TRANSKETOLASE ACTIVITY OF RAT LIVER AND ERYTHROCYTES DURING ACOUSTIC STIMULATION

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During acoustic stimulation (94-96 dB, 2 Hz), with an increase in the duration of exposure from 30 min to 2 h the liver transketolase activity progressively declines. During acoustic stimulation for 5 h daily for 38 days, the observed effect becomes weaker. During more prolonged exposure still (90-130 days), the activity of this enzyme fails by 50 and 75%, respectively. A decrease in transketolase activity of the erythrocytes is found only after prolonged acoustic stimulation (130 days).

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During exposure to acoustic energy, especially industrial noise, the amount of vitamin B available to the body is reduced [2]. Under these conditions, the activity of various enzymes of carbohydrate metabolism incorporating thiamin pyrophosphate in their composition may be depressed. Several workers have shown [1, 3, 4] that the enzyme most sensitive to vitamin B_1 deficiency is transketolase (CE 2.2.1.1), an enzyme of the nonoxidatory branch of the pentose-phosphate part of carbohydrate breakdown.

Transketolase activity was studied in animals exposed for various periods to acoustic stimulation at the upper limit of the industrial noise spectrum (94-96 dB, 2 Hz, GZ-2 generator).

EXPERIMENTAL METHOD

Experiments were carried out on 113 noninbred rats weighing initially 80-120 g, and kept for the 10 days before the experiment and during its course on a casein-starch diet recommended by the Institute of Nutrition, Academy of Medical Sciences of the USSR. Material for investigation (liver, erythrocytes) was taken from the animals after superficial ether anesthesia immediately after exposure to sound for 30 min, 1, 2, and 5 h, and 2, 5, 38, 90, and 130 days (for 5 h every day). Samples were taken at the same times from control animals.

The material was prepared for analysis and the transketolase activity determined by the method described by Bruns and co-workers [5] in the modification of Ostrovskii and Trebukhina [3]. Enzyme activity was expressed in micromoles sedoheptulose-7-phosphate per gram moist tissue per hour (for liver) or per milliliter erythrocytes per hour (for erythrocytes). Blood was stabilized with 0.1 M sodium oxalate solution in the ratio of 1:10.

EXPERIMENTAL RESULTS

The experimental results are given in Table 1. The liver transketolase activity varied depending on the season of investigation. Activity of this enzyme fell from autumn to winter and rose again toward spring and summer. Similar, but less marked changes affected the transketolase of the erythrocytes.

The liver transketolase activity of the experimental animals was reduced even after brief acoustic stimulation. The degree of the changes increased as the period of acoustic stimulation increased from 30 min to 2 h. After acoustic stimulation for 5 h, and also for 2 and 5 days, a less marked decrease in activity of the enzyme was found. This decrease was no longer significant on the 38th day of the experiment. When the duration of acoustic stimulation was increased to 90 days, the transketolase activity was reduced by almost 50%, and after 130 days by 75% compared with the corresponding control.

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TABLE 1. Transketolase Activity of Liver of Rats Exposed to Acoustic Stimulation

Statistical indices	Duration of acoustic stimulation																	
	hours								days									
	1/2		1		2		5		2		5		38		90		130	
	c	e	c	e	c	e	c	e	c	e	c	e	c	e	c	e	c	e
n	6	5	5	6	10	6	10	5	5	6	5	5	5	5	5	8	9	7
M	80.1	75.6	85.5	55.7	84.5	14.9	84.5	28.6	55.0	30.6	61.5	34.0	54.1	43.8	102.0	57.8	138.6	35.5
±m	3.03	7.83	3.31	2.57	2.14	2.07	2.14	3.27	4.05	1.30	3.62	0.92	6.00	5.45	4.00	4.57	10.50	4.00
P	> 0.05		> 0.001		< 0.001		< 0.001		< 0.001		< 0.001		> 0.05		< 0.001		< 0.001	
	October		October		October		October		November		November		December		May		June	

Legend: c) Control; e) experiment.

These results can be provisionally interpreted as follows. During brief acoustic stimulation, changes develop in the pituitary – adrenal system intensifying carbohydrate breakdown along the pathway providing for maximal liberation of energy: glycolysis and the tricarboxylic acid cycle. Under these conditions, the decrease in transketolase activity was evidently due to redistribution of thiamin pyrophosphate to those enzymes of terminal oxidation for which it acts as coenzyme. This hypothesis is confirmed by the absence of changes in transketolase activity in the erythrocytes, which do not contain enzymes of terminal oxidation that could compete with the transketolase for thiamin pyrophosphate.

The decrease in liver transketolase activity subsequently observed (on the 90th and, in particular, the 130th day of investigation) was evidently the result of vitamin B_1 deficiency. This hypothesis is also confirmed by the decrease in transketolase activity of the erythrocytes at these times (from 2.4±0.4 to 1.3±0.4 μmoles/ml/h; $P < 0.05$).

LITERATURE CITED

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