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Taurine Enrichment of Eggs with Feather Meal and Pyridoxine

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ABSTRACT : The effects of dietary supplementation of feather meal (FM) and pyridoxine (B_6) on the taurine content of egg yolk and performance of laying hens were investigated. A feeding trial was conducted in nine hundred 31-wk-old *Hy-Line*® Brown layers over 4 wk. The hens received 6 dietary treatments: Control, FM 3% supplemented diet (FM 3%), FM 3%+B_6 supplemented diet (FM 3%+B_6), FM 6% supplemented diet (FM 6%), FM 6%+B_6 supplemented diet (FM 6%+B_6), and synthetic taurine 0.25% supplemented diet (Taurine). Parameters of production were significantly ($p<0.05$) affected by treatments. The egg production of hens fed FM 3% was the highest and hens fed FM diets were more productive than the Taurine and Control groups. The egg weights of the Taurine group were significantly lower than those of the FM 3% and FM 6% groups, but not significantly different from those of other treatments. The feed intake of the Control group was highest among all groups. The feed conversion ratio of the Control group was higher than in groups receiving other treatments of which FM 6% was the lowest. The broken egg production of the Taurine group was highest, while that of the Control group was lowest among treatments. The taurine content of egg yolk was significantly ($p<0.01$) increased by supplementation of taurine (64.7%), FM 6%+B_6 (57%), FM 3%+B_6 (32.1%), and FM 6% (16.6%) over a 4 wk average. Sensory evaluation data of the Taurine group showed the highest score in all of the sensory attributes and those of other treatments were not significantly ($p<0.05$) different. In conclusion, taurine can be enriched in egg yolk by supplementation of 6% FM and B_6, as well as 0.25% synthetic taurine. (**Key Words :** Taurine, Feather meal, Pyridoxine, Egg Yolk)

INTRODUCTION

Taurine (β-aminoethylsulfonic acid; HO-SO_2-CH_2-CH_2-NH_2, molecular weight 125.14 g/mole) is the end product generated by the metabolic process of amino acids such as Met and cysteine (Cys), and exists as a free form in body tissues. Taurine is not used for protein synthesis or as an energy source. Taurine is not present in bacteria (Nakashio et al., 1982) and plants (Lahdesmaki, 1986), but exists at a high concentration in animals, algae (Ericson and Carlson, 1954), insects (Meyer et al., 1980), and mollusks (Von Wachtendonk and Kappler, 1977). The most well-known effect of taurine is that it forms taurocholic acid, one of the major bile acids, which improves micelle formation and lipid absorption in the intestinal tract (Gaull, 1983). It is reported that an adequate amount of taurine stimulates the emission of growth hormones that are directly involved in the growth of animals (Ikuyama et al., 1988), as well as the emission of prolactin, which has effects similar to those of growth hormones (Scheibel et al., 1980), and enhances the vitality of insulin by playing the role of an agonist to insulin receptors (Lampson et al., 1983; Maturo and Kulakowski, 1988). In addition, taurine is also known to have a variety of physiological functions including brain development (Chesney, 1985; Huxtable, 1992), osmoregulation (Chan and Fishman, 1979), protection of cell membranes from oxidation or peroxidation products (Li et al., 1993; Trachtman et al., 1993), protection of cell membranes from damage by exogenous toxic substances (Waterfield et al., 1993; Ding et al., 1993), neuromodulation (Arzate et al., 1986), activation of reproductive function (Alvarez and Storey, 1983), serum cholesterol reduction (Yokogoshi et al., 1999), and serum glucose reduction (Nakaya et al., 2000). However, as the activities of cysteine dioxygenase (CD) and cysteine sulfinic acid decarboxylase (CSAD), which are enzymes involved in taurine synthesis, are too low to trigger taurine biosynthesis in the human body (Rigo and Senterre, 1977; Sturman and Hayes, 1980), taurine must be supplied by outside sources. Decreases of serum taurine levels and abnormal electroretinograms were reported in infants ingesting milk replacers with no supplemental

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taurine (Rassin et al., 1983) or receiving long-term total parenteral nutrition (Vinton et al., 1987). It is also well known that retinal degeneration occurs in cats fed diets low in or devoid of taurine (Hayes et al., 1975).

