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Hold-Fast Organs of Piscean and Avian Cestode Parasites with Special Emphasis on Histopathology

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ABSTRACT

Present study deals with hold-fast organs and pathological changes induced by certain Piscean and avian Cestode parasites collected from Maharashtra State India. Hold-fast organs of tapeworms are important for attachment and adhesion. These organs of attachment are in the form of muscular suckers, rostellum, spines, hooks, tentacles etc. The work on hold-fast organs of Piscean and avian cestode parasites is essential for research in taxonomy and histopathology. Hence, the present study was undertaken on the role and status of diversity of holdfast organs with special reference to histopathology of Piscean and avian cestodes collected from Maharashtra State, India. Cestode parasites were collected and studied from certain fishes and birds from different localities of Maharashtra.

***Keywords*:** Hold-fast organs, Maharashtra, Piscean and Avian Cestodes, Histopathology

1. INTRODUCTION

Cestodes are endoparasites of vertebrates from fishes to mammals. Infection of cestodes leads to anemia complications and protracted illness. Parasitic diseases are major public health problems of tropical countries including India. Parasitic diseases of Fish seem to be one of the major problems confronting fish culturists. Fishes and birds are important from ecological, medicinal, nutritional and economical point of view. Livestock animals like

domestic fowl, *Gallus gallus domesticus* have a great Socio-economic importance than other animals domesticated by humans. It is an important item of human food as well as source of income due to production of meat, fiber and other substances. Farmers of Maharashtra used fertilizer which is formed from domestic fowl in their fields to increase soil fertility. But these domestic fowl are infected with helminth infection which is responsible for mortality and economic losses in a number of instances. Humans get automatically infected due to eating of infected and uncooked flesh of fishes and chicken.

2. MATERIALS AND METHODS

Study Area: Maharashtra State, India.

Taxonomy: Cestode parasites were collected from intestine of fishes and birds from Maharashtra State, India. Cestodes are preserved in hot 4% formalin, stained in Haematoxylin and Borax carmine, mounted in D.P.X, microphotograph were taken with digital camera and identification is done with the help of standard protocol (Yamaguti, 1959).

Histopathology: The fixed materials from Bouins fluid were removed, washed, dehydrated through alcoholic grades, cleared in xylene and embedded in paraffin wax (58-62 °C). The sections were taken at 7μ and slides were stained with Haematoxylin- Eosin double staining method.

3. RESULTS AND DISCUSSIONS

Present study focus on diversity of hold-fast organs of some Piscean and avian Cestode Parasites collected from Maharashtra State, India includes Seventeen genera of Eleven families (Table 1 & Figure 1).

Table 1. Piscean and Avian Cestode Parasites collected from Maharashtra State, India.

S.N.	Family	Name of Genera
1.	Amphicotyllidae (Ariola,1899)	*Marcipometra* (Capoor, 1917)
2.	Onchobothriidae (Braun,1900)	*Uncibilocularis* (Southwell, 1925)
3.	Phyllobothriidae (Braun,1900)	*Phyllobothrium*, (Beneden, 1849)
4.	Lecanocephallidae (Braun,1900)	*Polypocephalus* (Braun,1878), *Tylocephalum* (Linton, 1890), *Hexacanalis* (Southwell, 1911)
5.	Tentaculariidae (Poche,1926)	*Nybelina* (Poche,1926)
6.	Gmnnorhynchidae (Dollfus,1935)	*Gymnorhynchus* (Cuiver, 1817 Rudolphi, 1819)
7.	Tetragonocephalidae (Yamaguti, 1959)	*Tetragonocephalum* (Shipley et Hornell, 1905)

8.	Ptychobothridae (Luhe, 1902)	*Senga* (Dollfus, 1934)
9.	Proteocephalidae (La Rue, 1911)	*Gangesia* (Woodland, 1924), *Proteocephalus* (Weinland, 1858), *Silurotaenia* (Nybelin, 1942)
10.	Davaineidae (Fuhrmann, 1907)	*Davainea* (Blanchard, et. Railliet, 1891), *Cotugnia* (Diamare, 1893), *Raillietina* (Fuhrmann, 1920)
11.	Dilepididae (Wardle, Mcleod and Radinovsky, 1974)	Valipora (Linton, 1927)

In course of study the collected Piscean and Avian Cestode parasites possessing following morphological features in their scolex.

