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Incidence of gross and histopathological lesions in commercially available pigs slaughtered at Meat Technology Unit, Kerala Veterinary and Animal Sciences University#

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Abstract

Meat inspections are aimed to detect animal diseases or health problems early, helping to prevent foodborne illnesses, ensure the quality of animal-based products, and protect public health. Common pathological changes seen in healthy finishing pigs at slaughter, often manifesting as subclinical lesions, include pneumonia, pleuritis, atrophic rhinitis, arthritis, arthrosis, gastric ulcers, hyperkeratosis, white spots on the liver, ulcers in the preputial diverticulum, skin lesions, and abscesses. A study was conducted among 82 pigs received at the Meat Technology Unit, KVASU, Mannuthy to identify the major pathological conditions in finishing pigs. Out of the 82 animals included in the study, 81.71 per cent showed one or more lesions during the post-mortem inspection (PMI). Key post-mortem findings included abscesses (23.17%), pleuritis (19.25%), white spots on the liver (13.41%), white spots on the kidney (8.54 %), pneumonia (7.32%), pericarditis (4.88%), and hydronephrosis. Farm 2 showed a higher prevalence of pleuritic lesions (33.33%) and white spots on both the liver and kidney (41.67 %), while farm 5 had the highest occurrence of abscesses at 60.87 per cent. Additionally, pneumonic lesions (33.34%) and pleuritis (33.34%) were more frequent in animals over 200 kg. Microscopic examination revealed bronchopneumonia and bronchiolitis in lung tissue, while hepatic lesions exhibited abscess formation and interlobular fibrous tissue proliferation. Signs of congestion and haemorrhage were noted in affected tissues of the heart, kidney, and intestine.

Keywords: *Pneumonia, pleuritis, pigs, congestion, haemorrhage*

The abattoir serves as an effective monitoring system for evaluating the prevalence of disease conditions identified during slaughter. Abattoir provides important disease-related information at both global and regional levels. Subclinical infections have been associated with production losses, resulting in decreased weight gain and lower feed efficiency in pigs from nursery to finishing stages, along with diminished reproductive performance in sows (Baysinger *et al*., 1997). As far as large pig herds in developed countries are concerned, respiratory diseases remained a major challenge in intensive pig farming, as it is understood that most commercially raised pigs are likely to develop some type of lung condition before arriving at the slaughterhouse (Christensen *et al.,* 1999). Stärk (2000) noted that annually, lung lesions

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result in significant economic losses, including lower growth rates and feed conversion efficiency, higher mortality and morbidity, increased treatment costs, the condemnation of edible parts and carcasses at slaughter, and a decline in carcass and meat quality. *Ascaris suum* infection and liver milk spots resulted in multiple adverse effects including economic losses, alterations in haematological values, need to trim and dispose of organs unfit for human consumption and reduced quality of carcasses and pork. Apart from works on occurrence of some parasitic conditions, reports on systematic documentation of post-mortem lesions in slaughtered pigs in India scarce. Hence the current study was conducted to document the incidence of various gross and histopathological lesions observed during post-mortem inspection of commercially available slaughter pigs that were slaughtered at Meat Technology Unit, KVASU, Mannuthy.

Materials and methods

A total of 82 crossbred pigs of either sex procured from five farms were utilised in the study. The animals were classified based on sex, body weight and farms. After ante-mortem inspection each animal was subjected to slaughter and dressing according to scientific procedures at the Meat Technology Unit, KVASU, Mannuthy. A detailed post-mortem inspection was conducted by examining the carcass, viscera and head of each animal. The proforma for post-mortem inspection was a modification of Ante-mortem and Post-mortem Inspection of Meat Animals-code of Practice (BIS, 2015), incorporating additional common observations to add more specificity during the inspection process.

Gross pathology

Pneumonic lesions or cranioventral pulmonary consolidation (CVPC) were evaluated using a previously described method (Madec and Kobisch, 1982), in which each lobe is divided into quarters, and each lobe receives a value that ranges from 0 to 4 depending on the extension of the lesion, for a maximum value of 28 for each lung. The score of the lungs was calculated based on the sum of the scores for each of the seven lobes. The lung was scored as 0 when no lesion was present. Scores 1 to 4 indicated mild pneumonia, a score ≥ 5/28 was regarded as moderate to severe pneumonia. Pleurisy was scored at the individual level using a five-point scale (0 to 4) as per Fablet *et al*. (2012), where 0 was given if the lung was without lesions, a score of 1 indicated one pleural adhesion between or at the border of a lung lobe, a score of 2 indicated focal lesions with several pleural adhesions between lung lobes, a score of 3 indicated extensive parietal adhesions of the lung with the thoracic wall, and a score of 4 indicated extensive pleurisy when the entire lung was fixed to the thoracic wall. A score of 1 indicated mild pleurisy, while scores ≥ 2/4 were indicative of moderate to severe pleurisy. Liver, Kidney, heart, intestine and lymph nodes examined for gross pathological lesions.

