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# Effect of dandelion leaves and fenugreek seeds with or without enzyme addition on performance and blood biochemistry of broiler chicken, and evaluation of their *in vitro* antibacterial activity

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ABSTRACT

The study was conducted to evaluate effect of dietary supplementation of locally available herbs dandelion leaves and fenugreek seeds with or without enzyme treatment in broiler chicken. Day-old commercial broiler chicks (273) were reared together until 7 days of age and on 7$^{th}$ day, and individually weighed, and distributed randomly into 7 groups of 3 replicates with 13 chicks each. Birds in the control group were fed diets without additives ($T_1$). The other 6 treatment groups were fed the basal diet supplemented with 0.5% dandelion leaves ($T_2$), 1% fenugreek seeds ($T_3$), combination of 0.5% dandelion leaves and 1% fenugreek seeds ($T_4$), enzyme treated dandelion leaves 0.5% ($T_5$), enzyme treated fenugreek seeds 1% ($T_6$), and combination of enzyme treated dandelion leaves (0.5%) and (1%) fenugreek seeds ($T_7$). The results revealed a significant improvement in the live body weight of broiler chicken fed diets supplemented with dandelion leaves and fenugreek seeds with or without enzyme treatment ($T_5$, $T_6$ and $T_7$) when compared with the control group. A significant improvement in the live body weight and body weight gain was obtained in the said groups from 3 to 6 weeks of age. Highest live body weight was observed in the group fed combination of enzyme treated dandelion leaves and fenugreek seeds ($T_7$) followed by 1892.62g±5.11 in enzyme treated dandelion group ($T_6$). Among the groups fed dandelion leaves and fenugreek seeds without enzyme, highest body weight was achieved in the group fed 1% combination of dandelion leaves and fenugreek seeds in the diet ($T_4$), followed by the group fed fenugreek alone ($T_3$). Fenugreek seeds showed better results in terms of growth of birds than dandelion leaves. Highest cumulative feed consumption was recorded in all the groups in which 1% fenugreek seeds were supplemented when compared with the control group. However, a nonsignificant effect was observed in the dandelion groups compared to control in terms of cumulative feed consumption. The feed conversion ratio (FCR) was significantly improved in the birds fed diets containing either raw or enzyme treated dandelion leaves and fenugreek seeds, alone or in combination, when compared with the control group. Among the different treatment groups, best FCR was observed in the group fed combination of enzyme treated dandelion leaves and fenugreek seeds ($T_7$), followed by enzyme treated dandelion group. The mean values of serum glucose and cholesterol significantly reduced among different treatment groups compared to control, the highest reduction being observed in the groups fed combination of dandelion leaves and fenugreek seeds with or without enzyme addition. Further, the *in vitro* study revealed that both the dandelion leaves and fenugreek seeds have antibacterial properties with zone of inhibition as 2 mm from dandelion leaves and 2.1 mm from fenugreek seeds for the concentration of 0.5 mg/ml and 0.05 mg/ml of extract against *Escherichia coli* on the Mueller Hinton Agar, respectively.

**Key words**: Antibacterial, Blood biochemistry, Broiler, Dandelion, Fenugreek, Performance

Common feed additives used in poultry diets include antimicrobials, antioxidants, pH controlling agents and enzymes (Fulton *et al.* 2002). Of late, there has been an emphasis on the use of phytogenics (natural growth promoters or non-antibiotic growth promoters derived from herbs, spices or other plants) as feed additives in poultry because these products were found safe, less toxic, residue free and were thought to be ideal feed additives in food animal production (Hashemi *et al.* 2008). The primary mode of action of phytogenic feed additives arises from beneficially affecting the ecosystem of gastrointestinal microbiota through controlling potential pathogens. Improved digestive capacity in the small intestine may be considered an indirect beneficial effect of phytogenics

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stabilising the microbial eubiosis in the gut. Consequently, phytogenics relieve the host animals from immune defense stress during critical situations and increase the intestinal availability of essential nutrients for absorption, thereby helping animals to grow better within the framework of their genetic potential (Hashemi and Davoodi 2010).

