Growth performance, carcass characteristics and blood metabolites of broiler chickens fed diets formulated on total or digestible amino acids basis with bovine bile salts powder and soybean oil

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Abstract

An experiment was conducted to evaluate the growth performance, carcass characteristics and blood metabolites of broiler chickens fed diets formulated on total or digestible amino acids (TAA or DAA) basis with bovine bile salts powder (BBSP) and different levels of soybean oil (SO). A total of two hundred and forty 1-day old chicks were randomly allocated to eight treatments with three replicates of 10 birds. The experiment was carried out in a completely randomized design with 2×2×2 factorial arrangement, including two levels of BBSP, two levels of SO and two methods of amino acids balance (TAA or DAA) in diets. The results showed that main effects of BBSP, SO and feed formulation procedures (TAA or DAA) had no effects on all growth performance parameters ($P > 0.05$). Carcass traits, except for thigh weight, were not influenced by all dietary treatments ($P > 0.05$). The birds fed diets with BBSP had a greater thigh weight than the other group. The results of blood biochemical metabolites indicated that serum triglyceride was affected by amino acid formulation method ($P < 0.05$). In contrast, the other serum metabolites did not alter by dietary treatments ($P > 0.05$). The results indicated that liver enzymes activities including alanine aminotransferase (ALT) and aspartate aminotransferase (AST) were not influenced by dietary BBSP and SO ($P > 0.05$). However, AST activity was affected by amino acids formulation procedure ($P < 0.05$). In conclusion, the addition of bile salts (BBSP), different inclusion rate of SO and amino acids balance method (DAA or TAA) in broiler diets had no negative effects on all growth performance and carcass traits.

Keywords: bile salts, broiler, performance, soybean oil

Introduction

Slaughterhouse wastes produced daily in large quantities usually are used for the production of meat and bone meal in Iran. But part of the waste, such as the gallbladder and its contents can also be used in other ways, such as bile powder. Bile acids are a group of water-soluble steroids formed during the catabolism of cholesterol, and synthesized in the hepatocytes of the liver. The primary bile acids in poultry including cholic acid and chenodeoxycholic acid conjugated with glycine or taurine in the digestive tract and formed bile salts (Leeson and Summers, 2005). Bile salts have an important role in lipid digestion and absorption in the small intestine. Bile salts in aqueous solution spontaneously aggregate to form micelles, these also mix with lipid products during digestion to form mixed micelles and enhance absorption (Stamp and Jenkins, 2008). Several studies have been conducted to investigate the effects of bile salt supplements and emulsifiers on broiler performance (Maisonnier et al., 2003; Al-Zawqari et al., 2010; Guerreiro et al., 2011). The addition of bile salts to poultry diets has resulted in an improvement of fat absorption in chicks (Kussaibati et al., 1982). Also, Campbell et al. (1983) reported that adding of dietary sodium taurocholate improved lipid digestibility in broiler chickens. However, few studies have been conducted on the effects of bile salts on blood metabolites, especially liver enzymes activity, in broiler chickens.

Genetic improvement of broiler strains has increased their growth potential and the need for high intake of energy. For this reason, fats and oils have become essential components in the formulation of high energy broiler diets. Soybean oil is widely used in diets to increase the dietary energy density in Iranian poultry farms. It is cleared that oils from plants, consisting of high proportions of unsaturated fatty acids, are relatively easily digested by poultry (Tancharoenrat, 2012). Krogdahl (1985) reported that the physiological ability to digestion and absorption of fats is poorly developed in young broiler chicks, but improves with increasing age. The low digestibility of fat in young broiler chicks may be due to low level of bile salts or inefficient on the recycling process of bile salts (Leeson and Summers, 2005). Therefore, it is hypothesized that use of an exogenous source of bile salts can be improved fatty acids utilization in broiler chicks, especially during the starter phase of life.

The growth of the synthetic amino acid industry permitted the reduction of crude protein levels in broiler diets. In addition, recent interest in poultry feed formulation has led to take into account the digestible amino acids rather than total (Khaksar and Golian, 2009). In this regard, there have been a number of papers demonstrating the advantages of using digestible rather than total amino acids to formulate broiler diets (Maiorka et al., 2004, 2005; Farrell et al., 1999). However, no reports on the interaction between this method of amino acid formulation and the use of soybean oil with dietary bile salts found in broiler chickens.

