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MODIFICATION BY ENDOGENOUS PHOSPHOLIPIDS OF PORCINE KIDNEY Na, K-ATPase

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The specific nature of the transport of ions in individual segments of a nephron is interconnected with the heterogeneity of the properties of transport ATPases, which depends to a considerable degree on the phospholipid compositon of the membrane-bound ATPase complex [1]. The replacement of certain phospholipids (PLs) strongly bound to the enzyme molecule is accompanied by a substantial change in its activity [2-4]. However, literature information on the role of various PLs in the reactivation of delipidated Na, K-ATPase is contradictory and does not take the functional features of the objects investigated into account.

We have studied the protein-lipid ratios and phospholipic compositions of membrane-bound Na, K-ATPases from the cortical, medullary, and capillary zones of the porcine kidney, and also the influence of endogenous PLs on the activity of the enzyme. A decrease in the protein:lipid ratio in preparations of membrane-bound Na, K-ATPase was found along the cortical-papillary gradient: in the cortical zone it was 1:0.5; in the medullary zone, 1:0.9; and in the papillary zone, 1:1.4. The amount of PLs in the total lipid of the extract estimated on the basis of inorganic phosphorus (P_i) also differed over the zones of the kidney: in the cortical zone 54; in the medullary zone 60; in the papillary zone 62 μg P_i/mg lipid, which corresponds, when calculated to protein, to a threefold increase in the amount of PLs along the cortical-capillary gradient. The main differences in the phospholipid composition of the membrane-bound enzyme complex from functionally different sections of the nephron were observed in the amounts of polar PLs – phosphatidylserine, phosphatidylinositol, and sphingomyelin (Table 1). The enrichment of the composition with polar phospholipids correlates with a change in the activity of the Na, K-ATPase (% on the total ATPase activity (Table 2).

The modification of delipidated Na, K-ATPase was carried out by reconstructing it in sonicated (22 kHz, 5 min) proteoliposomes formed from proteins and lipids from different

TABLE 1. Phospholipic Composition (% on the total lipid P_i, M ± m) of Membrane-Bound Na, K-ATPase according to the Zones of the Porcine Kidney

Phospholipid	Zone		
	cortical	medullary	papillary
Phosphatidylethanolamine	48,2±1,31	41,0±1,89	39,0±1,42
Phosphatidylcholine	40,5±2,43	36,3±1,80	32,0±1,61
Phosphatidylinositol	8,1±0,57	12,2±0,43	11,1±0,74
Sphingomyelin	—	5,5±0,32	9,2±0,43
Phosphatidylserine	—	—	6,5±0,51
% of the lipid P_i found	96,8±1,64	95,0±1,21	97,8±1,16

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TABLE 2. Modification of the Specific Na, K-ATPase Activity (% of the total ATPase, M ± m) by Lipids from Functionally Different Sections of Nephron

Proteins	Lipids from the		
	cortical zone	medullary zone	papillary zone
Cortical zone	26,1±2,31	51,2±4,83	65,3±5,32
Medullary zone	30,8±2,74	49,8±4,42	63,4±6,83
Papillary zone	34,6±3,16	80,7±4,46	63,4±6,89
Membrane-bound enzyme	22,0±2,18	44,1±3,82	57,4±3,48

sections of the nephron. The proton:lipid ratio was kept in agreement with the ratio in the native preparations of membrane-bound complex. The amount of protein in a sample was 5-10 μg.

In our experiments, the lipids of the medullary zone possessed a considerably more pronounced capacity for modifying specific Na, K-ATPase activity than the lipids of the cortical zone (Table 2).

The results obtained, together with information from the literature [5, 6] on the restoration of the activity of Na, K-ATPase by individual polar PLs, from evidence in favor of the hypothesis put forward [1-3] of the determining role of polar PLs in the modification of the biological activity of ion-transporting proteins of functionally different sections of the nephron.

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