



PLANT EXTRACTS WITH ANTIBACTERIAL ACTIVITY AGAINST BACTERIAL PATHOGENS OF VETERINARY IMPORTANCE

Maria-Larisa Ardelean(căș.Rusu)¹, Daiana Cocoș¹, Mihai Folescu¹, Romeo Teodor Cristina¹ and Eugenia Dumitrescu^{1,*}

¹University of Life Sciences “King Mihai I” from Timișoara, Faculty of Veterinary Medicine, Department of Pharmacology and Pharmacy, Calea Aradului 119, 300645-Timișoara, Romania

Abstract: Antimicrobial resistance continues to reduce the effectiveness of treatments in veterinary medicine and to increase the economic and health impact of infectious diseases in animals. Recent studies show that medicinal plants, essential oils, and other natural compounds of plant origin can exert antibacterial, antibiofilm, and sometimes synergistic effects with conventional antibiotics. In particular, the literature frequently focuses on pathogens such as *Escherichia coli*, *Staphylococcus aureus*, *Salmonella spp.*, as well as bacteria involved in bovine mastitis and respiratory diseases of ruminants. However, direct comparison between studies remains difficult due to differences in extraction methods, phytochemical profiles, bacterial strains, and microbiological techniques. This narrative review synthesises recent evidence on the antibacterial activity of plant extracts relevant to veterinary medicine, with emphasis on the phytochemical classes involved, main veterinary applications, antibiofilm activity, and future directions of veterinary pharmacology based on natural products.

Keywords: medicinal plants; antimicrobial resistance; phytotherapy; bacterial biofilm

• Introduction

Antimicrobial resistance is one of the major challenges affecting animal health, farm productivity and the One Health approach. In veterinary medicine, the intensive use of antibiotics has contributed to the selection and persistence of resistant bacterial strains, particularly in recurrent and chronic infections. In this context, plant-based therapies have gained increasing attention as complementary antimicrobial strategies and as potential sources of new bioactive compounds.

Plant extracts contain diverse secondary metabolites, including phenols, flavonoids, terpenoids and alkaloids, which may interfere with bacterial membranes, enzymatic activity and biofilm formation (Figure 1). The main bacterial pathogens investigated in this field include *Escherichia coli*, *Staphylococcus aureus*, *Salmonella enterica* serovar Typhimurium, *Pasteurella multocida* and *Mannheimia haemolytica*. However, the clinical application of plant extracts remains limited by methodological variability, lack of standardisation and insufficient *in vivo* validation.

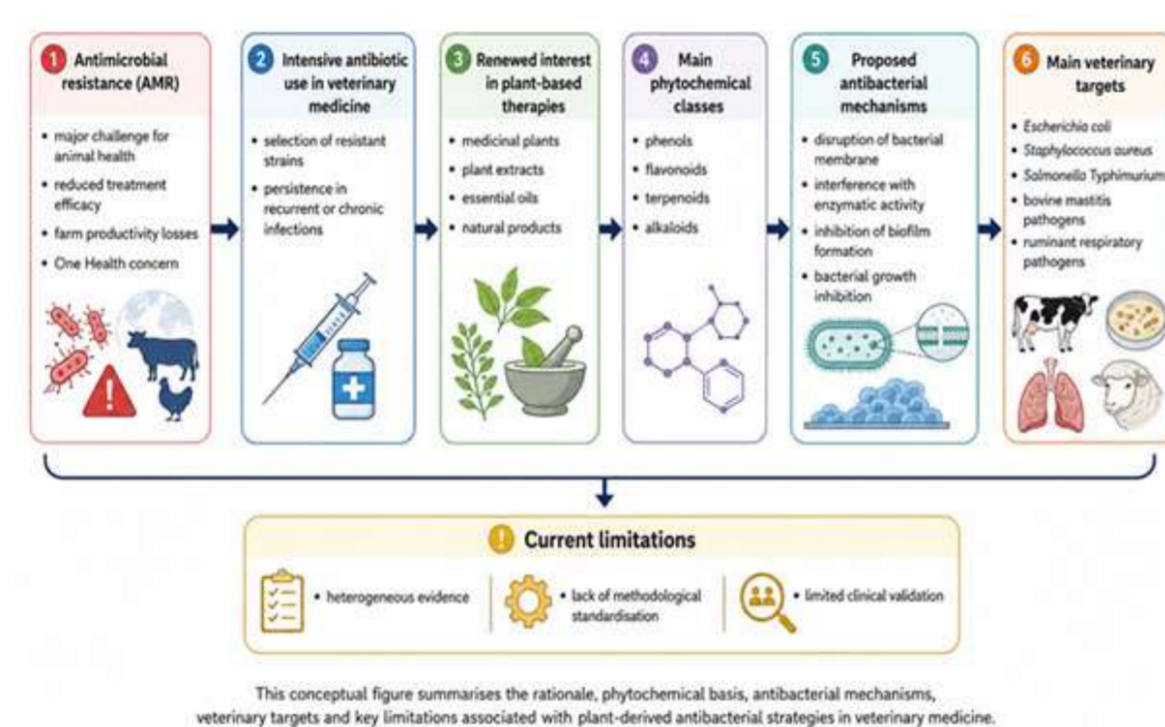


Figure 1. Conceptual overview of plant extracts as complementary antibacterial strategies in veterinary medicine

This review summarises recent evidence on the antibacterial potential of plant extracts in veterinary medicine and highlights their main limitations and future perspectives.