1. *MARSIPOMETRA* (CAPOOR, 1917) - Scolex pyramidal, arrow shaped, divided into two region. Anterior region is represented by a pyramidal arrow shaped apical disk. Posterior region represents suckers, which are oval to rounded in shape, arranged in two groups. Host: *Carcharhinus laticaudus*.
2. *UNCIBILOCULARIS* (SOUTHWELL, 1925) - Scolex rounded, oval, triangular. The bothridia are sessile, four in number, balloon shaped. Each bothridium is divided into two oval locula of which the anterior locula is larger than the posterior one. Accessory sucker absent. Each bothridium having bifurcated hooks. Host: *Aetomylaecus nichoffii*, *Dasyatis zugei*.
3. *PHYLLOBOTHRIUM* (BENEDEN, 1849) - Scolex oval, china rose shaped. Bothridia sessile,four, leaf like. Loculia 40-50 on each bothridium. The powerful longitudinal muscle fibers are attached to each bothridium. Host: *Carharhinus macloti*.
4. *POLYPOCEPHALUS* (BRAUN, 1878) - Scolex oval, rectangular. Anterior region represented by a crown of 10-20 tentacles. Posterior region with 4 suckers. Host: *Dasyatis walga, Dasyatis uarnak.*
5. *TYLOCEPHALUM* (LINTON, 1890) - Scolex divided into two region. Anterior region oval, globular. Posterior region quadrangular with four sucker. Host: *Aetomylaecus nichoffii, Dasyatis walga, D. sephen.*
6. *HEXACANALIS* (SOUTHWELL, 1911) - Scolex rectangular, square in shape. Anterior region is highly muscular and bears large protrusible sucker. Posterior region bears four small suckers at corner. Host: *Dasyatis bleekeri*.
7. *NYBELINA* (POCHE, 1926) - Scolex tubular. Anterior part consist four bothridia. Posterior consist pores bulbosa. Hooks three in numbers. Host: *Carcharlinus dussumieri.*
8. *GYMNORHYNCHUS* (CUVIER 1817) - Scolex Tubular, cylindrical in shape. Bothredia sessile and divided into four parts. Host: *Carcharhinus dissumeri.*
9. *TETRAGONOCEPHALUM* (SHIPLEY ET HORNELL, 1905) - Scolex divided into two region. Anterior region globular, muscular. Posterior region cushion like with four suckers. Host: *Dasyatis bleekeri, Dasyatis walga*.

10. *SENGA* (DOLLFUS, 1934) - Scolex triangular, tubular, conical, pear shaped, rectangular, pyramidal, barrel shaped, tapering anteriorly and broad posteriorly, having pair of sessile bothria, rostellum oval to rounded, armed with circled or semi circled hooks. Host: *Mastacembelus armatus*, *Channa* sp.
11. *GANGESIA* (WOODLAND, 1924) - Scolex fusiform, spherical, triangular, quadrangular, globular with marked rosetellum, rostellum armed with hooks, suckers four, muscular. Host: *Channa* sp., *Wallago attu, Macrones seenghala, Clarias batrachus, Labeo rohita, Cirrhina mrigala.*
12. *PROTEOCEPHALUS* (WEINLAND, 1858) - Scolex large, rounded, triangular, conical, globular, triangular, suckers four to five in numbers, muscular. Host: *Channa sp., Wallago attu, Mystus seenghala, Rita.* sp.
13. *SILUROTAENIA* (NYBELIN, 1942) - Scolex large, pear shaped, vessel shaped, quadrangular, triangular, suckers four, muscular, rostellum oval to rounded, armed with 'V' shaped hooks. Host: *Wallago attu, Macrones seenghala, Barbus ticto, Mystus seenghala*.
14. *DAVAINEA* (BLANCHARD, ET. RAILLIET, 1891) - Scolex medium, rounded, suckers four, muscular, rostellum large, oval to rounded, armed with 'single circle of hooks. Host: *Gallalus gallus domesticus*.
15. *COTUGNIA* (DIAMARE, 1893) - Scolex globular with four suckers, rostellum rectangular, oval, armed with hooks. Host: *Gallalus gallus domesticus*.
16. *RAILLIETINA* (FUHRMANN, 1920) - Scolex small, squarish, suckers four, muscular, rostellum armed with spines. Host: *Gallalus gallus domesticus*.
17. *VALIPORA* (LINTON, 1927) - Scolex oval, pointed at anterior extremity, suckers four, muscular, rostellum oval to rounded, armed with large sized hooks. Host: - *Gallalus gallus domesticus, Columba livia*.

