The light microscopic examination of development periods of foliate papillae and taste buds in the tongues of pre-and postnatal rats

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in this study, using light microscopy, we investigated the time of appearance, development, morphological features and topographical localisations of the foliate papillae and their taste buds in the tongue of male and female rats during pre-and postnatal periods. In both sexes, we observed the appearance of the primary epithelial downgrowth which is the first sign of the foliate papilla's development on the 17th fetal day, serous glands and their glandular ducts on the 19th fetal day, taste bud primordia in newborn, the adult-like formation of papillae and their taste buds on the 21st postnatal day.
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Key Words: Rat, Tongue, Foliate papillae, Taste buds, Glandular duct

In mammals, the fungiform, foliate and circumvallate papillae bearing taste buds are located on the upper surface of the tongue (2-11). Rats have all of these papillae on their tongues. While fungiform papillae and the single circumvallate papilla are located on the anterior and posterior-middle parts, respectively (2,5,6,8), foliate papillae found on the posterior lateral surfaces and oval foliate papilla areas of the tongue (2,6,11).

There are many reports on the morphologies, topographies, sizes and innervations of the papillae and taste buds. However, the development of these structures during embryogenesis were not studied well. There is a limited number of reports on the development of circumvallate papillae of mice (10), foliate papillae of guinea pig (4), and fungiform (2), foliate (11) and circumvallate (5) papillae of rats.

In this study, we aimed to determine the time of appearance, development, morphological features and topographical localisations of the foliate papillae and their taste buds in the tongues of rats during pre- and postnatal periods.

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MATERIALS AND METHODS

We studied on a total of 96 white rats of Rattus norvegicus. Eight groups of rats (6 males and 6 females in each group) consisting 17 and 19 days old fetuses, 0,5,7,10,14 and 21 days old newborn rats were used. Total tongues of the fetuses, and foliate papillae specimens of newborn rats were fixed with 10% formaldehyde solution and embedded in paraffin blocks. Then, the paraffin blocks were cut into 8 mm thick sections vertically to the surface of the tongue from anterior to posterior. The cross-sections were stained with hematoxylene-eosin and examined under light microscopy.

RESULTS

Tongue tissue was appeared as a mesenchymal mass covered with 2-3 layers of epithelial cells on the 17th day of fetal life. Primary epithelial bulgings extending to the mesenchymal tissue under the developing foliate papilla area were also observed during this period (Figure 1). On the 19th day of fetal life, epithelial tissue covering the tongue model was found to have 4-5 cell layers and to be keratinized. While the superficial cells were in flat shape, the middle and the basal cells were in polygonal and low prismatic shapes, respectively. The primary epithelial bulgings were seen to develop into the mesenchymal tissue and to form primary epithelial columns. There were small gland ducts at the end of some columns (Figure 2). In the newborns, cellular degenerations starting the cleavage of the surface of the primary epithelial

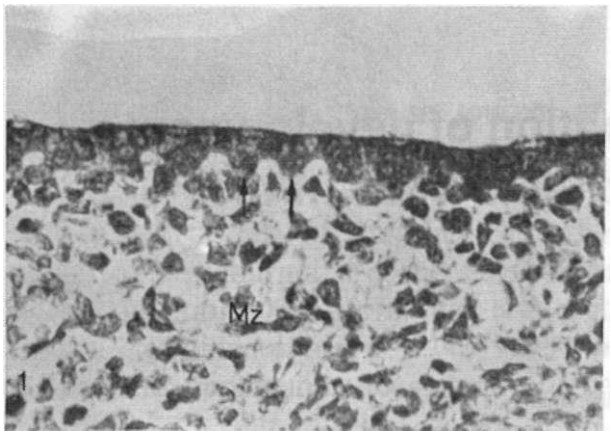

Figure 1. Primary epithelial bulgings extending to the mesenchymal tissue under the developing foliate papilla area of the tongue model (single arrows). Seventeen days old fetus, (H+E, x400).

