

SECRETORY ACTIVITY OF THE GASTRIC GLANDS  
AND DIGESTION OF PROTEIN IN THE STOMACH  
AFTER EXCLUSION OF THE EXTERNAL  
PANCREATIC SECRETION

D. F. Blagovidov, A. N. Pomel'tsov,  
and V. N. Shatalov

UDC 612.323+612.322.74]-06:612.342.6

Definite and regular changes in gastric secretory function and in the digestion of protein by the gastric juice were obtained in dogs with a gastric fistula and isolated gastric pouch when the external secretory (digestive) function of the pancreas was blocked. The dynamics of these changes was studied in relation to the time after ligation of the pancreatic ducts. It was also found that the digestion of protein by the gastric juice is substantially altered after exclusion of pancreatic secretion: the gastric juice acquires the power of splitting protein with the formation of large quantities of amino acids and peptone, many times stronger than the digestive power of the intestinal juice.

Although there have been several investigations of functional morphological changes in various parts of the digestive tract accompanying pathological changes in the pancreas [1-4], changes in the secretion of gastric juice, in enzyme production and in digestion in the stomach following disturbance of the external secretory activity of the pancreas have so far received little study.

The object of this investigation was to study changes in the secretory activity of the gastric glands and the digestion of protein by the gastric juice after exclusion of the external secretory function of the pancreas.

EXPERIMENTAL

Experiments were carried out on 9 dogs with a gastric pouch of the Brestkin-Savich type and a gastric fistula. Gastric secretion was induced by feeding with meat (200 g) or meat broth (0.5 liter) and by subcutaneous injection of histamine (2 ml of a 0.1% solution). The volume of gastric juice, its acidity, and its digestive power were determined by Hunt's method in Sabsai's modification. In the experiments of series I the normal secretion, acidity, and digestive power of the juice were determined in each animal. In addition, the degree of hydrolysis of a standard protein (dry bovine serum) by the gastric juice was determined. For this purpose, a known quantity of protein (2 ml of a 1% solution) was treated with the same volume of gastric juice in all experiments (1 ml). After incubation for 15 min the digest was investigated with an amino-acid analyzer. In the experiments of series II, after addition of protein to the gastric juice and exposure under the same conditions, intestinal juice diluted 1:20 was added to the samples. Each sample was incubated at 37°C for 15 min, after which the amino acids were analyzed quantitatively. In series III, gastric juice was added to a standard peptone solution.

After the series of experiments had been performed on the "intact" animal (gastric fistula + gastric pouch only), the pancreatic ducts were ligated. The gland was carefully separated from the duodenum and buried in the peritoneal cavity.

---

Main Department No. 4, Ministry of Health of the USSR. (Presented by Academician of the Academy of Medical Sciences of the USSR E. I. Chazov.) Translated from *Byulleten' Éksperimental'noi Biologii i Meditsiny*, Vol. 74, No. 11, pp. 19-21, November, 1972. Original article submitted September 13, 1971.

© 1973 Consultants Bureau, a division of Plenum Publishing Corporation, 227 West 17th Street, New York, N. Y. 10011. All rights reserved. This article cannot be reproduced for any purpose whatsoever without permission of the publisher. A copy of this article is available from the publisher for \$15.00.

TABLE 1. Content of Amino Acids (in mg%) after the Action of Intestinal Juice on Standard Protein Solution Predigested with Gastric Juice

Amino acid	Dog Modnitsa		Dog Zlyuka	
	expt.	control	expt.	control
Ammonia	29.2	13.1	15.5	5.5
Ornithine	Traces	0.1	11.9	1.0
Lysine	0.2	Traces	2.9	0.1
Histidine	Traces	Traces	3.5	2.0
Arginine	Traces	Traces	5.1	0.2
Taurine	0.2	Traces	3.7	0.06
Urea	Traces	Traces	12.0	3.6
Aspartic acid	Traces	Traces	2.7	0.8
Threonine	2.1	Traces	2.4	0.08
Serine	Traces	Traces	84.0	2.1
Glutamic acid	224.8	0.02	175.3	0.9
Glycine	172.4	Traces	596.3	6.8
Alanine	154.0	Traces	607.2	2.1
Valine	Traces	Traces	5.9	0.9
Cysteine	Traces	Traces	0.6	0.07
Methionine	0.5	Traces	1.8	0.01
Isoleucine	Traces	Traces	18.2	0.5
Leucine	Traces	Traces	13.1	0.8
Tyrosine	Traces	Traces	7.3	4.9
Phenylalanine	Traces	Traces	Traces	Traces

#### EXPERIMENTAL RESULTS AND DISCUSSIONS

The results of the experiments on all the animals were similar, and only very slight quantitative variations were found among the different animals. This was true both of changes in the secretion, acidity, and digestive power of the juice and of the dynamics of these changes after the operation. The same pattern was also observed with regard to the degree of hydrolysis of the protein in the stomach.

