ALKALINE AND ACID PHOSPHATASES IN THE KIDNEY OF FROG, LIZARD, BIRD AND SQUIRREL

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ABSTRACT

The phosphomonoesterases (alkaline phosphatase and acid phosphatase) have been localized in the kidney of frog, Rana tigrina, lizard Hemidactylus flaviviridis, bird, Passer domesticus and squirrel Funambulus pennanti. Microscopical determination reveals a difference in the distribution of both enzymes in different classes. Though reptiles, aves and mammals have metanephros type of kidney but the localization of these two enzymes differs in different classes. As the main function of phosphomonoesterases is reabsorption of glucose from the tubules, it seems that this process is carried out at different sites in different vertebrates.

INTRODUCTION

Among vertebrates three types of kidneys, viz., pronephros, mesonephros and metanephros are recognized. In the adult frog mesonephros is the functional kidney while in reptiles, aves and mammals the metanephros is the functional kidney. As the kidneys are the important organs of the body, their histology and physiology has been well studied. The localization of different enzymes has been worked out in the kidney of mammals but there seems to be practically little work in other animals. Jacobson et al. (1967) have studied phosphatase in three segments of the proximal tubules of rat kidney. Kamat and Samant (1969) have studied esterase histochemistry in the amphibian kidney. However there seems to be no reference on any lizard or bird.

The present work aims mainly at the comparative localization of alkaline and acid phosphatases in the kidney of frog, (Rana tigrina), wall lizard, (Hemidactylus flaviviridis), bird (Passer domesticus), and the squirrel (Funambulus pennanti).

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All the animals for the present study were locally collected. Six specimens of each species were sacrificed by decapitation. The kidneys were immediately chilled with ice and were fixed in absolute acetone, 10% neutral formaldehyde and cold chloroform for 24 hours at 4°C. Paraffin sections of 6 μ thickness were cut. Frozen sections were also prepared from fresh tissue. The localization of alkaline-phosphatase (orthophosphoric monoester phosphohydrolase 3.1.3.1) was determined by Gomori's method (Gomori, 1952). The acid phosphatase (orthophosphoric monoester phosphohydrolase 3.1.3.2) was also differentiated according to the method of Gomori (Gomori, 1950). The final reaction product was visualized by dilute ammonium sulphide and the sections were mounted in glycerogel. Control sections in each case were incubated in a media without substrate.

Observations

These experiments indicate that in the case of frog, the glomeruli and the wall of the capsule give positive reaction for alkaline phosphatase (Fig. 1). In lizard also the glomeruli give positive reaction for alkaline phosphatase while the wall of the capsule does not show any activity. Uriniferous tubules also show positive reaction (Fig. 2). In the case of house sparrow the positive reaction for alkaline phosphatase is found in cortex while the medulla gives negative reaction (Fig. 3). In the kidney of squirrel, alkaline phosphatase is localized in the proximal convolutions of kidney.

As for the acid phosphatase, it was found that the glomerulus, uriniferous tubules and the wall of the capsule of frog's kidney gave positive results (Fig. 4), while in lizard only the glomerulus gave the positive reaction (Fig. 5). There was no activity in the uriniferous tubules and the wall of the capsule. The results in respect of the house sparrow were interesting as there was no activity in the cortex while the medulla was positive. The kidney of common ground squirrel showed marked activity for acid phosphatase in the glomeruli and distal convolutions (Fig. 6). The controls in all cases gave negative results.

Discussion

The distribution of renal alkaline phosphatase has been studied in numerous mammals (Gomori, 1941; Bourne, 1943) including man (Kabat and Furth, 1941). In other classes of vertebrates Wilmer (1944) made an important contribution. Moog (1946) stated that in all cases phosphatase
Figs. 1–6
Phosphatases in Kidney of Frog, Lizard, Bird and Squirrel

has been found most highly concentrated in the proximal convoluted tubules. The present findings give an evidence that undoubtedly the distal tubules are invariably negative for alkaline phosphatase but the localization differs in the kidney of different vertebrates. Gomori (1941) mentioned that glomeruli are negative or practically so in all species except the cat. Present authors could demonstrate alkaline phosphatase in the glomeruli of lizard also.

The organ is a fairly rich source of acid phosphatase, although its content is only a small percentage of the content of the alkaline enzyme. Gomori (1941) noted that acid enzyme is sometimes found in glomeruli and throughout the tubule system into the excretory ducts. Present authors found that glomeruli in frog, lizard and squirrel were positive for acid phosphatase while in bird glomeruli were negative.

White and Schmitt (1926) and Lundsgaard (1933) have suggested that alkaline phosphatase in kidney is concerned with the reabsorption of glucose from the tubules. In the opinion of present authors the process of reabsorption is carried out at different sites in the kidney of different vertebrates.

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EXPLANATION OF PLATE

(Figs. 1 to 6)

FIG. 1. The wall of the capsule of frog's kidney is seen containing alkaline phosphatase, × 320 We=wall of the capsule.
Fig. 2. The glomerulus of lizard kidney was also found containing alkaline phosphatase, \( \times 320 \). G=glomerulus.

Fig. 3. Whole of the cortex is noted positive for alkaline phosphatase when there is no activity in medulla, \( \times 320 \). Magnified part indicates the precise localization, \( \times 500 \). Med=medulla, cor=cortex.

Fig. 4. It indicates the presence of acid phosphatase in the glomerulus of frog’s kidney, \( \times 300 \). G=glomerulus.

Fig. 5. In lizard’s kidney only glomerulus is positive for acid phosphatase, \( \times 320 \). G=glomerulus.

Fig. 6. Distal convolutions of squirrel’s kidney were observed positive for acid phosphatase, \( \times 300 \). Dc=distal, convolutions.