Kashmir is located at the northwestern tip of Himalayan biodiversity hot spot (Hussain 2001), which supports a rich and spectacular plant biodiversity of great scientific curiosity and promising economic benefits. Among the herbal flora available in the region, 2 herbal plants i.e. dandelion leaves (*Taraxacum officinale*) and seeds of fenugreek (*Trigonella foenum graecum*) were utilized for the study. Dandelion is a well known medicinal plant that grows in nature in Asia, Europe and North America (Malik *et al.* 2011). The roots of the herb are primarily considered for supporting digestion and liver function, while its leaves are used as diuretic and digestive stimulant (Mir *et al.* 2013). Fenugreek is grown mainly in India, Pakistan and China. Its seeds have many therapeutical effects such as hypoglycaemic, anti-helminthic, anti-inflamatory and anti-microbial properties (Bash *et al.* 2003). It also contains lecithin and choline that help to dissolve cholesterol and fatty substances. It also contains neurin, biotin, trimethylamine which tends to stimulate the appetite by their action on the nervous system (Michael and Kumawat 2003). Based on the aforementioned properties, a research study was conducted to explore the potential of dandelion leaves and fenugreek seeds as natural feed additives in the diets of broiler chicken.

## MATERIALS AND METHODS

Day-old commercial broiler chicks (273) were procured and reputed source. Chicks were reared in battery cages until 7 days of age. During this period all the birds were provided with a pre-starter mash (23% crude protein and 2,800 Kcal/kg metabolisable energy). Birds had free access to feed and water throughout and were maintained on a constant 24 h light schedule. On eighth day, the chicks were individually weighed, distributed into 7 treatment groups of 3 replicates with 13 chicks in each in a completely randomized design so that the treatment means differ as little as possible. Birds in the control group were fed diets without additives ($T_1$). The other 6 treatment groups were fed the basal diet supplemented with 0.5% dandelion leaves ($T_2$), 1% fenugreek seeds ($T_3$), combination of 0.5% dandelion leaves and 1% fenugreek seeds ($T_4$), enzyme treated dandelion leaves 0.5% ($T_5$), enzyme treated fenugreek seeds 1% ($T_6$) and combination of enzyme treated dandelion leaves (0.5%) and (1%) fenugreek seeds ($T_7$).

Ezyme used was a cocktail product of cellulase 180000,000, amylase 125,000, xylanase 1800,000, phytase 200,000, protease 16,000, lipase 40,000 and pectinase 7,000 IU/g of product; and added @ 50 g / 100 kg of feed. The diets were formulated to meet the recommendations of the BIS (1992). The diets were isonitrogenous and isocaloric. dandelion leaves (*Taraxacum officinale*) and fenugreek seeds (*Trigonella foenum graecum*) were procured, dried and subjected to proximate analysis as per the standard procedure. The ingredient and nutrient compositions of experimental diets are shown in Table 1. Percentage crude protein, total ash, ether extract and crude fibre content of the samples were determined as per AOAC (2005a). Dandelion leaves and fenugreek seeds in powder form were mixed thoroughly in aforesaid quantities to a small amount of feed (1 kg) in a premixer. The resultant mixture was then mixed with the rest of the feed in a mechanical blender until a thorough and consistent mixture was obtained. All chicks were vaccinated against Ranikhet disease on fifth day with F1 strain vaccine and IBV-95 vaccine against infectious bursal disease on 16th day. Chicks were checked twice daily for mortality, if any. Birds were kept under the same managerial, hygienic and environmental conditions.

The data on individual body weight of the experimental birds and the cumulative feed consumption and feed conversion ratio on group basis were recorded at weekly intervals.