• Review Methodology

This study was designed as a narrative review based on scientific literature published mainly between 2021 and 2025 (Figure 2). The review aimed to synthesise and critically analyse current evidence on the antibacterial activity of plant extracts in veterinary medicine. Original studies, reviews, meta-analyses and scientific editorials were selected if they addressed veterinary phytotherapy, medicinal plants, bacterial pathogens, bovine mastitis, respiratory infections in ruminants, bee products or antibiofilm activity. The literature was identified using open-access scientific databases, including PubMed Central, with keywords such as medicinal plants, plant extracts, antibacterial activity, veterinary medicine, *Escherichia coli*, *Staphylococcus aureus* and biofilm. A formal meta-analysis was not performed due to the high variability of the available studies regarding plant species, extraction methods, bacterial strains and microbiological indicators. Therefore, the study follows a narrative synthesis focused on the main research trends, convergent findings and methodological limitations.

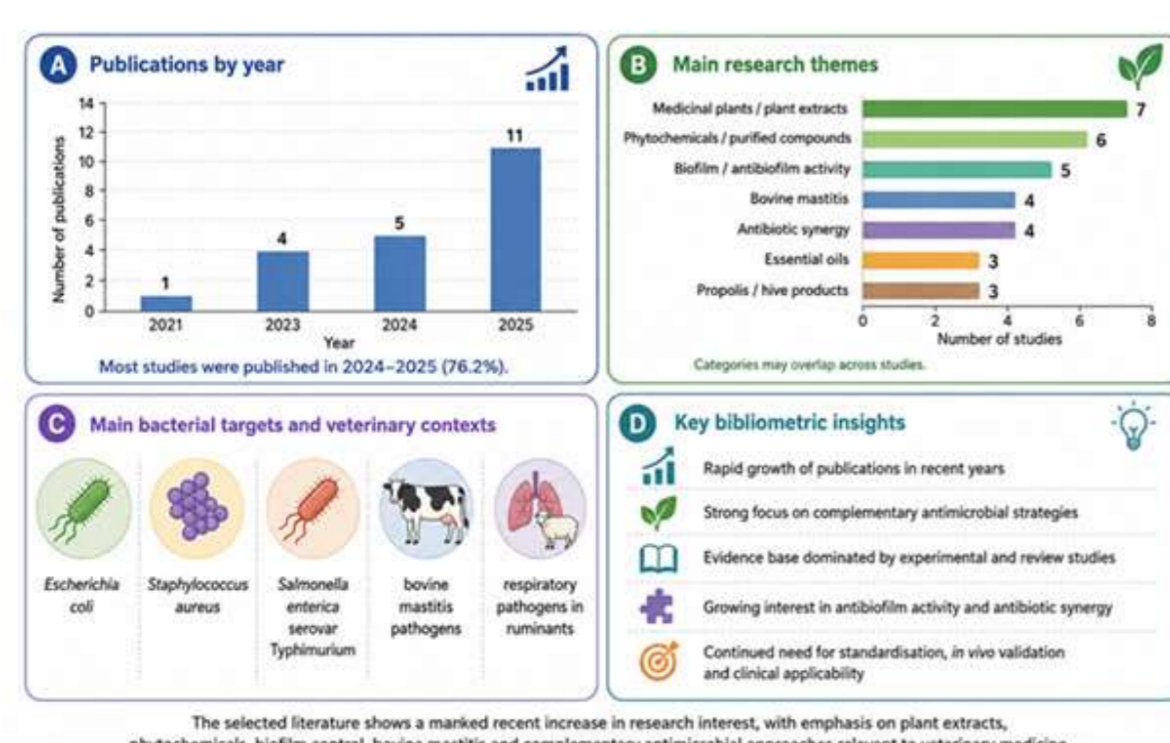


Figure 2. Bibliometric overview of the selected literature on plant-derived antibacterial strategies in veterinary medicine

• Phytochemical Classes and Mechanisms of Action

Plant extracts contain several phytochemical classes associated with antibacterial activity, including phenols, flavonoids, terpenoids, alkaloids and phenolic acids (Figure 3). These secondary metabolites may interfere with bacterial cell structures, membrane permeability, enzymatic activity and biofilm formation, contributing to the inhibition of bacterial growth.

Specific compounds such as sanguinarine and luteolin illustrate the antibacterial potential of plant-derived substances. Sanguinarine may affect the bacterial cell wall and membrane and induce reactive oxygen species, while luteolin has shown antibacterial effects against avian-origin *Escherichia coli* in both laboratory and biological models. Overall, current research is moving from simple *in vitro* testing towards more advanced validation in animal models.

