

BÖLÜM 1

SİNDİRİM SİSTEMİ HASTALIKLARI

Aynur ŞİMŞEK ¹

Akın KOÇHAN ²

Pelin Fatoş POLAT DİNÇER ³

Ömer Faruk KATANALP ⁴

Almina GÜNEŞ ⁵

Ahmet İÇİGEN ⁶

GİRİŞ

Primer ve sekonder nedenlerle bağlı olarak gelişen sindirim sistemi hastalıkları hayvanlarda anoreksi, depresyon, timpani, ishal, dehidrasyon ve konstipasyon gibi farklı klinik semptomların yanı sıra süt veriminde azalma, gelişme geriliği ve ölümlere neden olarak önemli ekonomik kayıplara da yol açarlar. Bu nedenle sığırlarda sindirim sistemi hastalıklarına doğru yaklaşım hastalıklara bağlı et ve süt veriminde azalma veya hayvan kayıplarından kaynaklanan ekonomik kayıpların önlenmesi açısından büyük önem taşımaktadır. Sağaltımda etiyolojik faktörlerin belirlenerek ortadan kaldırılması ve esas hastalığın tedavi edilmesi önemlidir. İştahsız olan hayvanların yeme-içmelerinin teşvik edilmesi, ağrının giderilmesi, timpani, ishal ve konstipasyon sağaltımı, sıvı-elektrolit bozukluklarının düzeltilmesi, bozulmuş rumen florasının düzeltilmesi, vitamin-mineral uygulamaları ile sekonder enfeksiyonlara karşı antibiyotik kullanımı başlıca uygulamalardır.

¹ Doç. Dr. Dicle Üniversitesi, Veteriner Fakültesi, İç Hastalıkları AD. asimsek@dicle.edu.tr, ORCID iD: 0000-0002-2006-6344

² Doç. Dr. Dicle Üniversitesi, Veteriner Fakültesi, İç Hastalıkları AD. akin.kochan@dicle.edu.tr, ORCID iD: 0000-0003-0199-453X

³ Doç. Dr. Dokuz Eylül Üniversitesi, Veteriner Fakültesi, İç Hastalıkları AD. pelinfatos.polat@deu.edu.tr, ORCID iD: 0000-0003-4885-6513

⁴ Dr. Öğr. Üyesi Dicle Üniversitesi Veteriner Fakültesi, İç Hastalıkları AD. omerfarukkatanalp@hotmail.com, ORCID iD: 0000-0003-3353-1871

⁵ Arş. Gör. Dicle Üniversitesi, Veteriner Fakültesi, İç Hastalıkları AD. almina.gunes@dicle.edu.tr, ORCID iD: 0000-0002-5542-2345

⁶ Arş. Gör. Dokuz Eylül Üniversitesi, Veteriner Fakültesi, İç Hastalıkları AD. ahmet.icigen@deu.edu.tr, ORCID iD: 0009-0003-4076-5104

