

Studies on the Structure of Three New Species of Strigeids Metacercariae from Indian Freshwater Food Fishes

Barrister Kumar Gupta*

Department of Zoology, Vardhaman College, Bijnor, 246701, Uttar Pradesh, India

*Corresponding Author E-mail: guptabarrister54@gmail.com

Received: 7.08.2016 | Revised: 15.08.2016 | Accepted: 18.08.2016

ABSTRACT

The author extensively studied on digenetic trematode larvae of Indian freshwater food fishes during research tenure. Three new species of strigeid metacercariae belonging to genus *Neascus* Hughes¹⁴, 1927 and *Tetracotyle Faust*¹⁰, 1918 were collected from *Anabas testudineus*, *Channa punctatus* and *Xenentodon cancilla* and named *Neascus kaisarbaghensis*, *Tetracotyle bhopalensis* and *Tetracotyle mauensis* from different location respectively.

Key words: *Metacercaria*, *Neascus*, *Tetracotyle*, *Strigeids*, *Trematode*.

INTRODUCTION

India is the seventh largest country in the world and Asia's second largest nation. It contains a great wealth of biological diversity. As we know that over half of all vertebrates, are fishes (Approx.11.7%, 2546 Indian sp. out of 21,730 world sp.). Fish provides nutritious food and are important source of fresh animal proteins. But almost all fishes carry infections of adult trematodes or metacercariae. They infect all the body parts and cause diseases thus reducing their food value. In case of heavy infections, mortality is also caused, which in turn is a great loss to fish industry. They can also transfer infections to man when infected with trematodes larvae i.e. metacercariae. They are dangerous parasites, primarily of carps and siluroids, causing massive epizootics. Currently about 800

million people suffer from insecure food supplies and malnutrition globally. The Pattern and determinants of inadequate nutrition are changing. People world over faces interrelated malnutrition burden leads to under-nutrition, and micronutrient deficiencies. To push the sustainable development agenda as per the United Nations in case of food, nutrition and environmental security such research fills the lacunae hence my commitment is to work on it.

MATERIAL AND METHODS

During study here fish specimens were collected from different water bodies of India especially north India including Eastern U.P., and Jhansi, with the help of fishermen or purchased from the fish markets.

Cite this article: Gupta, B.K., Studies on the Structure of Three New Species of Strigeids Metacercariae from Indian Freshwater Food Fishes, *Int. J. Pure App. Biosci.* 4(4): 221-228 (2016). doi: <http://dx.doi.org/10.18782/2320-7051.2347>

Fishes were identified by Fish Base¹¹. Trematode metacercariae were isolated from various parts of their hosts namely *Anabas testudineus*, *Channa punctatus* and *Xenentodon cancila* (especially Kaisarbagh, Bhopal and Mau respectively). Larval trematodes were identified in live conditions under binocular microscope and observed under a phase-contrast microscope. A few specimens of each worms were fixed in formalin- alcohol- acetic acid (FAA) (2:17:1) under light pressure and stained overnight in Aceto-carmine, whole mounts were made for taxonomic study.

RESULT

Neascus kaisarbaghensis n. sp.

Host: *Anabas testudineus* (Bl.)

Site of infection/Location: Cranium/Branchial region

Locality: Kaisarbagh fish market, Lucknow

No. of host examined: 05

No. of host found infected: 02

No. of metacercariae collected: 07

Description: Cyst (Fig.1) oval, transparent, 1.13 - 1.33 mm x 0.90 - 1.20 mm. Body (Fig.2) aspinose, foliaceous, well differentiated into fore and hind body, fore body 0.47 - 1.03 mm x 0.19 - 0.21 mm and hind body 0.19 - 0.22 mm x 0.13 - 0.19 mm. Oral sucker terminal, 0.03 - 0.04 mm x 0.02 - 0.03 mm. Ventral sucker smaller than oral sucker, elongate-oval, 0.03 - 0.04 mm x 0.02 - 0.03 mm. Pharynx absent. Intestinal caeca reaching upto posterior end of hind body. Hold fast organ strongly developed, situated behind ventral sucker, 0.13 - 0.15 x 0.17 - 0.20 mm. Hold fast gland bilobed, transversely elongated, located behind holdfast organ, 0.28 - 0.30 mm x 0.02 - 0.04 mm. Gonads represented by three dark stained cell masses; two large masses appear to be testes, 0.02 - 0.07 mm x 0.06 - 0.12 mm and 0.02 - 0.08 mm x 0.10 - 0.16 mm and one small elongated mass in between two testes, 0.01 - 0.03 mm x 0.05 - 0.09 mm, could be future ovary. Copulatory bursa, oval and located in hind body. Excretory bladder (Fig.3) 'V' shaped

