Global Veterinaria 5 (6): 302-306, 2010
ISSN 1992-6197

Histology of Bighead Carp *(Hypophthalmichthys nobilis)* Intestine

[1]M. Delashoub, [1]I. Pousty and [2]S.M. Banan Khojasteh

[1]Department of Anatomy and Histology, Faculty of Specialized Veterinary Sciences,
Science and Research Branch, Islamic Azad University, Tehran, Iran
[2]Department of Animal Biology, Faculty of Natural Sciences, University of Tabriz, Tabriz, Iran

Abstract: This study addressed the histology of intestine of the bighead carp. The histological characterization of the intestinal wall revealed that it is composed of the tunica mucosa, tunica submucosa, tunica muscularis and tunica serosa. It is line by simple columnar epithelium in association with goblet cell, where as the mucosa is thrown into folds (villi). A thin layer of smooth muscle fibers lies between tunica mucosa and submucosa. The tunica muscularis has two layers. Outer layer of intestine is tunica serosa. In the tunica mucosa and submucosa, many eosinophilic granular cells were observed.

Key words: Histology · Bighead carp intestine

INTRODUCTION

A better knowledge of alimentary canal normal morphological and histological structure is essential for a deeper understanding of the physiology and pathology of fish digestive tract. The intestine is an organ involved in important physiological functions, being the primary site of food digestion and nutrient uptake. Therefore optimum utilization of dietary nutrients depends generally on the effectiveness of these functions [1]. The morphological traits of the different fish alimentary canal is so related to the physical characteristics of food, feeding habits, taxonomy, as well as to body shape and size, that guts typical of carnivorous, herbivorous and omnivorous species are found in the same family. In addition, for a given species, the feeding habits differ according to locality, season, age or sex [2-4]. The alimentary tract of teleostean fish has been studied widely and described morphologically to determine the function of many specialized anatomical structures in relation to the different feeding adaptations [5-15].

In Iran, warm-water fish farming is based on Chinese carps namely common, grass, bighead and silver carp. These carps are easy to breed in hatcheries in large numbers at little cost and are distributed to farmers to grow out in ponds or open waters [16].

Thhe present study aimed to study the intestinal histology of the bighead carp. This study will give a deeper insight into the morphological and functional aspects of the intestine of bighead carp and will be the basis for its comparison with other teleostean fish.

MATERIALS AND METHODS

Ten live adult and macroscopically normal bighead carps of both sexes, weighing 1500-2000g, obtained from a local fish farm around Rasht city, Guilan Province, Iran. Fish were killed by decapitation and dissected immediately after catching. The digestive tracts were rapidly removed and the samples of anterior, middle and posterior intestine were fixed by immersion in 10% buffered formalin for light microscope studies. Samples were routinely processed by dehydration in an ethanol series and then embedding in paraffin. Six micrometer-thick histological sections were cut by microtome, prepared according to standard protocol and then stained with haematoxylin and eosin (H and E). Micrographs were taken with an Olympus microscope (Tokyo, Japan).

RESULTS

In the present study it was found that the intestinal wall was composed of the tunica mucosa, tunica submucosa, tunica muscularis and tunica serosa. The tunica mucosa has many folds (Villi) (Fig. 1) that shorten and become wider from anterior to posterior intestine

Corresponding Author: M. Delashoub, Department of Anatomy and Histology, Faculty of Specialized Veterinary Sciences, Science and Research Branch, Islamic Azad University, Tehran, Iran.
E-mail: masoud.delashoub@gmail.com.

Fig. 1: Anterior part of the intestine. V: Villi, M: Tunica Muscularis (x40).

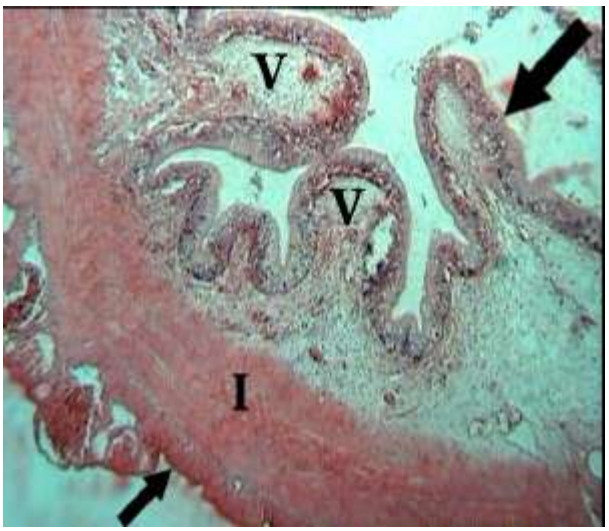

Fig. 2: Villi of the posterior intestine. V: Villi, I: inner circular muscle, small arrow: tunica serosa, large arrow: epithelium (x40).

