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CONTENTS

Degenerative renal pathology in swine: A comprehensive histopathological investigation in Rajasthan, India

SHOBHA BURDAK*, INDU VYAS, HEMANT DADHICH, MANISHA MATHUR, SHESH ASOPA, RENU

Department of Veterinary Pathology, College of Veterinary and Animal Science, Bikaner, Rajasthan University of Veterinary and Animal Sciences, Bikaner (Rajasthan)
**Corresponding author's email id: shobhaburdak011@gmail.com*

ABSTRACT: A total of 586 kidney samples from pigs were examined regardless of age group, gender, and breed during post-mortem examinations conducted from November 2019 to December 2020. Out of these, 154 samples exhibiting gross lesions underwent histopathological examination. The overall incidence of histopathological lesions in pig kidneys was recorded at 15.58% (24 out of 154 samples with gross lesions). Microscopic analysis revealed degenerative lesions including cellular swelling, hydropic degeneration, fatty change, renal amyloidosis, and renal necrosis, with incidences of 6.49%, 1.95%, 1.30%, 3.25%, and 2.60%, respectively. Cellular swelling (6.49%) and fatty change (1.30%) were identified as the most and least prevalent conditions, respectively, affecting pig kidneys during the study period.

Key words: Degenerative changes, histopathology, kidney, pig

The pig industry faces significant risks to public health and economic losses due to decreased animal performance and organ condemnation, particularly in the kidney (Oliveira Filho *et al.*, 2012). Understanding renal pathology in pigs is crucial not only for farm productivity but also as an appropriate animal model for studying renal drug elimination processes in humans (Dhondt *et al.*, 2020). The kidney plays a pivotal role in maintaining body homeostasis and influencing pig growth performance. Various extrinsic and intrinsic factors can impact renal function and morphology. Degenerative changes in the kidney, such as cellular swelling, hydropic degeneration, fatty changes, renal amyloidosis, and renal necrosis, can significantly affect pig health and productivity. Degenerative changes in the kidney can be triggered by a variety of factors, including heat stroke, irritants, bacterial infections, toxicity, metabolic disturbances, lack of essential nutrients such as choline, and administration of hypertonic solutions (Drevon and Hovig, 1977; Jones and Hunt, 1983; Hunter *et al.*, 1987; Vegad and Katiyar, 1998; Stoev *et al.*, 1998; Milicevic *et al.*, 2009; Swindle *et al.*, 2012; Rebez *et al.*, 2023). Amyloidosis may occur due to either inflammatory or immunological reactions, and chronic diseases such as Tuberculosis (DiBartola *et al.*, 1989; Segales *et al.*, 2005). Renal lesions, such as cloudy swelling, amyloidosis, and hydropic degeneration, not only indicate renal dysfunction but also serve as markers for underlying health issues such as chronic diarrhoea, weight loss, and poor productivity (Jones and Hunt, 1983). Understanding the aetiology and consequences of these lesions is essential for improving animal health outcomes and productivity. This article aims to review and consolidate current knowledge on degenerative histological changes in the kidneys of pigs reared in specific regions, particularly focusing on Rajasthan. By identifying knowledge gaps and emphasizing the need for more nuanced analyses, this research seeks to enhance our understanding of renal pathology in pigs and its implications for animal production. Investigating renal degenerative changes in pigs is crucial for improving animal health outcomes and agricultural productivity. By elucidating the causes, manifestations, and significance of these changes, this research contributes to the broader understanding of renal physiology and pathology in pigs and highlights the need for further research to

address existing knowledge gaps.

MATERIALS AND METHODS

A total of 586 kidney samples from pigs (Sus scrofa domesticus) were collected irrespective of age, sex, and breed. These samples were obtained from various organised and unorganised slaughterhouses located in Bikaner, Jaipur, and Alwar districts of Rajasthan. From the collected samples, 154 kidney tissue specimens exhibiting macroscopic lesions were identified and collected for further analysis. Twenty-four samples displaying macroscopic lesions indicative of degenerative changes in the kidney were selected for histopathological examination. The collected kidney samples were adequately preserved in 10% formalin solution. Tissue processing was carried out through paraffin embedding using a technique involving acetone and benzene, as described by Lillie (1965). Tissue sections with a thickness ranging from 4 to 6 microns were prepared. Routine staining was performed using the haematoxylin and eosin staining method, following the protocols outlined by Luna (1960) and Bancroft *et al.* (2013).

