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INTEGRATING BIOMEDICAL AND SUSTAINABLE STRATEGIES FOR EFFECTIVE PARASITE CONTROL IN LIVESTOCK: A REVIEW

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Abstract

Effective parasite control is critical for maintaining livestock health, optimizing productivity, and reducing economic losses. Parasitic infections can cause severe biomedical issues and significant financial burdens due to reduced milk production and increased veterinary costs. This study examines biomedical and sustainable strategies for parasite management, focusing on veterinary pharmaceuticals, such as anthelmintics, and the importance of integrating these with preventive practices like pasture rotation, hygiene, and nutrition. The research highlights the role of Integrated Parasite Management (IPM) in reducing resistance development while emphasizing the potential of sustainable practices, including biological control and resistance monitoring. Additionally, the study explores the economic impacts and the role of farmer education in adopting sustainable strategies. The findings suggest that precision livestock farming, biotechnology, and plant-based treatments provide sustainable alternatives to chemical therapies. Integrating biomedical care with preventive strategies like rotational grazing and biological control supports effective parasite management. Farmer education and policy support are vital for the long-term success of IPM and improved livestock productivity.

Keywords: *Veterinary Medications, Agricultural Practices, Preventive Measures.*

1. INTRODUCTION

Effective parasite control is essential for maintaining livestock health, optimizing productivity, and minimizing economic losses [1]. Parasitic infections can lead to serious biomedical issues such as weight loss, impaired growth, reduced fertility, and even mortality [2]. These health impacts compromise animal welfare and increase costs through reduced milk yield, lower meat quality, and higher veterinary expenses.

Biomedical parasite control primarily depends on veterinary pharmaceuticals like anthelmintics and antiparasitic agents, which offer targeted treatment [3]. However, overuse of these drugs has led to resistance, highlighting the need for sustainable practices such as precise dosing, drug rotation, and complementary strategies [4]. Integrated Parasite Management (IPM) merges biomedical approaches with environmental and management-based practices to achieve long-term parasite control.

Preventive veterinary care plays a pivotal role in reducing transmission, focusing on hygiene, waste management, and pasture rotation [5, 6]. Nutrition also supports parasite control by enhancing immunity [7], and regular health monitoring allows for early detection and timely intervention.

The integration of biomedical insights into agriculture is increasingly recognized as vital for promoting sustainability, resilience, and rural well-being. A growing body of research illustrates the value of this

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interdisciplinary approach. For instance, Ayasrah et al., [8] link food insecurity with osteoporosis in Jordan, while Tarawneh et al., [9] explore how biomedical and economic strategies support the bio-economy. Abu Harb et al., [10] demonstrate that combining biomedical and educational approaches can empower rural youth. Similarly, Al-Lataifeh et al., [11] and Dayoub et al., [12] show how smart technologies informed by biomedical knowledge can enhance livestock welfare and productivity. Studies by Roukbi et al., [13], Tarawneh et al., [14], and Tarawneh and Al-Najjar [15] highlight the role of biomedical insights in improving disease monitoring, consultancy, and agricultural finance. Abo Znemah et al., [16] and Al-Barakeh et al., [17] underscore the significance of veterinary care and food security, while Abu Harb et al., [18] calls for tailored extension programs that align biomedical knowledge with production systems.

Despite these advancements, several research gaps remain. Most existing studies focus either on pharmacological solutions or isolated management practices, without fully exploring how combined biomedical and ecological approaches can be adapted across diverse farming systems. There's also limited research on the socio-economic barriers to adopting Integrated Parasite Management (IPM), particularly in low-resource or smallholder contexts. Additionally, few empirical studies assess the long-term impacts of resistance monitoring or evaluate the cost-effectiveness of newer technologies such as vaccines and biosensors in real-world conditions. These gaps present opportunities to design integrated, context-specific models for sustainable parasite control.

This study investigates how biomedical treatments, combination therapies, and sustainable methods such as rotational grazing and biological control enhance parasite management. It also evaluates the economic and environmental impacts of Integrated Parasite Management (IPM) and explores resistance monitoring programs for long-term sustainability.

