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Full Length Article

Effect of Supplementing Olive, Blackseed and Flaxseed Oils on Growth Performance and Serum Biochemistry of Broiler and Economics of its Production

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Abstract

This study was conducted to investigate the effect of olive oil, blackseed oil and flaxseed oil on growth performance and serum biochemistry of broiler chicks. Three hundred broiler chicks were grouped into 30 experimental units having 10 chicks each. Three levels (0.5, 1.0 and 1.5%) of each of the oils were offered to the chicks such that each treatment was replicated thrice. The chicks fed on basal diet served as a control. The data on weekly body weight gain, feed intake, weekly feed conversion ratio, Newcastle Disease (ND) and IBD titers, serum triglycerides, serum cholesterol, low density lipoproteins and high density lipoproteins were recorded. Overall weight gain (1720.6 g) was significantly ($P<0.05$) highest in the treatment group having 0.5% flaxseed oil. Highest value of titer (213.33) against ND was observed in the treatment having blackseed oil 0.5%. Results of serum triglycerides, serum cholesterol, low and high density lipoproteins showed no effect of these treatments. Overall results depicted that 0.5% flaxseed oil improves growth performance in broiler chicks. © 2017 Friends Science Publishers

Keywords: Plant oil; Growth promoter; Immune booster; FCR

Introduction

Antibiotic growth promoters (GPs) are being used in poultry feed to enhance its performance for the last few decades. No doubt these antibiotics inhibit the growth of pathogenic microorganisms, prevent intestinal problems and improve performance of chicken (Dibner and Richards, 2005), but antibiotic residues found in the meat and eggs are of great risk for human health (Jang *et al.*, 2007). Due to the continuous use of antibiotics as GPs, pathogenic bacterial flora has become resistant to these antibiotics. It is expected that in next few years birds will show no response to antibiotics due to their continuous use of antibiotics as GPs. These drug resistant pathogens will also affect the human health and will emerge as a serious issue. Due to these facts, strong protest against the use of antibiotics as GPs and immune booster has been raised (Gustafson and Bowen, 1997; Waldroup *et al.*, 2003) and European Union has put a ban on use of antibiotics in poultry feed since 2006. This is the reason that scientific community and poultry experts are working on different alternates of these antibiotic GPs.

Fats and oils are good alternate of these antibiotic GPs and vegetable oils are added in poultry feeds as energy source. They not only increase feed intake but also have growth promoting effects. Many fats and oils have been reported in literature as GPs (Korver and Klasing, 1997; El-Sheikh *et al.*, 1998; Growell, 1999; Akhtar *et al.*, 2003; Ramadan, 2007; Windisch *et al.*, 2008). Plant oils have different biological activities like antibacterial, antioxidant and antifungal (Steiner, 2009) and supplementation of poultry feed with these oils improves the performance by changing gut microflora, profile of digestive enzymes and stimulation of immune system (Haijto *et al.*, 1989; Helander *et al.*, 1998; Jang *et al.*, 2004; Muzaffar *et al.*, 2016). Large number of studies have been conducted on antibacterial effects of plant oils *in vitro* (Jamroz *et al.*, 2003; Mitsch *et al.*, 2004). Improvement in growth performance of broilers may also be due to improvement in gut equilibrium, by lowering the fermentation, bacterial colony counts and stimulating the digestive secretions. It has been observed that vegetable oils increase the mucous production in intestine and reduce the bacterial adhesion in broilers (Jamroz *et al.*, 2006; Windisch *et al.*, 2008). Improved digestive enzyme activities (trypsin and amylase) and absorption of nutrients in intestine promote growth in broilers (Lee *et al.*, 2003; Jang *et al.*, 2007).

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Blackseed, flaxseed and olive oils have also been studied for antioxidative and antimicrobial effects (Gokce *et al.,* 2000; Ramadan, 2007). Blackseed oil also helps in the reduction of cholesterol synthesis in poultry by inhibiting the activity of hepatic 3-hydroxy-3-methylglutaryl coenzyme A. Reduction of total cholesterol, triglycerides and low density lipoprotein (LDL)-cholesterol and increase in high density lipoprotein (HDL)-cholesterol contents in egg yolk has been reported by the use of blackseed oil. Use of blackseed not only improves the overall performance, feed efficiency, growth rate and digestibility but also reduces the deposition of abdominal fat in broilers (Ashayerizadeh *et al.,* 2009). Olive oil helps to increase monounsaturated fatty acids and decrease LDL-cholesterol level without reducing HDL-cholesterol in serum (Bolukbasi and Erhan, 2005). Olive oil has 55.0–83.0% oleic acid, birds fed with the diet having olive showed higher live weight, dressing percentage and weights of visceral organs (Zarei *et al.,* 2011).

