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Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

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A Review on Positive Effects of Fenugreek as Feed Additive in Poultry Production

S. Adil, Saim Qureshi and R.A. Pattoo
Division of Livestock Production and Management, Faculty of Veterinary Sciences and Animal Husbandry,
Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir,
Shuhama, Srinagar-190006, Kashmir

Abstract: Following the prohibition on usage of antibiotics as growth promoters, the researchers used other alternatives. Nowadays, phytogenic feed additives like herbs are in vogue and are incorporated in the diet in order to enhance productivity by improvement of digestibility, nutrient absorption and elimination of pathogens residents in the gut. Among the various phytogenics available, this review will focus on one such herb known as Fenugreek (*Trigonella foenum graecum*), locally known as Methi. It is mainly cultivated in India, Pakistan and China. It is rich in protein, fat, total carbohydrates and minerals such as calcium, phosphorus, iron, zinc, magnesium, fatty acids predominantly linoleic, linolenic, oleic and palmitic. Fenugreek seeds are the most important and useful part of fenugreek plant having many therapeutic effects like hypoglycaemic, antibacterial, ant-inflammatory, antipyretic, antimicrobial and antioxidant properties. They have a role in improving the performance of poultry birds by their antibacterial activity and positive effect on gut morphology. Besides, they help in decreasing the blood cholesterol levels in poultry, hence have a potential role in prevention of arteriosclerosis.

Key words: Additive, fenugreek, gut, poultry, performance

INTRODUCTION

AFCO (American Feed Control Officials) defines feed additive as “an ingredient or combination of ingredients added to the basic feed mix to fulfill a specific need and usually used in micro quantities and requires careful handling and mixing." The European Union officially banned the usage of antibiotics as growth promoters in poultry and livestock in 2006 (Halfhide, 2003) that led the researchers to look for other alternatives. One of the possible alternatives reported in poultry production are phytogenic additives which include a group of natural feed additives; derived from herbs, spices or other plants or their extracts in the form of essential oils (Windisch *et al*., 2008). They are incorporated in the diet of animal feed in order to enhance productivity by improvement of digestibility, nutrient absorption and elimination of pathogens residents in the gut (Athanasiadou *et al*., 2007).

Among the various phytogenics available, this review will focus on one such herb known as Fenugreek (*Trigonella foenum graecum)*, locally known as Methi. The various common names of Fenugreek in different languages are presented in Table 1. It is a well known medicinal plant that grows in nature and mainly cultivated in India, Pakistan and China (Alloui *et al*., 2012) and has strong spicy and seasoning type sweet flavor (Blank, 1996). It is used in functional food, traditional food, nutraceuticals as well as in physiological utilization such as antibacterial, anticancer, antiulcer, anthelmintic, hypocholesterolemic, hypoglycemic, antioxidant, antidiabetic agent and has beneficial influence on digestion and ability to modify food texture (Murlidhar and Goswami, 2012). It is rich in protein, fat, total carbohydrates and minerals such as calcium, phosphorus, iron, zinc, magnesium (Gupta *et al*., 1996), fatty acids predominantly linoleic, linolenic, oleic and palmitic (Schryver, 2002). It also has neurin, biotin, trimethylamine which tends to stimulate the appetite by their action on the nervous system (Michael and Kumawat, 2003).

Composition of fenugreek: The taxonomical position of Fenugreek is presented in Table 2. It grows to a height of about three feet, has three part leaves, the long slender stems bear tripartite, toothed, grey-green obovate leaves, 20-25 mm (3/4-1 in) long (Snehlata and Payal, 2012). Its main chemical constituents are fibers, flavonoids, polysaccharides, saponins, flavonoids and polysaccharides fixed oils and some identified alkaloids viz., trigonelline and choline (Jayaweera, 1981; Yoshikawa *et al*., 1997). Fenugreek seeds are the most important and useful part of fenugreek plant having golden-yellow colour, small size, hard and four-faced stone like structure (Altuntas *et al*., 2005). Biologically, its seeds are endospermic in nature (Jani *et al*., 2009) and as a thumb rule harvested 150 to 170 days after sowing or 30 to 35 days after flowering (Kakani *et al*., 2009). Fenugreek seeds are used as spices (Altuntas *et al*.,

Corresponding Author: S. Adil, Division of Livestock Production and Management, Faculty of Veterinary Sciences and Animal Husbandry, Sher-e-Kashmir University of Agricultural Sciences and Technology Kashmir, Shuhama, Srinagar-190006, Kashmir

Table 1: Common names of Fenugreek in various languages

Language	Common name
Persian	Shanbalileh
Arabic	Hulba, Hilbeh
Urdu, Hindi, Punjabi, Bangla	Methi
Nepali	Menthiyam
Burmese	Penantazi
English	Fenugreek
Hindi	Methi, Sag methi (fresh leaves), Kasuri methi (dried leaves)
French	Fenugrec, Senegre, Trigonelle
German	Bockshornklee, Griechisch Heu
Georgian	Solinji, Chaman
Japanese	Koruha, Fenu-guriku
Dutch	Fenegriek
Romanian	Molotru, Molotru comun, Schinduf
Russian	Pazhitnik grecheski, Shambala, Pazhitnik cennoj
Sanskrit	Methika

