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The effect of different sources and levels of dietary fat on broiler's growth performance and carcass characteristics

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Abstract

An experiment was carried out to evaluate the effect of different levels of fat powder, tallow and soy bean oil to the growth performance and carcass traits of 252 commercial broiler chicks (Ross 308) were examined. In this experiment 3 replicates of l2 birds were randomly allocated to each treatment and received different fat levels including the control group (without fat), fat powder, tallow and soy bean oil in different percentages. Data were recorded for feed intake, body weight gain and feed conversion ratio (FCR) in periods of 1-21, 21-42, 42-49 and 7-49 days of age. At the age of 49 days two chicks from each replicate were slaughtered to investigate the analysis of carcass, liver, abdominal fat, pancreas and gallbladder weight. Results showed that treatments had significant effect on feed intake (7-21 days of age), body weight gain (7-21, 2l-42 and 1-49 days of age), FCR (7-21, 2l-42 and 1-49 days of age) and gallbladder percent. However treatments had no significant effect on feed intake (42-49 and 7-49 days of age), carcass, abdominal fat, liver and pancreas weight. Results concluded that addition of fat powder and non-saturated fats in diet of broiler chicks improve growth performance (feed intake, body weight gain and feed conversion ratio).

Keywords: broiler chick, performance, fat powder, tallow, non-saturated fats

INTRODUCTION

It is widely known that, the population is increasing continuously and led to increase in demands of animal protein. Consequently, broiler industry is increasing sharply all over the world (El-Bahra and Ahmed, 2013). The metabolisable energy of 1 kg fat powder is equal to 3 kg corn seeds or barley so using "fat" seems economical (NRC, 1994). Vegetable oils and animal usually used in broiler diets to increase energy density and improve feed utilization efficiency. Over the last years, full-fat oilseed, unextracted whole seeds are being used as a replacement of the supplemental lipids added to broiler diets, avoiding popular technical difficulties and quality problems related to the adding animal fat (Alzueta et al., 2007). Wisenman and Leissire (1987) and Doreu et al. (1997) mentioned that the intestinal absorption of fatty acids might vary largely because of the interactions between different fats added to diet. So, the nutritive value of a saturated fatty acid, defined in terms of the quantity of absorbed fat, may be improved in the presence of unsaturated fatty acids. The animal and vegetable oil have been used as a source of human food and animal nutrition and that is because of further advantage of energy suppling it can have some more advantages such as improving the fat-soluble vitamins absorption, diminishing the pulverulence, increasing the palatable of the ration, and increasing the efficiency of the consumed energy (lower caloric increment). Moreover, another advantage can be decreasinge the passage rate of the digest in the gastrointestinal tract, which helps to improve the absorption of all nutrients present in

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the diet. Baibo and Lara (2005) and Ahmed and Al-Azraq (2013) stated that the fats and oils are esters of glycerol and fatty acid; fats are solid however oils are liquid at room temperature. Lipids supply the main energy reserve of animals and it has the highest caloric value among all nutrients. The value of oil is mostly related to their quality, their energy value and factors as essential fatty acid content, oxidative stability and palatability (Nobakht and Mehmannavaz, 2012; Ahmed and Al-Azraqi, 2013). According to what Bryan et al. (2005), and Ahmed and Al-Azraq (2013) asserted regulating dietary energy by supplementing fat is believed to be one of the most effective ways to adjust feed intake of broilers. Even Ahmed and Al-Azraq (2013) showed that combination of canola and olive-canola oils in broilers ration increased body weight gain, improved feed conversion and keel length. It has been explained that, the administration of high caloric diet led to the development of dyslipidaemia, abdominal obesity (Innis, 2007), fatty liver disease (Altunkaynak, 2005; Bryant and Roland, 2005). The aim of this paper is studying the effect of the different levels and sources of dietary fat on broiler's growth performance and carcass characteristics.