Therefore, the aim of this study was to determine the growth performance, carcass characteristics and blood metabolites of broilers fed diets formulated on total or digestible amino acids basis with bovine bile salts powder and different levels of soybean oil.

Materials and Methods

The bovine bile salt was obtained from the gallbladder of the bovine killed freshly from a local slaughterhouse (Sari, Mazandaran province, north part of Iran). Briefly, the gallbladder contents were removed and transferred to glass containers. Then, to disinfect samples, glass containers were placed in boiling water for 30 minutes and then cooled at room temperature. In the next step, samples were filtered through a nylon mesh and then transferred to a closed container at -20 °C for 18 h. Then, samples were thawed and oven dried at 55 °C for 24 h. The oven-dried samples were finely ground to powder and stored at -18 °C until used.

Two hundred and forty 1 day-old Ross 308 broiler chicks (mixed sex) were obtained from a local hatchery. Birds were weighed and randomly assigned to 24 straw/wood shavings mix floor pens with 10 birds per pen. The males and females were distributed between pens with equal numbers. The chicks were raised on floor pens for 42d and had free access to feed and water during the whole period of experiment. The ambient temperature was maintained at 32 °C for the first 3d and then gradually decreased until 24 °C was reached by 21d. Also, lighting was continuous during the whole time of the experiment. The experiment was carried out in a completely randomized design with 2×2×2 factorial arrangement, including two levels of BBSP (0 or 2.5 $g*kg^{-1}$), two levels of SO (high or low) and two methods of amino acids formulation (TAA or DAA) in diets. Dietary treatments were formulated with equal nutrients to energy ratio to meet or exceed the minimum ROSS broiler chickens requirements (2009). The ingredients and chemical composition of experimental diets are shown in table 1.

Feed intake and body weight gain of each pen was measured at the end of experiment (42 days of age). Feed conversion ratio for each pen was calculated by dividing feed intake by body weight gain. Mortality was recorded daily and growth performance data were corrected for body weight of mortality.

Two birds per replicate were bled through the wing vein at 35 d of age to determine the blood biochemical parameters and liver enzymes activity. The blood sample (3 mL) was drawn and allowed to clot at room temperature (18 ºC) for 2 h prior to serum collection. Serum was separated by centrifugation and stored at -20 ºC for further analysis. Serum glucose, high-density lipoproteins (HDL), triglycerides and cholesterol were determined using commercial kits (Pars Azmun, Tehran, Iran). Also, sera samples were used to measure the activities of serum alanine aminotransferase (ALT) and aspartate aminotransferase (AST) as the indicators of liver health. The liver enzymes activity was assayed by auto analyzer (ALCYON 300).

At 42 days of age, eight randomly selected birds from each treatment were weighed, and slaughtered by cervical dislocation. The carcasses were then opened and the weight of intestinal tract (after digesta removal), breast, thigh, wing, abdominal fat, liver (without gallbladder), gizzard, spleen and pancreas were recorded. Related organ weights were calculated as [organ weight (g)/100 g body weight].

Data were subjected to ANOVA in a completely randomized design with 2×2×2 factorial arrangements of treatments using GLM procedure of SAS (v. 9.1, SAS Inst. Inc., Cary, NC, USA). Pen was the experimental unit. Statistical significance of differences among treatments was done using the Duncan’s multiple range test at ($P < 0.05$).

Table 1. Ingredients and chemical composition of experimental diets formulated on total amino acids basis

Ingredients (%)	Starter (1-10d)		Grower (11-24d)		Finisher (25-42d)	
	L	H	L	H	L	H
Corn	58.55	53.44	59.00	54.38	60.96	56.08
Soybean meal	35.00	34.60	32.69	32.35	28.95	28.55
Soybean oil	1.50	3.00	3.00	4.50	4.50	6.00
Wheat bran	0.00	4.00	1.27	4.70	1.80	5.55
Oyster shell	1.39	1.39	1.12	1.12	1.13	1.13
DCP	1.85	1.84	1.63	1.63	1.49	1.49
Salt	0.46	0.46	0.41	0.41	0.36	0.36
Vit-premix[a]	0.25	0.25	0.25	0.25	0.25	0.25
Min-premix[a]	0.25	0.25	0.25	0.25	0.25	0.25
DL-Met	0.36	0.37	0.25	0.26	0.23	0.24
L-Lys	0.29	0.29	0.10	0.11	0.07	0.08
L-Thr	0.10	0.11	0.02	0.03	0.01	0.02
AME ($MJ*kg^{-1}$)	12.39	12.39	12.77	12.77	13.18	13.18
CP	22.43	22.43	21.31	21.31	19.70	19.70
Ca	1.03	1.03	0.88	0.88	0.84	0.84
AP	0.49	0.49	0.45	0.45	0.42	0.42
Na	0.20	0.20	0.18	0.18	0.16	0.16
Lys	1.40	1.40	1.37	1.37	1.08	1.08
TSAA	1.04	1.04	0.92	0.92	0.85	0.85
Thr	0.82	0.82	0.81	0.81	0.74	0.74

