crystals were always the inclusions of protein bodies. Under polarized light the crystals were highly birefringent while the globoid inclusions were not birefringent (figures 4–6). Figures 4 and 5 are trans-sections of the mericarp viewed with fully crossed polarizers to see the crystals. The crystals show themselves in Nomarsky Interference Microscopy also (figure 3). Figure 4 depicts the crystal distribution in the endosperm. The central cells were devoid of any such crystals.

It is evident that carrot endosperm possessed two structural types of protein bodies — one with proteinaceous matrix and a number of globoid inclusions and the other of proteinaceous matrix and calcium-rich inclusions[4]. Both types were however not present in the same cell suggesting cell wall formation before the formation of protein body inclusions[2]. The use of polarization microscopy established whether calcium-rich crystals were present and their location in a given section, since such crystals were highly birefringent. On the contrary, the crystals may be either a solitary tetrahedron or an aggregated group of small crystals forming a druse (figure 6). The solitary crystals are few in number.

Besides protein bodies, the other major inclusions of the endospermous cells are some lipid droplets and starch grains (figure 2).

Much of the seed reserves of vital minerals occur as phytin which is mainly localized within the protein bodies as globoid inclusions[6], whereas the role of calcium oxalate crystals in seeds is clear. Formation of calcium oxalate crystals may prevent oxalic acid from accumulating in toxic quantities in the cytoplasm[1]. Alternatively the crystal may protect the plant against grazing animals or play a role in long-term calcium storage[7].

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1. Dwarte, D. and Ashford, A. E., *Bot. Gaz.*, 1982, **143**, 164.
2. Spitzer, E. and Lott, J. N. A., *Can. J. Bot.*, 1982a, **60**, 1381.
3. Spitzer, E. and Lott, J. N. A., *Can. J. Bot.*, 1982b, **60**, 1392.
4. Spitzer, E. and Lott, J. N. A., *Can. J. Bot.*, 1982c, **60**, 1399.
5. Lott, J. N. A., *Nordic. J. Bot.*, 1981, **1**, 421.
6. Lott, J. N. A., Spitzer, E. and Vollmer, C. M., *Can. J. Bot.*, 1982, **60**, 1404.
7. Franceschi, V. R. and Horner, H. T., *Bot. Gaz.*, 1980, **46**, 361.

## OCCURRENCE OF *HEPATIARIUS BENDAWESI* SP. NOV., FROM *ANAS POECILORHYNCHA* (FORSTER) FROM INDIA

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Two specimens of *Hepatiarius bendawesi* were collected from the liver of a single bird from Meerut. The following are the details:

Body (figure 1) cylindrically narrow, measuring 4.98×0 63 mm. Oral sucker well-developed 0.15 ×0.14 mm., ventral sucker poorly developed at anterior third of the body, 0.16×0.14 mm. Prepharynx absent. Pharynx well-developed 0.10×0.06 mm. Oesophagus 0.31 mm long and intestinal caeca extend up to the posterior end of the body. Testes tandem, lobed close to posterior

