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Potential benefits of herbal supplements in poultry feed: A review



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Abstract

Feed additives are a group of nutrient and non-nutrient compounds which helps in improving the efficiency of feed utilization and thus reducing the high cost of feed. Now days, use of herbal feed additives are gaining importance in poultry production due to ban on use of certain antibiotics because of their harmful residual effects. Herb is defined as a flowering plant whose stem above ground does not become woody and a plant when valued for its medical properties, flavor, scent, or the like.

Keywords: Potential benefits, herbal supplements, poultry feed

Introduction

Recent ban on the use of antibiotic growth promoters (AGP) in poultry feeds has drawn the concerns of researchers towards the presence of various natural substances like medicinal herbs, as a new class of additives to animal and poultry feeds, have beneficial properties such as anti-oxidant, anti-microbial and anti-fungal [24] as well as immune-modulatory and anti-coccidial effects. There are plenty resources of different kinds of medicinal herbs which can be used as natural feed additives for poultry. Commonly known herbs that have received particular attention from researchers are *Aloe vera*, Fenugreek, Ashwagandha, *Moringa oleifera*, Cinnamon, Tulsi, Garlic, Pepper etc.

Herbal preparations help in the digestion process and being a component of nature, these preparations are considered safe, cost effective and environment friendly with no side effect. Hence, their inclusion in the diet should be encouraged to enhance the bird's performance, improve feed utilization, maintain health and alleviate adverse effect of environmental stress.

Mode of action

The mode of action of herbs and plant extracts has not been fully elucidated. Most of the herbs have antibacterial, coccidiostatic, antihelminthic, anti-viral, anti-inflammatory or particularly, antioxidant properties. Herbs and spices can protect the feed against oxidative deterioration during storage. This is a widely used practice in food industry. The commonly used herb for feed/food preservation is rosemary (*Rosmarinus officinalis*). It can be used alone or in combination with tocopherols or synthetic antioxidants [28]. Herbs and their mixture can ameliorate the performance of birds by improving digestive tract function, by anti-inflammatory, anti-oxidative and anti-microbial effects and in addition some have influences on different physiological functions. Herbs may exert multiple functions in the bird's body system [27]. Most of them act as sialagogues and stimulate the secretion of saliva, which makes swallowing easier. The extracts from *Salvia officinalis*, *Thymus vulgaris* and *Rosmarinus officinalis* and the blend of carvacrol, cinnamaldehyde and capsaicin improved feed digestibility in broilers [27].

Aloe vera (*Aloe barbadensis* Miller), found in tropical and sub-tropical climates and most important part of *Aloe vera* is its leaf which is composed of two main sections: latex and gel [7]. The gel contained in *Aloe vera* leaves is composed of about 98.5% to 99.5% water [19] and the remaining dry matter contains more than 75 biologically active ingredients [7] which have medicinal properties. Major ingredients of *Aloe vera* include anthraquinones, saccharides, vitamins, enzymes, and low-molecular-weight compounds [10] which give *Aloe vera* its anti-inflammatory, immunomodulatory, wound-healing, anti-viral, anti-fungal, anti-tumor, anti-diabetic, and anti-oxidant effects [11].

Fenugreek (*Trigonella foenum-graecum*) grows naturally in sandy, alluvial and clay soils and cultivated all over the World.

Fenugreek, an annual legume, is one of the herbs having multi-functional characteristics [37]. Fenugreek is also used as an appetiser. Previously, it has also been reported to have anti-microbial, hypoglycemic, hypolipidemic, hypocholesterolemic and antioxidant effect [23, 57, 60]. Nazar and El Tinay [43] reported that its seeds contain 28.4% protein, 9.3% crude fibre and 7.1% crude fat. TFG (*Trigonella foenum-graecum*) seeds contain 7.5% total lipids, of which neutral lipids constituted 84.1%, glycolipids 5.4% and phospholipids 10.5% [32]. Whole TFG (*Trigonella foenum-graecum*) seed contains about 1.7- 4.8% saponins. TFG seed has many chemical compounds viz., N, N'-dicarbazyl, glycerol monopalmitate, stearic acid, beta-sitosteryl glucopyranoside, ethylalpha-D-glucopyranoside, D-3-O-methylchiroinsitol and sucrose [50], flavonoids vitexin, tricin, naringenin, quercetin and tricin-7-O-beta-D-glucopyranoside [40], saponins Xa, Xb, XIb, XIIa, XIIb, XIIIa, Ia, Ib, and Va, glycoside D, trigonelloside C, and compound C [41], Iia, Iib, IIIa, IIIb, glycoside D and trigofoenoside A [63].

