YEM KATKI MADDELERİ VE HAYVAN SAĞLIĞINDAKİ ROLÜ: GÜVENLİ GIDA ÜRETİMİNİN ANAHTARI

BÖLÜM 8

DOI: 10.37609/akya.3801.c299

Ayşe Özge DEMİR [1]

1. GİRİŞ: SAĞLIKLI HAYVAN, SAĞLIKLI İNSAN, SAĞLIKLI ÇEVRE

1.1. Birleşmiş Milletler gıda güvenliği ilkeleri

Hayvancılık sektörünün hızla gelişmesi, artan nüfus ve hayvansal protein ihtiyacı doğrultusunda daha verimli, sürdürülebilir ve ekonomik üretim sistemlerinin geliştirilmesini zorunlu kılmıştır. Bu bağlamda yem katkı maddeleri, hayvan besleme stratejilerinde önemli bir araç haline gelmiş; hem verim artışı sağlamak hem de hayvan sağlığını korumak amacıyla yaygın olarak kullanılmaya başlanmıştır (1).

Birleşmiş Milletler Gıda ve Tarım Örgütü (FAO) tarafından benimsenen "One Health" yaklaşımı doğrultusunda, hayvan sağlığı ile insan sağlığı arasındaki ilişkinin sürdürülebilir gıda sistemleri bağlamında ele alınması önerilmektedir (Şekil 1). Bu çerçevede sağlıklı hayvan üretimi, doğrudan toplum sağlığı ve gıda güvenliğiyle ilişkilendirilmekte; yem katkı maddeleri gibi tamamlayıcı bileşenler, bu sistemin dengeleyici unsurları arasında yer almaktadır (2).

[1] Dr. Öğr. Üyesi, Van Yüzüncü Yıl Üniversitesi, Ziraat Fakültesi, Zootekni Bölümü, aodemir@yyu.edu.tr, ORCID iD: 0000-0001-7203-4734

Ekler Listesi (Appendix List)

Ek No	Açıklama
Ek 6.	AI Destekli Katkı Reçeteleri Şematik Gösterimi
Ek 7.	Yem Katkı Maddelerinde Türkiye Mevzuat Akış Şeması
Ek 8.	Geri Çekme Prosedürü Akış Tablosu
Ek 9.	Enzim, Probiyotik, Fitobiyotik gibi Fonksiyonel Katkı Gruplarının Karşılaştırmalı Özeti
Ek 10.	Politika ve Araştırma Öncelikleri Çerçevesi (Öneri Matriksi)

