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The effects of different levels of poultry fat with vitamin E on performance and carcass traits of broilers

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The aim of this experiment was to investigate the effects of different levels of poultry fat with vitamin E on performance and carcass traits of broilers. This study was conducted as 4 × 2 factorial experiment with 4 levels of poultry fat (0, 2, 4 and 6%) and 2 levels of vitamin E (0 and 150 mg/kg) in 8 treatments, 3 replicates and 12 birds in each replicate in a completely randomized design. In this experiment 288 day old broiler chicks (Ross 308 strain) were used for 42 days. Inclusion poultry fat until 6% did not have any adverse effect on performance and carcass traits, whereas using 150 mg/kg vitamin E significantly affected the performance and carcass traits of broilers ($P < 0.05$). The lowest amounts of daily weight gain (40.22 g) and feed intake (81.89 g), the lowest percent of carcass (69%) were resulted in treatments contained 150 mg/kg of vitamin E. As interactive effects; the lowest amount of daily weight gain (39.11 g) and the lowest carcass percent (68.01%) were obtained by adding 2% of poultry fat and 150 mg/kg vitamin E. It is concluded that in broilers, dietary supplementation of poultry fat until 6% without having any adverse effects on their performance and carcass percent is possible, whereas inclusion 150 mg/kg vitamin E has adverse effects in these respects.

Key words: Broiler, carcass traits, performance, poultry fat, vitamin.

INTRODUCTION

The most practical method for increasing the energy density of diets in poultry feeding is through the addition of fats and oils (Peebles et al., 2000a). It was reported that fat metabolism and deposition in poultry could be affected by different dietary fats and fatty acids (Snaz et al., 2000; Pesti et al., 2002a). Also they assist vitamin A and Ca absorption (Sklan, 1979; Corino et al., 1980; Lesson and Atteh, 1995). By increasing fat sources to the diets of broilers amount of feed intake decreased and improved feed efficiency (Jeffri et al., 2010). Addition of fats may result in increased body weight in some cases (Sell et al., 1986). Although in many cases body weight gain is similar, but with improved feed efficiency (Pesti et al., 2002). Assessing the effects of the mixtures of vegetable and animal fats, corn oil and poultry fat on the proportions of 0, 3, 6 and 9% in the alimentation of broilers, observed that the birds fed with corn oil and poultry fat were significantly heavier than birds non-supplemented with fat (Griffiths et al., 1977). Carcass percentage, proventriculus, pancreas, spleen, heart and abdominal fat pad weights (as a percent of live weight) were not affected by using different levels of fish oil; Whereas inclusion at 4% level, increased the thigh, breast, liver and small intestine weights ($P < 0.05$). Adding 3% canola oil and poultry fat resulted in significant improvement in body weight and better feed conversion ratio in fed groups 3% canola oil and poultry fat than other groups observed, no significant different were found in liver, breast, thigh weights in between groups fed lipid in comparison with the control group. Addition of 6% poultry fat caused significant increasing on abdominal fat; gizzard weight was significantly higher in control group in comparison with supplemented groups (Shahyar et al., 2011)

Dietary supplementation of vitamin E is beneficial to the overall immunocompetence of growing broilers (Erf et al., 1998). Lipid oxidation is an important determinant of shelf life of fats (Morrisey et al., 1994). Recently in laying hens' dietary supplementation of 6% semi-refined sun-flower oil and 150 mg/kg vitamin E significantly improved egg production performance (Narimany-Rad et al., 2011). However, McCuaig and Motzok (1970) reported that there is negative interactions between vitamin A and vitamin E. Excessive vitamin E intake have been reported as generally considered as harmless and even been proclaimed by some medical practitioners and the popular press to be prophylactic against numerous disease manifestations and beneficial for health. Vitamin E is available

Table 1. The ingredients and nutrients composition of starter and grower diets of broilers.

