ISSN 1682-8356
ansinet.org/ijps

INTERNATIONAL JOURNAL OF

POULTRY SCIENCE

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

International Journal of Poultry Science 4 (10): 799-803, 2005
ISSN 1682-8356

Effect of Dietary Protein Levels and Soybean Oil Supplementation on Broiler Performance

A. Tabeidian[1], GH. Sadeghi[2] and J. Pourreza[3]
[1]Department of Animal Science, Khorasgan Islamic Azad University of Isfahan, Isfahan, Iran
[2]Department of Animal Science, University of Kurdistan, Kurdistan, Iran
[3]Isfahan University of Technology, Isfahan, Iran

Abstract: This study was conducted to examine the effect of different protein and soybean oil levels on broiler chickens. A total of 480 one-day old broiler chicks of a commercial breed (Ross 308) from both sex with equal ratio were placed in 32 pens, fifteen in each pen. Treatments were included soybean oil at 0, 2.5, 5 and 7.5% levels and crude protein levels were NRC (1994) recommendation and 10 percent more than NRC recommendation (NRC × 1.10). Each treatment replicated four times. Inclusion of soybean oil in diet had no significant effect on feed intake in chicks in NRC protein level. Feeding high protein diet resulted to more feed intake than NRC. Increasing diet protein up to 10 % more than NRC recommendation could not improve body weight gain in broiler chickens except for 7-21d old chicks that fed a diet containing no soybean oil and high protein level that resulted to highest weight gain. In 7-21 d old chicks feeding a diet with 2.5% soybean oil and a protein level 10% more than NRC recommendation resulted to lowest feed conversion ratio. Feeding different levels of soybean oil and protein had no effect of carcass, pancreas, intestine and preventriculus weight. Lowest abdominal fat was observed in chicks fed with a diet containing 7.5% soybean oil with NRC recommendation protein level. In chickens that fed with higher protein level, fat supplementation resulted to an increase in plasma triglyceride.

Key words: Protein, soybean oil, broiler, performance, organ weight

Introduction

Broiler industry is increasing dramatically throughout the developing countries. There have been a notable increase in growth rate and feed efficiency in commercial broiler chickens in last 20 years. Current commercial hybrids with high performance require high energy and protein diets which would enable the maximum exploitation of those genetic potential. There is a problem to meet such a high energy level with conventional feed ingredients such as maize, wheat, barley and soybean. Fats provide a concentrated source of energy to achieve high energy broiler diets. Another problem with new commercial broilers is the accumulation of large amount of fat in the abdominal cavity. In developed countries, fat or oils as energy rich feed are available from animal sources such as tallow and fish oil or from plant sources such as soybean oil, sunflower oil and maize oil. Fats also provide varying quantities of the essential nutrient linoleic acid (Lesson and summers, 2001). Another important role of fats in diet is its inhibition from *de novo* lipogenesis in broiler chickens (Yeh and Leveille, 1971) that could increase energy efficiency in diets. Tallow and other saturated animal fats are the principal sources that used in poultry nutrition, particularly in the later phases of feeding, because of limited digestibility in young chicken (Lesson and summers, 2001).

Soybean oil stimulated growth rate of chicks when included in certain types of poultry diets (Carew *et al*., 1961). Unsaturated vegetable fat or oils are more energetic than saturated animal fat.

One of other most important decisions for broiler nutritionist is level of protein in diet and its ratio to energy. Reduction in feed efficiency and production of leaner bird in diets with excess dietary CP and increasing fat accretion in broilers fed with a diet with low protein content reported by Buyse *et al*. (1992). These workers found that broilers reared on a 15% protein diet increased their feed intake in an attempt to meet their protein and amino acid requirement.

The results of Roseberg *et al*. (1999) experiment with broilers showed that the level of dietary CP must be considered when dietary fat is used to decrease *de novo* lipogenesis. They showed that dietary fat addition to diets containing low CP levels did not decrease lipogenesis to the degree noted when added to a diet containing a higher level of CP. Other researchers noted that fat accretion will increase when the energy to protein ratio of broiler diets increase (Kita *et al*. 1993, Nieto *et al*., 1997 and Collin *et al*., 2003).

