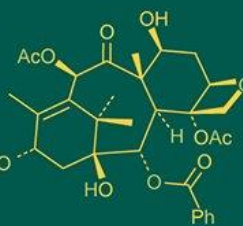
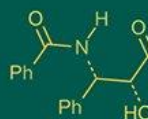


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; 10(9): 286-290
www.biochemjournal.com
Received: 01-07-2026
Accepted: 09-08-2026

Dr. Kanika Kalai
Associate Professor,
Department of Veterinary
Pathology, College of
Veterinary Sciences and
Animal Husbandry, R.K.
Nagar, West, Tripura, India

Dr. Aparajita Das
Assistant Professor,
Department of Veterinary
Microbiology, College of
Veterinary Sciences and
Animal Husbandry, R.K.
Nagar, West, Tripura, India

Dr. Biplab Debroy
Associate Professor,
Department of Veterinary
Pathology, College of
Veterinary Sciences and
Animal Husbandry, R.K.
Nagar, West, Tripura, India

Dr. Debasish Behera
Associate Professor,
Department of Veterinary
Pathology, College of
Veterinary Sciences and
Animal Husbandry, R.K.
Nagar, West, Tripura, India

Corresponding Author:
Dr. Kanika Kalai
Associate Professor,
Department of Veterinary
Pathology, College of
Veterinary Sciences and
Animal Husbandry, R.K.
Nagar, West, Tripura, India

Hematobiochemical and splenic pathological evaluation in slaughtered pigs

Kanika Kalai, Aparajita Das, Biplab Debroy and Debasish Behera

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i9d.9943>

Abstract

The spleen is a major lymphoid and haemolymphatic organ involved in systemic infectious, inflammatory, parasitic, and vascular disorders of pigs. This study characterized gross and histopathological splenic lesions in slaughtered pigs and evaluated their association with hematological and serum biochemical alterations, with particular reference to classical swine fever virus (CSFV) seropositivity. Two hundred randomly selected nondescript pigs slaughtered at an organized abattoir in Mumbai were investigated. Blood samples were subjected to hematological and serum biochemical analysis, spleens were examined grossly and histologically, and additional splenic samples were subjected to bacterial isolation. Serum samples were tested for CSFV antibodies by indirect ELISA, with titres $\geq 1:20$ considered positive. Splenic lesions were observed in 14/200 pigs (7%), comprising parasitic lesions in nine (4.5%), splenomegaly in two (1.0%), and other changes in five (2.5%). Histologically, parasitic lesions showed cystic structures surrounded by fibrous tissue and inflammatory cell infiltration. Splenomegaly was characterized by vasculitis, red-pulp expansion, lymphoid depletion, and perivascular haemorrhage, whereas atrophy, abscessation, and infarction were associated with haemosiderosis, necrosis, exudation, fibrosis, and lymphoid follicular hyperplasia. Leukocytosis and neutrophilia were prominent in cases of splenomegaly, while eosinophil counts were comparatively higher in parasitic lesions. Bacteria were isolated from 26 spleen samples (13%), with *Salmonella* spp. predominating. CSFV antibodies were detected in 142 pigs (71%). These findings demonstrate diverse splenic pathology and lesion-associated hematobiochemical alterations in slaughtered pigs. The high CSFV seroprevalence indicates substantial exposure and/or vaccination coverage in the population, though antibody positivity alone does not confirm active infection. Integrated slaughterhouse surveillance may thus offer valuable insights for population-level monitoring of pig health.

Keywords: Hematobiochemical study, pathological evaluation, pathology, slaughtered pig

