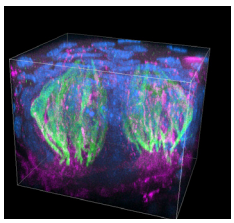
APPLICATION NOTE

AX R Confocal Microscope

Macroscopic and 3D imaging of small flower-like taste buds within the mouth by confocal microscopy



Which do you prefer, sweet or sour? Our sense of taste helps us enjoy our food while absorbing nutrients, and detects harmful substances before we ingest them. So, how do we perceive taste?
Taste buds consist of taste cells that convert the chemical stimuli of taste into electrical signals. As the name implies, taste buds resemble flower buds in shape and are found in the tongue, the soft palate (soft muscle tissue at the back of the maxilla), and the larynx. Taste buds consist of 50-150 taste cells.

In this application note, we used the AX R confocal microscope to capture the structure of taste buds.

Keywords: confocal microscope, taste bud, taste cell

Overview

Taste buds are 60-80 µm in height and 40 µm in width, and elongated taste cells are located along their long axis. As shown in Figure 1, taste cells are divided into three types: type Ⅰ taste cells (supporting cells), type Ⅱ taste cells (receptor cells), and type Ⅲ taste cells (presynaptic cells). Type Ⅱ taste cells detect sweetness, bitterness, and umami, while type Ⅲ taste cells detect sourness.

In this note, taste buds in the soft palate were labeled with GNAT3 (Guanine nucleotide-binding protein G(t) subunit alpha-3), a marker for type Ⅱ taste cells, and SNAP25 (Synaptosomal-associated protein 25), a marker for type Ⅲ taste cells, and images thereof were then captured by an AX R.

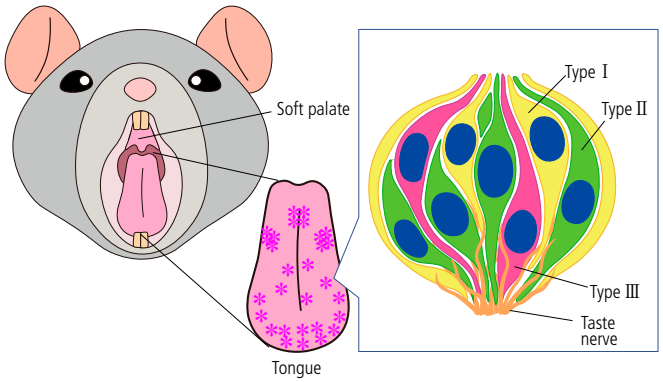
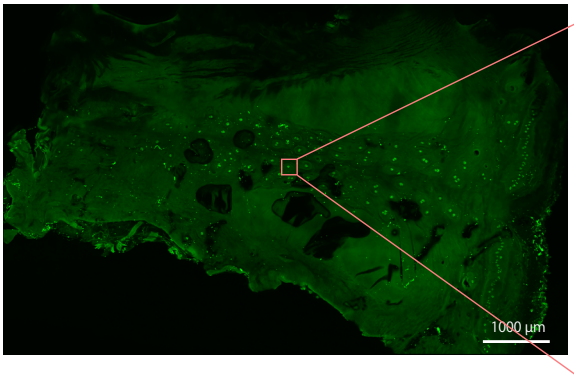