It is expected that the production of taurine-enriched eggs will be facilitated by feed supplementation with ingredients rich in Cys, thereby supplying a precursor of taurine. Feather meal (FM) has 4.34% Cys (NRC, 1994), which is the richest Cys source among the commonly used feed ingredients. Despite feather generation increasing yearly in proportion to the increase of poultry meat consumption, the use of FM in feed formulation is limited. Although FM contains 85% or more CP, its digestibility is low (Moran et al., 1966a, b; Morris and Balloun, 1973) due to its keratinous nature (Schor and Krimm, 1961a, b) and disulfide bonds (Harrap and Woods, 1964a, b). In the meantime, pyridoxal-5-phosphate (vitamin B_6 or pyridoxin) is needed as a coenzyme for the activities of various enzymes, such as CD and CSAD, necessary for the conversion of Cys into taurine. Therefore, the present study was conducted to examine the effects of dietary supplementation of FM as a source of Cys, a precursor of taurine, and pyridoxin as a coenzyme on egg production and taurine content in egg yolk.

MATERIALS AND METHODS

Experimental animals, diets, and design

The experiment was conducted over 4 wk with nine hundred 31-wk-old *Hy-Line*® Brown layers. Hens were housed in A-shaped two-tier cages and randomly assigned to six dietary treatments. Each treatment consisted of 5 replications of 30 birds in 15 two-bird cages (30 cm×38 cm) totaling 150 hens. The composition and nutrient content of the experimental diets are shown in Table 1. The experimental diets were prepared to be iso-caloric. The Control (basal) diet was prepared to contain 2,800 kcal ME/kg, 18.5% CP and 3.85% Ca. The six dietary treatments were Control (basal diet), FM 3% (basal diet+3% supplementary FM), FM 3%+B_6 (FM 3%+pyridoxine), FM 6% (basal diet+6% supplementary FM), FM 6%+B_6 (FM 6%+pyridoxine), and Taurine (basal diet+0.25% synthetic taurine; SIGMA®, Japan). Pyridoxine was supplemented at the level of 21 mg/kg, which is 10 times greater than the NRC requirement (1994). Feather meal was obtained from Harim Co. Ltd. (Korea), which produces it by steam cooking. The assayed values of FM by the producer were 2,800 kcal ME/kg, 97.6% DM, 71.0% CP, 16.8% crude fat, 6.1% crude ash, and 0.2% crude fiber. Mash form feed and water were presented *ad libitum* and 16 L:8 D of lighting system was provided during the experimental period.

Sampling and chemical analysis

Egg production (hen-housed), egg weight, and soft and broken egg production were measured every day, while feed intake and feed conversion ratios (FCR; feed, g/100 g egg mass) were measured weekly. At the end of each week, 125 eggs per treatment (25 median-wt eggs×5 replications) were collected. Eggs were cracked and the egg white and yolk were separated. Because egg white does not contain taurine, it was discarded and the yolks of 25 eggs from each replication were pooled and homogenized. Thirty pooled egg yolk samples (5 pooled samples×6 treatments) were made each wk, freeze dried, and stored at -50°C until analysis.

Taurine analysis

Taurine analysis was conducted in accordance with the method used by Zunin and Evangelisti (1999). Frozen pooled yolk samples were thawed and mixed with 0.4M perchloric acid in a ratio of 1:5. The resulting mixture was centrifuged at 18,000 g and 4°C for 20 min to collect the supernatant. This process was repeated twice. The supernatant 2 ml was passed through an anion-exchange-column (AG50W-X8, 200-400 mesh, H^+ form, 5×15 mm, Bio-Rad Laboratories, USA), and then washed with 1 ml distilled water 3 times to produce 5 ml extract in total. Out of this extract, 0.1 ml was reacted with an O-phthalaldehyde derivation reagent for 5 min. The OPA derivation and reagent storage were conducted according to the method of Pittaluga et al. (1997). The HPLC system used in the analysis is as follows: HPLC Model 305 system (Gilson, France), fluorometer Model 121 (Gilson, France), Merck LichroCART column (Superspher 100 RP-18 end-capped, 125×4 mm ID) combined with a Merck LichroCART pre-column (Lichrospher 100 RP-18, 4×4 mm ID). Because taurine was not detected in egg white, results were expressed in μg/egg yolk, DM.