Whole blood was collected, serum separated and

Table 1. Ingredient and nutrient composition of experimental basal diet

| Ingredients | Starter (1–3 weeks) | Finisher (4–6 weeks) |
|---|---|---|
| Yellow maize | 53.90 | 65.06 |
| Soybean meal | 39.00 | 30.80 |
| Deoiled rice bran | 2.90 | 0.00 |
| Oyster shell grit | 0.90 | 0.90 |
| Dicalcium phosphate | 1.90 | 1.90 |
| Lysine HCl | 0.25 | 0.22 |
| DL-methionine | 0.20 | 0.17 |
| Trace minerals mixture* | 0.20 | 0.20 |
| Vitamin premix** | 0.20 | 0.17 |
| Common salt | 0.40 | 0.40 |
| Toxin binder | 0.15 | 0.15 |
| Furazolidone, 20% w/w | 0.05 | 0.05 |
| Coccidiostat | 0.05 | 0.05 |
| Total | 100.00 | 100.00 |
| Nutrient composition | | |
| Crude protein | 22.35 | 19.82 |
| Crude fibre | 3.98 | 4.71 |
| Ether extract | 6.532 | 7.714 |
| Total ash | 4.89 | 5.761 |
| Calcium*** | 1.61 | 1.52 |
| Available phosphorus*** | 0.856 | 0.79 |
| Lysine*** | 1.32 | 1.17 |
| Methionine*** | 0.681 | 0.540 |
| Metabolizable energy (Kcal/kg diet)*** | 2856 | 2978 |

* Trace mineral premix provided the following per kg of diet: manganese 75 mg, iron 60 mg, zinc 70 mg, copper 10 mg, cobalt 0.2 mg, iodine 1 mg and selenium 0.3 mg. ** Vitamin premix contained (units/kg): Vitamin A 12375 IU, riboflavin 7.5 mg, cholecalciferol 1800 IU, vitamin K 1.5 mg, thiamine 1.2 mg, pyridoxine 2.5 mg, cynacobalamine 12 mcg, vitamin E 12 mg, pantothenic acid 12 mg, niacin 18 mg. ***Calculated values.

Table 2. Performance of broiler chicken fed raw and enzyme treated dandelion leaves and fenugreek seeds

| Week | Treatment groups | | | | | | |
|---|---|---|---|---|---|---|---|
| | Control | Basal diet + 0.5% dandelion leaves | Basal diet + 1% fenugreek seeds | Basal diet + 0.5% dandelion leaves + 1% fenugreek seeds | Basal diet + 0.5% fandelion leaves + enzyme | Basal diet + 1% fenugreek seeds + enzyme | Basal diet + 0.5% dandelion leaves + 1% fenugreek seeds +enzyme |
| Average body weight (g) | | | | | | | |
| 3rd | 628.54±3.38[a] | 665.23±6.62[b] | 662.88±9.35[b] | 672.82±6.48[b] | 671.65±3.98[b] | 670.18±10.37[b] | 684.87±3.93[b] |
| 6th | 1557.62±8.56[a] | 1750.35±1.96[b] | 1845.44±2.54[d] | 1863.10±3.94[e] | 1789.17±3.81[c] | 1892.62±5.11[f] | 1937.15±9.28[g] |
| Average feed consumption (g) | | | | | | | |
| 1–3 | 730.11±1.96[a] | 740.09±1.97[a] | 749.74±0.85[b] | 752.75±1.35[b] | 746.10±1.04[a] | 754.92±1.48[b] | 759.73±0.79[b] |
| 1–6 | 3054.07±0.71[a] | 3095.46±3.63[a] | 3304.42±1.19[b] | 3309.57±1.15[b] | 3107.83±3.40[a] | 3326.56±0.95[b] | 3354.37±1.05[b] |
| Average feed conversion ratio (FCR) | | | | | | | |
| 1–3 | 1.54±0.01[a] | 1.45±0.01[b] | 1.47±0.02[b] | 1.46±0.01[b] | 1.44±0.01[b] | 1.46±0.02[b] | 1.43±0.01[b] |
| 1–6 | 2.17±0.01[a] | 1.94±0.005[b] | 1.95±0.003[b] | 1.94±0.005[b] | 1.90±0.005[cd] | 1.91±0.003[c] | 1.88±0.008[d] |

Means within the same row with different superscripts are significantly different (P<0.05).