2. METHODOLOGY

A comprehensive literature review was conducted using Google Scholar to examine the intersection of biomedical treatments, sustainable parasite control practices, and Integrated Parasite Management (IPM). The review focused on English-language publications from 2016 to 2025, using targeted keywords including "biomedical parasite control," "livestock health," "IPM," "anthelmintics," "resistance monitoring," and "sustainable agriculture."

Out of an initial pool of 86 studies, 49 were selected based on inclusion criteria that required a direct focus on biomedical or sustainable approaches to parasite management in livestock. Key data were extracted from each study, including research objectives, findings, and insights related to health, economic, and environmental impacts.

The extracted data underwent thematic analysis to identify recurring concepts and approaches. This analysis clarified the role of biomedical innovations within broader IPM strategies and highlighted practical applications and challenges in real-world contexts.

While limited to English-language sources within a specific timeframe, the methodology ensured rigor and relevance. The review offers critical insights into the evolving strategies for parasite control and informs the design of effective, sustainable livestock management frameworks.

3. BIOMEDICAL AND SUSTAINABLE PARASITE CONTROL IN LIVESTOCK

3.1 Biomedical Approaches to Parasite Control

Parasitic infections significantly impact livestock health and economic performance. Biomedical treatments focus on strategic use of veterinary drugs such as albendazole, ivermectin, metronidazole, and sulfadiazine. To prevent resistance, therapies often include drug rotation and targeted

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combinations. Complementary measures like proper hygiene, nutritional supplementation, and biological controls strengthen host immunity and limit transmission. Integrated Parasite Management (IPM) brings together these biomedical and environmental strategies for more sustainable outcomes.

Table 1 outlines the main biomedical strategies used to manage parasitic infections in livestock. It includes the significance of parasite control, common diseases, commonly used medications, and complementary practices such as hygiene, nutrition, and biological control. Together, these strategies form the foundation of effective and sustainable parasite management.

Table 1: Key Biomedical Strategies for Parasite Control

Aspect	Details	References
Significance	Causes weight loss, infertility, and economic losses; can be fatal.	[19]
Common Diseases	Nematodes, lungworms, liver flukes, and bloodborne parasites.	[20]
Medications	Albendazole, ivermectin, metronidazole; strategic use prevents resistance.	[21]
Combination Therapy	Rotating drug classes enhances efficacy and delays resistance.	[22]
Hygiene & Sanitation	Clean barns, disinfected water, isolate infected animals.	[23]
Nutrition	Vitamins, minerals, and probiotics boost immunity.	[24]
Biological Control	Fungi like *Duddingtonia flagrans* reduce parasite larvae.	[25]
Monitoring	Regular screenings enable early detection and timely treatment.	[26]
Sustainable Management	Rotational grazing, biological controls minimize resistance.	[27]

3.2 Strategies for Parasite Prevention

Sustainable control of parasites integrates biomedical treatments with agricultural practices to minimize infestations and reduce resistance. Key measures include waste management, pasture rotation, hygiene, and health monitoring. Categorizing veterinary drugs based on parasite type, withdrawal period, and resistance risk ensures both efficacy and food safety.

Table 2 presents key sustainable approaches for controlling parasites in livestock. It highlights integrated methods such as pasture management, biological control, waste handling, and preventive veterinary care. These strategies aim to reduce parasite load, slow resistance development, and support long-term animal health and environmental sustainability.

Table 2: Sustainable Parasite Control Strategies

Solution	Description	References
IPM	Combines drugs with pasture rotation and biological controls.	[28]
Rotational Grazing	Moves livestock to prevent parasite buildup.	[29]
Pasture Rest	Allows land recovery, disrupts parasite life cycles.	[30]
Biological Control	Fungi like *Duddingtonia flagrans* reduce larvae.	[31]
Waste Management	Proper manure disposal reduces pasture contamination.	[32]
Preventive Vet Care	Routine checkups and meds for early intervention.	[33]
Nutritional Support	Balanced diets support immunity.	[1]
Hygiene & Sanitation	Clean environments lower exposure risk.	[34]
Isolation	Separates infected animals to prevent spread.	[35]
Monitoring	Early detection through regular health checks.	[36]

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3.3 Integrated Parasite Management (IPM)

IPM is a comprehensive approach that merges biomedical and sustainable strategies to maintain livestock health. It emphasizes resistance monitoring, targeted treatment, and innovations such as vaccines and herbal remedies. Economic assessments and farmer education are crucial to ensure adoption and long-term viability.

