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Different histochemical observations on the kidney of guinea fowl (*Numida meleagris*)

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Abstract

The Guinea fowl kidney was histologically observed after different components including capsule, cortex, medulla and different parts of uriniferous tubules. The mucopolysaccharide enzymatic activity in the kidney was revealed by PAS-AB (Periodic Acid-Schiff- Alcian blue) method. The PAS positive activity was witnessed at mesangial cells of renal corpuscle and basement membrane of the distal convoluted tubule while the Alcian blue reaction was positive in most of the components while the cortical and medullary collecting tubule showed intensively positive reaction. The acid phosphatase, alkaline phosphatase and succinic dehydrogenase methods were also performed. The acid phosphatase has shown its intensified activity in parietal & visceral layer of renal corpuscle and lumen & basement membrane of proximal convoluted tubule whereas, the alkaline phosphatase was showing the moderate activity in all components of the kidney. The Intense activity of succinic dehydrogenase was observed in the proximal & distal convoluted tubule and the collecting tubule except the renal corpuscle which showed a weak activity.

Keywords: Kidney, guinea fowl, histochemical activity, pas-ab, acid phosphatase, acid phosphatase

Introduction

Guinea fowl (*Numida meleagris*) is the oldest of gallinaceous birds of Africa which belong to the family Numididae of order Galliformes. The paired, elongated, fragile and reddish-brown colour organ of kidneys of Guinea fowl bird are located retroperitoneally in the depression of synsacrum and iliac fossa at each side of the vertebral column^[1]. Thin outer capsular structure wrapped over kidneys. Histologically the kidney of Guinea fowl shows capsule, cortex, medulla and the different parts of uriniferous tubules. The kidney of Guinea fowl bird shows a larger outer cortex and the smaller inner medulla. Nephrons, the functional microscopic units of kidneys are of two types viz. reptilian and mammalian. The cortex of kidney has shown numerous reptilian and few mammalian types of nephrons. Several researchers have documented their revelations on the different histochemical activity at different kidney components in various bird species^[2, 3, 4]. The present research work is aimed at the concise documentation with the findings on histochemical characterizations against each part of the kidney in Guinea fowl birds. It would help in enhancing the scientific perspective on histochemical observations after PAS-AB (Periodic Acid-Schiff- Alcian blue) for determining acidic mucopolysaccharides substances and neutral Mucopolysaccharides substances, Alkaline phosphatase, Acid phosphatase and Succinic dehydrogenase activities.

Materials and Methods

The present investigation on histochemical features of the kidney of Guinea fowl (*Numida meleagris*) was carried out in the Department of Veterinary Anatomy and Histology, College of Veterinary and Animal Science, Navania, Vallabh Nagar, Udaipur (Rajasthan). A total of 12 pairs of Guinea fowl kidneys were procured from various meat shops from Udaipur city. The kidney samples were collected from each bird at meat shops itself and carried to the laboratory on ice for evaluation of the histochemical study. The collected tissue samples from kidneys were fixed in 10% Neutral Buffered Formalin and chilled pure Acetone as per the protocol of staining procedure. Thereafter, these tissues were processed routinely for dehydration after ascending and descending graded alcohol, clearing in xylene and 5-6 μ thick paraffin sections were obtained as per Singh and Sulochna^[5]. In their accordance the paraffin sections were stained with Periodic acid Schiff's (PAS) and Alcian blue method for mucopolysaccharides, Gomori's cobalt Alkaline phosphatase method and Acid phosphatase method.

The unfixed fresh samples were used for cryostat sectioning and performed Succinic dehydrogenase staining procedure [6]. The aforesaid stained sections were examined under the microscope and photomicrography was performed.

Results and Discussion

1. Periodic Acid Schiff and Alcian Blue (PAS-AB): The Chemical characteristics of the secreting substances such as neutral mucopolysaccharides and acidic mucopolysaccharides, the Periodic acid Schiff-Alcian blue (PAS-AB) was performed [7]. In the encountered findings of PAS for glycogen has shown positive activity at mesangial cells of renal corpuscle and Basement membrane of the distal convoluted tubule (Fig. 1 and 2). The Alcian blue has showed positive reaction in capsule of kidney, parietal and visceral layer of renal corpuscle, proximal convoluted tubule, lumen of distal convoluted tubule, thin and thick loop of Henle, whereas the cortical collecting tubule and medullary collecting tubule were showed intensively positive reaction (Fig. 3 and 4). The present findings were comparable with the findings mentioned by Casotti and Braun, 2000 [8] who has related the tubular obstruction with acid mucopolysaccharides, however Casotti, 2001 [2] shown the presence of mucosubstances in renal tubules helping in the elimination of uric acid and components were involved in the optimal function for which the glycogens act as the source of energy. The revelations of the present studies were somewhat in tune with the reporting mentioned by Rovasio *et al.*, 1974 [3] who has reported positive activity of PAS in the basement membrane of proximal convoluted tubule and intensely positive in distal convoluted tubule and weak activity in collecting tubule. They were also reported scanty activity in proximal convoluted tubule, and distal convoluted tubule and intensely Alcian blue were showing in collecting tubule.

