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# Anatomy and histology of the stomach and pyloric caeca in Mugilidae, *Liza klunzingeri* (Day, 1888), from northeastern Persian Gulf

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**Abstract**
Five adult individuals of *Liza klunzingeri* (Day, 1888) were collected from northeastern Persian Gulf. The length and diameter of stomach and the length, diameter and number of pyloric caeca were measured. Anatomical and histological study showed the stomach is U-shaped and gizzard like; it is divisible into anterior cardiac and posterior pyloric portions while pyloric caeca is a finger like straight organs. In transverse section, the wall of the stomach and pyloric caeca is deeply folded with four-layered general structure.

**Keywords:** Morphology, epithelium, muscularis, gizzard.

## 1. Introduction
The alimentary canal of fish is well developed and structurally adapted to accommodate a wide variety of diets. In fact, each fish species has its own structural peculiarities to the alimentary canal specially stomach towards its specific food habits [1]. Knowledge of fish's alimentary canal morphology is becoming increasingly important in fish digestive physiology and improvement of nutrition protocols [2]. Among large number of species, though the stomach is also defined as actual organ, consists of anterior cardiac region and posterior pyloric region [1]. In Mugilidae family the stomach is a simple U- shaped sac which is divisible into a thin-walled cardiac crop and a very thick- walled biconical pyloric gizzard [3]. The function of the gizzard in fishes is similar to birds; to grind or triturate food [4]. The pyloric caeca are blind-ended sphincterless ducts associated with the anterior intestine [4]. The pyloric caeca is found in various number and diameter in different species in Mugilidae family, which the number of pyloric caeca is an important key for the identification of Mugilidae species [3]. The pyloric caeca increase the surface area for digestion and absorption but do not have a role in fermentation or storage [5]. *Liza klunzingeri* (Day, 1888), formerly known as *L. carinata* [6] is one of the commercially important fish species in Persian Gulf and the total catch of 220 ton was recorded in Hormozgan Province of Iran in the 2007-2008 fishing season [7]. There are numerous studies on the different aspects of *L. klunzingeri* from Persian Gulf [7, 8]. The aim of the present study was to explain the anatomical and histological aspects of stomach and pyloric caeca in *L. klunzingeri* (Mugilidae).

## 2. Materials and Methods
Five adult individuals of Mugilidae; *Liza klunzingeri* were collected from Northeastern (27°18'N, 56°26'E) Persian Gulf (Fig. 1). The fishes were killed by blow to the head. For each specimen, the body cavity was cut open through the ventral surface and the alimentary tract dissected out. The length and diameter (from thickest part) of the gizzard like stomach and pyloric caeca were measured (Fig. 2), and immediately fixed in 10% neutral buffered formalin. For histological study, the specimens were sent to the Marine Biology Laboratory of Khorramshahr University of Marine Science and Technology. The tissue was passed through graded ethanol, cleared in xylene, impregnated and embedded in paraffin wax by Tissue-Tek rotary Tissue Processor (Model RX-11B), and sections 5 µm thickness were obtained with Leica Microtome (Model LEICA-RM2245). They were stained with haematoxylin and eosin for light microscopy examination [9]. Photomicrographs were taken with DINO LITE camera attached to Olympus microscope. Statistical analyses were performed using the SPSS version 21 software package and Excel 2007.

