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EFFECT OF TAURINE SUPPLEMENTATION ON PRODUCTIVE PERFORMANCE, CARCASS QUALITY, IMMUNE ORGANS DEVELOPMENT AND BLOOD CONSTITUENTS OF BROILER CHICKS.

by

H. S. Zeweil*, A. A. Abdallah and M. Basyony

* Anim.& Fish Prod. Dept., Fac. of Agric. Saba Basha, Alex. Univ. Egypt.

Poult. Nutr. Dept, Anim. Prod. Res. Inst., Agric. Res. Center, Ministry of Agric., Egypt.

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Abstract: *A total number of 200 unsexed one-day old Ross commercial broilers were used to evaluate the nutritional value of taurine supplementation to plant protein diet on broiler performances. Chicks were distributed randomly and divided equally into four treatment groups nearly equal in average live body weight. Each treatment was represented by 50 chicks in five replicates (10 chicks each). Two different basal diets were formulated, the first was containing fish and meat meal (animal diet, AD) and fed to the first treatment (T1), another one was containing soybean and corn gluten meal as a source of protein (plant diet, PD) and fed to the second treatment group (T2). The third and fourth treatment groups (T3 and T4) were fed the second diet (PD) with taurine addition 0.025 and 0.05% of diet, for each treatment,(PD+Tu1 and PD+Tu2, respectively). The experimental period lasted for forty two days.*

Results of this study clearly indicated that, at the end of starting period (21 d of age), both levels of taurine addition to PD increased significantly (P≤ 0.01) broiler body weight (BW) and body weight gain (BWG) for both of T3 and T4 than those fed the PD (T2) or fed AD (T1). However, at the end of the experiment (42 d of age), chicks fed PD +Tu2 (T4) recorded the highest BW and BWG (2123.89 and 2070.04 g, respectively) comparing with the other treatments. Supplementation broiler PD (T3 and T4) with taurine during growing period (22-42 d of age) and for all excremental period (0 - 42 d of age), improved significantly (P≤ 0.01) feed conversion ratio (FCR) comparing with those fed PD (T2).

Addition of both levels of taurine to PD significantly (P ≤0.01) increase relative weights of eviscerated carcass, bursa of Fabricius and pancreas. Relative weights of abdominal fat dissected were significantly (P ≤0.01) decreased for the broiler fed PD+Tu1 and PD +Tu2 (T3 and T4) comparing with those fed AD or PD (T1 and T2). Chemical composition of chicks meat indicated that taurine supplementation to PD (T3 and T4) significantly (P ≤0.01) decreased ether extract percentages comparing with those fed AD or PD (T1 and T2) while, the crude protein percentages had the opposite trend. Additions of taurine to broiler PD significantly (P ≤ 0.01) decrease plasma total cholesterol, total lipid concentrations and broiler meat total cholesterol. Supplementation of taurine to PD significantly (P ≤ 0.01) increased digestibility coefficient values of crude protein, ether extract, crude fiber and nitrogen free extract comparing with the digestibility values for the broiler fed PD. Incorporation of taurine in the broiler PD at the highest level (T4, 0.05%) was superior for maximized the net return, economical efficiency (1.373) and relative economical efficiency (103.32) comparing with the other treatments.

In conclusion, the investigation clearly indicated that taurine supplementation to broiler plant diets has important role for improve broiler performances,blood lipids profiles and increasing the economical efficiency.

Key Word: Taurine, Carcass Quality, Immune Organs, Blood Constituents

INTRODUCTION

Taurine (2-aminoethanesulfonic acid, $^{+}NH_3CH_2CH_2SO_3^{-}$) is a sulfur amino acid that was originally named so, since it was first isolated in the bile of an ox, Taurus, ***(Tiedemann and Gmelin, 1827 and Stapleton et al., 1998)***. Taurine is a derivative of the sulfur-containing (sulfhydryl) amino acid cysteine and it is one of the few known naturally occurring sulfonic acids ***(Bouckenooghe et al., 2006).*** However, taurine is not linked to any protein by a peptide bond and it is not a constituent of any protein ***(Suarez et al., 2006).*** Taurine is a ubiquitous free amino acid in animals tissues, especially aquatic foods, and is virtually absent in plants ***(Ruiz-Feria et al., 1999 and Suarez et al., 2006). Zhao et al. (1998)*** found that sea foods contain 0.5 – 1.0 % taurine as compared to meats for example, chicken legs contain only around 0.38%. Chicken legs contain 10 times more taurine that chicken breasts, milk and vegetables contain practically little taurine and species of beans is known to contain around 0.0005% taurine. Bile had high concentrations of taurine, which are used to absorb fats and fat-soluble vitamins and can be found in the lower intestine and, in small amounts, in the tissues of many animals, including humans ***(Bouckenooghe et al., 2006).***