Corresponding Author: Gh. Sadeghi, Department of Animal Science, College of Agriculture, University of Kurdistan, Kurdistan, Iran

Table 1: Composition and specifications of starter chicken diets (7-21 d) and calculated major components (g kg^{-1} as fed)

Diet	A	B	C	D	E	F	G	H
Oil level	0	2.5	5	7.5	0	2.5	5	7.5
CP level	NRC	NRC	NRC	NRC	NRC×1.1	NRC×1.1	NRC×1.1	NRC×1.1
Corn	664.9	595	527	457	634	559	490	422
Soybean	244.5	264	271.5	289	245	325.5	326	343.5
Fish meal	60	56.5	61	59	96	51.5	61	58.5
Soybean oil	0	25	50	75	0	25	50	75
Oyster shell	15	15	15	15	10	15	15	15
Dicalcium phosphate	8	8.4	8.4	8.4	6	8.4	8.4	8.4
Sand	0	28.5	59.5	88.9	1.6	8	42	70
NaCl	2.6	2.6	2.6	2.6	2.4	2.6	2.6	2.6
Mineral premix[a]	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Vitamin premix[b]	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Calculated Composition								
ME (KCal/Kg)	2945	2945	2945	2945	2945	2945	2945	2945
CP (g/Kg)	211.6	211.6	211.6	211.6	232.7	232.7	232.7	232.7
Met (g/Kg)	4	4	4	4	4.6	4.3	4.3	4.3
Lys (g/Kg)	12.1	12.4	12.6	12.8	13.8	12.3	12.4	12.1
AP (g/Kg)	4.3	4.2	4.3	4.2	4.6	4.2	4.4	4.3
Ca (g/Kg)	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5

[a] supplemented (mg kg^{-1} of diet): Mn, 1200; Fe, 60; Zn, 120; Cu, 12; I, 1.2; Se, 0.24

[b] supplemented (mg or IU kg^{-1} of diet): Vit. A, 10800 IU; D_3, 2400 IU; E, 21.6 IU; K_3, 2.4 IU; B_1, 2.16; B_2, 7.9; B_3, 12; B_5, 3.6; B_9, 1.2; B_{12}, 0.015; Biotin, 0.12; choline chloride, 600; and adequate anti oxidant.

The finding on the effect of different levels of CP in isoenergetic diets on broiler metabolism and body composition are different and more researches are necessary to understanding of broiler response to different levels of protein in isoenergetic diets with low and high fat levels as a diet energy source.

The purpose of present study was to further examine the interaction of diet fat supplementation and crude protein levels in isoenergetic diets on productivity, fat deposition and transformation, and organs weight in broiler chickens.

Materials and Methods

A total of 480 one-day old broiler chicks of a commercial breed (Ross 308) from both sex with equal ratio were placed in 32 pens, fifteen in each pen. Feed and water were provided *ad libitum*. The chicks were allocated randomly to 8 experimental diets. The experiment arrangement consisted of a 4*2 factorial design (4 fat level and 2 crude protein level) with for replicate per each treatment. Soybean oil was used at 0, 2.5, 5 and 7.5% in diets and crude protein levels were NRC (1994) recommendation and 10 percent more than NRC recommendation (NRC × 1.10). The diets (Table 1, 2 and 3) were formulated to meet nutrient requirements according to NRC (1994). Diets were isocaloric and contain the same levels of methionine, lysine, vitamins and minerals. The chickens were weighed at the start of the experiment, and during the experiment, live weight and total feed consumption per pen were recorded and feed conversion ratio was calculated at 21, 42 and 49th days of the experiment. Mortality was also recorded for each treatment. Two birds (male and female) from each replicate were slaughtered after bleeding at days 49 and carcass, abdominal fat, liver, pancreas, proventriculus, gizzard, intestine, spleen and heart were weighed and presented as a percentage of live weight. The TG, cholesterol and total fat of plasma measured in blood samples.

