RUMEX SPECIES AN ALTERNATIVE FEED SOURCE OF NUTRIENTS FOR LIVESTOCK

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Abstract

Searching and finding low-cost natural nutritional solutions high in bioactive nutrients is imperative on today's livestock. Genus Rumex includes about 150 species of annual, biennial and perennial herbs distributed mostly in temperate areas, including Romania. As reported by some authors, dry matter (DM) and crude fibre (CF) concentration of this plant can gradually increase from spring to first cut in June and fat concentration is similar to alfalfa and maize. Rumex spp. leaves can be considered as a phytoadditive with antioxidant, antibacterial and antiparasitic properties, anticoccidial and antiinflammatory activities. The benefits of plant are due to its chemical composition: anthraquinones, tannins, flavonoids and phenolic acids. Some of these compounds have shown anti-inflammatory and antioxidant effects. This natural alternative source of nutrients can be collected from its natural habits and can be recommended as a valued medicinal herb and appreciated culinary vegetable. Some studies concluded that Rumex spp. can be used as fodder for livestock with real benefits effects on production performances, intestinal health, serum parameters and milk composition. Several broilers' studies noticed positive effects of patience dock on growth performances, duodenal morphology, serum thyroid hormones, and cecal microbiota. Taking into consideration the reported positive effects of Rumex spp. a dietary moderate inclusion in animal feed can be recommended.

Key words: *Rumex species; bioactive compounds; phytoadditive; microbiota; livestock*

INTRODUCTION

Nowadays scientists are investigating accessible low-cost natural ingredients with high content of nutrients that has beneficial effects on animal health without affecting animal productive performances. Genus *Rumex,* family *Polygonaceae* includes about 200 species of very common annual, biennial, and perennial herbal worldwide distributed. These wild plants are harvested mostly from their natural habits and offers a viable economic alternative as an accessible and an affordable source of nutrients for farm animals. Wild plants represent a source of pure active principles with a synergistic combination of active ingredients (Jain and Parkhe, 2018). *Rumex* spp. is widely used as food, as a medicinal herb (Łuczaj et al., 2012). Though harvesting wild herbs is regarded as time-consuming and season-dependent, their utilization in animal nutrition offers an abundance in bioactive phytochemicals needed for obtaining functional feed and food. Their economic value can be related to the worldwide growing interest in the functional food and feed sector, which may further encourage an increased production of these species utilization and their availability on the market (Łuczaj et al., 2012). Proximal analyses of different *Rumex* spp. indicated that the content in vitamins, minerals and essential oils determined in root and leaves can offer a suitable complementary diet (Idris et al., 2019). The utilization of natural antioxidants wild sources has recently drawn a lot of attention due to the fact that herbs and other biological components are safe, nutritional, and medicinal (Abbas et al. 2012, Quiroz and

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Dantán, 2015). Other studies confirmed that *Rumex* spp. exhibits antioxidant activities due to luteolin and kaempherol phenolic content (Sumaira et al., 2011). To date chemical analyses of these wild herb reported important bioactive components: 56 quinones were isolated from 17 *Rumex* spp., 57 flavonoids, 25 tannins, 6 stilbenes, 22 naphthalenes, 6 terpenes, 3 diterpene alkaloids, 14 lignans and 79 other components (Li et al., 2022). Occasionally, *Rumex* spp. is regarded as an unsuitable plant that decreases the feeding value and productivity of other yields. Using this phytoadditive into monogastric diets could represent a method of biological control of this wild herb (Ringselle et al., 2019). More than 14 *Rumex* spp. can be consumed freshly or cooked as vegetables being considered as a functional food with anti-inflammatory activity (Li et al., 2022). Mohamed et al. (2022) investigated *R. dentatus*, *R. pictus*, *R. vesicarius* potential for food preservation due to their antioxidant and antimicrobial activities.

The purpose of this review is to highlight the numerous beneficial effects of *Rumex* spp. utilization in livestock nutrition as an accessible and beneficial phytoadditive alternative.

MATERIALS AND METHODS

A search for animal nutrition and chemical analysis studies in specific databases was conducted. All collected data were compared among them. Similarity and differences of the recorded data were taken into consideration. To fulfill the review's objective of this study, 30 of bibliographic sources from the literature were consulted. Relevant articles were consulted by identifying scientific databases with keywords: *Rumex* species, antioxidant, antibacterial, antiparasitic, anticoccidial and antiinflammatory, livestock, performances, intestinal health.