2. Alkaline Phosphatase

Presently, the moderate alkaline phosphatase activity was observed in the capsule, parietal and visceral layer of the renal corpuscle, proximal convoluted tubule, distal convoluted tubule, Cortical collecting tubule, Medullary collecting tubule and loop of Henle (Fig. 5, 6, 7 and 8). Partly concurrent findings were reported by Sivakumar *et al.*, 2012 [4] who had observed the positive activity in capsule, brush border of proximal and distal convoluted tubules in kidneys of Guinea fowl. However, Mishra and Meshram 2019 [9] had mentioned the studies on organ component of pecten oculi where the activity of alkaline phosphatase was near to negative and quoted their inference that organ components which shown less activity must be performing extremely vigorous and in the active mode.

3. Acid Phosphatase

Acid phosphatase showed moderate activity in capsule, distal convoluted tubule, collecting tubule and loop of Henle whereas parietal and visceral layer of renal corpuscle, lumen and basement membrane of proximal convoluted tubule were showing intense activity (Fig. 9, 10, 11 and 12). The findings which we had in present studies were very much supportive with the findings mentioned by Sivakumar *et al.*, 2012 [4] in Guinea fowl that they had the intense activity of acid phosphatase in Capsule and brush border of proximal convoluted tubule and distal convoluted tubule. But the reporting of Mishra and Meshram 2019 [9] on pecten oculi has shown the negative activity of acid phosphatase. Their

inference pertaining to the less activity or nearly negative activity against for that organ component was more adaptable as they said, wherever the less the acid phosphatase activity higher the functioning efficiency of organ component performance would be there.

4. Succinic Dehydrogenase

The findings in present undertaken work has shown intense bluish to the purple colour activity of Succinic dehydrogenase in the proximal convoluted tubule, distal convoluted tubule and collecting tubule and renal corpuscle showed feeble activity (Fig. 13 and 14). Whereas, Sivakumar *et al.*, 2012 [4] reported that proximal convoluted tubule and distal convoluted tubule had shown positive reaction. Histochemical analysis showing high Succinic dehydrogenase in tissue demonstrates high mitochondrial content and high oxidative potential [10].

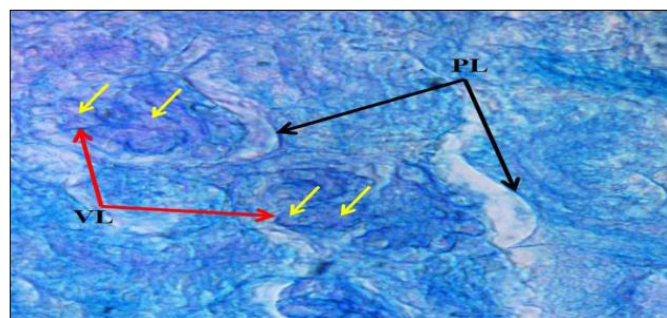


Fig 1: Photomicrograph Showing mucopolysaccharides of Mammalian Renal Corpuscle. PL- Parietal Layer and VL- Visceral Layer Alcian blue Positive and Yellow Arrow- Mesangial cells PAS Positive. PAS-AB 400 X

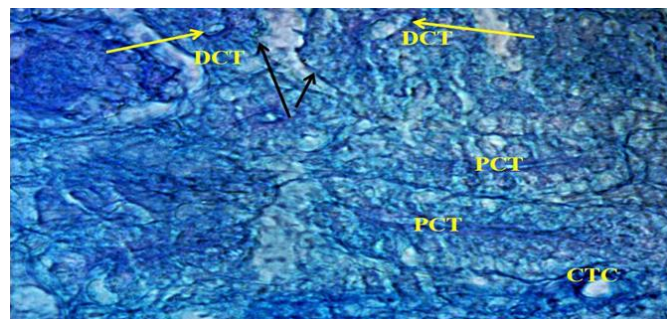


Fig 2: Photomicrograph Showing mucopolysaccharides of Guinea fowl kidney. PCT- Proximal convoluted tubule Alcian blue Positive, DCT- Distal Convoluted Tubule, Yellow Arrow- Lumen Alcian blue Positive and Black Arrow- Basement membrane PAS Positive. Cortical Collecting tubule (CTC) intensely positive for Alcian blue. PAS-AB 400 X