Dietary inclusion of oils has also been reported to have immuno-regulatory effects in broilers (Fritsche *et al.,* 1992). Extract from *Achillea talagonica* was found to stimulate the immune system (Rezaeipoor *et al.,* 1999). Oils rich in poly unsaturated fatty acids (PUFA) affect the inflammatory response and result in improved immune system functions (Korver and Klasing, 1997). Fish oil fed to male broilers resulted in improved cellular immunity but did not affect the humoral immunity (Korver and Klasing, 1997; Maroufyan *et al.,* 2012).

However, major hindrance in use of these plant oils as commercial feed additives is lack of knowledge on economics of its use, exact mechanism of action and dose level to be included in feed. Thus, present study was therefore, conducted to evaluate the economics of broiler production when plant oils are used as feed additives.

Materials and Methods

To explore the effect of olive, blackseed and flaxseed oils on the growth performance, serum biochemistry and economics of broiler production this project was executed at the Poultry Research Center, Department of Poultry Science, University of Agriculture, Faisalabad, Pakistan. Experimental shed was thoroughly cleaned, white washed, disinfected and fumigated before the arrival of chicks. Each experimental unit was kept in a separate pen having similar floor space and environmental conditions like temperature, relative humidity, ventilation and light etc. and drinking water was offered *ad libitum.* Three hundred day old broiler chicks (Hubbard strain) were purchased from hatchery and were divided into 30 experimental units having ten chicks each. All birds were vaccinated according to recommended vaccination schedule (Table 1). These units were randomly allocated to 10 treatment groups (Table 2).

Treatments were started from day 1 to 35 of experimental period. Commercial feed was used with or without supplementation of olive oil, blackseed oil and flaxseed oil. Body weights of all individual birds were recorded on first day and every week thereafter. Growth rate and feed consumption of each group were recorded on weekly basis. Feed conversion ratio (FCR) was calculated for each experimental unit on weekly basis, with the following formula.

Table 1: Vaccination Schedule of experimental birds

Age (day)	Vaccine	Method of administration
7	Newcastle Disease (Lasota)	Eye drop
12	Infectious Bursal Disease (Bur-706)	Eye drop
22	Newcastle Disease (Lasota)	Drinking water
25	Infectious Bursal Disease (Bur-706)	Drinking water

Table 2: Dose of oils administered to different experimental groups

Treatment Group	Feeding Plan
A1	Commercial Ration + 0.5% olive oil
A2	Commercial Ration + 1% olive oil
A3	Commercial Ration + 1.5% olive oil
B1	Commercial Ration + 0.5% blackseed oil
B2	Commercial Ration + 1% blackseed oil
B3	Commercial Ration + 1.5% blackseed oil
C1	Commercial Ration + 0.5% flaxseed oil
C2	Commercial Ration + 1.0% flaxseed oil
C3	Commercial Ration + 1.5% flaxseed oil
D (-ve Control)	Commercial Ration + No supplementation

$$\text{Feed Conversion Ratio} = \frac{\text{Feed intake (g)}}{\text{Weight gain (g)}}$$

Blood samples were collected from brachial vein of birds in 5 mL sterilized disposable syringes and placed at room temperature in upright tilted position for blood clotting. The syringes were placed in the same position in refrigerator for shrinkage of clot to increase the harvesting of serum. The serum samples were taken in 1.5 mL labeled Eppendorf tubes and were frozen (-20°C) till analysis. Antibody titers against Newcastle Disease (ND) and Infectious Bursal Disease (IBD) were estimated from serum samples collected on day 32 and day 35, using methods described by MAFF (1984) and Cullen and Wyet (1975), respectively. Serum triglycerides, serum cholesterol, LDL and HDL were estimated from samples collected at the end of experiment on MICROLAB 300 and TECHNO-786 using reagents from HUMAN and MERCK (Schettler and Nussel, 1975), respectively.

For interpretation of results, data were subjected to analysis of variance technique under completely randomized design. Treatment means were compared by Least Significant Difference test (Montgomery and Runger, 2010).

