MEDICINAL HERBS AND THEIR EXTRACTS IN RUMINANT ANIMAL PRODUCTION

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Abstract
The use of plants and plant secondary metabolites opens a diverse variety of choices for scientists to investigate the most effective, safe and economical means within the reach of smallholder farmers, especially in the developing countries. In fact, herbs, spices and their extracts were already used thousands of years ago in Mesopotamia, Egypt, India, China and old Greece, where they were appreciated for their specific aroma and various medicinal properties as they possess a positive impact on physiological functions, help to ensure good health and performance. The main objective of this review is to study the roles of herb medicine mixtures in productive and reproductive performance, ruminal fermentation and microbiota, methane mitigation, oxidative stress reduction and blood profile of ruminant animals.

Keywords: methane mitigation, ruminal fermentation and microbiota, blood profile, performance

Introduction

Herbal medicine is a whole or cut up, dry (occasionally raw) part of a plant, algae, fungi or lichen used for its medicinal properties. Apart from plant organs (root, rhizome, crust, flower, fruit, seed, etc.), plant exudates (tars, gums) are also herbal drugs. Herbal preparations are fat oil, essential oil, plant juices, tinctures and extracts (dry, soft, fluid) (Runjaić-Antić *et al*., 2010) obtained by special procedures such as distillation, extractions, etc. Essential oils, comprising more than 100 individual products (Tassoul and Shaver, 2009), are volatile and aromatic compounds, with an oily appearance, obtained from plants (Burt, 2004). Herbal plants have been used as phytogenetic feed additives because of their natural polyphenols content, and potent antioxidant, anti-cancer, anti-inflammatory and antimicrobial effects. Different herbs and their combinations can also affect specific physiological functions in animals such as feed intake and utilization, growth, heat stress, rumen fermentation pattern and CH_4 production (Bhatt, 2015). Studies with garlic, as an alternative growth promoter in livestock production, reported improved growth rate, digestibility and carcass traits (Bampidsis *et al*., 2005; Tatara *et al*., 2008). Lemongrass and peppermint, as feed additives, improved production performance of beef and dairy cattle (Hosoda *et al*., 2005; Wang *et al.*, 2007) and enhanced rumen fermentation (Wanapat *et al.*, 2008; Kongmun *et al.*, 2010).

Effect of medicinal herbal on productive performance of ruminants

Medicinal plant seeds improved the productivity of lactating animals and its hormonal alert effect through increasing prolactin and growth hormone release, in addition to activating udder tissues in line with increasing glucose concentration (Abo El-Nor *et al*., 2007). Using Rosemary and lemongrass herbs as phytogenic feed additives in diets of lactating goats, Kholif *et al*. (2017) observed improved feed efficiency (FE) and milk production and quality. Sar-saponin, a naturally occurring steroid saponin contained in *Yucca schidigera*, is believed to be a potent natural feed additive (Ryan *et al*., 1997). The methanol extract of *Sapindus rarak*

increased average daily gain (ADG) and FE of animals fed rice straw based diet (Thalib *et al.*, 1996). *Fructus ligushi lacid* supplementation increased heifers' ADG, final body weight and FE (Qiao *et al.*, 2013). Studies conducted by Lan *et al.* (2000) and Wang and Wang (2007) showed that some formulas of Chinese herbal medicines (CHM) containing *Radix astragali* and *Rhizoma atractylodis* increased growth of beef cattle. In contrast, Wang *et al*. (2011) did not find any differences in ADG of crossbred beef cattle supplemented with CHM.

Effect of medicinal herb on reproductive performance of ruminants

Most of the studies that reported the adverse effects of oxidative stress and efficiency of herbal mixtures and their extracts on animal reproduction focused on humans, rats, or mice models with little evidence on cattle, sheep, goats and pigs. Moreover, most of studies only reported results and failed to explain in detail the mechanisms/mode of actions of the herbal mixtures (Zhong and Zhou, 2013). However, the antioxidant component of the medicinal herbs have been reported to affect spermatogenesis, sperm quality and production and even fertility (Boonsorn *et al*., 2010).

Effect of medicinal herb on ruminal fermentation

Optimum feed utilization by ruminants is dependent on achieving maximum rumen fermentation and flow of microbial protein to the duodenum (Belete, 2000). Yang *et al*. (2007) and Wanapat *et al.* (2008) reported that ruminal pH was not affected by garlic powder or lemongrass meal supplementation while other researchers observed that peppermint supplementation decreased ruminal pH (Hosoda *et al*., 2005). Kholif *et al*. (2017) reported unaffected ruminal pH and acetate, reduced ruminal NH_3-N and butyrate and improved volatile fatty acids, propionate and acetate/propionate ratio in goats fed lemon or rosemary herb. In an *in vitro* study on rumen microbial fermentation, Busquet *et al*. (2005) confirmed methane reduction up to 19.5% and a reduction of acetate and increased proportion of propionate and butyrate proportion using garlic oil at doses 300 and 3000 mg/L and benzyl salicylate at doses 300 and 3000 mg/L, suggesting that methane was inhibited while at the same time efficiency of energy use was improved in the rumen.