Sensory test

The sensory test was conducted once a wk with 30 eggs per treatment. Egg samples were boiled for 20 min, and then cooled under running tap water. After peeling off the shell, wholesome 20 boiled eggs were selected, halved and put on 20 separate dishes for the sensory evaluation test in accordance with the Hedonic Scale Acceptance Test (Stone and Daniel, 1985). Each dish was provided to each of 20 untrained sensory panel members. Evaluations of yolk color, taste, smell, texture, and overall acceptability were scaled from 1 for poor to 5 for excellent.

Statistical analysis

The data were analyzed by ANOVA using the GLM procedure of SAS (1995). Significant differences between

Table 1. Composition and nutrient content of experimental diets

Ingredients	Treatments					
	Control	FM 3%	FM 3%+B_6	FM 6%	FM 6%+B_6	Taurine
Corn	55.43	55.43	55.43	55.43	55.43	55.29
Soybean meal	19.61	19.61	19.61	19.61	19.61	19.56
Limestone	8.73	8.73	8.73	8.73	8.73	8.71
Lupin	3.28	3.28	3.28	3.28	3.28	3.27
Meat meal	3.00	3.00	3.00	3.00	3.00	2.99
Tallow	2.10	2.10	2.10	2.10	2.10	2.09
Corn gluten	1.51	1.51	1.51	1.51	1.51	1.51
Dicalcium phosphate	1.18	1.18	1.18	1.18	1.18	1.18
Wheat bran	1.00	1.00	1.00	1.00	1.00	1.00
Rice bran	1.00	1.00	1.00	1.00	1.00	1.00
Soy hull	1.00	1.00	1.00	1.00	1.00	1.00
Oyster shell	0.80	0.80	0.80	0.80	0.80	0.80
Fish meal	0.50	0.50	0.50	0.50	0.50	0.50
Salt	0.21	0.21	0.21	0.21	0.21	0.21
Vitamin premix[1]	0.21	0.21	0.21	0.21	0.21	0.21
MHA[2]	0.10	0.10	0.10	0.10	0.10	0.10
Electrolytes[3]	0.15	0.15	0.15	0.15	0.15	0.15
Mineral premix[4]	0.12	0.12	0.12	0.12	0.12	0.12
Taurine	-	-	-	-	-	0.25
Choline-Cl (60%)	0.07	0.07	0.07	0.07	0.07	0.07
Feather meal (FM;CP 71%)	-	3.00	3.00	6.00	6.00	-
Vitamin B_6[5]	-	-	+	-	+	-
Total	100.00	103.00	103.00	106.00	106.00	100.00
Compositions[6]						
ME, Poultry (Kcal/kg)	2,800	2,800	2,800	2,800	2,800	2,800
Crude protein (%)	18.50	20.03	20.03	21.47	21.47	18.50
Calcium (%)	3.85	3.75	3.75	3.65	3.65	3.85
P-available (%)	0.63	0.62	0.62	0.62	0.62	0.63
Met and cys (%)	0.68	0.80	0.80	0.92	0.92	0.68

[1] Provides per kg diet: vitamin A (retinyl acetate), 10,000 IU; vitamin D, 2,500 IU; vitamin E, (DL-α-topcopheryl acetate) 20 mg; vitamin K, 2 mg; vitamin B_1, 1.5 mg; vitamin B_2, 4 mg; vitamin B_6, 3 mg; vitamin B_{12}, 10 μg; biotin, 100 μg; niacin, 25 mg; folic acid, 0.5 mg; Ca-pan, 10 mg; antioxidant, 60 mg.
[2] Methionine hydroxy analogue (88%).
[3] Provided by Biolyte® (Dong-A SF Co. Ltd., Dangjin-kun, Chungnam, Korea) which contains 17.0% K, 18.0% Na, and 5.0% S at minimum.
[4] Provides per kg diet: Zn, 90 mg; Mn, 96 mg; Fe, 50 mg; Cu, 24 mg; I, 1.2 mg; Se, 0.36 mg.
[5] Vitamin B_6: Pyridoxine HCl was supplemented at the level of 21 mg/kg diet.
[6] Compositions were calculated by using ingredient specification of Harim Co. Ltd for FM and those of NRC (1994) for others.