KAYNAKLAR

1. Khan RU, Khan A, Naz S, et al. Potential applications of Moringa oleifera in poultry health and production as alternative to antibiotics: A review. Antibiotics. 2021;10(12):1540. doi:10.3390/antibiotics10121540
2. FAO. One Health: Food and Agriculture Organization of the United Nations' contribution to addressing health threats at the human–animal–ecosystems interface. Rome: FAO; 2025. Available from: https://www.fao.org/one- health/overview/one-health-overview/en [Accessed: 24th Aug 2025]
3. Marshall BM, Levy SB. Food animals and antimicrobials: Impacts on human health. Clinical Microbiology Reviews. 2011;24(4):718–733. doi:10.1128/CMR.00002-11
4. Tarım ve Orman Bakanlığı. Yem Katkı Maddeleri Kılavuzu. Ankara: T.C. Tarım ve Orman Bakanlığı; 2024a.
5. Yan X, Xie F, Yang S, et al. Metagenomic insights into the rumen microbiome in solid and liquid fractions of yaks and their differences compared to other ruminants. Integrative Zoology. 2025. Advance online publication. doi:10.1111/1749-4877.12984
6. Gaggia F, Mattarelli P, Biavati B. Probiotics and prebiotics in animal feeding for safe food production. International Journal of Food Microbiology. 2010;141(Suppl):S15–S28. doi:10.1016/j.ijfoodmicro.2010.02.031
7. European Commission. Regulation (EC) No 1831/2003 on additives for use in animal nutrition. Official Journal of the European Union. 2003;L268:29–43. Available from: https://eur-lex.europa.eu/eli/reg/2003/1831/oj [Accessed: 24th Aug 2025]
8. Cheeke PR. Applied Animal Nutrition: Feeds and Feeding. Upper Saddle River (NJ): Pearson Prentice Hall; 2004.
9. Bedford MR, Partridge GG. Enzymes in Farm Animal Nutrition. 3rd ed. Wallingford: CABI; 2010.
10. Cromwell GL. Why and how antibiotics are used in swine production. Animal Biotechnology. 2002;13(1):7–27. doi:10.1081/ABIO-120005767
11. Castanon JI. History of the use of antibiotic as growth promoters in European poultry feeds. Poultry Science. 2007;86(11):2466–2471. doi:10.3382/ps.2007-00249
12. Mathew AG, Cissell R, Liamthong S. Antibiotic resistance in bacteria associated with food animals: A United States perspective of livestock production. Foodborne Pathogens and Disease. 2007;4(2):115–133. doi:10.1089/fpd.2006.0066
13. Tarım ve Orman Bakanlığı. Yem Mevzuatı Portalı. Available from: https://www.tarimorman.gov.tr [Accessed: 24th Aug 2025]; 2024b.
14. World Health Organization (WHO). Critically Important Antimicrobials for Human Me-

dicine. 6th rev. Geneva: WHO; 2019. Available from: https://www.who.int/publications/i/item/9789241515528 [Accessed: 24th Aug 2025]
15. EFSA. Guidance on the assessment of the safety of feed additives for the target species. EFSA Journal. 2021;19(1):e06355. doi:10.2903/j.efsa.2021.6355
16. Yang Y, Iji PA, Choct M. Dietary modulation of gut microflora in broiler chickens: A review of the role of six kinds of alternatives to in-feed antibiotics. World's Poultry Science Journal. 2009;65(1):97–114. doi:10.1017/S0043933909000087
17. Brenes A, Roura E. Essential oils in poultry nutrition: Main effects and modes of action. Animal Feed Science and Technology. 2010;158(1–2):1–14. doi:10.1016/j.anifeedsci.2010.03.007
18. Fuller R. Probiotics in man and animals. Journal of Applied Bacteriology. 1989;66(5):365–378. doi:10.1111/j.1365- 2672.1989.tb05105.x
19. Gibson GR, Roberfroid MB. Dietary modulation of the human colonic microbiota: Introducing the concept of prebiotics. The Journal of Nutrition. 1995;125(6):1401– 1412. doi:10.1093/jn/125.6.1401
20. Windisch W, Schedle K, Plitzner C, et al. Use of phytogenic products as feed additives for swine and poultry. Journal of Animal Science. 2008;86(14 Suppl):E140–E148. doi:10.2527/jas.2007-0459
21. Partanen KH, Mroz Z. Organic acids for performance enhancement in pig diets. Nutrition Research Reviews. 1999;12(1):117–145. doi:10.1079/095442299108728884
22. Bedford MR, Schulze H. Exogenous enzymes for pigs and poultry. Nutrition Research Reviews. 1998;11(1):91–114. doi:10.1079/NRR19980007
23. Scharek L, Guth J, Reiter KD, et al. Influence of a probiotic Enterococcus faecium strain on development of the immune system of sows and piglets. Veterinary Immunology and Immunopathology. 2005;105(1–2):151–161. doi:10.1016/j.vetimm.2004.12.022
24. Wang J, Deng L, Chen M, et al. Phytogenic feed additives as natural antibiotic alternatives in animal health and production: A review of the last decade. Animal Nutrition. 2024;17:244–264. doi:10.1016/j.aninu.2024.01.012
25. Allen HK, Levine UY, Looft T, et al. Treatment, promotion, commotion: Antibiotic alternatives in food-producing animals. Trends in Microbiology. 2013;21(3):114–119. doi:10.1016/j.tim.2012.11.001
26. Chaucheyras-Durand F, Fonty G. Establishment of cellulolytic bacteria and development of fermentative activities in the rumen of gnotobiotically-reared lambs. British Journal of Nutrition. 2001;85(2):201–212.
27. Ogunade IM, Pech-Cervantes AA, Schweickart H. Metabolomics in ruminant nutrition: A review. Journal of Animal Science and Biotechnology. 2019;10(1):1–15.
28. Pluske JR, Turpin DL, Kim JC. Gastrointestinal tract (gut) health in the young pig. Animal Nutrition. 2018;4(2):187– 196.
29. Hashemi SR, Davoodi H. Herbal plants and their derivatives as growth and health promoters in animal nutrition. Veterinary Research Communications. 2011;35:169–180. doi:10.1007/s11259-010-9458-2
30. Ringø E, Olsen RE, Gifstad TØ, et al. Prebiotics in aquaculture: A review. Aquaculture Nutrition. 2010;16(2):117–136.
31. Hai NV. The use of probiotics in aquaculture. Journal of Applied Microbiology. 2015;119(4):917–935.
32. Lee KW, Everts H, Beynen AC. Essential oils in broiler nutrition. International Journal of Poultry Science. 2004;3(12):738–752. doi:10.3923/ijps.2004.738.752
33. World Health Organization (WHO). Guidelines on Use of Medically Important Antimicrobials in Food-Producing Animals. Geneva: WHO; 2017. Available from: https://www.who.int/publications/i/item/9789241550130 [Accessed: 24th Aug 2025]