Source: Nathiya *et al.* (2014)

Table 2: Taxonomical classification of Fenugreek

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Fabales
Family	Fabaceae
Genus	Trigonella
Species	*T. foenum graecum*

Source: Verma *et al.* (2013)

2005) and have many therapeutic effects like hypoglycaemic, antibacterial, ant-inflammatory, antipyretic, antimicrobial and antioxidant properties (Xue *et al.*, 2007). The proximate composition of fenugreek seeds has been reported as 11.7% moisture, 25.8% cent crude protein, 6.5% ether extract, 3.2% ash, 6.24% crude fibre (Kochhar *et al.*, 2006) and 35% alkaloids, primarily trigonelline (Mullaicharam *et al.*, 2013).

Effect on production performance: Since long Fenugreek is being used as a growth promoter particularly in broiler chicken. Inclusion of Fenugreek seeds in the diet significantly improves the body weight of broiler chicken (Abaza, 2001; Guo *et al.*, 2004; Yatoo *et al.*, 2012; Qureshi *et al.*, 2015). Further, it improves the feed efficiency with reduction in feed cost when used as natural feed additive in broiler chicken diets (Azoua, 2001). Abdel-Azeem (2006) reported best results by fenugreek seeds when supplemented at 0.5% level in the diet of the broiler chicken. However, Weerasingha and Atapattu (2013) and Mamoun *et al.* (2014) reported 1% level and 1.5% Magda (2012) inclusion levels useful for improving live body weight, body weight gain, feed conversion ratio, protein efficiency ratio, feed consumption and efficiency of energy utilization. Rabia (2010) however reported 3 g/kg of feed as best inclusion level for enhancing the performance and body weight of broiler chickens. Abdul-Rahman *et al.* (2010) reported activation of reproductive performance and improved semen quality by inclusion of Fenugreek seeds in the diet of broiler breeder chicken. EL-Mallah *et al.* (2005) noted that fenugreek seeds at 2% in the diet of turkey chicks caused a significant increase in digestibility and absorption of nutrients and there was a significant improvement in body weight gains. Alloui *et al.* (2012) reported that feeding Fenugreek seeds at 3 g/kg of feed in broiler chicken significantly increases feed intake due to the presence of galactomannans and neurin which stimulates the appetite and improvement in FCR (feed conversion ratio) due to the beneficial effect on gut microflora. The improvement in body weights has been attributed to the presence of essential fatty acids and high quality proteins in the Fenugreek seeds (Murray *et al.*, 1991) and stimulating effect on the digestive system (Hernandez *et al.*, 2004; Hind *et al.*, 2013). Nevertheless, Petit *et al.* (1995) reported that isolated steroidal saponin fraction of fenugreek seeds increases feed intake and motivation to eat in normal rats and Abo El-Nor (1999) suggested that fenugreek seeds may have an effect on hypothalamus gland to stimulate hungriness center in the brain and increase the desire for eating. Improved appetite and feed consumption might in turn lead to improved body weights and performance.

Role in reproductive performance: Abdul-Rahman *et al.* (2010) reported activation of reproductive performance and improved semen quality by inclusion of Fenugreek seeds in the diet of broiler breeder chicken. Supplementation of Fenugreek seeds have also been reported to improvement the reproductive performances of aged layer chicken (Alobaidy, 2012). The productive performance, egg mass and egg quality of laying hens under the effect of dietary fenugreek seeds (ungerminated and germinated) showed significant improvement (Hanan and Mona, 2010). Abaza (2007) found that hens fed diet supplemented with 0.5% fenugreek had numerically highest values of shell thickness and albumen percentage. Further, Awadein *et al.* (2010) observed that hens supplemented with 0.5% fenugreek showed less time to reach the sexual maturity. In laying quails, supplementation of 10 g fenugreek seeds/kg feed showed a significant increase in fertility and hatchability percentages; total egg number, daily egg mass and egg quality traits such as egg shell weight, albumin, eggshell thickness and specific gravity compared with the control group (El-Shafei *et al.*, 2012). The phytoestrogen content of fenugreek stimulate aromatase activity and promotes estradiol synthesis which in turn may have beneficial effect on secretary activity.

Influence on carcass characteristics: Mamoun *et al.* (2014) reported that the supplementation of fenugreek

seeds at 1% level in the diet of broiler chicken caused significant improvement in the carcass percentage and intestinal length. A significant effect on the digestive parts and increase in length and weight of intestines has been documented due to dietary inclusion of fenugreek seeds (Duru *et al*., 2013). However, Weerasingha and Atapattu (2013) reported that supplementation of fenugreek seeds had no significant effect on intestinal length per when calculated in terms of per 100 g of body weight. Moreover, Bhaisare *et al*. (2014) found that dietary inclusion of Fenugreek seeds at 0.5% level in the diet of Nandanam Turkey poults for eight weeks duration resulted in significant ($p<0.05$) improvement in dressed weight and attributed it to the antimicrobial properties of fenugreek. The positive effect on intestinal morphology could prolong the contact between the digesta and mucosal epithelium, which may be more effective for nutrient absorption (Boguslawska-Tryk *et al*., 2012).

