Effects of Dietary Taurine Supplementation on Growth Performance, Serum Constituents and Antibody Production of Broilers*

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ABSTRACT : Three experiments were conducted to evaluate the effects of taurine (Tau) supplements on broiler growth performance, serum constituents and antibody production. In Exp. 1, 3 day old chicks received a basal diet supplemented with Tau at 0, 0.10, 0.20, 0.30 or 0.40% for 6 weeks. Although dietary Tau supplementing at 0.30 or 0.40% enhanced feed conversion and reduced feed consumption during 0 to 3 weeks ($p<0.05$), neither serum total cholesterol or anti-*Newcastle disease virus* (NDV) titer were affected. In Exp. 2, dietary Tau supplement at 0.25-0.75% enhanced feed conversion of broilers during 0 to 3 weeks, but daily gain and feed consumption were not affected. The 0.75% Tau supplement group displayed lower serum total cholesterol at 6 weeks ($p<0.05$) comparing with the control group but no difference in anti-NDV titers. In Exp. 3, broilers were treated with dietary Tau of 0 or 0.50% combined with low (0/0%), medium (0.18/0.08%), or high (0.36/0.16%) methionine (Met) levels for 6 weeks (0 to 3/3 to 6 weeks). The addition of Met significantly improved daily gain and feed conversion of broilers during 0 to 3 weeks ($p<0.01$). Dietary Tau interacted significantly with Met on daily gain and feed consumption. Broiler serum amino acids revealed that Met supplements only increased serum Met level, but only serum Tau level was enhanced as given dietary Tau supplementation. The broilers receiving Tau normalized serum triglycerides level by feeding with the low Met diet and tended to display higher anti-NDV titers ($p<0.10$). The experimental results suggest that the growth response obtained by Tau supplements results partly from interactions with sulfur amino acids. However, the modulation of the broiler lipid metabolism may be responsible for dietary Tau. ***(Asian-Aust. J. Anim. Sci. 2004. Vol 17, No. 1 : 109-115)***

Key Words : Taurine, Broiler, Growth Performance, Cholesterol

INTRODUCTION

Taurine (Tau), 2-aminoethanesulfonic acid, is found in tissues primarily as a free amino acid and is one of a number of low-molecular-weight organic constituents present in large quantities in mammals (Sturman and Hayes, 1980). Previously, Tau was considered the excreted end product of sulfur amino acid metabolism, and was biologically insignificant. Unlike methionine (Met) and cysteine, Tau is not used for protein synthesis or as a source of energy but influences membrane stabilization, bile salt formation, growth modulation and calcium homeostatsis (Huxtable, 1992; Redmond et al., 1998). Tau levels increase in chick plasma even when most amino acids decrease after hatching (Frampton et al., 1986). Additionally, high Tau was also noted in leukocytes, and the Tau contents of total amino acids in granulocytes and lymphocytes were 76 and 44%, respectively (Fukuda et al., 1982). Martin et al. (1966) proposed that Tau synthesis should be via sulfate rather than cysteine, and might not be produced in sufficient quantities to support maximum growth in chickens. Taurine synthesis from cysteine has been demonstrated in mammals (Hosokawa et al., 1988; Ohta and Ishibashi, 1997). Therefore to speculate that Tau synthesis in chicks may be different from mammals.

The role of Tau in broiler nutrition remains unclear (NRC, 1994). Previous studies reported that dietary Tau supplementation improved the performance of chicks receiving a purified diet deficient in sulfur amino acids (Anderson et al., 1975) or a glucose-soybean meal ration (Martin and Patrick, 1966). However, the benefits of Tau supplementation in corn-soybean meal diets for broilers have been shown to be transient or nil (Campbell and Classen, 1989; Blair et al., 1991; Dunnington et al., 1996). Meanwhile, Lacetera et al. (1992) noted that addition of 0.6% Tau significantly elevated the anti-*Newcastle disease virus* (NDV) titer beyond 14 days post-vaccination. Taurine appears to be an essential nutrient for chicks due to its enhancement of immunity. This study examined whether dietary Tau diets supplementation influenced growth performance, serum constituents and antibody production for broilers.