KAYNAKLAR

- Abdisa T. Study on the prevalence of bovine frothy bloat in and around Kebele Lencha, Tokke Kutaye District, Oromia Region. *Approaches in Poultry, Dairy & Veterinary Sciences*. 2018;2(3): 1–10. doi:10.31031/APDV.2018.02.000537
- Aksoy G. Abomasum deplasmanı ve torsiyonu. *Türkiye Klinikleri Journal of Veterinary Sciences*. 2014;5(3): 57–60.
- Aksoy G. Abomazum Hastalıkları. In: Gül Y (ed.) *Geviş Getiren Hayvanların İç Hastalıkları (Sığır, Koyun-Keçi)*. Malatya: Medipres; 2012. p. 81–94.
- Aksoy G. Bağırsak Hastalıkları. In: Gül Y (ed.) *Geviş Getiren Hayvanların İç Hastalıkları (Sığır, Koyun-Keçi)*. Malatya: Medipres; 2012. p. 95–114.
- Akyüz E, Aydın U, Sezer M, et al. Serum neopterin, prolactin, endothelin-1 and hematological parameters in cows with traumatic reticuloperitonitis and traumatic pericarditis. *Slovenian Veterinary Research*. 2025; 1–9 doi:10.26873/svr-1720-2024
- Albay MK, Akıncı İY, Gülbenli B. Sığırlarda mavi dil hastalığı. *Türkiye Klinikleri Veterinary Sciences-Internal Medicine-Special Topics*. 2022;8(1): 38–42.
- Al-Galil A, Akraiem A, Zaid A, et al. Clinical, hematological and biochemical findings in cattle suffering from rumen impaction in Libya. *Journal of Animal Science and Veterinary Medicine*. 2020;5(5): 148–152. doi:10.31248/JASVM2020.229
- Alkan İ, Aslan L, Karasu A, et al. Bir Montafon inekte sekum dilatasyonu ve dislokasyonu. *Kafkas Üniversitesi Veteriner Fakültesi Dergisi*. 2009;15(5): 811–814.
- Aschenbach JR, Zebeli Q, Patra AK, et al. The importance of the ruminal epithelial barrier for a healthy and productive cow. *Journal of Dairy Science*. 2019;102(2): 1866–1882. doi:10.3168/jds.2018-15243
- Asefa S, Ali A, Ayele B, et al. Comparative study of ruminal disorders with pathophysiology of ruminal fluid and hematological changes in sheep, Northwest Ethiopia. 2020; 1–21. doi:10.21203/rs.3.rs-20866/v1
- Athar H, Mohindroo J, Singh K, et al. Ultrasonographic features of omasal impaction in bovines. *Indian Journal of Veterinary Surgery*. 2009;30(2): 115–116.
- Aytuğ CN. Ön Sindirim Organları Hastalıkları. In: Aytuğ CN, Alaçam E, Görgül S, Gökçen H, Tuncer ŞD, Yılmaz K (eds.) *Sığır Hastalıkları*. İstanbul: Teknografik Matbaacılık ve Ambalaj Sanayi; 1991. p. 9–51.
- Barr C. Hepatotoxicities of ruminants. In: Anderson DE, Rings DM (eds.) *Current Veterinary Therapy: Food Animal Practice*. 5th ed. Missouri: Saunders Elsevier; 2009. p. 51-54.
- Batmaz H. *Sığırların İç Hastalıkları Semptomdan Tanıya Tanıdan Sağaltıma*. 3. Baskı. Bursa: F. Özsan Mat. San. ve Tic. Ltd. Şti; 2016.
- Belknap EB, Navarre CB. Differentiation of gastrointestinal diseases in adult cattle. *Veterinary Clinics of North America: Food Animal Practice*. 2000;16(1): 59–86. doi: 10.1016/s0749-0720(15)30137-7
- Bilal T. *Yeni Doğanların İç Hastalıkları*. İstanbul: İstanbul Üniversitesi Yayınları; 2007.
- Biradar SS, Bhatt RS, Parmar VK, et al. Clinical, haematological, radiographic, ultrasonographic and surgical findings in bovine affected with traumatic re-

