International Journal of Science, Environment and Technology, Vol. 5, No 3, 2016, 1137 – 1145
ISSN 2278-3687 (O)
2277-663X (P)

HERBAL FEED ADDITIVES IN POULTRY

T. Suganya*, S. Senthilkumar, K. Deepa, J. Muralidharan, G. Gomathi and S. Gobiraju
Department of Animal Nutrition,
Veterinary College and Research Institute, TANUVAS,
(Tamilnadu Veterinary and Animal Sciences University)
Namakkal – 637 002, Tamilnadu, India
E-mail: drsuganya92.ann@gmail.com (**Corresponding Author*)

Abstract: Use of herbal feed additive is gaining importance in animal production due to ban on use of certain antibiotics, harmful residual effects and cost effectiveness. Probiotics, prebiotics, enzymes and highly available minerals as well as herbs can be seen as alternatives. Herbs, spices and their extracts (botanicals) have a wide range of activities. They can stimulate feed intake and endogenous secretions or have antimicrobial, coccidiostatic or anthelmintic activity. A major field of application of herbs is the protection of animals and their products against oxidation**.**
Keywords: Herbs, feed additive, antimicorbial, antioxidant, immunostimulant.

INTRODUCTION

Beside the feed enzymes, probiotics (for monogastric animals mainly lactobacilli), prebiotics (oligosaccharides), organic acids, the herbs and botanicals can be used as feed additives. A definition can be derived from Webster's Encyclopedic Unabridged Dictionary of the English Language (1989):

Herb: A flowering plant whose stem above ground does not become woody and persistent. A plant when valued for its medical properties, flavor, scent, or the like.

Spices: Any of a class of pungent or aromatic substances of vegetable origin, as pepper, cinnamon, cloves, and the like, used as seasoning, preservatives, etc.

Botanical: A drug made from part of a plant, as from roots, leaves, bark etc. Essential oils are any of a class of volatile oils obtained from plants, possessing the odor and other characteristic properties of the plant, used chiefly in the manufacture of perfumes, flavors and pharmaceuticals (Extracts after hydro - distillation).

*Received April 22, 2016 * Published June 2, 2016 * www.ijset.net*

Different herbal feed additives, its active components and functions

Plant	Used parts	Active component	Function
Nutmeg (*Myristica fragrans*)	Seed	Sabinene	Digestion stimulant, antidiarrhoeic
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Cinnamon (*Cinnamomum zeylanicum*)	Bark	Cimetaldehyde	Appetite and digestion stimulant, antiseptic
Cloves (*Syzygium aromaticum*)	Cloves	Eugenol	Appetite and digestion stimulant, antiseptic
Cardmom (*Amomum subulatum*)	Seed	Cineol	Appetite and digestion stimulant
Coriander (*Coriandrum sativum*)	Leaves and seed	Linalol	Digestion stimulant
Cumin (*Cuminum cyminum*)	Seed	Cuminaldehyde	Digestive, carminative, galactogogue
Anise (*Pimpinella anisum*)	Fruit	Anethol	Digestion stimulant, galactogogue
Celery (*Apium graveolens*)	Fruit, leaves	Phtalides	Appetite and digestion stimulant
Parsley (*Petroselinum crispum*)	Leaves	Apiol	Appetite and digestion stimulant, antiseptic
Fenugreek (*Trigonella foenum graecum*)	Seed	Trigonelline	Appetite stimulant
Capscicum (*Capsicum annuum*)	Fruit	Capsaicin	Digestion stimulant
Pepper (*Piper nigrum*)	Fruit	Piperine	Digestion stimulant
Horsradish (*Armoracia rusticana*)	Root	Allyl izotiocianat	Appetite stimulant
Mustard (*Brassica Nigra*)	Seed	Allyl izotiocianat	Digestion stimulant
Ginger (*Zingiber officinale*)	Rizom	Zingerone	Gastric stimulant
Garlic (*Allium sativum*)	Bulb	Alkin	Digestion stimulant, antiseptic
Rosemary *Rosmarinus officinalis*	Leaves	Cineol	Digestion stimulant, antiseptic
Thyme (*Thymus vulgaris*)	Whole plant	Thymol	Digestion, stimulant, antiseptic, antioxidant

Mint (*Mentha piperita*)	leaves	Menthol	Appetite and digestion stimulant, antiseptic
Shatavari (*Asparagus racemosus*)	Root	Sapogenins, flavonoids and saponin	Prevention and treatment of gastric ulcers, dyspepsia and as a galactogogue.
Jivanti (*Leptadenia reticulata*)	Leaves and twigs	Stigmasterol, ß – itosterol, flavonoids, pregnane glycosides	Galactogogue, antimicrobial and anti inflammatory
Shatavari (*Asparagus racemosus*)	Root	Shatavarin-I-IV, qucertin, rutin, hyperoside	Galactogogue

(**Source:** Mirzaei-Aghsaghali, 2012)

MODES OF ACTION OF HERBS AND BOTANICALS

Beneficial effects of herbs or botanicals in farm animals 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. Most of these active secondary plant metabolites belong to the classes of isoprene derivatives, flavonoides and glucosinolates**,** and a large number of these compounds has been suggested to act as antibiotics or as antioxidants in vivo as well as in food. A main activity takes place in the digestive tract. Herbs or the phytochemicals can influence selectively the micro-organisms 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. Immune system and a stable, beneficial microflora (eubiosis) must be buildup. For that a regular intake of feed and water is of a high priority. 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.