[a]Provides per kg of diet: 9000 I.U. vitamin A; 2000 I.U. vitamin D3; 18 I.U. vitamin E; 2 mg menadion; 1.8 mg thiamine; 6.6 mg riboflavin; 30 mg niacin; 3 mg pyridoxine; 15 mg vitamin B12; 100 mg D-pantothenic acid; 1 mg folic acid; 0.1 mg biotin; 500 mg choline chloride; 100 mg antioxidant; 100 mg manganese; 84.7 mg zinc; 50 mg iron; 10 mg copper; 1 mg iodine; 0.2 mg selenium.
L- Low soybean oil; H- High soybean oil

The following model was considered for analysis:

$$Y_{ijkl} = \mu + A_i + B_j + C_k + (AB)_{ij} + (AC)_{ik} + (BC)_{jk} + (ABC)_{ijk} + e_{ijkl},$$

where Y_{ijkl} is the parameter that was measured; μ is the overall mean; A_i is main effect of the soybean oil; B_j is the main effect of bovine bile salt powder; C_k is the main effect of amino acid balance procedure; $(AB)_{ij}$ is the effect of interaction between soybean oil and bovine bile salt powder; $(AC)_{ik}$ is the effect of interaction between soybean oil and amino acid balance procedure; $(BC)_{jk}$ is the effect of interaction between bovine bile salt powder and amino acid balance procedure; $(ABC)_{ijk}$ is the three-way interaction of the soybean oil, bovine bile salt powder and amino acid balance procedure; and e_{ijkl} is the random error term.

Table 2. Ingredients and chemical composition of experimental diets formulated on digestible amino acids basis

Ingredients (%)	Starter (1-10d)		Grower (11-24d)		Finisher (25-42d)	
	L	H	L	H	L	H
Corn	58.42	53.52	59.14	54.35	61.00	56.12
Soybean meal	35.05	34.66	32.70	32.35	28.95	28.55
Soybean oil	1.50	3.00	3.00	4.50	4.50	6.00
Wheat bran	0.00	3.80	1.00	4.62	1.65	5.40
Oyster shell	1.39	1.39	1.12	1.12	1.13	1.13
DCP	1.85	1.84	1.63	1.63	1.49	1.49
Salt	0.46	0.46	0.41	0.41	0.36	0.36
Vit-premix[a]	0.25	0.25	0.25	0.25	0.25	0.25
Min-premix[a]	0.25	0.25	0.25	0.25	0.25	0.25
DL-Met	0.31	0.32	0.23	0.24	0.20	0.21
L-Lys	0.21	0.30	0.14	0.14	0.11	0.12
L-Thr	0.21	0.21	0.13	0.14	0.11	0.12
AME ($MJ*kg^{-1}$)	12.39	12.39	12.77	12.77	13.18	13.18
CP	22.43	22.43	21.31	21.31	19.70	19.70
Ca	1.03	1.03	0.88	0.88	0.84	0.84
AP	0.49	0.49	0.45	0.45	0.42	0.42
Na	0.20	0.20	0.18	0.18	0.16	0.16
Lys	1.24	1.24	1.07	1.07	0.96	0.96
TSAA	0.92	0.92	0.82	0.82	0.75	0.75
Thr	0.81	0.81	0.71	0.71	0.64	0.64

[a]Provides per kg of diet: 9000 I.U. vitamin A; 2000 I.U. vitamin D3; 18 I.U. vitamin E; 2 mg menadion; 1.8 mg thiamine; 6.6 mg riboflavin; 30 mg niacin; 3 mg pyridoxine; 15 mg vitamin B12; 100 mg D-pantothenic acid; 1 mg folic acid; 0.1 mg biotin; 500 mg choline chloride; 100 mg antioxidant; 100 mg manganese; 84.7 mg zinc; 50 mg iron; 10 mg copper; 1 mg iodine; 0.2 mg selenium.
L- Low soybean oil; H- High soybean oil

Results

The results of broiler growth performance are presented in Table 3. These results showed that the main effects of BBSP, SO and diet formulation procedures (TAA and DAA) had no significant effects on feed intake, weight gain and feed conversion ratio (FCR) in broilers ($P > 0.05$). Also, two-way and three-way interactions were not statistically significant for all of growth performance parameters ($P > 0.05$). Feed conversion ratio as an indicator for broiler performance was improved numerically in groups fed diets with low level of SO and BBSP supplementation.