- ticuloperitonitis. *Indian Journal of Animal Research*. 2025; 1–6. doi:10.18805/ijar.b-5453
- Biricik H. Süt sığırlarında abomasum deplasmanı. *Türkiye Klinikleri Journal of Veterinary Sciences*. 2012;3(1): 32–37
- Braun U, Beckmann C, Gerspach C, et al. Clinical findings and treatment in cattle with caecal dilatation. *BMC Veterinary Research*. 2012;8(1): 1–9. doi: 10.1186/1746-6148-8-75.
- Braun U, Gerspach C, Nuss K, et al. Clinical, laboratory and ultrasonographic findings in 94 cows with type-1 abomasal ulcer. *Schweizer Archiv für Tierheilkunde*. 2020;162(4): 235–244. doi:10.17236/sat00254
- Braun U, Gerspach C, Scheiwiller R, et al. Paralytic ileus in 57 cows—symptoms, diagnosis and treatment. *Acta Veterinaria Scandinavica*. 2025;67(1): 1–11. <https://doi.org/10.1186/s13028-025-00817-6>
- Braun U, Nuss K, Warislohner S, et al. Diagnostic reliability of clinical signs in cows with traumatic reticuloperitonitis and abomasal ulcers. *BMC Veterinary Research*. 2020;16:359. doi:10.1186/s12917-020-02515-z
- Braun U, Torgerson PR, Nuss K, et al. Clinical and laboratory findings in 503 cattle with traumatic reticuloperitonitis. *BMC Veterinary Research*. 2018;14(1): 1–9. doi:10.1186/s12917-018-1394-3
- Braun U, Widmer C, Nuss K, et al. Clinical, laboratory and ultrasonographic findings in 38 calves with type-4 abomasal ulcer. *Acta Veterinaria Scandinavica*. 2021;63(1): 1–11. doi:10.1186/s13028-021-00601-2
- Breukink H, Wensing T, Van Weeren-Keveling Buisman A, et al. Consequences of failure of the reticular groove reflex in veal calves fed milk replacer. *The Veterinary Quarterly*. 1988;10(2): 126–135. doi:10.1080/01652176.1988.9694159
- Bull L, Bush L, Friend J, et al. Incidence of ruminal parakeratosis in calves fed different rations and its relation to volatile fatty acid absorption. *Journal of Dairy Science*. 1965;48(11): 1459–1466. doi:10.3168/JDS.S0022-0302(65)88499-5
- Ceylan E, Başbuğan Y. Omazum konstipasyonu ve ostium retikulo omazinin obstrüksiyonu. *Türkiye Klinikleri Journal of Veterinary Sciences*. 2014;5(3): 48–50.
- Civelek T, Başer DF. Paralitik İleus. *Türkiye Klinikleri Veterinary Sciences-Internal Medicine-Special Topics*. 2015;1(2): 49–50.
- Constable PD, Hinchcliff KW, Done SH, et al. *Veterinary Medicine: A Text Book of the Diseases of Cattle, Horse, Sheep, Pigs, and Goats*. 11th ed. Missouri: Elsevier; 2017.
- da Costa Dutra L, Coutinho LT, de Mendonça CL, et al. Íleo paralítico em três bovinos: relato de caso. *Revista Brasileira de Ciência Veterinária*, 2020;27(2): 55–60. doi: 10.4322/rbcv.2020.011
- Değirmençay, Ş. Papüller Stomatitis. *Türkiye Klinikleri Veterinary Sciences-Internal Medicine-Special Topics*. 2022;8(1):9–13.
- Dehkordi A, Dehkordi Z. Occurrence of metabolic alkalosis in rumen lactic acidosis: A review article. *Comparative Clinical Pathology*. 2011;20: 1–3. doi:10.1007/s00580-010-1129-8
- Dezfouli MRM, Lotfollahzadeh S, Sadeghian S, et al. Blood electrolytes changes in peritonitis of cattle. *Comparative Clinical Pathology*. 2012;21(6): 1445–1449.

- doi: 10.1007/s00580-011-1312-6.
- Dinçer PFP, Gül Y. Prevalence of latent acidotic stress in dairy cows in the Şanlıurfa region. *Medycyna Weterynaryjna*. 2020;76(7): 411-415. doi.org/10.21521/mw.6424
- Dodurka T, Akdoğan Kaymaz A. Karaciğer Hastalıkları. In: Gül Y (ed.) *Geviş Getiren Hayvanların İç Hastalıkları (Sığır, Koyun-Keçi)*. Malatya: Medipres; 2012. p. 169-188.
- Doll K, Sickinger M, Seeger T. New aspects in the pathogenesis of abomasal displacement. *The Veterinary Journal*. 2009;181(2): 90-96. doi:10.1016/j.tvjl.2008.01.013
- Ebeid M, Ring DM. Generalized peritonitis in cattle: 31 cases (1993-1997). *The Bovine Practitioner*. 1999;33(2): 144-148.
- El-Mashad N, Salem N, Orabi S, et al. Effect of Rumen Alkalosis on Acid-base Balance, Electrolytes and Fecal Examination in Cows Fed on Silage (Mak-mora). *Veterinary Medical Journal (Giza)*. 2017;63(1): 135-143. doi:10.21608/vmjg.2017.355020
- Erdoğan HM, Gökçe E, Erkilic EE. Buzağlarda ön mide ve abomasum hastalıkları. *Türkiye Klinikleri Journal of Veterinary Sciences*. 2014;5(3): 72-80.
- Fecteau G. Management of Peritonitis in Cattle. *Veterinary Clinics of North America: Food Animal Practice*. 2005;21(1): 155-171. doi: 10.1016/j.cvfa.2004.12.007
- Franz S, Baumgartner W. A retrospective study of oesophageal endoscopy in cattle-oesophagoscopy for diagnosis of mucosal disease. *The Veterinary Journal*. 2002;163(2): 205-210. doi: 10.1053/tvjl.2001.0653
- Fubini S, Divers TJ. Noninfectious diseases of the gastrointestinal tract. In: Divers TJ, Peek SF (eds.) *Rebhun's Diseases of Dairy Cattle*. 2nd ed. Missouri: Saunders Elsevier; 2008. p. 156-167.
- Fubini SL, Ducharme N. *Farm Animal Surgery*. 2nd ed. Saunders; 2016.
- Gazioğlu A, Keçeci H. Sığır vebası. *Türkiye Klinikleri Veterinary Sciences-Internal Medicine-Special Topics*. 2022;8(1): 22-28.
- Guarnieri FA, Cramer G, Reist M, et al. Clinical presentation, diagnosis, treatment, and outcome of abomasitis in 23 calves: A retrospective study. *BMC Veterinary Research*. 2020;16(1):1-9.2.
- Guarnieri FA, Reist M, Meylan, et al. Clinical, laboratory, and ultrasonographic findings and long-term outcome of calves with abomasitis. *Journal of Veterinary Internal Medicine*. 2023;37(3):1315-1323.
- Gugjoo MB, Dar SH, Ahmad RA, et al. Traumatic reticuloperitonitis in cattle and buffalo: Recent advances in understanding of etiopathogenesis, diagnosis and treatment. *The Indian Journal of Animal Sciences*. 2021;91(11): 895-905. doi:10.56093/ijans.v91i11.118124
- Gül Y, Aksoy G. Sindirim Sistemi Hastalıkları. In: Gül Y (ed.) *Geviş Getiren Hayvanların İç Hastalıkları (Sığır, Koyun-Keçi)*. Malatya: Medipres; 2012. p. 19-80.
- Gül Y, İssi M. Rumen asidozu. *Türkiye Klinikleri Journal of Veterinary Sciences*. 2014; 5(3): 15-22.
- Gül Y, İssi M. Süt emen buzağların rumen asidozu (pansentrinken/pansentrinker nedeniyle buzağlarda oluşan rumen asidozu). *Fırat Üniversitesi Sağlık Bilim-*