Table 3 outlines key strategies used in Integrated Parasite Management (IPM), which combines biomedical treatments with sustainable practices. It includes targeted drug use, natural remedies, resistance monitoring, vaccination, and environmental interventions. These approaches aim to enhance treatment effectiveness, reduce drug resistance, and promote long-term livestock health and productivity.

Table 3: Integrated Parasite Management Strategies

Aspect	Details	References
Integrated Control	Combines biomedical treatments with sustainable practices.	[37]
Natural Remedies	Herbal options (e.g., garlic, neem) reduce resistance and chemical reliance.	[38]
Targeted Treatment	Focuses on specific parasites, limiting overuse.	[39]
Resistance Monitoring	Adjusts drug use based on resistance patterns.	[40]
Vaccination Programs	Promising vaccine research enhances immunity.	[41]
Environmental Modifications	Uses rotational grazing and habitat changes to reduce risk.	[27]
Biological Agents	Employs fungi and natural predators for control.	[42]
Economic Evaluation	Assesses cost-effectiveness of strategies.	[43]
Farmer Education	Training on IPM and drug protocols builds sustainability.	[44]
Animal Husbandry	Nutrition, stress reduction, and herd health support parasite control.	[45]

4. DISCUSSION

The impact of helminthic infections in livestock and the assessment of current control practices aimed at supporting sustainable development are discussed by [46]. Sustainable parasite control is essential for promoting long-term livestock health, farm productivity, and environmental stewardship. While veterinary drugs such as pyrantel, albendazole, and ivermectin are critical for immediate parasite suppression, their overreliance can lead to drug resistance and ecological harm. A shift toward integrated, sustainable approaches is therefore necessary.

The interdisciplinary approach works at multiple levels, from the field to the environment, emphasizing the importance of maintaining ecological balance [47]. Integrated Parasite Management (IPM) offers a pathway to more resilient and environmentally sound practices. By combining biomedical treatments with preventive strategies, such as rotational grazing, improved sanitation, balanced nutrition, and routine health monitoring, IPM reduces the need for chemical inputs while enhancing animal welfare and system resilience. This approach not only addresses short-term health crises but also contributes to long-term ecological balance and resource efficiency.

Simpah et al., [48] highlight that agroecology has the potential to promote sustainable small ruminant production in low- and middle-income countries, requiring a systematic approach, supportive policies, and a long-term commitment to sustainability, animal welfare, and social equity. In this context, Integrated Pest Management (IPM) plays a crucial role by encouraging circular and regenerative practices. For example, biological control and waste management help reduce environmental

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contamination, while early intervention prevents the escalation of parasite loads. The strategic integration of pharmaceuticals with these sustainable methods enhances natural immunity in herds and minimizes parasite transmission, reinforcing a holistic, systems-based approach to livestock management.

Advances in genomics, proteomics, and gene-editing tools have improved parasite control by enabling early detection, accurate diagnostics, targeted treatments, and advanced vaccine development [49]. New tools like plant-based anthelmintics, vaccines, and precision technologies, such as AI monitoring and biosensors, provide scalable, low-impact solutions that reduce drug dependence and support climate-smart, resource-efficient agriculture. These approaches enhance both environmental and economic sustainability.

Embedding sustainability into parasite control systems not only safeguards livestock health but also strengthens the resilience of agricultural ecosystems. The IPM framework exemplifies how integrating traditional knowledge, modern science, and emerging technologies can drive sustainable transformation in livestock farming.

5. CONCLUDING REMARKS

Sustainable parasite control depends on integrating biomedical treatments with preventive, nutritional, and environmental practices. While veterinary drugs remain key to managing infections, strategies like rotational grazing and biological control reduce resistance and improve environmental outcomes. Advances in biotechnology and precision farming provide promising alternatives, while farmer education and supportive policies will be essential for successful, long-term implementation of Integrated Parasite Management (IPM), ultimately strengthening livestock health, productivity, and economic resilience.