Results

Effect on Growth Performance

Overall weight gain of the birds differed significantly

Table 3: Five week cumulative weight gain, feed intake and feed conversion ratio of broilers fed with various levels of different oils

Treatment	Weight gain (g)	Feed intake (g)	Feed conversion ratio
Olive Oil (0.5%)	1691.4±40.90[a]	3063.3±4.28[a]	1.77±0.04[ab]
Olive Oil (1.0%)	1701.5±11.25[a]	3004.7±22.71[a]	1.72±0.01[a]
Olive Oil (1.5%)	1662.2±66.74[a]	3074.6±24.85[a]	1.81±0.07[ab]
Blackseed Oil (0.5%)	1678.7±14.27[a]	3055.7±48.94[a]	1.77±0.01[a]
Blackseed Oil (1.0%)	1674.1±20.74[a]	3051.1±34.88[a]	1.78±0.02[ab]
Blackseed Oil (1.5%)	1618.2±6.37[a]	3036.5±14.25[a]	1.83±0.00[bc]
Flaxseed Oil (0.5%)	1720.6±56.77[a]	3089.7±41.33[a]	1.75±0.04[a]
Flaxseed Oil (1.0%)	1676.6±55.45[a]	3052.2±54.99[a]	1.77±0.03[a]
Flaxseed Oil (1.5%)	1666.1±6.25[a]	3050.2±28.96[a]	1.78±0.02[ab]
Control	1489±24.89[b]	3031±4.93[a]	1.98±0.03[c]

[a-c] Values in the same column with different superscripts are significantly (P<0.05) different

Table 4: Serum lipid profile of broilers fed with different levels of various oils (mg/dL ±Std. Error)

Treatment	Cholesterol	Triglycerides	High Density Lipoproteins	Low Density Lipoproteins
Olive Oil (0.5%)	188.5±8.79	184.17±9.21	45.67±2.92	105.83±6.06
Olive Oil (1.0%)	171±12.27	189.67±16.47	41.83±0.93	90±8.39
Olive Oil (1.5%)	179.83±46.96	146.17±15.47	42.5±7.52	107.83±36.47
Blackseed Oil (0.5%)	169.83±29.94	187±19.79	45.67±6.13	86.5±24.67
Blackseed Oil (1.0%)	180.5±17.2	232.67±96.26	45.5±4.5	90±25.97
Blackseed Oil (1.5%)	178.33±14.62	124.17±21.68	46.83±2.62	106.33±12.81
Flaxseed Oil (0.5%)	199.5±52.42	194.17±41.21	45.67±6.77	114.5±37.92
Flaxseed Oil (1.0%)	164.67±11.42	171.17±51.56	40.83±4.28	90.17±9.43
Flaxseed Oil (1.5%)	152.33±16.17	136.5±16.77	38.67±3.24	86.33±15.09
Control	192.5±19.29	178.67±25.84	46.33±3.71	110.17±13.29

Table 5: Newcastle disease and infectious Bursal disease titer of broilers fed with various levels of different oils (Mean ± Std. Error)

Treatment	Newcastle Disease Titer	Infectious Bursal Disease Titer
Olive Oil (0.5%)	170.67±42.67[ab]	106.67±21.33[a]
Olive Oil (1.0%)	170.67±42.67[ab]	85.33±21.33[a]
Olive Oil (1.5%)	170.67±42.67[ab]	85.33±21.33[a]
Blackseed Oil (0.5%)	213.33±42.67[a]	42.67±10.67[a]
Blackseed Oil (1.0%)	170.67±42.67[ab]	53.33±10.67[a]
Blackseed Oil (1.5%)	128±0.00[abc]	42.67±10.67[a]
Flaxseed Oil (0.5%)	106.67±21.33[bc]	64±0.00[a]
Flaxseed Oil (1.0%)	64±0.00[c]	106.67±21.33[a]
Flaxseed Oil (1.5%)	170.67±42.67[ab]	85.33±21.33[a]
Control	53.33±10.67[c]	53.33±10.67[a]

[a-c] Values in the same column with different superscripts are significantly (P<0.05) different

Table 6: Economics of broilers with fed various levels of different oils when cost of chicks was Rs. = 35/- and cost of management per bird was Rs. = 5.97