The results obtained from the experiment were analyzed by an analysis of variance using the general linear model (GLM) procedure of SAS and means were compared by Duncan's Multiple Range Test (SAS Institute, 2001). There was no significant difference between both sexes in organs weight and blood parameters, so the data pooled and analyzed together.

Results and discussion

Feed Intake: The effect of soybean oil inclusion and different protein levels on feed intake has shown in Table 4. Inclusion of soybean oil in diet had no significant effect on feed intake in 7-21d old chicks in NRC protein level, but in higher protein level (NRC × 1.1) chicks fed with 5 % soybean oil had highest feed intake and its different was significant with other soybean oil levels. Also, feeding high protein diet resulted to more feed intake than NRC. These increases in feed intake could be attributed to better amino acid balance in high protein diet. D'Mello (1994) showed that amino acid imbalance adversely affect feed intake. In both protein

Table 2: Composition and specifications of grower diets (21-42 d) and calculated major components (g kg^{-1} as fed)

Diet	A	B	C	D	E	F	G	H
Oil level	0	2.5	5	7.5	0	2.5	5	7.5
CP level	NRC	NRC	NRC	NRC	NRC×1.1	NRC×1.1	NRC×1.1	NRC×1.1
Corn	709	640	571	505	680	610	542	475
Soybean	232.6	232.6	232.6	231.5	228.5	243	257	256
Fish meal	20	30	40	50	55	55	55	65
Soybean oil	0	25	50	75	0	25	50	75
Oyster shell	15	15	15	11.5	11.5	11.5	11.5	11.5
Dicalcium phosphate	10.6	10.6	10.6	8.2	8	8	8	7
Sand	5.2	39.2	73.2	110.9	8.6	39.9	63.3	102.9
Na Cl	2.6	2.6	2.6	2.6	2.4	2.6	2.6	2.6
Mineral premix [a]	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Vitamin premix [b]	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Calculated Composition								
ME (Kcal/Kg)	2950	2950	2950	2950	2950	2950	2950	2950
CP (g/Kg)	184	184	184	184	20.25	20.25	20.25	20.25
Met (g/Kg)	3.3	3.4	3.4	3.4	3.8	3.8	3.8	3.8
Lys (g/Kg)	9.8	10	10.1	10.3	10.5	10.5	10.5	10.5
AP (g/Kg)	3.7	3.9	4.1	4.3	4	4	4	4
Ca (g/Kg)	8.7	9.2	9.7	10.2	8.8	8.8	8.8	8.8

[a]supplemented (mg kg^{-1} of diet): Mn, 1200; Fe, 60; Zn, 120; Cu, 12; I, 1.2; Se, 0.24

[b]supplemented (mg or IU kg^{-1} of diet): Vit. A, 10800 IU; D_3, 2400 IU; E, 21.6 IU; K_3, 2.4 IU;B_1, 2.16; B_2, 7.9; B_3, 12; B_5, 3.6; B_9, 1.2; B_{12}, 0.015; Biotin, 0.12; choline chloride, 600; and adequate anti oxidant.

Table3: Composition and specifications of finisher diets (42-49 d) and calculated major components (g kg^{-1} as fed)

