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Utilization of Korean Wild Ginseng Adventitious Root Meal in Livestock

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Abstract: Owing to the restriction of most antibiotic feed additive for livestock in the European Union (EU) in 2006. A great effort has been devoted towards developing antibiotic alternatives to stabilize the health and growth performance in livestock. Therefore, various substances have been suggested such as feed enzymes, probiotics, prebiotics, organic acids and phytogenic feed additives among which phytogenic feed additive were generally consisted of herb, spices and botanical. The study is concerning a kind of herb named Korean wild ginseng which had already been used in Eastern Asia countries. Researchers reviewed the current state of knowledge of Korean wild ginseng as well as the understanding of mechanism involved in promotion of productivity and health statues of animals.

Key words: Korean wild ginseng, alternatives, antibiotics, livestock, productivity

INTRODUCTION

During the last few decades, antibiotics have been widely used in the livestock industry for growth promotion and feed efficiency. However, there is growing concern about the possibility that the use of antibiotics in livestock feed increases number of antibiotic-resistant pathogens and creates antibiotic residue problems in animal products, especially in meat and eggs (Kelley *et al*., 1998). These residues might pose a potential health hazard to humans (Donoghue, 2003; Dipeolu *et al*., 2005). Therefore, in response to the restriction most of the antibiotic feed additives within the EU in January 2006 (Regulation 1831/2003/EC), a great interest has been increased in identifying antibiotics alternatives for growth promotion.

Indeed with the great effort on the antibiotic alternative investigation, various substances have been suggested to be the antibiotic alternative such as feed enzymes, probiotics, prebiotics, organic acids and phytogenic feed additives (Patterson and Burkholder, 2003; Levic *et al*., 2008; Windisch *et al*., 2008). Among these, phytogenic feed additives are commonly defined as plant-derived compounds incorporate into diets to improve the productivity of livestock through amelioration of feed properties, promotion of the animals production performance and improving the quality of food derived from those animals (Windisch *et al*., 2008). Historically, Ginseng (Panax ginseng C.A. Meyer) is a valuable herb that has been used extensively in Eastern Asia, such as Korea, China and Japan for more than thousands of years. It is supposed to be one of the most famous medicinal plants in the world and its efficacy as a medicine has been studied for a long time. However, to the best of the knowledge, the utilization of Ginseng in livestock it especially limited. Only the earlier has state there is some beneficial effect on the livestock (Jang *et al*., 2008; Yan *et al*., 2011; Ao *et al*., 2011). Therefore, this review is mainly trying out the potential and demonstrated effect of ginseng in livestock.

MODES OF ACTION OF PHYTOGENIC FEED ADDITIVES

Beneficial effects of herbs or botanicals in livestock may arise from activation of feed intake and secretion of digestive secretions, immune stimulation, anti-bacterial, coccidiostatic, anthelmintic, antiviral or anti-inflammatory activity and inhibition or particularly antioxidant properties (Nasir and Grashorn, 2010). Most of these active secondary plant metabolites belong to the classes of isoprene derivatives, flavonoides and glucosinolates and a large number of these compounds have been suggested to act as antibiotics or as antioxidants *in vivo* as well as in food (Ghosh *et al*., 2010). Several researchers have given some overview on physiologically active secondary plant metabolites (Rhodes, 1996) and their principles of antioxidative characteristics (Halliwell *et al*., 1995). Herbs develop their initial activity in the feed of farm animals as flavor and can therefore influence the eating pattern, secretion of digestive fluids and total feed intake. A main activity takes place in the digestive tract.

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Herbs or the phytochemicals can influence selectively the microorganisms by an anti-microbial activity or by a favorable stimulation of the eubiosis of the microflora. The consequence can be a better nutrient utilization and absorption or the stimulation of the immune system. Finally, herbs can contribute to the nutrient requirements of the animals and stimulate the endocrine system and intermediate nutrient metabolism.

During the growth period of the animal the diverse activities of herbs or other feed additives have a variable relevance. In the very young animal metabolism and nutrient digestion are not yet functioning optimally, the immune system and a stable, beneficial microflora (eubiosis) must be built up. For that a regular intake of feed and water is of a high priority. Later the digestion processes can be optimized and adapted to the available feedstuffs. In the later stages of growth processes that are in relation with the product quality play a major role (Niewold, 2007).

Often the desired activity of herbs is not constant. Conflicting results may arise from the natural variability of the composition of plant secondary metabolites. Variety and environmental growth conditions, harvesting time and state of maturity, method and duration of conservation and storing, extraction method of the plants as well as possible synergistic or antagonistic effects, anti-nutritional factors or microbial contamination are factors which may substantially affect the results of *in vivo* experiments. For example, rosemary and sage from different geographical locations and types of processing (dried herbs and essential oils) or from different suppliers showed significant differences in anti-oxidative capacity. Furthermore, several secondary plant metabolites are showing strong flavors which may affect sensory characteristics of the feed and therefore, feed intake. Additionally, antibacterial properties and probably concentration dependent-effects on feed intake and digestion of nutrients can be expected and should be taken into consideration when conducting *in vivo* experiments with phytochemicals using farm animals.