Effects of dietary treatments on carcass components and internal organ of broiler chickens are shown in Table 4. These results indicated that the two-way interaction between BBSP and SO was significant for breast weight ($P < 0.05$). In this regard, the main effect of BBSP had a significant effect on thigh weight in broiler chickens ($P < 0.05$). The birds fed diets without BBSP supplement had a greater thigh weight than those fed BBSP supplemented diets. Also, the interaction between SO and DFP and the three-way interaction were significant for thigh weight ($P < 0.05$). The results of Table 4 showed that the other carcass traits including abdominal fat, liver, gizzard, spleen and pancreas weight were not affected by dietary treatments ($P > 0.05$).

The means of the blood biochemical parameters and hepatic enzymes activity are presented in Table 5. These results indicated that serum glucose, cholesterol and HDL were not influenced by dietary treatments (P > 0.05). The triglyceride concentration was affected by main effect of DFP (P < 0.05) and was greater in broilers fed diets formulated based on DAA requirements. Also, the three-way interaction was significant for serum trigyceride concentration (P < 0.05). The results of Table 5 showed that ALT activity, as an indicator for liver health, altered by the main effect of DFP (P < 0.05). The birds fed diets formulated based on DAA had a lower ALT activity than those fed TAA diets. The two-way interaction between SO and BBSP was also significant for AST activity in broilers (P < 0.05).

Table 3. The effects of dietary treatments on broilers weight gain, feed intake, and feed conversion ratio (FCR) per bird

SO	BBSP	DFP	Feed intake	Weight gain	FCR
			(g)	(g)	
High	0	TAA	102.4	48.68	2.10
High	0	DAA	103.9	48.63	2.12
High	0.25	TAA	102.9	49.61	2.08
High	0.25	DAA	103.1	48.71	2.13
Low	0	TAA	104.1	49.34	2.09
Low	0	DAA	103.2	49.70	2.07
Low	0.25	TAA	102.3	49.47	2.08
Low	0.25	DAA	103.3	50.93	2.03
SEM			0.33	0.67	0.03
Main effects					
High	-	-	102.8	48.90	2.11
Low	-	-	103.2	49.83	2.07
-	0	-	102.9	49.06	2.10
-	0.25	-	103.0	49.67	2.08
-	-	TAA	102.7	49.25	2.09
-	-	DAA	103.2	49.49	2.09
SEM			0.46	0.95	0.04
Source of variation				*P* value	
SO			NS	NS	NS
BBSP			NS	NS	NS
DFP			NS	NS	NS
SO×BBSP			NS	NS	NS
SO×DFP			NS	NS	NS
BBSP×DFP			NS	NS	NS
SO×BBSP×DFP			NS	NS	NS

SO -Soybean oil; BBSP- Bovine bile salt powder; DFP- Diet formulation procedure; SEM- Standard error of the means

Table 4. The effects of dietary treatments on carcass characteristics (relative to live body weight) of broilers