Antioxidant properties of Rumex species

Using wild herbs and plant extracts as efficient active ingredient in human traditional medicine it is a well-known practice worldwide (Ahmed, 2016). The deficit of antioxidant presence within food and feed can cause an insufficiency into body which generates more reactive oxygen species (ROS) especially under stress conditions. A higher content and level of phenolic compounds of *Rumex* spp. extracts determines a higher radical-inhibiting activity (Feduraev et al., 2022). As, Nisa et al., (2013) stated the plant extract of R. *dentatus* shown highly significant antioxidant activity ($p \leq 0.05$) comparable to ascorbic acid and butylated hydroxyl toluene. According to Lone *et al*. (2007), *R. patientia* root extract contains a highly level of polyphenols and high reduction potential which determine a strong antioxidant enzyme activity. Also, Sahreen et al. (2017) stated that *R. hastatus* leaves are an accessible source of natural antioxidants with sufficient amount of phenolics, that acts as a potent hepatprotective agent. Elzaawely et al. (2005) noticed that *R. japonicus HOUTT* registered the highest content of phenolic compounds and exhibited the highest reducing power and antioxidant activity when assayed. Gonfa et al., (2021) reported that roots and leaves of *R. nepalensis* showed significant antioxidant activities due to its polyphenols and flavonoids compounds. The root extract of *R. nepalensis* exhibits a better scavenging activity with potential medicinal remedies (Enyew et al., 2014). Other *in vitro* studies have shown a high scavenging activity against DPPH and lipid peroxidation on *R. dentatus* a ethnomedicinal plant with a high culinary value. Al-Quraishy et al., (2020) found that *R. nervosus* leaf extract included in broilers' diet, after being infected with *Eimeria tenella* registered an improved level of glutathione, malondialdehyde and nitric oxide. Also, Wang et al. (2018) observed that the antioxidants from natural sources improves the cells' oxidative status of caecum and reduces the oxidative damage caused by *Eimeria tenella* infections. Spinola et al., (2018) noticed that *R. maderensis* shown a high antioxidant activity due to its phenolic content with a real potential of developing functional products.

Anticoccidial and antiinflammatory activities of Rumex species

The control of avian coccidiosis it is often controlled using chemical drugs, but medicinal plants as *Rumex spp*. represents a natural alternative solution with anticoccidial and antiinflammatory properties. Qaid et al. (2021) tested *R. nervosus* leaf meal (5 g/kg feed) protective effects against *E. coli* in avian coccidiosis. The dietary *R. nervosus* leaf meal inclusion lowered significantly ($p \leq 0.05$) the lesion scores and the oocysts per gram within chicken droppings. Additionally, *R. nervosus* leaf meal shown high activity against Coxsackie virus B3 and influenza A virus. Remmal et al. (2013) stated that *R. nervosus* extract showed anticoccidial activity due to active several phytochemical compounds as eugenol. *In vitro* and *in vivo* animal studies experienced a combination of 5 plants extracts among which *R. acetosa* that indicated an efficient antiinflammatory activity of this herbal mixt (Jund et al., 2012). *R. nepalensis* root ethanolic extract demonstrated strong inhibitory inflammatory effects when compared to standard diclofenac Jain and Parkhe (2018). As Alberto et al. (2016) stated the responsibility of the inhibitory effects of this root plant extract is due to the presence of anthraquinones, naphthalenes, chrysophanol, physcion, endocrocin and nepodin secondary metabolites.

