

EFFECT OF STRESS ON CONTACT HYDROLYSIS OF SUCROSE IN RATS

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Activity of intestinal invertase immediately after immobilization for 4 h was studied in experiments on albino rats of both sexes and of different ages. The inhibitory effect of stress on the activity of contact digestion and enzyme formation in the intestinal epithelial cells was discovered, and the effect observed was found to depend on the sex and age of the animals. This was reflected in a greater degree of depression of invertase activity in young females and sharp fluctuations in its activity in old female rats.

KEY WORDS: contact digestion; stress; invertase.

Response of the organism to stress is invariably accompanied by disturbances of the gastrointestinal tract. It is accordingly interesting to assess the effect of stress situation on the state of contact digestion. The few facts relating to this problem have been obtained mainly by investigations in Ugolev's laboratory [7-9] in which, after prolonged immobilization of animals or after heat- or cold-induced stress or administration of ACTH, changes in various directions of various enzymes responsible for contact digestion (invertase, maltases, peptidases) were found.

In this investigation the effect of stress on contact hydrolysis of sucrose was studied, taking into account the sex and age of the animals.

EXPERIMENTAL METHOD

Experiments were carried out on noninbred albino rats of both sexes and of two age groups: young (140-190 g) and old (260-360 g). Immobilization on a frame for 4 h or (in a few experiments) electrical stimulation of the immobilized animals for 3 h [3] was used as the stressor. Invertase activity was judged from the increase in reducing sugars [6] after incubation of everted segments of small intestine (2 cm long) or a homogenate of the same segments for 10 min in 1% sucrose solution. The rate of sucrose hydrolysis

TABLE 1. Effect of Stress on Invertase Activity in Rats of Different Ages and Sexes ($M \pm m$)

Group of animals	Number of animals	Invertase activity (in mg %)					
		on surface of mucous membrane			in homogenate		
		control	experiment	change (in % of control)	control	experiment	change (in % of control)
Males 140-190 g P	31	48,6 \pm 5,7 0,05	32,7 \pm 5,1	-32,7	109,2 \pm 9,7 <0,01	66,1 \pm 9,7	-39,5
Females 140-180 g P	38	40,4 \pm 2,0 <0,001	25,6 \pm 2,5	-36,7	80,9 \pm 5,7 <0,001	46,2 \pm 4,4	-42,9
Males 270-360 g P	33	43,3 \pm 3,5 <0,01	27,3 \pm 3,1	-37,0	90,7 \pm 7,6 <0,01	54,0 \pm 7,1	-40,5
Females 260-340 g P	26	37,5 \pm 3,7 >0,5	39,1 \pm 5,7	+4,2	64,9 \pm 6,5 >0,05	70,2 \pm 9,9	+8,1

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by the everted segment of intestine characterized activity of the enzyme in the zone of the brush border of the intestinal epithelium (contact digestion), whereas the activity of the homogenate reflected the total content of enzyme in the intestinal epithelial cells. The animals were killed immediately after the end of exposure to stress. Intact rats served as the control. Altogether 150 rats were used.

EXPERIMENTAL RESULTS AND DISCUSSION

Since there were very few experiments involving electrical stimulation in each group of animals and since its effect on the enzyme activity differed very little from the effect of immobilization alone, the combined results of all the experiments are given in Table 1.

In the control a rather lower activity of the enzyme was found in the females of both age groups, and also some decrease in its activity (especially in the homogenate) was noted in the older animals. Stress had a similar effect on the male rats of both age groups, and it considerably lowered the hydrolytic activity both on the surface of the mucous membrane and in the homogenate. Similar but rather more marked changes than in the males were found in the young females. A greater decrease in the activity of the homogenate was observed than in the activity on the surface of the mucous membrane. Old females were an exception, for they had the lowest initial invertase activity and they showed a very inconstant response to stress. On the average for these animals hydrolytic activity both on the surface of the mucous membrane and in the intestinal homogenate was very slightly increased after stress.

Special experiments on 22 rats were carried out to study the duration of stress-induced changes in invertase activity. They showed that 24 h after stress the enzyme activity was a little reduced both on the surface of the intestine and in the homogenate, but on the third day it was back to normal. Despite the general similarity between the observed changes in invertase activity and results obtained previously [7], no sharp increase in enzyme activity was observed on the third day after stress, evidently because of differences in the experimental conditions.

The data showing the dependence of contact digestion and the enzyme-synthesizing function of the intestinal epithelium on hormonal changes in the body [1, 2, 11, 12] suggest that one of the factors responsible for the changes in these processes during stress is a change in the hormonal balance. The increased concentration of corticoid hormones, the effect of which on the synthesis and macromolecular characteristics of enzymes and on the permeability of cell membranes (a significant fact where transport of enzymes into the zone of contact hydrolysis is concerned) is well known [4, 5, 11, 12], may be important in this case.

The dependence of the degree of lowering of invertase activity on the sex and age of the animals observed in these experiments (the rather stronger stressor effect in females, especially in the group of young animals, and the sharp changes or reversal of its effect in old females) may be connected with age changes in the response of the hypothalamic-pituitary-adrenal system to stress [10]. These changes possibly arise earlier in females.

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