RESULTS AND DISCUSSION

The occurrence of degenerative changes of kidney of pig in the present study was recorded as 15.58 per cent. Major degenerative change in kidney of pig was cellular swelling recorded as 6.49 per cent. in contrast, the least changes were fatty changes observed at 1.30 per cent.

	Condition	Incidence (No. of sample)	Incidence (percentage)
1	Cellular swelling	10	6.49
2	Hydropic degeneration	3	1.95
3	Fatty change	2	1.30
5	Renal amyloidosis	5	3.25
6	Renal necrosis	4	2.60
	Total	24	15.58

Cellular swelling

The overall occurrence of this condition was observed in 10 (6.49 per cent) cases. Similar incidence was recorded by Gurjar (2018) as 10.2 per cent in sheep. A higher incidence was recorded by Milicevic *et al.* (2009) as 34.3 per cent in pig. Grossly, kidney was enlarged and pale in colour with smooth round bordered. Similar observation was noticed by Gujar (2018). In cellular swelling, there is an intra-cytoplasmic deposition of water. It could be widespread or localised, affecting the entire organ (McGavin and Zachary, 2006). Microscopically, lumens of tubules were narrowed, and the cytoplasm was granular. In some, In some, there was necrotic epithelial debris in the tubular lumen (Figure 1). This recording was in close resemble with result of Lohr (2008); Stoev *et al.*, 2012; Wallig and Janovitz (2013) and Gurjar (2018).

Hydropic degeneration

The overall occurrence of this condition was observed in 3 (1.95 per cent) cases. A similar incidence was reported by Gurjar (2018) as 2.54 per cent in sheep. A higher incidence was recorded by Laxmi (2001) as 71.76 per cent in canine. Grossly, focal or diffuse areas of pale discolouration and enlargement in size of the kidney. The above findings corroborate those of Laxmi (2001). Microscopically, the kidney showed dispersing oedema of the renal tubes, vacuolar degeneration of epithelial cells lining the renal tubules and necrosis (Figure 2). The above observations are also in accordance with Hunter *et al.* (1987); Stoev *et al.* (1998) and Stoev *et al.* (2012).

Fatty change

This condition was observed in 2 (1.30 per cent) cases. A nearby similar incidence was recorded by Jansen and Nordstaoga (1992) as 2.8 per cent in pig. A significant higher incidence was recorded by Milicevic *et al.* (2009) as 45.5 per cent in pig. Grossly, the affected kidneys were pale yellowish and enlarged and had a bulging out cut-surface. The above observations are also in accordance with Jansen and Nordstaoga (1992) and Vegad and Katiyar (1998). Microscopically, fat vacuoles were found particularly in epithelial cells of convoluted tubules. These fat vacuoles were variable in size (Figure 3). The gross and microscopic observations recorded in this study are in accordance with those described by Farber *et al.* (1976), and Vegad and Katiyar (1998).

