

Phytogenic Products: A Valuable Resources for Pig and Poultry Nutrition, Health and Management

D N Singh¹, P K Shukla², Amit Singh³, R. Sirohi⁴, Y. Singh⁵, Mamta⁶

Author Affiliation: ^{1,3,4,5,6}Assistant Professor, ²Professor and Head of Department of Livestock Production Management Veterinary Sciences and Animal Husbandry, Uttar Pradesh Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go Anusandhan Sansthan, Mathura 281001, Uttar Pradesh, India.

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Abstract

Due to over bacterial resistance as well as ban of antibiotic growth promoters (AGP) in the European countries many alternative substances have been investigated for their potential to replace AGPs. Phytogenic products are also called phytobiotics or biologicals. Phytogenic products are one of the promising alternatives due to their high content of pharmacologically active compounds. There are various in vitro and in vivo studies have confirmed a wide range of activities in terms of phytobiotics in poultry and pig nutrition, gut health and management like stimulation of feed intake, antimicrobial, coccidiostatic and anthelmintic effects. The use of antibiotics and other allopathic as well as homeopathic medicines reduced day by day. This trends are observed due to people are more health conscious about the side defects, quality of food, cost of production, poultry health and welfare is an ever-growing demand for low-priced, high quality food, improved feed hygiene, greater poultry health and welfare, and reduced environmental health hazards. Now days, Researcher has focused more on the development of alternative strategies to maintain poultry and pig health and enhance performance with numerous natural substances, termed as natural growth promoters (NGPs) have been identified as effective alternatives to antibiotics. Phytogenic products or phytobiotics are natural growth promoters that have been growing in popularity as feed additives, due to their beneficial effect on gut health and immunity and growth performance along with no residual or side defect on meat and egg qualities.

Keywords: Health and Management; Poultry Nutrition; Valuable Resources for Pig.

Corresponding Author: D N Singh, Assistant Professor, Department of Livestock Production Management, College of Veterinary Science and Animal Husbandry, Uttar Pradesh Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go Anusandhan Sansthan, Mathura-281001, Uttar Pradesh, India.

E-mail: drdeep25@gmail.com

Introduction

Poultry and pig industry plays a vital role for income generation to the rural people as well as for socio-economic up-liftment of farming community. Tremendous demand for animal protein, high growth rate and prolific values has caused an expansion of broiler and pig farming in India. To achieve more profit and benefits from

pig and poultry various natural growth promoters especially phytobiotics are used by the researchers as well as progressive farmers. The antibiotic growth promoters (AGPs) have been used extensively in livestock production for almost 50 years. Due to continuously public awareness towards potential health risks and environmental problems caused by the excessive use of synthetic pharmaceuticals including in-feed antibiotics as growth promoters,

growth hormones and also public demand for organic foods have gradually changed the attitude toward these synthetic antibiotics (Greathead 2003; Rochfort et al., 2008).

Phytobiotics can be defined as the plant derived products added to feed in order to improve the growth and productive performances of specific or all livestock species. It may originate either from leaves, roots, tubers or fruits of herbs, spices and other plants. It may be available in solid, semi-solid, liquid, dried and ground forms, or as extracts (essential oils). In simple terms, phytobiotics are products of plant origin and preparations such as thyme, oregano, turmeric, tulsi, sea buckthorn, giloy and garlic are gaining interest among researchers and poultry and pig producers. The beneficial effects of phytobiotics in poultry and pig may arise from the activation of feed intake and the secretion of various digestive enzymes, immune stimulation, antibacterial, coccidiostatic, anthelmintic, antiviral or anti-inflammatory activity or antioxidant properties for the welfare of farm animals. Plant's secondary metabolites, such as isoprene derivatives, flavonoids, flavones and glucosinolates, may act as antibiotics or as antioxidants in vivo also, as a result of these beneficial effects, they lead to an increase in performance. There are various potential effects of phytobiotics on immune function can be mediated either by alterations of the composition of the gut microflora or by direct effects on the gut associated general immune system. Phytogenic feed additives are often called as "Phytobiotics" or "botanicals". It can be commonly defined as plant-derived compounds incorporated into diets to improve the productivity, health and nutrition of livestock as well as quality of products through amelioration of feed (Windisch et al., 2008).

The phytogenic feed additives may present in seeds, leaf, root, or bark of the herbs and the active content of biologically active components or alkaloids may vary widely, depending on the plant parts used. Plenty of studies have been done using phytobiotics in poultry and swine nutrition which mostly shown the antimicrobial, antioxidant, anti-inflammatory and growth promoting effects of phytobiotics (Panda et al., 2006). Anti-oxidative properties of phytobiotics can positively affect the stability of animal feed and increase animal's products quality and storage time.

Specifications of Phytogenic Substances

Leaves, roots, flowers and whole plants are used for production of phytogenic products. Products may comprise the dried form of whole plants or

their parts or extracts of some valuable ingredients. In general, phytobiotics are described by primary and secondary plant compounds (Fig. 1).

