

Effects of Fenugreek (*Trigonella foenum-graecum* L.) Seed Powder on Growth Performance, Visceral Organ Weight, Serum Cholesterol Levels and the Nitrogen Retention of Broiler Chicken

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ABSTRACT. Fenugreek (*Trigonella foenum-graecum* L.) is a medicinal plant having a range of therapeutic, anti-microbial and growth promoting effects. Objective of this study was to evaluate the effects of fenugreek seed powder on growth performance, visceral organ weight, serum cholesterol levels and the nitrogen (N) retention of broiler chicken. In a Complete Randomized Design with six replicates, 108 chicks in 36 pens received one of the six experimental diets containing either 0, 1, 2, 3, 4, 5 % fenugreek powder from day 21-38. The weight gain of the birds that were fed with 4 and 5 % fenugreek was significantly lower ($p < 0.05$) than that of the birds fed with 1 % fenugreek powder. One percent fenugreek powder improved the feed conversion ratio (FCR) by 13.8 %, compared to birds in the control group. Dietary fenugreek linearly increased the relative length of the small intestine and the weight of the pancreas. The N retention and serum cholesterol level were not significantly ($p > 0.05$) altered by dietary fenugreek. It was concluded that 1 % dietary fenugreek has some growth promoting effects in broiler chicken.

Keywords: Broiler, cholesterol, Fenugreek, growth, pancreas

INTRODUCTION

Phytogenic feed additives are plant-derived products used in animal feeding to improve the performance of agricultural livestock (Windisch *et al.*, 2008). Herbs, spices, and various plant extracts have received increased attention as possible alternatives to antibiotic growth promotants (AGP), since they are considered natural products (Henandez *et al.*, 2004). Griggs and Jacob, (2005) and Windisch *et al.* (2008) reviewed the antimicrobial and growth promotant effects of a range of phytogenic feed additives including thyme (*Thymus vulgaris*), clove (*Syzygium aromaticum*), turmeric (*Curcuma longa*), black pepper (*piper nigrum*), oregano (*Oregano vulgar*), garlic (*Alum sativa*) and fenugreek (*Trigonella foenum graecum*).

Seeds of Fenugreek (*Trigonella foenum-graecum* L.) is reported to have many therapeutic effects such as hypoglycemic, hypocholesterolaemic, anthelmintic, antibacterial, anti-inflammatory, antipyretic and antimicrobial properties (Bash *et al.*, 2003; Safaa, 2007). Fenugreek seeds contain neurin, biotin and trimethylamine which tend to stimulate the appetite by their action on the nervous system (Al Habori and Roman, 2002). Alloui *et al.* (2012) reported that 0.3% fenugreek had positive effects on growth performance of broiler

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chick where as Abbas (2010) found negative effects on feed intake and no effect on live weight. Apart from a range of beneficial effects including growth promoting, having 24 % CP and 3819 (ME) Kcal/Kg of energy and rich in vitamins and minerals, fenugreek can be regarded as a nutritious feed ingredient as well. El-Mallah *et al.* (2005) reported that 2% fenugreek in diets of turkey chicks significantly increased the digestibility of nitrogen free extract due to saponin present in fenugreek. Meanwhile, Al-Habori *et al.* (1998) found that fenugreek reduced the plasma cholesterol levels of rabbit.

Objective of this study was to determine the effects of a range of dietary fenugreek seed powder on growth performance, serum cholesterol, HDL, LDL levels and visceral organ weights of broiler chicken.

METHODOLOGY

Day old broiler chicks were brooded on an electrically heated floor brooder for ten days. Until day 20, chicks were fed a commercial broiler starter diet. On day 20, chicks (n=108) were weighed and allocated into 36 pens (0.75m x 0.75m x 0.75m) so that live weight variation among the pens was minimum. Each Pen had a drinker, a feeder and paddy husk as the litter material. The experiment followed a completely randomize design with six replicate pens, each having three birds. Pens were randomly allocated into six dietary treatments. Except for energy and methionine+cystine, the basal diet with 0% fenugreek seed powder met the nutrient requirements as set out by NRC (1994) (Table 1). Other five experimental diets were prepared by mixing either 1, 2, 3, 4 or 5% fenugreek seed powder with basal diet. Fenugreek seeds were purchased from a local market and ground before being incorporated into the experimental diets. The experimental diets and water were given *ad libitum* from day 21-38.