and opens outside terminally through an excretory pore, at hind body region. Two main collecting canals of reserve excretory system originate, one of each side, from cornua of excretory bladder, run through lateral body margins upto level of pharynx where they unite with each other by an anterior transverse canal. A median reserve excretory canal originates from anterior transverse canal, runs posteriorly upto holdfast organ and joins posterior transverse canal which further opens into two main canals. Two lateral canals, on an each side of median canal also originate from anterior transverse canal, runs upto holdfast organ and form posterior transverse canal. Two median longitudinal canals, originate at junction of fore and hind body. These major canals are joined together by short transverse canals but their arrangement could be observed in detail. Small, black, excretory corpuscles flow freely in canals.

DISCUSSION

The Indian species of strigeid metacercariae of group *Neascus*¹⁴ are *N. vetastai*¹⁷, *N. chelai*¹⁸, *N. indicus*³², *N. cirrhinus*³², *N. elongates*^{29,30}, *N. hepatica*⁹, *N. channi*²⁶, *N. xenentodoni*²⁶, *N. komiyai* Pandey²⁸, *N. hoffmani*²⁸, *N. gussevi*⁸, *N. nanaksagrensis*⁵, *N. chauhani*³, *N. hanumanthai*³, *N. simhai*³, *N. moghei*³, *N. shahjahanpurensis*²³, *N. ramalingami*²³, *N. vedi*²³ and *N. bhopalensis*¹³ & *N. dohrighatensis*¹³. The present larva closely resembles with *N. vetastai*, *N. hepatica*, *N. xenentodoni*, *N. hoffmani*, *N. hanumanthai*, *N. simhai*, *N. moghei*, *N. ramalingami* and *N. vedi* in shape of body and number of genital rudiments but differs from them in shape of holdfast organ and holdfast gland. It further differs from *N. vetastai*, *N. xenentodoni*, *N. hoffmani*, *N. simhai* and *N. moghei* in ratio of suckers, from *N. hepatica* and *N. vedi* in ratio of fore and hind body, from *N. hanumanthai* and *N. ramalingami* in absence of pharynx. Besides this it differ from *N. bhopalensis*¹³, 2015 in ratio of suckers, presence of esophagus & intestinal caeca and shape of holdfast organ holdfast gland and lastly from

*N. dohrighatensis*¹³, 2015 in ratio of sucker, ratio of fore and hind body, shape of genital rudiments and pattern of reserve excretory systems.

Among the species described from foreign land, it comes closer to *Neascus* of *Ornithodiplostomum pychocheilus*, *Neascus* of *Posthodiplostomum minimum*, *Neascus* of *Posthodiplostomum cuticola*, *Neascus grandis*, *Neascus rhinichthysi*, *Neascus ellipticus*, and *Neascus pyriformis* in shape of body but differs in absence of pharynx and ratio of body. It further differs from *Neascus grandis*, *Neascus pyriformis* and *Neascus ellipticus* in number of genital rudiments, from *Neascus* of *Ornithodiplostomum pychocheilus*, *Neascus* of *Posthodiplostomum minimum* and *Neascus* of *Posthodiplostomum cuticola* in ratio of suckers and from *Neascus rhinichthysi* in shape of holdfast organ and holdfast gland. Therefore, the larva is regarded a new species and named *Neascus kaisarbaghensis* n. sp. after the locality wherefrom the host was procured.