treatment means were identified at $p<0.05$ or $p<0.01$ using Duncan's new multiple range test (Duncan, 1995). Treatment means of taurine content were assayed for significance; contrasts of Control vs. FM and Taurine treatments, FM treatments vs. Taurine treatment, FM 3% treatments vs. FM 6% treatments, and FM treatments vs. FM+B_6 treatments; linearity of the level of FM (0, 3, and 6%) and weekly (1 to 4 wk) change of taurine content; interaction of FM×B_6. A replication was the experimental unit.

RESULTS AND DISCUSSION

Laying performances of hens fed feather meal supplemented diets during the 4 week experimental period

Egg production, egg weight, feed intake, feed conversion ratio, and broken and soft egg production over a 4 wk experiment were significantly ($p<0.05$) affected by treatments (Table 2). Egg production was highest in the FM 3% treatment group, and the egg productions of FM supplemented treatment groups were higher than the Control group. However, there was no significant difference in egg production between Taurine treatment and the Control. The egg weights of FM 3% and FM 6% groups were significantly heavier than those of the Taurine group, which was not significantly different from those of other treatments. Feed intake was highest in the Control and

Table 2. Laying performance during the four weeks experimental period

Item	Treatments[1]						
	Control	FM 3%	FM 3%+B_6	FM 6%	FM 6%+B_6	Taurine	SEM (n = 5)
Egg production (hen-housed, %)	91.41^{c}	95.98^{a}	93.74^{ab}	94.07^{ab}	94.14^{ab}	93.55^{bc}	0.768
Egg weight (g/hen d)	65.45^{ab}	65.82^{a}	65.46^{ab}	65.68^{a}	65.46^{ab}	64.94^{b}	0.205
Feed intake (g/d)	138.84^{a}	136.77^{ab}	136.92^{ab}	132.39^{c}	135.04^{bc}	134.52^{bc}	1.206
FCR[2]	2.31^{a}	2.17^{bc}	2.23^{b}	2.14^{c}	2.19^{bc}	2.22^{b}	0.023
Broken and soft egg production (%)	0.13^{b}	0.52^{ab}	0.33^{ab}	0.23^{ab}	0.36^{ab}	0.64^{a}	0.137

$^{a-c}$ Means in a row with no common superscript differ significantly (p<0.05).
[1] Treatments: FM 3% = 3% Feather meal diet; FM 3%+B_6 = FM 3%+pyridoxine (21 mg/kg); FM 6% = 6% Feather meal diet; FM 6%+B_6 = FM 6%+pyridoxine (21 mg/kg); Taurine = 0.25% Synthetic taurine supplemented diet.
[2] Feed conversion ratio, g feed/100 g egg mass.

lowest in FM 6% treatment groups. Feather meal 6% groups (FM 6% and FM 6%+B_6) tended to have lower feed intake than FM 3% groups (FM 3% and FM 3%+B_6). Feed conversion ratio was highest in the Control and lowest in Taurine groups. Feather meal 3% groups (FM 3% and FM 3%+B_6) tended to show a higher FCR than FM 6% groups (FM 6% and FM 6%+B_6). Broken and soft egg production ratio was highest in the Taurine treatment group and lowest in the Control group, but there were no significant differences among FM treatments. It is well known that FM contains a high amount of CP, but its digestibility is low (Smith, 1968). Feather meal can be used in poultry diets if limiting amino acids such as, Met, Lys, Try, and His are properly supplemented (Gerry and Smith, 1954; Naber et al., 1961; Moran et al., 1966a, b). Compared to the composition of NRC (1994), the present experimental FM had higher energy (2,800 vs. 2,360 kcal ME/kg) and ether extract (16.8 vs. 8.0%) and lower CP (71.0 vs. 81.0%). The increment of CP in the diet by FM supplementation compared to the Control diet may have increased egg production. Generally, increase of egg production accompanies lower egg weight. The low egg weights observed after taurine treatment are in agreement with the results of a study by Yamazaki and Takemasa (1998) who reported that supplementation of taurine at the level of 0.25% and 0.5% in the diet decreased egg weight but egg production was not significantly affected. The low feed intake in high FM treatments may be related to the low palatability of FM. Feed conversion ratio was also significantly improved in the FM and taurine treatment groups probably due to extra CP or amino acid supplementation.