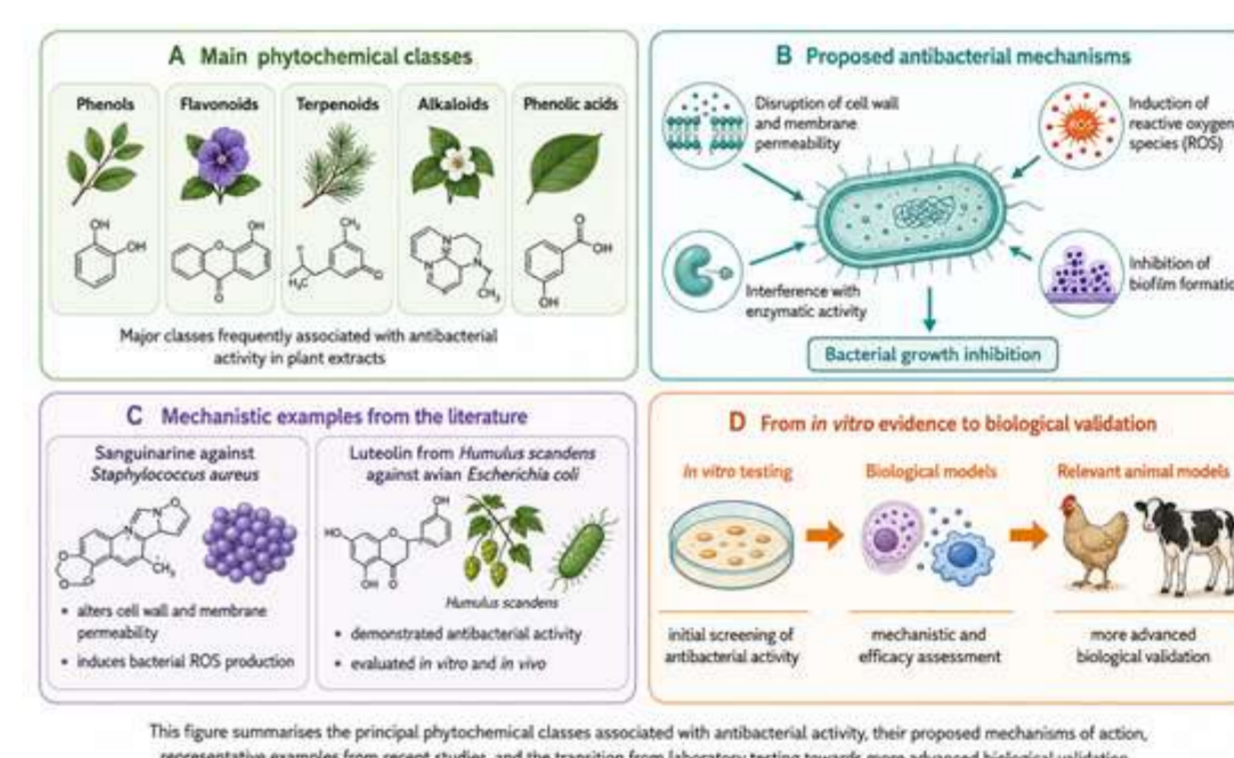


Figure 3. Main phytochemical classes and proposed antibacterial mechanisms of plant-derived compounds relevant to veterinary medicine

• Antibiofilm Potential, Synergy and Future Perspectives

Plant-derived compounds are increasingly investigated for their ability to reduce bacterial biofilm formation and improve the efficacy of antimicrobial strategies. Biofilm contributes to the persistence of infections and increases bacterial tolerance to antimicrobial agents, making its control an important target in veterinary medicine. Some plant extracts have shown antibiofilm activity, while combinations between natural compounds and conventional antibiotics may produce synergistic effects, suggesting a possible adjuvant role in infection management.

Despite this potential, several limitations restrict their clinical use. The main challenges include variability in plant species, chemical composition, extraction methods, solvents, bacterial strains and testing protocols. In addition, many studies remain limited to *in vitro* evaluations, while data on pharmacokinetics, bioavailability, toxicity, dosage and efficacy in target animal species are still insufficient. Future research should focus on extract standardisation, chemical characterisation, safety assessment, *in vivo* validation and the development of modern formulations, including nanostructured systems, to support the safe and effective use of natural products in veterinary pharmacology.

• Conclusions

Recent evidence highlights that numerous plants, plant extracts, essential oils and natural products rich in phenolic or terpenic compounds show antibacterial activity against pathogens of veterinary importance. In the current literature, *E. coli*, *S. aureus*, *Salmonella spp.*, as well as bacteria involved in bovine mastitis and respiratory diseases in ruminants, are frequently investigated as bacterial targets. The literature on biofilm and synergy with antibiotics suggests a promising research direction. However, the lack of standardisation and limited clinical validation represent factors that restrict the broad and regulated application of these products. Therefore, recent literature suggests that plant extracts represent a promising but still developing direction in contemporary veterinary pharmacology.