DEFINITION AND DESCRIPTION OF KOREA WILD GINSENG (KWG)

Earlier, the genus name *Panax* (Pan = all + axos = medicine) means cure all in Greek. Therefore, the herbal root is so named as ginseng because it is shaped like a man and is believed to embody his three essences (i.e., body, mind and spirit). Ginseng means literally the essence of the human and is also known as the king of the herbs (Hu, 1976). Ginseng genus (*Panax*) consists of 17 species. Among them, 3 species including *P. ginseng* (ginseng), *P. quinquefolius* (American ginseng) and *P. notoginseng* (sanchi) are recognized as a medicine in China and thus they are well cultivated. Panax ginseng is categorized as either cultivated or wild according to the different nurturing methods. For example, cultivated ginseng is systematically farmed on open land and harvested after 5-6 years when the growth rate and concentration of the active chemical constituents have peaked. On the other hand, wild ginseng is planted as seedlings in secluded mountain areas at an altitude between 800-1,500 m. Commercially available ginseng is classified into white and red ginseng. White ginseng is made by peeling the fresh ginseng roots and drying them without steaming. Red ginseng is made by drying the fresh ginseng with steaming called transformation which used heat to preserve ginseng for an extended period of time (Shin *et al*., 2000).

Besides, most Korean ginseng preparations are derived from the dried ground root of the plant. It is available in capsules, tinctures and teas. Korean ginseng has been used to treat many ailments for centuries including immune deficiencies, arthritis and other inflammatory diseases, cancer, attention and focus deficits and weight loss (Ha *et al*., 2009).

PROPOSED OR DEMONTRATED MECHANISM OF KOREAN WILD GINSENG

KWG (Panax ginseng) has been used as a folk medicine among people of Korea for thousands of years. The ginseng saponins, commonly known as ginsengosides are regarded as the most important active components in ginseng roots. The usefulness of KWG for its anticarcinogenic, antioxidant activity, immunoenhancing properties and stimulation of nitric oxide production in immune system cells in humans and animals is also well established (Gillis, 1997).

Effect on immune function: Txhat extracts of Panax ginseng affect the hypothalamus pituitary adrenal axis and the immune system which account for many of the documented effects. Animal models and *in vitro* studies also indicate that Panax ginseng enhances phagocytosis, natural killer cell activity and the production of interferon, improves physical and mental performance in mice and rats, causes vasodilation, increases resistance to exogenous stress factors and affects hypoglycemic activity.

Clinical studies on the effectiveness of Korean ginseng have had mixed results over time. The most beneficial effects noted have been psychological not physiological such as concentration, focus and sexual pleasure all show beneficial effects but less so with immune-boosting and anti-inflammatory effects.

From time immemorial, the drug ginseng (Panax ginseng C.A. Meyer-root) has been used in Chinese medicine for different purposes such as an anti-stress drug (Liu and Xiao, 1992), tonic for the central nervous system, improving mental concentration and as a general medicine for improving natural resistance to infection (Brekhman and Dardymov, 1969; Liu and Xiao, 1992). The major constituents of GS are saponins which are biological detergents because of glycosylation of the hydrophobic aglycone. In earlier studies, ginsenosides were found to have stimulatory effects on neutrophils in milk and peripheral blood lymphocytes from cattle *in vitro* (Concha *et al*., 1996). Subcutaneous injection of ginsenosides activated the innate immunity of cows with subclinical intramammary infection with *Staphylococcus aureus* (Hu *et al*., 2001). Isolation and characterization of the chemical constituents in drug ginseng have revealed that its active immune components are ginsenosides which are saponins chemically related to triterpenoid glycosides of the dammarane series (Chen and Zhang, 2001). Researchers found earlier that a vaccine administered with ginsenosides-enhanced antibody responses in guinea pig. Ginsenosides also enhanced the antibody response to viral and bacterial antigens (Rivera *et al*., 2003) but the adjuvant effect of ginsenosides in chickens has not yet been examined.

Effect on cerebral blood flow and cholesterol: The pharmacological effects of ginseng have been demonstrated in the central nervous system, cardiovascular, endocrine and immune system. Ginseng and its constituents have been ascribed to possess anti-stress and anti-oxidant activity (Gillis, 1997). Earlier studies had demonstrated that the saponin fraction of Korean Red Ginseng (KRG) had vasorelaxing and hypotensive effects (Jeon *et al*., 2000; Ao *et al*., 2011). The change of vasomotor tone is one of the important regulators in the cerebral circulation (Toda *et al*., 2001). Earlier reports indicate that KRG can influence vasorelaxation of cerebral vessels (Toda *et al*., 2001). Cerebral blood flow is controlled by complex factors such as neuronal, endocrine, metabolic factors. Although, the direct effect of ginseng on the cerebral blood flow has not been studied, researchers hypothesized that KRG might influence cerebral blood flow.