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Conflicts of Interest

The authors confirm that there are no conflicts of interest related to this study.

References

1) Bricarello, P.A., Longo, C., Da Rocha, R.A., & Hötzel, M.J. (**2023**). Understanding Animal-Plant-Parasite Interactions to Improve the Management of Gastrointestinal Nematodes in Grazing Ruminants. Pathogens, 12(4), 531. https://doi.org/10.3390/pathogens12040531

2) Silva Oliveira, F.M., Cruz, R.E., Gomide Pinheiro, G.R., & Caliari, M.V. (**2022**). Comorbidities involving parasitic diseases: A look at the benefits and complications. Experimental Biology and Medicine. https://doi.org/10.1177/ 15353702221108387

3) Surve, D.H., Bhide, A., Jindal, A.B., Devarajan, P.V. (**2023**). Nanomedicines for the Treatment of Veterinary Parasitic Infections. In: Patravale, V.B., Date, A.A., Jindal, A.B. (eds) Nanomedicines for the Prevention and Treatment of Infectious Diseases. AAPS Advances in the Pharmaceutical Sciences Series, vol 56. Springer, Cham. https://doi.org/10.1007/978-3-031-39020-3_6

4) Muteeb, G., Rehman, M.T., Shahwan, M., & Aatif, M. (**2023**). Origin of Antibiotics and Antibiotic Resistance, and Their Impacts on Drug Development: A Narrative Review. Pharmaceuticals, 16(11), 1615. https://doi.org/10.3390/ ph16111615

DOI: 10.5281/zenodo.15259217
Vol: 62 | Issue: 04 | 2025

5) Lorusso, V. (**2021**). Parasitology and One Health—Perspectives on Africa and Beyond. Pathogens, 10(11), 1437. https://doi.org/10.3390/pathogens10111437

6) Erkan Can, M. (**2020**). Hygiene Conditions and Animal-Environment Relations in Farm Animals Barns. Black Sea Journal of Engineering and Science, 3(2), 64-70. https://doi.org/10.34248/ bsengineering.628540

7) Karpe, A.V., Beale, D.J., & Tran, C.D. (**2023**). Intelligent Biological Networks: Improving Anti-Microbial Resistance Resilience through Nutritional Interventions to Understand Protozoal Gut Infections. Microorganisms, 11(7), 1800. https://doi.org/10.3390/microorganisms11071800

8) Ayasrah, A.I.I., Shnaigat S.F., Obeidat H.M., Al-Najjar K.A. (**2025**). Demographic, Health, And Socioeconomic Determinants of Food Insecurity and its Association with Osteoporosis. Journal of Tianjin University Science and Technology. Vol: 58 Issue: 03. https://doi.org/10.5281/ zenodo.15123550

9) Tarawneh, R.A., Abu Harb, S., Dayoub, M. and Al-Najjar, K. (**2025**). Leveraging the bioeconomy to drive sustainable development: a comprehensive review. International Journal of Agricultural Technology 21(1):327-338. http://www.ijat-aatsea.com/

10) Abu harb, S., Tarawneh R., Abu Hantash K., Altarawneh M., Al-Najjar K. (**2024a**). Empowering rural youth through sustainable innovation, entrepreneurship and peer learning in agriculture. Hunan Daxue Xuebao/Journal of Hunan University Natural Sciences. Vol: 61. Issue: 11. https://doi.org/10.5281/ zenodo.14058869

11) Al-lataifeh, F., Radi a. Tarawneh, Ebraheem s. Al-taha'at, Moammar Dayoub, Erkki Sutinen, & Khaled Al-Najjar. (**2024**). Smart Technologies for Livestock Sustainability and Overcoming Challenges: A Review. Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/ Journal of Xi'an Shiyou University, Natural Sciences Edition. (67, 09, 196-204). Zenodo. https://doi.org/10.5281/zenodo. 13744058

12) Dayoub, M, Shnaigat S, Tarawneh RA, Al-Yacoub AN, Al-Barakeh F, Al-Najjar K. (**2024**). Enhancing Animal Production through Smart Agriculture: Possibilities, Hurdles, Resolutions, and Advantages. *Ruminants*. 4(1):22-46. https://doi.org/10.3390/ ruminants 4010003