Scolex located at anterior end, is the attachment portion, the morphology and dimensions of which are key features in identification of these worms. To facilitate attachment to the host's intestinal wall, tapeworms utilize several types of structures on their scolices, viz. suckers, tentacles, bothridia and hooks. Results of present study are in agreement with those conducted by Jadhav et al., (2006) described diversity of hold fast organs of Lecanicephalidean tapeworms are importance for taxonomic observation and parasitic association. Edwin Linton studied hold fast organ in Cestodes of vertebrates. He noticed scolex of some Cestodes possessing only suckers, suckers with rostellar hooks, bothria, tentacles for adhesion purpose. Hiscock, (1954); described comparative morphological and functional information on scolex structures for use of systematic and phylogenetic investigation of *Trypanrhyncha*. Palm, (1997) uses number of bothridia, presence or absence of bothridial pits and bulbular organs to distinguish major *Trypanorhyncha* taxa. Campbell and Beveridge, (1994) classified the *Trypanorhynchs* largely on arrangements of tentacular hooks, structure of scolex, mature proglottids. Bhure and Nanware, (2015) studied hold-fast organs found in Cestode parasites of freshwater and marine fishes. Present work showed noticeable variation in hold fast organs in Piscean and avian Cestode parasites, which is important for taxonomic identification of Cestodes.

