Surface architecture of the mouth cavity in a carnivorous fish *Scomber japonicus* (Houttuyn, 1782) (Scombridae)

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Abstract

Chub mackerel *Scomber japonicus* (Scombridae) is a pelagic species that inhibits warm and temperate coastal waters of the Atlantic, Indian and Pacific Oceans. The topological characteristics of the mouth cavity of the carnivorous fish *S. japonicas* was studied by using light microscope. The results revealed that all the teeth of *S. japonicas* are pointed and canine-like, papilliform teeth present on the premaxillae and the anterior regions of the dentaries are associated with seizing, grasping and holding of prey. The morphology and distribution of different taste buds of *S. Japonicas* were predominantly localized at tongue and the anterior regions of the mouth cavity. Two types of taste buds are elevated from the epithelium at different levels, which may be useful for ensuring full utilization of the gustatory ability of the fish, detection and analyzing of taste substances, as well as for assessing the quality and palatability of food, during its retention in the mouth cavity. Observations of the surface architecture of the mouth cavity of *S. japonicas* have been discussed within the context of feeding and habitat preferences, as well as ecomorphological adaptation of the species.

Key words: *Scomber japonicus*, light microscope, surface architecture, mouth cavity, taste buds.

Introduction

Chub mackerel *Scomber japonicus* Houttuyn (1782), is middle size pelagic species, with a very wide distribution over the continental shelf of the tropical and subtropical regions of the Atlantic, Indian, Pacific oceans and adjacent seas, it is primarily coastal species, found from the surface down to 300m depth [5;8& 24]. Along its distribution, the species is found in isolated population with complex intraspecific structure [19]. *Scomber japonicus* is a key component in the marine food web of many tropical and subtropical areas of the Atlantic and Pacific oceans. In the Pacific Ocean, they are eaten by albacore *Thunnus alalunga* [27&4]. Scombrid fishes (Family scombridae) are considered as one of the important fishery resource in the Gulf of Aden. They are caught by the pursesein fishery. Their average landing has been estimated to be around 2202 tons, contributing about 12٪ of the total purse sein catch. Because of the great importance of *Scomber japonicus* to the economy of Yemeni fisheries, (Gulf of Aden and adjacent area), it was studied by [6,7, 16 and 23].The mouth shapes and buccal cavities of fishes are a good and important component of the digestive tract. It may be involved in the seizure, the selection of food, rejection of undesirable items ingested by fish and the predigesting preparation of food. Among species, buccal or oropharyngeal cavity structure shows great plasticity and structural adaptability for the exploitation of different food items [17,15,31,13 and 1]. The mouth cavity has been described using light microscopy in *Oryzias latipes* [12],*Oncorhynchus rhodurus*[20], *Tribolodon hakonensis*[21] and *Barbus bynni*, *Chrysichthys auratus*, *Mormyrus kannume* and *Synodontis schall*[1].In any vertebrate species, gustation contributes to the acceptance or rejection of potential foods for survival, since taste buds primarily function in the feeding behavior to detect chemicals from preys. Carnivorous fishes are endowed with taste buds, not only in the oral cavity including gill regions, but also on the lips, barbells, and external skin surface [11,25,10 and 30].Palatability and taste are two terms often used interchangeably which are determined mostly by the chemical characteristics

of the food, although its physical properties can also affect the acceptability and final ingestion or rejection of the food[29]. Fish have been often employed as a model for taste research, as they show a higher sensitivity (estimated thresholds for the most potent substances are less than10^{-9} M), to tastants than mammals [18].Taste buds are secondary sense organs of the gustatory chemosensory system, it may be useful in assessing the palatability of the food and decide whether to swallow or spit it out [31]. So, the aim of the present work is to examine and provide a better understanding of surface architecture of the mouth cavity of a carnivorous *S. japonicas* using light microscope.

Materials and Methods

Chub mackerel *Scomber japonicus* were collected from the fishermen at Mukalla sea (Gulf of Aden) (Fig. 1). These were brought to the laboratory of Biology, Faculty of Science, Hadhramout University. The shape, direction, position of mouth and the distribution of teeth in the different regions of buccal cavity were observed and recorded and, for the measurement of head, 10 specimens for each species were examined and the following measurements were taken: Mouth tube length (TL), Mouth opening height (M.O.H) and Mouth opening width (M.O.W)] in cm, and numbers of each of Interior Teeth (IT) and Posterior Teeth (ST). Data have been represented in the form of histograms using Microsoft office excel. The buccal cavity was opened, cleaned carefully in a physiological saline solution, fixed in 10 ٪ neutral buffered formalin, dehydrated, cleared and put in paraffin wax. Samples were sectioned (6-8µ thick) and stained with the counter stain haematoxylin and eosin (H&E) [2&26], then studied under microscope with digital camerafor photography.