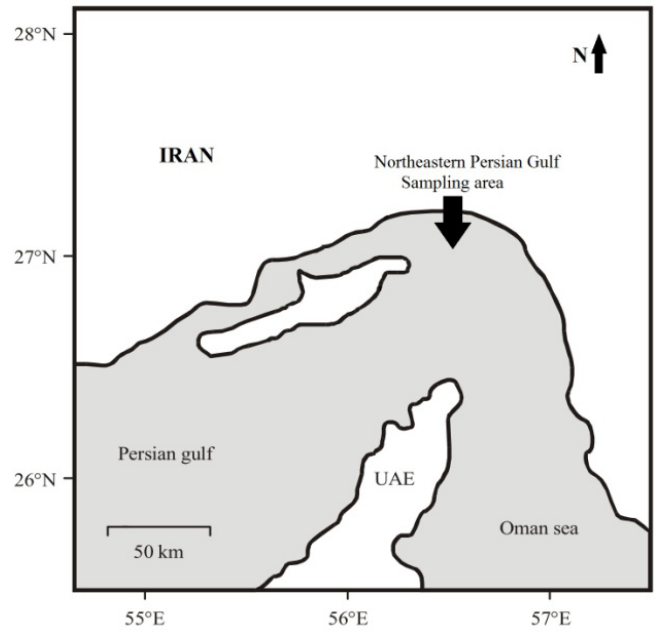


**Fig 1:** The map of sampling region in northeastern Persian Gulf for *Liza klunzingeri*

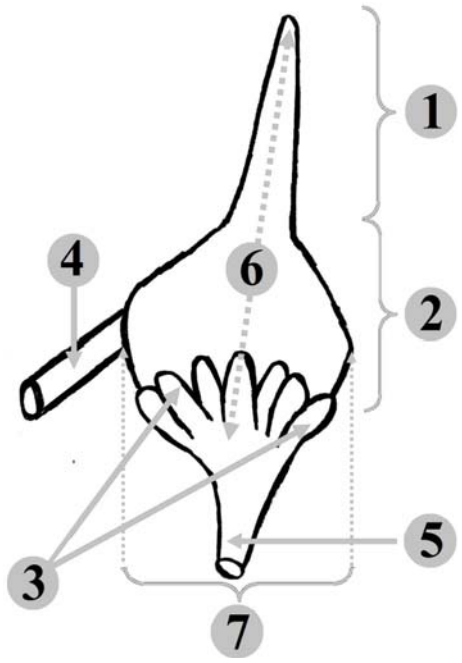


**Fig 2:** Illustration of stomach and pyloric caeca in Mugilidae. 1- Cardiac part, 2- Pyloric part, 3- Pyloric caeca, 4- Esophagus, 5- Intestine, 6- Length of stomach and 7- Diameter of stomach

## 3. Results

The stomach of *Liza klunzingeri* is U-shaped and gizzard like; it was divisible into anterior cardiac and posterior pyloric portions. Mean length and diameter of stomach (±) standard deviations were illustrated in Table 1. In Histological study, in transverse section, the wall of the stomach was thick and deeply folded (Fig. 3). It has a four-layered general structure: tunica mucosa which was of a single-layered columnar epithelium with a developed brush border and lamina propria in the form of connective tissue network, submucosa which was made up of thick fibres of connective tissue, tunica muscularis; an extremely thick layer of smooth muscle and tunica serosa as an outer loose connective tissue (Fig. 3). The circular smooth muscle layer in the pyloric region tends to be more developed than in the cardiac region (Fig. 3). The pyloric caeca of *L. klunzingeri* was finger like straight organs. Mean length and diameter (±) standard deviations and number of pyloric caeca were illustrated in Table 1. The wall of the pyloric caeca was thin and deeply folded (Fig. 3). Pyloric caeca also had a four-layered general structure like stomach but in this tunica muscularis had a thin layer of smooth muscle (Fig. 3).

**Table 1:** Characteristics of stomach and pyloric caeca in *Liza klunzingeri*

| | **Mean ± SD** |
|---|---|
| Length of Stomach (cm) | 1.11 ± 0.12 |
| Diameter of Stomach (cm) | 0.78 ± 0.08 |
| Length of Pyloric Caeca (cm) | 0.73 ± 0.06 |
| Diameter of Pyloric Caeca (cm) | 0.31 ± 0.01 |
| Number of Pyloric Caeca | 5 |

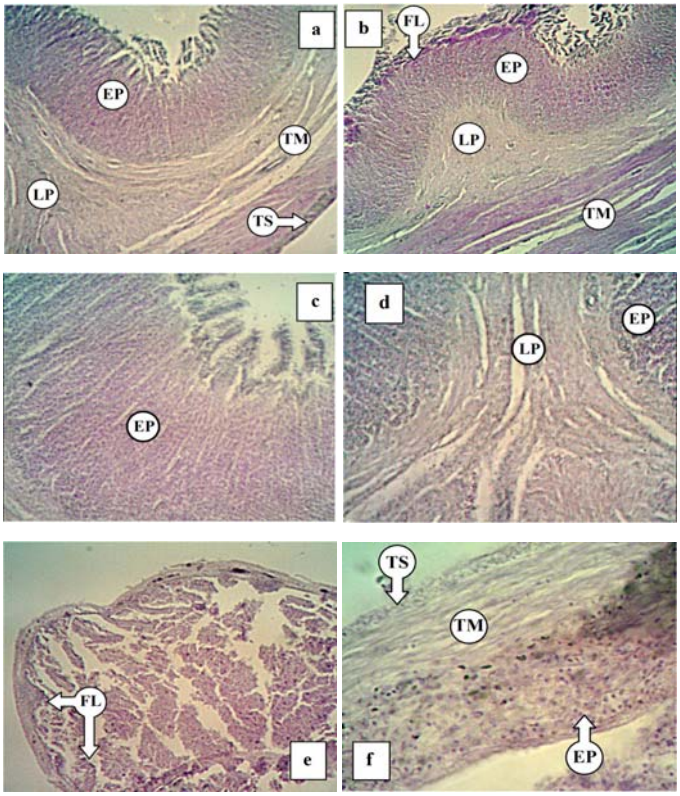


**Fig 3:** Light microscopy images, 5 µm transverse sections of stomach and pyloric caeca wall; haematoxylin /eosin staining. a and b: (×40 resolution, wall of stomach); c and d: (×100 resolution, wall of stomach); e: (×40 resolution, wall of pyloric caeca) and f: (×400 resolution, wall of pyloric caeca). Folds (FL), tunica serosa (TS), tunica muscularis (TM), lamina propria (LP), epithelium (EP).