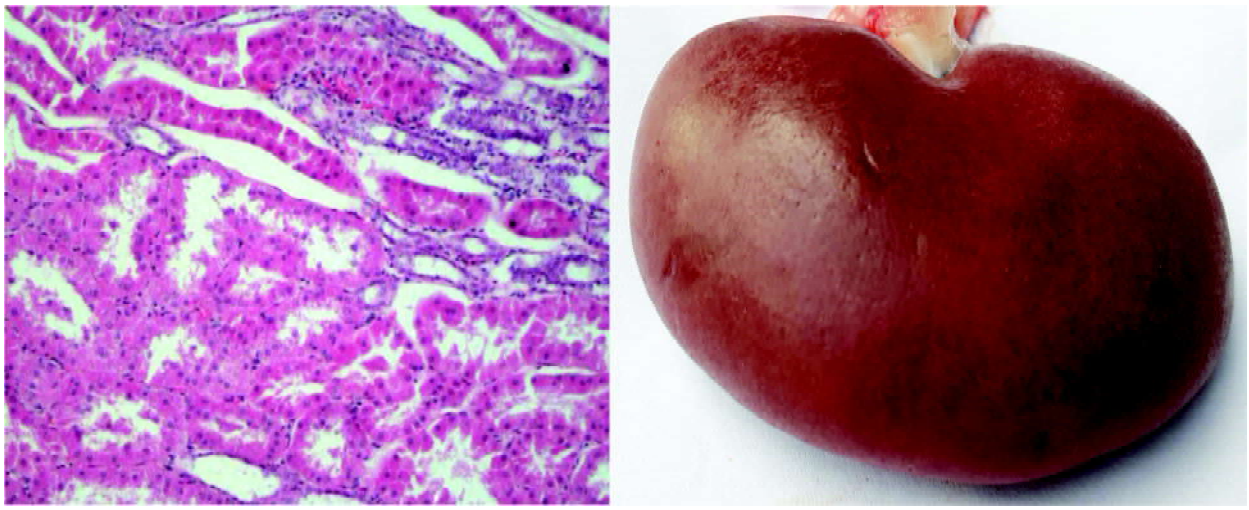

Fig.1: Microphotograph of kidney showing cloudy swelling, the lumen of tubules narrowed and the cytoplasm is granular (H & E -400x). Gross photograph showing swelling of kidney and its rounded border

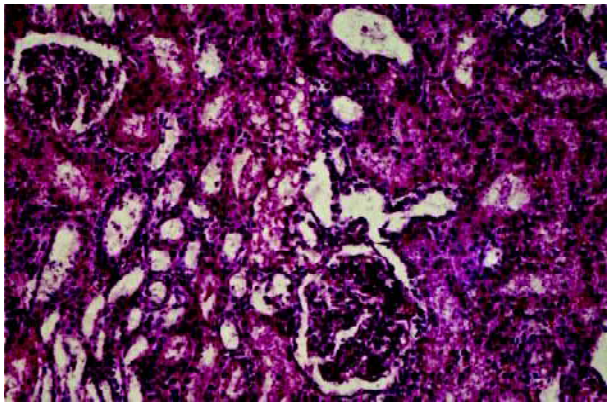

Fig. 2: Microphotograph of kidney showing hydropic degeneration, the cytoplasm of tubules showing numerous, small and large vacuoles in their cytoplasm (H & E -100x).

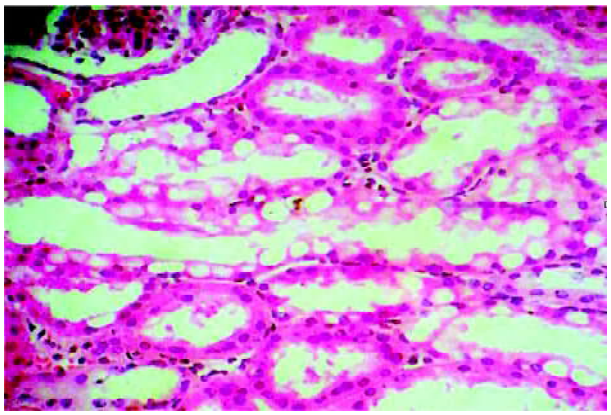

Fig. 3: Microphotograph of kidney showing fatty change, fat vacuole present in cells of tubules and nucleus displaced at periphery (H & E -400x).

Renal amyloidosis

The overall occurrence of this condition was observed in 5 (3.25 per cent) cases. Similar incidence recorded by Gurjar (2018) as 5.1 per cent in pig. Grossly, the kidney was enlarged, pale or yellow in colour, and sometimes waxy on cut section as with most nephrosis. The above findings are in accordance with those described by Jones and Hunt (1983); King *et al.* (2014) and Gaffney (2017). Microscopically, a portion of the normal glomerular architecture was replaced by eosinophilic, homogenous to slightly fibrillar material. In some cases, glomeruli loops were swollen and converted into hyaline balls. The amyloid was deposited in the tubular basement membrane and around the tubules. The tubules showed pink hyaline casts of protein and were dilated. Polymorphonuclear cells infiltration and tubular degeneration were noticed (Fig. 4). The above observations are also in accordance with Jones and Hunt (1983); DiBartola *et al.* (1989); Mensua *et al.* (2003); Segales *et al.* (2005) and Gaffney (2017).

Renal necrosis

This condition was observed in 4 (2.60 per cent) cases. A higher incidence was recorded by Elling (1979) at 31.25 per cent in pig, and Kosaka *et al.* (2016) at 17.4 per cent in animals. Grossly, the kidneys were bilaterally enlarged and pale. Oedema and petechiation of both kidneys were seen. These