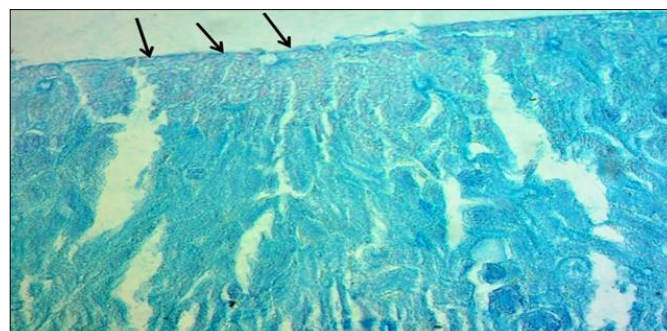


Fig 3: Photomicrograph Showing mucopolysaccharides of Guinea fowl kidney Capsule. Black Arrow- Alcian blue Positive. PAS-AB 100 X

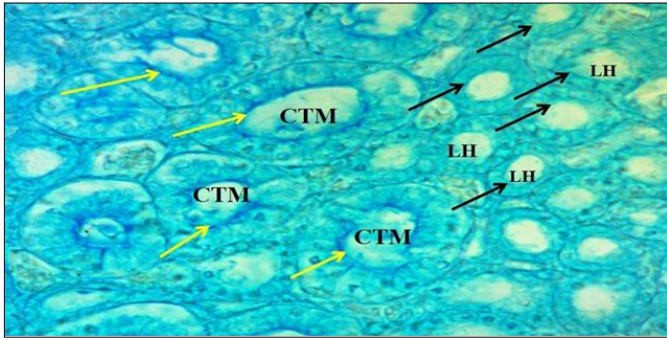


Fig 4: Photomicrograph Showing mucopolysaccharides of medulla of Guinea fowl kidney. CTM- Medullary Collecting Tubule and LH- Loop of Henle, Yellow Arrow and Black arrow- Alcian Blue Positive. PAS-AB 400 X

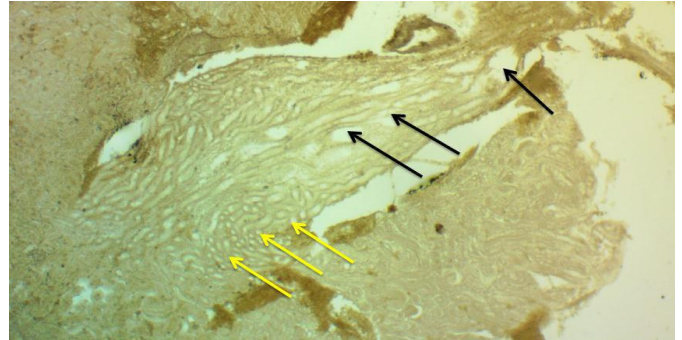


Fig 8: Photomicrograph Showing Histoenzymatic details of Guinea fowl kidney. Black Arrow- Moderate activity in Medullary Collecting Tubule and Yellow Arrow- Loop of Henle. Alkaline Phosphatase 40 X

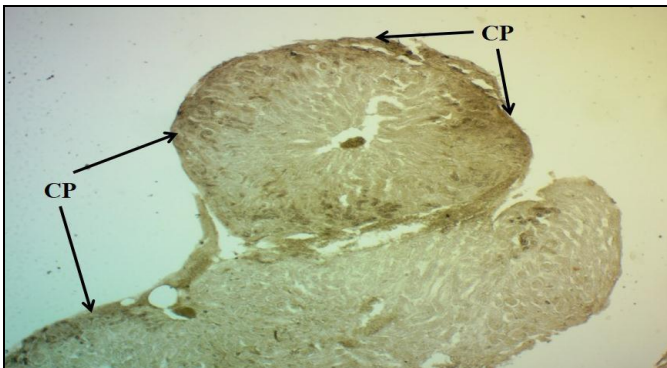


Fig 5: Photomicrograph Showing Histoenzymatic details of Guinea fowl kidney Capsule. CP- Capsule, Black Arrow- Moderate activity in Capsule. Alkaline Phosphatase 40 X