***Tetracotyle bhopalensis* n. sp.**

Host: *Channa punctatus* (Bloch)

Location: Gut

Locality: Fish market, Bhopal

No. of host examined: 20

No. of host found infected: 05

No. of metacercaria collected: 10

Description:

Cyst (Fig.4) oval, thin, transparent, 1.02 - 1.05 mm x 0.66 - 0.68 mm. Body (Fig.5) elongated, aspinose, 1.25 - 1.27 mm x 0.63 - 0.64 mm. Suckers well developed and muscular. Oral sucker sub-terminal, more or less circular, 0.10 mm - 0.11 mm. Ventral sucker pre-equatorial, larger than oral sucker, 0.11 - 0.12 mm x 0.12 - 0.13 mm. Prepharynx absent. Pharynx elongate-oval, 0.04 - 0.05 mm x 0.04 - 0.06 mm. Pseudo-suckers situated on each side of intestinal bifurcation, 0.15 - 0.17 mm x 0.09 - 0.10 mm. Hold fast organ well developed, 0.36 - 0.38 mm x 0.21 - 0.27 mm, elongate, 3 lobed, with a distinct 'U' shaped cavity. A 'U' shaped holdfast gland, behind holdfast organ

present. Genital rudiment represented by two tandem, elongated cell masses, at hind region of body. Excretory bladder (Fig.6) 'V' shaped, located at posterior end of body, opening outside by terminal excretory pore. Main reserve excretory canals, one on each lateral side, run anteriorly upto pseudosuckers and join fellow canal by a transverse canal. A median excretory canal, runs posteriorly, in median region of body, upto gonads and joins main canal. Canals are filled with free floating, round to oval corpuscles.

DISCUSSION

To the best of my knowledge, the following species of metacercariae are known under strigeid group *Tetracotyle*¹⁰ from India viz. *T. ranae*¹⁷, *T. sophorensis*³¹, *T. indicus*³¹, *T. ujjainensis*³³, *T. szidati*⁷, *T. xenentodoni*⁶, *T. aglandulata*⁵, *T. muscularis*⁶, *T. glossogobii*⁶, *T. lali*²⁹, *T. lucknowensis*²⁵, *T. singhi*²⁷, *T. baughi*²⁷, *T. tandani*²⁷, *T. bufoi*², *T. lymnaei*²¹, *T. gyanpurensis*⁴, *T. pandei*¹, *T. srivastavi*¹, *T. ramalingi*¹, *T. simhai*²⁴, *T. sanjivi*²⁴, *T. fotedari*²⁴, *T. kawi*²⁰, *T. kalyani*²², *T. satyapalii*²², and *T. multilobulata*¹² & *T. madhubanensis*¹². Of the above species, the present larva closely resembles with *T. ranae*, *T. indicus*, *T. ujjainensis*, *T. lali*, *T. singhi*, *T. gyanpurensis*, and *T. satyapali* in position of pseudosuckers and holdfast organ but differs from them in the number of genital rudiments which is two in the present larva. It further differs from *T. indicus*, *T. singhi*, and *T. satyapalii*, *T. ujjainensis* and *T. gyanpurensis* in the shape of holdfast organ, and from *T. ranae* and *T. lali* in shape of body which is elongate-oval. Besides this the present larva differ from *T. multilobulata* in ratio of sucker, shape & position of pseudosuckers, absence of esophagus and intestinal caeca, shape of holdfast organ and holdfast gland and number and shape of genital organ. While from *T. madhubanensis* the present larva differs in ratio of suckers, shape and position of pseudosuckers, absence of esophagus and intestinal caeca, shape of holdfast organ and

holdfast gland, number of genital rudiments and pattern of reserve excretory system.

Among the species described from foreign land, it differs from *Tetracotyle diminuta*¹⁵, in ratio of sucker and position of pseudosuckers, *Tetracotyle* of *Apatemon fuligulae* Yamaguti, 1933 and *Tetracotyle* of *Apatemon pellucidus* Yamaguti, 1933 in shape of body, absence of prepharynx, esophagus and intestinal caeca, from *Tetracotyle* of *Cotyluris communis* Hughes, 1928, *Tetracotyle biwaensis* Yamaguti, 1942 and *Tetracotyle tahoensis* Haderlie, 1953 in number of genital rudiments, shape of holdfast organ and holdfast glands. Therefore, the larva is regarded new to science and named *T. bhopalensis* n. sp. after the locality where from the host was obtained.

***Tetracotyle mauensis* n. sp.**

Host: *Xenentodon cancila* (Ham.)

Location: Liver/Gut

Locality: Mau (U.P.)