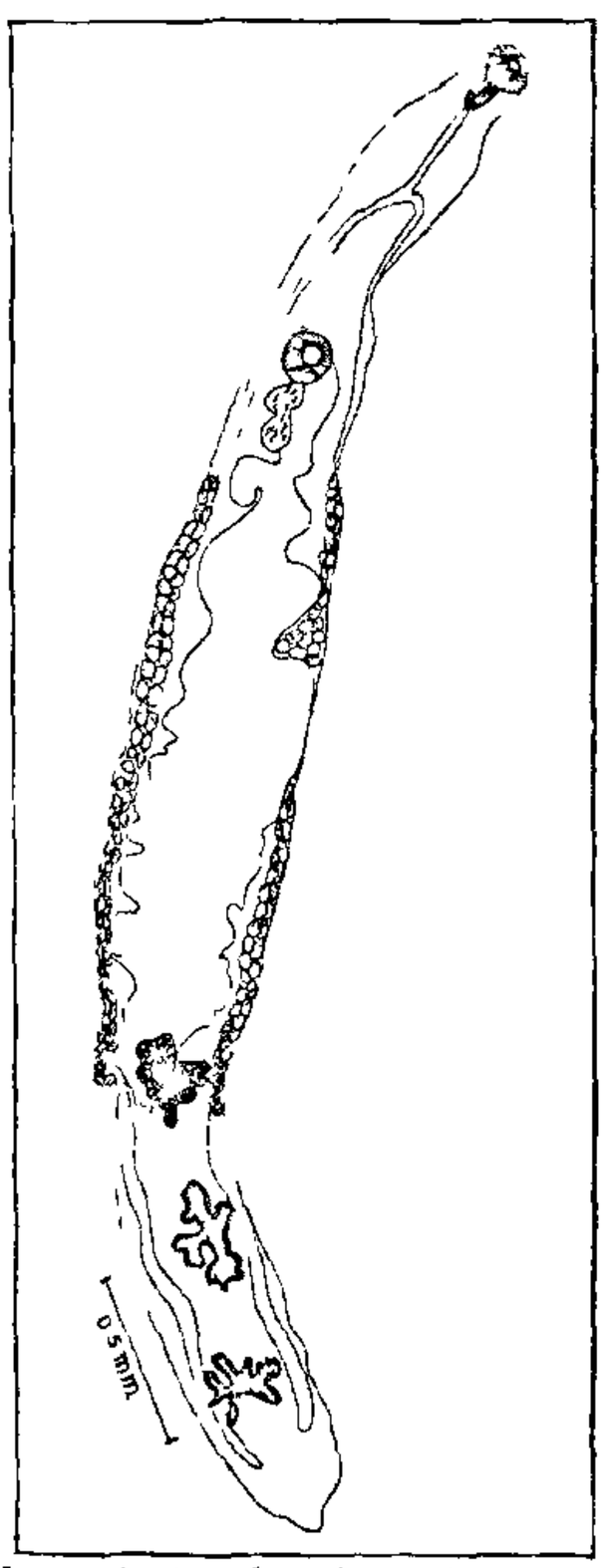


**Figure 1.** *Hepatiarius bendawesi* sp. nov., Ventral view.

extremity measuring 0.37–0.25×0.19–0.16 mm., cirrus sac posterior to ventral sucker, 0.15×0.08 mm. Genital pore immediately above the ventral sucker. Ovary multilobed, median, a little anterior to testes measuring 0.24×0.17 mm. Uterus extending between ovary and ventral sucker filled with yellowish eggs measuring 0.01×0.02 mm. Vitelline follicles small extending from posterior to ventral sucker, reaching near the level of ovary. Excretory bladder not distinguishable.

The genus *Hepatiarius* was created by Feizullaev[1] with *H. longissimus* as a type species. Because of a cylindrical, long body, tandem testes close to the posterior extremity and multilobed ovary, the specimens belong to the genus *Hepatiarius*. The genus has only two species, *H. longissimus* Feizullaev[1], *H. sudarikovi* Feizullaev[1], and the present form differs from both, in body size, long oesophagus and extension of Vitellaria. Hence it is regarded as a new species.

This is the first record of this genus from India and the species has been named in honour of Late Prof. Bandawes, an outstanding parasitologist.

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1. Feizullaev, N. A., *Akad. Nauk Azerbaijan SSSR.*, 1961, **17**, 635.
2. Yamaguti, S., *Synopsis of digenetic trematodes of Vertebrates*, Keigoku Publishing Co., Tokyo, 1971, Volumes 1 & 2.

## GLUTAMATE DEHYDROGENASE ACTIVITY IN NORMAL AND AESTIVATED *PILA GLOBOSA* — A POSSIBLE NEUROENDOCRINE REGULATION

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THE active life of the snail, *Pila globosa* is interrupted during drought conditions by aestivation when the animal undergoes a state of metabolic dormancy[1,2]. There is also a decrease in the activities of respiratory enzymes and the animal survives by anaerobic glycolysis slowly utilizing the glycogen reserve[3–5]. Changes in glutamate level in soft parts of the aestivating snail constitute a significant event during aestivation[6–8]. However, very little information is available regarding the involvement of hormonal principle(s) in the aestivation metabolism of *Pila globosa*. Hence an attempt was made to study the activity pattern of glutamate dehydrogenase (GDH) under the influence of different ganglia viz. cerebral, buccal, pleuropedal, supra-intestinal and visceral.

The collection and the maintenance of *Pila globosa* and the method of inducing aestivation have been described elsewhere[9]. Three-month-old aestivated snails were used for the present study. The five ganglia viz. cerebral, buccal, pleuropedal, supra-intestinal and visceral from active and aestivated snails were isolated separately and the extracts of the like ganglia were pooled. One per cent extract in 80% ethanol was made, centrifuged and the supernatant was collected. A hole was drilled near the operculum and 0.2 ml of the extract was injected (from active to aestivated and vice versa) into the foot

**Table 1** *Activity levels of GDH (μ mol of formazan formed/mg protein/h) in the hepatopancreas of active/aestivated snail administered with ganglionic extracts of aestivated/active snail*

| | Activity in the controls | Activity after the administration of ganglionic extracts | | | | |
|---|---|---|---|---|---|---|
| | | Cerebral | Buccal | Pleuropedal | Supra-intestinal | Visceral |
| Active | 0.53 ± 0.038 | 0.90 ± 0.031 (69.81) | 0.63 ± 0.052 (18.86) | 0.71 ± 0.059 (33.96) | 0.72 ± 0.063 (35.84) | 0.76 ± 0.054 (43.39) |
| Aestivated | 0.12 ± 0.011 | 0.23 ± 0.013 (91.66) | 0.16 ± 0.014 (33.33) | 0.19 ± 0.017 (58.33) | 0.20 ± 0.009 (66.66) | 0.21 ± 0.011 (75.00) |

Each value is mean ± SD of six individual observations; Values in the parentheses are per cent changes over control. All values are significant at $P < 0.05$.