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Anatomical Study of the stomach and pyloric caeca in *Thalassoma pavo* (Linnaeus, 1758), from northeastern Libya Jebel Akhdar Al Hamamah

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Abstract The aim of this study was to explain the anatomical aspects of stomach and pyloric caeca in (Linnaeus, 1758) were collected from Jebel Akhdar Al Hamamah. Ten adult individuals were collected. The length and diameter of stomach and the length, diameter and number of pyloric caeca were measured. Anatomical and histological study showed stomach is divided into anterior cardiac and posterior pyloric portions, while pyloric caeca is a finger-like straight organ. Histological specimens were and observed under light microscope. It was shown that pyloric caeca in Thalassoma pavo attached and formed a large mass between stomach and duodenum. the results show that the pyloric caeca are non-branched fingerlings structures numbering (13) and length rate was (0.3) cm The wall of pyloric caeca of main layers : mucosa ,submucosa , muscularis and serosa , lining epithelium of pyloric caeca were simple columnar consisting of enterocytes having goblet cells in between , goblet cells caeca , tunica submucosa was a thin layer of dense connective tissue , tunica muscularis consists of smooth muscle fibersarranged in two layers : internal circular and external longitudinal , tunica serosa was thin layer of loose connective tissue surrounded by mesothelium.
Keywords: Anatomical, stomach, Thalassoma pavo , Al Hamamah.

دراسة تشريحية للمعدة و الزوائد الاعورية في *Thalassoma pavo* (Linnaeus, 1758)، من شمال شرق ليبيا الجبل الأخضر الحمامة

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الملخص كان الهدف من هذه الدراسة شرح الجوانب التشريحية للمعدة والزوائد البوابية لسمكة *Thalassoma pavo* والتي جمعت من منطقة الحمامة بالجبل الأخضر شرق ليبيا. فقد تم جمع عشرة افراد بالغة من هذه السمكة. وتم قياس طول وقطر المعدة وايضا قياس طول وقطر وعدد الزوائد البوابية. وأظهرت الدراسة التشريحية والنسيجية ان المعدة تنقسم نسيجيا الي ثلاث اجزاء هي الامامية والوسطى والخلفية ، ويتكون جدارها من اربعة طبقات هي (المخاطية ، تحت المخاطية ، العضلية ،المصلية الخارجية). في حين أن الزوائد البوابية هي تركيب يشبه الاصابع يوجد بين المعدة والاثنى عشر. وتبين ان الزوائد البوابية هي تراكيب اصبعية الشكل غير متفرعة بلغ معدل عددها (13) وبلغ معدل طولها (0.3) سم. يتكون جدار الزوائد البوابية من الطبقات النسيجية الرئيسة وهي المخاطية ، تحت المخاطية ، العضلية ، المصلية . يكون النسيج الظهاري المبطن للزوائد البوابية من النوع العمودي البسيط المتكون من الخلايا المعوية ويتخلل النسيج الظهاري الخلايا المخاطية (الخلايا الكأسية). الغلالة تحت المخاطية تلي الغلالة المخاطية وتكون بشكل طبقة نحيفة من نسيج ضام كثيف ، اما الغلالة العضلية فأنها تتكون من الياف عضلية ملساء تكون مرتبة بطبقتين الداخلية دائرية والخارجية طولية ، الغلالة المصلية تمثل طبقة نحيفة من النسيج الضام المفكك الذي يكون محاط بالبطانة الميزوثيلية.
الكلمات المفتاحية : تشريح ، المعدة ، السمكة العروسة ، الحمامة.

Introduction

The ornate wrasse, *Thalassoma pavo*, is a small labrid fish native to the southeastern coast of the Mediterranean (1). It inhabits the rocky bottom of the shallow littoral zone at depths up to 25m (2; 3). have similar body lengths (with mean standard lengths of 67.03mm and 85.01mm, respectively) (4). In fact, each fish species has its own structural peculiarities to the alimentary canal specially stomach towards its specific food habits (4). Knowledge of fish's alimentary canal morphology is becoming increasingly important in fish digestive physiology and improvement of nutrition protocols (5). Among large number of species, though the stomach is also defined as actual organ, consists of anterior cardiac region and posterior pyloric region (4). In Thalassoma pavo family the stomach is a simple U- shaped sac which is divisible into a thinwalled cardiac crop and a very thick- walled biconical pyloric gizzard (6). The function of the gizzard in fishes is

similar to birds; to grind or triturate food (2; 3). The pyloric caeca are blindended sphincterless ducts associated with the anterior intestine (7). The pyloric caeca is found in various number and diameter in different species in Thalassoma pavo family, which the number of pyloric caeca is an important key for the identification of Mugilidae species (6). The caeca have a thin layer of longitudinal muscle, a thick circular muscle layer, muscularis mucosa, the submucosa and mucosa which is filled with connective tissue. The epithelial lining is made up of columnar absorptive cells with goblet cells for mucus secretion. The mucosa is elaborated into numerous filiform folds with a basal columnar membrane which is closely packed and clearly visible (8). The large mucosal folds in the stomachs are associated with carnivorous species. These large folds allow fishes to accommodate a large quantity of food items as a result of its ability to distend. The undifferentiated columnar epithelia cells and mucosal folds also provide large surface area for storage in the stomach (8; 5).