- leri *Veteriner Dergisi*. 2013;27(2): 115–121.
- Hinders R, Owen F. Relation of ruminal parakeratosis development to volatile fatty acid absorption. *Journal of Dairy Science*. 1965;48(8):1 069–1073. doi:10.3168/JDS.S0022-0302(65)88393-X
- Holliman A. Differential diagnosis of diseases causing oral lesions in cattle. *In Practice*. 2005;27(1): 2–13. <https://doi.org/10.1136/inpract.27.1.2>
- Hussain S, Uppal S, Hussain T, et al. Vagus indigestion in bovines: A review in historical perspective. *The Pharma Innovation Journal*. 2017;6: 157–163.
- Hussain S, Uppal S, Sood N. Secondary type 1 abomasal ulcer in cattle and buffalo: A necropsy based case control study. *Bulgarian Journal of Veterinary Medicine*. 2024;27(3): 511–521. doi:10.15547/bjvm.2022-0085
- Hussain SA, Uppal SK, Randhawa C, et al. Clinical characteristics, hematology, and biochemical analytes of primary omasal impaction in bovines. *Turkish Journal of Veterinary & Animal Sciences*. 2013;37(1): 329–336. doi: 10.3906/vet-1205-31
- Ider M, Yildiz R, Naseri A, Gülersoy E, Alkan F, Ok M, et al. Investigation of gastrointestinal injury-related biomarkers in dairy cattle with displaced abomasum. *Veterinary Medicine and Science*. 2023;9(6): 2893–2900. doi:10.1002/vms3.1292
- Imran S, Tyagi SP, Kumar A, et al. Ultrasonographic imaging of normal and impacted omasum in Indian crossbred cows. *Veterinary Medicine International*. 2011;2011: 485031. doi: 10.4061/2011/485031
- İmren HY, Şahal M. *Veteriner İç Hastalıkları*. 3. Baskı. Ankara: Medisan; 1994.
- İşler CT, Altuğ ME, Altuğ N, et al. Holştayn ırkı üç inekte sekum dilatasyonu, dislokasyonu ve torsiyonu. *Fırat Üniversitesi Sağlık Bilimleri Veteriner Dergisi*. 2012;26(3): 183–189.
- Jadhav KM, Undirwade SC, Devi S. Clinical Management of omasal impaction in a cow. *Intas Polivet*. 2015;16(1): 83–84.
- Kanoe M, Izuchi Y, Toda M. Isolation of *Fusobacterium necrophorum* from bovine ruminal lesions. *The Japanese Journal of Veterinary Science*. 1978;40(3): 275–281. doi:10.1292/JVMS1939.40.275
- Keleş, İ, Güneş V, Onmaz AC, et al. Barsaklarda patolojik vaziyet değişiklikleri. *Türkiye Klinikleri Journal of Veterinary Sciences-Special Topics*. 2015;1(2): 39–43.
- Khiaosa-ard R, Mahmood M, Lerch F, et al. Physicochemical stressors and mixed alkaloid supplementation modulate ruminal microbiota and fermentation in vitro. *Anaerobe*. 2020;102263. doi:10.1016/j.anaerobe.2020.102263
- Kırbaş A, Gökalp G, Sayar E. *Coryza gangrenosa* bovim (sığırların gangrenli nezlesi). *Türkiye Klinikleri Veterinary Sciences-Internal Medicine-Special Topics*. 2022;8(1): 14–21.
- Kobayashi I, Kajisa M, Farid AS, et al. Paralytic ileus and subsequent death caused by enteric parasite, *Strongyloides papillosus*, in Mongolian gerbils. *Veterinary Parasitology*. 2009;162(1-2); 100–105.
- Kureljušić B, Ivetić V, Savic B, et al. Pathomorphological characteristics of abomasal ulcers in high-yielding dairy cows. *Acta Veterinaria-Beograd*. 2013;63(2-3): 237–246. doi:10.2298/AVB1303237K