Results

Morphometrical Study

In the present work, the mouth is forward, spacious and elongated with M.O.H. equal to 3.22±0.80cm and M.O.W. was 1.88±0.41cm, having one row of numerous small teeth and palatine teeth, TL ratio was 0.84±0.31. Different measurements were taken, measured and listed in Table (1) and (Fig. 2).The buccal cavity of *S. japonicus*is spacious and opens anteriorly through a wide transverse mouth, which is bordered by the upper and the lower lips. The mouth cavity is divided into two regions – the dorsal roof and the ventral floor. The roof and the floor of the mouth cavity comprised antero-posteriorly, an upper jaw with premaxillary teeth and vomerine teeth, respectively. In the lower jaw, there are dentary teethobserved. Superior and inferior pharyngeal teeth are observed, the last one was found near the gill arch (Fig.3).

Figure 1: The morphology of *Scomber japonicus*.

Table 1. Different measurements of the mouth cavity of 10 specimens*S. japonicus* [Mouth tube length (TL), Interior Teeth (IT), Posterior Teeth (ST), Mouth opening height (M.O.H) and Mouth opening width (M.O.W)] in cm.

Number	1	2	3	4	5	6	7	8	9	10
TL(cm)	33	35	16.6	19.9	18.1	18.7	16.7	18.2	35	19.5
Interior Teeth	15	15	20	20	20	17	20	20	15	20
Posterior Teeth	15	15	20	20	20	17	20	20	15	20
M.O.H.	4	4.5	2.5	3	2.8	2.5	2.6	2.8	4.5	3
M.O.W.	2.5	2.2	1.1	2	2	1.5	1.6	1.7	2.2	2

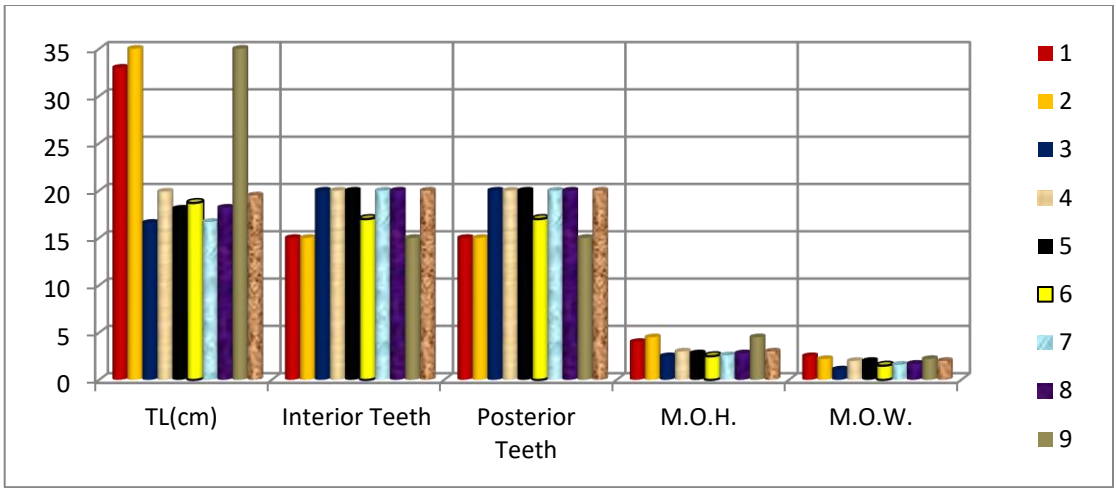

Figure 2: Histogram representing different measurements of the mouth cavity in10 specimens of *S. japonicus*

