ROLE OF ETHANOLAMINE, PHOSPHOETHANOLAMINE, AND PHOSPHATIDYLETHANOLAMINE IN OXIDATIVE PHOSPHORYLATION OF ALBINO RAT BRAIN MITOCHONDRIA

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Addition of ethanolamine, phosphoethanolamine, or phosphatidylethanolamine in concentrations of 0.5 μM to the brain mitochondrial fraction increases endogenous respiration and the P/O ratio. In insulin hypoglycemia, addition of these substances leads to a proportional increase in the level of respiration and inorganic phosphorus, so that the supply of energy remains at the characteristic level for intact rats.

KEY WORDS: phosphatidylethanolamine; brain mitochondria; oxidative phosphorylation; insulin hypoglycemia.

Many observations [3-5, 9] testify to the functional activity of phospholipids (PL) in tissue metabolism and, in particular, to their role as coenzymes in energy conversion reactions [1, 2, 6]. The action of phospholipase A on the inner mitochondrial membrane is manifested primarily toward phosphatidylethanolamine (PEA) [12-14]. The possibility cannot be ruled out that hydrolysis of PEA is coupled with ATP synthesis [2].

In connection with the facts described above it was decided to study the effect of ethanolamine (E), phosphoethanolamine (PE), and PEA on oxidative phosphorylation in brain mitochondria of normal rats and rats with insulin hypoglycemia.

EXPERIMENTAL METHOD

Experiments were carried out on the mitochondrial fraction of rat brain isolated by the method of Mandel et al. [10]. The oxygen consumption was measured manometrically in a Warburg apparatus and esterification of inorganic phosphate (IP) was determined from the decrease in its concentration in the incubation medium [7]. Protein was determined by Lowry's method [8].

EXPERIMENTAL RESULTS AND DISCUSSION

As Table 1 shows, addition of E in vitro appreciably increased the P/O ratio and the degree of esterification of IP compared with the control, without any clear increase in endogenous respiration. The addition of PE to the sample led to intensive absorption of oxygen combined with active utilization of IP and a decrease in the P/O ratio. PEA activated respiration and esterification of IP by 1.5 times and increased the P/O ratio.

In insulin hypoglycemia a very small decrease in respiration of the mitochondrial fraction of brain tissue was observed compared with the control and the intensity of esterification of IP was appreciably reduced, so that the P/O ratio decreased significantly. Addition of PEA increased the absorption of oxygen

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TABLE 1. Effect of E, PE, and PEA (0.5 μmole per sample) on Oxidative Phosphorylation in Mitochondrial Fraction of Brain of Normal Rats and Rats with Insulin Hypoglycemia (substrate – succinate; ΔO and ΔP given in μg-atom/kg body weight; M±m)

	Normal (6)			Insulin hypoglycemia (6)		
	O	P	P/O	O	P	P/O
Control	3,12±0,21	4,43±0,32	1,42±0,06	2,25±0,03	1,65±0,17	0,73±0,05
Ethanolamine	4,00±0,17	7,82±0,35	1,95±0,10	2,91±0,09	3,79±0,12	1,30±0,03
P	<0,01	<0,001	=0,001	<0,001	<0,01	<0,001
Phosphoethanolamine	3,75±0,03	6,76±0,34	1,80±0,02	2,51±0,06	3,31±0,38	1,32±0,10
P	<0,01	<0,001	<0,001	<0,001	<0,01	<0,001
Phosphatidylethanolamine	3,86±0,14	7,87±0,16	2,04±0,07	2,84±0,02	4,71±0,16	1,65±0,07
P	<0,01	<0,001	<0,001	<0,001	<0,001	<0,001

and, in particular, the esterification of IP, with lowering of the P/O ratio (1.65) compared with the corresponding control (2.04). Similar changes were found after the addition of E and PE. Despite the limited supply of glucose to the brain in insulin hypoglycemia, administration of these substances thus led to a proportional increase in the levels of ΔO and ΔP, so that the P/O ratio remained relatively high.

The highest value of P/O was observed in samples with PEA. It has been suggested [11] that the mechanism of participation of PEA in ATP synthesis is connected with conformational changes in this PL. The brain has a high content of PL and, in particular, of ethanolamine-containing PL; one of the many functional roles of these compounds could be to provide for the energy balance of the CNS.

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