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MATERIALS AND METHODS

Treatments and management

Experiment 1 : Three-hundred and sixty 3 day old commercial broilers were randomly allocated among treatments supplementation with 0, 0.10, 0.20, 0.30 or 0.40% Tau (Forever Chem., Co., ROC) for 6 weeks, divided into both a starting period (0 to 3 weeks) and a finishing period (3 to 6 weeks). Each treatment was administered to 3 pens (4 m^2), containing 12 male and 12 female chicks. The birds were fed experimental diets and water *ad libitum*. Table 1 lists the formula and chemical composition of the basal diets. All nutrients met or exceeded the nutrient requirements recommended by NRC (1994).

The birds were reared on the floor under continuous light throughout the experimental period. The environmental temperature was 23.1-25.7°C and heat was supplied during the first 2 weeks for broilers. All chicks were immunized nasally with a living virus vaccine of NDV (Clone 30 strain) on days 4 and 14, respectively. Feed intake and body weight were measured weekly. At the end of the experiment, four birds per pen were selected randomly for bleeding via the wing veins to measure serum constituents and anti-NDV titers.

Experiment 2 : Five-hundred and seventy-six commercial broilers were randomly allotted among treatments with 0, 0.25, 0.50 or 0.75% Tau supplement for 6 weeks. Each treatment was administered to four pens (8 m^2), contained 18 chicks of each gender. The environmental temperature was 25.8-28.0°C. Basal diets, management and measurements as in Exp. 1.

Experiment 3 : This experiment had a 2×3 factorial design with treatments at dietary 0 or 0.50% Tau and supplemental Met at 0/0 (low level), 0.18/0.08 (medium level), or 0.36/0.16% (high level) in starter/finisher diets. 576 commercial broilers were randomly allotted to 24 pens for 6 weeks, and each treatment contained 4 pens. Each pen (4 m^2) contained 24 chicks. The environmental temperature was 23.3-26.2°C. All chicks were immunized nasally with a living virus vaccine of NDV on day 4 and injected intramuscularly with an inactivated NDV vaccine (Kimber strain) on day 14. At 3 weeks after testing, two birds from each pen were selected randomly for bleeding via the wing veins to measure serum free amino acids. Basal diets, management and other measurements were as in Exp. 1.

Measurements

Mortality was recorded throughout the experimental period. Blood samples were coagulated at 4°C overnight, then centrifuged at 2,000×g for 15 min to obtain serum. The serum was mixed with a 1/4 volume of 10% sulphosalicylic acid (Merck, Germany) and vortexed. After incubation for

Table 1. Formula and nutrient composition of basal diets

	Exp. 1		Exp. 2		Exp. 3	
	Starter[1] (0-3 weeks)	Finisher[2] (3-6 weeks)	Starter[1] (0-3 weeks)	Finisher[2] (3-6 weeks)	Starter[1] (0-3 weeks)	Finisher[2] (3-6 weeks)
Ingredients (%)						
Corn	45.16	56.33	44.81	55.98	43.97	55.43
Soybean meal, 44%	43.35	34.46	43.35	34.46	43.78	34.75
Soybean oil	7.05	5.27	7.05	5.27	7.54	5.71
Taurine or corn starch[3]	0.40	0.40	0.75	0.75	0.50	0.50
DL-methionine or corn starch[4]	0.20	0.09	0.20	0.09	0.36	0.16
Choline-chloride, 60%	0.05	0.05	0.05	0.05	0.05	0.05
Dicalcium phosphate	1.58	1.13	1.58	1.13	1.59	1.13
Limestone, pulverized	1.36	1.42	1.36	1.42	1.36	1.42
Salt	0.40	0.40	0.40	0.40	0.40	0.40
Vitamin premix[5]	0.10	0.10	0.10	0.10	0.10	0.10
Trace mineral premix[6]	0.10	0.10	0.10	0.10	0.10	0.10
Coccidostat and antibiotic premix[7]	0.25	0.25	0.25	0.25	0.25	0.25
Analyzed nutrient composition						
Methionine (%)	0.48	0.37	0.50	0.40	0.52	0.42
Cystine (%)	0.39	0.34	0.42	0.41	0.52	0.43
Taurine (%)	1.30	1.10	1.10	1.06	1.17	1.01

[1] Formulated to 3,200 kcal ME/kg, 23.00% CP, 0.90% SAA, 1.29% Lys, 1.00% Ca and 0.45% nonphytate P.

[2] Formulated to 3,200 kcal ME/kg, 20.00% CP, 0.72% SAA, 1.08% Lys, 0.90% Ca and 0.35% nonphytate P.

