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Morphology of the Buccal Cavity of Sea Bream (*Sparus aurata*) and Its Relation to the Type of Feeding Using Scanning Electron Microscopy

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Abstract: The buccal cavity of a carnivorous fish (*Sparus aurata*) was investigated using scanning electron microscopy. Anatomically, the buccal cavity distinguished into roof and floor. The distribution and localization of the taste buds in different manner in the buccal cavity mucosa reflects its adaptive role in food processing and may help in food choice for aquaculture. The oral cavity of *Sparus aurata* was wide and characterized by strong dentition. The tongue lie in the floor of the buccal cavity, has a peculiar structure it is elongate with a triangular shape. The epithelia of the tongue characterized by rows of protrusions. The surface of the epithelial cells of the buccal cavity of *Sparus aurata* is characterized by a system of microridges. These can form whirls between the microridges connection. The occurrence of taste buds in tongue can be considered adaptive changes of the oral cavity related to the feeding habits and was a source to identify new and better methods of nutrition in aquaculture of the species. The teeth, epithelial protrusions and microridges of the buccal cavity of *Sparus aurata* could be taken as an adaptation to the food types.

Key word: buccal cavity · Fish · Scanning electron microscope · Feeding type

INTRODUCTION

The buccal cavity of fish play a major role in suction, ram (forward swimming) and manipulation of prey capture in fishes. Teleost fish are one of the more morphologically diverse groups of vertebrates [1,2]. Many functional, morphological and ecological studies related to feeding [3-6].

A few studies are done on the buccal cavity of fish; the adult's plankton feeder, *Catla catla* [7] and on carnivorous fish species, *Gadus morhua* [8]. The secretary epithelium in the buccal cavity of the carnivorous cichlid *Oreochromis alcalicus grahami* using scanning and transmission electron microscopy was observed [9]. Many differences including the morphology, presence of teeth and structure of the mucosa in the oral cavity of teleosts were reported [10-12]. Thus descriptions available for one species do not necessarily hold for another.

Recently, the morphology of the catfish and the carp oral cavity was described [11, 12]. The zebrafish oral cavity was described [13]. The histology and morphology of the digestive tract of the sea bream (*Sparus aurata*) was studied [14]. The European sea bass tongue was described [15] and the buccal cavity of the larval and adult stages of Sea bass (*Dicentrachus labrax*)was studied [16].

There are generally two stages to feeding in teleost fishes, prey capture and processing. The prey may be separated from unwanted material, such as sand or other debris, by winnowing behaviors, or a protective armor may be cracked to access the flesh of the prey, as in the case of molluscivore. During these processing behaviors teleost fishes usually employ a second set of jaws, the pharyngeal jaw apparatus.

There are broad methods of prey capture in fishes: i) filter feeding, where the prey is filtered from the water using a variety of retention mechanisms. ii) biting where the teeth of the oral jaws are applied to the prey. iii) ram feeding where the prey is overtaken and engulfed in an open mouth. iv) suction feeding where the prey is sucked into the mouth by a stationary predator. Suction feeding is believed to be the primary method of prey capture in teleost fishes [17]. It is the most common method of prey capture in predators of mobile animal prey.

An important and uniting contribution of these studies is the idea that morphology and diet reciprocally illuminate one another once the functionally relevant

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features of the buccal cavity are examined. Scarce data are present in recent literature about the relation between the diet and morphology using scanning electron microscopy.

Taste buds play an important role in food quality detection and segregation, whether for rejection of an item or for its acceptance and consumption [18-20].

The sea bream is one of the species most used for aquaculture. The gilt head sea bream *Sparus aurata* is a fish of the bream family (Sparidae) found in the Mediterranean sea and the eastern coastal regions of the North Atlantic ocean. It mainly feeds on shellfish including mussels and oysters but also plant material

The aim of the present study is to provide a basis for better knowledge of the surface architecture of the mouth cavity of adult *Sparus aurata* in relation to its feeding habits which will provide insight into how the fish adapt to their environment and survive and more used for aquaculture.

MARERIALS AND METHODS

The roof and floor of the mouth cavity of adult *Sparus aurata* which were collected from the Mediterranean Sea near Damietta-Egypt. They were treated and prepared for scanning electron microscopy. They were fixed in 10% formalin, post fixed with 1% osmium tetroxide in 0.1M sodium cacodylate buffer at pH 7.2 for 1h at 4°C. Thereafter, the specimens were dehydrated through graded series of ethanol and critical point dried. They attached to aluminum stubs facing upwards, covered with carbon tabs and then were, sputtered with gold and then examined with a scanning electron microscope (JSM. 5300) at an accelerating voltage of 15kV.