Table 3. Serum constituents of broiler chicken fed raw and enzyme treated dandelion leaves and fenugreek seeds

| Parameters | Treatment groups | | | | | | |
|---|---|---|---|---|---|---|---|
| | Control | Basal diet + 0.5% dandelion leaves | Basal diet + 1% fenugreek seeds | Basal diet + 0.5% dandelion leaves + 1% fenugreek seeds | Basal diet + 0.5% dandelion leaves + enzyme | Basal diet + 1% fenugreek seeds + enzyme | Basal diet + 0.5% dandelion leaves + 1% fenugreek seeds +enzyme |
| Glucose (mg/dl) | 215.16±0.16[a] | 191.00±0.05[b] | 190.16±0.16[c] | 184.83±0.44[e] | 191.30±0.05[b] | 190.30±0.05[c] | 185.56±0.88[d] |
| Protein (g/dl) | 5.12±0.04 | 5.21±0.01 | 4.98±0.22 | 5.18±0.08 | 5.24±0.12 | 4.95±0.09 | 5.19±0.01 |
| Cholesterol (mg/dl) | 161.00±0.57[a] | 151.13±0.08[c] | 150.36±0.08[d] | 147.10±0.05[e] | 152.03±0.03[b] | 150.10±0.00[d] | 147.56±0.03[e] |
| SGPT(µ/l) | 15.30±0.20 | 13.50±0.01 | 14.36±0.03 | 13.20±0.04 | 13.80±0.11 | 14.71±0.03 | 13.63±0.01 |
| SGOT(µ/l) | 98.52±0.44 | 96.20±0.11 | 98.11±0.03 | 97.36±0.07 | 96.85±0.02 | 98.30±0.76 | 97.60±0.56 |

Means within the same row with different superscripts are significantly different (P<0.05).

analysed for glucose, total protein, cholesterol, SGPT and SGOT with the aid of auto analyzer equipment by using commercially available respective biochemical kits.

Further, the dried and powdered dandelion leaves and fenugreek seeds (15 g) were extracted successively with 200 ml of ethanol (70%) in a soxhlet extractor for 5 h at a temperature not exceeding the boiling point of the solvent (Lin *et al*. 1999). The extracts were filtered and then concentrated to dryness to convert it into ethanol free powder. Antibacterial activity of extracts of dandelion leaves and fenugreek seeds was investigated against pure culture of *Eschericia coli*. The tested bacteria was cultured on Nutrient agar at 37°C for 24 h. The cultures were sub cultured regularly and stored at 4°C. The *in vitro* antibacterial activity of ethanolic extract of dandelion leaves and fenugreek seeds was investigated as per Dash *et al*. (2011). Extracts of the dandelion leaves and fenugreek seeds were diluted to various concentrations following the serial dilution technique. The *in vitro* antibacterial activities of the test samples were carried out by disc diffusion method (CLSI 2007). Paper discs were impregnated with the extracts of dandelion leaves and fenugreek seeds of different concentrations (0.5, 0.05, 0.1 and 0.01 mg/ml). The bacterial suspension was prepared to contain $10^8$ cfu/ml and the plates containing Mueller Hinton agar were inoculated with the bacterial culture. The discs were placed aseptically over the bacterial culture on plates and incubated at 37°C for 24 h. After incubation for 24 h, the zone of inhibition around the discs was measured by millimeter scale.

The data obtained were statistically assessed by the analysis of variance (ANOVA) through General Linear Model procedure of SPSS (10.0) software considering replicates as experimental units and the values were expressed as means±standard error. Duncan's multiple range test (Duncan 1955) was used to test the significance of difference between means by considering the differences significant at P<0.05.