No. of host examined: 18

No. of host found infected: 02

No. of metacercaria collected: 05

Description:

Cyst (Fig.7) oval, thick, 1.22 - 1.24 mm x 0.75 - 0.76 mm., two layered, outer layer thick, fibrous, tough, pigmented and inner layer thin, transparent. Body (Fig.8) undivided, aspinose, with narrow anterior and broad posterior ends, 0.33 - 0.43 mm x 0.24 - 0.29 mm. Oral sucker 0.09 - 0.11 mm x 0.09 - 0.10 mm. Ventral sucker smaller than oral sucker, 0.04 - 0.05 mm x 0.04 - 0.05 mm. Pseudo-suckers large, muscular, somewhat triangular, located at lateral sides of pharynx, 0.09 - 0.15 mm x 0.09 - 0.10 mm. Esophagus and intestinal caeca not visible. Hold-fast organ well developed, pear shape, posterior to ventral sucker, having a distinct cavity. A dark mass of cells, representing holdfast gland, at hind end of hold fast organ present. Genital rudiment, represented by an elongate-oval, dark stained cell mass at hind region of body, overlap the holdfast gland. Excretory bladder (Fig.9) 'V'

shaped. Inner and outer longitudinal canals are joined in region of pseudo-suckers. 9 - 11 transverse canaliculae join to outer longitudinal canals. Reserve excretory system filled with round excretory corpuscles.

DISCUSSION

The present larva closely resembles with *T. glossogobii*, *T. lucknowensis*, *T. kawi*, *T. sanjivi*, *T. pandei* and *T. satendri* in shape of body and shape and position of pseudosuckers but differs from them in ratio of suckers. It chiefly differs from *T. glossogobii*, *T. lucknowensis*, *T. sanjivi*, *T. pandei* and *T. satendri* in the number of genital rudiments, from *T. kawi* in shape of holdfast organ and holdfast gland. It also differs from *T. bhopalensis* n. sp. described in earlier pages, in shape, size and position of pseudosuckers, and also in the number of genital rudiments. Besides this the present larva differ from *T. multilobulata* in ratio of sucker, shape & position of pseudosuckers, presence of esophagus and intestinal caeca, shape and position of holdfast organ and holdfast gland and number, position and shape of genital organ. It also differ from *T. madhubanensis* in ratio of suckers, shape and position of pseudosuckers, absence of pharynx, shape and position of holdfast organ and holdfast gland, number and shape of genital rudiments and in pattern of reserve excretory system.

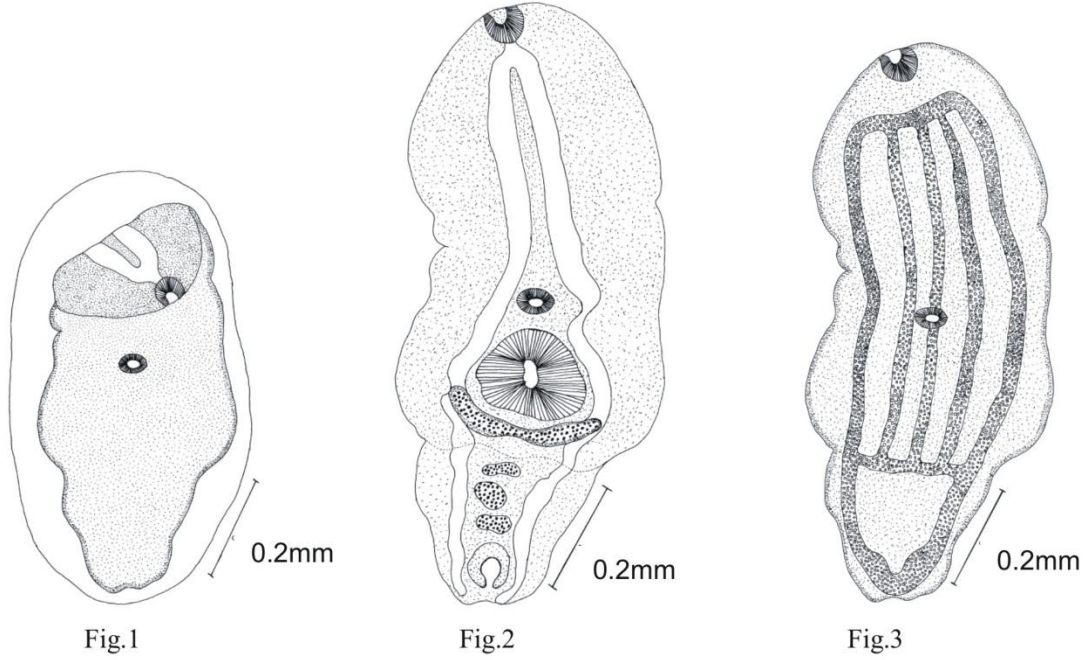
Among the species described from foreign land, it comes closer to *Tetracotyle* of *Cotyluris communis*, *T. diminuta*, *Tetracotyle* of *Apatemon pellucidus*, *Tetracotyle biwaensis* and *Tetracotyle tahoensis* by the absence of prepharynx and position of pseudosuckers but differs in shape of holdfast organ and holdfast gland. It further differs from *Tetracotyle* of *Cotyluris communis*, *T. diminuta*, *Tetracotyle biwaensis* and *Tetracotyle tahoensis* in absence of esophagus and intestinal bifurcation and ratio of suckers, from *Tetracotyle* of *Apatemon fuligulae* in absence of prepharynx and shape of holdfast organ and holdfast gland and from *Tetracotyle* of