The herbal feed additives exert their beneficial effects by

1. Influence of herbal feed additives on feed intake, digestibility of nutrients and animal performance:

After the ban on antibiotics, more herbs are used as feed additives for a better growth condition. Due to the wide variety of active components, different herbs and spices affect digestion processes differently. Most of them stimulate the secretion of saliva. Curcuma, cayenne pepper, ginger, anis, mint, onions, fenugreek, and cumin enhance the synthesis of bile acids in the liver and their excretion in bile, what beneficially effects the digestion and absorption of lipids. Most of the prelisted spices stimulate the function of pancreatic enzymes (lipases, amylases and proteases); some also increase the activity of digestive enzymes of gastric mucosa. Besides the effect on bile synthesis and enzyme activity, extracts from herbs and spices accelerate the digestion and shorten the time of feed/food passage through the digestive tract (Frankic *et al*., 2009). Plant herbs such as garlic (*Allium sativum*), lemon grass (*Cymbopogon citrates*) and peppermint (*Mentha piperita*) are widely used as antibacterial agents and extensively used to maintain the microbial ecosystem of the gastrointestinal tract especially in tropical regions (Shin and Kim, 2004). Garlic as an alternative growth promoter in livestock production reported improved growth rate, digestibility and carcass traits (Kongmun *et al*., 2011). Lemongrass and peppermint have been reported as feed additives to improve production performance of beef and dairy cattle (Yang *et al*., 2007). Recently menthol (*Mentha arvensis*) is reported to improved ileal protein and amino acid digestibility thus feed efficiency in weaned piglets (Maenner *et al*., 2011) and black paper improved performance in broiler chicken (Tazi *et al*., 2014).

2. **Herbal feed additives as antimicrobial supplements:** Several studies showed strong antimicrobial activity of certain plant extracts against Gram- and Gram+ bacteria. Plants readily synthesize substances for their defense against insects, herbivores, and microorganisms. Moreover, they may produce secondary antimicrobial metabolites as a part of their normal growth and development or in response to stress. Several researches have studied the antimicrobiol effect of oriental herbs including *Allium sativum, Angelica dahurica, Anguisorba officinalls, Artemisia argyi, Coptis chinensis, Dictamnus dasycarpus, Fraxinus rhynchophylla, Geranium thunbergii, Hydrastis canadensis, Phellodenron amurense, Polygonum cuspidatum, Scutellria baicalensis* and *Sophora flavesens*. These herbs contain major flavonoid components, baicalin, baicalein, limonene, cinnamaldehyde, carvacrol or eugenol which exerts antimicrobial effect along with other supportive herbs.

These herbs have antibacterial effect against *Salmonella spp* or *E. coli* and gram positive bacteria *Staphylococcus spp*. and *Streptococcus spp.* Active principles in herbal feed additives changes fatty acid composition which can affect surviving ability of microorganisms by increasing hydrophobicity. This confirms the fact that herbs and spices act as antimicrobial agents by changing the characteristics of cell membranes, and causing ion leakage, thus making microbes less virulent. Plant extracts, known as phytobiotics, have been exploited for their antimicrobial, anti-inflammatory, anti-oxidative, and anti-parasitic activities. There is a lot of variations in the composition of phytobiotics due to the biological factors (plant species, growing location, and harvest conditions), manufacturing (extraction/ distillation and stabilization) and the storage conditions (light, temperature, oxygen tension, and time; Huyghebaert *et al*., 2011).

3. **Herbal feed additives as anti-inflammatory:** Extracts of curcuma, red pepper, black pepper, cumin, cloves, nutmeg, cinnamon, mint and ginger showed anti-inflammatory effect. The major active molecules with anti-inflammatory action are phenols, terpenoids and flavonoids. These molecules suppress the metabolism of inflammatory prostaglandins. Phenolic compounds of plants are hydroxylated derivatives of benzoic acid and cinnamic acids and have been reported to possess anti-inflammatory effects. Flavonoids have long been recognized to possess antiinflammatory, anti-allergic, antiviral and antiproliferative activities (Muanda *et al*., 2011). The most known herbs and spices with anti inflammatory potential are chamomile, marigold, liquorice and anis (Frankic *et al*., 2009). Plants of the Labiatae families (like mint) have attracted a great interest. Their antioxidative activities are due to phenolic terpenes (Cuppett and Hall, 1998). Thyme and oregano contain large amounts of monoterpenes, thymol and carvacrol (Rahim *et al*., 2011). Plants rich with flavonoids such as green tea and other Chinese herbs have been described as natural antioxidant (Wei and Shibamoto, 2007). Black pepper (*Piper nigrum*), red pepper (*Capsicum annuum* L) and chili (*Capsicum fretuscene*) contain also several antioxidative compounds (Nakatani, 1994). But in many of these plants, the parts containing the active substances are of a very fragrant and/or spicy taste leading to restrictions of their use in animal feed. Recently anti-bacterial, anti-viral, anti-fungal, anti-tumor, anti-inflammatory, immunomodulatory, wound-healing, anti-oxidant, and anti-diabetic effects properties of *Aloe vera* have been reviewed for poultry (Babak and Nahashon, 2014).