Histopathology

Tissues showing gross abnormalities were fixed in 10 per cent neutral buffered formalin, processed and embedded in paraffin and sectioned at 4 µm thickness and stained using routine haematoxylin and eosin staining procedure for confirmation.

Results and discussion

The study included 82 animals from five different farms. About 81.71 per cent exhibited one or more lesions during post-mortem examinations. Sex, age and average live body weight of animals are presented in Table 1. The most commonly observed lesions included abscesses, pleuritis, white spots on the liver and kidneys, pneumonia and pericarditis (Table 2 and Table 3). The occurrence of pneumonia was 7.32 per cent in this study. Using a 5-point scale, 6.10 per cent of animals had a pneumonia score of 1, and one animal had a score of 2. The highest incidence (25%) of pneumonia occurred on farm 2. Of the animals with pneumonic lesions, four were male, and three were within the 80-120 kg weight range. These findings are consistent with those of Ghidini *et al.* (2021) and Andoni *et al.* (2023), who reported prevalences of 8.16 per cent and 8.5 per cent respectively. Maisano *et al.* (2020) reported a higher prevalence of 17.1 per cent, while Guardone *et al.* (2020) observed a lower prevalence of 3.5 per cent for pneumonia.

Pleuritis, also referred as pleurisy, is the inflammation of the pleura and was the most frequently observed lesion in finishing pigs during post-mortem inspections. In this study, pleuritis had a prevalence of 19.25 per cent. When the lesions were evaluated on a 5-point scale, 9.76, 6.1, 2.44 and 1.22 per cent animals were found to have scores of 1, 2, 3, and 4, respectively. Furthermore, 23.34 per cent of the animals with pleuritis were male, and 33.33 per cent of the animals from farm 2 exhibited grade 1 pleuritis. This result aligns with Ghidini *et al.* (2021), who reported a prevalence of 17.2 per cent. In contrast Andoni *et al.* (2023) and Maisano *et al.* (2020) reported prevalences of 10.2 per cent and 25.8 per cent, respectively. The variations in prevalence rates for pneumonia and pleuritis could be attributed to inconsistencies in how lung lesions were assessed by official meat inspectors, including specialised veterinarians

Table 1. The sex, age, and live body weight of pigs included in the study

No. of pigs inspected		82
Sex	Male	30
	Female	52
Age		8 month – 18 months
Average live body weight (kg)		144.04

