# ENZYMIC ACTIVITY OF THE MUCOUS MEMBRANE OF THE SMALL INTESTINE IN GROWING RATS EXPOSED TO PROLONGED HIGH TEMPERATURES

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UDC 612.65'332.84.014.43

Special experiments showed that a change in the spectrum of activity of the digestive enzymes in the mucous membrane of the small intestine of rats reared at a high temperature cannot be accounted for entirely by the reduced food intake. Prolonged exposure to heat (34-36°C) is accompanied by a decrease in the invertase activity and an increase in alkaline phosphatase activity. Monoglyceride lipase activity was unchanged. Dipeptidase activity was increased in the duodenum but unchanged in the jejunum. The proximal-distal gradient of enzyme activity was preserved in the mucous membrane of the small intestine.

During prolonged exposure to a high temperature profound changes are observed in metabolism, and the formation of skeletal muscles and some internal organs is delayed in growing animals [6, 7]. The development of the digestive system under these conditions, however, has been insufficiently investigated.

In the investigation described below the enzyme activity of the mucous membrane of the small intestine was studied in growing rats exposed for a long time to a high temperature.

## EXPERIMENTAL METHOD

Noninbred albino rats were kept during the period of maturation (from the 21st to the 45th days after birth) at 34-36°C and in a relative humidity of 30-40%; animals of the control group were kept at room temperature (23-25°C). The rats of both groups were kept in light for 12 h and in darkness for 12 h daily. Water and a standard diet were given ad lib.

At the end of the experiment the animals were killed, and the invertase [5], dipeptidase [4], monoglyceride lipase [7], and alkaline phosphatase [1] activity was determined in homogenates of the mucous membrane of the duodenum and various parts of the jejunum. Enzyme activity was calculated per gram wet weight of mucous membrane and expressed in micromoles of hydrolysis products of the corresponding substrates formed per minute.

## EXPERIMENTAL RESULTS

During prolonged exposure to heat the level of enzyme activity in the mucous membrane of the small intestine showed significant changes in the young rats (Table 1).

Invertase activity was reduced in both the duodenum and the jejunum. Dipeptidase activity was increased only in the mucous membrane of the duodenum. The monoglyceride lipase activity was relative constant in both parts of the intestine, while alkaline phosphatase activity increased in the mucous membrane of both duodenum and jejunum.

Prolonged exposure to heat thus led to changes in the spectrum of enzyme activity in the mucous membrane of the small intestine.

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Laboratory of Physiology of Digestion, Department of Physiology, Academy of Sciences of the Uzbek SSR, Tashkent. Presented by Academician V. N. Chernigovskii.) Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 75, No. 6, pp. 21-23, June, 1973. Original article submitted August 2, 1972.

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TABLE 1. Enzyme Activity of Mucous Membrane of Small Intestine (in moles/g/min) in Young Rats during Prolonged Exposure to Heat (M ± m)

| Enzyme | Parts of intestine | Control group | Experimental group | P |
|---|---|---|---|---|
| Invertase | Duodenum | 7,9±0,3 | 5,2±0,8 | <0,01 |
| | Jejunum | 6,8±0,6 | 3,8±0,5 | <0,01 |
| Dipeptidase | Duodenum | 6,2±0,9 | 9,1±1,1 | <0,05 |
| | Jejunum | 13,8±1,6 | 11,8±1,5 | >0,5 |
| Monoglyceride lipase | Duodenum | 6,5±0,4 | 6,0±0,3 | >0,05 |
| | Jejunum | 5,8±0,3 | 5,8±0,3 | >0,5 |
| Alkaline phosphatase | Duodenum | 2,6±0,5 | 3,8±0,3 | <0,05 |
| | Jejunum | 1,7±0,2 | 2,6±0,2 | <0,02 |

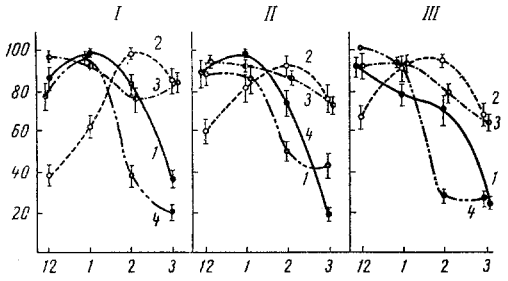


Fig. 1. Distribution of enzyme activity along mucous membrane of small intestine in rats kept at room temperature (I), at 34-36°C (II), and on a reduced food intake (III): 1) Invertase; 2) dipeptidase; 3) monoglyceride lipase; 4) alkaline phosphatase. Abscissa, segments of small intestine: 12) duodenum; 1-3) segments of jejunum; ordinate, activity of enzymes (in %; maximal activity of each segment calculated per gram mucous membrane taken as 100%). Standard errors of means are shown.

It is important to note that the animals of the experimental group ate less food than the controls while they were in the hot chamber. For this reason a series of experiments was carried out in which a group of rats was kept at room temperature but on the same food intake as the animals of the experimental group.

The reduced food intake by itself led to significant changes in enzyme activity in the mucous membrane of the small intestine of the growing animals.

For example, the monoglyceride lipase activity in the duodenal mucous membrane fell from 6.5 ± 0.4 to 4.6 ± 0.4 moles/g/min ($P < 0.01$), while dipeptidase and alkaline phosphatase activity rose from 6.2 ± 0.9 to 10.5 ± 0.8 ($P < 0.01$) and from 2.6 ± 0.5 to 4.0 ± 1.2 moles/g/min ($P < 0.01$), respectively. The invertase activity was virtually unchanged. A decrease in invertase (from 6.8 ± 0.6 to 4.3 ± 0.8 moles/g/min; $P < 0.05$) and monoglyceride lipase (from 5.8 ± 0.3 to 3.9 ± 0.2 moles/g/min; $P < 0.001$) activity was found in the mucous membrane of the jejunum, whereas the dipeptidase and alkaline phosphatase activity was not significantly changed.

Since the character of the changes in enzyme activity during exposure to heat and reduced food intake was not identical, the effect of a high temperature cannot be entirely attributed to the reduction in the food intake. This conclusion is supported by other investigations [2, 3] which showed that different agents have different effects on the biosynthesis of individual enzymes in the intestinal cells.

The mucous membrane of the small intestine in young rats aged 45 days exhibits a definite proximal-distal gradient of digestive enzyme activity (Fig. 1.). In the rats of the control group invertase and alkaline phosphatase activity was maximal in the proximal portions of the intestine (duodenum and beginning of the jejunum), and it fell gradually in the caudal direction. Dipeptidase activity, on the other hand, was minimal in the proximal portions, and it increased toward the distal part of the small intestine. Lipolytic activity was highest in the duodenum and proximal jejunum; it fell a little in the medial portion and rose again in the distal jejunum.

A high temperature had no appreciable effect on the character of distribution of enzyme activity along the small intestine, although with some enzymes a change was observed in the absolute values of activity in the mucous membrane of individual portions of the intestine.

In the rats kept on a reduced food intake the invertase activity fell only in the proximal parts of the jejunum. The proximal-distal gradient of activity of the other enzymes showed no special change.

Prolonged exposure to heat thus leads to significant changes in enzyme activity in different parts of the small intestine of the growing rats. These changes cannot entirely be attributed to inhibition of activity of the food center.

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