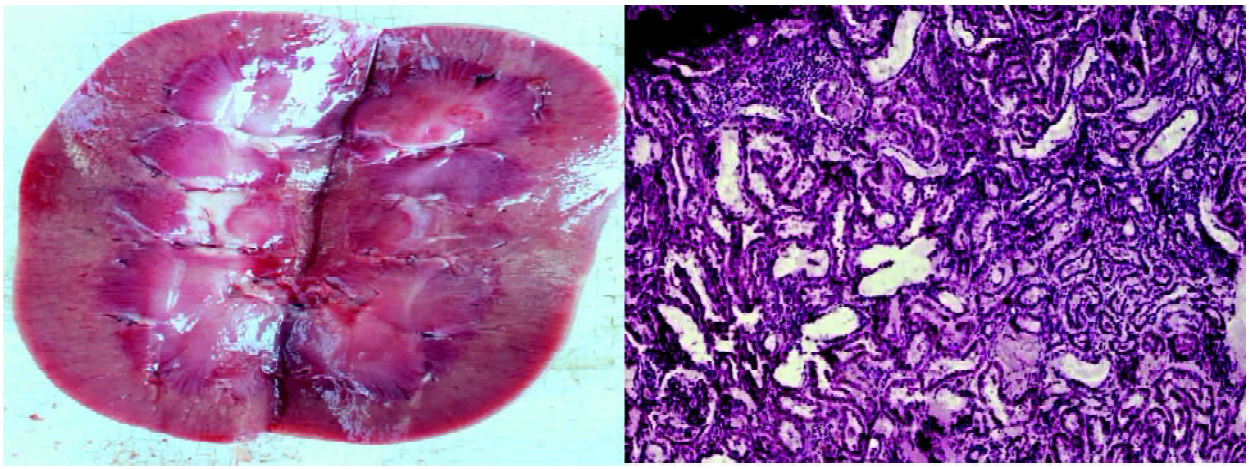

Fig. 4: Gross photograph showing pale and waxy appearance and Microphotograph of kidney showing amyloidosis, glomeruli loops swollen and converted into hyaline balls. (H & E -100x)

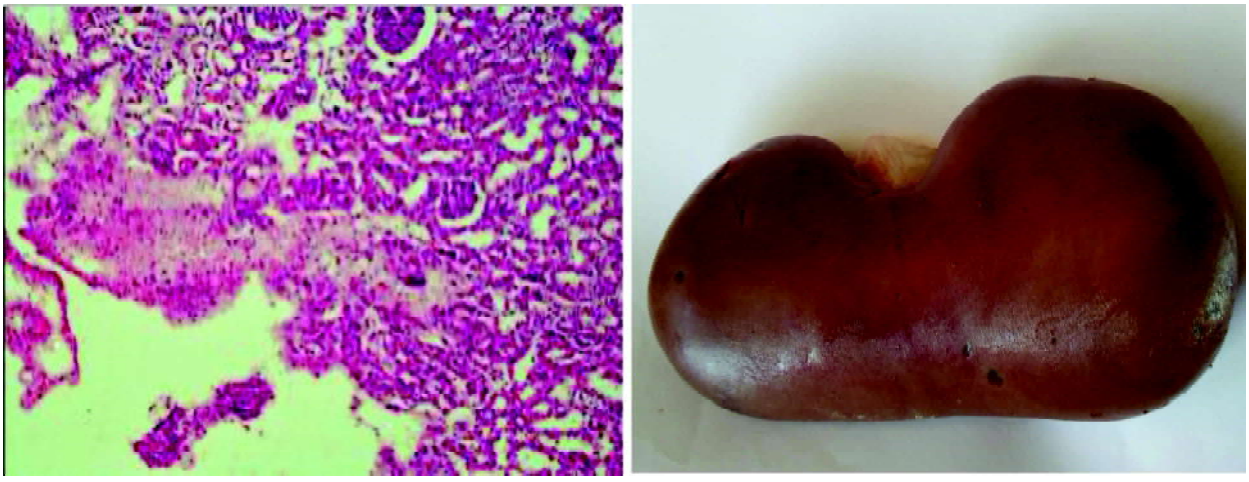

Fig. 5: Microphotograph of kidney showing necrosis of renal parenchyma (H & E -200x) and Gross photograph of kidney with black marking on surface showing necrosis

findings were in close approximation with results of Imai *et al.* (2006) and Phaneuf *et al.* (2007). Microscopically, multifocal necrosis with scarring of glomeruli and glomerular tufts which appeared swollen and hypercellular. Kidney showed multifocal tubular degeneration and necrosis which consisted of hydropic swelling, flattening and atrophy of renal tubular epithelial cells. The lumina of some proximal convoluted tubules contained necrotic debris and epithelial cells that had separated from the basement membrane (Figure 5). These findings were in close resemblance with that of Phaneuf *et al.*, 2007; Sabbagh *et al.*, 2011; Kosaka *et al.*, 2016.

