DUODENAL GLAND DEVELOPMENT IN RATS ON A CELLULOSE-RICH DIET

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Duodenal glands are found only in mammals [6, 8]. The degree of development of duodenal glands may differ in representatives of different orders, as well as within the same taxonomic group. We know that these glands attain the highest development in herbivorous animals [8], although this parameter varies among this group [9]. Since cellulose accounts for a certain proportion (often considerable — 40 to 45%) of the herbivorous diet [3], it can be tentatively suggested that this greatest abundance of the duodenal glands in certain herbivorous animals may be connected with the cellulose in the diet. The aim of this investigation was to test this hypothesis experimentally.

EXPERIMENTAL METHOD

Weaned (22-24 days) male Wistar rats were used. Animals of group 1 (control) received a standard pellet diet, animals of group 2 received a diet based on pellets but containing up to 30% of cellulose in the form of added bran and dried beetroot (20 and 10% of the dry weight of the diet, respectively). The animals were allowed food and water ad libidum for 3 months. The animals' body weight was measured weekly. At the end of the experiment the rats were killed with chloroform vapor and the duodenum was removed in toto; its lower border was identified as the point of origin of the first branch of the superior mesenteric artery [12]. The samples of intestine were treated by the method in [10]. The length of the intestine and the length of the glandular zone were measured by means of a micrometric ruler, and the relative index of development of the glands, defined as the glanduloduodenal index (GDI), was calculated from the results. The degree of filling of the stomach was recorded in each animal and the acidity of its contents in the region of the lesser curvature was determined chromatographically [4]. When the experimental results were assessed, parametric statistical methods were used: calculation of Student's t, determination of statistical correlation, and unifactorial dispersion analysis.

EXPERIMENTAL RESULTS

Throughout the period of observation the animals' body weight increased progressively in both groups, but it was rather less in the experimental group. These differences were probably due to the fact that cellulose causes a decrease in the absorption of certain hydrolysis products of the food, and also considerably stimulates intestinal movements; as a whole, these changes reduce the assimilation of digested substances [5, 7, 11]. Meanwhile the increase in body weight of the animals in the control and experimental groups did not differ significantly, except in the first week of the experiment, when it was 73 and 47.6%, respectively. The microscopic investigation showed that the duodenal glands begin immediately beyond the pyloric sphincter and initially they are arranged in the form of a compact mass, forming a continuous ring 3-5 mm wide around the whole wall of the duodenum. In the distal direction the terminal portions are more diffusely arranged (Fig. 1). When the length of the glandular zone was measured, its boundary was taken to be the location of the most distant single terminal portions. Morphometric analysis showed that, while the duodenum was virtually the same length in both groups, the length of the glandular zone was significantly greater in rats of the experimental group; the value of GDI also increased correspondingly (Table 1). Since correlation could not be found between the length of the duodenum and the degree of development of the duodenal glands ($r = 0.08$; $t = 0.36$), it can be tentatively sug-

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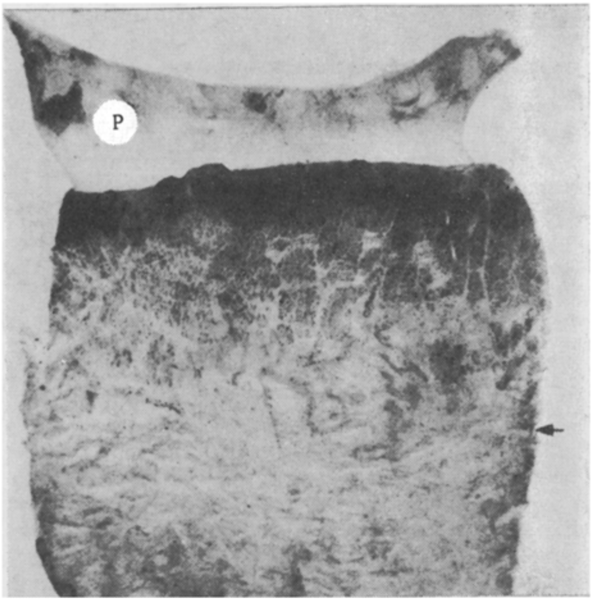

Fig. 1. Distribution of glands in wall of rat duodenum (total preparation). P) Pyloric part of stomach; arrow points to distal boundary of glandular zone. Hematoxylin. Photographic enlargement (horizontal lines indicate scale of 1 cm).