RESULTS

The oral cavity of *Sparus aurata* was wide characterized by strong dentition of their jaws, armored by one raw of sharp not curved tooth and several rows of flat teeth (Fig. 1a). Anatomically, the roof of the buccal cavity consisted of premaxilla, maxilla, velum, palatine bones and the palate while the floor consisted of dentaries, angulars, the velum and the tongue. The floor of the buccal cavity armored by one raw of sharp elongated teeth and several rows of flat teeth(Fig. 1a) between them several epithelial protrusions are found (Fig.1 b).If one of these protrusions are enlarged it indicates a huge number of epithelial microridges with secreted mucus (Fig.1c) which include several folds directed internally (Fig.1d).

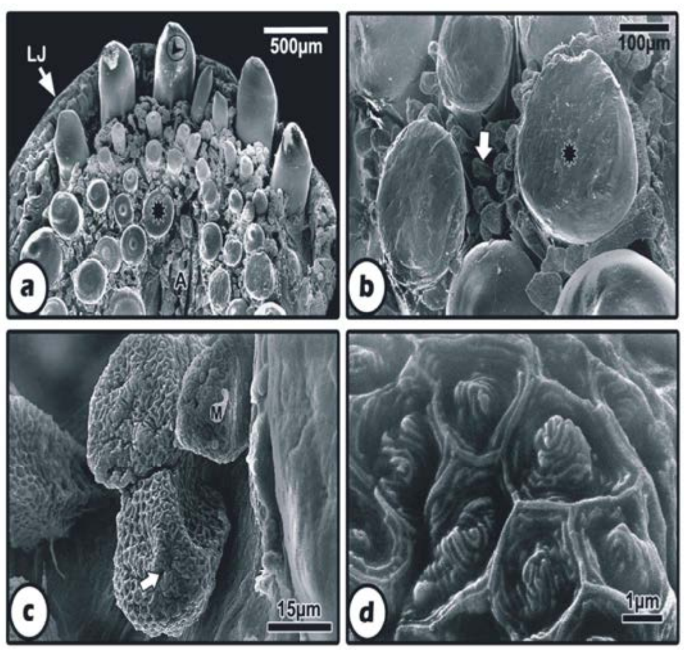

Fig. 1a: Scanning electron micrograph of the floor of the mouth cavity of *Sparus aurata* showing lower jaw (LJ), elongated teeth (arrow), flat teeth (star) and apex of tongue (A).Fig.1b-Scanning electron micrograph of the floor of the mouth cavity showing epithelial protrusions (arrow)between flat teeth(star).Fig.1c- Scanning electron micrograph of the epithelial protrusions indicate taste bud (arrow) surrounded by depressions indicate the opening of the goblet cell and mucus(M).Fig. 1d-Scanning electron micrograph of epithelial tissue covering protrusion which directed internally.