Reactive oxygen species appear to be a key mediator of cellular signaling. Potential enzymatic sources of superoxide in blood vessels include cyclooxygenease, xanthine oxidase, NAD (P) H oxidase (Cai and Harrison, 2000). In the circulatory system, the vascular endothelial cell is an early focus of free radical injury. Recent evidence, mainly from the aorta, suggests that NAD (P) H oxidase is a major source of vascular superoxide (Cai and Harrison, 2000). NADPH dose-dependently increased superoxide levels and induced vasoconstriction in the basilar artery (Didion and Faraci, 2002). Panax ginseng showed a remarkable capacity to protect brain tissue proteins from oxidative damage *in vitro* (Siddique *et al*., 2000). Also, it was reported that aqueous extracts of ginseng scavenged several reactive oxygen species (Kim *et al*., 2002). However, effect of saponin fraction of KRG on reactive oxygen species has not been studied so far.

Moreover, it has been known for many years that saponins form insoluble complexes with cholesterol. Saponins form micelles with sterols such as cholesterol and bile acids. Interactions of saponins with cholesterol and other sterols account for many of the biological effects of saponins, particularly those involving membrane activity. Implications of the roles of saponins in reducing blood cholesterol levels in humans will be discussed later. Oakenfull and Sidhu (1989) reviewed the effects of dietary saponins on blood and tissue cholesterol levels in poultry. It was demonstrated over 40 years ago that dietary saponin reduces blood cholesterol levels in chickens (Griminger and Fisher, 1958). This effect is likely a result of saponins binding to cholesterol in the bile in the intestine and preventing its reabsorption. Efforts to reduce egg cholesterol levels by feeding sources of saponins to laying hens have generally not been successful (Sim *et al*., 1984). The main source of egg cholesterol is endogenous synthesis in the ovary so, reductions in blood cholesterol in laying hens do not result in lowered egg cholesterol. Dietary saponins also reduce blood cholesterol levels in mammals (Oakenfull and Sidhu, 1989). In livestock species, a possible application might be the use of dietary saponin to reduce meat cholesterol levels. However, because cholesterol in meat is an integral component of muscle cell membranes, it is not likely to be possible to lower meat cholesterol levels by dietary manipulations.

Effect on antioxidant activity: Antioxidants are classified as compounds capable of delaying, retarding or preventing autoxidation processes. Synthetic antioxidants such as Butylated Hydroxytoluene (BHT) and Butylated Hydroxyanisole (BHA) are commonly employed as food preservatives, being consumed in appreciable quantities by humans. However, the use of such synthetic antioxidants has been associated with potential health risks, such as transfering resistance genes resulting in their strict regulation in food applications (Phillips *et al*., 2004). Consequently, there is a practical need for the screening and selection of natural antioxidants as effective alternatives in the prevention of food deterioration. Antioxidant properties of herbs, spices, plant and other food extracts are apparently related to their phenolic content, suggesting that their antioxidant action is similar to that of synthetic phenolic antioxidants. Thus the search for and development of other antioxidants of natural origin are highly desirable.

Recently, there has been a renewed interest in investigating pharmacological activities of ginseng using biochemical and molecular biological techniques. The biochemical and pharmacological activities of the ginseng have been demonstrated in the Central Nervous System (CNS), cardiovascular, endocrine and immune systems. Gillis (1997) also suggested that ginseng with many active components does have beneficial effects such as antiaging, antidiabetic, anticarcinogenic, analgesic, antipyretic and antistress, antifatigue, tranquilizing activities, promotion of DNA, RNA and protein synthesis activities and antioxidant activity. All of the extracts of Panax ginseng roots possessed the antioxidant activity and inhibited autoxidation of Methyl Esters of Unsaturated Fatty Acid (MEUFA) (Park *et al*., 1982). Especially, the antioxidant and free radical scavenging effects of ginseng and some of its selected ingredients have been extensively investigated and well documented (Choi *et al*., 1983).

In addition, ginseng extract was also reported to inhibit lipid peroxidation through transition metal chelation (Keum *et al*., 2000). However, few studies have been conducted to compare the antioxidant activities of fine and main roots extracts with different polarity. In this study, freeze-dried of main and fine roots of ginseng that extracted with ethanol, methanol and water were investigated for their antioxidant activities and compared to BHT, BHA and Trolox by measuring total phenolics, DPPH radical scavenging activity, ferrous ion chelating activity, reducing power, TBA-Reactive species (TBARs) and Ferric Reducing Aantioxidant Power (FRAP) assay.

CONCLUSION

In recent decades, phytogenic feed additives have been considered as potential candidates, among other feed additives, to antibiotics in farm animals. Some researchers have shown positive effects with dietary KWG additives in improving immunity and some other effect in human but scarify study is available in agriculture livestock. Therefore, the exactly mechanism how KWG affect on the animal is still warrant, more experiments are necessary to study the effects and mode of action of KWG in both swine and poultry.

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