## RESULTS AND DISCUSSION

Initially there was no significant difference in the body weight of chicks among the groups, but as the age of birds advanced, the average weekly body weight of broiler chicken fed either dandelion leaves ($T_2$) or fenugreek seeds ($T_3$) or combination ($T_4$) showed a significant ($P<0.05$) improvement than control birds ($T_1$) (Table 2). From fourth week onwards, a significant ($P<0.05$) increase in the body weight was noticed among all the treatment groups compared to control. Highest body weights were achieved in the groups fed enzyme treated dandelion leaves or fenugreek seeds followed by the groups fed these herbs in raw state. Highest final body weight was recorded in the group fed enzyme treated dandelion leaves and fenugreek seeds in combination followed by enzyme treated dandelion group ($T_6$). Among the groups fed dandelion leaves and fenugreek seeds without enzyme, highest body weight was achieved in the group fed 1% combination of dandelion leaves and fenugreek seeds in the diet ($T_4$), followed by the group fed fenugreek alone ($T_3$). When dandelion leaves and fenugreek seeds were compared, fenugreek seeds showed better results than dandelion leaves. However, dandelion leaves improved the body weight of birds compared to the control group. These results are in agreement with Galib *et al*. (2010) who reported that the supplementation of dandelion leaves in the diet of broiler chicken significantly ($P<0.05$) improves live body weight. The improvement in live body weight might be attributed to presence of bioactive constituents such as flavonoids, alkaloids present in the leaves of dandelion plants (Mir *et al.* 2013). Also, the leaves of dandelion are rich source of fibre, potassium, iron, calcium, magnesium, phosphorus, vitamins A and C, the B vitamins thiamine and riboflavin which play active role in metabolic processes of bird (Jackson 1982). Further, Yarnell and Abascal (2009) reported the antibacterial action of dandelion leaves which they attributed to the presence of phenylpropanoids, triterpenoid saponins and many other components that might have augmented the growth promoting effects. Moreover, the results achieved in the present study regarding fenugreek seeds are in harmony with other workers (Rabia 2010, Aksa *et al*. 2012, Raziq 2012, Weerasingha and Atapattu 2013) who reported that supplementation of fenugreek seeds in broiler chicken significantly ($P<0.05$) improves the body weight of broiler chicken. The improvement in live body weight due to fenugreek seeds might be due to the presence of the essential fatty acids and high quality proteins in the fenugreek seeds (Murray *et al.* 1991), stimulating effect on the digestive system of broilers (Hernandez *et al.* 2004) and improvement in the gut microflora (Aksa *et al*. 2012).

Further, the highest body weights obtained as a result of enzyme treatment of the herbs in the present study are in concordance with the results of Khan and Siddique (2006), Sundu *et al.* (2006), Luo *et al*. (2009) and Bansal *et al*. (2012) who reported significant ($P<0.05$) increase in the live body weight with the enzyme supplementation in the broiler chicken ration. The increase in body weight due to enzyme treatment was attributed to the increase in dry matter and nutrient digestibility; apparent metabolizable energy and enhanced absorption of nutrients especially fat and protein with concomitant decrease in digesta viscosity in the intestine (Lazaro *et al.* 2003). The *in vitro* antibacterial activity as recorded in the present study, further confirmed the fact that both these herbs have antibacterial activity which in turn might have results in better growth performance in the treatment groups.

The cumulative feed consumption was highest ($P<0.05$) in all the groups in which 1% fenugreek seeds were supplemented when compared with the control group (Table 2). Significantly ($P<0.05$) higher feed intake was observed in the birds fed diets supplemented with combination of enzyme treated dandelion leaves and fenugreek seeds ($T_7$). Our results are in concordance with the results of Magda (2012), Yatoo *et al*. (2012) who reported that inclusion of fenugreek seeds @ 1% level in the diet of broiler chicken significantly ($P<0.05$) increases the feed intake. This improvement in the feed intake with fenugreek seed could be attributed to the carbohydrates and their main component (galactomannan) which stimulated the appetizing and digestive process of broilers (Aksa *et al*. 2012 and Hernandez *et al.* 2004). Herbs develop their initial activity in the feed of animals as flavor and can therefore influence the eating pattern, secretion of digestive fluids and total feed intake (Wenk 2003).