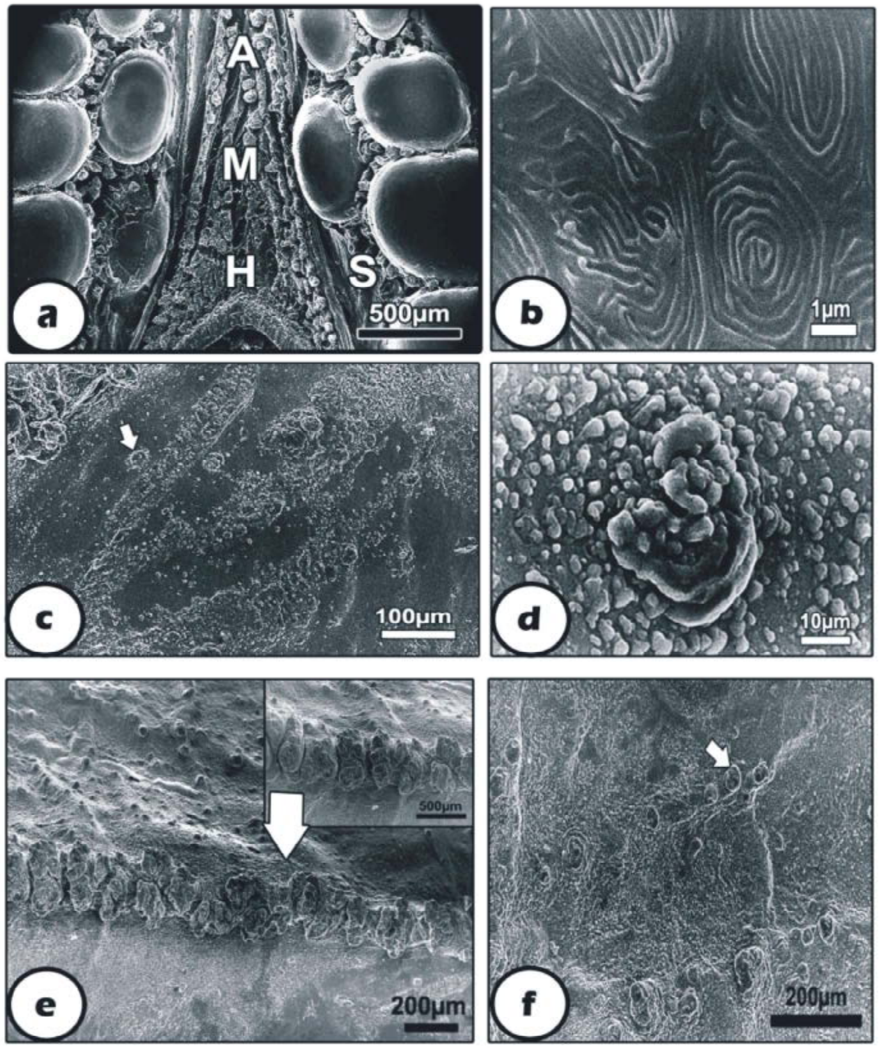

Fig. 2a: Scanning electron micrograph of the tongue of *Sparus aurata* indicate apical (A), mid (M), hind tongue (H) and lateral sac (S). Fig.2b-Scanning electron micrograph of the epithelia of the tongue tip which show microridges arranged on the fore tongue as circulars. Fig. 2c-Scanning electron micrograph of the fore tongue of *Sparus aurata* showing taste buds distributed irregularly. Fig.2d- Scanning electron micrograph of the fore tongue of *Sparus aurata* showing enlarged taste bud. Fig.2e-Scanning electron micrograph of the mid tongue of *Sparus aurata* showing epithelial folding. Fig. 2f- Scanning electron micrograph of the hind tongue of *Sparus aurata* showing taste buds in two lines.

The tongue lie in the floor of the buccal cavity, has a peculiar structure it is elongated with a triangular shape. Its apex is triangular in shape (Fig. 2a) Posterior to the apex, the mid tongue and the hind tongue respectively. the tongue strongly elongated being has a lateral sacs. Many epithelial protrusions are surrounded by flat teeth (Fig.2b). The epithelial surface of the tongue was characterized was characterized rows of protrusions (Fig.2c). If enlarged one of them at the posterior part it shows microridges which has several mucus secreting cell (Fig.2d).

Epithelial folds in the midtongue were surrounded by a large number of taste buds than those of the fore tongue (Fig.2e). The distribution of taste buds in the hind tongue is in two lines (Fig.2f). The roof of the buccal cavity of the investigated species characterized by several rows of teeth (Fig.3a) and the epithelial microridges between teeth system are not irregular in shape(Fig.3b). The middle of the roof of the oral cavity was characterized by several folds and much epithelial protrusion(fig.3c). If the epithelium of this area was enlarged it indicates compressed microridges internally (Fig.3d).

