

INSIGHTFUL APPLICATION OF HERBAL EXTRACTS IN THE PREVENTION AND TREATMENT OF ANIMAL DISEASES AND IMPROVEMENT OF MEAT QUALITY AND SAFETY

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Abstract: In an indirect way, through animal nutrition or selection, we can influence the composition and quality of muscle and fat tissue, and thus the nutritional and functional value of meat. The process is longer and is not fully controlled yet. Direct processes improve nutritional properties by adding components with functional properties and/or reducing or removing ingredients that may negatively affect health. Herbal raw materials and extracts, by-products and wastes from fruit and vegetable processing can modify feed in order to achieve a stable health status and preserve animal well-being and sensory quality of meat, with an extended shelf life.

Key words: herbal extracts, antimicrobial activity, animal health, fodder, meat quality

General considerations on modern concepts

In recent years, an alarming prevalence of multiresistant microorganisms has been observed as a consequence of the uncontrolled use of antibiotics in metaphylaxis in veterinary medicine or therapy in human and veterinary medicine. A number of studies have been designed with the aim of evaluating the effect of adding a mixture of plant extracts to animal feed on productive performance, blood constituents, carcass characteristics, percentage ratio of organ weight to live weight, meat sensory properties and overall quality (Dávila-Ramírez et al. 2020; Chen et al., 2021; Song et al., 2022; Xu et al., 2022; Zhang et al., 2022).

The increasing occurrence of dangerous infections caused by bacteria that are resistant to antibiotics of the latest generations (multidrug resistant - MDR) has made the research of new molecules in the field of medicine current on a

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global level. Compared to chemically synthesized substances, herbs provide greater structural diversity and offer more opportunities for the identification of new antimicrobial (AM) compounds. Plants show excellent antibacterial effect due to their safety, efficacy, synergism and reduced drug resistance. The combination of herbal and chemical AM agents (of synthetic origin) for the treatment of infectious diseases is popular in clinical practice in China because of their synergistic or potentiating effects (Song et al., 2022).

Numerous reasons limit the use of antiviral (AV) drugs in human and veterinary medicine, which is not the case with the use of natural AM agents (Antimicrobial Drugs - AMD). Limitations are due to the appearance of virus mutations or new viruses, toxic effects, the intensity of viral diseases, the ability of the virus to survive intracellularly, the high price and the absence of specific AV chemical preparations against pathogenic microorganisms that cause diseases in veterinary medicine. The low effectiveness of AV agents requires the discovery of new powerful AV substances. Most AV substances important in veterinary medicine are still used thanks to trials of AV drugs for human use in animal models (eg, a surrogate model for hepatitis C virus trials is Bovine Viral Diarrhoea Virus - BVDV).

A review by Karásková et al. (2015) points to the fact that the possibilities of using phytogetic additives are different. Their use does not carry great dangers, as for example the use of antibiotics or chemical compounds. Phytogetic additives and their wider practical application will undoubtedly be the subject of further research: sensory, technological, zootechnical, immunomodulation, improve production characteristics or the quality of animal products, reduce the negative effects of stress.

Information on the possible applications of phytogetic additives (probiotics, prebiotics, enzymes, plant extracts) in modern animal feed production is provided in the chapter by Pandey et al. (2019). A study by Ceruso et al. (2020) evaluated the antibacterial activity of about 800 plant extracts against *L. monocytogenes*. The results revealed that 12 plant extracts had an inhibitory effect against *L. monocytogenes* - new preservatives to reduce the risk of developing various pathogens and food contamination with *L. monocytogenes*. The most important reformulations of animal feed using plant-based supplements and their impact on meat quality parameters, which were shown in the world literature during the last two years (2020 - 2022), presented tabularly in recent review by Kurčubić et al. (2022).

One of the insurmountable challenges for the application of many phytochemicals is tracing efficient pathways, which can release the active

antimicrobial (AM) compound at the target site during systemic infections. The dilemma is how to select compounds that have AM activity in complex mixtures such as extracts and essential oils and how to use their potential pharmacological interactions most effectively and efficiently. For this purpose, it is necessary to use modern technologies, AM tests with internationally recognized standardized protocols and the use of herbal material with appropriate quality controls (Álvarez-Martínez et al., 2021).

A very useful scientific opinion created by experts from the Panel for additives and products/substances used in animal feed, at the request of the European Commission (EFSA FEEDAP, 2020). EFSA were asked to provide a conclusion on the safety and efficacy of the dried aqueous ethanolic extract of lemon balm (*Melissa officinalis* L.) leaves when used as a sensory feed additive for different animal species. The toxicity and genotoxicity of the identified components of herbal extracts are not at a worrying level. However, the analysis of the extracts is incomplete. In the absence of adequate data on the composition and in view of the incomplete genotoxicity testing, FEEDAP was not able to publish a definitive conclusion on the safety of the additive for the target species of animals and the health of consumers. Lemon balm is a European plant species and its use in animal feed is not expected to pose a risk to the environment. Lemon balm and its extracts flavor food, and the function in animal feed is the same as in human feed, so further confirmation of the effectiveness of the extract is not required.

