〔ORIGINAL〕

Actin Filaments of Taste Buds in the Goldfish and Parrot

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Abstract

The filaments in the apical region of the taste bud cells of both goldfish and parrot were examined by fluorescence histochemistry and electron microscopy. The apical cytoplasm of goldfish taste buds terminated in long, slender processes and microvilli, and contained thin and straight filaments composed of f-actin, as detected by fluorecein-labeled phalloidin binding. In the parrot, the apical cytoplasm of taste buds terminating in microvilli also showed phalloidin fluorescence. The result suggests that the apex of taste buds of most vertebrate species is composed of actin filaments.

Key words : actin filament, taste bud, goldfish, parrot

Introduction

It is generally accepted that the core filaments in the microvilli are composed of actin[1]. Studies on the mammalian taste buds have shown that the apical cytoplasm of taste bud cells terminates in microvilli that project into the taste pore. Evidence of actin filaments in the microvilli in mouse taste buds has obtained by immunohistochemistry using anti-actin antibody[2]. In the rabbit foliate papillae, the fluorescence of phallacidin has been observed in the microvilli of the taste buds, indicating the presence of f-actin[3]. In the frog, the apical cytoplasm of taste cells terminates in microvilli and rod-shaped processes. We observed actin filaments in both microvilli and these rod-shaped processes by histochemistry using phalloidin[4]. Although taste buds are widely distributed among the vertebrate species, there is no report about the filaments in the apical region in fishes, reptiles, and birds.

In the present study, we examined the cytoskeletal structures in the apical region of taste buds of a goldfish and parrot by fluorescence histochemistry and by conventional electron

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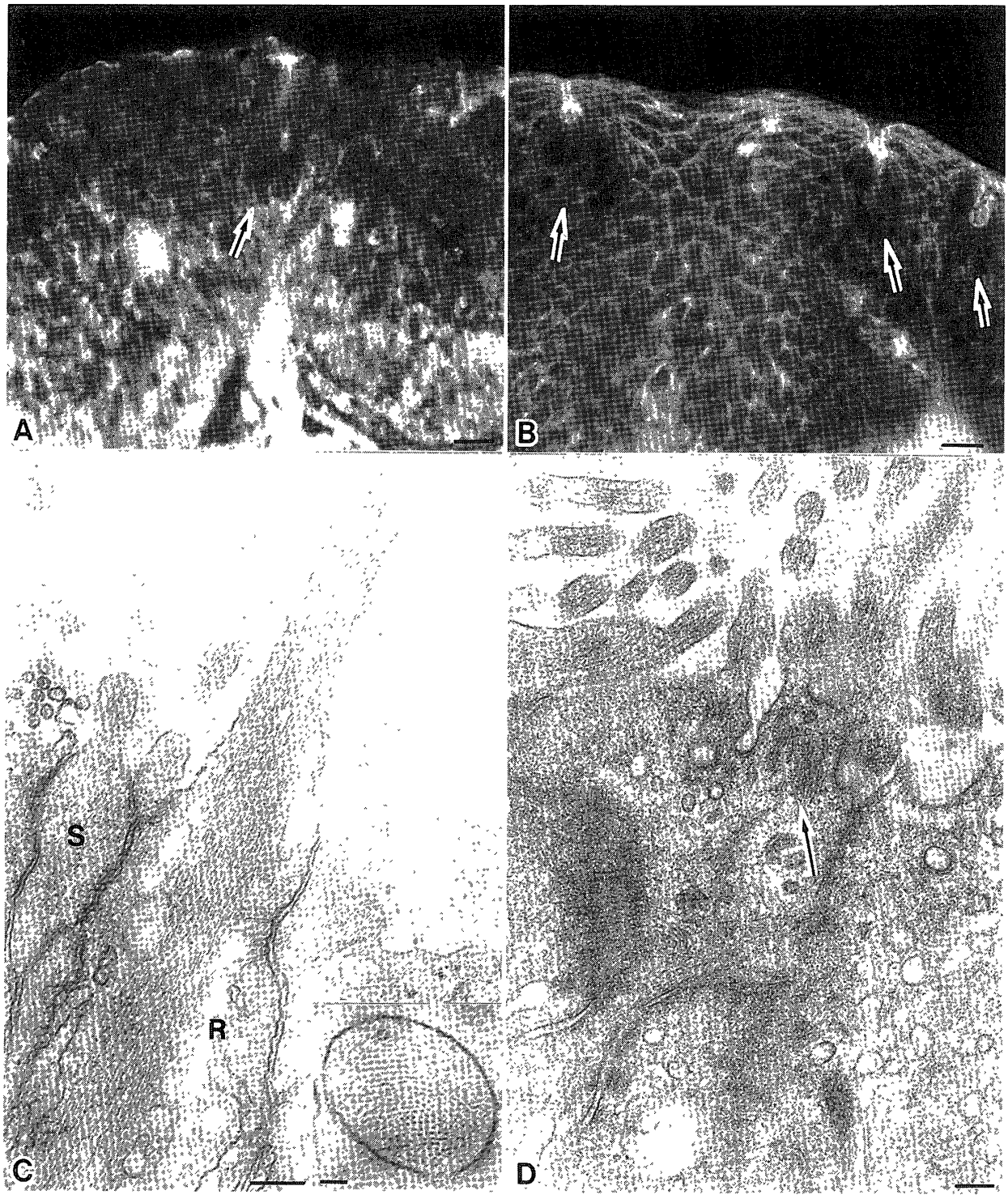