Ingredient (% in diets)	Diet							
	1-21 days				21-42 days			
	Control group	2% Poultry fat	4% Poultry fat	6% Poultry fat	Control group	2% Poultry fat	4% Poultry fat	6% Poultry fat
Yellow corn	62.33	54.72	48.69	42.66	66.39	60.36	54.33	48.29
Soybean meal	33.92	35.29	36.49	37.69	27.86	29.06	30.26	31.46
Poultry fat	0	2	4	6	0	2	4	6
Inert	0	4.27	7.2	9.93	2.41	5.24	8.07	10.9
Oyster shell	1.22	1.32	1.31	1.3	1.22	1.21	1.2	1.19
Dicalcium phosphate	1.27	1.43	1.44	1.45	1.27	1.28	1.29	1.31
Salt	0.28	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Vitamin premix1	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Mineral premix2	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
DL- Methionine	0.14	0.17	0.17	0.17	0.05	0.05	0.05	0.05
Calculated composition								
Metabolisable energy (Kcal/kg)	2850	2850	2850	2850	2900	2900	2900	2900
Crude protein (%)	20.5	20.5	20.5	20.5	18.125	18.125	18.125	18.125
Calcium (%)	0.96	0.96	0.96	0.96	0.83	0.83	0.83	0.83
Available phosphorous (%)	0.41	0.41	0.41	0.41	0.37	0.37	0.37	0.37
Sodium (%)	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Linoleic acid (%)	1.51	1.72	1.96	2.2	1.57	1.81	2.06	2.3
Lysine (%)	1.14	1.17	1.19	1.21	0.98	1	1.02	1.04
Methionine+ Cysteine (%)	0.83	0.83	0.83	0.83	0.65	0.65	0.65	0.65
Thryptophan (%)	0.27	0.27	0.27	0.27	0.23	0.23	0.23	0.23

[1]Vitamin premix per kg of diet: vitamin A (retinol), 2.7 mg; vitamin D_3 (cholecalciferol), 0.05 mg; vitamin E (tocopheryl acetate), 18 mg; vitamin K_3, 2 mg; thiamine, 1.8 mg; riboflavin, 6.6 mg; panthothenic acid, 10 mg; pyridoxine, 3 mg; cyanocobalamin, 0.015 mg; niacin, 30 mg; biotin, 0.1 mg; folic acid, 1 mg; choline chloride, 250 mg; Antioxidant 100 mg. [2]Mineral premix per kg of diet: Fe (FeSO4.7H2O, 20.09% Fe), 50 mg; Mn (MnSO4.H2O, 32.49% Mn), 100 mg; Zn (ZnO, 80.35% Zn), 100 mg; Cu (CuSO4.5H2O), 10 mg; I (K_1, 58% I), 1mg; Se (NaSeO3, 45.56% Se), 0.2 mg.

without prescription and has been used as a widespread self prescribed vitamin supplement. In fact, there is no satisfactory scientific or clinical evidence to prove that vitamin E supplement is beneficial at the present time. Some potential hazards of hypervitaminosis E have been suggested. Adverse effects of hypervitaminosis E in animals have also been investigated (Solomon et al., 1972; Corrigan and Marcus, 1974). In broilers increasing dietary vitamin E adversely affected bone ash, plasma calcium, and plasma and liver vitamin A concentrations (Aburto and Britton, 1998). High dietary tocopherol alleviated hypervitaminosis A in chicks (Sklan and Donoghue, 1982). It was found that hypervitaminosis E induced reticulocytosis, lowered hematocrit value, reduced thyroid activity and increased the requirement for vitamin D and vitamin K in chicks (March et al., 1973). Since between fats with animal sources, poultry fat has the high proportion of unsaturated fatty acids to saturated fatty acids, so it is thought that by supplementation Vitamin E, using different levels of poultry fat in diets of broilers without any adverse effects is possible. Poultry fat is also known as viscera oil and is obtained after the extraction of fat by autoclaving the fat is placed into a decantation tank to extract the acidulated soapstock and moisture excess. At this point, it is ready to be used in ration or to be refined. In present experiment the effects of four levels of poultry fat (0, 2, 4 and 6%) and two levels of vitamin E (0 and 150 mg/kg) were investigated on performance and carcass traits of broilers.

MATERIALS AND METHODS

Animals and dietary treatments

This study was conducted as 4 × 2 factorial experiment with four levels of poultry fat (0, 2, 4 and 6%) and two levels of vitamin E (0 and 150 mg/kg) in 8 treatments, 3 replicates and 12 birds in each replicate in a completely randomized design. In this experiment 288 day old male and female broiler chick (Ross 308 strain) were used for 42 days. The chicks were allocated randomly to 8 experimental diets. The diets were formulated (Table 1) to meet the requirements of broiler chicks as established by the NRC (1994).