MATERIALS AND METHODS

Experimental design

A total of two hundred and fifty two day old male broiler chicks (Ross 308) were obtained from a commercial hatchery and reared to Khorasgan University chicken farm for current study. Broiler chicks were fed with the commercial broiler starter diet from 1 to 6 day of age and at age seven were placed in 21 floor pens of 12 birds each in research section of Khorasgan University, Esfahan, Iran. The chickens had free access to water and feed. This experiment was conducted to study the effect of different levels of fat powder, tallow and soy bean oil on broiler's growth performance and carcass. In this experiment 3 replicate of 12 birds randomly received different fat levels including: the group A(control group) ,B (3% fat powder, 1.5% tallow), C(3% fat powder, 1.5% soy bean oil), D(1.5% fat powder, 3% tallow), E(1.5% fat powder, 3% soy bean oil), F(3% tallow, 1.5% soy bean oil), G(1.5% tallow, 3% soy bean oil). The fat powder used in this experiment was Berga fat the product of palm oil in Malaysia. Its colour was bright white. The tallow used in this experiment was cows tallow provided from Esfahan cow slaughtering factory and soy bean oil was provided from Esfahan oil factory which was liquid and easy to mix with feed. Data were recorded for feed intake, body weight and feed conversion ratio (FCR). At the end of experiment two birds per replicate were slaughtered to investigate the effects of dietary treatments on carcass yield, liver weight, pancreas and gallbladder percentage.

Data collection and Data analysis

Experimental factors: feed intake (g) in each experimental group were measured and divided to number of birds at the end of each period. The body weight were measured at the first and end of each period and body weight gain calculated. Feed conversion ratio (FCR) was calculated by dividing feed intake to body weight gain in each period. Carcass percentage calculated by dividing carcass weight includes abdominal fat (g) to live weight times by 100. For calculating different body parts every part including liver, abdominal fat, pancreas and gallbladder were weighed separately and then divided to live weight (g). Mortality was also recorded. According to have three types of fat (tallow, soy bean oil and fat powder) and 7 treatments, 3 replicates and 2 sample of each group data were analysed in a complete randomized design using SAS (version 9.1, North Carolina USA). The treatment means were compared by Duncan multiple range test. The level of significant was considered at ($P< 0.01$).

RESULTS AND DISSCUSSION

Feed intake

Table 1 showed the analysis of variance of the effect of different sources of fat on the daily feed intake of birds over different phases of production (starter, grower and finisher) and entire phase, feed intake (g) of each bird in each day. According to Tables in week 2-3 experimental treatments had significant effects (P< 0.01) on feed intake. Between 21-42 days of age effect of experimental treatments was significant (P> 0.05), however, from 42-49 days of age there was no significant effects on feed intake. Differences between experimental treatments (B, C, D and G) to experimental treatments (A, E and to F) were significant different (P< 0.05). However, treatments had no significant effect (P>0/05) on feed intake from 7-49 days of age even there was no any significant effects between experimental treatments in this age. Also treatments had no significant effects on feed intake (g) used by bird each day. Between experimental treatments in total phase and feed intake (g) bird in each day there was no significant effects. Result showed that control treatment in starter phase had lowest feed intake, and treatment F(3% tallow, 1.5% soy bean oil) had the highest feed intake (666.6 and 846.69 g) and between this two treatments and other treatments there was not significant effects. In grower phase the highest feed intake belonged to treatment 3% tallow and 1.5% soy bean oil (3039.28 gr) and the lowest feed intake belonged to treatment 1.5% tallow, 3% soy bean oil (2736.22 gr). In finisher phase the highest and the lowest feed intake recorded for treatments F and A (930 and 1108.19 g, respectively). Having significant effect in feed intake in starter and grower phase and even same energy and protein levels has been described to have better flavour and aroma (3% tallow and 1.5% soy bean oil). Also this effect might be because of different body weight at the end of last period. In entire phase between the experimental treatments there were no significant effects which could be because of the same levels of energy and protein in diets (National Cattlemen's Beef Association, 1997).

Table 1. Analysis of variance of the effect of different sources of fat on the daily feed intake of birds over different phases of production.

Source of variance	Feed Intake				
	Degree of freedom (df)	(7-21 day)	(21-42 day)	(42-49 day)	(7-49 day)
Treatment	6	8382.6723**	33130.7489*	10904.0801n.s	51499.6755 ns
Mean square	14	1486.13	10160.94	5525.68	37685.33
Total	20	* Significant differences at P < 0.05		** Significant differences at P < 0.01	

Table 2. Mean daily feed intake of birds over different phases of production.

Treatment	Feed Intake (g/bird)			
	(7-21 day)	(21-42 day)	(42-49 day)	(7-49 day)
A Control	846.69a	2779.73ab	930.50	4611.7
B 3% fat powder, 1.5% tallow	755.99b	2885.32bc	1019.69	4779.6
C 3% fat powder, 1.5% soy bean oil	747.83b	2892.68abc	1013.64	4764.3
D 1.5% fat powder, 3% tallow	755.54b	2971.70ab	986.44	4770
E 1.5% fat powder, 3% soy bean oil	744.67b	2928.32abc	1089.94	4970.7
F 3% tallow, 1.5% soy bean oil	666.60c	3039.28a	1108.19	4980.5
G 1.5% tallow, 3% soy bean oil	771.05b	2736.22c	1035.34	4742.7

The numbers in each column with same word have significant differences (P < 0.05).