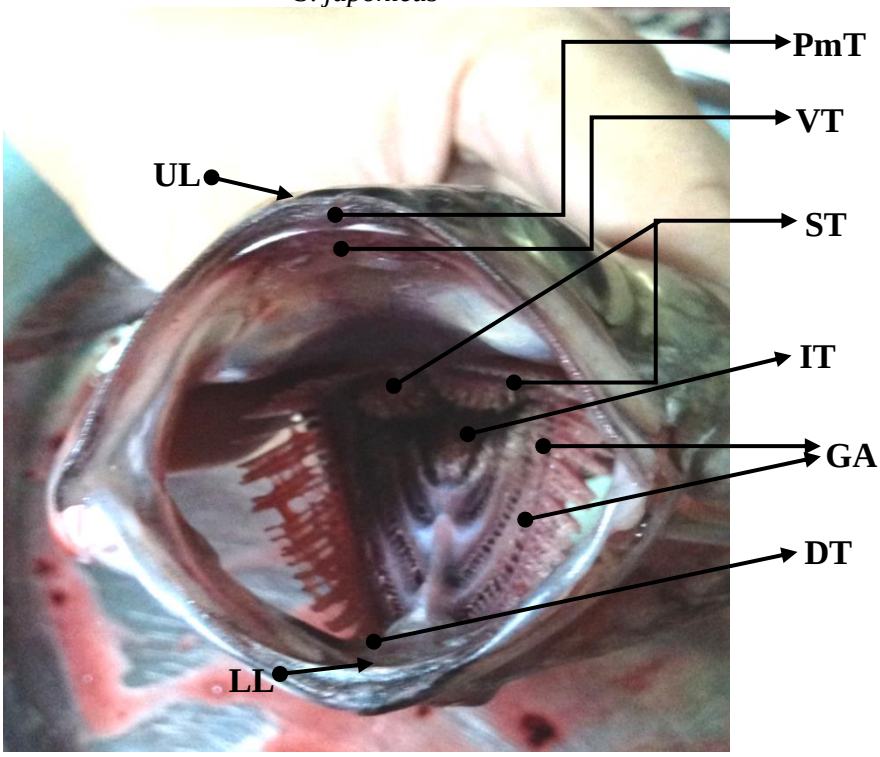

Figure 3: Photograph showing the morphology of the roof and the floor of the mouth cavity of *S. japonicus*. **UL**: upper lip, **PmT**: premaxillary teeth, **VT**: Vomerine teeth, **ST**: superior pharyngeal teeth, **IT**: inferior pharyngeal teeth and **GA**: gill arch, **DT**: Dentary teethand **LL**: lower lip.

Histological Studies

Optical microscope micrographs showed that taste buds are abundant on upper and lower lips of *S. japonicus*. These taste buds are elevated and located on epithelial protrusion. And they bears pointed canine-like and around between most of the surface of epithelial of the mouth cavity (Figs. 4-9).

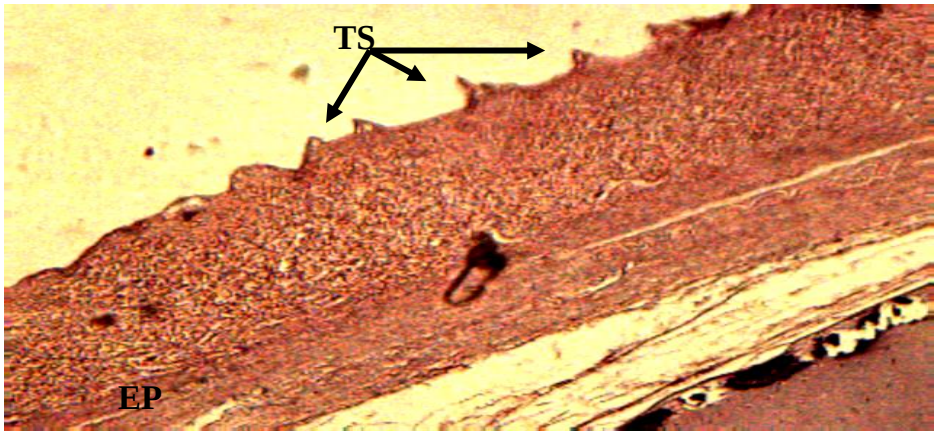

Figure 4: Photomicrograph of transverse section of upper lip of *S. japonicas* showing: TS: taste buds are elevated and located on epithelial protrusion, EP: epithelium surface (H&E, X 100).