CONCLUSION

In conclusion, this study provides valuable insights into the prevalence and histopathological characteristics of degenerative kidney changes in pigs from the Rajasthan region. The overall incidence of histopathological lesions was recorded at 15.58%, with cellular swelling being the most prevalent condition. The findings highlight the significance of understanding renal pathology in pigs for both farm productivity and as an animal model for studying renal diseases in humans. By identifying the various degenerative changes and their associated factors, this research contributes to

improving animal health outcomes and agricultural productivity. Further studies are warranted to explore additional factors influencing renal pathology in pigs and to develop targeted interventions for mitigating these degenerative changes.

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REFERENCES

Bancroft, J. D., Suvarna, S. K. and Layton, C. (2013). Bancroft's Theory and Practice of Histological Techniques (7th Edn.), British, Churchill Livingstone Elsevier Ltd.

Brown, G. (1996). A monoclonal gammopathy-induced canine renal amyloidosis. *The Canadian Veterinary Journal*, 37(2): 105.

Dhondt, L., Croubels, S., De Paepe, P., Wallis, S. C., Pandey, S., Roberts, J. A., Lipman, J., De Cock, P. and Devreese, M. (2020). Conventional Pig as Animal Model for Human Renal Drug Excretion Processes: Unravelling the Porcine Renal Function by Use of a Cocktail of Exogenous Markers. *Frontiers in Pharmacology*, 11: 883.

DiBartola, S. P., Tarr, M. J., Parker, A. T., Powers, J. D. and Pultz, J. A. (1989). Clinicopathologic findings in dogs with renal amyloidosis: 59 cases (1976-1986). *Journal of the American Veterinary Medical Association,* 195(3): 358–364.

Drevon, C. A. and Hovig, T. (1977). The effects of cholesterol/fat feeding on lipid levels and morphological structures in liver, kidney and spleen in guinea pigs. *Acta Pathologica Microbiologica Scandinavica A.*, 85(1): 1-18.

Elling, F. (1979). Nutritionally induced necrotizing glomerulonephritis and polyarteritis nodosa in pigs. Acta Pathologica Microbiologica Scandinavica Section A, 87(1-6), 387-392.

Farber, T. M., Ritter, D. L., Weinberger, M. A., Bierbower, G., Tanner, J. T., Friedman, M. H., Carter, C. J., Earl, F. L., Van Loon, E. J. (1976). The toxicity of brominated sesame oil and brominated soybean oil in miniature swine. *Toxicology*, 5(3): 319-336.

Gaffney, P. M. (2017). Amyloid A Amyloidosis: The Influence of Genetics and Seeding on Pathogenesis and the Utility of Mass Spectrometry. *Veterinary Pathology*, 54(1): 5-8.

Gurjar, T. (2018). Occurrence and pathology of various conditions in kidney of sheep (*Ovis aries*) in southern region of Rajasthan. M.V.Sc. thesis. College of Veterinary and Animal Science, Navania. RAJUVAS, Bikaner, Rajasthan.

Hunter, P., Van Der Vyver, F. H., Henton, M. M., Herr, S., De Lange, J. F. and Selmer-Olsen, A. (1987). Leptospirosis as a cause of "white spot" kidneys in South African pig abattoirs. *The Onderstepoort Journal of Veterinary Research*, 54(1): 59-62.

Imai, D. M., Cornish, J., Nordhausen, R., Ellis, J. and MacLachlan, N. J. (2006). Renal tubular necrosis and interstitial hemorrhage ("turkey-egg kidney") in a circovirus-infected Yorkshire cross pig. *Journal of Veterinary Diagnostic Investigation*, 18(5): 496-499.

Jansen, J. H. and Nordstoga, K. (1992). Renal lesions in Norwegian slaughter pigs. Macroscopic and light microscopic studies. *Journal of Veterinary Medicine Series A*, 39(1 10): 582-592.

Jones, T. C. and Hunt, R. D. (1983). The urinary system. In Veterinary Pathology, (5th Edn), Lea and Febiger, Philadelphia. Pp. 1443-1502.

King, J. M., Hsu, F. S., Hong, C. B. and Lee, R. C. T. (2014). An Atlas of General Pathology (Vol I): With Special Reference to Swine Diseases. Published by The Internet-First University Press.