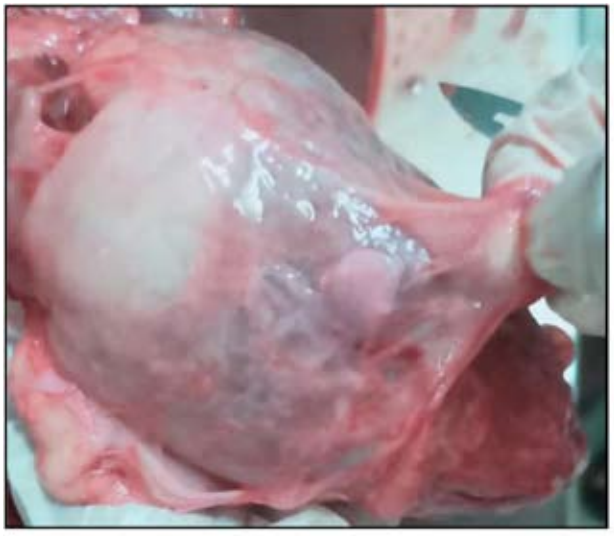

Fig. 1. Heart: Pericarditis

Fig. 2. Heart: Pericarditis

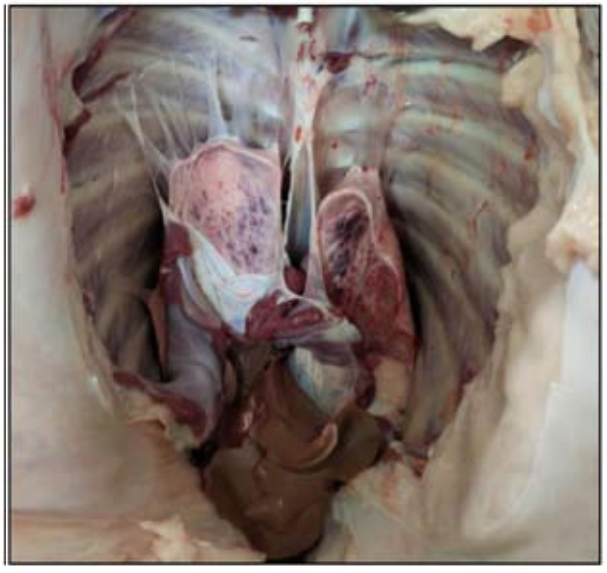

Fig. 3. Lung: Pleural adhesions

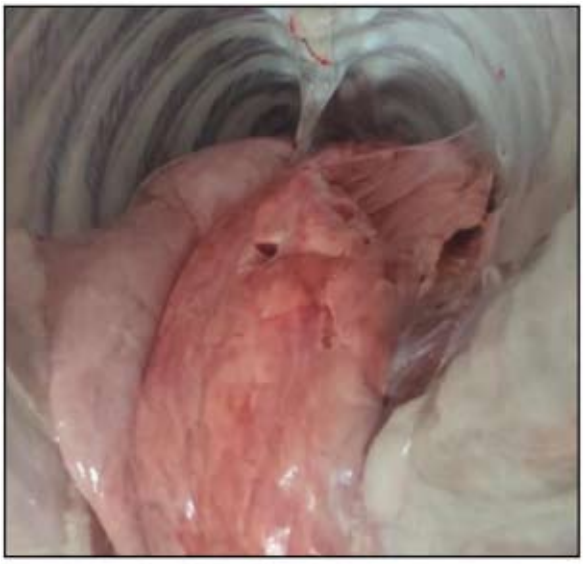

Fig. 4. Pleural adhesions

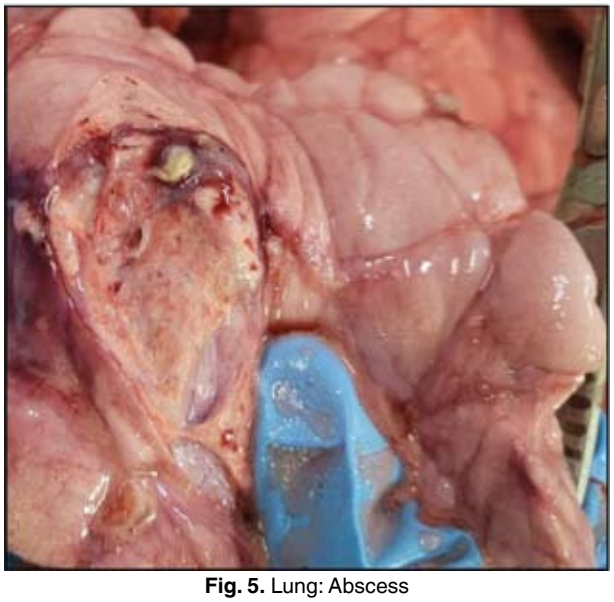

Fig. 5. Lung: Abscess

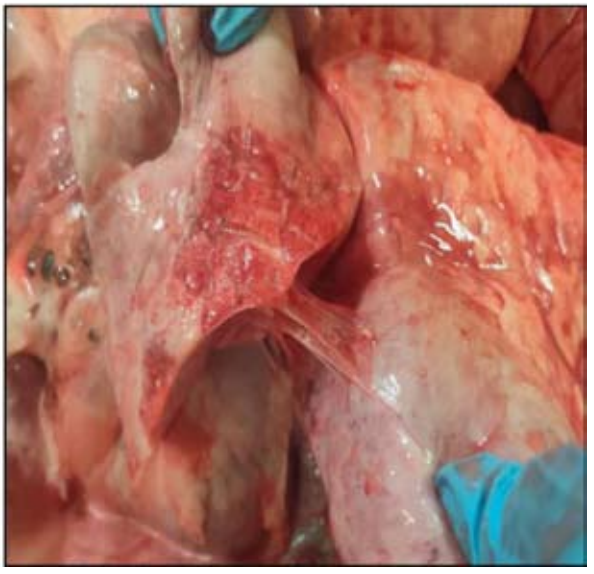

Fig. 6. Pleuritis

Table 2. Proportion of animals showing various abnormalities during PMI

Sl. No.	Condition		No. of animals (n=82)	%	Incidence in farms									
					Farm 1 (n=27)		Farm 2 (n=12)		Farm 3 (n=7)		Farm 4 (n=13)		Farm 5 (n=23)	
1	Pneumonia	0	76	92.68	27	100	9	75	7	100	12	92.31	21	91.3
		1	5	6.10			3	25			1	7.69	1	4.35
		2	1	1.22									1	4.35
		3												
		4												
2	Pleuritis	0	66	80.49	24	88.89	8	66.67	6	85.71	11	84.62	18	78.26
		1	8	9.76	3	11.11	4	33.33	1	14.29				
		2	5	6.1							2	15.38	3	13.04
		3	2	2.44									2	8.7
		4	1	1.22							1	7.69		
3	White spots on liver	0	71	86.59	24	88.89	7	58.33	7	100	12	92.31	21	91.30
		1	11	13.41	3	11.11	5	41.67			1	7.69	2	8.7
4	Pericarditis	Present	4	4.88	1	3.70			1	14.29	1	7.69	1	4.35
		Absent	78	95.12	26	96.3			6	85.71	12	92.31	22	95.65
5	Abscess	Present	19	23.17	3	11.11	1	8.33			1	7.69	14	60.87
		Absent	63	76.83	24	88.89	11	91.67	7	100	12	92.31	9	39.13
6	White spots on kidney	Present	7	8.54			5	41.67			2	15.38		
		Absent	75	91.46	27	100	7	58.33	7	100	11	84.62	23	100
7	Hydronephrosis	Present	6	7.32					1	14.29	5	38.46		
		Absent	76	92.68	27	100	12	100	6	85.71	8	61.54	23	100

Table 3. Proportion of animals showing various abnormalities during PMI

Sl. No.	Condition		No. of animals (n=82)	%	Body weight								Sex			
					80-120 Kg (n=18)		120-160 Kg (n=47)		160-200 Kg (n=11)		>200 Kg (n=6)		Male (n=30)		Female (n=52)	
1	Pneumonia	0	76	92.68	15	83.33	46	97.87	11	100	4	66.67	26	86.67	50	96.15
		1	5	6.10	3	16.67	1	2.13			1	16.67	4	13.33	1	1.92
		2	1	1.22							1	16.67			1	1.92
		3														
