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Fenugreek residue as nutraceutical and antibacterial agent in broiler ration

M R PURUSHOTHAMAN[1], D CHANDRASEKARAN[2] and S R JANANI[3]

Tamil Nadu Veterinary and Animal Sciences University, Namakkal, Tamil Nadu 637 002 India

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ABSTRACT

A study was conducted in broiler chicken for 6 weeks to find out the efficacy of fenugreek residue (FR) as an additive in poultry rations and to evaluate the nutraceutical property of FR as a replacement of antibiotic (AB) in broiler rations. Day-old broiler chicks (216) were divided into 9 treatment groups, each treatment group had 3 replicates with 8 birds in each replicate. The treatments were 0, 0.5, 1.0, 1.5 and 2.0 % FR with and without antibiotic (500 g of 10% oxytetracycline/tonne). At the end of 6 weeks (0 – 42 day), the body weight gain was comparable with the control, whereas significantly higher feed intake and poor FCR was found in 1.0% and 1.5% FR without AB group than the control. Slaughter studies with 6 birds/treatment group were conducted at the end of the experiment revealed that dressing %, giblet and abdominal fat (g/kg body weight) did not vary among the groups. The blood glucose was not influenced and muscle cholesterol levels reduced in all treatment groups than the control. The intestinal bacterial *Escherichia coli* and *Clostridium* spp. count was found to be reduced in FR without AB, however FR with AB fed birds have intestinal *Clostridium* content comparable (0.5 and 2.0% FR) or higher (1.0 and 1.5% FR) than the control. Inclusion of FR with AB provided better returns over that of control. Supplementation of FR up to 2% with or without AB (except 1.5% FR without AB) in feed improved the performance of birds and reduced the feed cost per unit gain.

Key words: Bacterial count, Blood glucose, Broiler performance, Fenugreek residue, Muscle cholesterol

The major growth promoters used in poultry production are various feed grade antibiotics. At present, phytogenic feed additives are incorporated in animal feeding to improve the performance of livestock (Windisch *et al*. 2008). Herbs, spices, and various plant extracts have received increased attention as possible alternatives to antibiotic growth promoters (AGP), since they are considered natural products (Henandez *et al*. 2004). Seeds of fenugreek (*Trigonella foenum-graecum* L.) are reported to have many therapeutic effects including antimicrobial properties (Bash *et al*. 2003, Safaa 2007). Fenugreek is used traditionally as a hypocholesterolemic, hypolipidemic and hypoglycemic activity in healthy and diabetic animals. The defatted seeds material of fenugreek may reduce gastrointestinal absorption of glucose and cholesterol and increase bile acid secretion (Dash *et al*. 2011). Fenugreek residue is obtained after the extraction of galactomannose. Supplementation of 0.5% fenugreek seed in the diet of broilers significantly lowered total bacterial count, gram negative and coliform bacteria and was ineffective on *Salmonella* (Pajouhesh and Sazandegi 2010). Hence, present study was conducted to ascertain whether the fenugreek residue (galactomannan excluded fenugreek seed) could be used as a nutraceuticals and antibacterial agent in broiler rations.

Present address: [1]Professor (m.r.purushothaman @tanuvas.org.in), [2]Professor and Head (chanda22@gmail.com), [3]Junior Research Fellow (janani0101@gmail.com), Department of Animal Nutrition.

MATERIALS AND METHODS

A biological trial was conducted with day-old broiler chicks (216). The broiler chicks were divided into 9 treatment groups; each treatment group had 3 replicates with 8 birds in each replicate. The birds in each replicates, were distributed such that there were even number of males and females. The treatments were 0, 0.5, 1.0, 1.5 and 2.0 % fenugreek residue (FR) with or without antibiotic (500 g of 10% oxytetracycline/tonne). All the diets were formulated to achieve isocaloric and isonitrogenic (The ingredients used for preparation of experimental rations (Table 1) were analyzed for protein as per AOAC (1995)). The birds were fed the prestarter, starter and finisher diets for day 1 to 14, 15 to 28 and 29 to 42 days of age respectively. The birds were housed in deep litter pens using coconut coir pith as litter material and reared from day-old to 42 days of age following standard management practices. Feed and water were provided *ad lib*. All the birds were vaccinated against Ranikhet disease on seventh day and IBD on 14th day of age.

The feed offered and mortality (if any) was recorded daily and fortnightly bird weight and feed intake was recorded. Fortnightly feed efficiency was calculated. Blood was collected on 42nd days of age from 6 birds / treatment for studying the glucose level.

