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BRUNNER'S GLANDS IN SOME INDIAN BATS

S. A. BHIDE
Department of Zoology, Institute of Science, Nagpur

ABSTRACT

The structure, distribution and some aspects of mucin histochemistry of the Brunner's glands of one megachiropteran and four microchiropteran species are described. Whereas the Brunner's glands are present throughout the pylorus and the proximal part of the duodenum in the fruit eating Megachiroptera, these glands are confined to a small proximal region on the duodenal side of the pyloric sphincter in the insectivorous and carnivorous Microchiroptera. Further, the Brunner's glands in all the species contain neutral mucins.

INTRODUCTION

EARLIER workers[1-3] have reported that the glands of Brunner are confined to the submucosa of the duodenum and that their ducts penetrate the muscularis mucosae and empty into the crypts of Lieberkuhn. Krouse[4,5] has demonstrated that these glands are confined to the distal stomach of monotremes, and to the proximal duodenum in the majority of Australian marsupials. The Brunner's glands have been reported to be present only in the region of the duodenum and as emptying into the crypts of Lieberkuhn in several eutherian forms[1,2,6]. The cells of these glands and their secretory tubules, according to Krause[7], failed to stain with alcian blue either at pH 1·0 or at pH 2·5 but were PAS-positive thereby indicating that the mucin elaborated by them may be a neutral mucopolysaccharide.

Amongst the bats the Brunner's glands have received very little attention from workers. Forman[8-10] noted that these glands extend into the pylorus of the stomach in the American fruit eating bats such as *Artibeus lituratus* and *A. palmarus* and to a lesser extent in *Sturnira lilium* and *Carollia perspicillata*. He demonstrated that these glands reacted positively to alcian blue in *Artibeus lituratus* and *Corollia presspicillata* and positively to Hale's colloidal iron and alcian blue in *Sturnira lilium* and *S. ludovici* thereby indicating the presence of acid mucopolysaccharides in these animals. He also showed that with the PAS staining procedure these glands reacted weakly in *Rhynchonycteri*, *Pteronotus* and *Pizonyx*, moderately in *Artibeus* and *Sturnira* and intensely in the other species he studied.

From the foregoing it is evident that there are considerable differences in the location, extent of development and physiological properties, as indicated by histochemical reactions, of the Brunner's glands among the different mammals. The present report is the first on the Brunner's glands of Indian bats and embodies descriptions of these glands in five species of bats belonging to different families and possessing different dietary habits.

MATERIAL AND METHODS

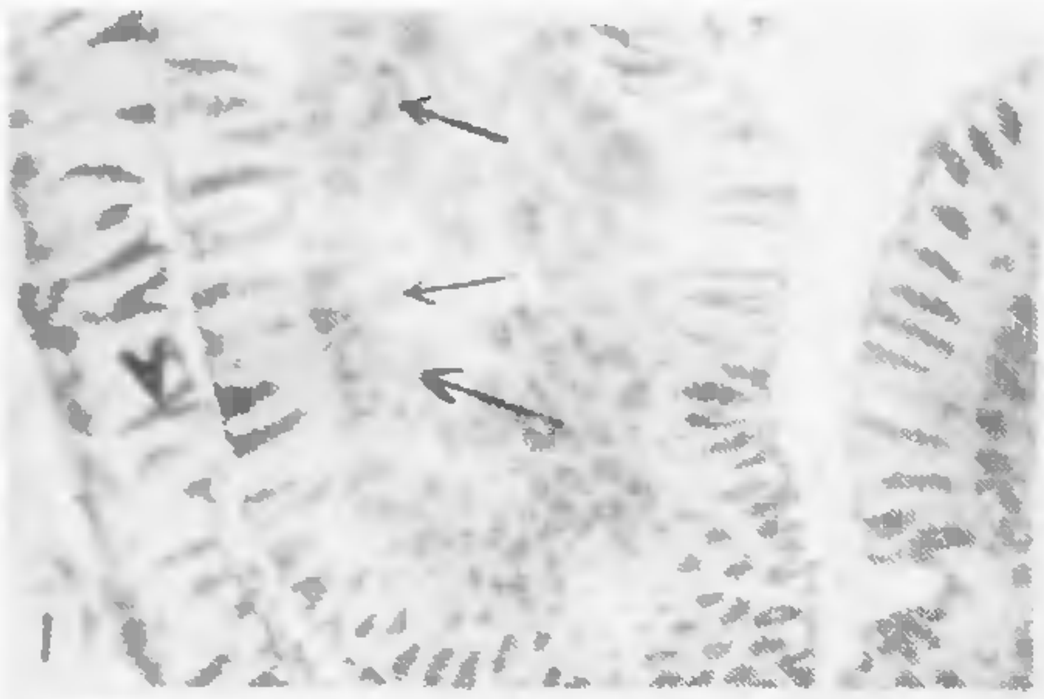
The Brunner's glands of the following bats are studied: *Pteropus giganteus giganteus* (Pteropidae; exclusively frugivorous), *Taphozous longimanus* (Emballonuridae; feeds on hard bodied insects like beetles), *Megaderma lyra lyra* (Megadermatidae; exclusively carnivorous feeding on small vertebrates), *Hipposideros speoris* (Hipposideridae) and *Miniopterus schreibersii* (Vespertilionidae). The latter two species feed on soft bodied insects such as mosquitoes, flies, butterflies and moths.