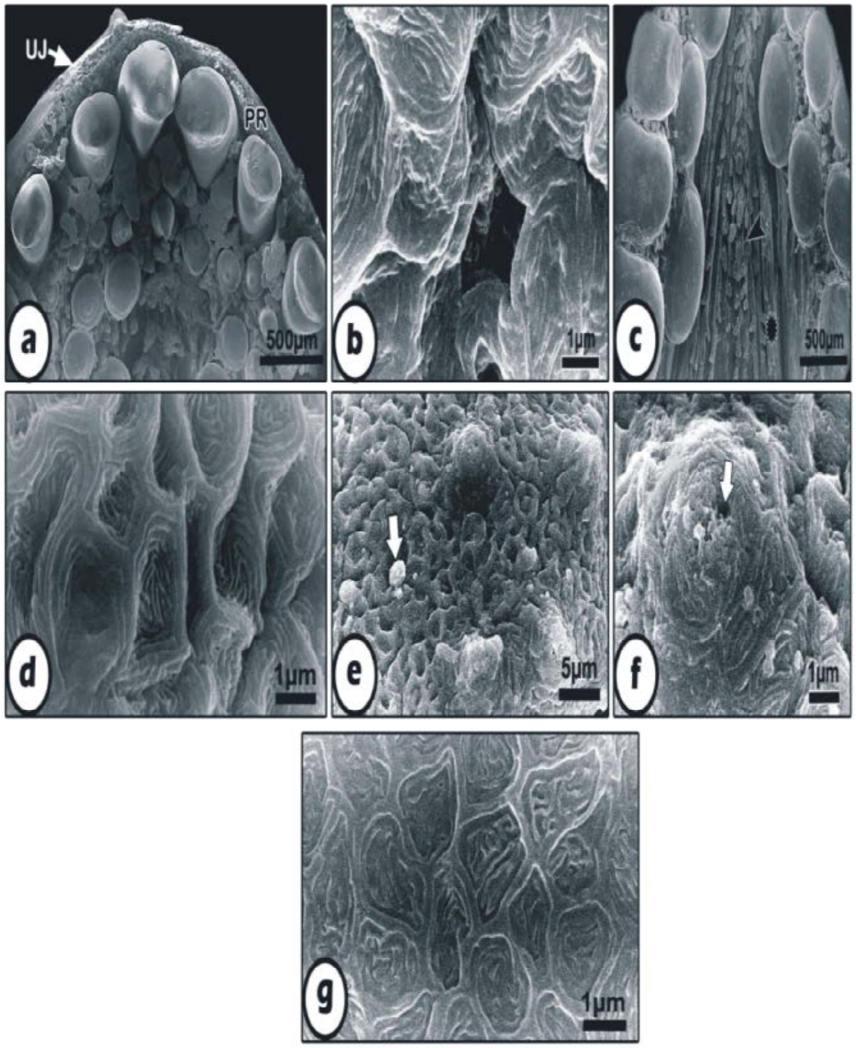

Fig. 3a: Scanning electron micrograph of the roof (UJ) of the buccal cavity of *Sparus aurata* showing proximal (PR) and numerous flat teeth. Fig.3b- Scanning electron micrograph of the roof (UJ) of the buccal cavity of *Sparus aurata* showing epithelial tissue between teeth. Fig. 3c- Scanning electron micrograph of the center of the roof (UJ) of the buccal cavity of *Sparus aurata* showing epithelial protrusion (arrow) and elongated folds (star). Fig.3d- enlarged scanning electron micrograph of the mid part of the roof of the buccal cavity showing epithelial folds compressed internally. Fig.3e-Scanning electron micrograph of taste buds. Fig. 3g- Scanning electron micrograph of the hind part of the roof of the buccal cavity showing epithelial tissue beside taste buds.

Taste buds in this part are numerous and several epithelial depressions are included (Fig.3e) include openings of the goblet cells (Fig.3f). The hind part of the roof of the buccal cavity showing epithetlial tissue besides taste buds (Fig.3g).

DISCUSSION

The teeth, epithelial protrusions and microridges of the buccal cavity of *Sparus aurata* could be taken as adaptations to the food types. The teeth of the adult *Sparus aurata* are elongated, arranged in one row and flattened arranged in several rows.

The occurrence of elongated teeth on jaws is required to hold or grasp and to prevent the escape of small prey but the flattened teeth to tear solid food in the buccal cavity. The presence of flat huge numbers of teeth indicates that the oral cavity is adapted to the hard food stuffs which need grinding and crushing of them. In *Sparus aurata* the tongue is not muscular, devoid of teeth and contributes to the feeding behavior by conducting water through its channel to the mouthy.

The taste is related with feeding and permitting fish to differentiate between a variety of foods available to them in the surrounding aquatic environment [21] and play important role in acceptance, rejection of potential food items [22,23]. The free surface of the epithelial cells at the mouth cavity of different fishes is characteristically differentiated into a series of microridges and referred to as cytoplasmic folds [24].

The surface of the epithelial cells of the buccal cavity of *Sparus aurata* is characterized by a system of microridges. These can form whirls between the microridges connection. These observations are in accordance with several studies [11, 25,26].

The secretions of mucous cells in the oral cavity are associated with lubricating the surface and protecting the epithelium from abrasions at these regions that are likely to be subjected to wear and tear during frequent friction and adhesion of the food to the mucosa [27].

The occurrence of taste buds in tongue can be considered adaptive changes of the oral cavity related to the feeding habits and was a source to identify new and better methods of nutrition in aquaculture of the species.

In conclusion, the present investigation proves that the distribution and localization of taste buds in the buccal cavity mucosa of *Sparus aurata* reflects suitable adaptations of the buccal cavity regions to undergo their vital activities. More research needs to be done to understand feeding and nutrition of *Sparus aurata* in different stages and to optimize diets for culture.

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