Ashwagandha (*Withania somnifera*) has long been used in

traditional medicine in India [53]. It has immunomodulatory [33], antioxidant [30], hepatoprotective [25] and antibacterial [45] effects.

Moringa oleifera leaves are reported to have potential prebiotic effects and potentially antioxidant phytochemicals, such as chlorogenic acid and caffeic acid [52]. *Moringa oleifera* leaf meal, widely available in many tropical countries, is also a good source of antioxidant compounds such as ascorbic acid, flavonoids, phenolics and carotenoids [56].

Garlic and ginger as natural growth promoters can be potential alternatives for common artificial growth promoters like antibiotics [16]. Ginger is the rhizome of the plant *Zingiber officinale*, consumed as a delicacy, medicine, or spice. Ginger extract might control the quantity of free radicals and the peroxidation of lipids [3] and have anti-diabetic properties [40]. Garlic (*Allium sativum*) has been used as a spice and a native medicine for many years. It has possessed antibacterial, antifungal, antiparasitic, antiviral, antioxidant, anticholesteremic, anti-cancerous, and vasodilator characteristics [22].

Table 1: Different herbal feed additives, its active components and functions

S. No.	Plant	Used part	Active component	Function
1.	<i>Aloe vera</i> (<i>Aloe barbadensis</i> Miller)	Leaf	Anthraquinones	anti inflammatory, immune-modulatory, anti-microbial anti-tumor, anti-diabetic, and anti-oxidant
2.	Amla (<i>Embellica officinalis</i>)	Fruit	Vitamin C, gallic acid, ellegic acid and tannins	Potent antioxidant
3.	Fenugreek (<i>Trigonella foenum graecum</i>)	Seed	Protodioscin, trigoneoside, diosgenin and vamogenin saponins	Appetite stimulant, cholesterol reducing, antimicrobial
4.	Ashvgandha (<i>Withania somnifera</i>)	Root, leaves, seeds	Withanolids, glycine, withanine	Immunomodulator, hepatoprotective, analgesic, antistress
5.	Cinnamon (<i>Cinnamomum zeylanicum</i>)	Bark, leaves	Eugenol, phenolic and polyphenolic substances	Astringent, warming, stimulating, carminative, antiseptic, antifungal, antiviral, blood purifying
6.	Garlic (<i>Allium sativum</i>)	Bulb	γ -glutamyl-S-alk(en)yl-L-cysteines and S-alk(en)yl-L-cysteinesulfoxides, Alkin	Digestion stimulant, Antiseptic
7.	Coriander (<i>Coriandrum sativum</i>)	Leaves and Seed	Oil contains carvone, geraniol, limonene, borneol, camphor, elemol, and linalool. flavonoids include quercitin, kaempferol, rhamnetin, and epigenin.	Appetizer, stomachic and carminative
8.	Ginger (<i>Zingiber officinale</i>)	Rhizome	Camphene, β -bisabolene and ar-curcumene	Methane reducing capacity Gastric stimulant
9.	Cumin (<i>Cuminum cyminum</i>)	Seed	Cuminaldehyde	Digestive, carminative, Galactogogue
10.	Pepper (<i>Piper nigrum</i>)	Fruit	Piperine	Digestion stimulant
11.	Tulsi	Leaf extract	Eugenol, ascorbic acid, beta- carotene, beta-sitosterol, palmitic acid, tannins	Anti-fungal, anti-microbial, hepatoprotective, cardioprotective, antiemetic, antioxidant, antispasmodic, analgesic, anti-ulcerogenic
12.	Turmeric (<i>Curcuma longa</i>)	Rhizome	Curcuminoids, ar-turmerone, zingiberene and curcone	antioxidative, anticarcinogenic, antihepatotoxic, anti-inflammatory and hypocholesterolemic activities
13.	<i>Moringa oleifera</i>	Leaf extract	Chlorogenic acid, caffeic acid, ascorbic acid, flavonoids, phenolics and carotenoids	Anti-bacterial and antioxidant activity.
14.	Neem (<i>Azadirachta indica</i>)	Leaves	Neem oil contains nimbin, nimbidin and nimbinine	Antibacterial, antifungal, antiviral, anthelmintic, stimulate fibre degrading enzymes, defaunating agent
15.	Rosemary(<i>Rosmarinus officinalis</i>)	Leaves	Volatile oil, tannin, bitter substances and resins	Anti inflammatory, antioxidant