[3] Tau substituted for corn starch. Tau levels were 0, 0.10, 0.20, 0.30 or 0.40% in Exp. 1, 0, 0.25, 0.50 or 0.75% in Exp. 2, and 0 or 0.50% in Exp. 3, respectively.

[4] DL-Met substituted for corn starch in Exp. 3. Met levels were 0, 0.18 or 0.36% in starter and 0, 0.08 or 0.16% in finisher, respectively.

[5] Premix provided per kg of complete diet: vitamin A, 8,000 IU; vitamin D_3, 2,000 IU; vitamin E, 10 IU; vitamin K_3, 2 mg; vitamin B_2, 1.5 mg; vitamin B_6, 3.0 mg; pantothenic acid, 15 mg; niacin, 30 mg; vitamin B_{12}, 7 µg and Folic acid, 900 µg.

[6] Premix provided per kg of complete diet: Cu, 10 mg; Zn, 45 mg; Fe, 80 mg; Mn, 55 mg; Se, 0.1 mg and I, 0.3 mg.

[7] Premix provided per kg of complete diet: Maduramycin ammonium, 5 mg and aureomycin, 44 mg.

30 min and centrifugation, supernatant was collected for free amino acid analysis using an automatic analyzer (Beckman 6300, Beckman Instruments, Inc., USA). Concentrations of serum triglycerides, total cholesterol, HDL cholesterol and urea nitrogen were analyzed using an automated clinical chemistry analyzer (Cobas Mira Plus, Roche Diagnostic Systems, Inc., Switzerland). Serum anti-NDV titer was assayed using the haemoagglutination inhibition method (Alexander, 1998).

Statistical analysis

Experimental data were analyzed using the SAS (1999) statistical program. The general linear model was used to analyze variance, and Duncan's new multiple range test was applied to compare the differences between treatments. $p<0.05$ represents the significant differences between treatments.

RESULTS

Experiment 1

Table 2 lists the growth performance results. The dietary treatments did not influence daily gain and mortality. Feed consumption was not reduced significantly by Tau supplements until the addition of Tau at 0.30 and 0.40% during 0 to 3 weeks and 0 to 6 weeks ($p<0.05$), and feed conversion improved during 0 to 3 weeks. Serum constituents and anti-NDV titers did not differ significantly between treatments (data not shown).

Experiment 2

Table 3 lists the results of growth performance. Taurine supplements significantly improved ($p<0.05$) feed conversion of broilers during 0 to 3 weeks, although different treatments displayed no significant differences in

Table 2. Effect of taurine supplement on growth performance of broiler (Exp. 1)

	Taurine supplement (%)					Pooled
	0	0.10	0.20	0.30	0.40	SEM
Initial weight (g)	52.1	52.4	51.1	52.3	51.6	0.51
Final weight (g)	2,633.0	2,532.0	2,463.7	2,435.4	2,485.3	62.24
Daily gain (g/day)						
0-3 wk	43.9	43.7	43.9	43.1	42.3	0.65
3-6 wk	79.0	74.4	71.0	70.4	73.6	3.05
0-6 wk	61.5	59.0	57.4	56.7	58.0	1.48
Feed consumption (g/day)						
0-3 wk	55.0^{a}	51.7^{ab}	51.6^{ab}	49.2^{bc}	46.3^{c}	1.42
3-6 wk	154.9	148.2	143.4	140.2	135.2	4.17
0-6 wk	95.0^{a}	90.3^{ab}	88.3^{b}	85.6^{bc}	81.8^{c}	1.78
Feed/gain						
0-3 wk	1.25^{a}	1.18^{ab}	1.18^{ab}	1.14^{b}	1.09^{b}	0.03
3-6 wk	1.96	1.99	2.03	2.01	1.84	0.09
0-6 wk	1.55	1.53	1.54	1.51	1.41	0.05
Mortality (%)	4.76	6.35	3.25	3.25	3.25	1.90

$^{a, b, c}$ Means within the same row without bearing the same superscripts differ significantly ($p<0.05$).