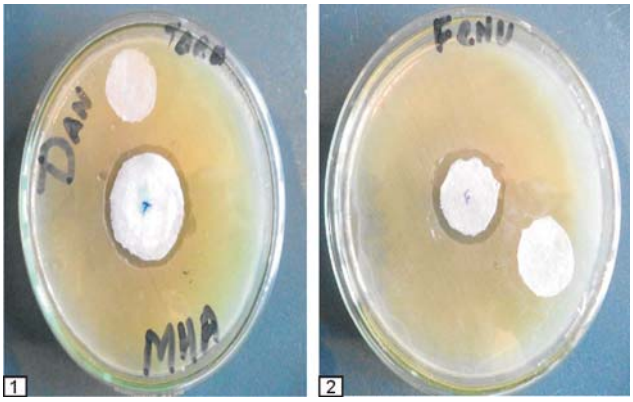
The feed conversion ratio was significantly ($P<0.05$) improved in the birds fed diets containing either raw or enzyme treated dandelion leaves and fenugreek seeds, alone or in combination, when compared with the control group (Table 2). Among the different treatment groups, best FCR of 1.88±0.008 was observed in the group fed combination of enzyme treated dandelion leaves and fenugreek seeds ($T_7$), followed by enzyme treated dandelion group and enzyme treated fenugreek group. These results are in harmony with the results of Galib *et al.* (2010) who reported that the supplementation of dandelion leaves in the diet of broiler chicken significantly ($P<0.05$) improves FCR. This could be attributed to the antibacterial action of dandelion (Yarnell and Abascal 2009) and antioxidant property that tends to increase the production of digestive enzymes and liver function (Langhout 2000). Further, Rabia (2010) and Raziq (2012) reported that supplementation of fenugreek seeds in broiler chicken significantly ($P<0.05$) improved FCR. The improvement in FCR may be due to the improvement in gut microflora due to fenugreek seeds (Aksa *et al*. 2012). The improvement in the FCR could also be due to the good nutritive composition of fenugreek seeds (Schryver 2002). Moreover, El-Gendi *et al.* (1994) reported that there was an improvement in FCR with feeding of herbal products which they attributed to their effect on improving the digestibility of dietary protein in the small intestine.

The serum glucose significantly ($P<0.05$) reduced among different treatment groups compared to the control (Table 3). Among different treatment groups, highest reduction was

observed in the groups fed combination of dandelion leaves and fenugreek seeds with or without enzyme addition with values of 184.83±0.44 mg/dl and 185.56±0.88 mg/dl in $T_4$ and $T_7$ respectively. Similar results were reported by Al-Kassie *et al.* (2008) who reported that dandelion leaves cause reduction in the blood glucose levels of broiler chicken. This has been attributed to the fact that dandelion is a source of flavonoids, saponins and glycosides (sugars), including taraxacosides, taraxacolides, dihydrolactucin, ixerin, taraxinic acids. These compounds have been found to have hypoglycaemic property attributed to insulin secretagogue effect i.e. stimulating pancreatic beta-cell release of insulin (Yarnell and Abascal 2009). Further, Eman (2011) have reported that fenugreek seeds cause a significant (P<0.05) reduction in the blood glucose level of chickens. It might be due to pectins in the fenugreek seeds which delay stomach emptying and glucose absorption from intestine (Ali *et al*.1995). The reduction in the serum glucose levels may also be related to the direct α- cell stimulation by amino acid (4-hydroxyisoleucine) present in fenugreek seeds, which increases insulin secretion, thus improves glucose tolerance (Broca *et al.* 2000).