Table 2: Effect of different herbs on the physiological functions of Poultry

S. No.	Plant	Effect	References
1.	Amla fruit powder	Microbial load of gram negative <i>E. coli</i> decreased and beneficial gram positive <i>Lactobacilli</i> increased significantly as compared to control group.	Dalal <i>et al.</i> , 2018a [14]
2.	Tulsi extract	Significantly increased the glutathione peroxidase activity, ascorbic acid level in serum	Vasanthakumar <i>et al.</i> , 2013 [59]
3.	Cinnamon	Enhanced antioxidant status	Faix <i>et al.</i> 2009 [18]; Al-Kassie <i>et al.</i> 2009 [2]
4.	Tulsi	Combated oxidative stress in broilers and increased antioxidant enzymes level.	Reddy <i>et al.</i> , 2009 [47]
5.	<i>Moringa oleifera</i>	Immune-stimulant activities	Ghazalah & Ali, 2008 [21]
6.	Marigold extract	Enhanced yolk colour	Sirri <i>et al.</i> , 2007 [54]
7.	Carvacrol, cinnamaldehyde and capsaicin	Improved feed digestibility in broilers	Hernandez <i>et al.</i> 2004 [27]
8.	<i>Sophora flavicens</i>	Anticoccidial effect	Youn <i>et al.</i> , 2001 [64]
9.	Rosemary	Improved antioxidant capacity of products	Lopez-Bote <i>et al.</i> 1998 [34]
10.	Shatavari	Augments the appetite and stimulates the liver, possess anabolic properties	Sharma <i>et al.</i> 1986 [51]

Table 3: Effect of different herbs on the performance of Poultry.

S. No.	Herb	Level	Effect	References
1.	Amla powder	0.25, 0.50, 0.75 and 1% of diet	Significantly higher values of Hb%, lowest serum cholesterol value were reported in broilers. Heterophil count was also significantly reduced in amla supplemented group as compared to control group.	Dalal <i>et al.</i> , 2018b [13]
2.	<i>Aloe (A.) vera</i> polysaccharides	100, 200 and 300 mg.kg ⁻¹ body weight	Daily weight gain, Percent protection and anti-coccidial indices were higher in administered groups as compared to control.	Khaliq <i>et al.</i> , 2017 [31]
3.	Turmeric powder	2.5 g per kg feed	Recorded significantly increased body weight gain during starter (0 to 21 d) period as compared to control group.	Naderi <i>et al.</i> (2014) [42]
4.	Ethanol and aqueous extracts of <i>Aloe vera</i> pulp	300 mg/kg body weight/day for 3 days	Significantly increased antibody titer in broilers against SRBC compared to the control group.	Akhtar <i>et al.</i> (2012) [1]
5.	<i>Aloe vera</i>	1.5%, 2%, and 2.5% in feed	Improved intestinal microflora, increased <i>Lactobacillus</i> count and decreased <i>E. coli</i> count in broilers.	Darabighane <i>et al.</i> , 2012 [15]
6.	Mixture of cumin and turmeric	0.00, 0.25, 0.50, 0.75 and 1% of diet.	Significant improvement ($P<0.05$) in body weight gain of chicks as compared to the control.	Al-Kassie <i>et al.</i> (2011) [4]
7.	<i>Moringa stenopetala</i> leaf meal	2%, 4% and 6% of feed.	Resulted in significant ($P<0.05$) increase in feed and crude protein intake, average weight gain, feed efficiency ratios, and protein efficiency ratios when compared to a control diet in Rhode Island chicks.	Melesse <i>et al.</i> (2011) [38]
8.	Garlic	Blend of 0.1% aq. extract of: thyme, garlic coneflower.	Improved feed conversion rate compared to virginiamycin (antibiotic), reduce the serum lipid profile	Rahimi <i>et al.</i> , 2011 [46]
9.	<i>Aloe vera</i> powder	0.5%, 0.75% and 1% AV gel in drinking water	Supplemented broilers had smaller fecal oocyst shedding count compared to infected group fed with the standard diet.	Yim <i>et al.</i> (2011) [62]
10.	Cinnamon	100 ppm and 200ppm essential oil derived from cinnamon	An improvement in the live weight gain and the health of broilers and feed conversion ratio (FCR)	Al-Kassie <i>et al.</i> (2009) [2]
11.	Turmeric powder	0.5% of diet	Recorded significantly ($P<0.05$) improved body weight gain of chicks.	Yarru <i>et al.</i> (2009) [61]
12.	<i>Aloe vera</i>	0.1% Aloe vera gel	Reduced <i>E. coli</i> count while increased the number of <i>Lactobacillus</i> and <i>Bifidobacteria</i> .	Dai <i>et al.</i> (2007) [12]
13.	<i>Moringa oleifera</i> leaf meal	0, 5, 10 and 20% MOLM	Feed conversion ratio (kg feed/kg egg) of laying hen increased.	Kakengi <i>et al.</i> (2007) [29]
14.	<i>Rosmarinus officinalis</i> , carvacrol, cinnamaldehyde and capsaicin	200ppm essential oil extract (EOE) from oregano, cinnamon, and 5,000 ppm Labiateae extract (LE) from rosemary.	Improved feed digestibility in broilers	Hernandez <i>et al.</i> 2004 [27]
15.	Shatavari powder	Shatavari root powder (SRP) @ 0.5, 1 and 1.5% of diet	Significantly improved ($P<0.05$) body weight, weekly gain in body weight and feed conversion ratio of broilers.	Rekhate <i>et al.</i> (2004) [48]
16.	Garlic	0.5% of the diet	Improved broiler growth and feed conversion ratio (FCR) and decreased mortality rate.	Tollba and Hassan (2003) [58]