Table 3. Effect of taurine supplement on growth performance of broilers (Exp. 2)

	Taurine supplement (%)				Pooled
	0	0.25	0.50	0.75	SEM
Initial weight (g)	54.0	54.1	53.7	54.1	0.42
Final weight (g)	2,408.0	2,442.9	2,440.5	2,360.2	33.63
Daily gain (g/day)					
0-3 wk	39.2	39.2	39.3	38.4	0.73
3-6 wk	72.9	74.5	74.4	71.4	1.65
0-6 wk	56.1	56.9	56.8	54.9	0.80
Feed consumption (g/day)					
0-3 wk	55.8	54.6	54.9	53.2	0.77
3-6 wk	145.0	147.3	144.0	142.8	2.50
0-6 wk	100.4	100.9	99.5	98.0	1.33
Feed/gain					
0–3 wk	1.43^{a}	1.39^{b}	1.40^{b}	1.38^{b}	0.01
3-6 wk	1.99	1.98	1.94	2.00	0.06
0-6 wk	1.79	1.78	1.75	1.78	0.04
Mortality (%)	2.86	2.86	3.04	2.08	0.97

$^{a, b}$ Means within the same row without bearing the same superscripts differ significantly ($p<0.05$).

daily gain or feed consumption. Dietary Tau supplements did not influence mortality. Figure 1 illustrates serum constituents of broilers. Serum total cholesterol was significantly lower ($p<0.05$) in the broilers receiving 0.75% Tau compared with the other groups; however, serum triglycerides, HDL cholesterol or urea nitrogen was not affected by treatment. The broilers in the 0.25% Tau treatment group had higher anti-NDV titer ($p<0.10$) compared to those in the 0.75% Tau group following 6 weeks of feeding.

Experiment 3

Table 4 lists the growth performance results. Dietary supplements of Met significantly increased daily gain and feed conversion during 0 to 3 weeks. The broilers receiving medium Met levels displayed heavier final weight ($p<0.07$). Although the addition of dietary Tau did not significantly

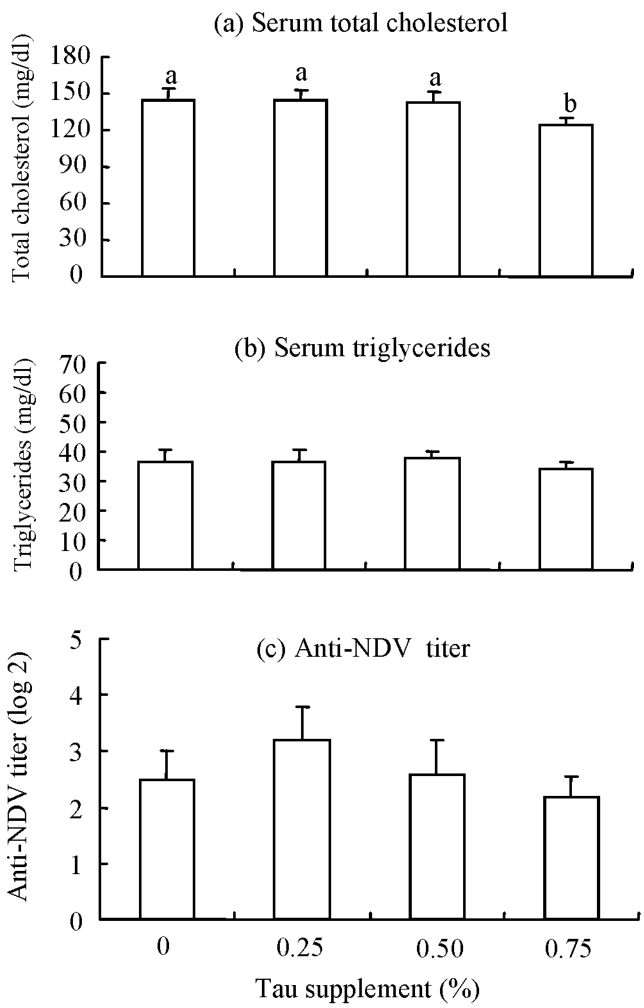

Figure 1. Effect of supplemental taurine on the levels of serum total cholesterol (a), triglycerides (b) and anti-NDV titer (c) at 6 weeks old broilers. The values are mean±SE. [a, b] Means without bearing the same superscripts differ significantly ($p<0.05$) (Exp. 2).

influence growth performance, significant interactions existed between supplements of Met and Tau on daily gain ($p<0.01$) and feed consumption ($p<0.05$). The addition of Tau tended to increase daily gain throughout the experimental period and also improved feed conversion during 0 to 3 weeks for low Met level diet.