Fig. 1. A. B. Fluoresence micrograph of lingual epithelium of goldfish (A) and parrot (B) after the application of FITC-labeled phalloidin. The reactions are seen in the apex of taste buds (arrows). C. D. Electron micrograph of the apical region of taste buds of goldfish (C) and parrot (D). C : Note the bundles of filaments of 6-nm diameter in the long processes of receptor cells (R) and microvilli of supporting cells (S) in the goldfish epithelium inset : A transverse section of a long process, showing the alignment of filaments. D : Filaments of 6-nm diameter are seen in the microvilli of taste bud cells and extend toward the junctional complex in the apical cytoplasm (arrow). Scale bar, A, B = 20 μm, C, D = 0.2 μm, inset C = 0 05 μm

mıcroscopy

Materials and Methods

The goldfish (*Carracius auratus*) and parrot (*Melopsittacus undulatus*), both of whıch are commercially avaılable, were used The tongues were removed and cut into small blocks For fluorescence microscopy, the tıssues were fıxed in 4% paraformaldehyde dissolved ın phosphate-buffered salıne (PBS) for 1 hr at 4°C, and rinsed overnight at 4°C in PBS containıng 10% sucrose The tıssues were then frozen in a spray freezer (Oken, Japan) at -20°C, sectioned sagıttally at 10 μm ın a cryostat and mounted on gelatin-coated slıdes The sections were treated wıth FITC-labeled phalloidın (Sigma, 33 ng for each section) for 30 mın at room temperature They were then rınsed in PBS, mounted with glycerin, and examined under a fluorescence microscope For electron microscopy, the tissues were fıxed ın a phosphate-buffered (pH 7 4) solutıon contaıning 2% glutaraldehyde and 1 6% paraformaldehyde They were postfixed in phosphate-buffered (pH 7 4) 1% OsO_4, dehydrated, and embedded in Epon 812 Ultrathin sections were cut, stained with uranyl acetate followed by lead citrate, and examined under a Hitachi H7000 electron mıcroscope

