Histomorphological Development of the Circumvallate Papillae in Goat Foetii 
(Capra hircus)
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Abstract
The present study was conducted on the tongue of 18 goat foetii divided into three prenatal age groups to study the sequential events with regard to histological development of circumvallate papillae in goat foetii. The first indication of formation of circumvallate papillae in goat foetii was observed at 62 days of gestation (CRL =10.10 cm. At 120 days of gestation (CRL=31.10 cm), the papillary epithelium invaginated into the propria-submucosa to form serous acini. ). A well developed moat was marked on the lateral aspect of the papillae. At 134 days of gestational age in goat foetii (CRL= 32.00 cm), taste buds were observed on the apical surface of the circumvallate papillae and the papillae were lined by stratified squamous epithelium. At 146 days of gestation (CRL =35.50 cm), the stratified squamous epithelium of the circumvallate papillae showed a slight degree of keratinisation. In the present study, the mean values in regard to height of circumvallate papillae in the goat foetii of group I, II and III were recorded to be 28.05 ± 4.00 μ which increased significantly (P≤ 0.05) to 128.33 μ ± 9.84 in group II and then to 231.57 ± 20.36 μ in group III. Similarly, the mean diameter of the circumvallate papillae were recorded as 36.07 ± 2.73 μ, 161.03 ± 17.52 μ and 395.5 ± 33.50 μ in group I, II and III, respectively. In 146 day old foetus vallate papillae were developed locating 7 on right side and 5 numbers on the left side of the tongue.

Key words: Prenatal Development, Goat Foetii, Tongue, Circumvallate Papillae

Introduction
Tongue is the most important organ of prehension situated partly on the floor of the buccal cavity and partly in the anterior wall of the oral part of the pharynx. It is covered with mucous membrane and is an important organ for prehension, mastication, swallowing of food and appreciation of taste. The dorsum of tongue is provided with projections of mucous membrane called papillae, disseminated on the lingual surface. These have two specific functions – gustatory and masticatory. The bulk of tongue is skeletal muscle, arranged in three layers all at right angles to each other (Sisson and Grossman, 1975; Reece, 2004) giving it a degree of flexibility for prehension and mastication of food (Getty, 1975; Dyce et al., 1996). Majority of tongue muscles are somatic in origin (Yamane, 2005). The presence of prominent
torus linguae with a crescentic depression – fossa linguae was reported in the tongue of ox and sheep (Habel, 1975), goat (Qayyum and beg, 1975), buffalo (Dhingra and Barnwal, 1979; Prakash and Rao, 1980). The torus linguae probably compensates for the deficient masticatory mechanism caused by absence of incisors in the upper jaw (Labh and Mitra, 1969).

It has been observed that the morphogenesis and cytodifferentiation in developing vertebrate organs is controlled by the sequential and reciprocal interaction between the epithelial and mesenchymal tissues (Jitpukdeebodintra et al., 2002). Development of different papillae occurs prenatally and in a very specific spatial and temporal pattern. Although each type is morphologically distinct, the initial events in the development in all mammals are histologically similar (Mistretta, 1991) and later on there must be progressive differentiation to acquire the papillary epithelial taste progenitor cell and finally taste cell within the papillary apex (Mistretta and Liu, 2006).

Paucity of literature on prenatal development of the circumvallate papillae in goats prompted this study.

**Materials and Methods**

The present study was conducted on the tongue of 18 goat foetii which were collected from the slaughter houses in and around Jammu city. These foetii were ranged from early pregnancy to near full term. Immediately after collection, the umbilical cords of these foetii were ligated properly and were cleaned with cotton soaked with water to remove the amniotic fluid. The weight of each foetii was recorded with the help of analytical balance. The approximate age of the foetii were calculated by putting the body weight values in the formula (Singh et al., 1979)

For estimation of age in goat foetus as mentioned below.

Formula for estimation of foetal age in goat:

\[ W^{1/3} = 0.096 \times (t-30) \]

Where, \( W \) = body weight of foetus in gm.