Body weight gain

Analysis of variance of the effect of different sources of fat on the body weight gain of birds over different phases of Production is shown in Table 3 and 4. As we can see in Table 3 different levels of fats had significant effects (p < 0.05) on body gain weigh over 7-21 days of age and significant effects (p < 0.01) over the growth and entire phase of production. On the other hand this effect over finisher phase was not significant. In the starter phase treatment E, G and F (468.30, 451.38, 494.37 g) had higher body weight gain compared to other treatments. The treatments with soy bean oil plus other sources of fats had better efficiency in body weight gain than other sources. However, in the starter phase treatment E (1466.62 g) and in finisher phase treatment of F (506.12 g) had highest body weight gain and the lowest body weight gain in that phases belonged to control group (359 and 1240 g). In the entire phase and final phase treatments E and F (2467 and 2360 g) containing soy bean oil plus tallow or fat powder had better body weight gain compared to other treatments. Further analysis showed that adding fat powder to diets had significant effect on body weight gain. Even treatments containing soy bean oil plus fat powder or tallow had significant different in body weight gain related to other treatments which is described because of coverage effects of animal and vegetable oil (Ouart et al., 1992) and positive effects of using soy bean oil . Table 4 illustrated that, tallow had significant effects on body weight gain in starter phase (P < 0.05). In grower phase the highest body weight gain belonged to treatments E (1466.62 g) and in finisher phase belonged to treatment F (506.12 g). But the lowest one recorded for control group (359 and 1240 g). In entire phase and finisher phase treatments E and F (2467 and 2360 g) which had soy bean oil plus fat powder or tallow had better body weight gain compared to other groups. Next analysis showed that fat powder in diets had significant effects on body weight gain. Even in entire phase treatments E and D showed that diets with 1.5% fat powder had best body weight efficiency. This could be explained in the light of better digestibility of vegetable oils (Ouart et al., 1992).

Table 3. Analysis of variance of the effect of different sources of fat on the daily body weight gain of birds over different phases of production

Source of variance	Degree of freedom (df)	Body Weight Gain (7-21 day)	(21-42 day)	(42-49 day)	(7-49 day)
Treatment	6	2304.050*	16788.59**	6623 n.s	64862.292**
Mean square	14	814.0582	1799.3524	3396.64	12991.112
Total	20	* Significant differences at P < 0.05		** Significant differences at P < 0.01	

Table 4. Daily body weight gain of birds over different phases of production

Treatment	Body Weight Gain (g/bird) (7-21 day)	(21-42 day)	(42-49 day)	(7-49 day)
A Control	449.28ab	1240.02d	350.37	2011c
B 3% fat powder, 1.5% tallow	420.81b	1291.13bcd	426.86	2157bc
C 3% fat powder, 1.5% soy bean oil	419.02b	1268.94cd	443.41	2172bc
D 1.5% fat powder, 3% tallow	422.18b	1366.09b	440.41	2237b
E 1.5% fat powder, 3% soy bean oil	494.37a	1466.62a	485.29	2467a
F 3% tallow, 1.5% soy bean oil	451.38ab	1308.43bcd	506.12	2360ab
G 1.5% tallow, 3% soy bean oil	463.30ab	1331.93bc	427.72	2227b

The numbers in each column with same word have significant differences (P< 0.05).

Feed conversion ratio (FCR)

The analysis of variance of the effect of different sources of fat on the Feed conversion ratio (FCR) of birds over different phases of production illustrated in Table 5 and 6. According to Table 5 in starter phase and grower phase the experimental treatments had significant effects on FCR (P< 0.01), however, this effect in finisher phase was not significant. Even in entire phase of production this effect was significant (P < 0.01). Also according to Table 6 in starter phase treatments E and F (1.56 and 1.47) had best FCR having different body weight gain and feed intake with other treatments it was predictable. Extra analysis showed that adding soy bean oil plus other sources of fat in diet improved efficiency of FCR it could be explained as a result of using vegetable oils to improve FCR in recent researches (National Cattlemen's Beef Association, 1997). In grower phase treatment (3% soy bean oil and 1.5%

fat powder) had lowest FCR (1.996) and this different with other treatments was significant ($p < 0.05$). In final phase control group showed the highest FCR (2.59) and the lowest one belonged to F group (2.2). In addition, in total phase treatment E (2.01) had the highest FCR it could be related to better digestibility of unsaturated fats (Ouart et al., 1992; Azman and Seven, 2004).