Results

After the application of FITC-labeled phalloıdin, ıntense fluorescence was observed ın the apical regıon of the taste buds of both goldfısh and parrot specimens In the goldfısh tongue, fluorescence was observed also in the cells of the lingual epithelium and ın muscle fıbers ın the lamına proprıa (Fıg 1A, B) Under the electron microscope, the apical cytoplasm of receptor cells of goldfısh taste buds termınated ın a sıngle tapering process, which protruded outward from the taste pore The apical cytoplasm of supportıng cells termınated in mıcrovılli Straight and thın fılaments (6 nm in dıameter) filled both the taperıng processes and microvılli The fılaments, in parallel alignment in the tapering processes, were bound to the cell membrane at one end, the other end extended downward about 5 μm ınto the apıcal cytoplasm of the taste bud cells (Fig 1C) In transverse section of the processes, many filaments were packed ın regular alıgnment (Fıg 1C, ınset) In the parrot, the apical cytoplasm of taste bud cells termınated ın mıcrovilli and thin and straight filaments were observed in them At the base of mıcrovillı, these filaments extended downward to the level of the zonula adherens of the junctıonal complex (Fıg 1D)

Discussion

In both the goldfish and parrot taste buds, we regard the 6-nm filaments ın the apical cytoplasm of taste bud cells to be f-actin, judging from the characterıstic bindıng of FITC-labeled phalloidın there In the goldfısh specımens, a greater number of fılaments exısted ın the long processes of receptor cells than ın the mıcrovılli A sımılar distributıon pattern of

actin filaments has been observed between rod-shaped processes of taste cells and microvilli of supporting cells in frog taste organ[4] This suggests that the actin filaments are related to the support of the taste cell membrane, where the taste stimulus may occur In fact, in the frog inner ear, actin filaments in the sensory hairs of receptor cells have been found to exhibit considerable stiffness, as determined by micromanipulation of sensory hairs where the membrane has been removed by treatment with Triton-X-100[5] In other species of teleost fishes, e g , silurid fish, the apex of receptor cells terminates in the long tapering processes, in which thin filaments with parallel alignment are seen[6] In chicken and canary, the apical end of taste bud cells consists of microvilli and thin filaments were also observed in them[7,8] We did not examine the taste buds in reptiles in the present study, but it is reported that the apical processes of cells in the taste buds of tortoises, lizards, and snakes terminate in microvilli[9] The apexes of taste buds in the silurid fish, chicken, canary, tortoise, lizard, and snake are likely to be composed of actin filaments Therefore, the apical ends of taste buds or taste organ throughout the verterbrates are suggested to be composed of actin filaments, which may afford a rigid structure to taste-sensing region of the taste cell membrane

References

1 Ishikawa, H , Bischoff, R , Holzer, H Formation of arrowhead complexes with heavy meromyosin in a variety of cell types J Cell Biol 43 312-328, 1969

2 Takeda, M , Obara, N , Suzuki, Y Cytoskeleton in the apical region of mouse taste bud cells Jpn J Oral Biol 31 317-323, 1989

3 Hirakawa, Y , Nomura, H F-actin bundles in the microvilli of taste bud cells Matsumoto Shigaku 12 42-45, 1986

4 Suzuki, Y , Takeda, M Filaments in the cells of frog taste organ Zool Sci 6 487-497, 1989

5 Flock, A , Flock B , Murray, E Studies on the sensory hairs of receptor cells in the inner ear Acta Oto-Laryngol 83 85-91, 1977

6 Fujimoto, S , Yamamoto, K Electron microscopy of terminal buds on the barbels of the silurid fish, *Corydoras paleatus* Anat Rec 197 133-141, 1980

7 Suzuki, Y , Takada, M Ultrastructure of taste buds in birds Jpn J Oral Biol 26 669-678, 1984

8 Ganchrow, D , Ganchrow, J R , Goldstein, R S Ultrastructure of palatal taste buds in the peri-hatching chick Am J Anat 192 69-78, 1991

9 Uchida, T Ultrastructure and histochemical studies on the taste buds in some reptiles Arch histol Jap 43 459-478, 1980