## 4. Discussion

The digestive tract of teleost is well adapted to various modes of feeding and different kinds of diet. The alimentary canal of fish exhibits a remarkable diversity of morphological and functional characteristics [2, 10-12]. The teleost stomach shows a morphology which exhibits a distinct difference on that correlates with diet, feeding habit, body shape and also environmental conditions [13-15]. In fact, each fish species has its own structural adaptations of the stomach towards its specific food habit [1]. In *Liza klunzingeri* such as other fishes of Mugilidae family, the stomach was U-shaped and gizzard like [3]. U-shaped stomach probably allow for stretching during

food consumption and gizzard like shape is adapted for trituration of coarse plant, sand and/or mud [1]. The mucosal epithelium of the stomach of *L. klunzingeri* was similar to that of other teleosts [1, 16-20], and it was entirely composed of columnar epithelium. The circular smooth muscle layer in the pyloric region tends to be more developed than in the cardiac region; however, extreme thickening assumes a globular or spindle-like shape giving the appearance of the gizzard [3, 4, 21]. Some fish also possess caeca which are located in the proximal gut adjacent to the pyloric sphincter (hence the name pyloric caeca). The pyloric caeca increase the surface area for digestion and absorption but do not have a role in fermentation or storage [5].

The number and the structure of pyloric caeca is used for taxonomic separation of the genera of mullets by earlier workers [22-26]. The number is known to vary from 2 to 22 in the genus *Mugil*, while in the genus *Liza* it is between 2 and 17 [25, 27]. In this study *L. klunzingeri* had 5 long pyloric caeca which conformed to [3]. The pyloric caeca and proximal intestine are structurally similar and have the same function in digestion [28]. The wall of pyloric caeca was thin and deeply folded and it had a four-layered general structure: tunica mucosa which was of a single-layered columnar epithelium with a developed brush border and lamina propria, submucosa, tunica muscularis; a thin layer of smooth muscle and tunica serosa as a loose connective tissue.

## 5. Conclusion

The present study provided basic information about mean length and diameter of stomach and mean length and diameter and number of pyloric caeca from *Liza klunzingeri* (Day, 1888). Anatomical and histological study showed the stomach of *L. klunzingeri* is U-shaped and gizzard like; it is divisible into anterior cardiac and posterior pyloric portions. In transverse section, the wall of the stomach is thick and deeply folded. It has a four-layered general structure: tunica mucosa, submucosa, tunica muscularis and tunica. The circular smooth muscle layer in the pyloric region tends to be more developed than in the cardiac region. The wall of the pyloric caeca is thin and deeply folded and it has a four-layered general structure like stomach but in which tunica muscularis has a thin layer of smooth muscle.