Effect on blood biochemistry: Abdul-Rahman (2012), Safaei *et al*. (2013) and Mamoun *et al*. (2014) reported that incorporation of dietary Fenugreek seeds in broilers at 1% level significantly decreased the blood cholesterol and glucose levels. The reduction in the serum glucose levels may be related to direct β-cell stimulation by amino acid (4-hydroxy isoleucine) which increases insulin secretion thus improves glucose tolerance when Fenugreek seeds are fed (Sauvaire *et al*., 1998; Schryver, 2002). Reduction in blood cholesterol levels by supplementation of fenugreek seeds at 40 g/kg in diet of broiler chicken has also been reported by Duru *et al*. (2013). Clinical studies have demonstrated a statistically significant decline in the human serum total cholesterol, triglycerides and LDL cholesterol by Fenugreek supplementation (Mullaicharam *et al*., 2013). Abdouli *et al*. (2014) reported that ground fenugreek seeds given to laying hens at 6 g/hen/day resulted in reduction in serum cholesterol level. The reduction in the serum cholesterol level might be due to the presence of saponins and resins in fenugreek which inhibit bile acid and cholesterol absorption from intestine, thereby, decreasing cholesterol level in blood (Petit *et al*., 1995) and hence have a potential role in prevention of arteriosclerosis (Mullaicharam *et al*., 2013).

Abdul-Rahman (2012) investigated that feeding of Fenugreek seeds at 10 g/kg of diet in broiler breeder chicken significantly ($p \leq 0.05$) improved the packed cell volume percentage, red blood count and Hb concentration and attributed this improvement in erythropoiesis to the enhancement of antioxidant activity in RBCs which decreases the production of free radicals that destroy Hb and cause hemolysis of RBCs. Bhaisare and Thyagarajan (2014) reported that haemoglobin content were significantly ($p<0.05$) high when fenugreek seeds were used in turkey poults, indicating that certain bioactive principles in fenugreek seeds have positive effect on haemopoietic process in the body. Further, no effect on SGOT, SGPT and Alkaline phosphatase levels were recorded by fenugreek supplementation (Toppo *et al*. 2009; Ali and Ismail, 2012; Qureshi *et al*., 2015) indicating that it has no toxic effect.

Antibacterial effect: Qureshi *et al*. (2015) investigated the *in vitro* antibacterial activity of Fenugreek and reported the 2.1 mm of zone of inhibition for the concentration of 0.05 mg/ml of extract against *E. coli* on the Mueller Hinton agar. Similarly, *in vitro* antibacterial activity of methanolic extract of fenugreek against *E. coli* has been reported by Dash *et al*. (2011) and ascribed to the flavonoids, saponins and phenols present in it (Schryver, 2002). However, not much literature regarding the *in vivo* effect of fenugreek in poultry could be found.

Impact on gut histomorphology: Awadein *et al*. (2010) investigated that incorporation of fenugreek at 0.5% level in the diet of laying hens reduced total lipid content in liver. The hepato-protective role of Fenugreek seeds have been attributed to the bioactive ingredients present in it, which enhance hepatic function and due to its antioxidant activity as reported by Bukhari *et al*. (2008) who reported the antioxidant capacity of the Fenugreek extracts. Abdel-Rahman *et al*. (2014) observed that the incorporation of fenugreek seeds at 5.33 kg per ton of broiler ration resulted in a significant ($p \leq 0.05$) increase in the villus height and width, crypt depth and surface area of the intestine. Increased villus height helps to enhance the absorptive surface area for better utilization of nutrients Adil *et al*. (2010). The short or damaged villi impair the absorption of intestine, which might lead to poor performance of birds (Samanya and Yamauchi, 2002). The improvement in the villus height/crypt depth ratio is regarded as a good indicator of better intestinal health (Petrolli *et al*., 2012). The beneficial effect on intestinal histomorphology by Fenugreek seeds might be attributed to their antimicrobial action as has been reported by Qureshi *et al*. (2015) which in turn has been reported to decreases the inflammatory reactions at the mucosa, thereby increasing the villus height (Loddi *et al*., 2004; Mahmood *et al*., 2015).

Conclusion: A number of feed additives are available for inclusion in poultry diets in order to improve their performance, however, the unfavourable effect of chemical products especially antibiotics led to the use of natural products viz herbs to improve the efficiency of feed utilization and growth performance of poultry. Fenugreek in this regard has many beneficial effects particularly in improvement the growth performance and gut morphology of poultry without causing any harmful effect on their health.

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