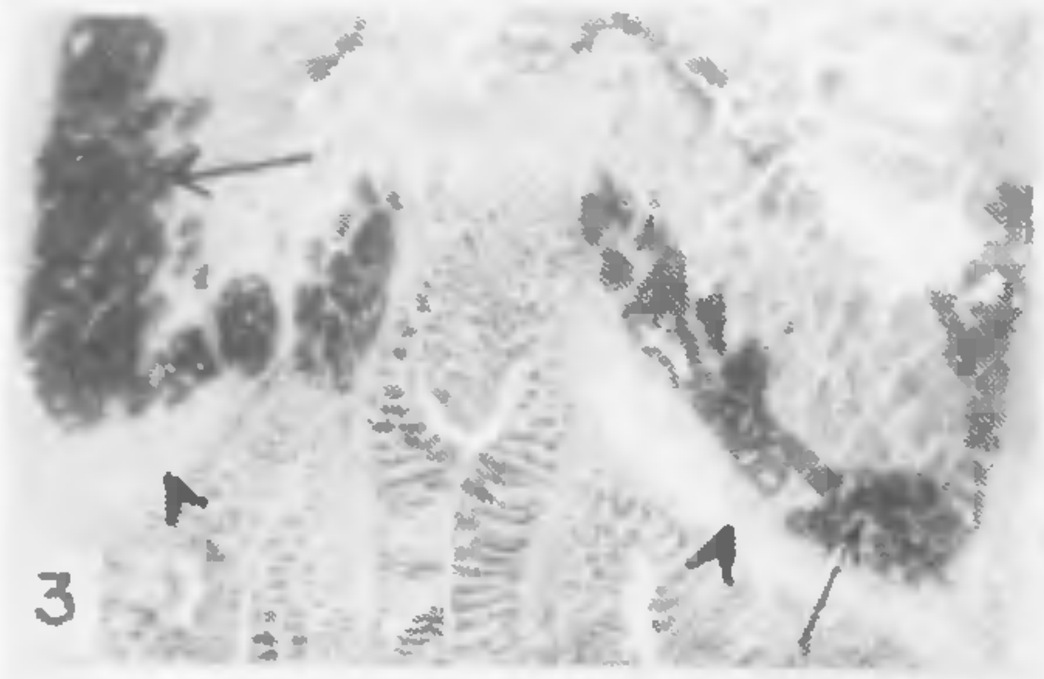
The empty stomach and the duodenum of the above mentioned species were dissected out and fixed in neutral formalin or Rossman's fixative. Paraffin embedded tissues were stained for routine histological examination by Ehrlich's haematoxylin and eosin. Selected sections were stained in the following ways for histochemical examination: periodic acid-Schiff (PAS) with or without prior salivary digestion, alcian blue (AB) pH 1·0, AB (pH 2·5), AB (pH 1·0)–PAS, AB (pH 2·5)–PAS, Colloidal iron–PAS. All these techniques are as given by Pearse[11].