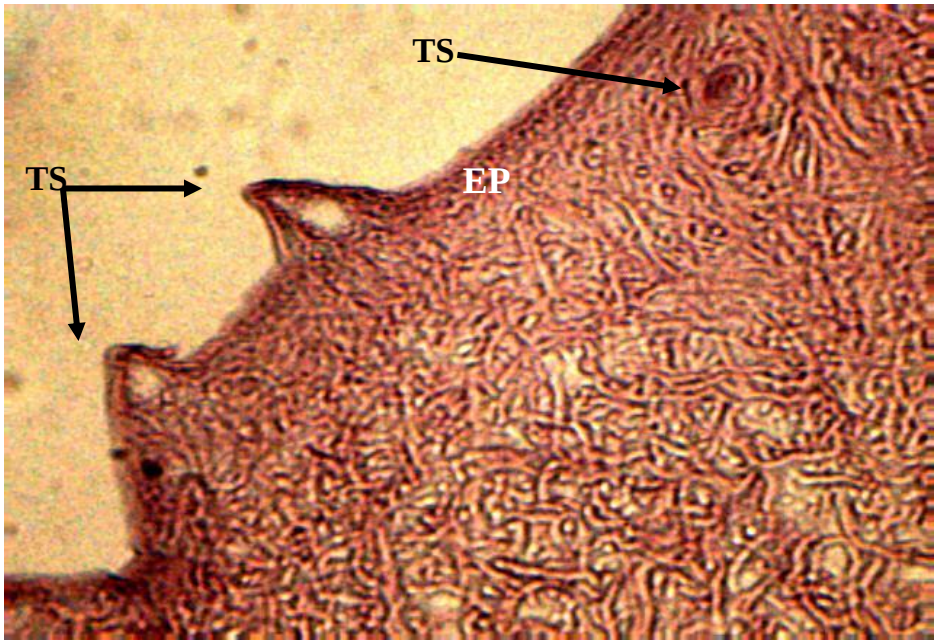

Figure 5: Photomicrograph of magnified part of the previous section showing **TS**: taste buds elevated and located on epithelial protrusion, **EP**: epithelium tissue(H&E, X 400).

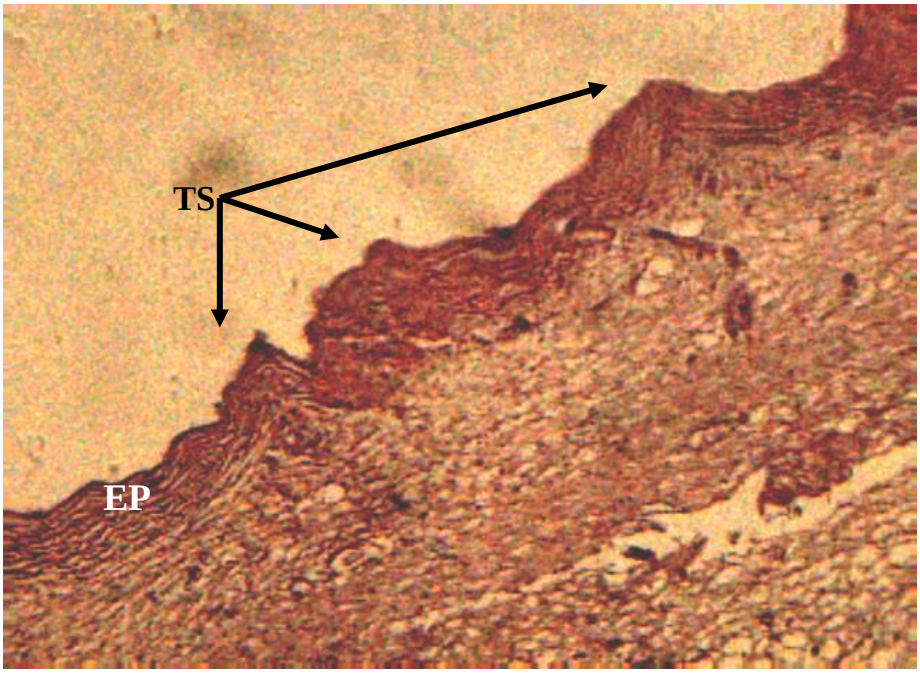

Figure 6: Photomicrograph of transverse section of lower lip of *S. japonicus* showing: **TS**: taste buds are elevated and located on epithelial protrusion, **EP**: epithelium surface (H&E, X 100).

