose in preference to fructose *in vitro*⁸.

Thus, the above study shows the importance of G-6-Pase in the release of glucose, which seems to be used as a preferred substrate in varying degrees by the caput, corpus and cauda epididymis of *Taphozous longimanus*. This is substantiated by biochemical data as well (Swami, 1979, unpublished data).

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INCIDENCE OF *VIBRIO PARAHAEMOLYTICUS* IN RELATION TO FEEDING HABIT OF FISHES

Vibrio parahaemolyticus, an enteropathogenic, facultative anaerobic halophile, has been implicated as the etiologic agent in a number of food poisoning outbreaks in many countries¹. About 7 to 10% of cases admitted to the Infectious Diseases Hospital, Calcutta, are due to *V. parahaemolyticus*². This marine bacterium is widely distributed in coastal waters, sediment, plankton and in a variety of organisms especially finfish and shell-fish inhabiting these environs³. The objective of the present study was to examine a variety of fishes from the aquatic environs of Porto Novo to investigate if feeding habit of fishes had any relation to the incidence of *V. parahaemolyticus*.

From November, 1977 to October, 1978, 1,047 fishes originating from brackish and neritic environs of Porto Novo, S. India (Lat. 11° 30' N, Long. 79° 46' E) were examined for the presence of *V. parahaemolyticus*. Sampling was performed at monthly intervals. Fish specimens caught in the field were immediately put into fresh polythene bags and transported to the laboratory in insulated containers (< 5° C). Generally, preference was given to average sized commercially

important fishes with no visible signs of deterioration, injury or disease. Bacteriological examination was taken up within two hours after collection. At the laboratory, sand and detritus adhering to the fish were washed off with sterilised estuarine water. First swabs of the external surface (both flanks) were taken using sterile cotton tipped applicator sticks. Subsequently the entire gill surface was swabbed. An incision was then made in the vent region of the fish to expose the rectum and swabs of the faecal matter were taken. The swabs were inoculated in 10 ml glucose salt teejol broth and incubated for 6 hr at 37° C. A loopful of culture was then streaked on thiosulphate citrate bile salt sucrose agar and incubated for 18 hr at 37° C. Representative 'typical' green presumptive *V. parahaemolyticus* colonies⁴ were picked up from positive plates and maintained on sea water yeast extract agar slopes. Identification was confirmed at the end of each month using the minimal diagnostic tests as advocated by Hugh and Sakazaki⁵.

Based on their gut contents, fishes were broadly classified into four major feeding groups namely, carnivores, planktivores, omnivores and detritus feeders. Thirtyseven fishes, however, could not be categorised into any of these feeding types since their gut contents were completely digested. This group was designated as unidentified. Major groups of fishes examined among the carnivores were Silver bellies (*Leiognathidae*), Clupeoids (*Chirocentridae*, *Clupeidae* and *Engraulidae*), Catfishes (*Tachysuridae*), Ribbon fishes (*Trichiuridae*), Drummers and Croakers (*Sciaenidae*), Crescent perches (*Theraponidae*), Pomfrets (*Stromateidae*), Rabbit fishes (*Siganidae*), Lizard fishes (*Synodidae*) and Thread fins (*Polynemidae*). In the planktivores, the fishes sampled could be categorised under three groups, viz., Indian Mackerel (*Scombridae*), Sardines (*Clupeidae*) and Milk fish (*Chanidae*) while in the omnivores the fishes examined comprised of *Oxyurichthys* sp. (*Gobiidae*), Tilapia and Pearl spots (*Cichlidae*). Detritus feeders were solely comprised of Mulletts (*Mugilidae*).

Of the 1,045 fishes examined in the present study, 385 (36.8%) were positive for *V. parahaemolyticus*. Our results are in conformity with the findings of De *et al.*² which showed that 35.2% of sea water fishes in Calcutta environs harboured *V. parahaemolyticus*. A still higher isolation rate (47.3%) of *V. parahaemolyticus* in freshly caught fishes from lake Togo and adjoining lagoons (West Africa) has been reported⁶. However, investigations conducted in Canadian maritime regions⁷ and in fish and shell-fish marketed in Netherlands⁸, imply that *V. parahaemolyticus* was practically absent. These contrastive results from different geographical areas suggest a marked preponderance of *V. parahaemolyticus* in aquatic organisms, especially in finfish and shell-fish, inhabiting tropical systems.