On day 33, birds were transferred to raised wire-floors fixed to the same cages. A total collection of feces was done for three days (from day 35-37), after two days of acclimatization period. N retention was determined as described by Leeson and Zubair, (1997). Blood was collected from wing vein of one randomly selected bird from each pen, on day 33. Blood sugar, serum cholesterol, LDL, HDL and total triglyceride were determined using commercial assay kits (SPINREACT, S.A. Ctra, Santa Coloma, Spain). One randomly selected bird from each pen was sacrificed on day 38 and visceral organ weights were determined. Small intestine was determined as the length from gizzard-duodenum junction to ileo-caeco-colic junction. Visceral organ weights were expressed as a percentage of de-skinned empty carcass.

Data were analyzed using SAS (1989), as a completely randomize design experiment. Pen means served as replicates in the analysis of growth performance parameters while randomly selected birds were the replicates of carcass and blood parameter analysis. Means were compared using DMRT procedure.

Table 1. Ingredient and nutrient composition of the basal diet

Ingredient	%
Maize meal	56.8
Soybean meal	37
Coconut oil	3
Dicalcium phosphate	1.2
Shell powder	1.5
Salt	0.25
Vitamin mineral mixture	0.25
Nutrient composition (Calculated)	
Energy (ME Kcal/kg)	3081
Crude protein (%)	19.9*
Calcium (%)	0.9
Non phytate phosphorus (%)	0.35
Lysine (%)	1.1
Methionine + Cystine (%)	0.67
Crude fibre (%)	4

*Analyzed

RESULTS AND DISCUSSION

Contrary to a number of studies (Abaza, 2007; Alloui 2012; Awadein *et al.*, 2010; Alloui *et al.*, 2012; Abaza, 2007; Alloui *et al.*, 2012) fenugreek did not significantly improve the feed intake or live weight (Table 2). Instead, 5% fenugreek tend to reduce the live weight on day 38 ($p=0.054$) and feed intake ($p=0.06$). Abaza, (2007) and Awadein *et al.* (2010) also indicated that the 0.5% fenugreek seeds decreased the feed consumption in laying hens. It is noted that all the studies in which fenugreek produced positive effects on growth performance have used lower inclusion levels than what used in this experiment. Therefore, it is hypothesized the optimum level of dietary fenugreek that induces positive effects on growth performance is lower than 1%. Comparable or sometimes superior performance of birds fed 1% fenugreek over the control birds further support this assumption.

Table 2. Effects of dietary fenugreek powder on growth performance, serum cholesterol levels and N retention of broiler chicken from 21-38 days

Parameter	Level of dietary fenugreek (%)						Pooled SEM	P value
	0	1	2	3	4	5		
21 d	623	614	614	607	617	618	13	0.55
38 d	1776	1831	1741	1731	1599	1560	164	0.054
Weight gain (g)	1152 ^{ba}	1216 ^a	1127 ^{ba}	1123 ^{ba}	982 ^b	941 ^b	163	0.04
Feed intake (g)	2640	2629	2589	2518	2437	2412	152	0.06
FCR	2.52	2.17	2.36	2.25	2.54	2.58	0.39	0.46
Blood parameters (mg/dl)								
Sugar	215	202	222	205	207	221	17	0.47
Cholesterol	149	149	150	153	131	138	18	0.37
HDL	67	66	69	68	57	61	11	0.55
LDL	58	56	55	60	48	49	8.6	0.10
Triglyceride	115	128	123	123	128	137	13	0.21
Ratio	2.2	2.28	2.19	2.26	2.31	2.26	0.15	0.87
N retention *g/100 body weight)	0.48	0.55	0.53	0.56	0.57	0.60	0.06	0.08

Weight gain of the birds given 1% fenugreek was significantly higher than that of 4 and 5% fenugreek fed counterparts. Though there were no significant differences in live weight on day 38, weight gain and FCR between the broilers given 0 and 1% fenugreek, the latter group reported the highest live weight and weight gain. Furthermore, giving a 13.8% improvement compared to control group, the birds fed 1% fenugreek reported the best FCR. Above findings suggest that 1% dietary fenugreek has some growth promoting effect in broilers.

