

AMYLOLYTIC ACTIVITY OF GASTRIC JUICE OF DOGS AFTER BLOCKING EXTERNAL PANCREATIC SECRETION

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In chronic experiments on dogs with isolated Brestkin-Savich gastric pouches and fistulas amylolytic activity of the gastric juice was found to appear after blocking of the pancreatic external secretion and to persist for up to 20 months. This activity was exhibited in an acid medium (pH 0.5-5.0) with pH optimum 1.5-2.5. The gastric juice of dogs after these operations has about that pH. Within certain limits of its concentration the rate of hydrolysis of starch by the gastric juice was directly proportional to its concentration. The amylolytic activity of the gastric juice after blocking of the external pancreatic secretion was high enough to be of real significance in the digestion of starchy foods.

There is no information in the literature on the existence of a significant amylolytic activity of the gastric juice in dogs.

This paper describes an investigation which demonstrated the appearance of amylolytic activity in the gastric juice of dogs after blocking external pancreatic secretion and gives an account of this phenomenon.

EXPERIMENTAL METHOD

Five dogs with Brestkin-Savich isolated gastric pouches and three dogs with Basow gastric fistulas were used.

Gastric secretion was induced by feeding with bread, starch gel, meat, meat broth, and subcutaneous injection of histamine solution. The amylolytic activity of the gastric juice and blood was determined by the Wohlgemuth and Smith-Roy-Ugolev methods. In the first case a mixture of 0.4% starch solution (2 ml) and gastric juice (1 ml) was incubated at 37°C for 30 min, after which iodine solution was added to the sample. Samples in which the gastric juice was replaced by the equivalent volume of distilled water, 0.1 N HCl solution, and gastric juice of intact dogs were used as the controls. The degree of hydrolysis was investigated with the FÉK-56 photoelectric colorimeter with a red filter.

At the end of the control experiments the pancreatic ducts of the dogs were ligated; the pancreas was carefully mobilized from the duodenum, wrapped with omentum, and buried in the peritoneal cavity after which the amylolytic activity was investigated for up to 20 months.

EXPERIMENTAL RESULTS

Approximately from the end of the third or beginning of the fourth month after blocking the external secretion of the pancreas the gastric juice acquired the ability to split starch. As a rule the amylolytic activity of the gastric juice was 26-34% (Smith-Roy-Ugolev) or 16-64 units (Wohlgemuth).

Further investigations on the same animals showed that the amylolytic activity of the gastric juice remained constant throughout the period of testing (up to 20 months).

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TABLE 1. Amylolytic Activity of Gastric Juice of Dogs and pH of Gastric Juice before and at Various Times after Ligation of Pancreatic Ducts

Type of chronic operation	Dog's name	Before operation	Days after operation					
			90	180	270	360	450	540
Gastric fistula	Modnitsa Tsygan Trus Dana	0/1,24	0/1,75	32/1,8	33/2,5	29/2,4	31/2,5	32/2,4
		0/1,6	19/1,6	26/1,9	29/2,7	34/2,8	32/2,5	30/2,7
		0/1,8	0/2,4	30/2,8	30/3,0	28/2,8	31/2,9	34/3,0
		0/1,7	29/2,1	32/2,2	31/2,1	33/2,5	32/2,3	30/2,2
Isolated gastric pouches	Plaksa Volk Dikar' Drachun	0/1,8	26/1,9	28/2,8	27/2,8	29/2,6	27/2,6	26/2,9
		0/1,9	0/2,5	33/2,2	34/2,4	32/2,6	30/2,8	31/2,5
		0/2,0	27/2,4	29/2,5	31/2,7	30/2,9	30/2,9	28/2,8
		0/1,1	0/1,9	34/2,7	28/2,4	34/2,9	30/2,3	31/2,8

Note. Numerator - amylolytic activity, in %; denominator - pH.

The results of tests on all the animals were practically the same.

It was also found that the amylolytic activity of the gastric juice was exhibited to the greatest degree in samples incubated at pH 1.5-2.5, but the activity persisted over a wide range of pH values - from 0.5 to 5.0 (Fig. 1). It is interesting to note that the pH of the gastric juice of the experimental dogs varied at corresponding times after the operation from 2.0 to 3.0 (Table 1).

Special experiments were carried out to study the nature of the factor responsible for the amylolytic activity of the gastric juice. The relationship between the rate of hydrolysis of starch by the gastric juice and the concentration of substrate split was studied. Within the range of substrate (starch) concentrations of 0.1 to 0.5% the rate of its hydrolysis was directly proportional to its concentration, a characteristic feature of an enzyme reaction.

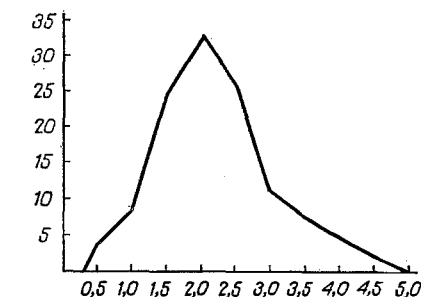


Fig. 1. Amylolytic activity of gastric juice as a function of pH. Abscissa - pH of incubation medium; ordinate - percent hydrolysis of starch.

In these experiments the blood amylase level was considerably increased at those times after ligation of the pancreatic ducts when amylolytic activity of the gastric juice was either absent or had only just started to appear. When this activity became relatively constant, the blood amylase level was the same as normal.

The results of these experiments thus demonstrate that amylolytic activity appears in the gastric juice of dogs after blocking of the external secretion of the pancreas and persists for a long time. The appearance of amylolytic activity of the gastric juice not only in dogs with a gastric fistula, but also in animals with an isolated gastric pouch, rules out its extragastric origin (reflux from the intestine, from the saliva, and so on). The factor inducing amylolytic activity of the gastric juice possesses certain properties of an enzyme. Its nature requires further study.

It is important to note that the pH optimum of the amylolytic factor of the gastric juice lies on the acid side, at the same figure as the pH of the gastric juice at the corresponding times after blocking the external secretion of the pancreas. The amylolytic activity of the gastric juice was of considerable magnitude, so that it can play a significant role in digestion.

Comparison of these results with those of determination of the secretory activity of the stomach and the proteolytic activity of the gastric juice in dogs after ligation of the pancreatic ducts suggests that the newly acquired amylolytic activity of the gastric juice reflects a complex compensatory and adaptive response of the stomach to disturbance of external pancreatic secretion.

LITERATURE CITED

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