Effect of medicinal herb on ruminal microbiota

Cobellis *et al*. (2016) investigated the effect on dietary supplementation of rosemary (*Rosmarinus officinalis* L.) leaves in sheep and reported that the herbal medicine did not affect the abundance of total bacteria, protozoa, or *Ruminococcus flavefaciens*, but the leaves, decreased the abundance of archaea and the genus Prevotella, *Ruminococcus albus* and *Clostridium aminophilum*, while the essential oil increased the abundance of *Fibrobacter succinogenes*. Rosemary leaves and the oil extract affect the abundance of several groups of rumen microbes that are involved in degradation of protein and fibre and production of methane and ammonia, and can be used to modulate rumen microbiome and its function (Cobellis *et al*., 2016). Essential oils are able to manipulate rumen fermentation, due to selective pressures exerted on different microbial populations, resulting in different bacterial numbers and activities, in both the liquid and solid milieu of the rumen (Bhatt, 2015). The effect of supplying disodium fumarate (derived from a plant called *Fumaria officianalis)* to sheep fed on high forage diets on ruminal fermentation and microbial communities was studied recently by Zhou *et al.* (2012) which resulted in a decreased ruminal pH and inhibition of growth of methanogens, protozoa and fungi.

Effect of medicinal herb on methane mitigation in ruminants

Microbial rumen fermentation process has energy losses as methane and protein losses as ammonia N. These inefficiencies limit the production performance of the host animal and contribute to the release of greenhouse gas pollutants to the environment. Any sustainable solutions to inhibit loss of energy as methane and protein as ammonia N should be practical, cost effective and have no substantial adverse effect on the profitability of ruminant livestock production (Belete, 2000). Several types of phytochemicals from medicinal herbs have been extensively evaluated both *in vitro* and *in vivo*, including saponins, tannins (Bhatta *et al*., 2015), essential oils (Patra and Yu, 2014) and lipids for methane mitigation (Benchaar *et al*., 2015). In most studies, however, effective CH_4 suppression was accompanied by a significant decrease in feed digestion and fermentation (Grainger and Beauchemin, 2011).

Effect of medicinal herb on oxidative stress reduction in ruminants

Oxidative stress is responsible for numerous disease processes in animals, including sepsis, mastitis, enteritis, pneumonia and respiratory and joint diseases Lykkesfeldt and Svendsens (2007). Oxidative stress is a main underlying cause which can interfere with spermatogenesis, reduce sperm quality and production and even cause infertility (Boonsorn *et al*. 2010). Numerous secondary metabolites formed by plants serve as defence agents against physiological and environmental stressors, predators and pathogenic microorganisms. Myain molecules responsible for the antioxidative properties of herbs and spices are phenolic substances (flavonoids, hydrolysable tannins, proanthocianidins, phenolic acids, and phenolic terpenes) and vitamins A, E and C (Bhatt, 2015). Frequently used herbs rich in phenolics are *Rosmarinus officinalis*, *Thymus vulgaris*, *Origanum vulgare*, *Salvia officinalis*, *Camellia sinensis*, *Taraxacum officinale* and *Ginkgo* (Halliwell *et al.*, 1995; Craig, 2001; Ćetković *et al.*, 2004; Fasseas *et al.*, 2008). Gallic acid, tannins and essential oil, as antioxidants, have been recognized to be better than synthetic antioxidants due to lower cytotoxicity and residue (Gupta and Sharma, 2006; Nagulendran *et al*., 2007).

Effect of medicinal herb on blood profile of ruminants

Blood profile is an indication of animal health status and productive performance. Several medicinal herbs are used to enhance the immune system or bring it back up to normal levels following an illness. The immune system generally benefits from the herbs and spices rich in flavonoids, vitamin C and carotenoids (Bhatt, 2015). Qiao (2013) stated that diet supplemented with *Fructus ligushi lacidi* (FLL) improved blood antioxidant and immunity status of dairy heifers. They attributed the increased growth performance of the dairy heifers to the fact FLL supplementation improved digestion, or antioxidant status, or immunity status, or all of them. Chinese herbal mixtures in a corn, corn silage and alfalfa hay based diet increased the digestive enzymes activities in post-ruminal digestive tract and enhanced antioxidant status of serum in a formulation dependent manner (Wang *et al.*, 2011).

Conclusion

Various studies have shown promising results regarding the use of medicinal herbs as growth promoters, antioxidants, immune enhancers and therapeutic agents. They can successfully replace antibiotics and hormones effectively. However, there is still a need for further research on their effects on reproductive performance in ruminants as major works on this aspect focused on non-ruminants.

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