\( t \) = age of the foetus in days.

The collected foetii were then divided into three groups based on their estimated ages viz. Group I (below 50 days of gestation), Group II (between 50-100 days of gestation) and Group III (above 100 days of gestation to up to full term) containing 6 number of foetii in each group.

After estimation of age, the tongues were dissected out from the foetii. Tissue pieces from the tip, body, torus linguae and root of the tongue were fixed in 10% Neutral Buffered Formalin solution and processed for paraffin block preparation by alcohol-benzene schedule. Tissue sections of 5-6 μm were obtained
from these blocks on clean glass slides with the help of rotary microtome (Luna, 1968). The sections were then subjected to various histological and histochemical methods viz. Haematoxylin & Eosin, Mallory’s Stain, Hart’s Stain, Gomori’s Stain and Bielschowsky’s method for routine histology, collagen fibres, elastic fibres, reticular fibres and nerve fibres, respectively.

Fig 1: Photomicrograph of tongue 62 days old goat fetus showing formation of Circumvallate Papillae

Fig 2: Photomicrograph of tongue 120 days old goat fetus showing formation of Von Ebner’s Glands

Fig 3: Photomicrograph of tongue 121 days old goat fetus showing formation of Von Ebner’s Glands

Fig 4: Photomicrograph of tongue 120 days old goat fetus showing formation of nerve fibers, Bielschowsky’s stain
Fig 4: Photomicrograph of tongue 134 days old goat fetus showing taste buds were observed on the apical surface of the Circumvallate Papillae

Results and Discussion

The first indication of formation of circumvallate papillae in goat foetii was observed at 62 days of gestation (CRL =10.10 cm) (Fig.1). The formation of circumvallate papillae has been reported in human embryo at 6th week of gestation (Witt and Reutter, 1997), in dog foetii at 38th day of gestation (Ferrell, 1984), in sheep foetii at 50th day of gestation (Mistretta and Haus, 1996), in cross bred pig foetii by 56th - 70th day of gestation (Sarma et al., 2003) and in buffalo foetii of 10-15 cm CVR length (Scala et al., 2005). These growing papillae were lined by dark layered basal cells and 2-3 layers of apical cells as also observed in goat foetii (Ramayya et al., 2000). These broad primitive papillae had a core of mesenchyme (Fig.1).

At 120 days of gestation (CRL=31.10 cm), the papillary epithelium invaginated into the propria-submucosa to form serous acini (Fig.2,3) as also reported in mouse by Embryonic day 17 by Jitpukdeebodintra et al. (2002). With advancing gestational age in the goat foetii, the invaginated serous acini were transformed into Von Ebner’s glands and they were better differentiated. The connective tissue core of the vallate papillae were highly vascularised with a considerable number of nerve fibres penetrating the papillary cores (Fig. 4) as reported in sheep foetii at 110th day of gestation (Mistretta and Bradley, 1983) and in buffalo foetii by 20-25 cm CVR length (Scala et al. 2005, Uppal et al., 2006). Nerves play an important role in the formation of gustatory papillae (Whitehead and Kachele, 1994). A well developed moat was marked on the lateral aspect of the papillae (Fig. 3).

At 134 days of gestational age in goat foetii (CRL= 32.00 cm), taste buds were observed on the apical surface of the circumvallate papillae (Fig.5) and the papillae were lined by stratified squamous
epithelium. Similar findings were observed in buffalo calves (Trautmann and Fiebiger, 1957; Singh, 2001; Gadre and Singatairi, 2006; Uppal et al., 2006 and Verma, 2008) and in lesser mouse deer (Agungpriyono et al., 1995).

At 146 days of gestation (CRL =35.50 cm), the stratified squamous epithelium of the circumvallate papillae showed a slight degree of keratinisation. The connective tissue core of the papillae was composed of fibroblasts, blood vessels and nerve fibres. Large numbers of taste buds were observed on the apical and lateral surfaces of the papillae (Fig. 2).