Figure 2. A small gland duct with a lumen at the end of the primary epithelial column (single arrow). A serous gland among striated muscle fibers under the ductus of a gland (double arrow). Nineteen days old fetus, (H+E, x200).

columns were observed. There were irregular models of taste buds on the primary epithelial columns. Also, secondary epithelial bulgings located proximally to the

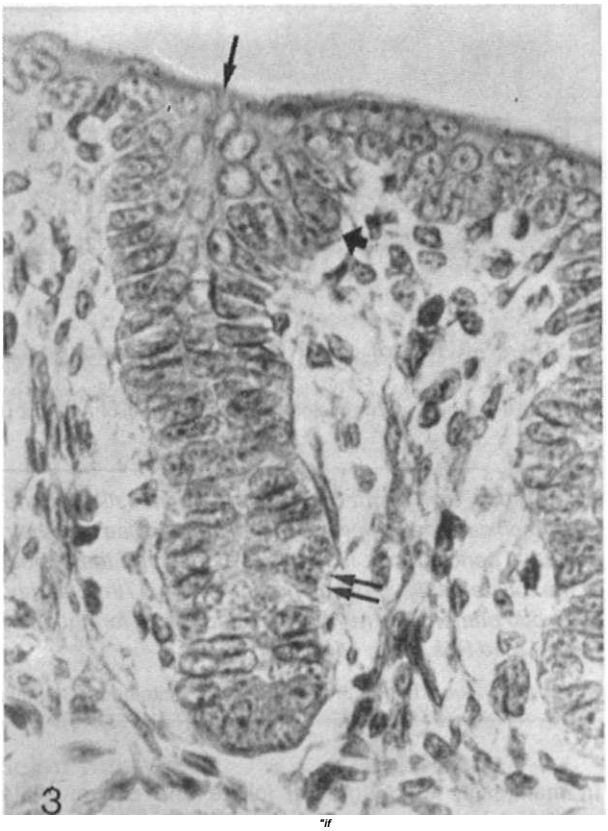

Figure 3. The beginning of the epithelial cleavage of proximal primary epithelial column (single arrow), secondary epithelial bulgings extend to the mesenchymal tissue (thick arrow), and a taste bud model on the primary epithelial column (double arrow). Newborn male rat (H+E, x400).

primary ones wt.e seen to lay into the mesenchymal tissues (Figure 3). In the 5 days old rats, while papilla groove and lateral sides of papillae were formed from the cleavage of primary epithelial columns, the secondary epithelial bulgings growed up to the secondary epithelial columns. There was a few oval shaped taste buds on each side of the papilla^ (Figure 4). Papillae, taste buds and papilla grooves were prominent in the 7,10 and 14 days old rats (Figure 5). The papillae and taste buds of the 21 oays old rats were similar to that of the adult ones. Each papilla had 2-3 oval shaped facte buds located vertically to the epithelium on the lateral walls (Figure 6).

DISCUSSION

State et al reported that primary epithelial bulgings starting the development of foliate papilla, and primary epithelial columns and gland ducts formed on the 16th and 21st days of fetal life, respectively. They also found first taste buds to be formed on the second postnatal day, spindle cells of taste buds to appear on the 10th day and foliate papilla and taste buds to be

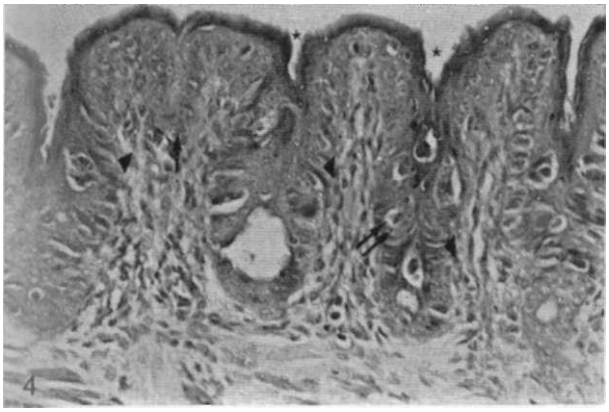

Figure 4. Papilla groove on the developing foliate papilla (*), lateral walls of the papilla (arrow heads), secondary epithelial column extending from the top of the papilla to the underlying mesenchymal tissue (double arrow), 5 days old male rat (H+E, x200).