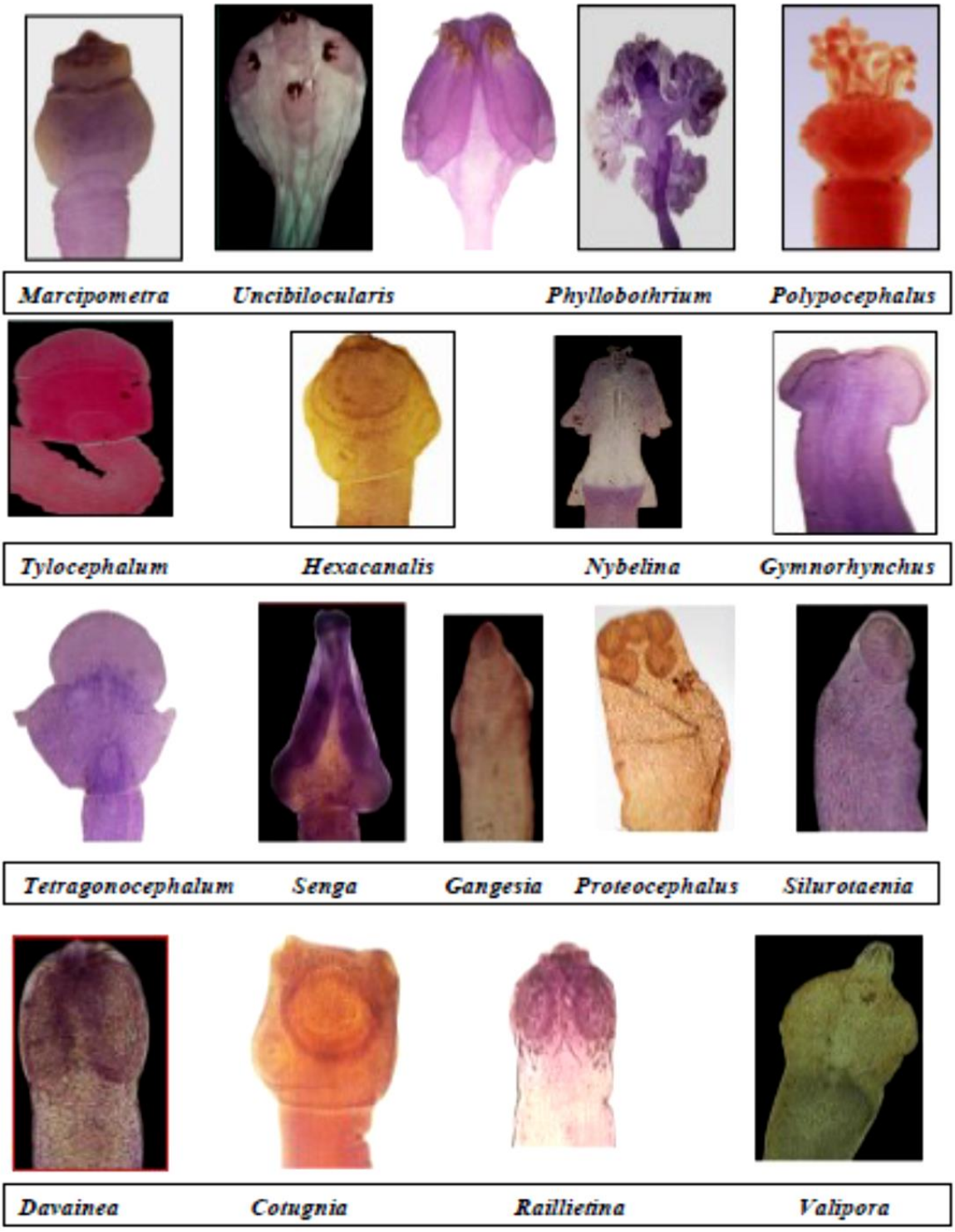


Fig.1: Diversity of Hold fast organs of Piscean and Avian Cestode Parasites Cestode Parasites.

Histopathology

Helminth parasites are important agents among etiology of many fish diseases and may harm their hosts in different ways. These parasites may cause irritation, injury or atrophy of tissues and occlusions of alimentary canal, blood vessels or other ducts. Their presence may lead to certain changes in the activity of enzymes, vitamins or hormones of their hosts. Also, they may introduce toxic metabolic byproducts that may lead to deprive fish from normal feeding (Williams, 1967). Histopathology is the microscopic study of tissues affected by disease. The procedures adopted for preparation of material for such studies are known as histological or histopathological techniques. Host parasites relationship results in gain of one organism and loss of another. It leads to various diseases and disorders. Helminths infect almost all regions of alimentary tract of fish and birds. Any damage to alimentary canal will alter physiological activities of host. For cestode parasites most favourable and selected site is alimentary canal, and the reason is to meet their primary need of food from the host. Cestodes have also been found to infect many Piscean and avian host and cause pathological effects on host. In some cases parasites have caused severe changes in host.

Microscopic study of tissues affected by the cestode parasites revealed different pathological conditions.

Normal histological structure (Healthy intestine) of the host showed that the healthy villi and all layers i.e. serosa, muscularis mucosa, submucosa and mucosa are clearly observed (Fig. 2), where as infected intestine (Fig. 3) has been observed that worm attached to the mucosal layer of intestine and slowly invades the deeper layers of host tissue.

A) *Uncibilocularis* sp. - The worms *Unicibilocularis* sp. is having penetrative scolex, and have close contact with the intestinal tissue of the host *Dasyatis zugei*. In T.S. of intestine of *Dasyatis zugei*, cestode attached to mucosal, sub-mucosal and muscularis mucosa of intestine are damaged and destroys the intestinal Villi by penetrative scolex.

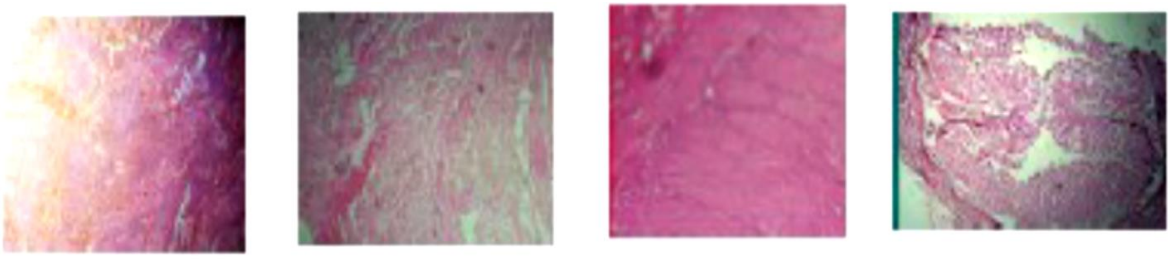
B) *Tylocephalum* sp. - Scolex of *Tylocephalum* sp. is Penetrative, it adhere with intestinal wall causing damage to intestinal epithelim of Villi, Destruction of epithelium at the point of attachment was also observed and large connective tissue origin in paramucosal lumen of *Aetomylaecus nichoffii.*