Introduction

The spleen is a major secondary lymphoid organ involved in blood filtration, removal of senescent erythrocytes, antigen processing and immune responses. Because of its close association with the circulating blood and mononuclear phagocyte system, splenic lesions frequently accompany systemic infectious and inflammatory diseases. In pigs, commonly recognized splenic abnormalities include enlargement, atrophy, haemorrhage, infarction, abscessation, parasitic lesions and lymphoid depletion. Slaughterhouse examination provides a practical opportunity to identify such lesions in animals that may have shown no obvious clinical abnormalities before slaughter (Khonde *et al.*, 2026) [7]. It can therefore complement farm-level disease surveillance and provide information on the occurrence of infectious and other pathological conditions within the source population. Classical swine fever (CSF), caused by classical swine fever virus (CSFV), is an important transboundary disease of swine (Choudhury *et al.*, 2025) [4]. Its pathological expression varies with viral virulence, host factors and immune status. Splenic enlargement, haemorrhage, infarction and lymphoid depletion are recognized pathological findings, although none is individually pathognomonic for CSF (Blome *et al.*, 2017) [2]. Experimental studies have demonstrated marked depletion of splenic lymphoid tissue during CSFV infection, associated with lymphocyte apoptosis and macrophage activation (Sánchez-Cordón *et al.*, 2005) [14]. Serological detection of CSFV antibodies is useful for assessing population exposure; however, antibody positivity may reflect either previous infection or vaccination. Consequently, seropositivity should not be equated with active infection in the absence of direct evidence of viral infection (Blome *et al.*, 2017) [2].

Although splenic pathology, bacterial infection and CSFV serology have been studied individually in pigs, integrated assessment of naturally occurring splenic lesions together with hematobiochemical changes in slaughtered pigs is limited. Slaughterhouse inspection is an important component of animal disease surveillance and food safety (Ocepek *et al.*)^[10]. Systematic post-mortem examination of slaughtered animals provides an opportunity to identify gross and microscopic pathological lesions that may remain clinically undetected during life. Such surveillance can generate valuable information on the prevalence and distribution of infectious, parasitic and other pathological conditions and may contribute to reducing the risk of contaminated meat entering the food chain, including diseases of potential public health significance (Barbara *et al.*, 2020; Quiroga-Robayo *et al.*, 2026)^[1,11]. The present study therefore aimed to characterize gross and histopathological splenic lesions in slaughtered pigs and evaluate their association with hematological and serum biochemical parameters, bacterial isolation and CSFV antibody status.

Materials and Methods

The investigation was conducted in the Department of Pathology, Bombay Veterinary College, Mumbai on 200 randomly selected nondescript pigs slaughtered at an organized slaughterhouse. The animals originated from different districts of Maharashtra and Gujarat. Blood was collected before slaughtering into EDTA-containing tubes for hematological examination and into plain tubes for serum separation. The spleen was examined grossly during postmortem examination and representative tissue was collected in 10% neutral buffered formalin for histopathology (Luna, 1968)^[9]. Additional splenic tissue was collected aseptically for bacterial isolation. Hemoglobin, packed cell volume (PCV), total erythrocyte count (TEC) and total leukocyte count (TLC) were determined using an automated hematology analyzer (Abacus-Diatron). Differential leukocyte counts were performed manually on Leishman-stained blood smears and converted to absolute counts. Serum total protein and albumin were estimated using commercial reagent kits on a semi-automated analyzer. Globulin was calculated from total protein and albumin, and the albumin (A) ratio was determined. Formalin-fixed splenic tissues were routinely processed and stained with hematoxylin and eosin (H & E). Bacterial isolation was performed using enrichment and selective culture methods followed by standard identification and biochemical testing (Sarma and Sarma, 1996)^[15]. Serum samples were examined for antibodies against CSFV by indirect ELISA at the DBT Network Project Centre on Classical Swine Fever, Department of Pathology, Nagpur Veterinary College. Titres of $\geq 1:20$ were considered positive according to the protocol used in the original study. For analysis of CSFV serological status, animals were categorized according to antibody titre as 1:20, 1:40, 1:80, $>1:80$ and negative (Sarma and Sarma, 1996)^[15]. Data were analyzed using the completely randomized design following Snedecor and Cochran, 1994^[16].

Results

Splenic lesions were identified in 16/200 (8%) pigs. Nine animals (4.5%) had parasitic lesions (Fig. 1, a), two (1.0%)

had splenomegaly, five (2.5%) had atrophy (Fig. 1, b), abscessation (Fig. 1, c) and/or nodular hyperplasia (Fig. 1, e). Parasitic lesions consisted of cystic structures surrounded by fibrous tissue and inflammatory cells. In one case, a parasitic larval structure was observed within a necrotic mass (Fig. No.1, g). Lymphoid follicles were normal in some animals and hyperplastic in others. The spleens with splenomegaly showed vasculitis, red-pulp expansion, diffuse lymphoid depletion and multifocal perivascular haemorrhage (Fig.1, h & i). *Salmonella* spp. were isolated from both animals in this group. Animals with atrophy, abscessation and infarction showed diffuse haemosiderosis, infarcted areas, focal exudation, multiple abscesses, fibrous septal proliferation and lymphoid follicular hyperplasia. Bacteria were isolated from 26/200 (13%) spleen samples. *Salmonella* spp. were isolated from seven samples (26.92% of isolates), followed by *Pseudomonas* spp. and *Shigella* spp. (19.23% each), Streptococci (15.39%), *Proteus* spp. (11.54%) and *Pasteurella* spp. (7.69%). Notably, *Salmonella* spp. were recovered from both animals with splenomegaly, whereas isolation of *Pseudomonas* spp. was not accompanied by gross or microscopic splenic lesions in the corresponding animals.