The diets and water was provided *ad libitum*. The lighting program during the experimental period consisted of a period of 23 h light and 1 h of darkness. Environmental temperature was gradually decreased from 33 to 25°C on day 21 and was then kept constant. The data were subjected to analysis of variance procedures appropriate for a completely randomized design using the general linear model procedures of SAS Institute (2005). Means were compared using the Duncan multiple range test. Statements of statistical significance are based on P < 0.05.

Performance parameters

Body weight, feed intake and feed conversion ratio were determined weekly on bird bases. Mortality was also recorded.

Carcass components

At 42 days of age, two birds from each replicate randomly chosen based on the average weight of the group and sacrificed. Carcass yield was calculated by dividing eviscerated weight by live weight. Abdominal fat, liver, gizzard, thigh and breast were collected, weighed and calculated as a percentage of live body weight.

RESULTS AND DISCUSSION

The effects of different levels of poultry fat and vitamin E and interactions of them on broiler performance are summarized in Table 2. There were no significant differences between treatments due to added dietary poultry fat. However, by inclusion of poultry fat in broiler diets, the amounts of weight gain, feed intake and feed conversion improved. As the digestibility of fats is more, it therefore provides more energy for broilers, so they can improve performance. These results are in accordance with the findings of Fuller and Readon (1972). They found that increasing the level of energy in broiler diets through fat addition may have a beneficial effect on performance. Increasing dietary fat improved feed efficiency, but also may result in increased fat deposition (Salmon and Neils, 1971; Rivas and Firman, 1994).

Inclusion of 150 mg/kg vitamin E in broiler diets had adverse effects on there performance (P<0.05). Supplementation of diets with 150 mg/kg vitamin E significantly decreased weight gain and feed intake. By using high dosage of vitamin E, the problems such as interactions between vitamin E and vitamin A, reduce thyroid activity can be have adverse effects on performance. Reported that in broilers hypervita minosis E can cause various problems like reticulocytosis, lowered hematocrit value, reduced thyroid activity and increased the requirement for vitamin D and vitamin K in chicks (March et al., 1973), on the other hand vitamin E has interaction with vitamin A (McCuaig and Motzok, 1970; Sklan and Donoghue, 1982). Studied have demonstrated that high dietary tocopherol alleviated hypervitaminosis A in chicks. Feeding excess amount of vitamin E decreases the blood and liver levels of vitamin A and feeding excess vitamin A decreases the blood and liver levels of vitamin E (Aburto and Britton, 1998).

The interaction of poultry fat × vitamin E was significant difference for body weight (P < 0.05). Dietary supplementation of vitamin E depressed growth rate and the lowest daily weight gain (39.18 g) was resulted by 2% of poultry fat × 150 mg/kg vitamin E. The reasons those mentioned about vitamin E, could also cause significant difference in interactions between poultry fat levels and vitamin E. Compared with the levels of vitamin E, interaction poultry fat × vitamin E could not significantly affected the amount of feed intake. However using vitamin E and poultry fat had adverse effects on feed intake and feed conversion. The highest amount of daily weight gain (47.85 g) and the best feed conversion (1.76) were obtained in group 5 by using 6% of poultry fat with no vitamin E supplementation. The effects of different levels of poultry fat and vitamin E on carcass parts of broilers are shown in Table 3.

Adding different levels of poultry fat and vitamin E significantly affected the carcass percent of broilers (P < 0.05). The highest percent of carcass (70.40%) was obtained by using 4% of poultry fat, whereas the lowest percent (68.75%) obtained in group 2, however there were not any significant different between control group and groups with added poultry fat in this respect. The high and low percents of carcass yield in 3 and 2 groups may be related with high and low amounts of daily weight gain that occurred in these groups. As there is positive relationship between daily weight gain and carcass yield, so changes in weight gain, may be significantly affected the carcass percent in these groups. This finding not supported by reported results of Navidshad (2009) about the effects of fat sources on carcass percent of broilers.