In comparison with the vast number of research papers published on the plant extract supplementation to broiler diets in the past decade there is relatively little published data on laying hens [6, 8] and broiler breeders (Ather, 2000) [5], which demonstrated antioxidant, immune-stimulator, and performance enhancer aspects. In a study by Ather [5], 48-wk-old broiler breeders were given diets supplemented with a polyherbal additive that consisted of 6 herbs. The author reported that hen-day egg production, settable egg rate, and fertility significantly improved for hens receiving the herbal

additive supplementation in their diet during the 8-wk trial period. Çabuk *et al.* [11] studied the hen-day egg production of brown layers between 54 to 74 wk of age that were given diets supplemented individually with an Essential Oil Premix (EOM), Antibiotic (ANT), and mannan oligosaccharide were 79.64, 77.05, and 78.92%, respectively; hence, the egg production rate for EOM and mannan oligosaccharide treatments was significantly higher than that of the ANT group ($P<0.01$).

Table 4: Effect of different herbs on the layers performance

S. No	Herb	Level	Effect	References
1.	Aloe vera powder and a combination with <i>Curcuma longa</i> powder	Both @ 0.1%	White Leghorn birds that were fed with <i>Aloe vera</i> as a single additive or in combination with <i>Curcuma longa</i> resulted in layers producing significantly more eggs and heavier compared to Control layers.	Moorthy <i>et al</i> (2009) [39]
2.	<i>Aloe vera</i>	100 ml/litre water	Japanese quails where the total cumulative egg number and the hen day egg production including the albumin diameter were significantly higher in supplemented quails than the control.	Hasan, 2014 [26]
3.	Propolis	100 and 150 mg/kg diet	Supplemented hens produced significantly more eggs and heavier eggs compared to the control group.	Galal <i>et al</i> (2008) [20]
4.	<i>Moringa oleifera</i> leaf meal (MOLM)	0.5kg/100kg diet	There was improvement ($P<0.05$) in egg production and feed conversion ratio (FCR) in supplemented group.	Swain <i>et al.</i> , 2017 [55]
5.	MOLM	2.5%	Birds fed with supplemented diet had significantly better egg production and external egg quality characteristics compared to control.	Ebenebe <i>et al.</i> (2013) [17]
6.	Garlic powder	3% & 5%	Results revealed significant ($P<0.05$) increases of 0.81 mm in albumen height and 2.71 Haugh units of fresh eggs at 3% GP addition. Egg and albumen weights increased significantly ($P<0.05$) by 2.06 and 1.84 g, respectively, at 5% GP over the control treatment.	Olobatoke and Mulugeta (2011) [44]
7.	Garlic powder	1%	A 10% increase in BW in layers.	Marshall and Kokoete (2008) [36]
8.	Olive leaf powder	0, 1%, 2%, or 3%	Had no effect on feed intake, egg weight, egg yield and feed conversion ratio ($p>0.05$) while increased final body weight of hens ($p<0.05$). Also increased yellowness in yolk color ($p<0.01$) and yolk cholesterol content was tended to decrease about 10% ($p>0.05$).	Cayan and Erener (2015) [9]

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