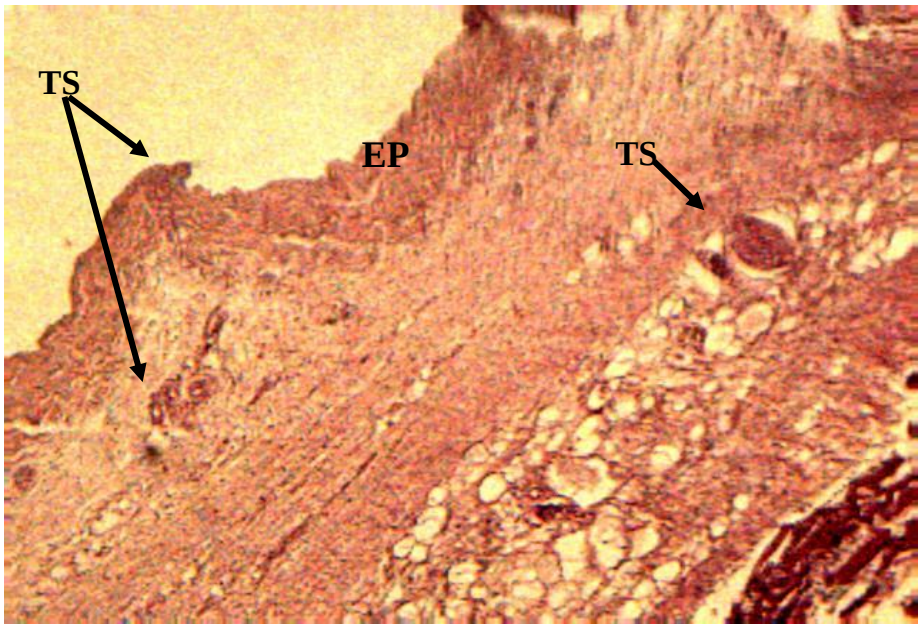

Figure 7: Photomicrograph of magnified part of the previous section showing **TS**: taste buds elevated and located on epithelial protrusion, **EP**: epithelium tissue (H&E, X 400).

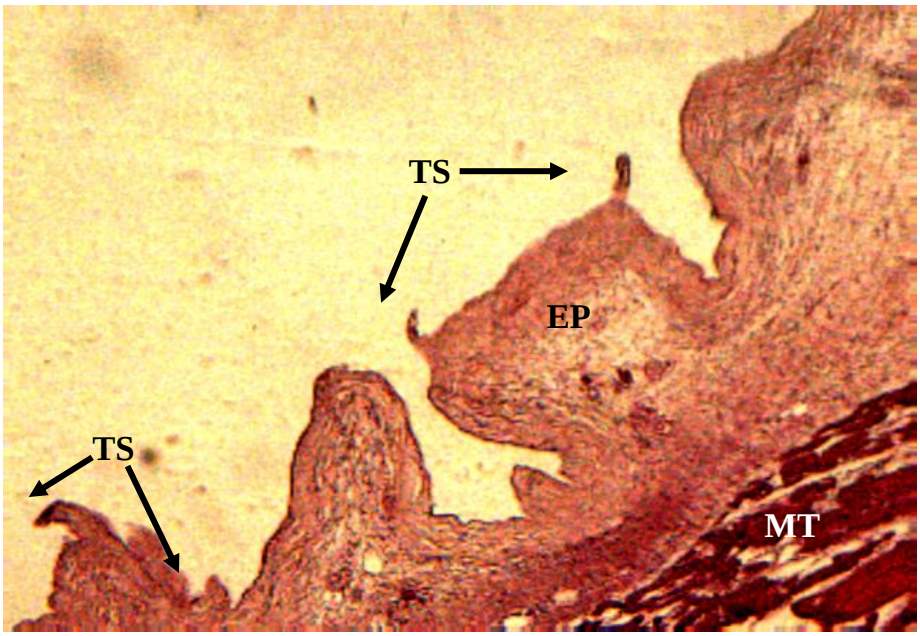

Figure 8: Photomicrograph of transverse section of the surface architecture of roof of the mouth cavity of *S. Japonicas* showing: **TS**: taste buds, **EP**: epithelium tissue and **MT**: muscular tissue (H&E, X 400).