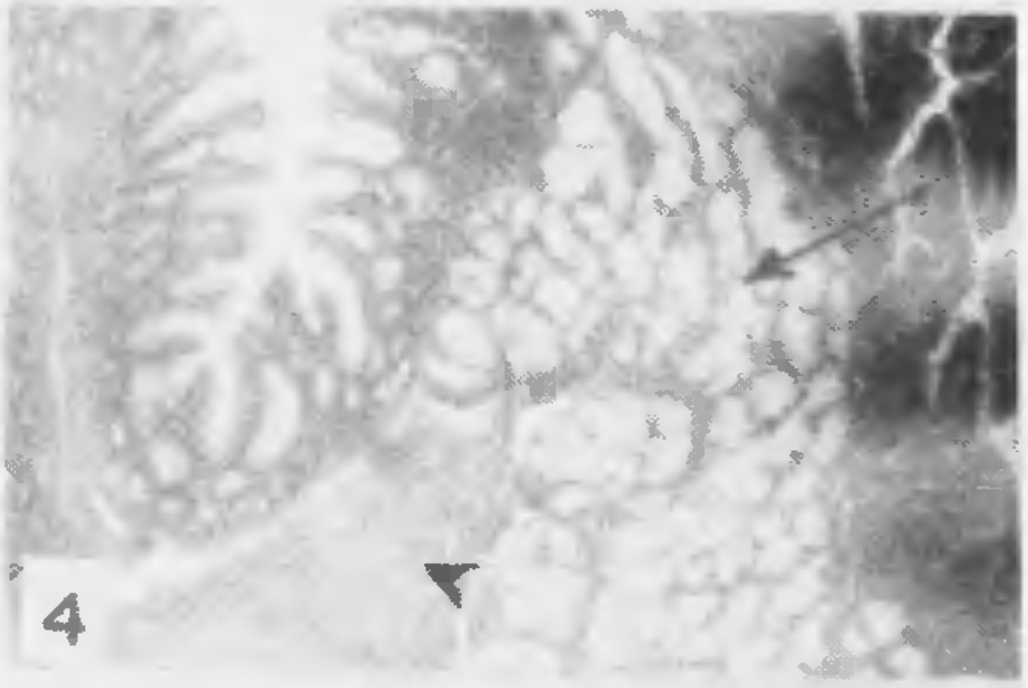
OBSERVATIONS AND DISCUSSION

The extent of development, the location and the structure of the Brunner's glands vary among the different species studied here. Whereas these glands are present throughout the pylorus (Fig. 1) as well as to some extent along the duodenum (Fig. 2), they are present only on the duodenal surface of the pyloric sphincter and extend to a very short distance along the duodenum in all the other species studied here. The acini of these glands in *Taphozous longimanus* (Fig. 4) and *Hipposideros speoris* (Fig. 5) are in the form of large lobes which are compactly arranged in the submucosa. The glands of *Miniopterus schreibersii* (Fig. 6) occur in the form of small lobules

separated by distinct connective tissue septa. The major part of the Brunner's glands in *Megaderma lyra lyra* (Fig. 3) are concentrated in the form of a ring of compactly arranged acini at the gastro-duodenal junction. A few acini in this species occur interspersed between patches of lymphoid tissue. The glands empty directly into the bases of the crypts of Lieberkuhn in all the micro chiropteran species examined here, and by







FIGS. 1–6. Fig. 1. Part of the section through the mucosa of the pyloric region of the stomach of *Pteropus* Note the Brunner's glands (arrow) in the mucosa which stain intensely. The pyloric glands (arrowhead) give a very intense reaction, (PAS), × 100. Fig 2. Part of the transverse section through the duodenum of *Pteropus* to show the Brunner's glands (arrow) in the submucosa, (PAS), × 56. Fig. 3. Longitudinal section through the gastro-duodenal junction of *Megaderma*. Note the very intensely stained Brunner's glands (arrow) along the pyloric sphincter (arrowhead), (PAS), × 44 Fig. 4. Part of the longitudinal section of the gastro-duodenal junction of *Taphozous*. Note the acini of the Brunner's glands (arrow) lying on the duodenal side of the pyloric sphincter (arrowhead), (H.E.), × 100. Fig. 5. Longitudinal section through the gastro-duodenal junction of *Hipposideros*. Note that the Brunner's glands (arrow) are on the duodenal side of the sphincter (arrowhead), (PAS), × 64. Fig. 6. Part of the longitudinal section through the gastro-duodenal junction of *Miniopterus*. The acini of the Brunner's glands (arrow) occur in the form of lobules separated by connective tissue septa, (PAS), × 100.

way of small ducts while open into the bases of the crypts of Lieberkuhn in the duodenal region and between the gastric glands in the pyloric region in the frugivorous megachiropteran species–*Pteropus*.