Table 5. Analysis of variance of the effect of different sources of fat on Feed conversion ratio (FCR)

Source of variance	Feed Conversion Ratio				
	Degree of freedom(df)	(7-21 day)	(21-42 day)	(42-49 day)	(7-49 day)
Treatment	6	0.06548**	0.04624**	0.05558 n.s	0.02299**
Mean square	14	0.01265	0.004953	0.03839	0.004732
Total	20	* Significant differences at P < 0.05		** Significant differences at P < 0.01.	

Table 6. Feed conversion ratio (FCR) of birds over different phases of production

Treatment	Feed Conversion Ratio (g/g)			
	(7-21 day)	(21-42 day)	(42-49 day)	(7-49 day)
A Control	1.88a	2.243ab	2.59	2.29a
B 3% fat powder, 1.5% tallow	1.796ab	2.235ab	2.39	2.21ab
C 3% fat powder, 1.5% soy bean oil	1.793ab	2.322a	2.308	2.19ab
D 1.5% fat powder, 3% tallow	1.788ab	2.174bc	2.256	2.13bc
E 1.5% fat powder, 3% soy bean oil	1.560c	1.996d	2.271	2.01c
F 3% tallow, 1.5% soy bean oil	1.472c	2.308a	2.2	2.11bc
G 1.5% tallow, 3% soy bean oil	1.66bc	2.055cd	2.465	2.13bc
The numbers in each column with same word have significant differences (P< 0.05)				

Analysis of carcass

Analysis of variance of the effect of different sources of fat on carcass efficiency and percentage of carcass traits (carcass weight, percentage of abdominal fat, percentage of liver weight, percentage of pancreas weight and percentage of gallbladder weight) over different phases of production are illustrated in Table 7 and 8. Table 7 showed that experimental treatments had not significant effects on carcass traits, however, this effects on percentage of gallbladder weight was significant ($P < 0.01$). As Leenstra (1989) asserted before, genetic factors and age of birds have more important effects on carcass traits than nutrition. So because of using similar breed birds with same age different fat levels had not significant effect on carcass traits (NRC, 1994). The most important nutrient factor for abdominal fat is the energy level of diet (Azman and Seven, 2004) thus because of having diets with same energy levels the effects of treatments was not significant. Another factor which can affect abdominal fat is sex of birds (Ozdagan and M.Aksit, 2003) so according to have birds with same age and sex diferent fat levels have no any significant effect on carcass traits. Zollitsch, and Lettner (1997) stated that effect of different sources of fats on abdominal fat could be related to better digestibility and metabolisable energy of fats. Experimental treatment did not have significant effects on percentages of pancreas weight. However, the effects of experimental treatments on percentage of gallbladder weight were significant and group F (% 0.0486) had the highest percentage of gallbladder weight which could be explained because of more percentage of saturated fatty acids compared to other treatments needed more liverish elements synthesis (Matyka and Bogusz, 1990).

Table 7. Analysis of variance of the effect of different sources of fat on carcass efficiency and percentage of carcass traits over different phases of production.

Source of variance	Carcass Characteristics					
	Degree of freedom(df)	carcass weight%	abdominal fat%	liver weight %	Pancreas weight%	Gallbladder weight%
Treatment	6	2.29 n.s	0.986 n.s	0.243 n.s	0.00185 n.s	00037 n.s
Mean square	21	2.567	0.791	0.158	0.00185	0.00022
Total	41	* Significant differences at P < 0.05. ** Significant differences at P < 0.01				

Table 8. Effect of different levels of fat on carcass efficiency and percentage of carcass traits.

Treatment	Carcass Characteristics (% of live body weight)				
	carcass weight%	abdominal fat%	liver weight %	Pancreas weight %	Gallbladder weight %
A Control	73.310	2.8127	2.8430	0.24333	0.03633
B 3% fat powder, 1.5% tallow	73.243	2.2622	2.8602	0.2825	0.03783b
C 3% fat powder, 1.5% soy bean oil	72.613	2.9553	2.8562	0.23283	0.5166
D 1.5% fat powder, 3% tallow	71.800	2.4162	3.1858	0.2535	0.05033
E 1.5% fat powder, 3% soy bean oil	73.128	2.7410	2.8018	0.23567	0.545
F 3% tallow, 1.5% soy bean oil	73.310	3.2048	2.9170	0.2443	0.48683
G 1.5% tallow, 3% soy bean oil	72.142	2.610	3.3245	0.23167	0.036333

CONCLUSIONS

The following conclusions can be drawn from the study:

– The results of this experiment indicated that addition of fat powder and non-saturated fats in diet of broiler chicks improve growth performance (feed intake, body weight gain and feed conversion ratio) but do not have effects on characteristics.