Apatemon pellucidus in the presence of pharynx and ratio of body. Therefore, the larva is regarding as new to science and named

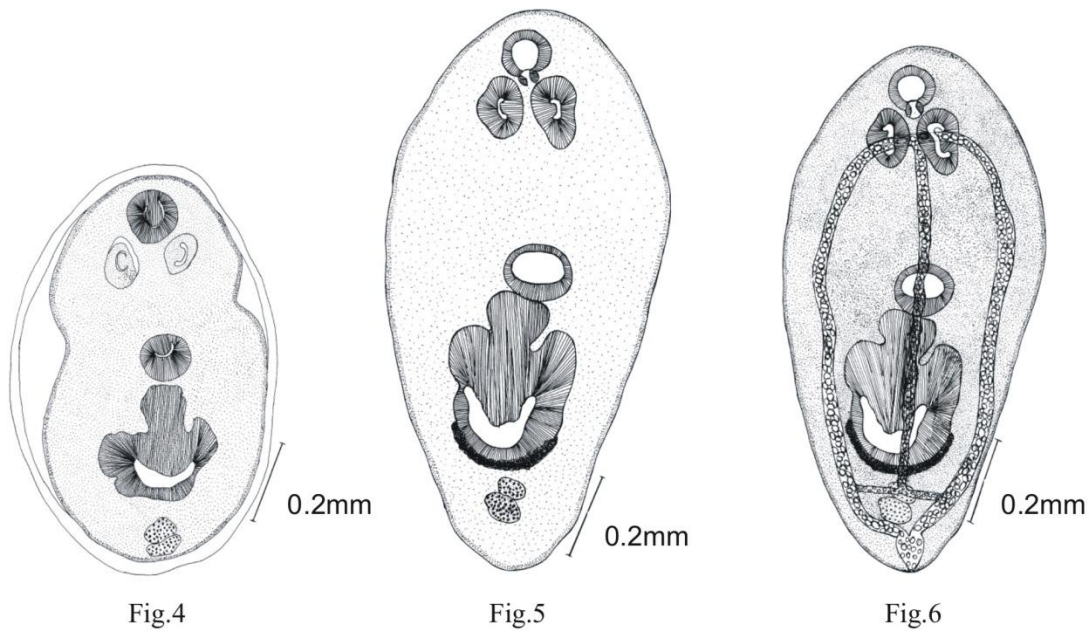
Tetracotyle mauensis n. sp. after the locality wherefrom the host was procured.

Figures

Neascus kaisarbaghensis n. sp.



Tetracotyle bhopalensis n. sp.