34. Casewell M, Friis C, Marco E, et al. The European ban on growth-promoting antibiotics and emerging consequences for human and animal health. Journal of Antimicrobial Chemotherapy. 2003;52(2):159–161. doi:10.1093/jac/dkg313
35. Dibner JJ, Buttin P. Use of organic acids as a model to study the impact of gut microflora on nutrition and metabolism. Journal of Applied Poultry Research. 2002;11(4):453–463. doi:10.1093/japr/11.4.453
36. Choct M. Enzymes for the feed industry: Past, present and future. World's Poultry Science Journal. 2006;62(1):5–16. doi:10.1079/WPS200480
37. Tarım ve Orman Bakanlığı. Yem Kontrol Laboratuvarları Faaliyet Raporu. Ankara: T.C. Tarım ve Orman Bakanlığı; 2024c.
38. Resmî Gazete. Yem Katkı Maddeleri Kayıt Yönetmeliği. Ankara: T.C. Cumhurbaşkanlığı; 2023. Available from: https://www.resmigazete.gov.tr and https://www.tarimorman.gov.tr/Konular/Gida-Ve-Yem- Hizmetleri/Yem-Hizmetleri/Yem-Katki-Maddeleri [Accessed: 24th Aug 2025]
39. EFSA. Feed additive efficacy guidelines. EFSA Supporting Publications. 2020;17(1):EN-1745. doi:10.2903/sp.efsa.2020.EN-1745
40. Kutlu HR. Yem Değerlendirme Analiz Yöntemleri [Ders notu]. Adana: Çukurova Üniversitesi, Ziraat Fakültesi, Zootekni Bölümü; 2008. Available from: http://www.zootekni.org.tr/upload/File/sunular/tm.pdf [Accessed: 24th Aug 2025]
41. Tarım ve Orman Bakanlığı. Yem katkı maddeleri ve premikslerin izlenebilirliği ile resmi kontrollerine ilişkin rehber doküman. Ankara: Gıda ve Kontrol Genel Müdürlüğü; 2023.
42. Yiğit Ö. Yem üretim proseslerinde üç farklı risk değerlendirme metodunun uygulanması ve yöntemlerin karşılaştırılması [Uzmanlık Tezi]. Ankara: Çalışma ve Sosyal Güvenlik Bakanlığı, İSGGM; 2015. Available from: https://www.csgb.gov.tr/Media/b00d4nbw/ozlemyigit.pdf [Accessed: 24th Aug 2025]
43. Swiatkiewicz S, Swiatkiewicz M, Arczewska-Wlosek A, et al. Chitosan and its oligosaccharide derivatives as feed supplements in poultry and swine nutrition. Journal of Animal Physiology and Animal Nutrition. 2015;99(1):1–12. doi:10.1111/jpn.12222
44. Desai KGH, Park HJ. Recent developments in microencapsulation of food ingredients. Drying Technology. 2005;23(7):1361–1394. doi:10.1081/DRT-200063478
45. Pradhan S, Dubey N, Shukla SS, et al. A review of the fundamentals of pharmaceutical granulation technology. International Journal of Pharmaceutical and Phytopharmacological Research. 2023;13(2):1–17.
46. Contreras-López G, Carrillo-López LM, Vargas-Bello- Pérez E, et al. Microencapsulation of feed additives with potential in livestock and poultry production: A systematic review. Chilean Journal of Agricultural & Animal Sciences. 2024;40(1):229–249. doi:10.29393/CHJAAS40- 21MFGI40021
47. Garba AM, Fırıncıoğlu SY. Role of encapsulation nutrients for improvement of ruminant performance and ruminant derived-products. Eurasian Journal of Agricultural Research. 2023;7(2):109–126. Available from: https://dergipark.org.tr/en/pub/ejagr/issue/78151/1293361 [Accessed: 24th Aug 2025]
48. EFSA. Feed additive technical guidance. EFSA Journal. 2020;18(1):e06157. doi:10.2903/j.efsa.2020.6157
49. Kiarie EG, Romero LF, Nyachoti CM. The role of added feed enzymes in promoting gut health in swine and poultry. Nutrition Research Reviews. 2013;26(1):71–88. doi:10.1017/S0954422413000048
50. Nikolaev SI, Karapetyan AK, Chekhranova SV, et al. Premixes and protein vitamin-mineral concentrates in livestock and poultry breeding: Technological properties. International Journal of Engineering and Advanced Technology. 2019;8(6):5307–5312. doi:10.35940/ijitee.