Changes in the volume of juice secreted and in its acidity and digestive power are shown in Fig. 1, illustrating a typical experiment on the dog Sharik with a gastric fistula. After the operation on the animal considerable changes occurred in all the indices of secretion tested. Immediately after a marked increase in the volume of gastric juice observed in the early periods of observation there was a decrease in secretion, with a subsequent rise and stabilization at a definite level. At approximately the same time (180th day), after a gradual increase in the digestive power of the gastric juice it became stabilized at a level much higher than initially. With regard to acidity, a different pattern was observed. A marked increase in the early periods of the investigation was followed by a decrease in the acidity of the gastric juice. In the late periods of the investigation the acidity of the gastric juice became stabilized at a somewhat lower level than initially. Similar results were obtained in the other dogs. The dynamics of the changes in response to histamine or to administration of broth and meat was similar. However, besides changes in secretory and enzymic activity, depending on the times after operation there were distinct and regular changes in the course of secretion and of the formation of enzymes of the gastric juice within each individual experiment, mainly affecting the second phase of the gastric secretory response to meat and broth. The main problem studied in this investigation was that of qualitative changes in gastric digestion after the blocking of pancreatic secretion. The results of the experiments of series I showed that, starting from the 4th week after ligation of the ducts, the gastric juice digested protein with the formation of large quantities of amino acids, whereas in the initial experiments and in those using the gastric juice of intact dogs (control), amino acids were found only in traces (Table 1).

As described above, in the experiments of series II, which were performed on the same animals, a sample of protein + gastric juice was incubated and then treated with an equal volume of intestinal juice diluted 1:20. After exposure for 15 min at 37°C the amino-acid content was determined in the control (gastric juice of intact dogs) and experimental samples. It is clear from the results given in Table 1 that

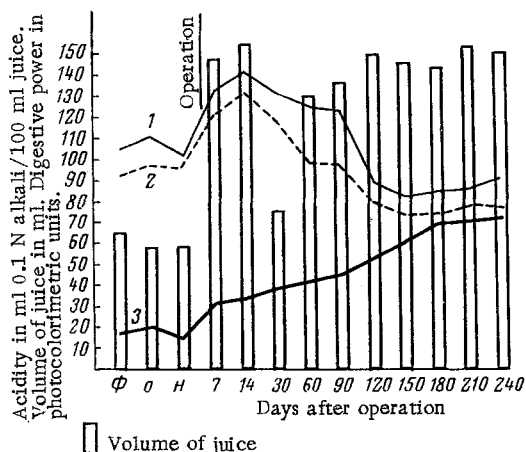


Fig. 1. Dynamics of changes in total (1) and free (2) acidity, digestive power (3), and volume of gastric juice (unshaded columns) in the dog Sharik with a Basow gastric fistula after blocking the external secretory function of the pancreas.

qualitative reorganization of digestion of the stomach, i.e., hydrolysis of the protein by the gastric juice followed a different course than in intact animals, to smaller particles, thereby facilitating its more intensive digestion by the intestinal juice.

3 months after the operation on the dog Zlyuka there was a sharp increase in the total amino acid content (by 150 times in that experiment). There was also an increase in the content of several amino acids.

Similar results were obtained in the experiments of series III (peptone used instead of serum).

Hence, in approximately the 4th week after ligation of the pancreatic ducts, digestion of standard protein solution by the action of the gastric juice was so modified that large quantities of certain amino acids were produced. The digestive products of protein by the gastric juice of the experimental animals also were hydrolyzed to a far greater degree by the enzymes of the intestinal juice. The same result was obtained if the protein was replaced by a standard solution of peptone.

After ligation of the pancreatic ducts very considerable changes took place in the secretory activity of the stomach. Two stages of these changes can be recognized conventionally: the first consisted mainly of quantitative changes in secretion, digestive power, and acidity; the second (starting from the 4th week) was in the form of a

qualitative reorganization of digestion of the stomach, i.e., hydrolysis of the protein by the gastric juice followed a different course than in intact animals, to smaller particles, thereby facilitating its more intensive digestion by the intestinal juice.

#### LITERATURE CITED

1. D. Abel'man, Assimilation of Protein after Extirpation of the Pancreas. Dissertation, St. Petersburg (1890).
2. O. I. Gol'mberg, Activity of the Gastro-Intestinal Tract after Exclusion of External Pancreatic Secretion. Dissertation, St. Petersburg (1913).
3. I. P. Zhegalov, The Secretory Work of the Stomach after Ligation of the Pancreatic Ducts and on the Protein Enzyme in the Bile. Dissertation, St. Petersburg (1900).
4. Yu. N. Leporinskii, Fiziol. Zh. SSSR, No. 12, 1471 (1962).