Antibacterial and antiparasitic activities of Rumex species

Regarding the different plant parts of *Rumex species*, usually the roots proved to have significant effects against multiple bacterial strains. For example, *R. patientia* leaf extract did not possess any antibacterial activity; in case of its flowers, only the extract C was active, while the root extract of the plant showed activity against almost all bacterial strains (Jeppesen et al., 2012). *Rumex spp*. roots, leaves and flower extract demonstrated strong antibacterial activity against practically all strains (Jeppesen et al., 2012). Al-Asmari et al. (2015) examined antibacterial impact of *R. nervosus* aerial parts on *Staphylococcus aureus*, *Enterococcus faecalis*, *Escherichia coli*, *Pseudomonas Aeruginosa*, and the fungus *Candida albicans*. According to Orbán-Gyapai et al. (2017) the antibacterial effects of n-hexane, chloroform extracts, and aqueous fractions of methanol extracts generated from various sections of 14 Rumex species shown strong antibacterial activity against one or more bacterial strains. Wegiera et al. (2011) concluded that *R. confertus*, *R. crispus*, *R. hydrolapathum*, and *R. obtusifolius* presented inhibitory effects on Gram-positive (Staphylococci) and Gram-negative (E. coli, P. mirabilis, and P. aeruginosa) bacterial strains growth. According to Jeppesen et al. (2012), *R. patientia*, showed a minimal inhibitory impact on *S. aureus*, E. *coli*, *B. subtilis*, and *P. aeruginosa*. Elzaawely et al. (2005) discovered that *Rumex japonicus HOUTT's* ethyl acetate extract had the most potent antibacterial effect on *Bacillus subtilis*, B. *cereus*, and *E. coli*. By providing a diet containing 1,000 mg/kg *R. Nervosus*, Mahmoud et al. (2020) found that the amount of cecal *Escherichia coli* was significantly ($p \leq 0.001$) reduced.

Effects of Rumex species on livestock performances and intestinal health

Only a few works in literature demonstrate the effects of *Rumex* spp. dietary utilization in livestock nutrition. Azam *et al*. (2020) confirmed that using *R. nervosus* leaves meal in broiler chickens´ diet, during the starter period, improved production performances, intestinal health and morphology and serum thyroid hormones when added into diets up to 1,000 mg/kg. Using *R. nervosus* leaves meal (1,000-5,000 mg/kg) Mahmoud et al. (2020) found that body weight gain parameter was significantly ($p \leq 0.05$) improved on 10 days of age and increased significantly ($p \leq 0.05$) on 14 days of age at 3,000 mg/kg dietary inclusion. Feeding 1,000 mg/kg RN reduced significantly ($p \leq 0.05$) feed conversion ratio as compared to control on day 14 of age (1.11 vs. 0.96). The growth performances were unaffected ($p > 0.05$) on days 21 and 34 of age. The relative weight of the breast meat was increased ($p = 0.003$) by the addition of R. *nervosus* leaves meal. A significant high

($p \leq 0.05$) duodenal villus was obtained by feeding a diet containing 1,000 mg/kg RN when adding 1,000 mg/kg dietary *R. Nervosus* spp., *R. crispus* spp. *Polygonum aviculare*, *and Potentilla anserine* extracts have recently been discovered to reduce the amount of cecal E. coli (Kupczyski et al., 2019).

Effects of Rumex species on livestock serum parameters

Rumex species has been reported to possess medicinal properties such as purgative, depurative, antipyretic, anti-inflammatory, etc. (Suleyman et al., 1999, 2001, 2004). A significant improvement in the levels of liver damage markers: AST, ALT, ALP and bilirubin following extract pretreatment suggested it to protect against liver damage. *R. patientia* is considered to be an essential constituent of the Chinese herbal medicine, ‘‘Yangti’’, which is used as haemostatic and antifungal agent (He et al., 1981). Phytochemical analysis of the plant have shown to be rich in anthraquinones, tannins, naphthalene derivatives, etc. (Demirezer et al., 2001)**.** *R. nervosus* and *R. abyssinicus* demonstrated macrophage cell proliferation. As macrophage cells are important components of the immune system, this result suggests that the plants may have a role in improving the immune system of the body. Mahmoud et al. (2020) noticed that on day 10 of age, the levels of serum albumin on broilers were significantly increased ($p \leq 0.05$) by dietary supplemental with *R. nervosus* (1,000–5,000 mg/kg). However, total protein, uric acid, aspartate aminotransferase, and alanine aminotransferase were not differed among dietary treatments. The addition of graded levels of *R. nervosus* leaves meal (1,000–5,000 mg/kg) significantly increased triiodothyronine level ($p \leq 0.05$).

CONCLUSIONS

Within the present study significant antioxidant, anticoccidial, antiinflammatory, antibacterial and antiparasitic properties were demonstrated by mostly *in vitro* studies in order to show that *Rumex* spp. can be a valuable ingredient for human and animal nutrition. Although there are numerous studies presenting the noteworthy benefits of *Rumex* spp. by its content of secondary phenolic compounds, a further systematic analysis is required to study the effects of different *Rumex* spp. in livestock nutrition.

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