CSFV antibodies were detected in 142/200 (71%) pigs. Among the seropositive animals, 26 (18.3%) had a titre of 1:20, 54 (38.0%) had 1:40, six (4.23%) had 1:80 and 56 (39.44%) had titres $>1:80$.

Discussion

The present study demonstrates that splenic lesions in slaughtered pigs are morphologically diverse and may reflect parasitic, bacterial, inflammatory and vascular processes. Although only 8% of the examined pigs had identifiable splenic lesions, the lesions were associated with discernible hematological changes; particularly in animals with splenomegaly (Suardana *et al.*, 2024)^[17]. The parasitic lesions were characterized by organized inflammatory responses around cystic or larval structures (Krishna and Dayal, 2024)^[8]. The comparatively higher eosinophil count in this group was compatible with a parasitic stimulus (Poulsen *et al.*, 2024)^[12]. Splenomegaly represented the most distinctive clinicopathological group. The marked leukocytosis and neutrophilia, together with vasculitis, red-pulp expansion and perivascular haemorrhage, suggested an active systemic inflammatory response. The isolation of *Salmonella* spp. from both animals strengthens this interpretation. Systemic salmonellosis in pigs is known to produce septicemic disease with involvement of lymphoid organs and can be associated with splenomegaly (Brown *et al.*, 2006)^[3]. Nevertheless, the small number of animals in this group warrants caution in attributing the lesion exclusively to *Salmonella* infection.

The coexistence of infarction, haemosiderosis, fibrosis and abscessation in Group C suggests multiple pathological mechanisms. Pigment form of excess iron is frequently deposited in phagocytic cells of the reticuloendothelial system when there is iron excess, as in chronic hemolytic anemia or other pathological conditions (Brown *et al.*, 2006)^[3]. It also occurs in association with chronic passive congestion of the spleen, leading to hemolysis of excessive numbers of erythrocytes (Jones *et al.*, 1992)^[6].

Infarction reflects vascular compromise, whereas abscessation represents localized suppurative inflammation.

Splenic infarction is a recognized lesion in acute CSF but is not specific for the disease (Blome *et al.*, 2017) [2]. Thus, infarction in a slaughter pig should be interpreted in conjunction with other pathological and laboratory findings rather than considered diagnostic of CSF.

The lower globulin concentrations and increased A ratios observed in animals with splenomegaly and atrophy/abscess/infarction indicate altered serum protein balance. Spleen lesions are heavily correlated with an altered albumin-to-globulin (A:G) ratio, typically manifesting as a low A:G ratio (<1.0). Because the spleen is a core lymphoid organ responsible for filtering blood, mounting immune responses, and housing B and T lymphocytes, pathology in this organ reflects major systemic disruptions that directly skew these blood proteins (Oh SI *et al.*, 2022) [11].

These changes should not, however, be interpreted as direct evidence of immunosuppression because serum globulin comprises several protein fractions and was not individually characterized in the present study.

An important finding was the high prevalence of CSFV antibodies, with 71% of animals testing positive. CSF is associated with lymphoid depletion and other splenic lesions during active infection^{3& 4}. However, the absence of corresponding lesions in the seropositive-normal group

emphasizes an important distinction between serological exposure and active disease. Indirect ELISA detects antibodies and therefore cannot by itself establish current viral replication. The 13% bacterial isolation rate from spleen samples also demonstrates the value of microbiological examination alongside histopathology. The concordance between *Salmonella* isolation and splenomegaly in both affected animals provides stronger pathological context. *Salmonella* infection is also relevant to food safety because pigs can serve as reservoirs of human-associated *Salmonella* (Summerfield and Ruggli, 2015) [18]. Overall, the findings illustrate the value of integrating postmortem pathology with hematology, serum protein analysis, microbiology and serology. The study was conducted on a slaughterhouse population and therefore did not permit longitudinal assessment of disease progression. Individual vaccination histories were unavailable for most animals, limiting interpretation of CSFV antibody titres. Furthermore, no CSFV antigen detection, PCR or immunohistochemical confirmation was performed; hence, seropositivity cannot be interpreted as evidence of active CSFV infection. The relatively small number of pigs within individual splenic lesion categories also limits statistical inference.