The serum protein content was not affected. Similar results were observed earlier by Abbas (2010) and Duru *et al*. (2013). Further, there was a significant (P<0.05) reduction in the serum cholesterol level among different dietary treatment groups compared to control. Among different treatment groups, highest reduction was observed in the groups fed combination of dandelion leaves and fenugreek seeds with or without enzyme. These results are in harmony with Jassim *et al*. (2012) who reported that dandelion leaves cause reduction in serum cholesterol levels which they attributed to the fact that leaves of dandelion are rich in glycosides, alkaloids, phenolic compounds, tannins and flavonoids which have an influence on reducing the cholesterol levels in the blood by intensification of bile secretion. Fenugreek also reduced serum cholesterol levels (Eman 2011, Mamoun *et al*. 2014). The reduction in the serum cholesterol level could be due to the presence of saponins and resins in fenugreek seeds which might have inhibited the bile acid and cholesterol absorption from intestine, thereby, decreasing cholesterol level in blood (Petit *et al*. 1995). Moreover, the steroidal saponins in fenugreek seeds (diosgenin, yamogenin, tigogenin and neotigogenin) are thought to inhibit cholesterol absorption and its synthesis, hence has a potential role in prevention of arteriosclerosis (Mullaicharam *et al.* 2013).

The serum SGPT and SGOT levels were also unaffected. The levels are in concordance with the findings of Ali and Ismail (2012) who reported that supplementation of fenugreek seeds in the diet of broiler chicken had no significant (P>0.05) effect on the serum level of liver enzymes when compared with the control, indicating the role of fenugreek seeds as hepatoprotective agent (Meghwal and Goswam 2012). Similarly other workers have reported the hepatoprotective role of dandelion leaves (Park *et al.* 2007, Tabassum *et al.* 2010). Further, Shakmak (2003) and




Figs 1–2. **1.** *In vitro* antibacterial activity of extract of dandelion leaves on Mueller Hinton agar depicted by zone of inhibition around the disc and no zone of inhibition around control disc. **2.** *In vitro* antibacterial activity of extract of fenugreek seeds on Mueller Hinton agar depicted by zone of inhibition around the disc and no zone of inhibition around control disc.

Al-Harthi (2006) have found that cell-wall degrading enzymes and/or phytase supplementation had no adverse effect on biochemical constituents of plasma and liver function of broiler chicks. This indicated that dandelion leaves @ 0.5% and fenugreek seeds @ 1% have no toxic effect and could be safely used as feed additives in the diets of broiler chicken.

The zone of inhibition of dandelion leaves was 2 mm for the concentration 0.5 mg/ml of extract against *Escherichia coli* (E.coli) on the Mueller Hinton agar whereas, the zone of inhibition of fenugreek seeds was 2.1 mm for the concentration of 0.05 mg/ml of extract against *E.coli* on the Mueller Hinton agar (Figs 1 and 2). Both dandelion leaves and fenugreek seeds showed antibacterial property against E.coli. The antibacterial property of Fenugreek seeds against E.coli was found to be better than the dandelion leaves. The Fenugreek seeds may contain higher amount of active components which resulted in higher antibacterial property. The results of present study are in harmoy with Jassim *et al*. (2012) who reported that the ethanolic extract of dandelion @ 0.5 mg/ml resulted in the zone of inhibition between 1–4 mm. Yarnell and Abascal (2009) attributed the antibacterial action of dandelion to the presence of phenylpropanoids, triterpenoid, saponins and many other components present in it. Similarly, *in vitro* antibacterial activity of methanolic extract of fenugreek against *E.coli* was effective (Dash *et al*. 2011) and ascribed to the flavonoids, saponins and phenols present in it (Schryver 2002).

In conclusion, supplementation of dandelion leaves at 0.5% or fenugreek seeds at 1% in diet either alone or in combination resulted in an improvement in the body weight and feed conversion ratio of broiler chicken. Further, additional supplementation with enzymes resulted in augmentation of growth promoting effects and improved FCR. Further, both the herbs, at aforementioned levels could be safely incorporated in the diets of broiler chicken without any toxic effect on their health. Moreover, both dandelion

leaves and fenugreek seeds showed i*n vitro* antibacterial activity against *Escherichia coli* with fenugreek seeds having better antibacterial effect than dandelion leaves.

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