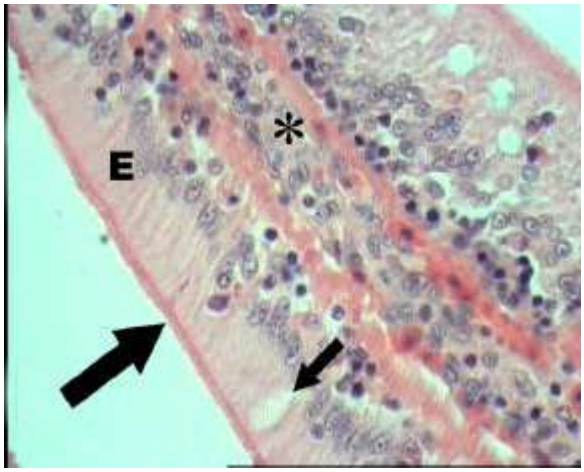

Fig. 3: Part of a villous, E: epithelium, *: Tunica mucosa, small arrow: goblet cell, large arrow: brush border (x400).

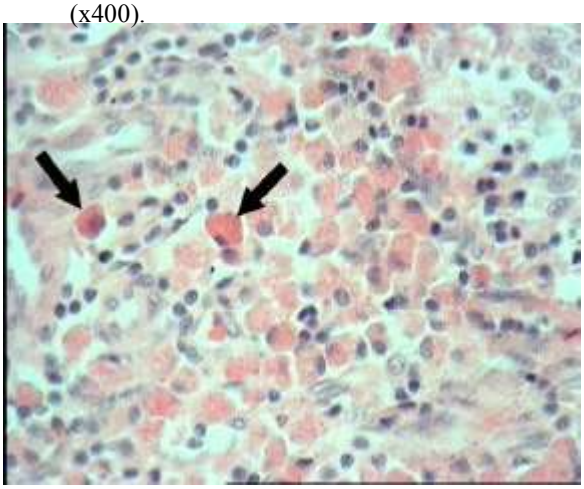

Fig. 4: Eeosinophilic granular cells (arrows) (x400).

(Fig. 3). The numbers of goblet cells are higher in posterior part of intestine than in the anterior part. (Fig. 2). The mucosal epithelium is simple columnar composed of enterocytes with brush border, where there are mucus secreting goblet cells between them Under the simple columnar epithelium, there is a layer of loose connective tissue with many eosinophilic granular cells (Fig. 4). A thin layer of smooth muscle fibers lies between tunica mucosa and submucosa (Fig. 5). The tunica muscularis had two layers of smooth muscle: a thick inner longitudinal and a thinner outer circular (Fig. 6) that many nerve plexuses lies between them (Fig. 7). The inner longitudinal muscle layer in anterior part is thicker than posterior part. Under the flat epithelium of the tunica serosa, there are vessels and nerves. No tubular mucosal and/ or submucosal glands and also lymph nodules are seen throughout the intestine.

Fig. 5: Muscularis mucosae (arrow) (x400).

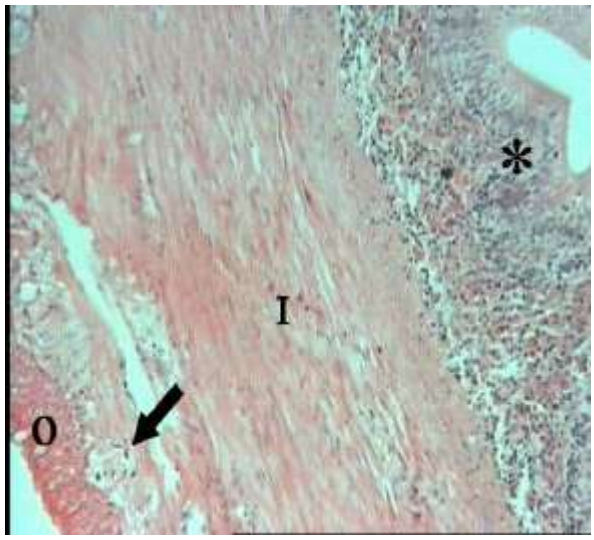

Fig. 6: Tunica muscularis. I: inner circular layer, O: outer circular layer, arrow: nerve plexus, Ý: tunica mucosa (x100).