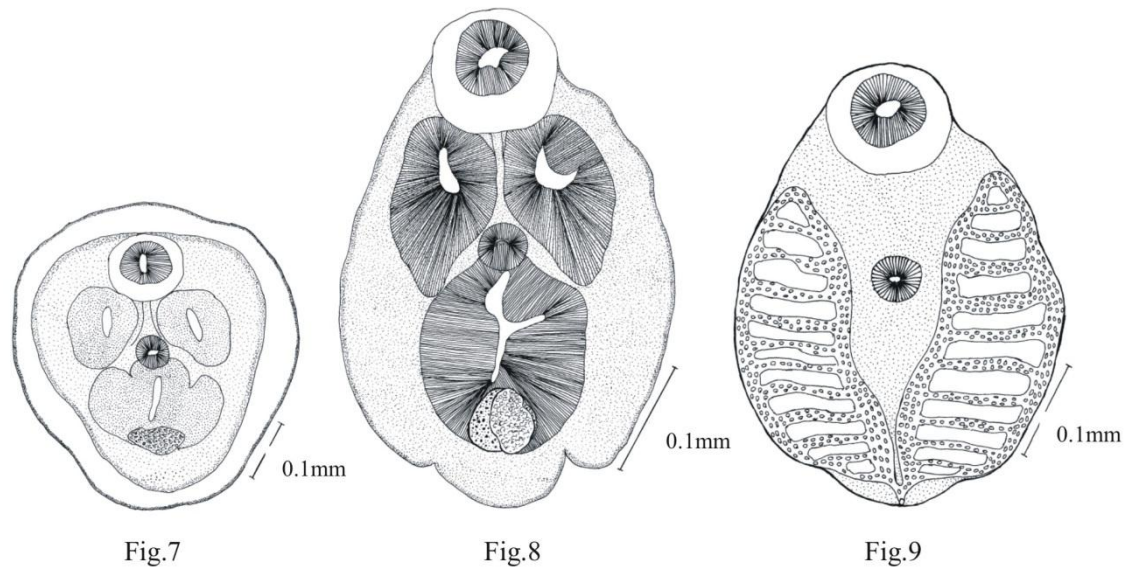
Tetracotyle mauensis n. sp.

Fig. 1, 4, 5 Encysted metacercariae Fig.2, 5, 8 metacercariae Fig.3, 6, 9 metacercariae, showing reserve excretory system (drawn from live specimens)

CONCLUSION

During study on the structure geographical distribution & pathogenic significance of trematode parasites, author successes to collect three new species of strigeid metacercariae belonging to genus *Neascus* Hughes¹⁴, 1927 and *Tetracotyle* Faust¹⁰, 1918 from *Anabas testudineus*, *Channa punctatus* and *Xenentodon cancilla* and named *Neascus kaisarbaghensis*, *Tetracotyle bhopalensis* and *Tetracotyle mauensis* from different location respectively. It serves as base line information on current status of fish trematodes for upcoming researcher. Author has no competing interest.

Acknowledgement

I am thankful to Prof. Nirupama Agrawal and Prof. K. C. Pandey, Department of Zoology, Lucknow University, Lucknow, for their valuable suggestions. Authority of Department of Science and Technology, New Delhi are thankfully acknowledged for financial assistance (SR/SO/AS-44/2005).

REFERENCES

1. Agrawal, N. and Khan, S., Studies on some *Tetracotyle* Fillipi (1859)

metacercariae from fishes of Lucknow. *Proc. Indian Acad. Sci.*, **91**: 515-521 (1982).

2. Agrawal, N., A new strigeid larva (*Tetracotyle bufoi* n. sp.) from a common toad. *Indian J. Zootomy.*, **16**: 187-188 (1975).
3. Agrawal, N. and Khan, S., Studies on some strigeid (*Neascus*) metacercariae from fishes of Lucknow. *Uttar Pradesh J. Zool.*, **2**: 32 – 40 (1982).
4. Agrawal, N. and Singh, H.S., Infection of *Channa punctatus* (Bloch) with a metacercaria *Tetracotyle gyanpurensis* n. sp. *Matsya*. **6**: 84 – 86 (1980).
5. Baugh, S.C. and Chakravarti, K.K., A restudy of *Neopodocotyle lucknowensis* (Gupta and Chakravarti, 1966). *Indian J. Zoot.*, **2**: S3 - S7 (1970).
6. Bhalerao, G. D., Strigeidae from India. *Rec. Indian Mus.* **44**: (1942).
7. Chakrabarti, K.K., A new strigeid metacercaria, *Tetracotyle glossogobii* sp. n., from an Indian freshwater fish, *Glossogobius giuris* (Ham.). *Helminthologia.*, **11**: 1 – 4 (1970).
8. Chakrabarti, K.K. and Baugh, S.C., *Tetracotyle szidati* n. sp. A metacercaria