The aim of the present study was to explain the anatomical and histological aspects of stomach and pyloric caeca in *Thalassoma pavo*.

Materials and Methods

Ten adult individuals of Thalassoma pavo ; were collected from Northeastern (32°54′52″N 21°37′43″E) Al Hamamah is a village on the coast of eastern Libya (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 tissue was passed through graded ethanol, cleared in xylene, impregnated and embedded in paraffin, and sections 5 µm thickness were obtained with Leica Microtome. They were stained with haematoxylin and eosin for light microscopy examination (10). Photomicrographs were taken with camera attached to microscope. Statistical analyses were performed using the SPSS version 21 software package and Excel 2007.

Fig. 1: The map of sampling region in Al Hamamah is a village on the coast of eastern Libya.

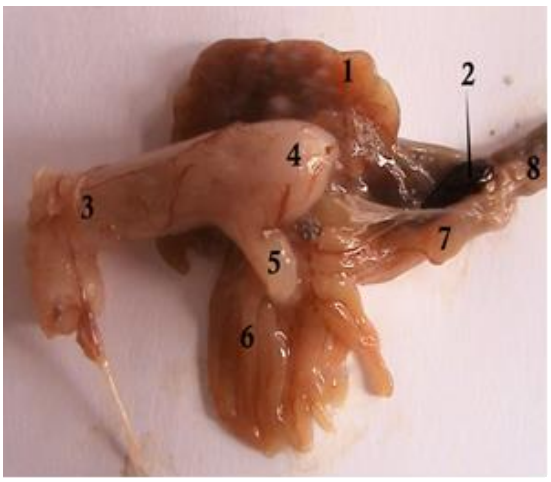

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Fig. 2: Illustration of stomach and pyloric caeca in Thalassoma pavo.
1-Liver, 2-portion of pancreas, 3-Esophagus, 4-stomach, 5-Pyloric part, 6-Pyloric caeca, 7-mid-gut, 8-hindgut.

Results

The stomach was sac-like with the whole surface lined with secretory simple columnar epithelium and could be divided into three parts based on histology: the cardiac, fundic and pyloric regions (Fig. 2). the muscular layer consisted of smooth muscle tissue with fibres circumferentially oriented in the internal sublayer, and longitudinally on the external one, both showed loose connective tissue. The serosa layer exhibited loose connective tissue and mesothelium. 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. 3a). 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. 3b). The circular smooth muscle layer in the pyloric region tends to be more developed than in the cardiac region (Fig. 3c). The pyloric caeca consisted of 13 finger-like structures present between the connection of the stomach and anterior portion of the intestine (Fig. 2). Pyloric caeca also had a four-layered general structure like stomach but in this tunica muscularis had a thin layer of smooth muscle (Fig. 3d)

Table 1: Characteristics of stomach and pyloric caeca in *Thalassoma pavo*

	Length of Stomach (cm)	Diameter of Stomach (cm)	Length of Pyloric Caeca (cm)	Diameter of Pyloric Caeca (cm)	Number of Pyloric Caeca
Mean ± SD	1.35 ± 0.18	0.83 ± 0.06	0.78 ± 0.07	0.36 ± 0.03	13