4. **Herbal feed additives as antioxidants:** Antioxidants are compounds that help delay and inhibit lipid oxidation and when added to foods tend to minimize rancidity, retard the

formation of toxic oxidation products, and help maintain the nutritional quality (Muanda *et al*., 2011). The healthpromoting effect of antioxidants from plants is thought to arise from their protective effects by counteracting reactive oxygen species. Several studies suggested that plants rich in antioxidants play a protective role in health and against diseases, and their consumption lowered risk of cancer, heart disease, hypertension and stroke. The antioxidant potential of medicinal plants may be related to the concentration phenolic substances (flavonoids, hydrolysable tannins, proanthocianidins, phenolic acids, phenolic terpenes) and some vitamins (E, C and A). Garlic and onion biological action products are ascribed to its sulfur-containing active principle which has been reported to their lipid lowering effects and inhibit oxidation of low-density lipoproteins (Ahmed and Bassuony, 2009). Often used herbs rich in phenolics are: rosemary, thyme, oregano, sage, green tea, chamomile, ginko, dandelion and marigold. Herbs and spices can protect the feed against oxidative deterioration during storage.

Anti- and pro-oxidative properties of essential oils

Anti-oxidative	Pro-oxidative	No activity
Almond bitter	Cardamom	Almond sweet
Clove	Coriander	Anise
Cinnamon	Estragon	Fennel
Laurel	Eucalyptus	Ginger
Mint	Lime	Lemon
Mutmeg	Sage	Marjoram
Pepper	Verbena	Melissa
Peppermint	-	-
Rosemary Thyme	-	-

(Deans *et al*., 1993)

5. **Herbal feed additives as immunostimulant:** The immune system generally benefits from the herbs and spices rich in flavonoids, vitamin C and carotenoids. The plants containing molecules which possess immunostimulatory properties are echinacea, liquorice, garlic and cat's claw. These plants can improve the activity of lymphocytes, macrophages and NK cells; they increase phagocytosis or stimulate the interpheron synthesis (Frankic *et al*., 2009). Lavinia *et al*. (2009) have shown that essential oils extracted from medicinal plants improve the immune response and also are able to cause changes of the duodenal mucosa with beneficial effects for the animal (Lavinia *et al*., 2009). Recently effect of ß-glucan and cow urine distillate have been highlighted as immunomodulator in broiler chicken (Ganguly, 2013).

6. **Herbal feed additives as *coccidiostat*:** some plant extracts have demonstrated an activity against some chicken parasites, especially coccidian (Naidoo *et al*., 2008) Betaine is a byproduct of the sugar beet industry; it has recently been seems to have a positive impact in fighting coccidiosis. It protects against osmotic stress associated with dehydration and permits normal metabolic activity of cells. However, the protective effects of betaine on the intestinal cells are also exerted on parasitic cells. The active component is curcumin; a phenolic compound coming from the rhizome of *Curcuma longa* exerts its anticoccidial effect through its antioxidant action on the immune system. *Galla rhois* and *Nectaroscordum tripedale* extracts have shown promising result against coccidial infection.

7. **Advantages of Herbal Feed Additives**

Selection and feeding of herbal feed additives over other feed additives is due to

1. Natural constituent of feeds.
2. Absence of residual effects.
3. Non-hazardous eco-friendly.
4. Minimum problem of drug resistance.

8. Limitations of Herbal Feed Additives

- Not easily quantifiable and standardized due to their complex composition.
- The location, soil type, weather conditions, altitude, season during which the plant is grown, harvesting procedure and storage conditions may affect the composition of plants.
- Although majority of herbals are stable, there are various constituents which are photo labile thermo labile thus less stable.
- 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 use of herbal feed additives.

CONCLUSION

In the concept of the production of healthy farm animals without the use of antibiotics herbs can be relevant in many different ways. They can regulate feed intake and stimulate digestive secretions. An optimized digestion capacity and reduced risk of digestive disorders are the consequence. Several phytochemicals like essential oils or dietary fiber can contribute to a balanced microflora (eubiosis), an optimal precondition for an effective protection against pathogenic micro-organisms and an intact immune system. Herbs and botanicals contain

many different antioxidants with a high potential for the protection of nutrients against oxidation in the digestive tract, in metabolism as well as in the products.

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