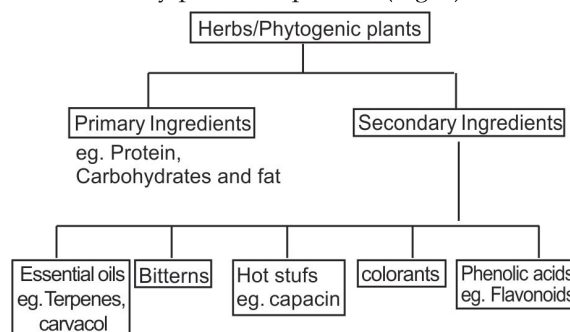


Fig. 1: Herbs phytobiotics are described by primary and secondary plant compounds.

Primary compounds are main nutrients (e.g., content of protein, fat, etc.), whereas, secondary compounds comprise essential (ethereal) and/or volatile oils, bitterns, hot stuffs, colorants and phenolic compounds (Wald, 2003). In general, phytobiotics do not add significantly to the intake of main nutrients in poultry. Therefore, secondary plant compounds are the main ingredients of interest. The main constituents of essential oils are lipophilic, liquid and volatile and belong to chemical groups of alcohols, aldehydes, esters, ethers, ketones, phenols and terpenes.

Beneficial Effects of Phytobiotics

The beneficial effects of phytobiotics in poultry and pig may arise from the activation of feed intake and the secretion of digestive enzymes, immune stimulation, antibacterial, coccidiostatic, anthelmintic, antiviral or anti-inflammatory activity, or from antioxidant properties. Many plant secondary metabolites, such as isoprene derivatives, flavonoids and glucosinolates, may act as antibiotics or as antioxidants in vivo. As a result of these beneficial effects, they lead to an increase in performance.

Improvement in Feed Consumption and Digestive Enzymes

Addition of herbal supplement in the feed as a flavor enhancer, therefore influence eating patterns and feed consumptions in pig and poultry. The secretion of digestive fluids and total feed intake is often considered to be one of the important actions of phytobiotics. The most of the herbs develops their initial activity in the feed as flavor and therefore

it influences eating patterns or eating behaviour, secretion of digestive fluids and total feed intake of animals. Due to stimulation of digestive secretions, including saliva, digestive enzymes, bile and mucus is often considered as one of the important actions and benefits of phytobiotics. A product from the rhizomes of *Sanguinaria canadensis* is frequently used in Europe for poultry and pig while garlic and horseradish, when included in feed, stimulate the production of saliva and gastric juices. Turmeric, a powder derived from the rhizome of *Curcuma longa* has been shown to improve feed intake in poultry when used at 0.25% in feed as well as reduce the occurrences of coccidiosis and other diseases of bacterial and protozoal origin. The CPDO, Hyderabad, has shown that 0.25% inclusion of turmeric powder in the diet of broiler chicken significantly increased the body weight gain at five weeks of age. It has been mostly reported that addition of herbal products to diets has growth promoting effect on poultry and swine (Wenk 2003; Kim et al., 2010; Mohammadi Gheisar et al. 2015a, b). The performance of pigs fed with the diets supplemented with essential oils and reported weight gain and digestibility of dry matter and crude protein were improved by 10.3, 2.9 and 5.9%, respectively (Li et al., 2012). They observed that improved performance of pigs was due to improvement in the intestinal morphology and consequently improvement of nutrients digestibility. Yan et al. (2010) also found that growing-finishing pigs with diet supplemented with essential oils (thyme, rosemary, oregano extracts) and reported that the average daily gain (ADG) and feed conversion ratio (FCR) significantly improved during the growing period. Stimulating the secretion of digestive enzymes, improving palatability and flavour of feed, increasing feed intake, and increasing antimicrobial activity are some of the main modes of action that might have led to the improved growth performance of poultry and swine (Jang et al., 2004; Czech et al. (2009). Singh et al. (2016, 2019a,b,c) also reported that supplementation of sea buckthorn leaf meal in coloured breeder bird and broiler chicken improves the FCR, egg production, growth rate, health condition etc.

Yan et al. (2011) have reported that adding a herb extract blend (containing buckwheat, thyme, curcuma, black pepper and ginger) to the diet of growing pigs resulted in increases in average daily feed intake (ADFI) and final body weight. Mohammadi Gheisar et al. (2015a) reported that feeding broiler chickens with diet containing 0.075% of a phytogenic blend led to 3.9% and

3.4% improvement in BWG and FCR, respectively. Results of some studies have shown that feeding pigs with essential oils extracted from fennel and caraway or extracted from thyme and oregano resulted in dose-related detrimental effect on palatability (Schone et al., 2006). Some other reports have shown that addition of phytobiotics to the diet of broiler chickens and laying hens resulted in significant depression in feed intake (Roth-Maier et al., 2005). On the other hand, there is evidence showing improvements in feed intake by adding PFA to swine diet (Kyriakis et al., 1998).