Literature cited

Ahmed, A. S., El-Bahr, S. M., and Al-Azraqi, A. A. (2013). Effect of Canola and Olive Oils on Productive, Immunological and Some Biochemical Parameters of Broiler Chickens Fed Iso Caloric and High Caloric Diets. Int. J. Poult. Sci. *12(12),* 726.

Azman, M. A., Konar, V., and Seven, P. T. (2004). Effects of different dietary fat sources on growth performances and carcass fatty acid composition of broiler chickens. Revue de médecine vétérinaire, *155*(5), 278-286.

Altunkaynak, Z. (2005). Effects of high fat diet induced obesity on female rat livers (a histochemical study).

Alzueta, C., Ortiz, L. T., Rodriguez, M. L., Rebole, A., and Trevino, J. (2007). Effect of dietary inclusion of high-oleic acid sunflower seed on the utilization of crude palm oil by broiler chickens. J. Anim. Feed Sci. *16(2),* 214.

Baião, N. C., and Lara, L. J. C. (2005). Oil and fat in broiler nutrition. Revista Brasileira de Ciência Avícola, *7(3),* 129-141.

Bryant, M., Wu, G., and Roland, D. (2005, January). Optimizing dietary energy for profit and performance of two strains of White Leghorns. In Poultry Science (Vol. 84, Pp. 114-114). 1111 N Dunlap Ave, Savoy, Il 61874-9604 Usa: Poultry Science Assoc Inc.

Doreau, M., and Chilliard, Y. (1997). Digestion and metabolism of dietary fat in farm animals. Br. J. Nutr. *78(01),* S15-S35.

El-Bahra, S. M., and Ahmed, A. S. (2013). Effect of vegetable oils on growth, lipid profile, and immunologic response in broiler chicken fed isoenergetic diet.

Innis, S. M. (2007). Dietary lipids in early development: relevance to obesity, immune and inflammatory disorders. Current Opinion in Endocrinology, Diabetes and Obesity, *14(5),* 359-364.

Kenneth, J.W. (2000). Poultry nutrition information for the small flock. Poult. Sci Kansas state University, http://www.oznet.ksu.edu

Leenstra, F. R. (1989). Influence of diet and genotype on carcass quality in poultry, and their consequences for selection. Recent developments in poultry nutrition, 131-144.

Matyka, S., Korol, W., and Bogusz, G. (1990). The retention of phytin phosphorus from diets with fat supplements in broiler chicks. Anim. Feed Sci. Technol. *31(3),* 223-230.

National Cattlemen's Beef Association. (1997). Beef facts: Nutrition Research.

Berg, L., and Bearse, G. (1962). Nutrient requirements of poultry. Poult. Sci. *41*, 1328-1335. 9th. Rev. edition, National Academy Press, Washington, D.C.

Nobakht, A. A., and Mehmannavaz, Y. (2012). Effects of Saturated and unsaturated fats in starter and grower feeds on performance and carcass traits of broilers. J. Basic. Appl. Sci. Res, *2(2),* 967-970.

Ouart, M. D., Damron, B. L., Martin, F. G., Christmas, R. B., and Sloan, D. R. (1992). Effects of poultry fat and yellow grease on broiler performance and profitability. Poult. Sci. *71(5),* 821-828.

Özdoğan, M., and Akşit, M. (2003). Effects of feeds containing different fats on carcass and blood parameters of broilers. J. Appl. Poultry Res. *12(3),* 251-256.

Statistical Analysis System (SAS). (2000). User's Guide. Statistics, SAS Institute Inc. Cary, North Carolina, USA.

Wiseman, J., and Lessire, M. (1987). Interactions between fats of differing chemical content: apparent metabolisable energy values and apparent fat availability. Brit. Poultry Sci. *28(4),* 663-676.

Zollitsch, W., Knaus, W., Aichinger, F., and Lettner, F. (1997). Effect of different dietry fat source on performance and carcass character of broiler.Anim. Feed Sci. Technol. *66*, 63-73.