Antibiotics, disinfectants and chemotherapeutic agents used for the prevention and treatment of diseases lead to the appearance of antibiotic and chemical residues in fish products, multi-resistant microorganisms resistant to antibiotics and damage to the aquatic environment and human health. This situation has led researchers to use alternative additives in fish nutrition such as: medicinal herbs, plant extracts, phytochemicals, and secondary metabolites of plants, immunostimulators and probiotics. A recent review (Yılmaz et al., 2022) includes research conducted in Turkey between 2001 and 2020 to summarize findings regarding the use of medicinal plants, plant extracts, phytochemicals, plant secondary metabolites, and immunostimulants in fish feed for the prevention and treating diseases, improving immunity, increasing disease resistance and reducing stress in fish towards better management and best practices in aquaculture for the sustainability of the growing aquaculture industry in the region and around the world.

Kurćubić et al. (2013) determined the effectiveness of 0.3% ethanolic herbal extract of the *Kitaibelia vitifolia* applied as a spray, lasting 5 seconds, to destroy

E. coli on beef carcasses. The strong AM action of the ethanolic extract of the plant *K. vitifolia* applied as a spray on the reduction of the number of *E. coli* (Enterobacteriaceae), which was applied as an inoculum in a known number to the surface of the meat, was confirmed.

Endophytes (microorganisms that live in plant tissues without typically causing any harmful effects on them on a commercial scale) could progressively eliminate our direct dependence on high-value vulnerable plants, thus opening a sustainable way to use plant resources in a sustainable manner (Sharma et al., 2021).

The prevention of respiratory diseases in cattle as the most economically significant health disorder implies that each control program must be designed by experts as multicomponent. That includes the use of different vaccines and types during vaccination/revaccination, the use of antimicrobial drugs (AMD) upon arrival of calves in facilities (feedlots), biosecurity measures, diagnostic procedures for determining the occurrence of the disease and its treatment, breeding practices, testing the quality of animal feed and nutrition programs, monitoring and intervention programs for the preservation of animal health (Ives and Richeson, 2015; Brault et al., 2019; Lhermie et al., 2019). The synergistic or potentiating effect of herbal AMD and chemical AMD is embodied in clinical practice. Tulathromycin and gallic acid combined were very effective against *M. haemolytica*, *P. multocida* and their mixed cultures. Separately, they had a very weak effect on both mentioned bacteria. Tulathromycin pre-exposure generates bacterial resistance to AMD in *M. haemolytica* but not in *P. multocida* (Rajamanickam et al., 2019).

An attempt to check in tissue culture the antiviral effect of plant extracts on those viruses that cause Bovine Respiratory Disease Complex (BRDC), proven to be the most economically significant syndrome of fattening steers and cattle worldwide, in general, in Serbia, was carried out by Kurćubić et al. (2019). They investigated the in vitro AV activity of 5 selected plant extracts against Bovine Herpes Virus-1 (BHV-1) subtype 1.1 and Bovine Viral Diarrhea Virus (BVDV) genotype 1, which together with other viral and bacterial agents cause BRDC. Two prepared samples of aqueous plant extracts/macerates showed an antiviral (AV) effect against BHV-1 as a representative of herpesvirus (DNA virus), but none of the tested samples showed an AV effect against BVDV genotype 1 strain NADL, which belongs to RNA viruses. In this test, the Selectivity Index (SI = CTC50/EC50) for aqueous extracts of *Matricaria chamomilla* (SI = 32) and *Achillea millefolium* (SI = 8) indicated significant selective inhibition of DNA virus (BHV-1, strain TN41). The obtained results require new and significantly

more extensive research, which would reveal the active ingredients of the examined plants and the mechanisms of their AV effect.

Due to the need to protect the efficacy of significant AMDs for use in human medicine, WHO has published guidelines presenting evidence-based recommendations and best practice statements on the use of "medically important antimicrobials" in animal feed, defined as AM classes that used in human medicine (WHO, 2017). Medically important AMDs are categorized according to appropriate criteria as "important", "extremely important" or "critically important" for human medicine. WHO recommends that the overall use of medically important AMD in animal feed be reduced. Their use for growth promotion in animals not diagnosed with clinical disease is prohibited.

Conclusion

In the future, studies on the AM power of plants will be designed through understanding the mechanisms of action, pharmacodynamic basis and pharmacokinetics. The WHO recommendations that critical AMD be used only for the treatment of certain animal diseases, and for the group of "critically important" AMD of the highest priority, use as a feed additive are prohibited, seem very reasonable.

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