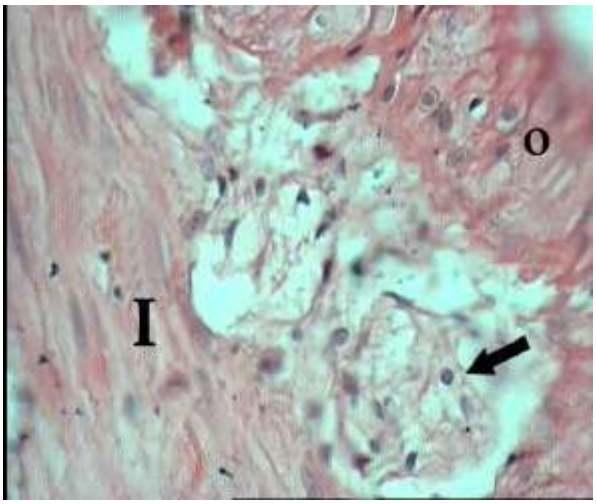

Fig. 7: Nerve plexus between inner and outer muscle layers. I: inner circular layer, O: outer circular layer, (x400).

DISCUSSION

Although there are many different characteristics among species [18], the wall of the intestine of bighead carp, as also occurs in other teleostean fish, is composed of the four layers described for vertebrates. In present study, in has found that, villi became shorter and wider toward the posterior intestine. Albrecht *et al*. [19] reported that there were no mucosal differences between different regions in two related neotropical omnivorous fish except for villi lengths. There are similar results in rice field eel [7]. Some researchers have reported distinct Villi in the first two regions and not in the posterior intestine [6].

The elevation of the mucosa into villi favores the absorptive role of it [14].

The presence of columnar absorptive cells (enterocytes) in bighead carp, are generally similar to those in other vertebrates as are goblet cells, which secrete mucus to lubricate and protect the intestinal mucosa against physical and chemical damage and microorganism attacks [17].

It has cleared that intestinal digestive ability depends on goblet cell secretions, proteolytic action of pancreatic juice and / or intracellular digestion. The epithelial lining cells of fish intestine produce different glycoconjugates [3]. So, the occurrence of mucus is a common feature in the digestive tract of the teleosts. The mucosubstances secreted, differ between species and also along the fish alimentary canal [4].

The goblet cells can be determined early during the differentiation of the intestinal mucosa of fish [5], but in some species like European catfish, there were rare goblet cells on the intestinal villi [12]. The increased number of goblet cells toward the distal part of intestine that observed in this investigation, is similar to other fish [5, 7].

The findings of this study showed the presence of a thin layer of muscularis mucosae and also eosinophilic granular cells in tunica mucosa and submucosa. Banan khojasteh *et al.* [5] reported that there was no muscularis mucosae in rainbow trout intestine, but a collagenous layer named stratum compactum observed in this fish. It is believed that the stratum compactum containing dense collagen layers function to strengthen and preserve the entirety of the gut wall [5].

Eosinophilic granular cells *(EGCs)* observed in this study, are considered to be analogus to mammalian mast cells. It has characterized a series of rapid morphological EGCs responses to bacterial pathogens which may be involved in mediating inflammation in fish [5, 20].

In conclusion, many histological features of intestine of big head carp are similar with other vertebrates and also bony fish, because the basic structure of gut wall i.e. presence of tunica mucosae, tunica submucosae, tunica muscularis and serosa are present. However there are some differences. It seems that intestinal structure is more identical in various species of family *Cyprinidae.*