F9158.0981119
51. Huyghebaert G, Ducatelle R, Van Immerseel F. An update on alternatives to antimicrobial growth promoters for broilers. Veterinary Journal. 2011;187(2):182–188. doi:10.1016/j.tvjl.2010.03.003
52. Beauchemin KA, Kreuzer M, O'Mara F, et al. Nutritional management for enteric methane abatement: A review. Australian Journal of Experimental Agriculture. 2008;48(2):21–27. doi:10.1071/EA07199
53. Halas D, Heo JM, Hansen CF, et al. Organic acids, prebiotics and protein level as dietary tools to control the weaning transition and reduce post-weaning diarrhoea in piglets. CABI Reviews. 2007;:1–13. doi:10.1079/PAVSNNR20072079
54. Hardy RW, Barrows FT. Diet formulation and manufacture. In: Halver JE, Hardy RW, eds. Fish Nutrition. 3rd ed. San Diego (CA): Academic Press; 2002. p. 505–600.
55. Stein HH, Sève B, Fuller MF, et al. Amino acid bioavailability and digestibility in pig feed ingredients: Terminology and application. Journal of Animal Science. 2007;85(1):172–180. doi:10.2527/jas.2005-742
56. Haddad SG, Goussous SN. Effect of yeast culture supplementation on nutrient intake, digestibility and growth performance of Awassi lambs. Animal Feed Science and Technology. 2005;118:343–348. doi:10.1016/j.anifeedsci.2004.10.003
57. Placha I, Gai F, Pogány Simonová M. Editorial: Natural feed additives in animal nutrition—Their potential as functional feed. Frontiers in Veterinary Science. 2022;9:1062724. doi:10.3389/fvets.2022.1062724
58. Nahm KH. Evaluation of the nitrogen content in poultry manure. World's Poultry Science Journal. 2003;59(1):77– 88.
59. Gupta RK, Gangoliya SS, Singh NK. Reduction of phytic acid and enhancement of bioavailable micronutrients in food grains. Journal of Food Science and Technology. 2015;52(2):676–684. doi:10.1007/s13197-013-0978-y
60. Gerber PJ, Steinfeld H, Henderson B, et al. Tackling Climate Change Through Livestock – A Global Assessment of Emissions and Mitigation Opportunities. Rome: FAO; 2013. Available from: https://www.fao.org/4/i3437e/i3437e.pdf [Accessed: 24th Aug 2025]
61. Cappelaere L, Le Bellego L, Van Milgen J. Amino acid supplementation to reduce environmental impacts of broiler and pig production: A review. Frontiers in Veterinary Science. 2021;8:689259. doi:10.3389/fvets.2021.689259
62. T.C. Çevre, Şehircilik ve İklim Değişikliği Bakanlığı. Türkiye'de entansif hayvancılık faaliyetlerinde azot ve fosfor yönetimi: ÇED süreçlerine yönelik teknik izleme rehberi. Ankara: T.C. ÇŞİDB Yayınları; 2024.
63. Dumlu B. Importance of nano-sized feed additives in animal nutrition. Journal of Agricultural Production. 2024;5(1):55–72. doi:10.56430/japro.1433614
64. Han CS, Kaur U, Bai H, et al. Invited review: Sensor technologies for real-time monitoring of the rumen environment. Journal of Dairy Science. 2022;105(8):6379– 6404. doi:10.3168/jds.2021-20576
65. Ky I, Parkouda C, Somda MK, et al. Optimization of poultry feed formulation using experimental design methodology. International Journal of Poultry Science. 2021;20(2):59–66. doi:10.3923/ijps.2021.59.66
66. Altshuler Y, Calvao Chebach T, Cohen S, et al. From microbes to methane: AI-based predictive modeling of feed additive efficacy in dairy cows. Frontiers in Sustainable Food Systems. 2025;9:1548223. doi:10.3389/fsufs.2025.1548223
67. Kleter GA. Food safety assessment of crops engineered with RNA interference and other methods to modulate expression of endogenous and plant pest genes. Pest Management Science. 2020;76(10):3333–3339. doi:10.1002/ps.5957