***C*) *Senga* sp.** - *Senga Sp.* is having scolex with rostellum, which is medium, triangular, rounded, with 45-50 hooks which are used for attachment of worm to the intestine of host *Mastacembelus armatus.* In T.S. of intestine of *Mastacembelus armatus* it has been observed that cestode attached to mucosal, sub-mucosal and muscularis mucosa of intestine and slowly damaged hosts intestinal villi, invaded deep and forming the cyst like structure and pad formation took place for invading and sucking the content in the region of villi.

D) *Cotugnia* sp. - Scolex of *Cotugnia* sp. is penetrative and well developed. Worm is very easily adhere itself to the host tissue and sucks the nourishment, scolex with rostellar muscular pad with spines and four suckers which help them adhering to the intestine tissues. Microscopical observations of infected intestinal tissue showing damage and disturbed the intestinal wall and broken the intestinal villi by adhering scolex of *Cotugnia* sp.

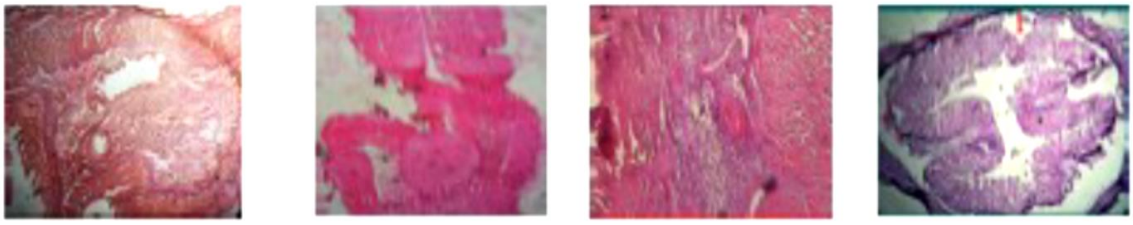
Cestode infection causes alteration which leads to destruction of internal anatomy, resulting in total change of its appearance. Infected host includes shortening of villi, thickening of the muscle layer, destruction of villi, hold fast penetration of mucosa and damage of both the mucous and submucous membranes.

Present findings are more or less similar to observations made by (Bose and Sinha, 1983) who reported the pathological changes mainly enhanced mucus secretion in *Heteropneustes fossilis* infected by nematode, *Procamallanus spiculogubernaculus*.



A B C D

Fig.2: T.S. of Non-infected intestines of A- *Dasyatis zugei* B- *Aetomylaeus nichofii* C- *Mastacembelus armatus* D-*Gallus gallus domesticus*



A B C D

Fig.3: T.S. of Infected intestines of A- *Dasyatis zugei* B- *Aetomylaeus nichofii* C- *Mastacembelus armatus* D-*Gallus gallus domesticus*

Ahuwalia, (1960) studied the histopathology of *Gastrodicoides hominis* a digenean trematode of pig and reported leucocytic infiltration and mucosal epithelium destruction. Thurston (1965) reported monogenean gill parasites pathogenic in massive infestations because they damage epithelia and cause secretion excessive amount of mucus which affects respiration.

Bauer *et al*. (1969) report high mortality among heavily infected juvenile carp (90%) and also report pathological changes in infected fish, which include pressure lesions, inflammation of the intestine and severe "catarrhalhaemorrhagic enteritis" at the parasite attachment point, with proliferation of the peripheral connective tissue.

