

## Occurrence of *Photobacterium leiognathi*, as the bait organ symbiont in frogfish *Antennarius hispidus*

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Bait organs of the frogfish *Antennarius hispidus*, collected from a coralline habitat off Bombay from the depth of about 50 m, were luminescent and revealed the exclusive presence of luminous bacterium *Photobacterium leiognathi*. Occurrence of *P. leiognathi* as the bait organ symbiont of *A. hispidus* is the first report. Being very strong mimics of their surrounding, frogfishes may couple the bacterial bioluminescence originating from their bait organs with that of their camouflaging ability for the purpose of: (a) luring smaller prey and (b) evading the attention of aggressive or larger predators. This paper also highlights the scanty distribution of *P. leiognathi* in the water column of both coastal and offshore environs of the Arabian Sea.

Light organ association of luminous bacteria with many marine fishes and squids is reported to be species specific<sup>1</sup>. In that, these animals maintain a homogeneous and pure culture of a single species of luminescent bacterium in their light glands. Several species of fishes in as many as 20 families have so far been reported to harbour either *Photobacterium phosphoreum*, *P. leiognathi*, *Vibrio fischeri* or noncultivable bacterial symbionts as their light organ symbionts<sup>2-5</sup>. Recently, Fukasawa and Dunlap<sup>6</sup> reported the occurrence of *P. leiognathi* as the light organ symbiont of the squid, *Doryteuthis kansaki*. Present report deals with isolation and characterisation of *P. leiognathi* for the first time from the bait of the frogfish *Antennarius hispidus* (Lohiiformes: Antennariidae) collected while trawling on a coralline substratum off Bombay.

Four live specimens of frogfish were sorted out from the fish catch from 50 m depth during the 48<sup>th</sup> cruise of *R V Sagar Kanya* (30 Dec. 1988 to 14 Jan. 1989). The specimens were taken into a dark room to observe light emission from the bait organ. On confirming a dim light these glands were severed, washed several times with sterile seawater to eliminate adhering saprophytic microflora and mashed up using inoculation needle. Seawater complete agar (SWCG) plates (consisting of peptone 5 g, yeast extract 3 g, glycerol 3 ml, agar 15 g, aged seawater 750 ml and deionised water 250 ml) were used for enumerating and isolating bacteria from these glands. These plates were incubated at 25°C for 24 h and were noticed to contain numerous brightly luminous colonies. After enumerating these colonies, several isolates were collected, purified and

characterised<sup>7</sup> by comparing their biochemical traits with many of the reference strains.

All these luminous strains responded identically and compared very well with the reference strains of *P. leiognathi* (Table 1) and all these isolates are similar to those isolated from the light organs of leiognathids<sup>8</sup>. The dilution technique and spread plate method yielded as high as  $2.5 \times 10^5$  to  $3.0 \times 10^6$  cells of *P. leiognathi* in 1 ml of the gland diluent indicating that the luminous bacterial cells are densely packed in the bait glands which measured about 1.5-2 mm dia. in the specimens of 6 to 7.5 cm standard length. When observed in dark, all 4 bait organs appeared very dim. Being very strong mimics of their surroundings<sup>9</sup>, these fishes may couple dim luminescence from their bait organ to attract small sized prey and at the same time evade the attention of large predators. In contrast to these dim bait organs, internal light glands of all the leiognathids are reported to be bright<sup>8</sup>. But the strains of *P. leiognathi* isolated from the fishes of both these families appear to be brightly luminescent when grown on SWCG agar. It is therefore, like in leiognathids, probable that the light intensity is controllable by frogfishes to their maximum functional advantage.

Incidentally, many of the deep sea members of Ceratioidae in the same order Lohiiformes are reported to house non-cultivable luminous symbionts<sup>5,9</sup>. But, such observations are not available for frogfishes. It is likely that many members of Antennariidae may harbour easily culturable *P. leiognathi*.

The ecology of *P. leiognathi* in the seawater seems to be intriguing as the occurrence of *P. leiognathi* in

Table 1—Comparison of luminous bacterial strains from the bait organs of *Antennarius hispidus* with reference strains (Figures in the parentheses are the number of strains included for characterisation)

Characteristics	<i>Vibrio harveyi</i> (10)	<i>Vibrio fischeri</i> (10)	<i>Photobacterium leiognathi</i> (10)	Bait organ isolates (25)
<b>Growth at</b>				
35°C	+	-	+	+
40°C	+	+	+	+
4°C	-	-	-	-
<b>Production of</b>				
amylase	+	-	-	-
lipase	+	-	-	-
gelatinase	+	-	-	-
<b>Growth on</b>				
maltose	+	+	-	-
cellobiose	+	+	-	-
gluconate	+	-	+	+
glucuronate	+	-	-	-
mannitol	+	+	-	-
proline	+	+	+	+
lactate	+	-	+	+
acetate	+	-	+	+
alanine	+	+	+	+
tyrosine	+	-	-	-
galactose	+	+	+	+
Gas from glucose	-	-	-	-

the seawater was found to be rather low<sup>10,11</sup>. It accounted for < 10% of the total of over 1400 luminous isolates collected and analysed from the Arabian Sea<sup>12</sup>. This is surprising because, its symbiotic leiognathid hosts— all three genera—harbour as high as 10<sup>9</sup> cells per gland and these fishes are significantly abundant<sup>13</sup>. Large numbers of

luminous cells are known to be released/shed from the light organs<sup>14</sup>. In the laboratory experiments Haygood *et al.*<sup>14</sup> have recorded high release rates of luminous bacteria in the range of  $1.1 \times 10^6$  to  $2.2 \times 10^8$  cells. h<sup>-1</sup>. Given a release rate of at least a few thousand *P. leiognathi* cells. gland<sup>-1</sup>. h<sup>-1</sup> (besides egestion through feces), its recovery from the water should have been much more on SWCG agar where it readily grows. It is therefore, necessary to study the ecology of luminous bacteria in general, and *P. leiognathi* in particular to understand its ecology and to record the spectrum of its host range.

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