REFERENCES

1. Caballero, M.J., M.S. Izquierdo, E. Kjorsvik, D. Montero, J. Socorro, A.J. Fernandez and G. Rosenlund, 2003. Morphological aspects of intestinal cells from gilthead seabream *(Sparus aurata)* fed diets containing different lipid sources, Aquaculture, 225: 325-340.
2. Kapoor, B.G., H. Smith and I.A. Verighina, 1975. The alimentary canal and digestion in teleosts, Advances in Marine Biology, 13: 109-139.
3. Scocco, P., G. Menghi and P. Ceccarelli, 1997. Histochemical differentiation of glycoconjugates occurring in the tilapine intestine, J. Fish Biol., 51: 848-857.
4. Diaz, A.O., A.M. Garcia and A.L. Goldemberg, 2008. Glycoconjugates in the mucosa of the digestive tract of cynoscion guatucupa: a histochemical study, 110: 76- 85.
5. Banan khojasteh, S.M., F. Sheikhzadeh, D. Mohammadnejad and A. Azami, 2009. Histological, histochemical and ultrastructural study of the intestine of rainbow trout *(oncorhynchus mykiss)*, world Appl. Sci. J., 6: 1525-1531.
6. Cinar, K. and N. Senol, 2006. Histological and histochemical characterization of the mucosa of the digestive tract in flower fish *(Pseudo-phoxinus antalyae)*, Anatomia Histologia Embryologya, 35: 147-151.
7. Dai, X., M. Shu and W. Fang, 2007. Histological and ultra structural study of the digestive tract of rice field eel, Monopterus albus, J. Appl. Ichthyol., 23: 177-183.
8. Domeneghini, C., G. Radaelli, G. Bosi, S. Arrighi, A. Di Giancamillo, M. Pazzaglia and F. Mascare, 2006. Morphological and histochemical differences in the structure of the alimentary canal in feeding and runt (feed deprived) white sturgeons *(Asipenser transmontanus)*. J. Appl. Ichthyol., 18: 341-346.
9. Kuperman, B.I. and V.V. Kuzmina, 1994. The ultra structure of the intestinal epithelium in fishes with different types of feeding, J. Fish Biol., 44: 181-193.
10. McDonald, N.L., 1987. An electron microscopic examination of the gastrointestinal epithelium in Dover sole, Solea Solea (L), J. Fish Biol., 31: 27-36.
11. Park, J.Y. and I.S. Kim, 2001. Histology and mucin histochemistry of the gastrointestinal tract of the mud loach, in relation to respiration, J. Fish Biol., 58: 861-872.
12. Petrinec, Z., S. Nejedli, S. Kuzir and A. Opacak, 2005. Mucosubstances of the digestive tract mucosa in northern pike (ESOX lucius L) and European catfish *(Silurus glanis L.)*,Veterinarski Arhiv, 75: 317-327.
13. Domeneghini, C., S. Arrighi, G. Radaelli, G. Bosi and F. Mascarell, 1999. Morphological and histochemical peculiarities of the gut in the white sturgeon, *Acipenser transmontanus*, European J. Histochem., 43: 135-146.
14. Murray, H.M., G.M. Wright and P. Goff, 1996. A Comparative histological and histochemical study of the post- gastric alimentary canal from three species of pleuronectid, the Atlantic halibut, the yellowtail flounder and the winter flounder, J. Fish Biol., 48: 187-206.

15. Carrason, M., A. Grau, L.R. Dopazo and S. Crespo, 2006. A histological, histochemical and ultrastructural study of the digestive tract of *Dentex dentex (Pisces, sparidae*), Histology, Histochem. Pathol., 21: 579-593.
16. Salehi, H., 2004. Carp culture in Iran, Sustainable Aquaculture, 1: 8-11.
17. Marchetti, L., M. Capacchietti, M.G. Sabbieti, D. Accili, G. Materazzi and G. Menchi, 2006. Histology and carbohydrate histochemistry of the alimentary canal in the rainbow trout *Oncorhynchus mykiss*, J. Fish Biol., 68: 1808-1921.
18. Pedini, V., P. Scocco, A.M. Gargiulo, P. Ceccarelli and S. Lorvik, 2002. Glycoconjugate characterization in the intestine of *Umbrina cirrosa* by means of lectin histochemistry, J. Fish Biol., 61: 1363- 1372.
19. Albrecht, M.P., M.F.M. Ferreira and E.P. Caramschi, 2001. Anatomical Features and histology of the digestive tract of two related neotropical omnivorous fish (*characiformes; anastomidae*), J. Fish Biol., 58: 419-430.
20. Powell, M.D., H.A. Briand, G.M. Wright and J.F. Burka, 1993. Rainbow trout *(Oncorhynchus mykiss)* intestinal eosinophilic granular cell (*EGC*) response to *Aeromonas salmonicida* and *Vibrio anguillarum* extracellular products, Fish and Shellfish Immunology, 3: 279-289.