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Unconventional plants as a source of phytochemicals for broiler chicken

Martínez-Aispuro, José A.[1]; Figueroa-Velasco, José L.[1*]; Sánchez-Torres María T.[1]; Cordero-Mora, José L.[1]

[1]Programa de Ganadería, Colegio de Postgraduados, Campus Montecillo. Texcoco, Estado de México, México. CP. 56230.
***Corresponding author**: jlfigueroa@colpos.mx

ABSTRACT

Objective: To carry out a review to know the modes of action and the commercial application of unconventional plants as growth promoters in broiler chicken production.

Design/Methodology/Approach: A bibliographic review of unconventional and commonly used plants was carried out, which have shown efficacy as growth promoters on broiler chickens.

Results: Numerous reports have demonstrated the efficacy of phytochemicals present in plants as antioxidants, antimicrobials, and immune-stimulants.

Limitations of the study/Implications: Alternative use of unconventional plants can help to develop sustainable production systems and the production of innocuous meat products.

Findings/Conclusions: The use of additives of natural origin in poultry feed represents a viable option to replace or reduce the use of antibiotics and growth promoters on broiler chickens.

Keywords: Phytochemicals, secondary metabolites.

INTRODUCTION

Bacterial resistance by the use of antibiotics as growth promoters has caused the search for alternatives to develop sustainable production systems for meat products that consider the welfare of the consumers of those products and the animals from which products are obtained (Lillehoj and Lee, 2012). The use of herbal products is an antimicrobial alternative and promoter of animal growth due to their contents of secondary metabolites (Dhama *et al*., 2015).

The herbs begin to be used in the poultry industry as promoters of growth in the fight against various infections for their potential as alternatives to antibiotics and their content of bioactive substances that could improve production parameters attributed to some phytochemicals which may favorably modify the metabolism of the animal (Dhama

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et al., 2015; Vinus *et al*., 2018). However, additional complications arise because herbal additives for animal feed can vary widely by agro-climatic origin, processing and composition, when the additive is an extract or an essential oil (Hashemi and Davoodi, 2010). The objective of this review was to provide an overview of recent knowledge about the use of some unconventional plants as a source of phytochemicals for feeding broiler chickens, excluding the use of extracts and essential oils.

Unconventional plants as sources of phytochemicals

Sweet wormwood (*Artemisia annual*). Active compounds: artemisinin, flavonoids, phenols, purines and lipids (Brisibe *et al*., 2009). Effect: 2 to 4% of the diet as anti-parasite, antioxidant (Cherian *et al*., 2013), coccidiostats (Brisibe *et al*., 2009), reduces the count of enterobacteria and increases the content of lactobacilli in the intestine (Panaite *et al*., 2018; 2%).

Garlic (*Allium sativum*). Active compounds: ajoene, allyl cysteine, diallyl sulfide and allicin. Effect: the inclusion of up to 3% garlic improves weight gain, feed conversion, decreases the mortality rate (Makwana *et al*., 2015; Karangiya *et al*., 2016; Patel *et al*., 2017; Belal *et al*., 2018). It has antimicrobial properties, increases the quantity of antibodies, decreases the concentration of triglycerides, cholesterol, low-density lipoproteins and increases the levels of high-density lipoproteins (Toghyani *et al*., 2011; Faghani *et al*., 2014).

Anise (*Pimpinella anisum*). Active components: The seed contains trans-anethole eugenol, methyl-chavicol, anisaldehyde, estragole, coumarins, scopoletin, umbelliferone, estroles, terpene hydrocarbons, polyenes and polyacetylenes (Barakat *et al*., 2016). Effect: the inclusion of anise seed in the feed improves weight gain, feed consumption and feed conversion (Yazdi *et al*., 2014; Mahmood *et al*., 2014a; Barakat *et al*., 2016), increases the quantity of antibodies against avian influenza virus (10 g kg^{-1} of feed; Yazdi *et al*., 2014), Gumboro and Newcastle (1 g kg^{-1} of feed; Mahmood *et al*., 2014b) and increases the amount of immunoglobulins [(5-15 g kg^{-1} of feed; Barakat *et al*., 2016); (0.5-1 g L^{-1} of water; Al-Shammari *et al*., 2017)].