		4														
2	Pleuritis	0	66	80.49	12	66.67	41	87.23	9	81.82	4	66.67	23	76.67	43	82.69
		1	8	9.76	4	22.22	4	8.51					5	16.67	3	5.77
		2	5	6.10	1	5.56	1	2.12	2	18.18	1	16.67	2	6.67	3	5.77
		3	2	2.44			1	2.12			1	16.67			2	3.85
		4	1	1.22	1	5.56									1	1.92
3	White spots on liver	0	71	86.59	16	88.89	40	85.11	10	90.91	5	83.33	23	76.67	48	92.31
		1	11	13.41	2	11.11	7	14.89	1	9.09	1	16.67	7	23.33	4	7.69
4	Pericarditis	Present	4	4.88	2	11.11	1	2.12			1	16.67	2	6.67	2	3.85
		Absent	78	95.12	16	88.89	46	97.87	11	100	5	83.33	28	93.33	50	96.15
5	Abscess	Present	19	23.17	1	5.56	11	23.4	4	36.36	3	50	3	10	16	30.77
		Absent	63	76.83	17	94.44	36	76.6	7	63.64	3	50	27	90	36	69.23
6	White spots on kidney	Present	7	8.54	2	11.11	4	8.51	1	9.09			2	6.67	5	9.61
		Absent	75	91.46	16	88.89	43	91.49	10	90.91	6	100	28	93.33	47	90.38
7	Hydronephrosis	Present	6	7.32	2	11.11	4	8.51					1	3.33	5	9.62
		Absent	76	92.68	16	88.89	43	91.49	11	100	6	100	29	96.67	47	90.38

and trained assistants. (Fig. 3-6, gross lung lesions).

White spots on liver is characterised by white fibrotic areas in the liver parenchyma, resulting from an inflammatory response caused by the migration of *Ascaris suum.* In this study, white spots on liver were found in 13.41 per cent of the animals. Farm 2 had the largest percentage of liver white spots (41.67%). Among the 11 animals with white spots on liver, seven were in the 120-160 kg weight range, and seven were male. Ghidini *et al.* (2021) reported an average prevalence of 7.60 per cent for milk spot liver during post-mortem inspections. Other studies by Ghidini *et al.* (2018), Maisano *et al.* (2020), and Scollo *et al.* (2017) reported prevalence rates of 7.6 per cent, 25 per cent, and 24 per cent, respectively. Scollo *et al.* (2017) noted that variations in the frequency of white spots across studies may be due to differences in the parasitic control measures implemented on pig farms.