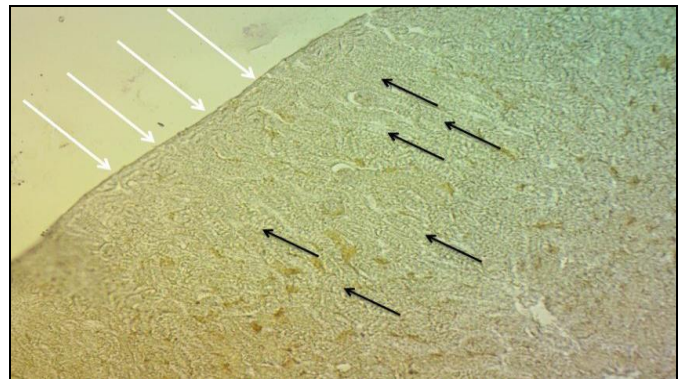


Fig 9: Photomicrograph Showing Histoenzymatic details of Guinea fowl kidney. White Arrow- Moderate Activity in Capsule and Black Arrow- Proximal Convoluted Tubule. Acid Phosphatase 100 x

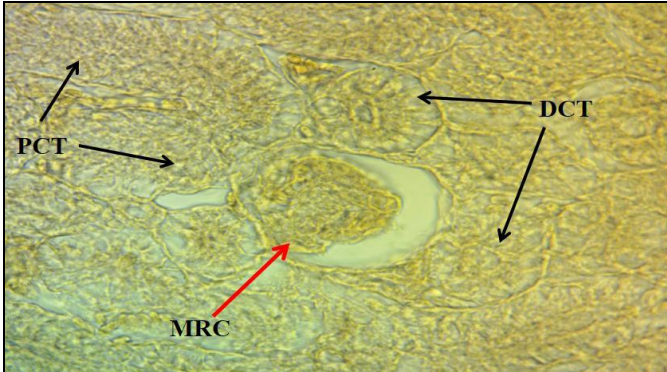


Fig 6: Photomicrograph Showing Histoenzymatic details of Guinea fowl Kidney. Moderate Activity in MRC- Mammalian Renal Corpuscle, PCT- Proximal Convoluted Tubule, DCT- Distal Convoluted Tubule and CTC- Cortical Collecting Tubule. Alkaline Phosphatase 400 X

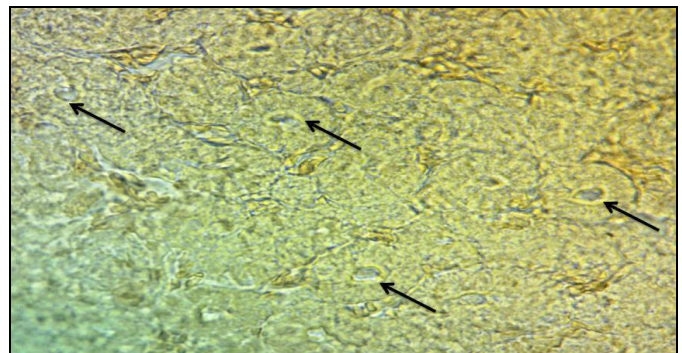


Fig 10: Photomicrograph Showing Histoenzymatic details of Distal convoluted tubule. Black Arrow- Moderate activity. Acid Phosphatase 400 X

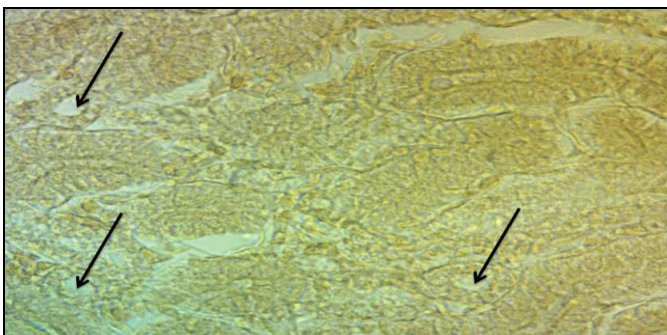


Fig 7: Photomicrograph Showing Histoenzymatic details of Guinea fowl kidney. Black Arrow- Moderate Activity in Cortical Collecting tubule. Alkaline Phosphatase 400 X

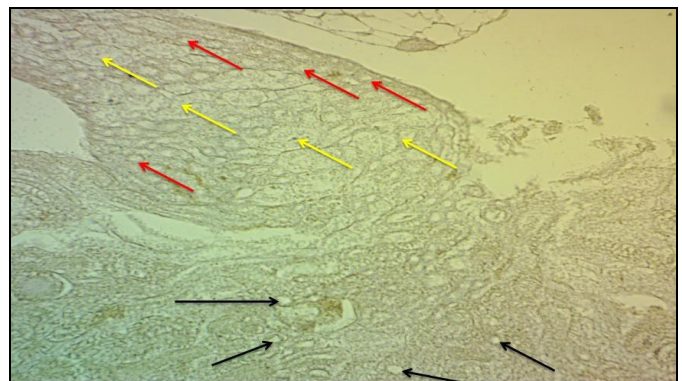


Fig 11: Photomicrograph Showing Histoenzymatic details of Guinea fowl kidney. Moderate activity showing in; Black Arrow- Cortical collecting tubule, Yellow Arrow- Medullary collecting tubule and Red Arrow- Loop of Henle. Acid Phosphatase 100 X