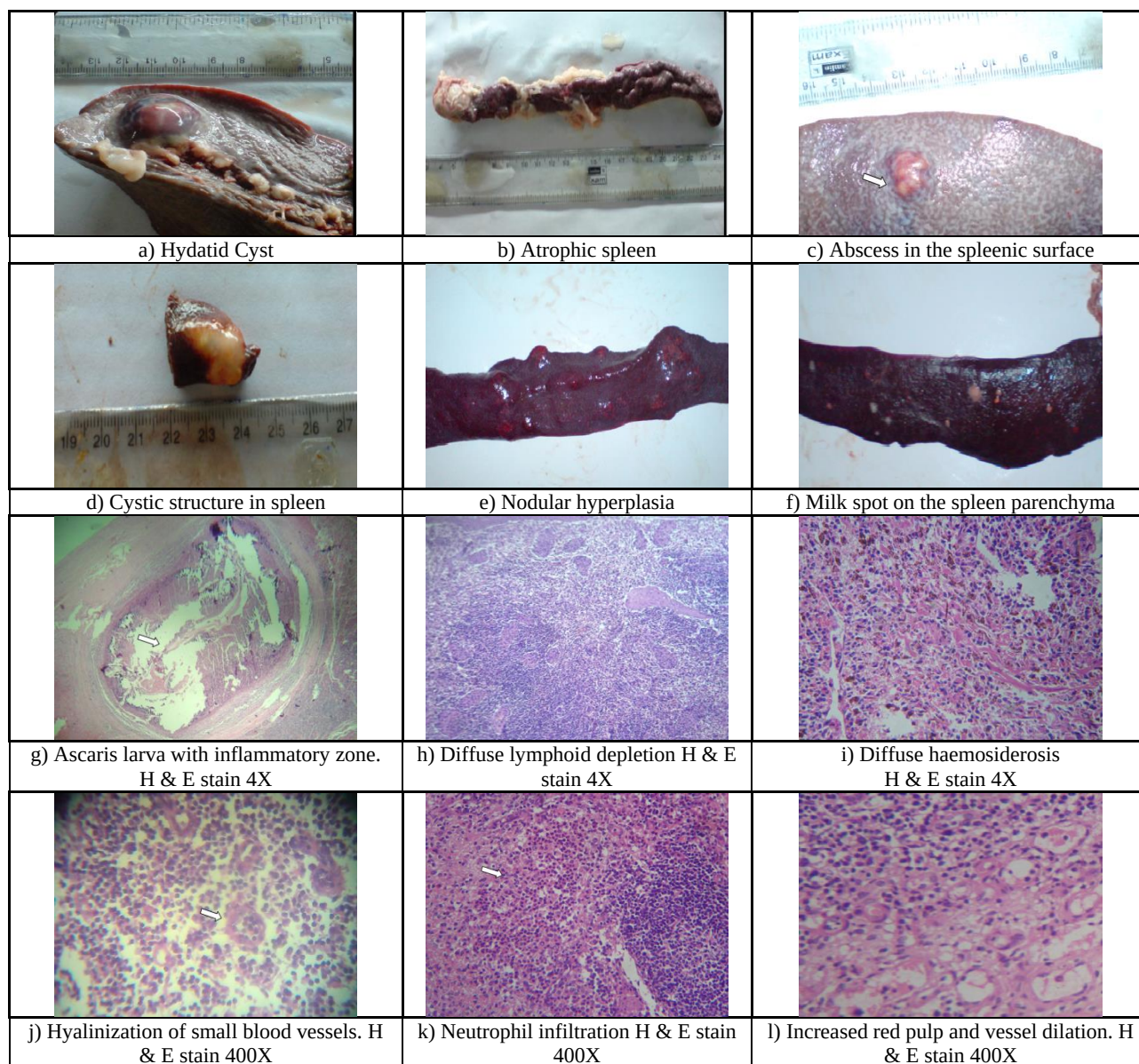


Table 1: Group of animals according to gross and microscopical alterations of spleen:

Groups	Conditions	Total No. of animals
A	Parasitic condition	9
B	Enlargements/ Splenomegaly	2
C	Atrophy, nodules, necrosis, abscess	5
D	Normal spleen from where Antibody titer against Swine fever was positive	118
E	Normal	66

Table 2: Mean of related haematological and serum biochemical values according to lesions found on spleen between the groups:

Parameter	Group A	Group B	Group C	Group D	Group E
TEC (million/ μ l)	6.51 $\pm$ 0.235	6.80 $\pm$ 0.105	6.12 $\pm$ 0.400	6.44 $\pm$ 0.075	6.75 $\pm$ 0.137
Hb (gm %)	12.53 $\pm$ 0.176	12.35 $\pm$ 0.250	12.10 $\pm$ 0.647	12.51 $\pm$ 0.128	12.52 $\pm$ 0.165
PCV (%)	39.06 $\pm$ 1.716	38.00 $\pm$ 0.00	38.92 $\pm$ 1.255	38.66 $\pm$ 0.422	39.72 $\pm$ 0.609
TLC (thousand/ μ l)	20.28 $\pm$ 2.058 ^{ab}	28.30 $\pm$ 0.100 ^a	19.04 $\pm$ 4.273 ^b	19.11 $\pm$ 0.623 ^b	16.62 $\pm$ 0.707 ^c
Abs Lymphocyte (thousand/ μ l)	8.11 $\pm$ 0.827 ^a	8.92 $\pm$ 0.173 ^a	5.54 $\pm$ 1.277 ^c	7.77 $\pm$ 0.303 ^b	6.23 $\pm$ 0.286 ^c
Abs Neutrophil (thousand/ μ l)	9.41 $\pm$ 1.205 ^b	16.13 $\pm$ 0.000 ^a	11.40 $\pm$ 2.922 ^{ab}	9.21 $\pm$ 0.365 ^b	8.19 $\pm$ 0.441 ^b
Abs Eosinophil (thousand/ μ l)	1.98 $\pm$ 0.242	1.84 $\pm$ 1.500	1.58 $\pm$ 1.463	1.42 $\pm$ 0.076	1.49 $\pm$ 0.085
Abs Monocyte (thousand/ μ l)	0.77 $\pm$ 0.212	1.41 $\pm$ 0.561	0.53 $\pm$ 0.132	0.71 $\pm$ 0.038	0.72 $\pm$ 0.058
Globulin (gm/dL)	4.10 $\pm$ 0.329 ^a	2.76 $\pm$ 0.075 ^b	3.00 $\pm$ 0.553 ^b	4.40 $\pm$ 0.068 ^a	4.37 $\pm$ 0.107 ^a
A:G	0.64 $\pm$ 0.070 ^{ab}	0.79 $\pm$ 0.084 ^a	0.78 $\pm$ 0.055 ^a	0.56 $\pm$ 0.016 ^b	0.58 $\pm$ 0.022 ^b

NS: Non significant at $p \leq 0.05$ * Significant at $p \leq 0.05$

Conclusion

Splenic lesions were detected in 8% of slaughtered pigs and included parasitic, inflammatory, suppurative and vascular alterations. Splenomegaly was associated with marked leukocytosis and neutrophilia and coincided with *Salmonella* isolation, whereas parasitic lesions showed a comparatively higher eosinophil response. Alterations in serum globulin and A ratio accompanied some splenic lesion groups. CSFV antibodies were detected in 71% of pigs, but the absence of significant splenic lesions in seropositive animals and the occurrence of high titres in vaccinated animals indicate that antibody positivity should be interpreted as evidence of exposure and/or vaccination rather than active CSF.

Acknowledgments

The authors are thankful to the Dean, Bombay Veterinary College for providing support and to Prof. Dr. Renuka Nehete, former Head, Department of Veterinary Pathology, Bombay Veterinary College and Dr. N. V. Kurkure, former Professor, Department of Veterinary Pathology, Nagpur Veterinary Collegefor their valuable guidance.

References

1. Barbara N, Michael JC, Gulihan U. Meat safety and quality: a biological approach. International Journal of Food Science and Technology. 2020;56(1):39-51.