Table 5 lists serum free amino acid concentrations of the broilers after 3 weeks of feeding. Serum Met concentration increased with increasing dietary Met supplements; nevertheless, most serum amino acids including threonine, serine, valine, lysine and histidine declined with increasing dietary Met supplements. Taurine supplementation only increased serum Tau level. Notably, Tau addition did not elevate serum Met concentration. On the other hand, dietary Met supplements tended to increase serum Tau levels. Serum cysteine concentration did not different significantly among treatments.

Figure 2 illustrates the serum constituents of the broilers. The broilers receiving 0.50% Tau displayed normalized serum triglycerides level when receiving the low Met diet. Moreover, the broilers receiving Tau supplementation displayed higher anti-NDV titers ($p<0.09$) than the control group. Dietary supplements of Met and Tau did not influence the serum total cholesterol and HDL cholesterol concentration of the broilers.

DISCUSSION

The current study showed that dietary Tau supplements affected the growth performance of broilers due to interactions with the Met level in the basal diet. Tufft and Jensen (1992) demonstrated that male broiler chickens supplemented with 0.8% Tau achieved improved feed conversion during the first week only in one of two experiments, while daily gain was unaffected. Unfortunately, the dietary Tau content was not listed in this study. Anderson et al. (1975) found that Tau addition enhanced the growth performance of chicks fed a purified diet deficient in sulfur amino acids. It is reasonable to speculate that the effect of Tau on growth performance may depend on dietary sulfur amino acid levels. Experiment 3 observed the interactions between Met and Tau on growth performance, and found Tau to exert a significant sparing effect on sulfur amino acids requirement of broilers receiving corn-soybean basal diets. Nevertheless, in Exp. 1 and 2, the positive effects of Tau supplementation on growth performance may result from the lower sulfur amino acid levels in the basal diets. The serum free amino acids data showed that Tau concentration was correlated with the dietary Tau supplement. This finding is consistent with previous observations in both cats and humans (Vinton et al., 1986; Laidlaw et al., 1987). Dietary Tau supplementation increased serum Tau level also support the hypothesis that

Table 4. Effect of supplemental methionine and taurine on growth performance of broilers (Exp. 3)

Item Met	Tau	Initial weight (g)	Final weight (g)	Daily gain (g) 0-3 wk	3-6 wk	0-6 wk	Feed consumption (g) 0-3 wk	3-6 wk	0-6 wk	Feed/gain 0-3 wk	3-6 wk	0-6 wk
L	0	56.2	2,048.1	36.5	58.3	47.4	53.7	122.6	88.2	1.47	2.12	1.86
L	0.50	56.6	2,164.3	38.5	61.6	50.2	54.3	131.9	93.1	1.41	2.18	1.86
M	0	56.3	2,366.3	42.0	67.9	55.0	56.6	140.2	98.4	1.35	2.09	1.79
M	0.50	56.4	2,062.6	39.0	56.5	47.8	52.8	126.8	89.8	1.36	2.30	1.89
H	0	56.1	2,182.4	41.9	59.1	50.6	56.0	129.0	92.5	1.34	2.20	1.83
H	0.50	56.8	2,222.4	40.8	62.3	51.6	55.4	132.0	93.7	1.36	2.14	1.82
SEM		0.39	46.78	0.75	2.1	1.11	0.95	3.77	2.24	0.01	0.08	0.03
Met effects												
L		56.4	2,106.2	34.5[a]	60.0	48.8	54.0	127.3	90.6	1.44[a]	2.15	1.86
M		56.4	2,214.4	40.5[b]	62.2	51.4	54.7	133.5	94.1	1.35[b]	2.19	1.84
H		55.9	2,202.4	41.4[b]	60.7	51.1	55.7	130.5	93.1	1.35[b]	2.17	1.82
SEM		0.27	33.07	0.53	1.51	0.79	0.67	2.67	1.59	0.01	0.05	0.02
Tau effects												
0		56.2	2,198.9	40.1	61.8	51.0	55.4	130.6	93.0	1.39	2.13	1.83
0.50		56.3	2,149.8	39.4	60.1	49.9	54.1	130.2	92.2	1.37	2.21	1.86
SEM		0.22	27.01	0.44	1.23	0.64	0.55	2.18	1.30	0.01	0.04	0.02
Source of variation (probabilities)												
Met		NS	p<0.07	p<0.01	NS	p<0.07	NS	NS	NS	p<0.01	NS	NS
Tau		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Met×Tau		NS	p<0.01	p<0.05	p<0.01	p<0.01	p<0.08	p<0.05	p<0.05	p<0.01	NS	NS

[a, b] Means within the same column without bearing the same superscripts differ significantly (p<0.01).