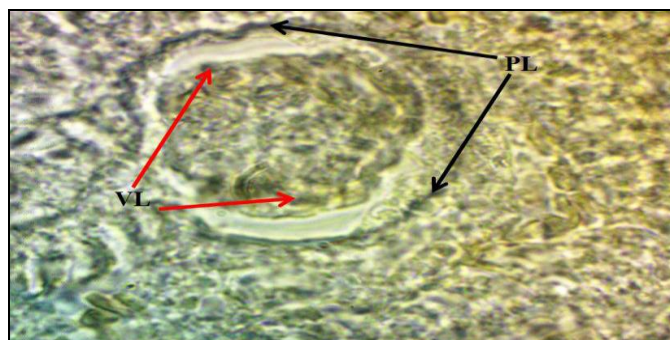


Fig 12: Photomicrograph Showing Histoenzymatic details of Mammalian Renal Corpuscle. PL- Strong activity in parietal layer and VL Visceral layer. Acid Phosphatase 1000 X

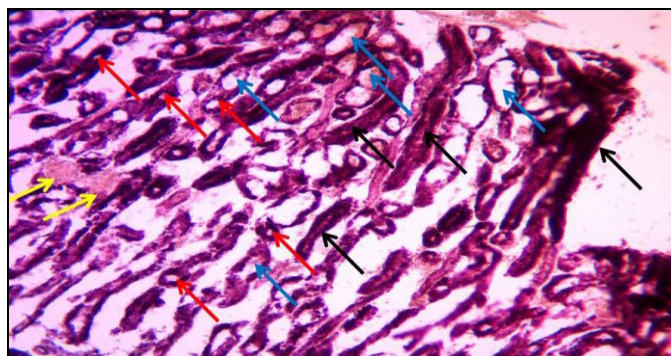


Fig 13: Photomicrograph Showing Histoenzymatic details of Guinea fowl kidney. Yellow Arrow- Weak Activity in Renal corpuscle, Black Arrow- Intense activity in Proximal Convoluted Tubule, Red Arrow- Intense Activity in Distal Convoluted Tubule and Blue Arrow- Intense Activity in Cortical collecting tubule. Succinic Dehydrogenase 100 X

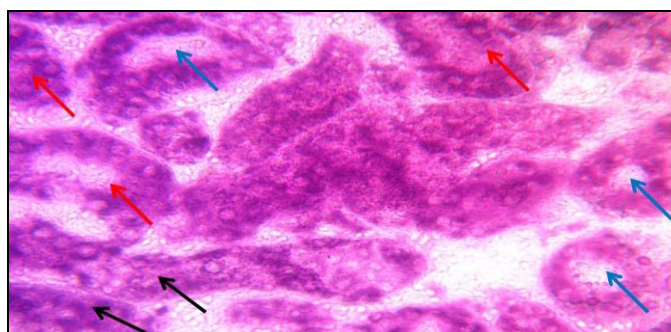


Fig 14: Photomicrograph Showing Histoenzymatic details of Guinea fowl kidney. Black Arrow- Proximal convoluted tubule, Red Arrow- Distal Convoluted Tubule and Blue Arrow- Cortical collecting tubule. Succinic Dehydrogenase 40 X

Conclusion

Histologically the kidney of Guinea fowl has shown different components including capsule, cortex, medulla and different parts of uriniferous tubules. The Periodic Acid-Schiff- Alcian blue (PAS-AB) method was used to ascertain the mucopolysaccharide enzymatic activity. The mesangial cells of renal corpuscle and basement membrane of the distal convoluted tubule has shown PAS positive activity and most of the juxtamedullary nephron components were positive for the Alcian blue reaction. The acid phosphatase has shown its intensified activity in parietal & visceral layer of renal corpuscle and lumen & basement membrane of proximal convoluted tubule whereas, the alkaline phosphatase was showing the moderate activity in all components of the kidney. The succinic dehydrogenase was intensified in the

proximal & distal convoluted tubule and the collecting tubule except the renal corpuscle showed a weak activity.

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