Pericarditis is characterised by adhesions forming between the heart and the pericardium and is a leading cause of cardiac condemnations. In this study, the prevalence of pericarditis during post-mortem inspections was 4.88 per cent. This result aligns with those of Ghidini *et al.* (2018) and Andoni *et al.* (2023), who reported prevalences of 3.22 per cent and 3.3 per cent respectively. Correia-Gomes *et al.* (2017) and Maisano *et al.* (2020) also reported similar prevalence rates. In contrast, Guardone *et al.* (2020) observed a higher prevalence of 6.94 per cent, while Ghidini *et al.* (2021) noted a prevalence of 7.82 per cent. According to the Welfare Quality® (2009), a prevalence of 5 per cent for pericarditis is considered a warning threshold. Therefore, the prevalence rate found in this study is not regarded as a significant concern. (Fig. 1 and 2, pericarditis).

Abscesses were found in 23.17 per cent of the animals during post-mortem inspections. Abscesses were mainly observed in the shoulder (3 cases), thigh (4 cases), loin regions (1 case) and internal organs (11 cases). Of the carcasses with abscesses, 16 were female, making up 30.77 per cent. Significantly, 60.87 per cent of the animals from farm 5 had abscesses. The highest prevalence of abscesses was observed in animals weighing between 160 and 200 kg. Ghidini *et al.* (2021) reported an average prevalence of abscesses at 0.91 per cent during post-mortem inspections. Huey (1996) indicated that abscesses in carcasses or lungs were often linked to infections from tail biting or other skin injuries. Additionally, Garcia-Diez and Coelho (2014) found that approximately 8.42 per cent of carcasses were condemned due to abscesses. (Fig. 8-11, abscesses).

White spots on the kidneys were observed in 8.54 per cent of the animals. Farm 2 had the highest percentage of white spots on kidney (41.67%). Of the seven animals exhibiting these spots, four were in the 120-160 kg weight category, and five were female. Hunter *et al.* (1987) noted

Fig. 7. Kidney: Hydronephrosis

Fig. 8. Liver: Micro abscessation

Fig. 9. Lymph node: Microabscessation

that, without laboratory testing, the presence of grey-white foci in the renal cortex—commonly called “white spots”—was the only sign of leptospiral infection. Additionally, Baker *et al.* (1989), studied 197 slaughter hogs and found that 63 of them (32%) displayed significant kidney lesions

Fig. 10. Abscess

Fig. 11. Abscess

characterised by multiple grey-white foci throughout the kidneys.

Sastry (1983) described kidneys affected by hydronephrosis as resembling a bag with a thin capsule. Microscopic feature revealed atrophy of the tubules, which were significantly dilated, along with evidence of fibrous tissue proliferation. Jansen and Nordstoga (1992) studied renal lesions in 668 slaughtered swine and found hydronephrosis in two cases, representing 0.29 per cent. In this study, hydronephrosis was found in 7.32 per cent of the animals, with Farm 4 having the highest rate at 38.46 per cent. Among the six animals exhibiting hydronephrosis, five were female. Burdak (2021) reported an incidence of 2.60 per cent for hydronephrosis (Fig. 7, hydronephrosis).

Histopathology

Microscopic analysis of lung tissue affected by pneumonia showed that the alveoli were filled with inflammatory cells, primarily neutrophils. It also revealed localised to widespread necrosis of the bronchial epithelium, along with necrotic debris and inflammatory

Fig. 12. Lung: Bronchiolitis- (H&Ex100)

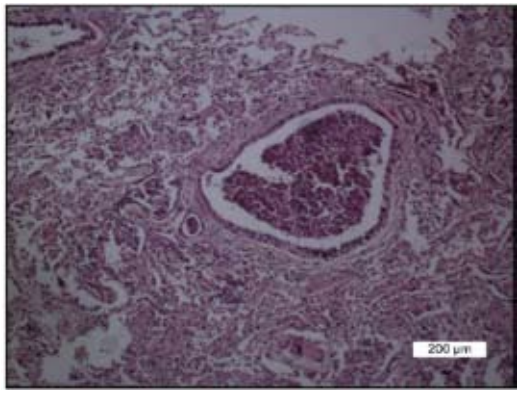

Fig. 13. Lung: Broncho pneumonia- (H&Ex100)