Taurine is involved in several physiological processes including membrane stabilization, a key component of bile as it is necessary for lipid metabolism and regulating cholesterol, modulation of cellular calcium flux and modulation of immunity ***(Ogawa, 1996; Satoh and Sperelakis, 1998 and Refik-Mas et al., 2004)***, osmoregulation and antioxidation ***(Satoh and Sperelakis, 1998; Refik-Mas et al., 2004; Lambert, 2004 and Roig- Pe´rez et al., 2005)*** and detoxification ***(Lambert, 2004 and Roig- Pe´rez et al., 2005)*** Taurine works by increasing the action of insulin, improving glucose tolerance and enhancing antioxidant levels which are important functions to balance the negative effects of high sugar diets ***(Balakrishnan et al., 2002 and Nandhini and Anuradha 2002)***. ***Monson (1969)*** reported that one of the unidentified growth factors in fish meal is taurine. ***Anderson et al. (1975)*** observed that dietary taurine addition improved performance of chicks fed a purified diet deficient in sulfur amino acid (SAA). Researchers compared the behavior and development of birds fed a taurine-supplemented diet to a control diet and found that juveniles that were fed taurine-rich diets as neonates were much larger risk takers and more adept at spatial learning tasks ***(Arnold et al., 2007).*** Feed efficiency was improved by taurine supplementation to broiler cockerels and turkey poults at 1 wk of age ***(Tufft and Jensen, 1992). Wang et al. (2009)*** concluded that the taurine-supplemented diet has a beneficial effect on immune responses and performance in growing Japanese quail fed with maize-soybean meal based diets containing 0.01 or 0.05% taurine for 42 d.

This study examined whether dietary taurine supplementation to broiler plant protein diets influenced growth performance, carcass quality, immune organ development, blood constituents and digestibility coefficients of nutrients for broilers.

MATERIALS AND METHODS

The experimental work was carried out at the Poultry Research Laboratory, affiliated to the Department of Animal and Fish Production, Faculty of Agriculture (Saba Basha), Alexandria University. Two hundred unsexed one-day old Ross commercial broilers were wing-banded, weighed and randomly distributed into four experimental groups. Each treatment was represented by 50 chicks in five replicates of 10 chicks each. All chicks were reared under similar hygienic, environmental and managerial conditions on four pens (1.5 m X 2 m) during starting and growing periods (0-21 and 22-42 days of age).

Two different basal mash diets were formulated, the first one contained fish and meat meal (animal protein diet, AD) and fed to the first group (T1), the other one contained soybean and corn gluten meal without animal protein source (plant protein diet, PD) and fed to the second treatment group (T2). The third and fourth groups (T3 and T4) were fed the same basal PD supplemented with 0.025 and 0.05% of taurine, respectively. All diets were formulated to be isocaloric and isonitrogenous in each of the experimental periods, starting (0-21days of age) and growing (22-42 d of age), Table (1). Fresh feed was mixed weekly and was not stored for more than one week. Feed and water were provided *ad-libitum*, meanwhile birds were allotted with 24 hr light during all experimental periods. Vaccination and medical program were done under supervision of a veterinarian.

The four experimental treatments and diets were as follows:

T1:- fed animal diet without taurine supplementation, (AD)

T2:- fed plant diet without taurine supplementation, (PD)

T3:- fed plant diet + 0.025 % of taurine (PD+Tu1).

T4:- fed plant diet + 0.050 % of taurine (PD+Tu2).

Individual body weights (BW) were obtained at one day, three and six weeks of age. Feed intake (FI) and mortality during these periods were also recorded. At six weeks of age, ten birds from each treatment (one male and one female from each replicate) were randomly chosen, weighed and slaughtered.

Relative carcass weights data for all traits were calculated as g/100 g of live body weight. Skinless-boneless pooled samples of breast and thigh muscles were chemically analyzed for crude protein (CP) and ether extract (EE) according to ***AOAC (1995)*** and the values were expressed on dry matter basis.

Two blood samples were collected from each bird at slaughter time, one in heparinized test tubes and another without heparin. Samples were centrifuged at 3500 rpm for 15 minutes to obtain plasma or serum. Plasma samples were assigned for determination of total protein ***(Peters, 1968)***, total cholesterol ***(Ellefson and Caraway, 1976)***, total lipids ***(Zollner and Kirsch, 1962)***, transaminase enzymes activities ALT and AST ***(Reitman and Frankel, 1957)***. Cholesterol level in skinless-boneless pooled samples from breast and thigh muscles was extracted and determined according to ***Folch et al. (1957) and Charles and Richmond (1974)***. Serum samples were used for determination of malonaldhyde ***(Yagi, 1984)***. Procedures were similar as described by available commercial kits (Bio-Diagonosis Co., Cairo, Egypt).