Taurine content in egg yolk

Weekly data of taurine content in egg yolks from hens fed experimental diets are shown in Table 3. There were significant (p<0.01) differences in weekly taurine contents in egg yolk from hens fed treated diets for 4 wk. The overall mean (4 wk) taurine content was highest in the Taurine group (59.6 g/g egg yolk, DM) followed by FM 6%+B_6 (56.8 μg), FM 3%+B_6 (47.8 μg), FM 6% (42.2 μg), FM 3% (36.5 μg), and the Control (36.2 μg) groups. The increases of taurine content in yolks from hens fed treated diets were 64.6%, 56.9%, 32.0%, 16.6%, and 0.8% over the Control group. Supplementation of FM 3% and FM 6% alone

Table 3. Effects of dietary feather meal on taurine content in egg yolk

Wks	Treatments[1]						
	Control	FM 3%	FM 3%+B_6	FM 6%	FM 6%+B_6	Taurine	SEM (n = 5)
	μg taurine/g egg yolk (DM)						
1*	37.2^{C}	37.9^{C}	47.3^{B}	40.7^{C}	58.4^{A}	58.6^{A}	1.10
2	35.2^{C}	36.5^{C}	47.9^{B}	43.2^{BC}	58.0^{A}	59.1^{A}	2.10
3	36.4^{D}	35.4^{D}	49.3^{BC}	41.7^{CD}	55.2^{AB}	60.1^{A}	1.82
4	36.0^{C}	36.2^{C}	46.7^{B}	43.2^{B}	55.7^{A}	60.7^{A}	1.42
Overall mean**	36.2^{D}	36.5^{D}	47.8^{B}	42.2^{C}	56.8^{A}	59.6^{A}	0.79

$^{A-D}$ Means in a row with no common superscript differ significantly (p<0.01).
[1] Treatments: FM 3% = 3% Feather meal diet; FM 3%+B_6 = FM 3%+pyridoxine (21 mg/kg); FM 6% = 6% Feather meal diet; FM 6%+B_6 = FM 6%+pyridoxine (21 mg/kg); Taurine = 0.25% Synthetic taurine supplemented diet.
* Linearity of overall means: Control, FM 3% and FM 6%; p<0.001, Control, FM 3%+B_6 and FM 6%+B_6; p<0.001.
** Orthogonal contrast of overall means: Control vs. FM 3%, FM 3%+B_6, FM 6%, FM 6%+B_6, and Taurine; p<0.001.
FM 3% and FM 6% vs. FM 3%+B_6 and FM 6%+B_6; p<0.001., FM 3% and FM 3%+B_6 vs. FM 6% and FM 6%+B_6; p<0.001.
*, ** Interaction of FM and B_6: 1st wk; p = 0.007, overall means; p = 0.048.

(without B_6) did not linearly increase taurine content in the first week. But FM 3% and 6% along with B_6, which was administered at 10 times the NRC recommendation (1994) as a coenzyme increased taurine content linearly from the first wk.