TABLE 1. Parameters of Degree of Development of Glands and Acidity of Gastric Contents (M ± m)

Experimental conditions	Length of duodenum, mm	Length of glandular zone, mm	GDI, %	pH of gastric contents
Control (n = 10)	91,8±0,8	5,4±0,3	5,9±0,4	4,4±0,3
Experiment (n = 13)	90,6±1,7	8,6±0,4	9,5±0,5	3,4±0,3
P	—	<0,001	<0,001	<0,05

Legend. n) Number of animals.

gested that the differences found were due to the higher content of cellulose in the diet of the animals of the experimental group. This hypothesis was confirmed by analysis of the strength of the effect of this factor (consumption of cellulose with the diet) on the degree of development of the duodenal glands, when a quite high degree of correlation was found between the result and the experimental conditions ($n = 0.64 \pm 0.017$; $F = 37.66$; $P < 0.01$). It was also shown that the acidity of the gastric contents, irrespective of the degree of gastric filling, was always higher in the experimental than in the control group. In rats whose stomach was highly, moderately, or poorly filled, the acidity of its contents (in pH units) was 5.0, 4.7, and 3.4 for the control group and 4.0, 3.8, and 2.5, respectively, for the experimental group. The combined values of this parameter for the two groups of animals also differed significantly (Table 1). These results are evidence that, despite the continuous secretion of gastric juice [1] and its high total acidity [2] in the rats, the pH of the gastric contents varied depending on the degree of filling. A change in the qualitative composition of the food may also affect the magnitude of this parameter; in particular, with an increase in the cellulose content of the animals' diet, increased acidity of the gastric contents was observed. Negative correlation was found between the pH of the gastric contents and the degree of development of the duodenal glands ($r = -0.54$; $t = -2.97$; $P < 0.05$). It can be postulated that the duodenal glands, by releasing a mucous secretion on the surface of the duodenum, protect it from the injurious action of the acid chyme, coming in from the stomach [8]. Changes found in pH of the gastric contents of animals on a high cellulose diet may be one of the causes of the more marked development of glands in the duodenum in this case.

The results of this investigation thus suggest that the more intensive development of the duodenal glands in herbivorous mammals may be connected with the character of their diet and, in particular, with its cellulose content. Consumption of a vegetable diet with a high cellulose content evidently requires the surface of the duodenal mucosa to be protected against the mechanical and chemical action of the coarse and acid food masses arriving from the stomach. The possible mechanism of this protection is the formation of a powerful protective layer of mucus, formed on account of secretion of the duodenal glands, which are much more highly developed in such cases.

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EFFECT OF NEONATAL CASTRATION OF MALE RATS ON PITUITARY STEROID RECEPTOR CONCENTRATION

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Estrogens and androgens participate in the regulation of gonadotropin secretion in male rats by a negative feedback method as a result of interaction with corresponding receptors in the adenohypophysis and hypothalamus [4, 5]. Intracellular receptors binding estrogens and androgens are present in these structures, and protein molecules may probably partipate in modulation of the pituitary response by steroids [9, 10]. It has also been shown that changes in the hormonal background in young male rats lead to significant changes in the concentration of receptors for sex hormones in the adult hypothalamus [3, 5, 9].

The aim of this investigation was to study receptor binding of estradiol and testerone in the pituitary gland of mature male rats castrated during the first days of life or in the adult state.

EXPERIMENTAL METHOD

Noninbred male rats were used. The testes were removed from the animals at the age of 1-3 days, and they were decapitated at the age of 90 days. Males castrated at puberty, which were killed a week after the operation, were used for comparison. Adenohypophyses from 40 to 50 animals were homogenized in buffer containing 0.01 M Tris-HCl, 0.0015 M EDTA, and 0.01 M

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