Cinnamon (*Cinnamomum zeylanicum*). Active compounds: cinnamaldehyde, 2-hydroxycinnamaldehyde, cinnamyl acetate, coumarin, eugenol and caryophyllin (Saeed *et al*., 2018). Effects: improves weight gain, feeding efficiency, digestion, intestinal microflora activity and immune response (Toghyani *et al*., 2011; Singh *et al*., 2014; Faghani *et al*., 2014; Saeed *et al*., 2018). It decreases the plasma concentration of cholesterol, triglycerides, low-density lipoproteins and increases high-density lipoproteins (Faghani *et al*., 2014). Antioxidant and anti-inflammatory activity (Bansode, 2012). Dose: 0.02 to 7%.

Coriander (*Coriandrum sativum*). Active components: essential oil, tannins, terpenoids, reducing sugars, alkaloids, phenolic compounds, flavonoids, fatty acids, sterols and glycosides (Hosseinzadeh *et al*., 2014). Effect: coriander seeds (1 to 3% in the diet) improve weight gain, feed conversion (Al-Jaff, 2011; Saeid and Al-Nasry, 2010; Abou-Elkhair *et al*., 2014), stimulate the immune system (Hosseinzadeh *et al*., 2014), decreases cholesterol, glucose, low-density lipoproteins and high-density lipoproteins (Al-Jaff, 2011).

Chile (*Capsicum annuum*). Active compounds: capsaicin, capsisin and capsanthin. Effects: antioxidant capacity (Thiamhirunsopit *et al*., 2014), increases weight gain, feed consumption and reduces feed conversion, information obtained by evaluating doses between 0.25-1.7 % (Al-Kassie *et al*., 2011a; Thiamhirunsopit *et al*., 2014; Puvaca *et al*., 2015). It strengthens the immune system of poultry (Al-Kassie *et al*., 2011a; 0.25-1.00%) and is effective against Salmonella infection (Alaa, 2010; 1-2%). Chili pepper decreases the blood concentration of cholesterol (Alaa, 2010; Al-Kassie *et al*., 2011a; Puvaca *et al*., 2015), triglycerides, low-density lipoproteins, increases the concentration of high-density lipoproteins (Puvaca *et al*., 2015), and total serum protein (Alaa, 2010).

Black cumin (*Nigella sativa*). Active compounds: alkaloids, essential oils, imoquinone, dithymoquinone, thymol, carvacrol, nigelycine, nigelidin and hedrin (Azeem *et al*., 2014). Effects: viable alternative to replace the use of antibiotics, growth promoter, antioxidant and immune-regulator (Azeem *et al*., 2014; Kumar and Patra, 2017). Black cumin increases the quantity of antibodies against Newcastle, Gumboro and Bronchitis (Durrani *et al*., 2007; Kumar and Patra, 2017). The addition of cumin seeds to the diet causes greater weight gain, feed consumption and better feed conversion [Durrani *et al*., 2007 (4%); Kumar and Patra, 2017 (0.5-2.0%)]. In addition, adding 0.4% to the diet reduces the concentration of triglycerides and cholesterol (Kumar and Patra, 2017).

Turmeric (*Curcuma longa*). Active compounds: curcumin, cinnamic acid, curlone and niacin (Guil-Guerrero *et al.*, 2017). Effects: antioxidant (Guil-Guerrero *et al.*, 2017), improves the immune response (Nayaka *et al.*, 2012) of chickens infected with Newcastle (Guil-Guerrero *et al.*, 2017) and Eimeria (Lee *et al.*, 2010). Turmeric powder supplementation improves weight gain and feed conversion (0.5%) (Al-Sultan, 2003; Abou-Elkhair *et al.*, 2014), and decreases blood triglycerides (Nouzarian *et al.*, 2011).

