THE DISTRIBUTION OF FREE SULFHYDRYL GROUPS IN THE PROTEINS OF THE MUCOUS MEMBRANE OF DIFFERENT DIVISIONS OF THE STOMACH AND THE CHANGE IN THE AMOUNT OF THEM IN CONNECTION WITH THE SECRETION OF GASTRIC JUICE

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In previous work on the functional biochemistry of the stomach we demonstrated the role of sulfhydryl groups in the biochemical mechanism of the secretory function of the stomach, the formation of hydrochloric acid and the neurohumoral regulation of this physiological process [3, 4, 5]. This was demonstrated by the reversible depression of hydrochloric acid formation through blocking with thiol inhibitors and removing the blocks with cysteine and by the direct stimulation of gastric secretion and hydrochloric acid formation through use of cysteine [5]. Since, aside from the soluble thiols glutathione and coenzyme A, the fundamental bearers of thiol groups are proteins, both enzymatic and structural protoplasmic proteins, the question naturally arose of the quantity of these most important reactive groups in proteins in the different sections of the mucous membrane of the stomach, i.e., in the proteins of its secretory apparatus, as well as the question of a change in content of sulfhydryl groups or their reactivity as a result of stimulation of gastric secretion.

EXPERIMENTAL METHODS

The free sulfhydryl groups of proteins were detected by Mirsky's ferricyanide method [7] as modified by A. S. Tsiperovich and A. L. Loseva [6] in homogenates of the stomach mucose (1 g of mucosa tissue + 9 ml 0.9% NaCl) obtained in glass homogenizers. After oxidation of the SH group by ferricyanide the intensity of the Prussian blue color in the protein-free filtrates was measured photometrically in a photoelectric colorimeter with a red light filter as against distilled water. The quantity of SH groups was expressed in microequivalents (μE) per g of tissue.

The experiments were performed on cats. The animals were exsanguinated via the carotid arteries; their stomachs withdrawn and carefully washed and the mucous membranes removed.

RESULTS OF THE EXPERIMENTS

In the first series of experiments after 24 hours without food, a determination was made of the content of sulfhydryl groups in the mucosa of the four divisions of the stomach: the cardia, the greater curvature, the lesser curvature and the pyloric portion (see Table).

As the table shows, most of the sulfhydryl groups are contained in the main and functionally the most active part, the body of the stomach, which secretes the acidic juice containing hydrochloric acid. Of the two divisions of the body of the stomach, the greater and lesser curvatures, in the state of functional rest, the quantity of SH groups is higher in the greater curvature

Quantity of Sulfhydryl Groups in μE per g of Stomach Mucous Membrane in the Resting State and During Secretion Induced by Histamine

No. of the Experiment	Cardia		Greater curvature		Lesser curvature		Pyloric portion	
	At rest	After injection of histamine	At rest	After injection of histamine	At rest	After injection of histamine	At rest	After injection of histamine
1	6.1	7.5	7.6	7.8	6.5	6.8	5.8	6.0
2	4.6	7.6	7.3	8.3	8.3	9.1	5.7	6.7
3	6.7	7.4	8.0	12.0	4.6	7.6	6.5	6.6
4	6.6	6.9	7.5	9.0	5.8	7.6	4.0	6.6
5	6.6	6.7	8.4	10.5	6.7	8.0	5.0	6.4
6	6.5	7.7	7.5	8.1	4.5	8.0	4.4	6.5
7	4.0	5.8	8.4	9.0	—	7.0	6.6	5.5
8	—	6.0	8.6	8.9	—	8.4	5.9	5.8
9	—	—	8.0	8.0	—	7.6	3.6	5.0
10	—	—	5.6	6.7	—	—	5.1	3.0
11	—	—	6.7	—	—	—	6.6	—
12	—	—	6.0	—	—	—	3.5	—
Average	5.9	6.8	7.5	8.8	6.1	7.8	5.2	5.8
increase in %		15.2		17.3		27.9		11.5

The least amount of sulfhydryl groups is contained in the pyloric portion, which secretes the juice of an alkaline reaction that does not contain hydrochloric acid.

Thus the distribution of sulfhydryl groups in the proteins of the secretory apparatus of the different divisions of the stomach corresponds to their functional secretory properties and to the significance of these groups in gastric secretion and the formation of hydrochloric acid [3, 4, 5].

When the mucous membrane was taken for analysis its delimitation into four divisions was not completely exact, and the differences in quantity of sulfhydryl groups were therefore leveled off to a considerable extent.

If the secretory function of the stomach is in fact linked with sulfhydryl groups, then an increase in the amount of them was to be expected with the stimulation of secretion. In the second series of experiments, determinations were made of the sulfhydryl groups in cats following prior subcutaneous injection of histamine at the rate of 1 ml per kg of body weight. Fifteen minutes after the injection the stomachs of the animals were taken for analysis. The data of these experiments are also included in the table.

As is apparent from the table, the change-over of the secretory apparatus of the stomach from the state of rest to physiological activity is accompanied by an increase in the amount of free sulfhydryl groups of the protein substances. The greatest increase occurs in the body of the stomach, the least in the pyloric portion. It is interesting to note that in the lesser curvature the accumulation of sulfhydryl groups is significantly greater than in the greater curvature.

According to the data of K. M. Bykov's laboratory [1], the juice released by the lesser curvature has the highest acidity. According to K. M. Bykov, a leading role in the development of the secretory process of the entire stomach belongs to the lesser curvature.

Yu. M. Lozovsky [2] showed that the most marked changes in structure during secretion occur in the glandular cells of the lesser curvature of the stomach.

Thus the characteristic topographic distribution of SH groups in the mucosa of the stomach and the change in the quantity of them in connection with secretion show that in the development and accomplishment of the physiological act of secretion the structure of the protein substance of the secretory apparatus is of considerable importance. To all appearances secretion is linked with a change in the structure of the proteins, as a result of which there is a change in the number of their free sulfhydryl groups, which activate the biochemical processes that cause the physiological act of secretion. The question still remains open concerning the extent to which

there occurs an actual increase in the number of SH groups and in their reactivity in a given instance of oxidizability. It is also possible that the characteristic distribution of sulfhydryl groups reflects a difference in the structure and properties of the proteins of the secretory apparatus of the different divisions of the stomach. This idea provides a biochemical basis for K. M. Bykov's conception of the secretory fields of the stomach. There is a need for study of the proteins of the mucous membrane of the stomach in connection with its secretory function.

SUMMARY

The quantity of free SH-groups in the proteins of the stomach mucous membrane is differently distributed in the divisions of this organ: the smallest amount of these groups is to be found in the pyloric portion, whereas the maximal content is characteristic of the greater and lesser curvatures. Secretion being stimulated by means of histamine, the quantity of SH-groups increases particularly in the lesser curvature and least in the pyloric region.

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