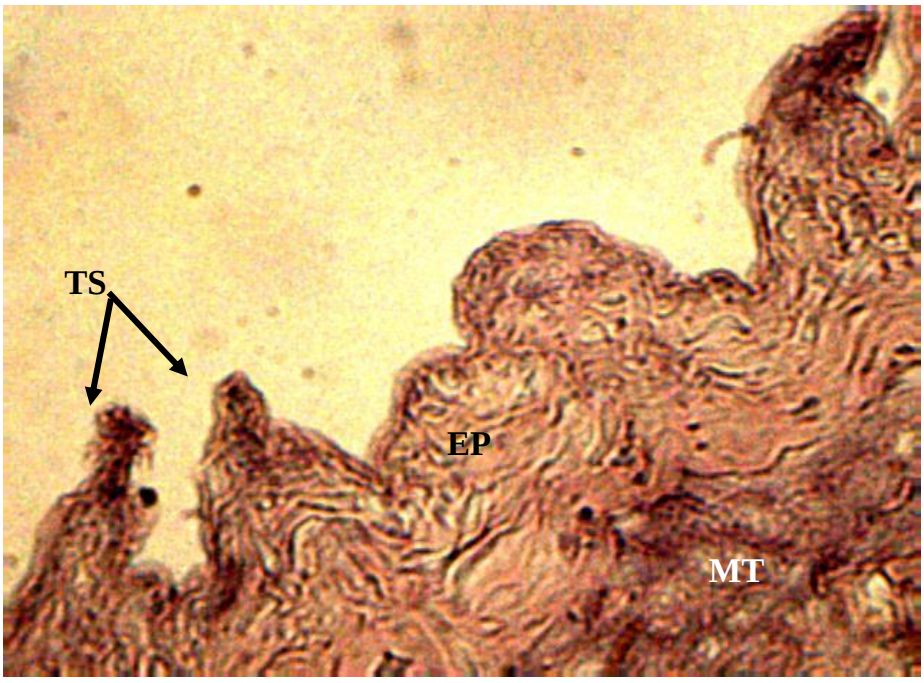

Figure 9: Photomicrograph of transverse section of the surface architecture of floor of the mouth cavity of *S. Japonicas* showing: **TS**: taste buds, **EP**: epithelium tissue and **MT**: muscular tissue (H&E, X 400).

Discussion

In *Scomber japonicus*, the position and direction of mouth is suitable for capturing and obtaining food; its terminal and forward direction facilitate the process of predation and indicate the predatory nature of fish under investigation. This result agrees well with that recorded by [9&14].A diversity exists in the form and size of fish teeth. The character of dentition is a clue to the fish's feeding habits and the kind of food it consumes [22].Carnivorous *S. japonicas* has pointed canine-like teeth, this type of teeth does a good job of grasping and piercing.Our findings agree with studying the teeth of *Atherion elymus*[28], studying the teeth of carnivorous in *Rita rita*; [31],studying the teeth of carnivorous *Bagrus docmak* and the omnivorous *Claris gariepinus*; [13]studying the teeth of herbivorous *Barbus bynni*, carnivorous *Chrysichthys auratus* and *Mormyrus kannume* and omnivorous *Synodontis schall*[14]and studying the teeth of carnivorous *Epinepheluschlorostigma*[14]. Differences described for dentition and distribution of taste buds on the epithelial cells at different regions of the roof and floor of the mouth cavity of fishes could be considered as adaptation to various food preferences and feeding behavior of fish **[**31, 13, 1, 10, 3, 30 and 31].The present study describes the morphology and distribution of different taste buds that located on the epithelium surface of the mouth cavity of *S. japonicus*. The taste buds may be useful in assessing the palatability of the food and decide whether to swallow or spit it out.

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التركيب السطحي للتجويف الفمي في سمكة سكومبر جابونكس (الطبوب) (Houttuyn, 1782) (اسقمريات)

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الملخص

في هذا البحث تمت دراسة خصائص البطانة السطحية للتجويف الفمي الطبوب (آكلة اللحوم) باستخدام المجهر الضوئي. أوضحت النتائج أنَّ جميع أسنان السمكة قيد الدراسة مدببة وتشبه الكلاليب، إنّ جميع الأسنان الموجودة على المناطق الأمامية من التجويف تتناسب مع الاستيلاء والإمساك بالفريسة. تم تحديد موقع مورفولوجيا وتوزيع براعم التذوق المختلفة للسمكة قيد الدراسة، في الغالب تتمركز في المناطق الأمامية واللسان من تجويف الفم. وُجدت نوعين من براعم التذوق: نوع يكون في مستويات سطحية مختلفة ونوع يعلو الطبقة الطلائية (الظهارية)، التي قد تكون مفيدة لضمان الاستفادة الكاملة من القدرة الذوقية للأسماك. كشفت هذه الدراسة مدى ملائمة بنية سطح تجويف الفم في السمكة قيد الدراسة مع طبيعة غذائها و التكيفات الشكلية البيئية.

الكلمات المفتاحية: سكومبر جابونكس (الطبوب)، المجهر الضوئي، البطانة السطحية، التجويف الفمي، براعم التذوق.