- from the Indian freshwater fish, *Channa punctatus* (Bloch). *Indian J. Zool.*, **11**: 79 – 82 (1970).
9. Chakrabarti, K.K., Studies on some metacercariae of the Indian freshwater fishes *Channa punctatus* (Bloch) and *C. striatus* (Bloch). *Rev. Iber. Parasitol.*, **34**: 57 – 80 (1974).
 10. Chakrabarti, K.K., Two new species of Strigeid metacercariae from an Indian freshwater fish, *Xenentodon cancilla* (Ham.). *Proc. Helminth. Soc. Wash.*, **37**: 5 – 10 (1970).
 11. Dwivedi, M. P. and Dwivedi, U. A new strigeid metacercaria *Tetracotyle chauhani* n. sp. (Trematoda: Proterodiplostomidae) from the frog *Rana cyanophlyctis* and its probable identity with *Proalarioides tropidonotis*, Vidyarthi, 1937. *Uttar Pradesh J. Zool.* **1**: 57 – 61 (1981).
 12. Faust, E.C., The anatomy of *Tetracotyle Iturbi* with a synopsis of *Tetracotyliform* larvae. *Joun. Parasit.*, **5**: (1918).
 13. Froese, R. and Pauly, D., Fishbase. Worldwide web electronic publication www.fishbase.org, version (06/2009) (2009).
 14. Gupta, B.K. and Rajvanshi, S., Two new species of the genus *Tetracotyle* (Order: Strigeatoidea La Rue¹⁹, 1926) strigeid metacercariae, parasitizing freshwater food fishes from North India. *Journal of Parasitology*. Photon **105**: 219 – 223 (2015).
 15. Gupta, B.K., Two new species of *Neascus* Hughes, 1927 strigeids metacercariae from freshwater food fish of North India. *Proc. 2nd NSFP*, Indian J. Helminth (n. s.), **34**: 7 – 14 (2015).
 16. Haffman, G.L., *Neascus nolfi* n. sp. (Trematoda: Strigeida) from cyprinid minnows with notes on the artificial digest recovery of helminthes *Trans. Amer. Micr. Soc.* **53**: 198-204 (1955).
 17. Hughes, R.C., Studies on the trematode family Strigeidae (Holostomidae) VI. A new metacercaria, *Neascus ambloplitis* sp. nov. representing a new larval group. *Trans. Amer. Micr. Soc.*, **46**: 248-267 (1927).
 18. Hughes, R.C., Studies on the trematode family Strigeidae (Holostomidae). IX. *Neascus vancleavei* (Agersborg). *Trans. Amer. Micr. Soc.*, **47**: 32 – 241 (1928a).
 19. Hughes, R.C., Studies on the trematode family Strigeidae (Holostomidae). X. *Neascus bulboglossa* (Van Haitsma). *Jour. Parasitol.*, **15**: 53 – 57 (1928b).
 20. Hughes, R.C., Studies on the trematode family Strigeidae. XIII. Three species of *Tetracotyle*. *Trans. Amer. Micr. Soc.* **47**: 414 – 433 (1928).
 21. Hughes, R.C. and F. R. Piszczek. Studies on the trematode family Strigeida (Holostomidae). XI. *Neascus ptychocheilus* (Faust). *Jour. Parasitol.* **15**: 58 – 62 (1928).
 22. Hunter and Wanda. A new strigeid metacercaria, *Neascus rhinchthysi*, n. sp. *Trans. Amer. Micr. Soc.* **52**: 255 – 258 (1933).
 23. Kaw, B.L., Studies in Helminthology: Helminth parasites of Kashmir. Part I. Trematoda. *Indian J. Helminth.*, **2**: 67 – 126 (1950).
 24. Khera, S., *Neascus chelai* nov. sp. (Trematoda) from the fish *Chela clupeoides*. *Anales de la escuela Nat. Cien. Biolo.*, **9**: 1 – 4 (1958).
 25. La Rue, G.R., Studies on the trematode family Strigeidae (Holostomidae) No. III (1926).
 26. Pandey, K.C. and Tyagi, V., A rare infection in frog *Rana tigrina* (Daud) of a strigeid larva. *Uttar Pradesh J. Zool.*, **7**: 105 – 106 (1987).
 27. Pandey, K.C. and Agrawal, N., A new *Tetracotyle* larva, *T. lymnaei* n. sp. from a fresh water mollusk *Lymnaea auricularia*. *Indian J. Parasit.*, **2**: 119 – 120 (1978).
 28. Pandey, K.C. and Pandey, N., Studies on two new strigeid metacercariae from *Xenentodon cancila* (Ham.) *Indian J. Helminth.* (n. s.) **17**: 29 – 32 (2000).
 29. Pande, B. P., Bhatia, B. B. and Rai, P. On a strigeid metacercaria from *Heteropneustes fossilis* (Bloch) ‘Singhi.