Economic Factors	Olive (0.5%)	Olive (1.0%)	Olive (1.5%)	Blackseed (0.5%)	Blackseed (1.0%)	Blackseed (1.5%)	Flaxseed (0.5%)	Flaxseed (1.0%)	Flaxseed (1.5%)	Control
Feed Consumed (kg/Bird)	3.06	3	3.07	3.05	3.05	3.03	3.8	3.05	3.05	3.03
Feeding Cost/Bird; (feed/kg = Rs. 40.6)	124.236	121.8	124.642	123.83	123.83	123.018	125.048	123.83	123.83	123.018
Oil Used Per Bird (mL)	15.3	30	46.05	15.25	30.5	45.45	15.4	30.5	45.75	0
Cost Of Oil / Treatment (Rs.)	9.18	18	27.63	13.725	27.45	40.905	3.85	7.625	11.4375	0
Body Weight/Bird (kg)	1.69	1.7	1.66	1.67	1.67	1.61	1.72	1.67	1.66	1.48
Income/Bird; (Live weight/kg = Rs. 128)	216.32	217.6	212.48	213.76	213.76	206.08	220.16	213.76	212.48	189.44
Expenditure Per Bird (Rs.)	174.386	180.77	193.242	178.525	192.25	204.893	169.868	172.425	176.2375	167.988
Profit Per Bird (Rs.)	41.934	36.83	19.238	35.235	21.51	1.187	50.292	41.335	36.2425	25.452

(All prices are in Pakistani Rs.)

(P<0.05) among treatment groups. Maximum weight gain was observed in the treatment having flaxseed oil 0.5% (1720.6 g) followed by the treatment group having olive oil 1.0% (1701.5 g) and olive oil 0.5% (1691.4 g), while minimum weight gain was recorded in –ve control group that was 1489 g (Table 3). As far as comparison of weight gain is

concerned all the treatment groups showed significantly better growth rate than the control group but between the treatments difference was non-significant. Similarly, maximum overall feed intake was observed with flaxseed oil 0.5% that was 3089.7 g. Effect of inclusion of dietary oils in broiler showed statistically significant ($P<0.05$) effect on FCR. The best FCR was observed in the treatment group having olive oil 1.0% that was 1.72 followed by the treatments having flaxseed oil 0.5% and blackseed oil 0.5% with FCR 1.75 and 1.77, respectively (Table 3).

Serum Biochemistry

Detailed results of serum biochemistry have been presented in Table 4. Maximum level of cholesterol was observed in the treatment group having flaxseed oil 0.5% that was 199.5 mg/dL followed by control group that was 192.5 mg/dL. Minimum value of cholesterol was found in the treatment having flaxseed oil 1.5% that was 152.33 mg/dL. Similarly, maximum value of triglycerides was observed in treatment having blackseed oil 1.0% that was 232.67 mg/dL and minimum value of triglycerides was found in the treatment having blackseed oil 1.5% that was 124.17 mg/dL. The highest value of serum HDL was found in the group fed on blackseed oil 1.5% that was 46.83 mg/dL followed by control and treatment groups having olive oil 0.5% that was 46.33 mg/dL and 45.67 mg/dL, respectively. Birds fed on 1.5% showed 86.33 mg/dL of LDL followed by treatments having blackseed oil 0.5% and flaxseed oil 1.0% that was 86.5 mg/ dL and 90.17 mg/dL, while maximum value of LDL was found in treatment group having flaxseed oil 0.5% that was 114.5 mg/dL. Statistical analysis of the experimental data showed non-significant ($P<0.05$) effect on cholesterol, triglycerides, LDL and HDL due to supplementation of different oils in the feed of broiler birds.

Antibody Titer after Vaccination

Maximum value of ND titer was observed in treatment group having blackseed oil 0.5% that was 213.33. Minimum value of ND titer was observed in control group that was 53.33. Statistical analysis of experimental data showed significant ($P<0.05$) effect on ND titer due to varying levels of different oils in the feed of broiler birds. Comparison of the mean values with least significant difference test showed that groups having flaxseed oil 0.5% depicted maximum ND titer as compared to all the treatment groups including control. Similarly, feeding of different oils also affected the IBD titer. Maximum titer was observed in olive oil 0.5% and flaxseed oil 1.0% that was 106.67, followed by treatments having olive oil 1.0% & 1.5% and flaxseed oil 1.5% with titer 85.33. Detailed results have been presented in Table 5.

Economics of Oil Based GPs

Mortality of only one bird was observed in the group treated with blackseed oil 1.5% on 11th day of the trial. No disease symptoms were observed in the dead bird. Maximum profit was calculated in the group fed on flaxseed oil 0.5% that was 50.292 rupees followed by olive oil 0.5% and flaxseed oil 1.0% with 41.934 and 41.335 rupees, respectively. Whereas minimum profit was recorded in the treatment with blackseed oil 1.5%that was 1.187 rupees (Table 6).