- Lamego EC, Santos IR, Paz MC, et al. Pathology of peritonitis in cattle. *Journal of Comparative Pathology*. 2025;217: 16–24. <https://doi.org/10.1016/j.jcpa.2024.12.003>
- Lenkova, N. Comprehensive treatment for rumen acidosis. *Proceedings of Gorsky State Agrarian University*. 2024;61(3): 37–6. https://doi.org/10.54258/20701047_2024_61_3_37.
- Mamak N, B rk  MK. Hemorrhagic bowel syndrome in cattle. *Mehmet Akif Ersoy  niversitesi Veteriner Fak ltesi Dergisi*. 2019;4(2): 108–112. doi: 10.24880/maeuofd.638881
- Mamak N. Listeriosis. *Turkiye Klinikleri Journal of Veterinary Sciences-Special Topics*. 2016;2(1): 48–54.
- Melendez P, Pock S. Outbreak of clostridial abomasitis in dairy calves. *Veterinary Record Case Reports*. 2018;6(1): e000573. <https://doi.org/10.1136/vet-reccr-2017-000573>.
- Mohan G, Kumar A, Naik B. Effect of rumen fermentative disorders on physiological parameters in buffaloes. *International Journal of Veterinary Science*. 2015;4(1): 10–14.
- Munch S, Nielsen S, Krogh M, et al. Prevalence of abomasal lesions in Danish Holstein cows at the time of slaughter. *Journal of Dairy Science*. 2019;102(6): 5403–5409. doi:10.3168/jds.2018-15757
- Neto A, Silva J, Mendon a C, et al. Epidemiological and anatomopathological findings of type 1 and 2 abomasum ulcers in cattle with different comorbidities. *Ci ncia Animal Brasileira*. 2023;24: e-74772P. doi:10.1590/1809-6891v24e-74772E
- Ok M, Alhallaq A. Buza ılarda  n mide hastalıkları. *Turkiye Klinikleri Veterinary Sciences-Internal Medicine-Special Topics* 2024;10(2): 83–89.
- Owens FN, Secrist DS, Hill WJ, et al. Acidosis in cattle: a review. *Journal of Animal Science*. 1998;76(1): 275–286. doi: 10.2527/1998.761275x
- Parlak K, Arıcan M. Sı ırlarda abomasum'un sa  ve sol deplasmanı ve operasyon sonu ları: retrospektif  alı ma-73 olgu. *Dicle  niversitesi Veteriner Fak ltesi Dergisi*. 2016;2(9): 106–111.
- Patil AS, Dodmani MS, Balappanavar BR. Therapeutic management of acute diffused peritonitis in a cow with intraperitoneal administration of dimethylsulfoxide (DMSO). *Intas Polivet*. 2011;12(2): 290–291.
- Peek SF, Divers TJ. *Rebhun'un Sı ır Hastalıkları*. (Murat G ZEL,  ev. Ed.). Malatya: Medipres; 2018.
- Proios I, Hoedemaker M, Kioussis E. Caecal dilatation and dislocation in 20 dairy cows. A retrospective study. *Journal of the Hellenic Veterinary Medical Society*. 2023;74(4): 6631–6640.
- Ramu V, Raghunath M, Harikrishna NVV, et al. Diagnosis and management of rumen and omasal impaction in bovines. *Intas Polivet*. 2017;18(2): 318–321.
- Reis ABSB, Bomjardim DA, Oliveira CMC, et al. Vagal indigestion in Zebu cattle in Brazil. *Revista Salud Animal*. 2016;38(3): 149–153.
- Roeder BL, Chengappa MM, Nagaraja TG, et al. Experimental reproduction of hemorrhagic enteritis in calves with *Clostridium perfringens* type A. *American Journal of Veterinary Research*. 1988;49(2):201–207. <https://doi.org/10.2460/>