13) Roukbi, M., Al-Omar A.N., Khaled Al-Najjar., Salam Z., Al-Suleiman H., Mourii M., and Gourie S. (**2016**). Seroprevalence of antibodies to Chlamydophila abortus in Small Ruminants in Some Provinces in Syria. Net Journal of Agriculture Science. 4(2):29-34. https://www.netjournals.org/pdf/NJAS/ 2016/2/16-019.pdf

14) Tarawneh, R.A., Tarawneh, M.S., and Khaled A. Al-Najjar. (**2022**). Agricultural Policies among Advisory and Cooperative Indicators in Jordan. International Journal of Research - GRANTHAALAYAH, 10(2), 10–17. doi:10.29121/ granthaalayah. v10.i2.2022.4489.

15) Tarawneh R. and Al-Najjar K. (**2023**). Assessing the Impacts of Agricultural Loans on Agricultural Sustainability in Jordan. IOSR Journal of Economics and Finance (IOSR-JEF). Vol. 14, Issue 6 Ser. PP 49-56. https//doi.org/10.9790/ 5933-1406014956

16) Abo Znemah S., Tarawneh R., Shnaigat S., Al-Najjar K. (**2023**). Estimating Some Indicators of Food Security for Rural Households. Asian Journal of Agriculture and Food Sciences. Volume 11 – Issue 1. https://doi.org/10.24203/ ajafs.v11i2.7171

17) Al-Barakeh, F.; Khashroum, A.O.; Tarawneh, R.A.; Al-Lataifeh, F.A.; Al-Yacoub, A.N.; Dayoub, M.; Al-Najjar, K. (**2024**). Sustainable Sheep and Goat Farming in Arid Regions of Jordan. Ruminants, 4, 241-255. https://doi.org/10.3390/ ruminants4020017

18) Abu harb, S., Dayoub, M. and Al-Najjar, K. (**2024b**). The impact of agricultural extension program effectiveness on sustainable farming: A survey article. International Journal of Agricultural Technology 20(2):477-492. http://www.ijat-aatsea.com/

19) Fauziah, N., Aviani, J.K., Agrianfanny, Y.N., & Fatimah, S.N. (**2022**). Intestinal Parasitic Infection and Nutritional Status in Children under Five Years Old: A Systematic Review. Tropical Medicine and Infectious Disease, 7(11), 371. https://doi.org/10.3390/tropicalmed7110371

DOI: 10.5281/zenodo.15259217
Vol: 62 | Issue: 04 | 2025

20) Springer, A., Jordan, D., Kirse, A., Schneider, B., Campe, A., Müller, K.E., Hoedemaker, M., & Strube, C. (**2021**). Seroprevalence of Major Pasture-Borne Parasitoses (Gastrointestinal Nematodes, Liver Flukes and Lungworms) in German Dairy Cattle Herds, Association with Management Factors and Impact on Production Parameters. Animals, 11(7), 2078. https://doi.org/10.3390/ ani11072078

21) Mcpherson, S. (**2024**) Safety of the Co-Administration of Azithromycin, Albendazole and Ivermectin Versus Standard Treatment Regimens During Mass Drug Administration (MDA) in Ethiopia: A Cluster Randomized Trial. PhD thesis, London School of Hygiene & Tropical Medicine. https://doi.org/10.17037/PUBS.04673426

22) Sharma, M., Bakshi, A. K., Mittapelly, N., Gautam, S., Marwaha, D., Rai, N., Singh, N., Tiwari, P., Agarwal, N., Kumar, A., & Mishra, P.R. (**2022**). Recent updates on innovative approaches to overcome drug resistance for better outcomes in cancer. Journal of Controlled Release, 346, 43-70. https://doi.org/10.1016/j.jconrel.2022.04.007

23) Yadav, J.P., Mani, S., & Singh, M. (**2025**). General Hygiene, Sanitation, and Disinfection of Animal Housing and Hospital Environment. 537-550. https://doi.org/10.1002/9781394208180.ch46

24) Suardi, C., Cazzaniga, E., Graci, S., Dongo, D., & Palestini, P. (**2020**). Link between Viral Infections, Immune System, Inflammation and Diet. International Journal of Environmental Research and Public Health, 18(5), 2455. https://doi.org/10.3390/ijerph18052455