SO	BBSP	DFP	Breast	Thigh	AF	Liver	Gizzard	Spleen	Pancreas
						(%)			
High	0	TAA	20.34	17.79	0.77	2.78	1.78	0.16	0.22
High	0	DAA	21.25	17.87	0.60	2.80	1.80	0.14	0.29
High	0.25	TAA	23.62	16.09	0.46	3.23	1.61	0.13	0.28
High	0.25	DAA	22.39	17.25	0.40	3.06	1.81	0.10	0.19
Low	0	TAA	23.04	17.63	0.55	3.02	1.68	0.11	0.24
Low	0	DAA	21.91	17.53	0.42	3.33	1.73	0.12	0.26
Low	0.25	TAA	20.20	18.03	0.51	3.19	1.56	0.12	0.26
Low	0.25	DAA	21.46	16.82	0.62	3.50	1.63	0.14	0.29
SEM			0.44	0.13	0.06	0.11	0.03	0.01	0.01
Main effects									
High	-	-	21.90	17.28	0.56	2.97	1.75	0.13	0.25
Low	-	-	21.65	17.50	0.52	3.26	1.68	0.12	0.27
-	0	-	21.63	17.73	0.59	2.98	1.74	0.13	0.25
-	0.25	-	21.92	17.05	0.49	3.25	1.68	0.11	0.26
-	-	TAA	21.80	17.39	0.57	3.05	1.66	0.13	0.25
-	-	DAA	21.75	17.40	0.51	3.18	1.76	0.12	0.26
SEM			0.62	0.19	0.08	0.15	0.05	0.02	0.02
Source of variation							*P* value		
SO			NS	NS	NS	NS	NS	NS	NS
BBSP			NS	0.02	NS	NS	NS	NS	NS
DFP			NS	NS	NS	NS	NS	NS	NS
SO×BBSP			0.04	NS	NS	NS	NS	NS	NS
SO×DFP			NS	0.02	NS	NS	NS	NS	NS
BBSP×DFP			NS	NS	NS	NS	NS	NS	NS
SO×BBSP×DFP			NS	0.03	NS	NS	NS	NS	NS

SO- Soybean oil; BBSP- Bovine bile salt powder; DFP- Diet formulation procedure; SEM- Standard error of the means; AF- Abdominal fat

Table 5. The effects of dietary treatments on serum biochemical parameters and hepatic enzymes activity of broilers

SO	BBSP	DFP	Glucose mg*dl^{-1}	Cholesterol mg*dl^{-1}	Triglyceride mg*dl^{-1}	HDL mg*dl^{-1}	ALT IU*L^{-1}	AST IU*L^{-1}
High	0	TAA	224.61	121.32	86.67	56.23	25.28	275.00
High	0	DAA	214.35	116.24	87.34	58.62	22.75	293.04
High	0.25	TAA	219.63	112.66	82.30	62.00	25.70	259.17
High	0.25	DAA	231.32	118.61	100.01	57.31	24.54	269.33
Low	0	TAA	214.29	127.00	89.02	56.01	24.59	273.01
Low	0	DAA	230.00	103.55	94.00	58.40	24.18	256.34
Low	0.25	TAA	208.67	109.01	90.00	62.02	26.65	268.66
Low	0.25	DAA	220.28	116.46	95.33	56.00	23.71	295.32
SEM			2.96	3.28	1.13	1.32	0.36	3.97
Main effects								
High	-	-	222.50	117.25	89.08	58.58	24.57	274.25
Low	-	-	218.41	114.08	92.07	58.08	24.79	273.41
-	0	-	220.91	117.08	89.25	57.33	24.20	274.41
-	0.25	-	220.00	114.25	91.90	59.32	25.15	273.25
-	-	TAA	216.83	117.50	87.00	59.08	25.56	269.16
-	-	DAA	224.08	113.83	94.16	57.56	23.80	278.50
SEM			4.19	4.65	1.60	1.88	0.51	5.62
Source of variation					*P* value			
SO			NS	NS	NS	NS	NS	NS
BBSP			NS	NS	NS	NS	NS	NS
DFP			NS	NS	0.005	NS	0.02	NS
SO×BBSP			NS	NS	NS	NS	NS	0.03
SO×DFP			NS	NS	NS	NS	NS	NS
BBSP×DFP			NS	NS	NS	NS	NS	NS
SO×BBSP×DFP			NS	NS	0.03	NS	NS	NS

SO- Soybean oil; BBSP- Bovine bile salt powder; DFP- Diet formulation procedure; SEM- Standard error of the means

Discussion

The results of the present experiment are in accordance with findings of previous study (Karimi et al., 2011) who reported that different inclusion rate of fat in diets did not improve feed conversion ratio of broilers. In addition, growth performance parameters were not affected by addition of different inclusion rates of soybean oil in broiler chickens (Rezaeipour et al., 2011). According to Anderotti et al. (2004), broiler feed efficiency was not affected by incorporation of different levels of soybean oil in diets. In contrast, female broiler chicks fed diets containing soybean oil were significantly different from those fed diets with other source of fat in their live weight (Scaife et al., 1994). In this context, the results of another study showed that broilers fed diets with high levels of fats had better performance than the groups fed diets with low inclusion rate of fat (Tabeidian et al., 2005).