Table 5. Effect of supplemental methionine and taurine on the levels of serum amino acids constituents of 3 week old broilers (Exp. 3)

Item Met	Tau	Tau	Met	Cys	Thr	Ser	Val	Ile	Leu	Tyr	Phe	Trp	Lys	His	Arg	Urea
		(μmol/L)														
L	0	299.2	23.2	38.8	827.0	588.1	170.4	86.4	161.9	134.4	97.9	47.1	598.0	79.3	262.4	594.3
L	0.50	949.1	27.6	33.3	694.0	509.9	140.8	74.5	151.0	130.9	81.4	43.4	440.9	71.1	232.0	498.4
M	0	357.6	35.1	40.3	301.5	289.1	119.5	64.8	128.0	114.4	74.0	39.9	242.0	52.7	243.2	1046.0
M	0.50	910.7	36.4	39.0	386.9	374.5	126.5	65.6	129.3	143.9	81.4	46.8	277.8	57.2	214.9	535.1
H	0	288.8	80.4	41.6	360.8	314.5	139.8	74.4	146.1	124.9	84.4	46.9	247.0	64.2	250.8	776.6
H	0.50	1,049.7	56.7	38.9	353.8	328.8	114.3	75.5	153.4	125.0	87.0	43.8	280.3	62.2	222.6	791.8
SEM		44.53	6.37	2.49	44.43	27.06	12.19	5.67	9.15	9.82	4.42	2.56	30.67	3.89	19.02	111.7
Met effects																
L		624.1	25.4[a]	33.6	760.5[a]	549.0[a]	155.6[a]	80.4[a]	156.4[a]	132.7	89.7[a]	45.2	519.5[a]	75.2[a]	247.2	546.3
M		634.1	35.8[a]	39.6	344.2[b]	331.8[b]	123.0[b]	65.2[b]	128.6[b]	129.2	77.7[b]	43.3	259.9[b]	54.9[b]	229.1	790.6
H		669.2	68.4[b]	40.3	357.3[b]	321.6[b]	127.0[b]	75.0[ab]	149.7[a]	125.0	85.7[ab]	45.3	263.6[b]	63.2[c]	236.7	784.2
SEM		31.5	4.50	1.76	31.42	19.13	8.62	4.01	6.47	6.94	3.12	1.81	21.69	2.75	13.45	78.99
Tau effects																
0		315.2[a]	46.2	40.2	496.5	397.2	143.2	75.2	145.3	124.6	85.4	44.6	362.3	65.4	252.1	805.6[a]
0.50		969.8[b]	40.1	37.1	478.2	404.4	127.2	71.9	144.6	133.3	83.3	44.7	333.0	63.5	223.1	608.4[b]
SEM		25.7	3.68	1.43	25.65	15.62	7.04	3.27	5.28	5.67	2.55	1.48	17.71	2.25	10.98	64.49
Source of variation (probabilities)																
Met		NS	p<0.01	NS	p<0.01	p<0.01	p<0.05	p<0.05	p<0.05	NS	p<0.05	NS	p<0.01	p<0.01	NS	p<0.10
Tau		p<0.01	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	p<0.10	p<0.05
Met×Tau		p<0.10	p<0.10	NS	NS	p<0.05	NS	NS	NS	NS	p<0.05	p<0.10	p<0.05	NS	NS	p<0.10

[a, b, c] Means within the same column without bearing the same superscripts differ significantly (p<0.05).

Tau intake may be insufficient to maintain normal serum Tau level in broiler only receiving corn-soybean basal diet. Serum Tau level tends to increase (p<0.10) with high dietary Met supplementation. This result resembles that of other chick and mammal experiments that is excess dietary Met converts into Tau (Hosokawa et al., 1988; Ohta and Ishibashi, 1997; Lu et al., 2003). As expected, Tau supplementation did not influence the serum Met and cysteine concentrations of the broilers.