25) Kumar, K.D., Huntriss, R., Green, E., Bora, S., & Pettitt, C. (**2023**). Development of a nutrition screening tool to identify need for dietetic intervention in female infertility. Journal of Human Nutrition and Dietetics, 36(1), 154-168. https://doi.org/10.1111/jhn.13055

26) Haddad, K.K. (**2023**). How Successful Are Veterinary Weight Management Plans for Canine Patients Experiencing Poor Welfare Due to Being Overweight and Obese? Animals, 14(5), 740. https://doi.org/10.3390/ani14050740

27) Sands, B., Giroux, L., Bruce, J., & Darby, H. (**2024**). Integrated parasite management (IPM) and the pasture ecosystem: Optimizing outcomes for cattle, insect biodiversity, and soil health. Agriculture, Ecosystems & Environment, 368, 109022. https://doi.org/10.1016/j.agee.2024.109022

28) Mendoza-de Gives, P. (**2022**). Soil-Borne Nematodes: Impact in Agriculture and Livestock and Sustainable Strategies of Prevention and Control with Special Reference to the Use of Nematode Natural Enemies. Pathogens, 11(6), 640. https://doi.org/10.3390/pathogens11060640

29) Lifschitz, A., Nava, S., Miró, V., Canton, C., Alvarez, L., & Lanusse, C. (**2024**). Macrocyclic lactones and ectoparasites control in livestock: Efficacy, drug resistance and therapeutic challenges. International Journal for Parasitology: Drugs and Drug Resistance, 26, 100559. https://doi.org/10.1016/ j.ijpddr.2024.100559

30) Castro-Saines, E., Lagunes-Quintanilla, R. & Hernández-Ortiz, R. (**2024**). Microbial agents for the control of ticks Rhipicephalus microplus. Parasitol Res 123, 275. https://doi.org/10.1007/s00436-024-08291-1

31) Baiak B.H.B., Gasparina J.M., Ianke L., et al. (**2021**). Predatory activity of nematophagus fungus Duddingtonia flagrans in infective larvae after gastrointestinal transit: biological control in pasture areas and in vitro. Journal of Helminthology. 95: e31. https://doi.org/10.1017/S0022149X21000195

32) Matthews, K.R. (**2022**). Manure management. The Produce Contamination Problem (Third Edition), 47-66. https://doi.org/10.1016/B978-0-12-819524-6.00001-X

33) Bagster, A., & Elsheikha, H. (**2022**). Perception of UK companion animal veterinarians on risk assessment-based parasite control. Veterinary Parasitology: Regional Studies and Reports, 34, 100774. https://doi.org/10.1016/ j.vprsr.2022.100774

34) Saxena, H., Kumar, A., Sarkar, V.K., Kansal, M., & Verma, K. (**2025**). Strategies of Disease Management. 145-154. https://doi.org/10.1002/9781394208180.ch10

35) Stockmaier, S., Stroeymeyt, N., Shattuck, E.C., Hawley, D.M., Meyers, L.A., & Bolnick, D.I. (**2021**). Infectious diseases and social distancing in nature. Science. https://doi.org/abc8881

DOI: 10.5281/zenodo.15259217
Vol: 62 | Issue: 04 | 2025

36) Sadhukhan, S.K. (**2022**). Prevention and Control of Parasitic Zoonoses. In: Parija, S.C., Chaudhury, A. (eds) Textbook of Parasitic Zoonoses. Microbial Zoonoses. Springer, Singapore. https://doi.org/10.1007/978-981-16-7204-0_9

37) Charlier, J., Bartley, D., Sotiraki, S., Martinez-Valladares, M., Claerebout, E., Von Samson-Himmelstjerna, G., Thamsborg, S., Hoste, H., Morgan, E., & Rinaldi, L. (**2021**). Anthelmintic resistance in ruminants: Challenges and solutions. Advances in Parasitology, 115, 171-227. https://doi.org/10.1016/ bs.apar.2021.12.002