In the present study, the mean values in regard to height of circumvallate papillae in the goat foetii of group I, II and III were recorded to be 28.05 ± 4.00 μ which increased significantly (P≤ 0.05) to 128.33 μ ± 9.84 in group II and then to 231.57 ± 20.36 μ in group III. Similarly, the mean diameter of the circumvallate papillae were recorded as 36.07 ± 2.73 μ, 161.03 ± 17.52 μ and 395.5 ± 33.50 μ in group I, II and III, respectively. The diameter of these papillae also showed a significant (P≤ 0.05) enhancement between the succeeding age groups (Table 1). Singh (2001) reported in the height and diameter of the vallate papillae to be as 553.80 ± 78.70 μ 538.90 ± 127.30 μ, respectively in neonatal bufflalo calves while Gadre and Singatairi (2006) observed in buffalo calves that the maximum width of vallate papillae ranged between 324 - 472 μ. On the other hand, Davies et al. (1979) reported the height of adult bovine vallate papillae as 1.00- 1.50 mm. Similarly, Ramayya et al. (2000) reported the height and diameter of the vallate papillae ranging from 0.7 -0.8 mm and 0.9-1.0 mm, respectively in goat.

Table 1: Micrometrical observations of height and diameter (Mean ± S.E in μ) of various lingual papillae of the tongue in goat foetii at different age groups

| Lingual Papillae | Group I | | Group II | | Group III | |
|------------------|---------|-----------------|---------|-----------------|---------|
| | Height | Diameter | Height | Diameter | Height | Diameter |
| Filiform papillae | 39.46\(^a\) ± 2.11\(^*\) | 13.56\(^a\) ± 1.56\(^*\) | 78.16\(^b\) ±8.16\(^*\) | 38.5\(^b\) ± 2.39\(^*\) | 305.66\(^c\) ±49.48 | 84.78\(^c\) ±8.85 |
| Fungiform papillae | 35.15\(^a\) ± 2.82\(^*\) | 22.50\(^a\) ±2.15\(^*\) | 72.33\(^b\) ±5.61\(^*\) | 91.04\(^b\) ± 15.6\(^*\) | 184.55\(^c\) ±20.26 | 179.66\(^c\) ±15.19 |
| Vallate papillae | 28.05\(^a\) ± 4.00\(^*\) | 36.07\(^a\) ±2.73\(^*\) | 128.33\(^b\) ±9.84\(^*\) | 161.03\(^b\) ±17.52\(^*\) | 231.57\(^c\) ±20.36 | 395.5\(^c\) ±33.50 |

\(^*\) Not fully differentiated so height and diameter of dome shaped primitive papillae were recorded. Mean with common super script do not differ (P<0.05) significantly.
Fig 1: Showing measurements of diameter (μm) and height (μm) of circumvallate papillae of goat tongue at different prenatal age groups

In 146 day old foetus vallate papillae were developed locating 7 on right side and 5 numbers on the left side of the tongue. Similar observations were also observed in goat (Sarma et al., 2005) and Rocky mountain goats (Kobayashi et al., 2005). Habel (1975) 8-17 numbers of vallate papillae arranged in two rows in goat. Dhingra and Barnwal (1979) reported the number of circumvallate papillae on the right and left side of the tongue to be 18 – 21 and 15 – 18, respectively in Indian buffalo. Again, Mack et al. (1997) observed 850 and 826 fungiform papillae and 1 – 2 circumvallate papillae, respectively in the tongue of pig. Getty (1975) also reported the presence of two vallate papillae in pig and horses. This variation in number of vallate papillae in different animals is a species specific characteristic feature.

Conclusion

The first indication of formation of circumvallate papillae in goat foetii was observed at 62 days of gestation (CRL =10.10 cm. At 134 days of gestational age in goat foetii (CRL= 32.00 cm), taste buds were observed on the apical surface of the circumvallate papillae and the papillae were lined by stratified squamous epithelium. The mean values in regard to height and diameter of circumvallate papillae increased significantly (P ≤ 0.05) from group I to group III.

References


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