Among the four feeding groups, *V. parahaemolyticus* was isolated from 56.3% of the detritus feeders while in carnivores, planktivores and omnivores, it was relatively less (Table I). Detritus feeders ingest bottom mud and sediment from which food items like benthic organisms and decaying flocculent deposits are separated by certain structural adaptations. Ecological studies in Chesapeake Bay⁴ revealed the ubiquitous presence of *V. parahaemolyticus* in sediments even during winter months when *V. parahaemolyticus* counts in water and plankton were below detectable levels. Other investigators^{9,10} also observed the pronounced predilection of *V. parahaemolyticus* for sediments and bottom mud. Studies on the seasonal distribution of *V. parahaemolyticus* at Porto Novo and the report of Manavalan *et al.*¹¹ have shown that sediments provide the most conducive ecological niche for this halophile in estuarine and mangrove environs of Porto Novo. In the present study, detritus feeders were solely composed of Mulletts (Mugilidae). Mulletts

are known to feed on detritus, including mud and sand, and microalgae¹². The same author has also suggested that much of the unrecognizable 'detritus' could be bacteria and protozoa. A recent study¹³ on the gastrointestinal microflora of *Liza dussumieri* (Mugilidae) has established the generic predominance of vibrios in the gut of this species. According to Moriarty¹⁴, the Grey Mullet (*Mugil cephalus*) is capable of selecting small particles of sand rich in organic matter, especially algae and bacteria. All these findings clearly show a larger bacterial intake by detritus feeders than other feeding groups. It is therefore not surprising that *V. parahaemolyticus* could be isolated in greater frequency from detritus feeders. The results of this study indicating higher incidence of *V. parahaemolyticus* in detritus feeders may be attributed to their feeding habit.

The percentage incidence of *V. parahaemolyticus* in different feeding groups of fishes were tested employing the statistic 'd' of Bailey¹⁵ and the results are

TABLE I

Incidence of V. parahaemolyticus in different feeding groups of fishes and regions of isolation

Feeding group	No. of samples examined	No. of samples positive (Percentage positive)	Regions of positive isolation		
			External surface	Gills	Faeces
Carnivores	690	252 (36.5)	83	55	143
Planktivores	156	49 (31.4)	11	41	42
Omnivores	45	12 (26.7)	6	3	8
Detritus feeders	119	67 (56.3)	17	46	64
Unidentified	37	5 (13.5)	3	1	2
Total	1047	385 (36.8)	120	146	259

TABLE II

Comparison of the incidence (percentage) of V. parahaemolyticus in fishes with different feeding habits

Sl. No.	Feeding habit	Feeding habit in comparison	Observed statistic 'd' value	Significance P = 0.05
1. Carnivores		Planktivores	1.2052	Not significant
		Omnivores	1.3365	Not significant
		Detritus feeders	4.0784	Significant
2. Planktivores		Omnivores	0.6093	Not significant
		Detritus feeders	4.1414	Significant
3. Omnivores		Detritus feeders	3.3902	Significant

presented in Table II. It is discernible that the incidence of *V. parahaemolyticus* was significantly higher ($P = 0.05$) in detritus feeders than in other feeding groups.

In all four feeding groups, *V. parahaemolyticus* could be isolated more frequently from faecal samples of fishes than from the external surface or gills (Table I), suggesting that the gastro-intestinal tract of fishes may provide a suitable niche for their proliferation. The rich nutrient store available in the gut of fishes¹⁶ may also aid the colonization of this pathogen especially during periods of unfavourable environmental conditions. Kaneko and Colwell³ have postulated that *V. parahaemolyticus* can survive low temperatures of winter in sediments and in association with, or in, shell-fish and scavenger fish such as gobies. The results of the present study agree with the above observations, since it appears that the gut of fishes might serve as a 'provisional' environment to tide over unfavourable conditions like hypersalinity (tropical systems) and low temperatures (temperate systems). In planktivores, isolation of *V. parahaemolyticus* from the gills was quite high (Table I). The association of *V. parahaemolyticus* with zooplankton has been well documented¹⁷. The gills of planktivores are suitably developed to sieve plankton from water and such contact may result in *V. parahaemolyticus* adhering to the mucus of gill surface, resulting in the greater incidence of this pathogen in this region.

V. parahaemolyticus caused gastroenteritis, is less frequent in India compared to Japan since food items are well cooked and spiced here. However, chances of cross contamination via kitchen utensils or by handling may result in infection especially while handling mullets, the potential reservoirs of this pathogen. Degutting fishes immediately after the catch and washing them well would be advisable precaution to reduce the load of *V. parahaemolyticus* in such contaminated fishes.

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HAEMATOLOGICAL STUDIES IN *SAROTHERODON (TILAPIA) MOSSAMBICA* (PETERS) EXPOSED TO LETHAL ($LC_{50}/48$ HRS) CONCENTRATION OF SUMITHION AND SEVIN

ORGANOPHOSPHATE and carbamate insecticides are now extensively used in plant protection operations on account of their less persistence in the environment. But their excessive and indiscriminate use produce more hazards to non-target and useful fauna of freshwater environment. It was found that exposure to Sumithion and Sevin inhibited enzymes like AChE, SDH but increased Ach content, LDH activities¹ and inhibited tissue respiration in the fish *T. mossambica*². Many vital physiological processes are altered in *T. mossambica* after pesticide treatment³. The present communication deals with the effect of Sumithion an organophosphate compound and Sevin, a carbamate insecticide on certain haematological parameters.

Maintenance, size and weight range of fish used have been described earlier¹. $LC_{50}/48$ hrs value as calculated by probit method⁴ was 6 mg/l for Sumithion