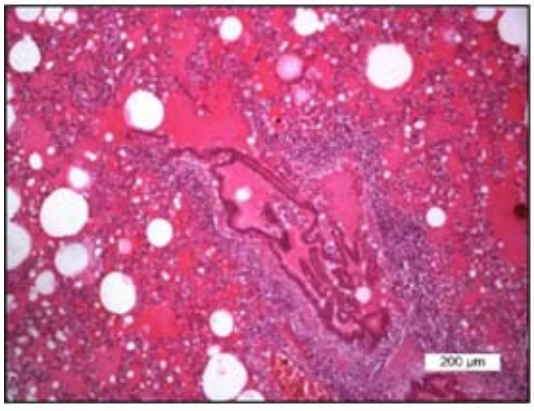

Fig. 14. Lung: Broncho pneumonia, edema and congestion- (H&Ex100)

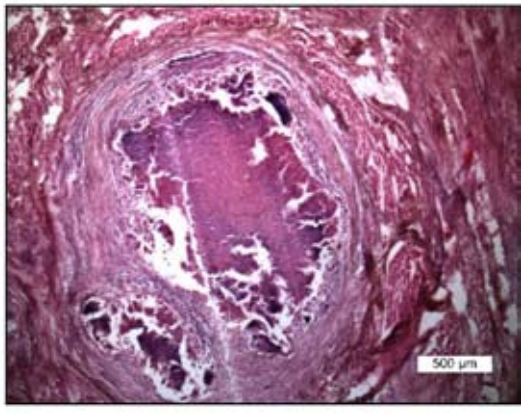

Fig. 15. Liver: Abscess- (H&Ex40)

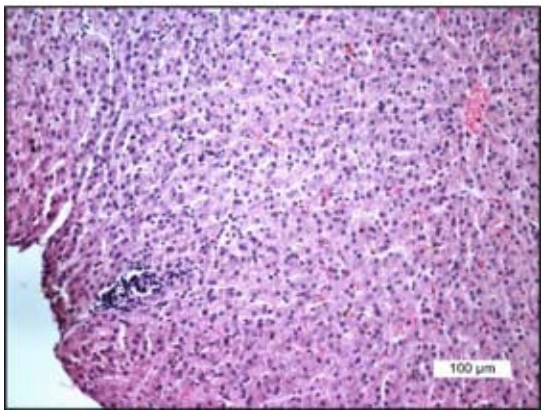

Fig. 16. Liver: Necrosis and mono nuclear cell infiltration- (H&Ex200)

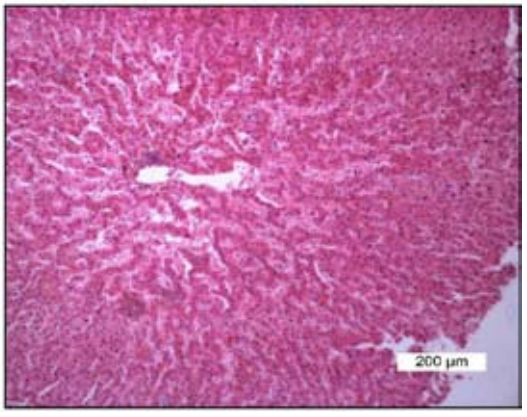

Fig. 17. Liver: Sinusoidal dilation- (H&Ex100)

exudate in the bronchiole lumen, as well as pulmonary congestion and oedema (Fig. 12-14). These observations pointed to an acute infection. According to Hansen *et al.* (2010), acute lesions are characterised by a predominance of neutrophils, significant oedema, and/or fibrin exudation, with no signs of chronicity. In contrast, Karabasil *et al.* (2017) noted that chronic interstitial pneumonia is marked by the buildup of mononuclear cells in the interstitium, hyperplastic type II pneumocytes in the alveolar lumen, and the development of fibrosis. Although lesions indicative of pleuritis were observed in 16 animals, these were not reflected in the histopathological examination.

Microscopic analysis of the liver showed signs of congestion, infiltration by mononuclear cells, abscess formation, and fibrous tissue growth, suggesting the presence of chronic inflammation. Pankaj *et al.* (2022) observed that in cases of acute hepatitis, microscopy revealed infiltration of polymorphonuclear cells in perilobular and periportal areas. Estheru (2010) found that chronic hepatitis was marked by significant fibrous tissue proliferation in the interlobular septa, extensive infiltration by various mononuclear cells - such as lymphocytes, macrophages, and plasma cells - and the formation of new bile ducts in the portal regions. While lesions indicative of white spots on the liver were seen in 11 animals, these