Diet	A	B	C	D	E	F	G	H
Oil level	0	2.5	5	7.5	0	2.5	5	7.5
CP level	NRC	NRC	NRC	NRC	NRC×1.1	NRC×1.1	NRC×1.1	NRC×1.1
Corn	727	656.5	590	520	700	630	560	491
Soybean	210	225	238.5	253	252	266	281	295
Soybean oil	0	25	50	75	0	25	50	75
Oyster shell	15	15	15	15	15	15	15	15
Dicalcium phosphate	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4
Sand	30	60.5	88.5	119	15	46	76	106
Na Cl	2.6	2.6	2.6	2.6	2.4	2.6	2.6	2.6
Mineral premix [a]	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Vitamin premix [b]	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Calculated Composition								
ME (Kcal/Kg)	2900	2900	2900	2900	2900	2900	2900	2900
CP (g/Kg)	162.3	162.3	162.3	162.3	17.85	17.85	17.85	17.85
Met (g/Kg)	2.8	2.8	2.8	2.8	3.1	3.1	3.1	3
Lys (g/Kg)	8.3	8.4	8.6	8.8	9	9.2	9.3	9.4
AP (g/Kg)	3	3	3	3	3.1	3	3	3
Ca (g/Kg)	7.6	7.6	7.6	7.6	7.7	7.7	7.8	7.8

[a]supplemented (mg kg^{-1} of diet): Mn, 1200; Fe, 60; Zn, 120; Cu, 12; I, 1.2; Se, 0.24

[b] supplemented (mg or IU kg^{-1} of diet): Vit. A, 10800 IU; D_3, 2400 IU; E, 21.6 IU; K_3, 2.4 IU;B_1, 2.16; B_2, 7.9; B_3, 12; B_5, 3.6; B_9, 1.2; B_{12}, 0.015; Biotin, 0.12; choline chloride, 600; and adequate anti oxidant.

levels, inclusion of 7.5 % soybean oil resulted to lowest feed intake. This may be attributed to poor fat digestion in young broiler chickens (Leeson and Summers, 2001). High fat levels also could decrease stomach emptying by stimulate the entrogastrine secretion from intestine. Ali *et al.* (2001) showed that total feed intake of the broilers fed 10% soybean oil diet was significantly ($P<0.01$) lower than the broilers fed with lower levels soybean oil diets. Inclusion of different levels of soybean oil and protein had no significant effect on feed intake in 21-42 and 42-49 days old broiler chicks.

Weight gain: Feeding different levels of soybean oil in chicks fed with a NRC recommended protein level had

Table 4: Effect of different levels of fat and protein on broiler chicks performance at different ages

Fat level	Protein level	Feed Intake (g)			Weight Gain (g)			Feed Conversion (g/g)		
		7-21	22-42	42-49	7-21	22-42	42-49	7-21	22-42	42-49
0	NRC	53.8^{bc}	130.3	123.8	30.5^{dc}	67.1^{ab}	48.2^{bc}	1.76^{b}	1.94	2.56^{a}
2.5	NRC	52.3^{c}	126.9	125.9	31.8^{bc}	63.8^{ab}	49.2^{bc}	1.66^{bc}	1.98	2.55^{a}
5	NRC	53.9^{bc}	128.2	117.9	31.7^{bc}	67.8^{a}	49.8^{bc}	1.67^{bc}	1.89	2.35^{ab}
7.5	NRC	51.0^{c}	126.6	122.3	31.7^{bc}	64.3^{ab}	59.2^{a}	1.65^{bc}	1.97	2.07^{b}
0	NRC×1.1	56.4^{b}	132.1	120.6	33.3^{a}	64.1^{ab}	48.9^{bc}	1.69^{bc}	2.02	2.45^{ab}
2.5	NRC×1.1	52.8^{c}	126.1	113.8	32.1^{ab}	63.2^{ab}	53.3^{ab}	1.64^{c}	1.97	2.13^{b}
5	NRC×1.1	63.5^{a}	126.7	123.1	29.5^{d}	64.1^{ab}	52.3^{ab}	2.13^{a}	1.97	2.38^{ab}
7.5	NRC×1.1	51.8^{c}	124.7	117.1	30.4^{dc}	62.4^{b}	43.9^{c}	1.70^{bc}	1.93	2.65^{a}

Table 5: Effect of different levels of fat and protein on carcass and organs weight in 49 days old broiler chicks (As percentage of carcass weight)