Table 1. Ingredient composition (%) of broiler prestarter, starter and finisher rations

Ingredients	Prestarter					Starter					Finisher				
	Control	0.5	1	1.5	2	Control	0.5	1	1.5	2	Control	0.5	1	1.5	2
Maize	557.7	555.9	554.0	552.2	550.4	550.0	550.0	550.0	550.0	550.0	591.7	590.9	590.1	589.3	588.6
Soya	380.4	377.6	374.8	372.0	369.2	361.8	365.9	361.4	356.9	352.4	314.7	310.9	307.2	303.4	299.7
Fenugreek residue*	0.0	5.0	10.0	15.0	20.0	0.0	5.0	10.0	15.0	20.0	0.0	5.0	10.0	15.0	20.0
Calcite/LSP	16.4	16.4	16.5	16.5	16.5	20.5	15.6	15.6	15.7	15.7	14.1	14.1	14.1	14.1	14.1
Di calcium phosphate	9.3	9.2	9.2	9.2	9.1	10.1	9.8	9.8	9.7	9.7	11.1	11.1	11.1	11.1	11.0
Oil/fat	16.9	16.6	16.3	16.0	15.7	39.5	37.5	36.9	36.3	35.6	52.0	51.5	50.9	50.4	49.8
Salt	3.0	3.0	3.0	3.0	3.0	2.3	3.0	2.9	2.8	2.7	2.9	2.8	2.7	2.6	2.5
Methionine	3.0	3.0	3.1	3.1	3.1	2.8	2.8	2.8	2.8	2.8	2.5	2.6	2.6	2.6	2.6
Lysine	3.3	3.3	3.3	3.2	3.2	1.8	1.5	1.6	1.6	1.6	1.9	1.8	1.8	1.8	1.8
Threonine	1.4	1.4	1.4	1.4	1.4	0.6	0.5	0.5	0.5	0.6	0.5	0.5	0.6	0.6	0.6
Sodium bicarbonate	1.2	1.2	1.2	1.2	1.2	3.3	1.2	1.3	1.5	1.8	1.3	1.5	1.7	1.9	2.1

Prestarter nutrient in %: CP 22.5, ME (Mcal/kg) 3.0, C: P 133.3, lysine – 1.42, methionine - 0.62, MET+CYS – 0.96, threonine - 0.96, calcium – 0.94, available phosphorus – 0.50; starter nutrient in %: CP 21.40, ME (Mcal/kg) 3.125, C: P 146.03, lysine – 1.25, methionine - 0.59, MET+CYS – 0.92, threonine - 0.85, calcium – 1.1, available phosphorus – 0.51; finisher nutrient in %: CP 19.68, ME (Mcal/kg) 3.25, C: P 165.16, lysine – 1.14, methionine - 0.54, MET+CYS – 0.85, threonine - 0.77, calcium – 0.88, available phosphorus – 0.50; additives supplied in kg / ton broiler vitamin premix – 0.5, broiler trace mineral – 1.35, choline chloride – 1.5, nsp enzyme – 0.5, phytase 2500 - 0.225, lysoforte - 0.5, coxistac - 0.5, hepatocare – 1, vitamin E 50% - 0.05, endox dry – 0.1, US curotox – 0.5, oxytetracycline 10 % - 0 .5. In prestarter, starter and finisher ration 6 and 7 similar to ration 4 and 5 except for oxy 100 FS is not added.

After the 42 days experimental period 6 birds per treatment were slaughtered and dressing, giblet abdominal fat were quantified. The total lipid was extracted from breast muscle (6 birds / treatment) as per Folch *et al*. (1957) and total cholesterol was estimated by one-step method of Wybenga *et al*. (1970). From the slaughter birds, intestinal contents were collected for quantification of total bacterial, coliform and *Salmonella* spp.

The costs of different experimental rations were worked out based on the actual cost of the feed ingredients, supplements and additives. The cost of feed per unit gain in weight in different groups was calculated and compared.

The data collected on various parameters were statistically analyzed as per Snedecor and Cochran (1989) and the means of different experimental groups were tested for statistical significance by Duncan's multiple range test (Duncan 1995).

RESULTS AND DISCUSSION

Weight gain, feed intake, feed efficiency and feed cost/ weight gain of birds fed different levels of fenugreek residues are presented in Table 2. In the first fortnight, inclusion of FR at 0.5% with antibiotic (AB) alone has comparable weight gain to control, whereas the weight gain was lower in 1 % and above FR fed birds with or without AB. In the period between 0 and 28 days, FR up to 1% level with or without AB, the growth performance was comparable. In the overall 0–42 days, the weight gain was comparable up to 2% level with or without AB. However, Shalash and Azouz (2002) reported that supplementation of fenugreek resulted in significantly ($P<0.01$) less body weight than those fed the control diet.