38) Eldin, A.B., Ezzat, M., Afifi, M., Sabry, O., & Caprioli, G. (**2023**). Herbal medicine: the magic way crouching microbial resistance. Natural Product Research, 37(24), 4280–4289. https://doi.org/10.1080/14786419.2023.2172009

39) Wolstenholme, A. J., Andersen, E.C., Choudhary, S., Ebner, F., Hartmann, S., Holden-Dye, L., Kashyap, S.S., Krücken, J., Martin, R.J., Midha, A., Nejsum, P., Neveu, C., Robertson, A.P., Walker, R., Wang, J., Whitehead, B.J., & Williams, P.D. (**2024**). Getting around the roundworms: Identifying knowledge gaps and research priorities for the ascarids. Advances in Parasitology, 123, 51. https://doi.org/10.1016/bs.apar.2023.12.002

40) Karnan A., Jadhav U., Ghewade B., et al. (**2024**). A Comprehensive Review on Long vs. Short Regimens in Multidrug-Resistant Tuberculosis (MDR-TB) Under Programmatic Management of Drug-Resistant Tuberculosis (PMDT). Cureus 16(1): e52706. https://doi.org/10.7759/cureus.52706

41) Alzan, H.F., Mahmoud, M.S., & Suarez, C.E. (**2024**). Current vaccines, experimental immunization trials, and new perspectives to control selected vector borne blood parasites of veterinary importance. Frontiers in Veterinary Science, 11, 1484787. https://doi.org/10.3389/fvets.2024.1484787

42) Lawal, I., Fardami, A.Y., Ahmad, F.I., Yahaya, S., Abubakar, A.S., Sa'id, M.A., Marwana, M., & Maiyadi, K.A. (**2022**). A Review on Nematophagus Fungi: A Potential Nematicide for the Biocontrol of Nematodes. Journal of Environmental Bioremediation and Toxicology, 5(1), 26–31. https://doi.org/10.54987/ jebat.v5i1.677

43) Alcon, F., De-Miguel, M.D., & Martínez-Paz, J.M. (**2021**). Assessment of real and perceived cost-effectiveness to inform agricultural diffuse pollution mitigation policies. Land Use Policy, 107, 104561. https://doi.org/10.1016/ j.landusepol.2020.104561

44) Thapa, S., Piras, G., Thapa, S., Goswami, A., Bhandari, P., & Dahal, B. (**2021**). Study on farmers' Pest management strategy, knowledge on pesticide safety and practice of pesticide use at Bhaktapur district, Nepal. Cogent Food & Agriculture, 7 (1). https://doi.org/10.1080/23311932.2021.1916168

45) Ponnampalam, E.N., Kiani, A., Santhiravel, S., Holman, B.W., Lauridsen, C., & Dunshea, F.R. (**2021**). The Importance of Dietary Antioxidants on Oxidative Stress, Meat and Milk Production, and Their Preservative Aspects in Farm Animals: Antioxidant Action, Animal Health, and Product Quality—Invited Review. Animals, 12(23), 3279. https://doi.org/10.3390/ani12233279

46) Rehman, A., & Abidi, S. (**2021**). Livestock health: Current status of helminth infections and their control for sustainable development. Advances in Animal Experimentation and Modeling, 365-378. https://doi.org/10.1016/B978-0-323-90583-1.00029-5

47) Yarahmadi, F., & Rajabpour, A. (**2024**). Insecticides and natural enemies: applications in integrated pest management programs – challenges, criteria, and evaluation for recommendations. In Insecticides in pest control - impact, challenges and strategies (pp. 1-19). (Agricultural Sciences). InTechOpen. https://doi.org/10.5772/intechopen.1005830

48) Simpah, A., Sasu, P., Bosch, C., Mabiki, F.P., Frimpong, Y.O., Emmambux, M.N., & Greathead, H.M. (**2022**). Sustainable Small Ruminant Production in Low- and Middle-Income African Countries: Harnessing the Potential of Agroecology. Sustainability, 15(21), 15326. https://doi.org/10.3390/su152115326

49) Kumar, S., Gupta, S., Mohmad, A. et al. Molecular tools-advances, opportunities and prospects for the control of parasites of veterinary importance. Int J Trop Insect Sci 41, 33–42 (**2021**). https://doi.org/10.1007/s42690-020-00213-9