The empty carcass weight of the broilers given control and 1% fenugreek was also significantly higher than those fed 3, 4 or 5% fenugreek fed birds (Table 3). The relative length of the small intestine was significantly higher for birds given 2, 4 or 5% fenugreek than those fed 0 or 1% fenugreek. There was a significant linear increase in relative length of the small intestine with increasing dietary fenugreek levels; $y = 13.2 + 1.11 x$ dietary fenugreek %. It is suggested that, though fenugreek has negative effects on growth in general, the growth of the intestine has not been retarded. The findings of Govaerts *et al.* (2000) and Susbilla *et al.* (1994) that growth of supply organs such as stomach and intestine receives priority in nutrient partitioning within the body support the above hypothesis.

Table 3. Effects of dietary fenugreek seed powder on visceral organ weights of broiler chicken

Organ	Dietary fenugreek level (%)						SEM	P value
	0	1	2	3	4	5		
¹ Empty carcass	1296 ^a	1273 ^a	1165 ^{ba}	1104 ^{bc}	1068 ^{bc}	975 ^c	16	0.002
Crop	0.41	0.46	0.60	0.37	0.38	0.46	0.02	0.50
Proventriculus	0.55	0.70	0.70	0.73	0.75	0.79	0.32	0.34
Gizzard	2.87	3.02	2.81	3.05	3.3	3.02	0.06	0.43
² Small intestine (length) cm/100g BW	13.8 ^b	13.9 ^b	14.3 ^b	17.0 ^a	17.3 ^a	19.0 ^a	0.24	0.001
Liver	4.4	3.3	2.9	3.2	3.3	3.7	0.11	0.12
Pancreas	0.32 ^b	0.28 ^b	0.37 ^b	0.43 ^b	0.46 ^b	0.70 ^a	0.002	0.000
Spleen	0.23	0.26	0.25	0.32	0.17	0.19	0.01	0.41
Cloacal fat	1.53	1.42	1.34	1.67	1.14	1.74	0.10	0.76
Bursa	0.27	0.30	0.28	0.28	0.14	0.20	0.05	0.22
Heart	0.72	0.70	0.79	0.69	0.74	0.87	0.05	0.51

1. De-skinned

2. From gizzard-duodenum junction to ileo-caeco-colic junction

Meanwhile, the relative weight of the pancreas of the birds fed 5% dietary fenugreek was significantly higher than other groups. There was a significant linear increase of relative pancreas weight with increasing dietary fenugreek levels; $y = 0.250 + 0.0715 x$ dietary fenugreek level. Perilla *et al.* (1997) and Chohan *et al.* (1993) have shown that pancreas become hypertrophic to compensate the negative effects of anti-proteolytic substances on protein digestibility resulting in an increased relative weight of the pancreas. Gacche *et al.* (2010) reported moderate level of anti-proteolytic activity in fenugreek. Suggesting that pancreatic hypertrophy compensated the negative effects of anti-proteolytic substances, the N retention was not reduced by higher dietary fenugreek levels (Table 2). Trypsin inhibitors reduced the feed intake of broilers (Carmen *et al.*, 1999; Chohan *et al.*, 1993) and thus reduced feed intake of the birds fed fenugreek may be due to the anti-proteolytic substances. Even though fenugreek contain as high as 24 % CP and 3800 Kcal ME/Kg (Abbas, 2010), the use of it at higher levels as a feed ingredient of poultry feed formulations may be limited due to the presence of anti-proteolytic substances. Relative weights of the crop, proventriculus, gizzard, heart, spleen, bursa of fabricious and the cloacal fat contents were not significantly altered due dietary fenugreek. Abbas, (2010) and Abaza, (2007) have also reported similar results.

A number of studies (Abbas, 2010; Abdel-Rasoul and Yousif, 2003; El-Ghamry *et al.*, 2002) have shown that serum cholesterol levels were reduced when fenugreek was added. However, none of the serum parameters including serum cholesterol was significantly reduced due to fenugreek levels used in this experiment.

CONCLUSIONS

It is concluded that 1 % dietary fenugreek seed powder has some growth promoting effects in broilers. Higher than 1% dietary fenugreek has negative effects on feed intake and growth performance. Dietary fenugreek increases the relative length of the small intestine and the weight of the pancreas. Serum cholesterol levels are not affected by the dietary fenugreek.

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