Feed intake in the first fortnight in all the FR containing diets (with and without AB) was lower. However, between 0–28 days, feed intake was comparable, when FR was incorporated up to 1.5% with AB. But when AB was not supplemented, the feed intake was less than the control. In the overall 0–42 days, feed intake was comparable when FR was incorporated with AB, but in AB withdrawal groups, it was significantly higher except in 2% of FR without AB. This suggested that the birds adapt to higher level FR diets as age advances. Supplementation of AB helps in stimulation of FR. This was in agreement with the findings of Abaza (2007) and Abbas (2010) who reported that fenugreek seed reduced feed intake in laying hens and broilers.

The feed conversion efficiency was good when FR was incorporated up to 1% without AB and 1.5% with AB during the first 0–14 days. However in 0–28 and 0–42 days, feed efficiency was poor even at 0.5% without AB whereas it was comparable at all levels of FR with AB. Aygun *et al*. (2011) suggested that fenugreek seed supplementation in broiler diets resulted in poor feed conversion ratio.

FR supplemented group (except 1.5% without AB) showed better returns than the control. When FR was incorporated with AB the returns were better than the unsupplemented groups. FR at 0.5 % with AB had the highest additional returns of ₹ 12.84 followed by 1.5% (10.58) over the control.

The slaughter parameters, blood glucose (mg/dl), muscle cholesterol (mg/dl), total bacterial count, coliform count and *Salmonella* spp. of birds fed with different levels of FR are presented in Table 3. The slaughter parameters namely dressing %, giblet and abdominal fat (g/kg body weight) were not influenced by FR supplementation up to 2% with and without AB. Farman *et al.* (2009) reported

Table 2. Weight gain (g), feed intake (g), feed efficiency (FCR) and feed cost/weight gain of birds (₹) fed different levels of FR with and without AB

Attribute	Days	Control	0.5% FR without AB	1% FR without AB	1.5% FR without AB	2% FR without AB	0.5% FR without AB	1% FR without AB	1.5% without AB	2% without AB
Body weight gain (g)	0–14	377^{d}±6	354^{b}±5	351^{b}±6	344^{ab}±7	327^{a}±6	374^{cd}±8	357^{bc}±5	346^{b}±6	343^{ab}±6
	0–28	1245^{c}±27	1225^{bc}±25	1179^{abc}±21	1157^{ab}±29	1133^{a}±21	1229^{bc}±32	1185^{abc}±25	1130^{a}±29	1204^{abc}±27
	0–42	1833±43	1841±43	1822±40	1816±53	1800±41	1886±46	1787±52	1725±42	1759±38
Feed intake (g)	0–14	569^{b}±3	483^{a}±5	462^{a}±7	487^{a}±10	463^{a}±5	464^{a}±3	476^{a}±1	438^{a}±3	490^{a}±2
	0–28	2403^{c}±11	2306^{c}±18	2315^{c}±19	2368^{c}±13	2085^{b}±58	1843^{a}±9	1976^{ab}±19	1766^{a}±11	1955^{ab}±28
	0–42	3236^{abc}±12	3793^{de}±17	3830^{e}±22	3886^{e}±16	3509^{cd}±81	3198^{ab}±16	3367^{bc}±22	2992^{a}±9	3295^{bc}±51
Feed conversion ratio (FCR)	0–14	1.51^{d}±0.02	1.37^{bc}±0.02	1.32^{abc}±0.02	1.42^{cd}±0.02	1.41^{cd}±0.02	1.24^{a}±0.01	1.33^{abc}±0.01	1.27^{ab}±0.01	1.43^{cd}±0.01
	0–28	1.61^{a}±0.030	1.88^{cd}±0.010	1.96^{d}±0.004	2.05^{d}±0.04	1.85^{bcd}±0.06	1.49^{a}±0.002	1.66^{abc}±0.02	1.56^{a}±0.01	1.62^{ab}±0.01
	0–42	1.77^{ab}±0.007	2.05^{cd}±0.01	2.10^{cd}±0.01	2.14^{d}±0.04	1.95^{bcd}±0.05	1.69^{a}±0.01	1.89^{abc}±0.03	1.73^{ab}±0.01	1.87^{abc}±0.01
Economics										
	Cost of prestarter feed (₹)	25.94	25.84	25.84	25.79	25.74	25.89	25.89	25.84	25.79
	Cost of starter feed (₹)	26.25	26.22	26.13	26.03	25.94	26.27	26.18	26.08	25.99
	Cost of finisher feed (₹)	25.69	25.62	25.54	25.47	25.39	25.67	25.59	25.52	25.44
	Cost of feeding 0–6 weeks	111.39±1.06	104.56±1.49	105.16±1.79	106.29±1.43	96.25±5.69	89.3±1.08	93.42±1.84	83.46±0.48	91.0±3.98
	Weight gain (kg)	1883.2±43.4	1841.8±43.2	1822.3±40.7	1816.8±53.8	1800.7±41.5	1886.±46.0	1787.0±52.5	1725.2±42.8	1759.8±38.0
	Cost of feed / kg weight gain	59.16	58.26	56.91	59.96	57.21	46.32	53.69	48.58	54.92
	Difference in feed cost over the control		+0.9	+2.25	–0.8	+1.95	+12.84	+5.47	+10.58	+4.24