Dietary supplementation 0.75% Tau caused reduced

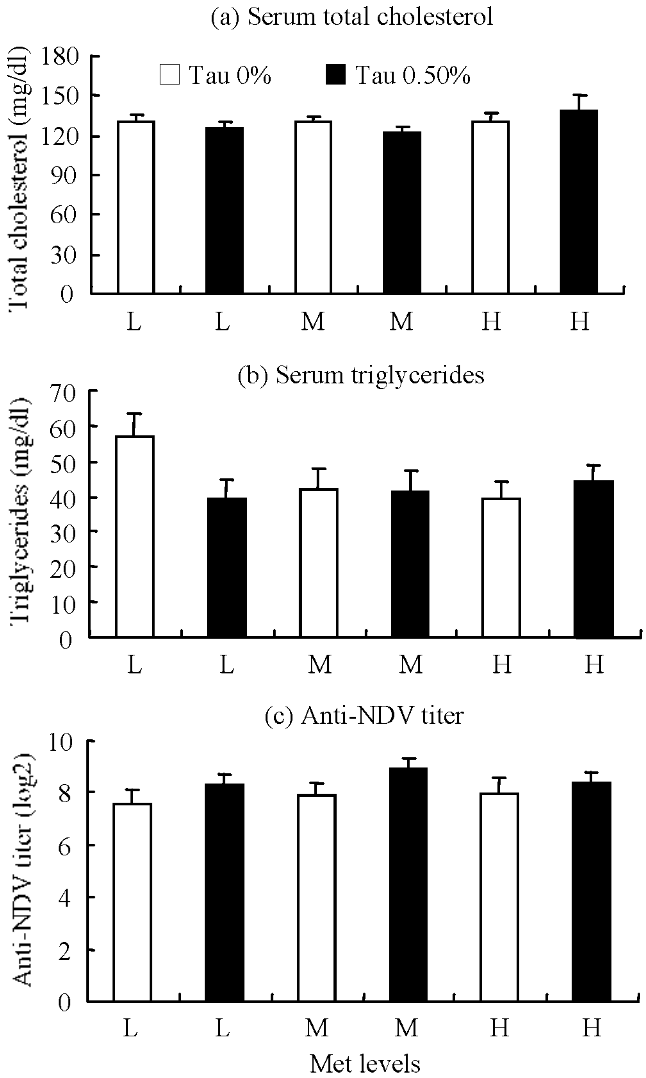

Figure 2. Effect of supplemental methionine and taurine on the levels of serum total cholesterol (a), triglycerides (b), and anti-NDV titer (c) of 6 weeks old broilers. The values are mean±SE. (Exp. 3).

serum total cholesterol in Exp. 2, while Exp. 3 revealed that the 0.50% Tau supplements normalized serum triglycerides. Numerous investigations have demonstrated the actual effects of dietary Tau on the lipid metabolism of rats and mice. For example, Tau has hypocholesterolemic and hypotriglyceridemic actions in rodents receiving high-cholesterol diets (Park et al., 1998; Yokogoshi et al., 1999). Recently, Tau has received considerable attention related to its important physiological role linking heart operation and blood pressure, while no attempt has been made to differentiate between Tau supplementation and the incidence of sudden death syndrome (Campbell and Classen, 1989; Blair et al., 1991; Jacob et al., 1991).

Of the three experiments, only Exp. 3 showed that dietary Tau supplements tended to enhance the anti-NDV titer. Previous investigation has demonstrated that the addition of 0.6% Tau significantly enhanced the antibody titers of NDV and *Pasteurella anatipestifer* in broilers (Lacetera et al., 1992). However, dietary Tau supplements did not change apparent resistance to E. coli exposure in either selection for high or low SRBC antibody response line of white Leghorn chicks (Dunnington et al., 1996). Recently, Tau has been demonstrated to significantly influence immunoregulatory properties (Redmond et al., 1998). The positive regulatory effects of dietary Tau on immunity may depend on sulfur amino acid contents in basal diets and on the genetic merit of animals. This hypothesis requires further testing.

In conclusion, the present findings clearly showed that diets supplemented with Tau improve feed utilization for young broilers, and this effect results partly from interactions with sulfur amino acids. Tauine supplements can normalize serum total cholesterol and triglycerides, but their beneficial effects on anti-NDV antibody production require further study. This study provides further evidence that Tau is important in diet formulation.

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