Antimicrobial and Coccidiostatic Properties

Phytogenic products can selectively influence microorganisms through antimicrobial activity or by a favourable stimulation of the eubiosis over the microflora. This leads to better utilization and absorption of nutrients resulting in higher performance. Various plant extracts, especially essential oils, have been studied for their antimicrobial properties. Most research carried out in this area has been conducted in vitro, but there have been a few studies with live poultry flocks. Phytogenic substances derived from oregano (*Origanum vulgare*), especially the major active substances thymol and carvacrol, are known to exert antimicrobial and bacterial actions in vitro, while eugenol, a component of the essential oil from cloves, has been shown to inhibit *Salmonella typhimurium*. Blends of oil containing thymol, eugenol, curcumin and piperin could be used to control *Clostridium perfringens*, the bacterium that causes necrotic enteritis in broiler chickens. Essential oil from cinnamon has been shown to improve the digestibility of nutrients in poultry, while polysaccharides from mushroom (*Tremella fuciformis*) and the herb *Astragalus membranaceus* have demonstrated promising responses in controlling experimental coccidial infections. Directorate of Poultry studies into the effects of turmeric found that the addition of 0.2% to broiler diets resulted in a significant reduction in *Escherichia coli* count.

Immuno-modulatory Effect

The herbal plants are rich source of polysaccharides and also contain phenolic acids, tannins, flavonoids, glycosides, and terpenes. The polysaccharides derived from many herbal plants plays an important role in stimulating the growth of immune organs, such as the spleen, thymus and bursa which

helpful in increasing the number and activities of T, B lymphocytes, macrophages, natural killer (NK) cells and increasing cellular as well as humoral immune responses of pig and poultry. It is also proved that dietary addition of 200 g turmeric per quintal of feed significantly increased antibody production in response to sheep red blood cells (1%SRBC) inoculation of chickens. It was observed that the persistency of antibody titer was better in birds fed turmeric in the diet in comparison to control or basal diet.

Antioxidant Activity

The antioxidant properties of phyto-genic compounds such as α -tocopheryl acetate or butylated hydroxytoluene are very helpful in protection of dietary lipids from oxidative damages (Nakatani, 2000). The major role of phyto-antioxidants in poultry and pig meat production is only on to check lipid oxidation in meat and meat products. The plant oils containing natural antioxidants contribute to the improved oxidative stability of meat and meat products containing higher levels of polyunsaturated fatty acid. These antioxidants are mainly tocopherols, however phenols, present in appreciable amounts in olive oil, are effective non-tocopherol antioxidants. Placha et al. (2014) have demonstrated that supplementing the diet of broiler chickens with thymol can reduce the oxidation of fatty acids indicated by the lower malondialdehyde level in duodenal mucosa. Phytobiotics can beneficially affect some antioxidant enzymes such as glutathione peroxidase and superoxide dismutase, consequently affecting lipid metabolism in animals (Franz et al., 2010). Other plant species such as ginger, curcuma, anise, coriander and plants that are rich in flavonoids or anthocyanins (e.g. many fruits) also have antioxidant activities (Nakatani 2000; Wei and Shibamoto 2007). There is also evidence showing that black pepper (*Piper nigrum*), red pepper (*Capsicum annum* L.) and also have antioxidant activities (Nakatani 2000).

Anti-inflammatory Response

Some metabolites or essential oils viz. rosmarinic acid, oleanolic acid and ursolic acid are the major nonvolatile secondary metabolites found mainly in *Origanum* spp having anti-inflammatory responses (Shen et al., 2010). Other essential oils from eucalyptus, rosemary, lavender, millefolia and other plants (pine, clove and myrrh) have been generally used in mixed formulations as anti-inflammatory drugs (Darsham and Doreswamug

2004).

Conclusions

In present scenario, the poultry and pig meat production and management faces several challenges viz. climatic change, changes of feed, microbial load, stress during rearing disturbing the normal functioning of the livestock especially pig and poultry. The gastrointestinal tract may be influenced resulting in impaired absorption of nutrients resulting in reduced performance and increased mortality and morbidity cases. Therefore, with the ban of antibiotics as in feed growth promoters farmers lost an effective tool to help poultry and pig to perform better growth, production and reproductive performances. Phyto-genic products such as thyme, oregano, turmeric and garlic are gaining interest among researchers and poultry producers. In these conditions, Phyto-genic products seem to be the most promising ones as they are of natural origin and as they are generally regarded as safe. These phyto-genic products play a significant contribution for improving growth performance and health status as well as productive and reproductive performances. So, addition of phyto-genic products in the diet of pig and poultry will be helpful for improving the performances health and nutrition as well as to improve the socio-economic status of the farmers.

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