Discussion

All the groups fed with the oils (olive, blackseed and flaxseed) differed non significantly from each other but showed significantly higher weight gain than the control group. Similar findings were reported by Maroufyan *et al*. (2012) who found that omega-3 and omega-6 fatty acids in broiler diets from various oil sources with different levels gained significantly higher body weight. These oils could also be used as energy sources for growth (Gardiner, 1973). These results have also been supported by the findings of Du and Ahn (2002) who reported that use of oils in commercial diet significantly improved the weight gain. In contrast to Ebeid *et al*. (2011) and Bou *et al*. (2005) observed that the use of oils had no effect on body weight gain of poultry birds. Gonzalez-Esquerra and Leeson (2000) also stated that feeding of vegetable oils had no effect on body weight of broilers. The differences in results of present study with those observed by other scientists mentioned above may be due to the use of different oils, as different plants contain different group of chemicals. This difference in chemical groups results in difference in biological activity of each plant.

Though the feed intake by birds do not differ due to addition of plant oils but a statistically significant difference in weight gain was observed. This increase in weight gain of birds due to addition of plant oil in feed has also been also reported by many researchers previously (Olomu and Baracos, 1991; Bou *et al*., 2005; Febel *et al*., 2008; Ebeid *et al*., 2011). In present study, improve in weight gain might be due to the improved digestibility as a result of presence of oils in diets of broilers (Balevi and Coskun, 2000; Iftikhar *et al.*, 2015). In contrast to our findings, Maroufyan *et al*. (2012) observed that omega-3 and omega-6 fatty acids in broiler diets from various oil sources showed significantly improved feed intake. Gonzalez-Esquerra and Leeson (2000) also concluded in their study that feed intake may be improved by the inclusion of oils in the diet of broilers. Similarly, in this trial, overall FCRs of the groups supplemented with vegetable oils were significantly better than the control group. These results are in line with the findings of Maroufyan *et al*. (2012) and Gardiner (1973). They concluded that the use of vegetable oils such as flaxseed oil, olive oil and blackseed oil or fatty acids like omega-3 and omega-6 improved the FCR and feed efficiency of the broiler birds. The improved FCR and performance might be due to the presence of PUFA in vegetable oils. These PUFA decrease the rate of passage of

digesta in the digestive system and as a result adsorption of nutrients is increased resulting in improved digestibility, which ultimately improved the body weight and performance of birds (Balevi and Coskun, 2000; Sultan *et al.*, 2015; Awaad *et al.*, 2016). It was also reported that the feeding of linoleic acid and lenoleinic acid did not affect the feed consumption in broilers but helpful for the growth as these fatty acids produce dynamic heat and as a result FCR is improved (Schreiner *et al.*, 2005; Mridula *et al.*, 2011).

In present study, supplementation of olive oil, blackseed oil and flaxseed oil in feed of broilers did not showed significant effect on lipid profile (serum cholesterol, triglycerides, HDL and LDL). These findings are similar to the findings of An *et al*. (1997) and Crespo and Garcia (2003). They used different dietary oil and fat sources and found non-significant effects on cholesterol, triglycerides, HDL and LDL. It is evident that n6 fatty acids have the ability to lower the cholesterol level in serum whereas n3 fatty acids decrease cholesterol and triglycerides (An *et al*., 1997).

Statistical analysis of the experimental data showed significant ($P<0.05$) effect on ND titer after feeding the birds with different levels of plant oils. These results are in line with the findings of Fritsche *et al*. (1991) who reported that the use of different vegetable oils such as corn oil, canola oil and flaxseed oil significantly improved the antibody titer. Maroufyan *et al*. (2012) also reported that the combination of tuna oil and sunflower oil significantly improved the titer of ND and IBD. This improvement in titer might be due to the presence of PUFA in plant oils. As PUFA affects inflammatory response which ultimately results in improved immune response (Korver and Klasing, 1997). The PUFA may improve the membranes of the immune cells and these fatty acids have anti-microbial properties. That's why there might be improvement in ND titer (Pathponysiriporn and Scheideler, 2005).

Conclusion

The broilers fed with feed having flaxseed oil 0.5% showed the cumulative best FCR, no doubt this FCR was non-significantly different ($P>0.05$) with other treatment groups except for blackseed oil 1.5% and control group. But it was also observed that flaxseed oil 0.5% showed better ND titer than the control group. Other oils showed best ND titers but flaxseed oil 0.5% was economical also, so it can be recommended that flaxseed oil 0.5% level is the best for production of economical broilers having best FCR and disease resistance.

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