Fat Level	Protein level	Carcass	Abdominal Fat	Liver	Pancreas	Intestine	Pre-ventriculus	Gizzard	Heart
0	NRC	71.4	1.72^{ab}	2.35^{ab}	0.186	3.43	0.323	2.12^{abc}	0.44
2.5	NRC	73.0	1.30^{ab}	2.26^{ab}	0.220	3.43	0.386	2.27^{abc}	0.41
5	NRC	73.5	2.09^{a}	2.15^{b}	0.166	3.20	0.360	2.08^{bc}	0.48
7.5	NRC	73.5	1.13^{b}	2.27^{ab}	0.240	3.34	0.390	2.37^{ab}	0.45
0	NRC×1.1	73.0	1.52^{ab}	2.28^{ab}	0.223	3.69	0.356	1.72^{c}	0.44
2.5	NRC×1.1	72.9	2.10^{a}	2.67^{a}	0.197	3.85	0.313	2.18^{abc}	0.53
5	NRC×1.1	73.2	1.37^{ab}	2.61^{a}	0.190	3.40	0.346	2.35^{ab}	0.40
7.5	NRC×1.1	71.4	1.59^{ab}	2.51^{ab}	0.233	3.64	0.340	2.72^{a}	0.43

Table 6: Effect of different levels of fat and protein on plasma fat, triglyceride and cholesterol in 49 days old broiler chicks

Fat Level	Protein level	Triglyceride	Cholesterol	Total Fat
0	NRC	82.0^{a}	135.0	41.3
2.5	NRC	59.2^{ab}	120.3	30.1
5	NRC	57.2^{ab}	134.5	43.0
7.5	NRC	48.5^{b}	117.5	32.5
0	NRC×1.1	58.5^{ab}	128.5	40.6
2.5	NRC×1.1	79.1^{ab}	111.5	47.3
5	NRC×1.1	88.2^{a}	130.1	33.0
7.5	NRC×1.1	81.5^{a}	141.83^{a}	35.5

no significant effect on weight gain in 7-21 and 21-42 d old chicks, but in age 42-49 using a diet containing 7.5 % soybean oil significantly (P< 0.05) decreased weight gain (Table 4). Increasing diet protein up to 10 % more than NRC recommendation could not improve body weight gain in broiler chickens except for 7-21d old chicks that fed a diet containing no soybean oil and high protein level that resulted to highest weight gain. This may be because of better diet digestibility and higher levels of energy and amino acid in this diet. Nitsan *et al.* (1997) showed that addition of 3% soybean oil in the diet improved weight gain than the diet containing 0% soybean oil.

Feed conversion ratio: In 7-21 d old chicks feeding a diet with 2.5% soybean oil and a protein level 10% more than NRC recommendation resulted to lowest feed conversion and highest feed conversion had belonged to chicks fed with 5% soybean oil and high protein level and its different from other groups was significant (P<0.05), that it is well coincidence with higher feed intake and lower weight gain in this group. There was no significant difference in feed conversion ratio in chicks fed with different experimental diets in age 21-42. Feeding a diet with a large amount (7.5%) soybean oil and high protein level resulted to highest feed conversion ratio in 42-49 day old chicks and lowest feed conversion ratio was belonged to chicks fed with a diet containing 7.5% soybean oil and a protein level according to NRC recommendation.

Organs weight and blood parameters: Feeding different levels of soybean oil and protein had no effect of carcass, pancreas, intestine and preventriculus weight

(Table 5). Lowest abdominal fat was observed in chicks that fed with a diet containing 7.5% soybean oil with NRC recommendation protein level and its different with chicks that fed with 5% soybean oil was significant ($P<0.05$). Dietary fat can influence lipid metabolism in bird. Yeh and Leveille (1971) fed large amounts of fat to chickens and noted a decrease in quantity of free coenzyme-A available to support *de novo* lipogenesis. It was generally thought that the inhibition of lipogenesis by dietary fat involved the flux rate of fatty acyl coenzyme-A or availability of lipid precursors in the form of dietary carbohydrate (Roseberg *et al*., 1999). Some reports indicate that unsaturated dietary fat may be used for metabolic purposes; consequently, this could affect deposition of body fat (Awad, 1981). Also, it has been shown that diets containing large energy: protein ratios promote *de novo* lipogenesis and result in obese broiler chicken (Donaldson, 1985)