Values in a row with at least one common superscript are not significant (P>0.05). Each value of weight gain is the mean of 24 observations. Each value of feed intake and feed efficiency is the mean of 3 observations. AB, antibiotic (oxytetracycline 10% added at 50g/100 kg feed).

Table 3. Slaughter parameters, blood glucose (mg/dl), muscle cholesterol (mg/100g), total bacterial count and coliform count of birds fed with different levels of FR with and without AB

% Fenugreek	Dressing (%)	Giblet (g/kg body weight)	Abdominal fat (g/kg body weight)	Blood Glucose Level (mg/dl)	Muscle cholesterol (mg/100g)	*E.coli* (log10 CFU/g)	*Clostridium* (log10 CFU/g)	*Salmonella*
Control	81±0.7	42±1.3	10±1.0	294±8.7	134±7.1	82.0±45.4	8.3^{cd}±1.5	Absent
0.5% without AB	80±1.6	45±1.8	9±0.6	309±9.2	122±21.0	42.2±15.3	1.2^{a}±0.6	Absent
1% without AB	80±1.4	48±2.0	7±1.3	269±12.1	140.2±27.0	25.7±6.6	3.5^{b}±1.1	Absent
1.5% without AB	80±0.9	46±1.3	9±1.7	274±6.3	144.8±12.8	26.8±5.4	1.2^{a}±0.5	Absent
2% without AB	81±0.7	47±1.0	11±2.0	281±11.4	112±26.4	15.8±5.6	1.5^{a}±0.7	Absent
0.5% with AB	82±0.7	46±0.9	13±1.8	293±9.5	148±24.3	89.3±37.0	10.2^{e}±1.7	Absent
1% with AB	82±0.7	46±1.5	10±0.6	270±4.1	129±13.1	24.3±7.3	9.2^{de}±1.7	Absent
1.5% with AB	79±0.8	47±1.3	12±1.1	284±11.9	153±6.9	75.8±33.9	7.0^{d}±2.2	Absent
2% with AB	81±0.8	41±1.1	8±1.7	283±11.9	107±9.3	41.2±10.9	16.7^{f}±1.7	Absent

Values in a column with at least one common superscript are not significant (P>0.05). Each value is a mean of 6 observations.

that there was no significant difference in slaughter parameters when birds fed with fenugreek.

The blood glucose level was not influenced at all levels of FR incorporation, which differed with the earlier works in laying hens by Abaza (2007) and Safaa (2007). The level of muscle cholesterol reduced at 2% FR in both the groups. The hypocholestermic effects of fenugreek have mainly been attributed to its fibre, gum, saponin and amino acid content (Mathur and Choudhry 2009).

The jejunum bacterial count - *E.coli* and *Clostridium* sp. of birds fed with FR at different levels with and without antibiotic suggested that numerical reduction in *E. coli* due to FR supplementation. The *Clostridium* sp. count reduced when FR was provided without antibiotic up to 2%. The intestinal *Clostridium* content was comparable (0.5 and 2.0% FR) or higher (1.0 and 1.5% FR) than the control. The reduction in microbial count might be due to the antimicrobial properties of FR (Ahmadiani *et al*. 2001, Khan *et al*. 2009).

From this study, it may be concluded that the production was comparable even without antibiotic usage, but feed efficiency was poor in antibiotic withdrawn groups, FR along with antibiotics resulted in comparable feed efficiency to that of control. The yield of edible parts and blood glucose were not affected by FR incorporation, whereas muscle cholesterol was reduced. Intestinal bacterial count was reduced due to FR supplementation. The cost of feed/kg body weight was better when FR was added along with antibiotics.

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