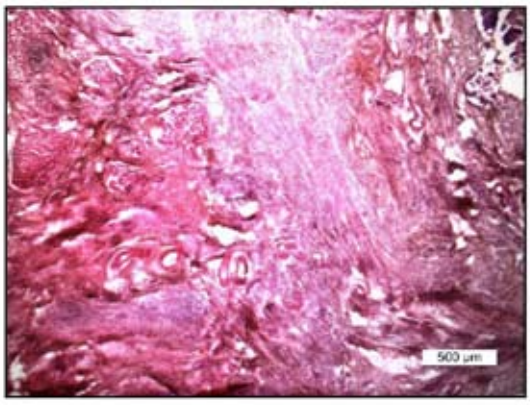

Fig. 18.Liver: Inter lobular fibrous tissue proliferation- (H&Ex40)

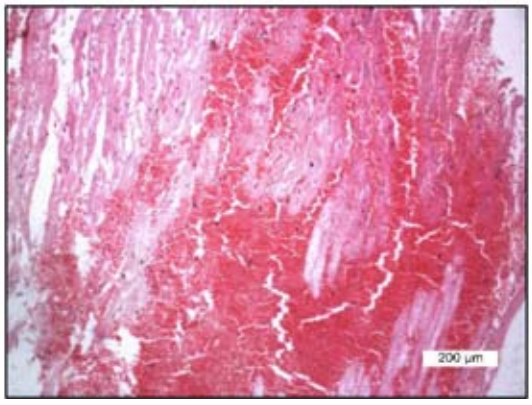

Fig. 19. Heart: Extensive haemorrhage - (H&Ex100)

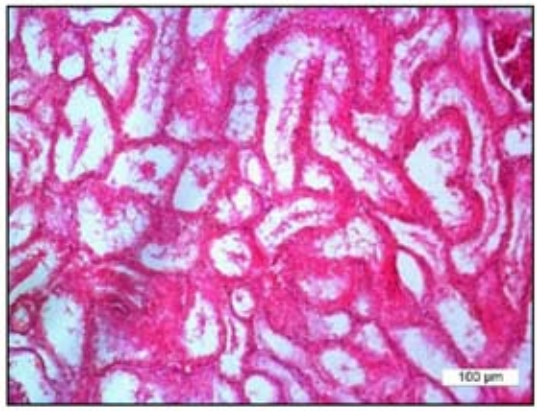

Fig. 20. Kidney: Epithelial degeneration and vacoulation- (H&Ex200)

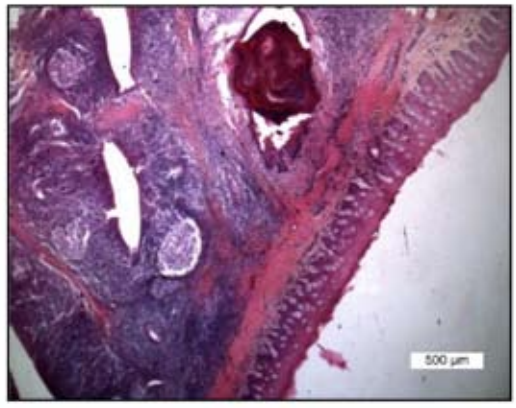

Fig. 21. Tonsil: Crypt abscess- (H&Ex40)

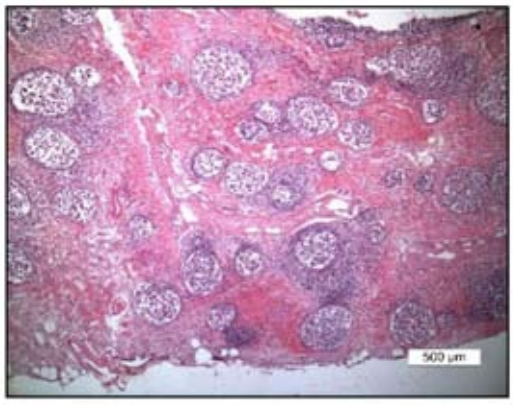

Fig. 22. Lymph node: Congestion, haemorrhage and diffused lymphocytic depletion- (H&Ex40)

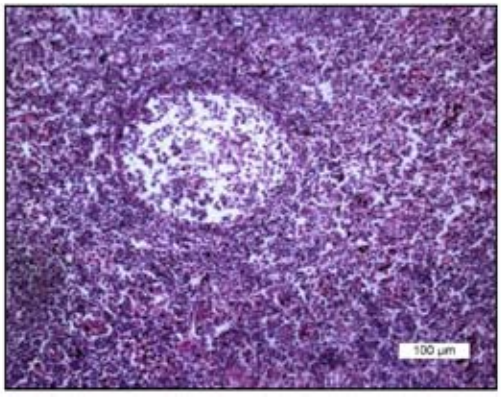

Fig. 23. Lymph node: Lymphoid depletion- (H&Ex200)

findings were not evident in the histopathological analysis (Fig. 15-18).