Inclusion Vitamin E significantly decreased the percent of carcass (P < 0.05). In present study adding vitamin E negatively affected the carcass percent. These subjects have been seen in Poultry Fat × vitamin E effects. It was found that hypervitaminosis E induced reticulocytosis, lowered hematocrit value, reduced thyroid activity and increased the requirement for vitamin D and vitamin K in

Table 2. The effects graded levels of poultry fat on broiler performance (1 to 42 days).

Supplement	Performance		
	Weight gain (g)	**Feed intake (g)**	**Feed conversion (g:g)**
Control group	42.65	83.64	1.97
2% poultry fat	41.94	84.05	2.01
4 poultry fat	43.89	88.56	2.03
6 poultry fat	43.76	84.21	1.94
SEM	0.82	2.06	0.06
No Vitamin E	45.81[a]	88.34[a]	1.92
150 mg/kg vitamin E	40.32[b]	81.89[b]	2.04
SEM	0.58	1.46	0.04
No poultry fat × No vitamin E	43.96[ab]	85.86	1.96
No poultry fat× 150 mg/kg vitamin E	41.34[ab]	81.33	1.98
2% poultry fat× No vitamin E	44.58[ab]	87.36	1.96
2% poultry fat× 150 mg/kg vitamin E	39.18[b]	80.74	2.06
4% poultry fat× No vitamin E	46.71[a]	91.15	1.96
4% poultry fat× 150 mg/kg vitamin E	47.08[ab]	85.96	2.1
6% poultry fat× No vitamin E	47.75[a]	88.91	1.76
6% poultry fat× 150 mg/kg vitamin E	39.68[b]	79.54	2.02
SEM	1.17	2.92	0.08

Values in the same row not sharing a common superscript differ significantly (P < 0.05). SEM = Standard error of mean.

Table 3. The effects graded levels of poultry fat on carcass traits of broilers.

Supplement	Carcass trait					
	Carcass	**Abdominal fat**	**Gizzard**	**Liver**	**Breast**	**Thigh**
Control group	69.66[ab]	2.48	2.37	2.50	21.95	19.18
2% poultry fat	68.75[b]	2.55	2.25	2.51	21.55	18.75
4% poultry fat	70.40[a]	2.80	2.06	2.36	22.47	18.47
6% poultry fat	69.69[ab]	2.64	2.05	2.39	22.42	18.60
SEM	0.33	0.18	0.09	0.11	0.45	0.27
No Vitamin E	70.25[a]	2.62	2.17	2.40	22.55	18.84
150 mg/kg vitamin E	69[b]	2.60	2.14	2.48	21.65	18.66
SEM	0.23	0.13	0.06	0.08	0.31	0.19
No poultry fat × No vitamin E	70.01[a]	2.65	2.25	2.37	21.45	19.50
No poultry fat× 150mg/kg vitamin E	69.32[b]	2.31	2.29	2.61	22.37	18.86
2% poultry fat× No vitamin E	69.48[a]	2.46	2.13	2.42	22.37	18.71
2% poultry fat× 150mg/kg vitamin E	68.01[b]	2.63	2.38	2.60	20.73	18.78
4% poultry fat× No vitamin E	71.38[a]	2.85	2.20	2.36	23.35	18.59
4% poultry fat× 150mg/kg vitamin E	69.43[a]	2.76	1.92	2.37	21.60	18.35
6% poultry fat× No vitamin E	70.57[a]	2.55	2.71	2.43	22.95	18.54
6% poultry fat× 150mg/kg vitamin E	69.23[a]	2.73	1.98	2.35	21.90	18.66
SEM	0.46	0.25	.012	0.15	0.64	0.38

Values in the same row not sharing a common superscript differ significantly (P < 0.05). SEM = Standard error of mean.

chicks (March et al., 1973). As these vitamins are important factors in performance, so decreases of them, can be affected of performance and carcass traits. There were not seen any significant difference between treatments in other carcass traits such as percent of abdominal fat. Whereas reported that adding of 6% poultry fat into broiler diets significantly increased the amount of abdominal fat (Shahyar et al., 2011). Diets levels of metabolical energy is the main factor in accumulation of abdominal fat in broilers, as diets had the same amounts of energy, so there could not significantly affected the amounts of abdominal fat.

Conclusion

The overall results indicated that in broilers adding poultry fat until 6% without having any adverse effects on their performance and carcass traits is possible, but inclusion 150 mg/kg vitamin E has adverse effects in these respects and is not recommended.

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