## 6. References


1. Chakrabarti P, Ghosh SK. A comparative study of the histology and microanatomy of the stomach in *Mystus vittatus* (Bloch), *Liza parsia* (Hamilton) and *Oreochromis mossambicus* (Peters). Journal of Microscopy and Ultrastructure. 2014; 2:245-250.
2. Banan Khojasteh SM. The morphology of the post-gastric alimentary canal in teleost fishes: a brief review. International Journal of Aquatic Science. 2012; 3(2):71-88.
3. Thomson JM. The Mugilidae of the world. Mem. Queensland Mil: Memorial Museum 1997; 41:457-562.
4. Wilson JM, Castro LFC. Morphological diversity of the gastrointestinal tract in fishes. In: Grosell M, Farrell AP, Brauner CJ, (Eds). The multifunctional gut of fish. Academic Press is an imprint of Elsevier 2010; XXX:1-55.
5. Buddington RK, Diamond J. Pyloric caeca of fish: a ‘‘new’’ absorptive organ. American Journal of Physiology. 1987; 252:65-76.
6. Carpenter EK, Krupp F, Jones DA, Zajonz U. The Living Marine Resources of Kuwait, Eastern Saudi Arabia, Bahrain, Qatar and the United Arab Emirates. FAO Species Identification Field Guide for Fishery Purposes, Food and Agriculture Organization of the United Nations, Rome, Italy, ISBN: 9251037418, 1997, 239.
7. Hakimelahi M, Motlagh AT, Kamrani E, Shojaei MG, Vahabnezhad A. Female reproductive biology of the Klunzinger's mullet (*Liza klunzingeri*) in the Persian Gulf and the Oman Sea. Journal of Persian Gulf. 2011; 2:21-28.
8. Evans JJ, Klesius PH, Gilbert PM, Shoemaker C, Al-Sarawi M, Landsberg J *et al*. Characterization of β-haemolytic group B *Streptococcus agalactiae* in cultured seabream, *Sparus auratus* L. and wild mullet, *Liza klunzingeri* (Day), in Kuwait. Journal of Fish Diseases. 2002; 25:505-513.
9. Bancroft JD, Stevens A. Theory and practice of histological techniques. New York, USA: Churchill Livingstone, 1977.
10. Murray HM, Wright GM, Goff GP. A comparative histological and histochemical study of the post-gastric alimentary canal from three species of pleuronectids, the Atlantic halibut, the Yellowtail flounder and the winter flounder. Journal of Fish Biology. 1996; 48:187-206.
11. Buddington RK, Krogdahl A, Bakke-Mc, Kellep AM. The intestines of carnivorous fish: structure and function and the relations with diet. Acta Physiologica Scandinavica 1997; 161:67-80.
12. Khalaf Allah HMM. Morphological adaptations of digestive tract according to food and feeding habits of the broomtail wrasse, *Cheilinus lunulatus*. Egyptian Journal of Aquatic Biology and Fisheries. 2013; 17:123-141.
13. Reifel CW, Travill AA. Structure and carbohydrate histochemistry of the stomach in eight species of teleosts. Journal of Morphology. 1978; 158:155-167.
14. Anderson TA. Histological and cytological structure of the gastrointestinal tract of the luderick, *Girella tricuspidata*, in relation to diet. Journal of Morphology. 1986; 190:109-119.
15. Winemiller KO, Kelso-Winemillar LC, Brenkert AL. Ecomorphological diversification and convergence in fluvial cichlid fishes. Environmental Biology of Fishes 1995; 44:235-261.
16. Elbal MT, Agulleiro B. A histochemical and ultrastructural study of the gut of *Sparus auratus* (Teleostei). Journal of Submicroscopic Cytology. 1986; 18:335-347.
17. Grau A, Crespo S, Sarasquete MC, González de Canales ML. The digestive tract of the amberjack *Seriola dumerili*, Risco: A light and scanning electron microscope study. Journal of Fish Biology. 1992; 41:287-303.
18. Gargiulo AM, Ceccarelli P, Dallaglio C, Pedini V. Ultrastructural study on the stomach of *Tilapia* spp (Teleostei). Anatomia, Histologia, Embryologia 1997; 26:331-336.
19. Arellanol JM, Storch V, Sarasquetel C. Histological and histochemical observations in the stomach of the Senegal

sole, *Solea senegalensis*. Histology and Histopathology 2001; 16:511-521.
20. Ghosh KS, Chakrabarti P. Histological and histochemical characterization on stomach of *Mystus cavasius* (Hamilton), *Oreochromis niloticus* (Linnaeus) and *Gudusia chapra* (Hamilton): Comparative study. The Journal of Basic & Applied Zoology. 2015; 70:16-24.
21. Kapoor BG, Smit H, Verighina AI. The alimentary canal and digestion in teleosts. Advances in Marine Biology 1975; 13:109-239.
22. Thomson JM. The Mugilidae of Australia and adjacent seas. Australian Journal of Marine & Freshwater Research. 1954; 5(1):70-131.
23. Thomson JM. The Grey Mullets. Oceanography and Marine Biology; An Annual Review 1966; 4:301-315.
24. Pillay SR. A revision of Indian Mugilidae. Journal of Bombay Natural History Society. 1962; 59(1):254-170, 59(2):547-576.
25. Luther G. New characterstics for consideration in the taxonomic appraisal of grey mullets. The Marine Biological Association of India 1977; 19(1-2):1-9.
26. Jayaram KC. The freshwater fishes of the Indian region. Narendra Publishing House, Delhi, 1999, 225-331.
27. Kurma RR, Babu KR. Studies on Grey Mullets Collected from Interu Swamp, at Krishna Estuarian region, Andhra Pradesh, India. Research Journal of Marine Sciences. 2013; 1(2):12-16.
28. Catladi E, Cataudella S, Monaco G, Rossi A, Tancioni L. A study of the histology and morphology of the digestive tract of the sea-bream, *Sparus aurata*. Journal of Fish Biology. 1987; 30:135-145.