Figure 1: Distribution and cellular components of taste buds



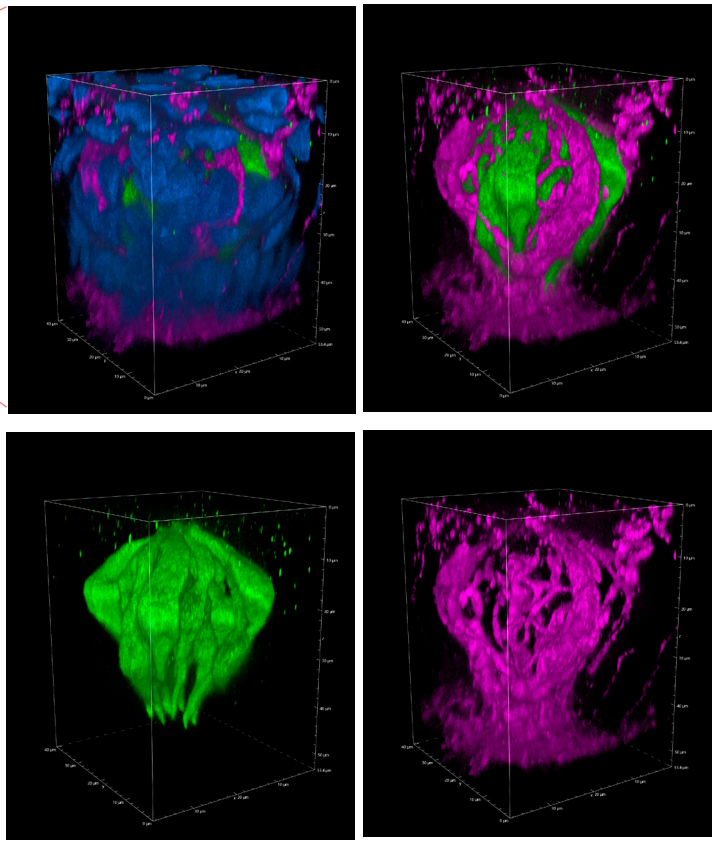


Figure 2: Confocal images of taste buds in the soft palate

(a) Stitched confocal MIP image of soft palate (processed by Denoise.ai)
Green: GNAT3 (type Ⅱ taste cell marker)
[Acquisition conditions]
Objective: CFI Plan Apo VC 20X, Scanner: Resonant
Resolution: 512 x 512 pixels, Averaging: 4 times
Z Step: 5 µm, Image stitching: 8 x 11

(b) Confocal 3D images of a taste bud
Blue: DAPI (nuclear marker)
Green: GNAT3 (type Ⅱ taste cell marker)
Magenta: SNAP25 (type Ⅲ taste cell marker)
[Acquisition conditions]
Objective: CFI SR HP Plan Apo Lambda S 100XC Sil
Scanner: Galvano, Resolution: 1024 x 1024 pixels
Z Step: 0.3 µm, Z Range: 53.4 µm
Cropped in the XY direction, Blending mode: Alpha

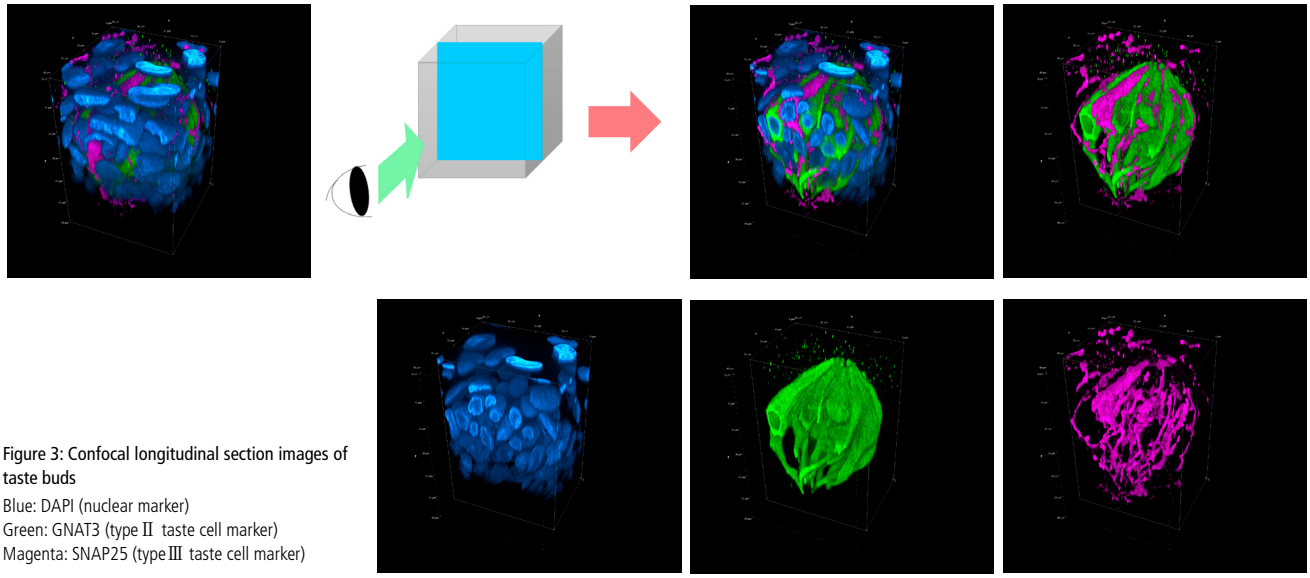


Figure 3: Confocal longitudinal section images of taste buds
Blue: DAPI (nuclear marker)
Green: GNAT3 (type Ⅱ taste cell marker)
Magenta: SNAP25 (type Ⅲ taste cell marker)