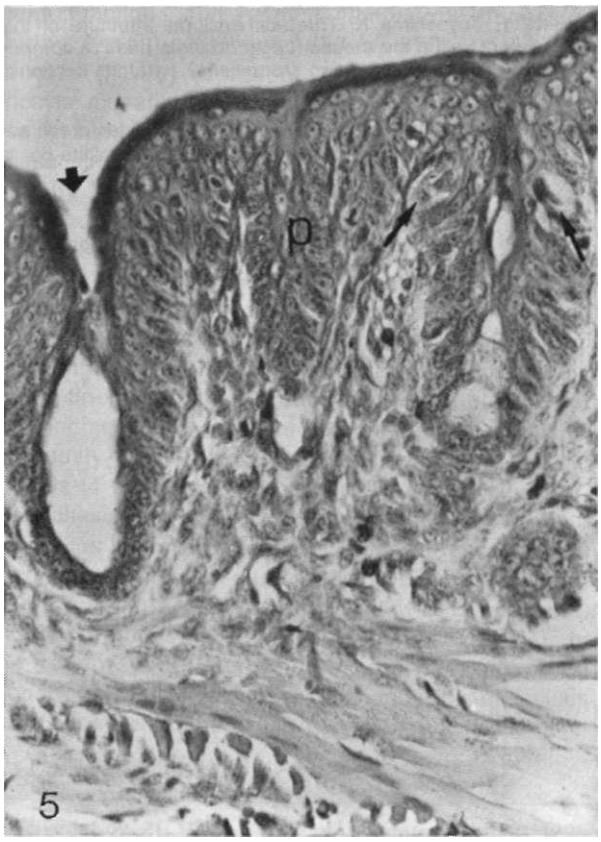

Figure 5. Developing foliate papilla (p), Taste buds on the lateral wall of the papilla (single arrows), papilla groove (thick arrow). 7 days old female rat (H+E, x200).

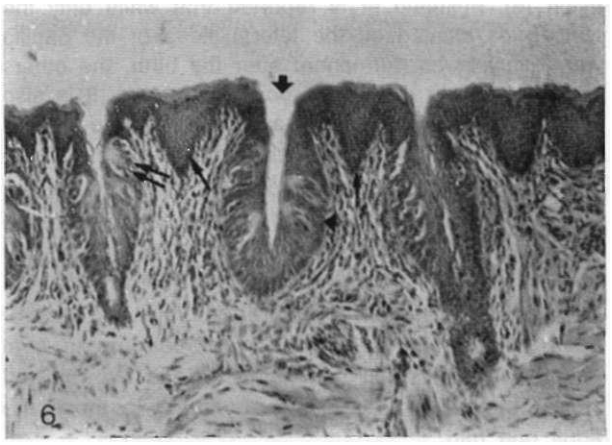

Figure 6. Lateral wall of the developing foliate papilla (arrow head), papilla groove (thick arrow), secondary epithelial column extending from the top of the papilla to the underlying mesenchymal tissue (single arrows), taste buds on the lateral wall of the papilla (double arrow), 21 days old female rat (H+E, x100).

similar to that of the adult rats on the 21st postnatal day (11). In contrary to this, we found that primary epithelial columns, ducts of glands, and taste bud models in the areas of foliate papilla were formed earlier. However, we consider that these structures had no functions at this period, since there were no papilla grooves connecting these structures. There were various suggestions about the forming of papilla grooves. While, Helmes et al (4) suggested that epithelial cleavage related with the formation of papilla groove was started from the proximal part of the primary epithelial column, the others (3) suggested the cleavage of distal part. According to the latter group of researchers, the papilla groove were formed by the shed of epithelial mass between the ducts of glands whenever they reached to the surface.. It is likely that papilla groove may develop from bipolar degenerations of both proximal and distal parts of the primary epithelial columns. But this conclusion needs to be confirmed with further studies.