Eucalyptus (*Eucalyptus globulus*). Active component: terpene-eucalyptol and tannins (Farhadi *et al.*, 2017). Effects: *Eucalyptus* leaves improved productive behavior, it is also associated with the manipulation of the intestinal microbiota and better immunity (Hassan *et al.*, 2011; Farhadi *et al.*, 2017).

Ginger (*Zingiber officinale*). Active compounds: gingerdiol, gingerol, gingerdione and phenolic compounds. Effects: antioxidant properties (Zhang *et al.*, 2009). The addition of 0.02 to 1.5% to the feed improves weight gain, feed conversion, reduces mortality in chickens (Oleforuh-Okoleh *et al.*, 2014; Youssef *et al.*, 2016; Belal *et al.*, 2018) and stimulates the immune system (Valiollahi *et al.*, 2014).

Laurel (*Laurus nobilis*). Active compounds: cineol, eugenol, acetyl and methyl eugenol, α- and β-pinene, felandrene, linalool, geraniol and terpineol (Zekovic *et al.*, 2009). Effect: by using 2 to 6 g kg^{-1} of bay leaves in feed, the total of bacteria and aerobic bacteria in the colon is inhibited (Nafea *et al.*, 2018).

Moringa (*Moringa oleifera*). Active compounds: polyphenols, vanillic-, ferulic-, melilotic- acids, vitamins A, E, C and complex B. Effects: alternative source of protein in diets at levels of 50 to 140 g kg^{-1} of leaves in the diet replacing the soybean meal (*Glycine max* L.), finding as a result greater weight gain and feed conversion (Melesse *et al.*, 2013). The inclusion of moringa leaves (1, 2, 5, 10 and 15%) in the diet reduced abdominal fat, increased omega 3 and 6 fatty acids, improving meat color, attributed to greater oxidative stability (Cui *et al.*, 2018).

Neem (*Azadirachta indica*). Active compounds: triterpenoids (azadirachtin, nimbine, salanine, meliacin). Effects: by supplementing 0.25% of Neem leaves, weight gain increase, and it improves feed conversion; it also has antimicrobial, antiviral and antifungal action (Ansari *et al.*, 2012).

Black pepper (*Piper nigrum*). Active compounds: glutathione peroxidase, glucose-6-phosphate dehydrogenase, vitamin C, curcurmin and piperine (Khalaf *et al.*, 2008). Effects: the addition in the diet (0.02 to 1.0%) improves weight gain, feed intake and feed conversion (Al-Kassie *et al.*, 2011b; Shahverdi *et al.*, 2013; Valiollahi *et al.*, 2014; Abou–Elkhair *et al.*, 2014). Black pepper improves the immune system through increasing the concentration of immunoglobulins in serum (Al-Kassie *et al.*, 2011b; Abou-Elkhair *et al.*, 2014; Valiollahi *et al.*, 2014); also, it decreases the blood concentration of cholesterol, triglycerides, low-density lipoproteins and increases the concentration of high-density lipoproteins (Al-Kassie *et al.*, 2011b; Shahverdi *et al.*, 2013; Puvaca *et al.*, 2015; Singh *et al.*, 2018).

Green tea (*Camellia sinensis*). Active compounds: catechins, flavonoids with antioxidant activity (Farahat *et al.*, 2016). Effect: the addition of green tea leaves (0.5 to 2% in the diet) decreases the plasma cholesterol level (Yang *et al.*, 2003), improves the immune response (Wang *et al.*, 2018) to coccidiosis (Jang *et al.*, 2007) and to H9N2 influenza (Lee *et al.*, 2012) and Newcastle (Farahat *et al.*, 2016) viruses.

CONCLUSION

There are several products of herbal origin that can be used in the production of broiler chickens as growth promoters, natural antibiotics and antivirals, as well as alternative sources of antioxidants, all of which offers a viable alternative to partially or totally replace antibiotics in the diet.

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