- Proc. Nat. Acad. Sci.* **34**: 245 – 248 (1964).
30. Pandey, K.C. and Agrawal, N., Metacercarial fauna of India. *ZSI*, 1-310 (2013).
31. Pandey, K.C. and Tewari, S. K., Studies on few strigeid metacercariae. Part I. *Adv. Biosci.*, **5**: 21 – 31 (1986).
32. Pandey, K.C. and Tewari, S.K., Studies on some new strigeid metacercariae, Part II. *J. Adv. Zool.*, **4**: 115 – 122 (1983).
33. Pandey, K. C. and Tewari, S. K. A new strigeid metacercaria from freshwater fish *Mastacembelus armatus* (Lac.) Uttar Pradesh *J. Zool.* **4**: 122 – 124 (1984).
34. Pandey, K.C., Studies on metacercaria of fresh water fishes of India VIII. On the morphology of *Tetracotyle lucknowensis* n. sp. from *Channa punctatus* (Bloch). *Proc. Indian Acad. Sci.*, **44**: 1 – 5 (1971)
35. Pandey, K.C., Studies on metacercaria of freshwater fishes of India. VIII. On two n. sp. of *Neascus* Hughes, *Proc. Ind. Acad. Sci.*, **43**: 78 – 83 (1971).
36. Pandey, K.C., Studies on metacercariae of fresh water fishes of India. II. Description of a known and five unknown strigeid metacercariae from Lucknow. *Indian J. Zoot.*, **14**: 197 – 219 (1973).
37. Pandey, K.C., Studies on metacercariae of freshwater fishes of India. II. Description of a known and five unknown strigeid metacercariae from Lucknow. *Indian J. Zoot.*, **14**: 155 – 166 (1973).
38. Pandey, K.C., Studies on trematode parasites of fishes of Lucknow (India). *Indian. J. Zoot.*, 145 – 148 (1970).
39. Rai, P. and Pande, B. P. A metacercarial infection in the common freshwater eel and two other fishes. *Indian J. Helminth.* **17**: 18 – 21 (1965).
40. Rai, P. and Pande, B. P. On the morphology and pathogenic significance of the strigeoid metacercariae in some Indian freshwater fishes. III. *Diplostomulum*. *Indian J. Anim. Sci.* **39**: 539 – 552 (1969).
41. Sinha, A.K., Sinha, C. and Nikhil, R. Studies on yellow grub diseases of freshwater fish *Channa punctatus* (Bloch). *Curr. Sci.* **57**: 218 – 219 (1988).
42. Singh, K.S., On some Strigeids from India. *Jour. Zool. Soc. Ind.*, **8**: 47 – 56 (1956).
43. Singh, R.N., Studies on a new strigeid metacercaria parasitic in cyprinoid fishes. *Pro. Nat. Acad. Sci.*, **26**: 255 – 263 (1956).
44. Tewari, S.K., A new strigeids metacercaria from *Colisa fasciatus* (Bloch). *Read. Zool.* **1**: 46 – 47 (1982).
45. Tewari, S.K. and Tyagi, V., A new *tetracotyle* larva *T. satendri* n. sp. from *Channa punctatus* (Bloch). *Indian J. Helminth.* (n. s.), **3**: 91 – 95 (1986).
46. Thapar, G.S., Some new larval strigeids causing black spot disease in fishes from Tungabhadra dam. *Indian J. Helminth.* **19**: 173 -182 (1967).
47. Trivedi, H.S., On two metacercariae from freshwater fishes in Ujjain. *J. Vik. Univ, Ujjain.*, **8**: 91 – 94 (1964).
48. Vasantha Kumari, M. and Srivastava, C.B., On a collection of digenetic trematodes from Calcutta and adjoining areas. *News 1. Zool. Surv. India*, **2**: 199 – 204 (1976).