68. Tang KL, Caffrey NP, Nóbrega DB, et al. Restricting the use of antibiotics in food-producing animals and its associations with antibiotic resistance in animals and humans: A systematic review and meta-analysis. The Lancet Planetary Health. 2017;1(8):e316–e327. doi:10.1016/S2542-5196(17)30141-9
69. U.S. Food and Drug Administration (FDA). Veterinary Feed Directive (VFD) requirements for veterinarians. Silver Spring (MD): FDA; 2024. Available from: https://www.fda.gov/animal-veterinary/development- approval-process/veterinary-feed-directive-requirements- veterinarians [Accessed: 24th Aug 2025]
70. European Food Safety Authority (EFSA). Feed additive applications: Regulations and guidance (Webinar presentation, 8 July 2021). Parma: EFSA; 2021. Available from: https://www.efsa.europa.eu/sites/default/files/2021- 07/webinar-presentation-application-procedure-feed- additives-intended-renewal-applications.pdf [Accessed: 24th Aug 2025]
71. FAO. Greenhouse gas emissions and mitigation in livestock supply chains. Rome: FAO; 2020. Available from: https://www.fao.org/statistics/highlights-archive/highlights- detail/greenhouse-gas-emissions-from-agrifood-systems.- global--regional-and-country-trends--2000-2022/en [Accessed: 24th Aug 2025]