Microscopic analysis of the heart showed signs of congestion and haemorrhage, indicating acute inflammation. Balena *et al.* (2016) noted that in instances of haemorrhagic septicemia, an acute condition in cattle, the heart displayed congestion and haemorrhage in both the epicardium and myocardium, accompanied by infiltration of inflammatory cells in the myocardium. Although lesions suggestive of pericarditis were seen in four animals, these were not evident in the histopathological findings (Fig. 19).

Microscopic analysis of the kidney showed congestion, degeneration of epithelial cells, and vacuolation. While lesions suggestive of white spots were observed in seven animals, these findings were not evident in the histopathological examination. (Fig. 20, lesions in kidney).

The characteristic lesions seen in the lymphoid organs included infiltration of inflammatory cells, haemorrhage, congestion, lymphoid depletion, and abscesses in the tonsillar crypts. The microscopic changes noticed on lymphoid organs are depicted in Fig. 21-26.

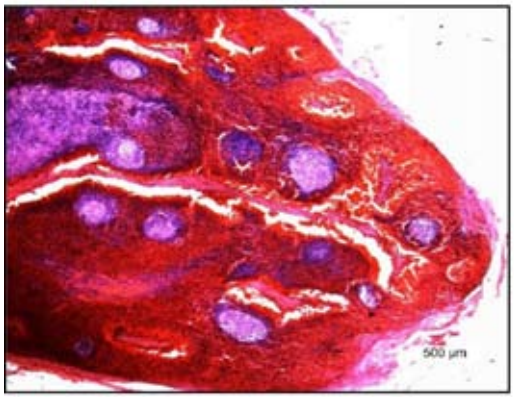

Fig. 24. Lymph node: Diffused congestion and haemorrhage - (H&Ex40)

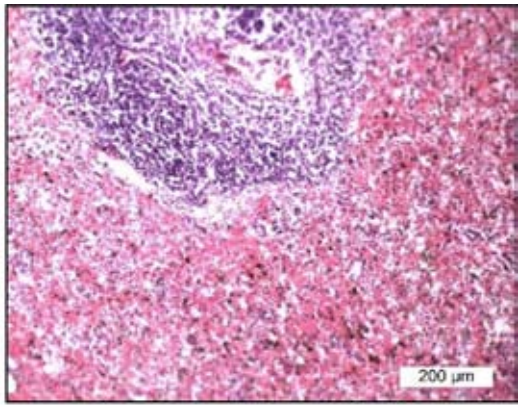

Fig. 25. Lymph node: Haemorrhage- (H&Ex100)

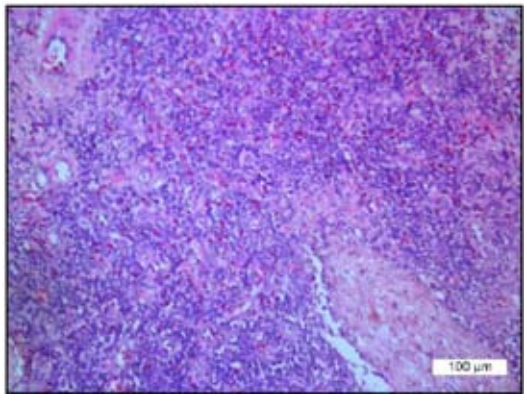

Fig. 26. Lymph node: Eosinophilic infiltration- (H&Ex200)

Conclusion

The study found that 81.71 per cent of the 82 animals exhibited one or more pathological lesions. Major post-mortem findings included abscesses (23.17%), pleuritis (19.25%), white spots on the liver (13.41%), white spots on the kidney (8.54%), pneumonia (7.32%), pericarditis (4.88%), and other conditions such as hydronephrosis. Farm 2 had a higher prevalence of pleuritic lesions (33.33%) and white spots on the liver and kidney (both 41.67%), while farm 5 had the highest rate

of abscesses at 60.87 per cent. Additionally, pneumonic lesions (33.34%) and pleuritis (33.34%) were more common in animals weighing over 200 kg. Microscopic examination of lung tissue revealed bronchopneumonia and bronchiolitis, while hepatic lesions showed abscess formation and interlobular fibrous tissue proliferation. Affected tissues in the heart, kidney, and intestine displayed signs of congestion and hemorrhage.

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Conflicts of interest

The authors declare that they have no conflict of interest.

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