It is reported that the histological and histochemical differentiation of the foliate papilla of Guinae pig starts in the early prenatal period and complete in the postnatal period (4). In the current study we observed that foliat papilla of the rat begin to develop in the late prenatal period and complete in the postnatal period. This finding shows that foliate papilla of the rat may become mature earlier than that of the Guinea pig. Also, the opened eyes of Guinea pigs and closed eyes of rats during birth denotes that the Guinea pig newborns met with the food earlier than the rats (4). The rat newborns have no mature taste buds on their papillae. Their taste buds serve only successful breastfeeding. Abscence of mature taste buds on the tongues of newborns may cause death due to malnut-

rision (6). Fujimato et al reported that while only the taste buds located on the lateral sides of the papilla were likely to be permanent after the birth, the others may degenerate during the postnatal period. It is also accepted that smelling has an important role on the sensorial control of breastfeeding (6,11).

In conclusion, we found that primary epithelial bulgings, which is the first sign of foliate papilla, formed on the 17th day of fetal life, serous glands and their ducts appeared on the 19th day of fetal life, taste bud models appeared on the first day of postnatal period, taste buds were become in oval shape in 5 days old rat, and 21 days old rat had similar papilla and taste bud structures to those the adult one had.

Pre-ve postnatal dönemlere ait sıçanlarda foliat papillalar ile tat tomurcuklarının gelişmesinin ışık mikroskobu düzeyinde incelenmesi

Bu araştırmada, pre- ve postnatal dönemlere ait erkek ve dişi sıçan dillerinde foliat papaklarla tat tomurcuklarının ortaya çıkış zamanı, gelişmeleri, morfolojileri ve topogratiluri ışık mikroskobu ile belirlenmeye çalışıldı. Heriki cinste, feıal 17.günde foliat papilla gelişmesinin ilk işareti olan primer epitelyal kabartıların, fetal 19.günde seröz bez ve bez kanallarının, yenidoğanda tat tomurcuğu taslaklarının görüldüğü, postnatal 21.günde papillalarla tat tomurcuklarının ergin hayvandakine benzer şekillendikleri saptandı.
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REFERENCES

1. Conn HJ, Darrow MA, Emmel VM. Staining procedures. America The Williams and Wilkins Co, 1962:39-40.
2. Farbman AI. Electron microscope study of the developing taste bud in rat fungiform papilla. Dev Biol 1965; 11:110-35.
3. Fujimato S, Yamamoto K, Yoshizuka M, et al. Pre and postnatal development of rabbit foliate papillae with special reference to foliate gutter formation and taste bud and serous gland differentiation. Microsc Res Tech 1993; 26:120-32.
4. Hamed MS, Serafy AK, El-Eishi IH. Histological and histochemical study on the development of foliate papillae in guniea pigs. Acta Anat 1980; 106:101-7.
5. Hirata K, Kanaseki T. Immunohistochemical studies on neuron specific enolase in developing rat vallate papillae. Anat Embryol 1989; 180:159-63.
6. Hosley MA, Oakley B. Postnatal development of the vallate papilla and taste buds in rats. Anat Rec 1987; 218:216-22.
7. Kock K, Blaker M, Schmale H. Postnatal development of von Ebner's glands: accumulation of a protein of the lipocalin superfaimly in taste papillae of rat tongue. Cell Tissue Res 1992; 267:313-20.
8. Mistretta CHM, Baum BJ. Quantitative study of taste buds in fungiform and circumvallate papillae of young and ages rats J Anat 1984; 138:323-32.
9. Seta Y, Toyoshima K. Three-dimensional structure of the gustatory cell in the mouse fungiform taste buds: a computer-assisted reconstruction from serial uitrathin sections. Anat Embryol 1995; 191:83-8.
10. State EA, Bowden REM. Innervation and cholinesterase activity of the developing taste buds in the circumvallate papilla of the mouse. J Anat 1974; 118:211-21.
11. State FA, El-Eishi HI, Naga IA. The development of taste buds in the foliate papillae of the albino rat. Acta Anat 1974; 89:452-60.