2. Blome S, Staubach C, Henke J, Carlson J, Beer M. Classical swine fever—an updated review. Viruses. 2017;9(4):86. doi:10.3390/v9040086.

3. Brown CC, Dote C, Baker CD, Barker KI. Alimentary system. In: Jubb, Kennedy and Palmer's Pathology of Domestic Animals. 5th ed. Vol. 2. Melbourne; 2006. p. 59.

4. Choudhury F, Rajkhowa T, Yadav D, Pathak M, Paul D. Spatio-temporal dynamics and risk factors of African swine fever, classical swine fever, and emerging viral co-infections in Assam: implications for one health monitoring. Tropical Animal Health and Production. 2025;58:1-11. doi:10.1007/s11250-025-04786-w.

5. Cruickshank R, Duguid JP, Marmion BP, Swain RH. Medical Microbiology. 12th ed. Edinburgh and London: Churchill Livingstone; 1975.

6. Jones JET. Urinary system. In: Leman AD, Straw BE, Mengeling WL, Allaire SD, Taylor DJ, editors. Diseases of Swine. 7th ed. London: Wolfe Publishing Ltd.; 1992.

7. Khonde SK, Naringrekar RP, Palampalle HY, Gudewar JG, Bhangale GN, Gadhave PD, et al. Economic and zoonotic potential of helminthic parasites in pigs: a cross-sectional study with meta-analytical insights. Asian Journal of Microbiology and Biotechnology. 2026;11(1):310-320. doi:10.56557/ajmab/2026/v11i110614.

8. Krishna M, Dayal S. Parasitic infections and host tissue response in histopathology: a rare retrospective research study from rural India. Turkiye Parazitoloji Dergisi. 2024;48(3):150-154. doi:10.4274/tpd.galenos.2024.04706.

9. Luna AG. Manual of Histological Staining Methods of Armed Forces Institute of Pathology. 3rd ed. New York: McGraw-Hill; 1968.

10. Ocepek M, Lapoši J, Pažek K, Langerholc T. Integrating on-farm welfare assessments, slaughterhouse health data and critical path analysis to explain carcass outcomes in commercial pigs. Animal. 2026;20:101949. doi:10.1016/j.animal.2026.101949.

11. Oh SI, Nguyen TTH, Yang MS, Nga BTT, Bui VN, Le VP, et al. Blood parameters and pathological lesions in pigs experimentally infected with Vietnam's first isolated African swine fever virus. Frontiers in Veterinary Science. 2022;9:978398. doi:10.3389/fvets.2022.978398.

12. Poulsen CS, Yoshida A, Wellbrant TT, Leifsson PS, Skallerup P, Thamsborg SM, et al. Migratory pattern of zoonotic *Toxocara cati* and *T. canis* in experimentally infected pigs. European Journal of Clinical Microbiology and Infectious Diseases. 2024;43:587-596. doi:10.1007/s10096-024-04753-7.

13. Quiroga-Robayo MA, Dórea FC, Correa-Valencia NM. Syndromic surveillance in slaughterhouses: a scoping review. Preventive Veterinary Medicine.

- 2026;254:106940.
doi:10.1016/j.prevetmed.2026.106940.
14. Sánchez-Cordón PJ, Núñez A, Salguero FJ, Pedrera M, Fernández de Marco M, Gómez-Villamandos JC. Lymphocyte apoptosis and thrombocytopenia in spleen during classical swine fever: role of macrophages and cytokines. *Veterinary Pathology*. 2005;42(4):477-488. doi:10.1354/vp.42-4-477.
 15. Sarma PC, Sarma DK. Localization of hog cholera virus antigen in tissues of infected piglets and rabbits by ELISA. *Indian Journal of Virology*. 1996;12(2):105-108.
 16. Snedecor GW, Cochran WG. *Statistical Methods*. 6th ed. Calcutta: Oxford and IBH Publishing Company; 1994.
 17. Suardana IW, Aristha Dewi IGAP, Utama IH. Haematological changes to assess stress arising from different methods of slaughtering in pigs. *Indian Journal of Animal Sciences*. 2024;94(6):513-517. doi:10.56093/ijans.v94i6.147959.
 18. Summerfield A, Ruggli N. Immune responses against classical swine fever virus: between ignorance and lunacy. *Frontiers in Veterinary Science*. 2015;2:10. doi:10.3389/fvets.2015.00010