Increment of supplementary FM level (0, 3, and 6%) and B_6 supplementation significantly increased taurine content in the egg yolks from hens fed experimental diets. Efficient taurine enrichment by administration of FM in broilers (Lee et al., 2004), pork (Seo et al., 2009), and milk (Bae et al., 2005) has been also previously reported. Taurine is synthesized from Cys in the liver of chicken by CSDA (Jacobsen and Smith, 1968). However, taurine content in egg yolk was very low compared to that of broiler meat, 778 μg/g leg muscle, fresh matter (Lee et al., 2004), indicating that the efficiency of taurine transfer from chicken body to egg yolk is very low. Low taurine content in egg yolk compared to other animal products was also reported by Spitze et al. (2003). The taurine content in the egg yolks of FM 6%+B_6 treatment groups was not significantly different from that in the egg yolks of the Taurine treatment group. Feather meal contains 4.34% Cys and 0.57% Met (NRC, 1994). Thus, FM 6% provides approximately 0.29% Met+Cys. Taurine treatment supplemented 0.25% synthetic taurine. Considering the similar response in egg yolk (56.8 μg for FM 6%+B_6 treatment vs. 59.6 μg taurine/g egg yolk for Taurine treatment), the amount of taurine biosynthesized in laying hens of FM 6%+B_6 treatment must be quite similar to that of supplemented taurine (0.25% of diet) of Taurine treatment. Taurine in tissues is biosynthesized via the trans-sulfuration pathway and is a derivative of sulfur-containing amino acids. The major pathway is Cys oxidization into cysteine sulfinic acid, decarbonization into hypotaurine, and finally oxidization into taurine. Here, CSAD is an important enzyme, which relies greatly on the coenzyme, vitamin B_6 together with cystathionine synthase, cystathionase, and CD which are important for sulfur-containing amino acid metabolism. This synthetic system is the major pathway in the liver and brain of many animals. However, it is not developed in premature babies and new-born babies. CD and CSAD, the key enzymes for taurine biosynthesis differ in the ability of taurine biosynthesis according to body tissues or animal species. As CSAD production, in particular, is extremely low in monkeys, humans, and cats compared to rats or dogs, it is reported that taurine biosynthetic abilities in these animals are very restricted (Worden and Stipanuk, 1985; Chapman and Greenwood, 1988). Therefore, taurine enriched animal products will be beneficial to human beings. When combining the above findings, although the taurine content of egg yolk is very low compared to that of chicken meat, it can be increased up to 56.9% ((56.8-36.2)/36.2×100) by supplementing 6% FM along with vitamin B_6. A linear increase in taurine content by increasing FM level (0, 3, and 6%) was observed at the 1st wk when B_6 was supplemented together, but at the 2nd wk when FM was supplemented alone. Because there were no significant linear increase of taurine content as the feeding period (wk of age) increased, FM supplemented diet may need to be fed for 1 wk along with B_6 or 2 wk without B_6 to produce taurine enriched eggs in practice. There were significant interactions between FM and B_6 treatment in the 1^{st} wk (p = 0.007) and 4 wk overall means (p = 0.048). Supplementation of B_6 increased taurine content by 24.8% (1^{st} wk) and 30.1% (overall mean) in FM 3% diet, and 43.5% (1^{st} wk) and 34.6% (overall mean) in FM 6% diet. This interaction indicates that the effect of B_6 supplementation was greater at the high FM (6%) treatment than the low FM (3%) treatment.

Sensory evaluation

The results of sensory testing are as shown in Table 4 and Figure 1 (radar chart). All 5 palatability items, yolk color, taste, smell, texture, and overall quality were significantly ($p<0.05$) different among treatments. Eggs produced by hens administered the taurine treatment were superior to others in all items. Other treatments did not yield significantly different yolk color, taste, smell, and

Table 4. Sensory evaluation[1] of eggs from layers fed experimental diets for 28

Item	Treatments[1]						
	Control	FM 3%	FM 3%+B_6	FM 6%	FM 6%+B_6	Taurine	SEM (n = 20)
Yolk color	2.76^b	2.99^{ab}	2.83^{ab}	2.93^{ab}	3.00^{ab}	3.20^a	0.128
Taste	2.80^b	2.91^b	2.83^b	2.76^b	2.80^b	3.45^a	0.106
Smell	2.70^b	2.73^b	2.83^b	2.75^b	2.70^b	3.06^a	0.077
Texture	3.05^b	3.06^b	2.58^c	2.73^c	2.78^{bc}	3.46^a	0.099
Overall quality	2.83^b	2.90^b	2.76^b	3.00^b	2.86^b	3.43^a	0.115

[a-c] Means with no common superscript differ significantly ($p<0.05$).