Gizzard weight was higher in chickens fed with large amounts of soybean oil (7.5%) and protein (NRC×1.1). Feeding high levels of soybean oil (5 and 7.5%) and protein (NRC×1.1) also resulted to higher liver weight than other treatments and it could be representing the higher activity of liver for metabolizing these nutrients.

Effect of soybean oil supplementation and protein level on plasma fat has shown in Table 6. Plasma total fat and cholestrol does not affect by these treatments. In chickens that fed with higher protein level, fat supplementation resulted to an increase in plasma triglyceride, but in chicks that fed with NRC recommendation protein level, adding of soybean oil decreases plasma triglyceride, that this is in agree with lower body fat in this group.

References

Ali, M.L., A.G. Miah, U. Salma and R.P. Chowdhury, 2001. Effect of soybean oil on finisher period of broiler at hot weather in Bangladesh. On Line J. Biol. Sci., 8: 714-716.

Awad, A.B., 1981. Effect of dietary lipids on composition and glucose utilization by rat adipose tissue. J. Nutr., 111: 34-39.

Buyse, J., E. Decuypere, L. Berghman, E.R. Kühn and F. Vandesande, 1992. The effect of dietary protein content on episodic growth hormone secretion and on heat production of male broilers. Br. Poult. Sci., 33: 1101-1109.

Carew, L.B., M.C. JR. Nasheim and F.W. Hill, 1961. An in vitro method for determine the availability of soybean oil in unextracted soybean products for the chicks. Poult. Sci., 41: 1962.

Collin, A., R.D. Malheiros, V.M.B. Moraes, P. Van As, V.M. Darras, M. Taouis, E. Decuypere and J. Buyse, 2003. Effects of dietary macronutrient content on energy metabolism and uncoupling protein mRNA expression in broiler chickens. Br. J. Nutr., 90: 261-269.

D'Mello, J.P.F., 1994. Amino acid imbalance, antagonisms and toxicities. In *Amino Acids in Farm Animal Nutrition,* pp. 63-97. J.P.F. D'Mello, Editor. CAB International.

Donaldson, W.E., 1985. Lipogenesis and body fat in chicks: effect of calorie-protein ratio and dietary fat. Poult. Sci., 64: 1199-1204.

Kita, K., T. Muramatsu and J. Okumura, 1993. Effect of dietary protein and energy intakes on whole-body protein turnover and its contribution to heat production in chicks. Br. J. Nutr., 69: 681-688.

Leeson, S. and J.D. Summers, 2001. Scoot's Nutrition of the Chicken. University Book. Guelph, Canada.

National Research Council, 1994. Nutrient requirements of poultry. National Academic Press, Washington, DC. USA.

Nieto, R., J.F. Aguilera, I. Fernandez-Figares and C. Prieto, 1997. Effect of a low protein diet on the energy metabolism of growing chickens. Arch. Tierernahr, 50: 105-109.

Nitsan, Z., A. Dvorin, Z. Zoref and S. Mokady, 1997. Effect of added soybean oil and dietary energy on metabolizable and net energy of broiler diets. Br. Poult. Sci., 38: 101-106.

Roseberg, R.W., J.P. Mcmurtry and R. Vasilatos-Younken, 1999. Dietary fat and protein interaction in broiler. Poult. Sci., 78: 992-998.

SAS Institute, 2001. SAS User's Guide: Statistic. Version 8.2, SAS institute Inc., Cary, NC, USA.

Yeh, Y.Y. and G.A. Leveille, 1971. Studies on the relationship between lipogenesis and the level of coenzyme A derivatives, lactate and pyruvate in the liver of the growing chick. J. Nutr., 101: 911-920.