Satpute and Agrawal (1974) noticed shortening of villous processes and inflammatory response in the submucosa and serosa of *C. batrachus* infected with *Lytocestus indicus* and *Diphyllobothrium penetram*. Banhawy *et al*, (1975) as degenerative changes in gut wall, liver and pancreas of *Synodontis schall* as a result of *Wenyonia virilis* infection. Kapustina Kapustina N.I., (1978) noted damage to intestinal mucosa adjacent to the strobila of *K. sinensis*, which was attributed to cestode feeding strategies, migration of the parasite in the

gut, and previous sites of attachment. Haque and Siddiqui, (1978) reported infection of *Fasciolopsis buski* causing surface desquamation and destruction of mucosal epithelium, infiltration of eosinophils and plasma cells. Nassef (1988) showed complete destruction of the intestinal villi with leukocyte infiltration due to *Paragorgorhynchus albertianum* infested the gastrointestinal tract of *Lates niloticus*. Nasira Khatoon,(2004) studied the total destruction and necrosis of all layers of intestinal wall and severe destruction occurs in mucosa and sub-mucosa *Nesokia indica* parasitized by *Syphacia* sp. Such types of changes were also observed in fishes parasitized by *Anisakis* larvae (Bilqees, F.M. and Parveen, S. 1996).

Destruction of the epithelium at the point of attachment was observed by some workers and large numbers of detached cells of epithelial and connective tissue origin in the paramucosal lumen (Chaicharn, A. and Bullock, W.L. 1967). Nanware *et al*., (2005) reported intestinal infilammation and vasodilation of intestinal tissue of *Carcharias acutus* by *Phoreobothrium* sp. and destruction of intestinal villi by invasion of Scolex of *Moniezia sp.* inhabiting intestinal tract of *Capra hircus* L. Ruhela *et al*. (2006) revealed pyknotic epithelial cells in mucosa, vacuolization, separation of muscular layers, rupturation of serosa and shortening and truncated villi in the intestine of *C. batrachus* experimentally infected by *Procamallanus*.

Akinsanya Bamidele (2007) reported histopathology of the fish tissues shows different pathological conditions. There was mucosal oedema, haemorrhage with haemosiderosis in some tissues examined while there was moderate focal lymphocytic infilterations of myocardium of heart in some fish species. Jadhav B.V.*et al.,* (2008) reported intestinal pathology of *Gallus gallus domesticus* parasitized by *Davainea* sp. V. Gupta and S.K. Srivastava, (2007) observed heavy infection of *Fasciolopsis buski* damaging lamina propria, submucosa and mucosa with profuse infiltration of eosinophils, lymphocytes and plasma cells of pig intestinal tissue. Khadap, (2009) reported plug formation at ruptured epithelial portion which may have formed from lymphocytes and eosinophilic cells of intestinal tissue of *Gallus domesticus* parasitized by *Cotugnia*. Amina Mansi *et al.,* (2011) recorded Severe damage occurred to the gill tissue due to the monogeneans opithohaptor, Limited lesions to the infected tissue of the fish due to buccal capsule of nematodes, Deep penetration of intestinal tissue due to Cestode scolex.

Nanware and Bhure, (2011) studied intestinal histopathology of *Capra hircus* L. infected with *Stilesia jadahave*, and their results shows, that the worm is not having very close contact but it has developed very weak contact and attached loosly to crypts of Liberkuhn. Pathan *et al.,* (2011) studied infected intestinal tissue gets broken due to penetration of hooks and formed ulcer from intestine *Aetomylaeus nichoffii* parasitized by *Uncibilocularis* sp. Rezaei *et al*. (2013) studied histo-pathological changes in the intestinal wall of *Neogobius bathybius* infected by *D. minutus* and revealed mucosal erosion, increased number of goblet cells, hyperplastic changes in the epithelial cells, and remarkable hyperplasia that formed nodule-like structures with hyperemia in the submucosa.

Laxma Reddy and Benarjee (2014) observed that the stomach is highly effected due to helminth infestation which was evidenced by total eruption of villi from the mucous membrane which resulted to a major disruption of the structural organization of the organ which might have profound influence on the nutrition and digestion process of the fish. Bhure and Nanware (2015) reported Piscean cestodes were attached to intestinal tissue and ruptured villi, destructed mucosal, sub mucosal layer of intestine.

4. CONCLUSION

Study reveals that, Cestode parasites are attached with holdfast organs to tissues of intestine; the villi of crypts of liberkuhn are ruptured, destructed mucosa, sub mucosa of intestine and shifted apart by penetrating the worm. Host is in loss, not able to drive away the parasite or to kill it by secreting toxins in the cavity formed by the encircling villi**.** Due to occurrence of these Cestodes, physiological activities of victimized fishes are hindered and their growth is retarded which cause economic loss to fishery.

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