Histochemical analysis reveals that the Brunner's glands are intensely PAS-positive in *Pteropus* and very intensely PAS-positive in the other species. The intensity of the reaction was not altered by prior salivary digestion. Further, except for a few isolated cells of the Brunner's glands of *Pteropus* the glands in all the species gave a negative reaction to AB at pH 1·0 and at pH 2·5 and colloidal iron. In sequential staining procedures the glands took only PAS stain. These reactions indicate that the Brunner's glands in all the species contain neutral mucins and that a few isolated cells of the Brunner's glands of *Pteropus* contain traces of acidic mucins.

The present studies have, therefore, revealed that there are marked differences in the distribution of the Brunner's glands between the Megachiroptera and the Microchiroptera. While there is an extensive development of the Brunner's glands in the Megachiroptera, in which they are present not only on the duodenal side of the sphincter but also along the entire length of the pyloric region of the stomach, these glands are restricted to a small segment of the duodenum distal to the pyloric sphincter in all the microchiropteran species.

On comparing the present observations with those of earlier workers two interesting facts become evident. First, the distribution and the extent of development of the Brunner's glands differ in different bats. Secondly, the Brunner's glands are consistently extensively developed and occur also in the pyloric region of the stomach in the fruit eating bats—both Megachiroptera and the Phyllostomatidae among the Microchiroptera.

From a physiological point of view these glands have been reported to help in neutralizing the acid material coming from the stomach and thus prevent any damage to the mucosal lining of the duodenum[21]. Evidently, the greater development and the more extensive distribution of the Brunner's glands in the frugivorous bats is an adaptation to meet the demands for neutralizing the possible excess acid produced in the stomach of frugivorous bats which normally consume a large bulk of food during each feeding. The present state of our knowledge does not encourage us to attribute any enzyme action to the secretions of the Brunner's glands although this cannot be altogether ruled out.

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1. Mathis, J., *Anat. Anz.*, 1928; 65, 1.
2. Carleton, A., *Proc. Zool. Soc. London*, 1935, 91. 385
3. Landboe–Christensen, E., *Acta. Path. Microbiol. Scand.*, 1944, 52, 1.
4. Krause, W. J., *Amer. J. Anat.*, 1971, 132, 147.
5. —, *Acta Anat.*, 1972, 82, 17.
6. Elias, H., *Amer. J. Vet. Res.*, 1947, 8, 311.
7. Krause, W. J., *Acta Anat*, 1975, 93, 580.
8. Forman, G. L., *Trans. Illi. Acad. Sci.*, 1971, 64, 273.
9. — *Univ. Kansas Sci. Bull.*, 1972, 49, 591.
10. — *J. Mammal.*, 1973, 54, 909.
11. Pearse A. G. E., *Histochemistry Theoretical and Applied.* 3rd Ed., J & A Churchill Ltd. London, 1969, 1.
12. Grossman, M. I., *Physiol. Rev.*, 1958, 38, 675.

AWARD OF RESEARCH DEGREES

Berhampur University, Orissa, has awarded the Ph.D. degree in Zoology to Sri Kirttan Chandra Patra; Ph.D. degree in Mathematics to Smt. Subhadra Rath.

Utkal University, Bhubaneswar, has awarded the Ph.D. degree in Botany to Sri P. Sen.

Sri Venkateswara University, Tirupati, has awarded the Ph.D. degree in Botany to Sri N. Rajkumar; Ph.D. degree in Chemistry to Sri K. Subramanyam Reddy; Ph.D. degree in Zoology to the following candidates: Sri K. Raghavaiah, Sri K. Narayana Reddy, Sri M. Sreeramachandra Murthy, Sri T. Pavan Kumar and Sri N. Sreeramulu.

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