- ajvr.1988.49.2.201.
- Romão FTM, Barberini DJ, Marcondes GDM, et al. Functional pyloric stenosis in dairy cow: case report. *Revista de Medicina Veterinária*. 2011;18(4): 233–236.
- Sağkan Öztürk A, Konaş Aşkar T. Evaluation of motility hormones in dairy cattle with omasal impaction and caecal dilatation. *Kafkas Üniversitesi Veteriner Fakültesi Dergisi*. 2015;21(6): 919–922.
- Sasikala K, Vijayakumar G, Sivaraman S, et al. Endoscopic evaluation and successful management of oesophagitis in cattle—A review of two cases. *The Indian Veterinary Journal*. 2017;94(11): 90–91.
- Scott P. Chronic peritonitis in adult cattle. *Livestock*. 2013;18(4): 102–108. <https://doi.org/10.12968/live.2013.18.4.102>
- Scott PR, Penny CD, Macrae AI. *Cattle Medicine*. Barcelona: Grafos SA; 2011.
- Silva A, Righeti C, Lopes C, et al. Causas de timpanismo em bovino. *Revista FT*. 2024;28(138): 8–9. doi:10.69849/revistaft/ma10202409301108
- Singh G, Udehiya RK, Mohindroo J, et al. Differential diagnosis and surgical management of cecal dilatation vis-a-vis cecal impaction in bovine. *Veterinary World*. 2018;11(9): 1244–1249. doi: 10.14202/vetworld.2018.1244-1249
- Smith BP. *Large Animal Internal Medicine*. 4th ed. Missouri: Elsevier; 2009.
- Smith GW. Treatment of calf diarrhea: Antimicrobial and ancillary therapies. *Veterinary Clinics of North America: Food Animal Practice*. 2018;31(1):103–115. <https://doi.org/10.1016/j.cvfa.2014.11.007>
- Som C, Steiner J, Jöbstl J, et al. A systematic review on leptospirosis in cattle: A European perspective. *One Health*. 2023;17: 100608. <https://doi.org/10.1016/j.onehlt.2023.100608>
- Tamara F, Mobaid N, Romão A, et al. Estenose funcional pilórica em vaca leiteira: relato de caso. *Revista Acadêmica*. 2012;10(1): 99–103. doi:10.7213/academica.7535
- Tosaki K, Kojima H, Akama S, et al. Bovine esophageal and glossal ulceration associated with *Pseudomonas aeruginosa* and *Fusobacterium* spp. *Journal of Veterinary Medical Science*. 2018;80(7):1174–1178.
- Turgut K, Ok M. *Veteriner Gastroenteroloji: Semptomdan Teşhise*. Konya: Bahçıvanlar Basım San. AŞ; 1997.
- Ural K, Akin İ, Toros G, et al. 'Unutulmuş mide' omasumda konstipasyon olgusu. *Animal Health, Production and Hygiene*. 2012;1(1): 27–30.
- Williamson S, Woodger N, Darpel, K. Differential diagnosis of bluetongue in cattle and sheep. *In Practice*. 2008;30(5): 242–251. <https://doi.org/10.1136/inpract.30.5.242>
- Zhang K, Zhang Y, Qin J, et al. Early concentrate starter introduction induces rumen epithelial parakeratosis by blocking keratinocyte differentiation with excessive ruminal butyrate accumulation. *Journal of Advanced Research*. 2023;66: 71–86. doi:10.1016/j.jare.2023.12.016