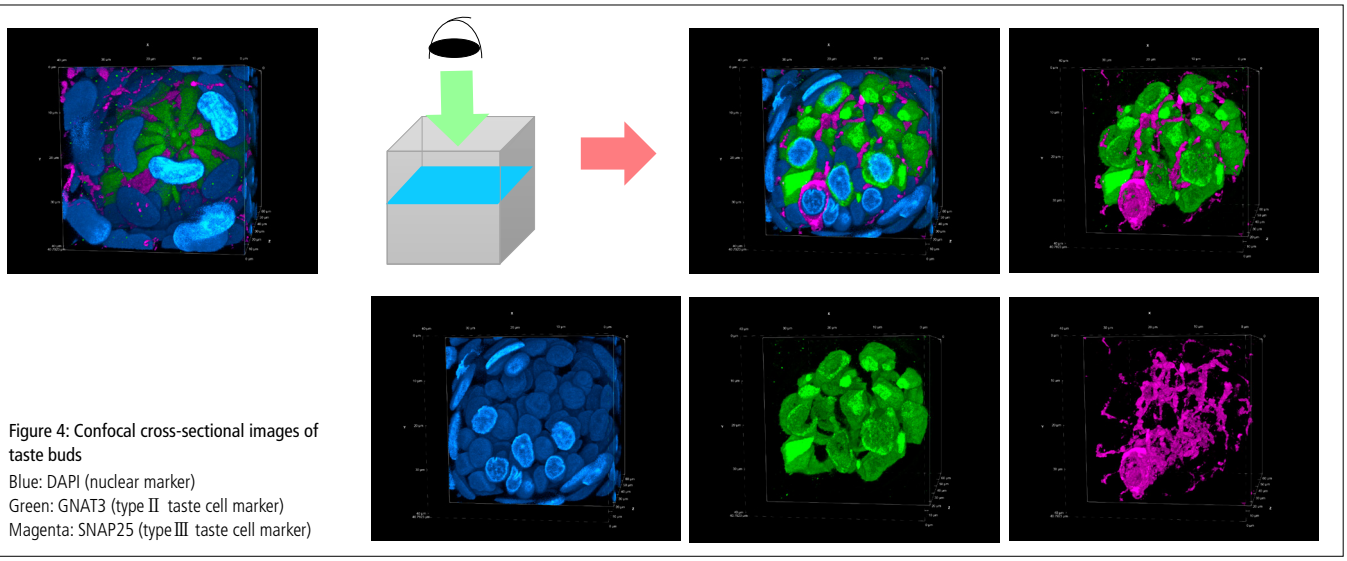


Figure 4: Confocal cross-sectional images of taste buds
Blue: DAPI (nuclear marker)
Green: GNAT3 (type Ⅱ taste cell marker)
Magenta: SNAP25 (type Ⅲ taste cell marker)

Summary

The AX R confocal microscope offers a large field of view, even in resonance mode. This allows the positions of taste buds to be quickly identified even at low magnification. First, the approximate locations of the taste buds could be identified using macro images acquired in resonant mode with Denoise.ai. The detailed structures of the taste buds were then obtained in Galvano mode with a high-magnification, high-NA objective. Furthermore, the internal structure of the taste buds could be captured by constructing 3D images and cutting them through various cross-sections.

In conclusion, small structures present in large samples can be captured from the macro to the micro by combining the various strengths of the AX R, which can achieve large field-of-view imaging in both high-speed resonant mode and high-resolution Galvano mode, in combination with high-resolution objectives and image processing by NIS-Elements.

Acknowledgments

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Confocal 3D video of a taste bud

References

Morphology and chemical characteristics of taste buds associated with P2X3-immunoreactive afferent nerve endings in the rat incisive papilla
Motoi Ito, Takuya Yokoyama, Masato Hirakawa, Yoshio Yamamoto, Wakana Sakanoue, Kenichi Sato, Tomoyuki Saino
https://doi.org/10.1111/joa.13583

Products information

CFI SR HP Plan Apochromat Lambda S 100xC Sil

With minimal asymmetric aberrations and improved axial chromatic aberration correction, this objective is ideal for high power laser applications.

- NA: 1.35
- WD: 0.31-0.28
- Cover glass thickness: 0.15-0.19

AX R Confocal Microscope

Supports high-speed, high-resolution, large field-of-view confocal imaging, with reduced phototoxicity to living cells and photobleaching.

- High speed: Up to 720 fps (resonant at 2048 x 16 pixels)
- High resolution: Up to 8K (galvano)/2K (resonant)
- High throughput: Ultra-wide FOV of 25 mm