[1] Scale from 1 (poor) to 5 (excellent).

[2] Treatments: FM 3% = 3% Feather meal diet; FM 3%+B_6 = FM 3%+pyridoxine (21 mg/kg); FM 6% = 6% Feather meal diet; FM 6%+ B_6 = FM 6%+pyridoxine (21 mg/kg); Taurine = 0.25% Synthetic taurine supplemented diet.

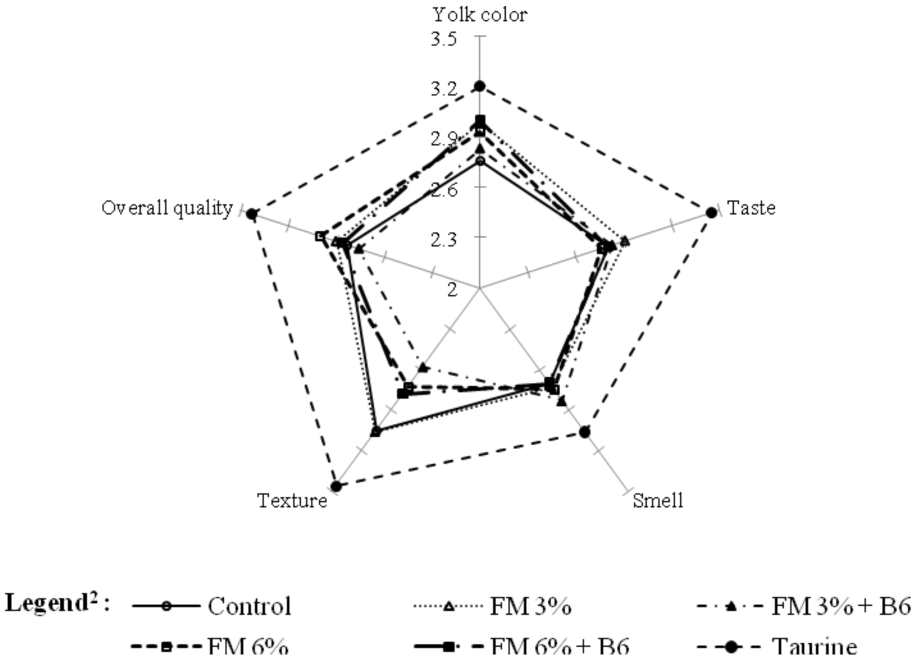

Figure 1. Radar chart scale[1] for the sensory evaluation of eggs from layers fed experimental diets for 28 days. [1] Scale from 1 (poor) to 5 (excellent). [2] Legend: FM 3% = 3% Feather meal diet; FM 3%+B_6 = FM 3%+pyridoxine (21 mg/kg); FM 6% = 6% Feather meal diet; FM 6%+B_6 = FM 6%+pyridoxine (21 mg/kg); Taurine = 0.25% Synthetic taurine supplemented diet.

overall quality. In the score of texture, FM 3%+B_6 and FM 6% treatments were significantly ($p<0.05$) lower than those of the Control and FM 3% treatments. The results show that taurine supplementation at the level of 0.25% significantly improves the sensory attributes of eggs. However, supplementations of FM with or without B_6 do not influence overall quality compared with the Control.

CONCLUSIONS

The taurine content of egg yolk could be increased up to 57% (4 wk average) by supplementation of FM at the level of 6% and vitamin B_6. A significant linear increase in taurine content by increasing FM (0, 3, and 6%) was obtained at the 1st week when B_6 was supplemented together, but at the 2nd wk when FM was supplemented alone. FM supplemented diet may need to be fed for 1 wk along with B_6 to produce taurine enriched eggs in practice. There were significant interactions between FM and B_6 in the 1st and 4 wk overall means resulting in higher B_6 effect on taurine content at high FM treatment. All scores of the sensory attributes were highest in the taurine supplemented group and those of FM treatments were not significantly different from the Control.

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