Kosaka, J., Lankadeva, Y. R. May, C. N. Bellomo, R. (2016). Histopathology of Septic Acute Kidney Injury: A Systematic Review of Experimental Data. *Critical Care Medicine*,

44(9): e897-e903.

Laxmi (2001). Hepato-renal pathology in canines. M.V.Sc. thesis. Centre of Excellence in Pathology. College of Veterinary and Animal Science Mannuthy, Thrissur, Kerala.

Lillie, R. D. (1965). Histo-pathological technique and practical histochemistry. Mc-Graw Hill Book Company, New York and London.

Lohr, C. V. (2008). Book Review: Color Atlas of Veterinary Pathology: General Morphological Reactions of Organs and Tissues. Published by SAGE Publications Sage CA: Los Angeles.

Luna, G. (1960). Manual of Histological Staining of the Armed Forces Institute of Pathology. (3rd Edn.) New York: McGraw Hill Book Company, Pp: 32-40.

McGavin, M.D. (2006). Zachary JF. Pathologic basis of veterinary disease. Elsevier Health Sciences.

Mensua, C., Carrasco, L., Bautista, M. J., Biescas, E., Fernandez, A., Murphy, C. L. and Lujan, L. (2003). Pathology of AA amyloidosis in domestic sheep and goats. *Veterinary Pathology*, 40(1): 71-80.

Milicevic, D. R., Jovanovic, M., Juric, V. B., Petrovic, Z. I. and Stefanovic, S. M. (2009). Toxicological assessment of toxic element residues in swine kidney and its role in public health risk assessment. *International Journal of Environmental Research and Public Health*, 6(12): 3127-3142.

Oliveira Filho J. X., De Paula D. A. J., Mores N., Pescador C. A., Ciacci-Zanella J. R., Coldebella A., Dutra V. and Nakazato L. (2012). Interstitial nephritis of slaughtered pigs in the State of Mato Grosso, Brazil. Pesquisa *Veterinaria Brasileira*, 32(4): 303-318.

Phaneuf, L. R., Ceccarelli, A., Laing, J. R., Moloo, B. and Turner, P. V. (2007). Porcine dermatitis and nephropathy syndrome associated with porcine circovirus 2 infection in a Yorkshire pig. *Journal of the American Association for Laboratory Animal Science,* 46(3): 68-72.

Rebez, E. B., Sejian, V., Silpa, M. V., Dunshea, F. R. (2023). Heat Stress and Histopathological Changes of Vital Organs: A Novel Approach to Assess Climate Resilience in Farm Animals. *Sustainability*, 15(2): 1242.

Sabbagh, R., Chawla, A., Tisdale, B., Kwan, K., Chatterjee, S., Kwiecien, J. M., and Kapoor, A. (2011). Renal histopathology features according to various warm ischemia times in porcine laparoscopic and open surgery model. *Canadian Urological Association Journal*, 5(1): 40-43.

Segales, J., Vicente, J., Lujan, L., Toussaint, M. J. M. Gruys, E. and Gortazar C. (2005). Systemic AA-amyloidosis in a European wild boar (*Sus scrofa*) suffering from generalised tuberculosis. *Journal of veterinary Medicine. A Physiology, Pathology, Clinical Medicine,* 52: 135–137.

Stoev, S. D., Hald, B. and Mantle, P. G. (1998). Porcine nephropathy in Bulgaria: a progressive syndrome of complex or uncertain (mycotoxin) aetiology. *Veterinary Record*, 142(8): 190-194.

Stoev, S. D, Gundashevaa, D., Zarkov, I., Mirchevac, T., Zapryanovac, D., Denev, S., Miteve, Y., Daskalovf, H., Duttong, M., Mwanza M. and Schneider, Y. (2012). Experimental mycotoxic nephropathy in pigs provoked by a mouldy diet containing ochratoxin A and fumonisin B. *Experimental and Toxicologic Pathology*, 64(7-8): 733-741.

Swindle, M. M., Makin, A., Herron, A. J., Clubb, F. J, Frazier, K. S. (2012). Swine as Models in Biomedical Research and Toxicology Testing. *Veterinary Pathology*, 49(2): 344-356.

Vegad, J. L. and Katiyar, A. K. (1998). Urinary System. Textbook of Veterinary Systemic Pathology, (1st Edn). International Book Distributing Company, Lucknow.

Wallig, M. A. and Janovitz, E. B. (2013). Haschek and Rousseaux's Handbook of Toxicologic Pathology (3rd Edn), Academic Press, Pp. 77-105.

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