CONTENT OF AMMONIA AND AMIDES IN THE BRAIN DURING HIBERNATION

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During hibernation the ammonia content in the brain of the little suslik increases. The content of amide groups in the total brain proteins falls. Awakening from deep and prolonged hiberation causes a further increase in the ammonia content and decrease in the content of amide groups in the brain proteins.

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An artificial lowering of the body temperature of the warm-blooded animal is accompanied by the accumulation of free ammonia in the brain and by disturbance of the ratio between amidation and deamidation of proteins and dicarboxylic amino acids [1-3]. Our previous investigations [7, 8] showed that in cold-adapted rats the ammonia content in the brain is increased. Hypothermia in these animals is characterized by further considerable accumulation of ammonia in the brain tissue. The increase in the ammonia concentration in the brain at a low body temperature may be regarded as having adaptive importance.

It was therefore decided to investigate the relationship between the content of ammonia and amides in the brain and the duration of hibernation and the body temperature.

EXPERIMENTAL METHOD

Experiments were carried out on little susliks (Citellus pygaeus Pallas), caught in May. The animals were kept until the late fall in a vivarium under ordinary conditions. In November the animals were transferred to a warm room at a temperature of 8-9 or 15-16°, reproducing natural conditions [5]. Waking susliks kept at 20-22° served as controls. After various intervals the susliks were decapitated, and the head was frozen complete in liquid nitrogen. The brain (without the cerebellum) was ground in liquid ni-

TABLE 1. Content of Ammonia and Amides in Brain of Susliks during Hibernation

Group of animals	Body temp. (in deg.)	Ammonia nitrogen (in mg %)	Amide nitrogen of glutamine (in mg%)	Nitrogen of amide groups (in μg/mg dry protein)		
				labile groups	firmly bound groups	L_{total}
Waking	38—37	0,49±0,49	6,98±0,343	1,90±0,02	3,50±0,035	5,40±0,03
Starting hibernation	24—23	3,12±0,160	10,49±0,377	1,17±0,008	3,54±0,054	4,71±0,033
Sleeping after one week	17—16	0,88±0,015	6,25±0,301	1,80±0,05	2,25±0,036	4,05±0,026
after two months		1,10±0,122	8,12±0,263	1,36±0,018	3,08±0,014	4,44±0,012
Sleeping after one week	11—10	1,45±0,089	8,36±0,609	1,31±0,02	2,40±0,045	3,71±0,05
after two months		0,76±0,054	4,66±0,263	1,08±0,006	3,11±0,006	4,19±0,008
Awakening from two months of hibernation	37	0,94±0,064	4,55±0,405	1,03±0,004	2,38±0,01	3,41±0,008

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trogen to a powder. Proteins were precipitated by 5% TCA. Ammonia and glutamine in the supernatant liquid were determined by Seligson's method [9] as modified by A. I. Silakova and co-workers [6]. Nitrogen of amide groups was determined in the total brain proteins [4].

EXPERIMENTAL RESULTS

At the time the animals fell into hibernation (body temperature 24-23°), the ammonia content in their brain had increased almost six times (Table 1). The glutamine concentration also showed an increase. The content of amide groups in the total brain proteins had fallen, but was still twice as high as in the control. The glutamide concentration had fallen to the control level. The total amide group of proteins in the sleeping animals continued to decrease at the expense of firmly bound groups.

In animals sleeping for two months (body temperature 17-16°), the glutamine content in the brain increased by 32% compared with the figure in animals sleeping one week. Some increase in the total content of amide groups of the brain proteins also was observed. In the case of deep hibernation during which the body temperature fell to 11-10°, the ammonia and glutamine content in the brain increased in the early period of hibernation but subsequently fell.

In susliks awakened after two months of deep hibernation the ammonia content in the brain was increased by 23.7%, but the content of firmly bound amide groups was decreased by 23.5% compared with the control.

These results show that ammonia plays an active role in metabolic processes taking place in the brain as a result of physiological hypothermia. Ammonia and amides evidently participate in adaptive mechanisms acting in the brain during hibernation.

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