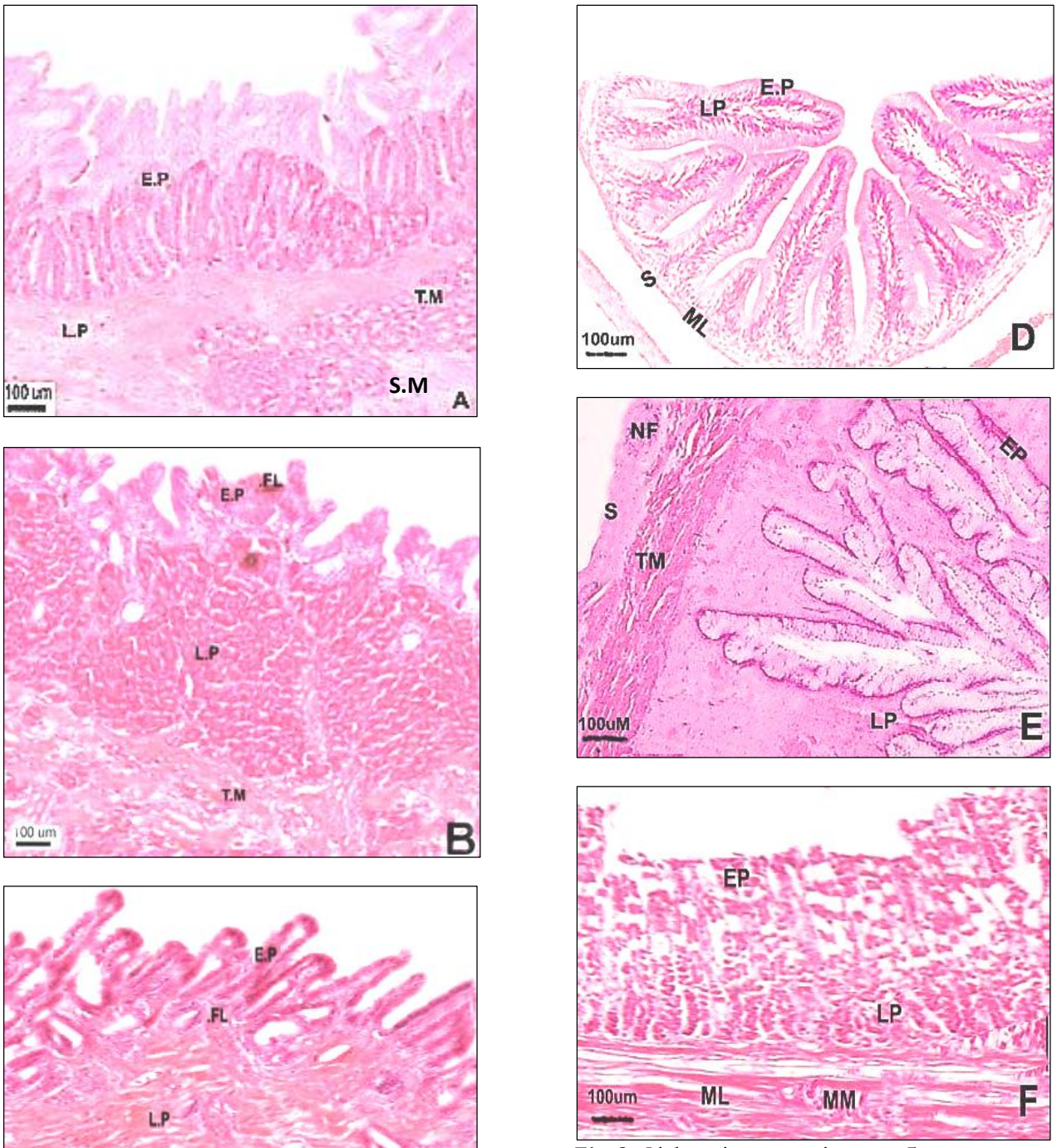

Fig 3: Light microscopy images, 5 µm transverse sections of stomach(A,B,C) and pyloric caeca wall(D,F,G); haematoxylin eosin staining. a and b: (×100resolution).
Folds (FL), tunica muscularis (TM), nerve fiber (NF), submucosa (S.M), muscularis layer (ML), serosa (S), muscularis mucosa (MM), lamina propria (LP), epithelium (EP).

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 (10). The teleost stomach shows a morphology which exhibits a distinct difference on that correlates with diet, feeding habit, body shape and also environmental conditions (11; 12). In fact, each fish species has its own structural adaptations of the stomach towards its specific food habit (13). In Thalassoma pavo such as other fishes of Labridae family, the stomach was U-shaped and gizzard like (14). U-shaped stomach probably allow for stretching during Feeds on small mollusks and crustaceans(10). The mucosal epithelium of the stomach of Thalassoma pavo was similar to that of other teleosts (15 ; 16 ; 17). 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 (14; 7; 18). 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 (19). The number and the structure of pyloric caeca is used for taxonomic separation of the genera of Labridae by earlier workers (6; 20). The pyloric caeca in piranha formed blind, fingerlike projections off the proximal intestine. They serve to increase the effective absorptive surface area of the proximal intestine without increasing intestinal length or thickness, however, pyloric caeca tend to be better developed in carnivores than herbivores, especially in carnivores with short guts (21). 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 (22).

Conclusion

The histological and anatomical studies about mean length and diameter of stomach and mean length and diameter and number of pyloric caeca from Thalassoma pavo (Linnaeus, 1758). Anatomical and histological study showed the stomach of Thalassoma pavo 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. the present study revealed that despite short length of pyloric caeca it provides a large absorption area because of numerous villi, special lobulation and mucosal structure. Presence of goblet cells indicates development of the organ toward chemical digestion and mucous secretion that facilitates passage of ingesta in intestine.

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