In the present experiment, chicken carcass characteristics were not affected by the use of soybean oil in the diets. Chicken abdominal fat is one of the important carcass traits and is a problem in modern broiler strains. Diets rich in unsaturated fatty acids have been found to reduce fat deposition in broiler chicks when compared to diets supplemented with the same inclusion rate of fats rich in saturated fatty acids (Sanz et al., 1999). Monfaredi et al. (2011) reported that supplementation of broiler diets with up to 40 g soybean oil*kg^{-1} feed significantly reduced abdominal fat in comparison with chicks receiving diets containing beef tallow.

Broiler performance was not influenced by dietary BBSP in the present study. In this regard, several studies demonstrated that use of bile salts and emulsifiers in broiler diets did not improve feed efficiency ratio (Maisonnier et al., 2003; Karimi et al., 2011). While, Al-Zawqari et al. (2010) reported that feed conversion ratio was improved in broilers fed diets with bile salts supplement. They stated that addition of bile salts to broiler diets increased lipid digestibility and improved the absorption situation in the small intestine. Maisonnier et al. (2003) reported that the addition of bile salts to diets increased weight gain. However, they observed that feed efficiency was not influenced by dietary bile salt in broilers. Parsaie et al. (2007) also reported a significant increase in feed intake and weight gain of broilers fed a diet supplemented with bile acid. It is well documented that the digestion and absorption of fat in young chickens is poor due to the immaturity of physiological functions. In particular, the secretion of lipase and bile seem to be first limiting during the initial weeks of life (Krogdahl, 1985). Also, it is generally recognized that following digestion, micelle formation is an important role for absorption into the portal system. Micelles are complexes of bile salts, fatty acids, some monoglycerides and glycerol (Zelenka et al., 2003). Therefore, fat absorption in broiler chickens depends on an adequate supply of bile in the small intestine and the inclusion rate of unsaturated fatty acids in the diets. In addition, it is reported that fat digestibility was significantly affected by addition of bile salt to diets of broiler chickens (Al-Zawqari et al., 2010).

The method of amino acids formulation (TAA and DAA) had no effect on broiler performance in the present research. These results are in consistent with the findings of Maiorka et al. (2004) and Fernandez et al. (1995) who reported that feed efficiency was improved in broilers fed diets formulated on DAA than TAA basis. Improved feed efficiency in DAA fed birds is due to more balanced nutrients, absorption and protein synthesis which was influenced by the diet formulated based on DAA (Khaksar and Golian, 2009).

Total blood biochemical parameters were not affected by different inclusion rate of SO in present research, as observed by Fascina et al. (2009) and Guerreiro et al. (2011) who did not find any blood parameters differences between broilers fed vegetable oils. However, results of some studies do not agree with the findings of present experiment. Monfaredi et al. (2011) reported that serum glucose and cholesterol were affected by the use of soybean oil in broiler chickens. They stated that broilers fed diets supplemented with soybean oil had a lower glucose and cholesterol concentration compared with those fed dietary beef tallow.

The observation on the dietary inclusion of bile salts in the present experiment is consistent with those of other studies (Al-Zawqari et al., 2010; Edwards et al., 1962) that incorporation of desiccated Ox bile and Lithocholic acid to broiler and hen diets increased serum cholesterol. It is well known that lipids such as cholesterol, which are highly insoluble in water but are solubilized in bile salt micelles, are almost completely dependent on bile salts for absorption. A dearth of information exists in terms of blood parameters such as serum glucose and triglyceride in broiler chickens response to bile salts and diets formulated on DAA and TAA basis. Therefore, direct comparisons cannot be made.

Liver as a main organ in avian metabolism is sensitive to nutritional modifications and activities of ALT and AST in serum are usually considered as an important index for understanding the liver health. It is cleared that when liver works healthy, the activity of these two enzymes in serum will reduce in broiler chickens (Corduk et al., 2007). It is reported that high fat diets could alter the related enzyme profile in serum and liver tissue (Ishii et al., 2010). The results of the present study are in contrast with this statement. The present results indicated that diets formulated on DAA basis reduced ALT significantly in broilers.

Conclusions

In is concluded that the addition of bile salts (BBSP), different inclusion rate of SO and amino acids balance (DAA or TAA) in broiler diets had no negative effects on all growth performance and carcass traits. The method of diet formulation (DAA or TAA) had an effect on ALT activity as a liver enzyme. But, the mechanism of this effect is not fully understood. Therefore, further experiments are needed to clarify the effects of BBSP and method of amino acids formulation on liver function and metabolism in broilers.

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