Digestibility coefficients of nutrients of all experimental diets were obtained using five male birds at six weeks of age from each treatment. Faecal nitrogen was determined following the procedure outlined by ***Jakobsen et al. (1960)***. The proximate analysis of feeds and excreta were carried out according to ***A. O. A. C. (1995)***. Digestion coefficients of nutrients were calculated according to ***Fraps (1946)***.

At the end of experiment, economic efficiency (EE) and relative economic efficiency (REE) were calculated according to input-output analysis data.

Data obtained were statistically analyzed using the General linear model of ***SAS (1996)***. Differences among treatment means were estimated by Duncan's multiple range test ***(Duncan, 1955)***.

RESULTS AND DISCUSSION

Growth Performance:

Results of BW, BWG, FI and feed conversion ratio (FCR) of broilers are shown in Tables (2 and 3). Results showed that BW and BWG of broilers fed PD significantly ($P \leq 0.01$) reduced by 5.7 and 6.3 %, respectively, compared with broilers fed AD at the end of starting period (21 d of age). On the other hand, taurine supplementation at 0.025 or 0.050 % (T3 and T4) to the PD clearly indicated that BW and BWG were surpassed chicks fed PD without supplementation (T2) by 8.1 and 8.6 % for BW and by 8.8 and 9.7 % for BWG, respectively. Similar values at 42 days of age were non-significantly increased by 1.9 for BW and BWG, respectively, in the group received 0.025 % taurine (T3) and significantly increased by 4.6 and 4.8 %, respectively, for the group fed diet containing 0.050 % taurine (T4). Values of BWG for all treatments, during the growing period (22-42 d of age), were almost equal and insignificantly affected by taurine supplementation. Also, it was noted that broilers fed PD containing 0.050 % taurine (T4) insignificantly surpassed the group of broilers fed AD. Reduced BW and BWG for the broiler fed PD (T2) compared to those fed AD during starter period were in agreement with that reported by ***Zeweil et al.*** **(2007)** who reported that including animal protein source in broiler diets significantly deteriorated BW and BWG compared with those of PD. On the other hand, insignificant differences between final BW and BWG for the broiler fed AD or PD at the end of experiment (42 d of age) were in agreements with the finding of ***Abou El-Wafa (2003)*** who reported that broilers fed on plant protein diets showed no significant differences in growth performance compared to those fed animal protein diets. Positive effects due to taurine supplementation on growth performances clearly indicated that it had an important role in the early period of broiler growth. Our results were supported by ***Anderson et al. (1975)*** who found that taurine addition enhanced the growth performance of chicks fed a purified diet deficient in sulfur amino acids. As it is responsible to speculate the effect of taurine on growth performance may depend on dietary sulfur amino acid level. Recently, ***Zeng et al. (2009)*** reported that dietary taurine of 0.1 % increased the average daily gain of Japanese quail in the starter phase (1 to 21 d), while in the grower phase (22 to 42 d)body weight gain was not affected. ***Warskulat et al. (2004)*** suggested that taurine is needed for proper maintenance and functioning of mice skeletal muscles. On the other hand, ***Tufft and Jensen (1992)*** reported that supplementary taurine appears to have little effect on performance of broilers and turkeys.

The nutritional and physiological requirements for taurine in animals are partially supplied by dietary taurine sources and partially by biosynthesis from methionine and cysteine ***(Tsuboyama et al., 1996)***. Taurine is synthesized from methionine via cysteine by a series of enzymatic reactions. The enzyme cysteine sulfinate decarboxylase appears to be the rate-limiting step in taurine biosynthesis in many mammalian species and chicks ***(Jacobsen and Smith, 1968; Sass and Martin, 1972)***. The activities of cysteine sulfinate decarboxylase in fetal liver and brain of humans, monkeys, rabbits, rats, guinea pigs and cats are lower than in adult tissues ***(Sturman and Hayes, 1980)***. The higher need for taurine during development and the low capacity for endogenous biosynthesis make it difficult to satisfy the

body needs. The synthesis rate may be inadequate to fulfill the taurine needs of broilers fed an all-plant protein diet in the starting phase. This may explain the difference in growth of the broilers in starting and growing phases.

The amount of FI was insignificantly different among broiler treatment groups fed AD and PD with or without taurine supplementation, during the starting period (0-21 d of age), Table (3). On the other hand, during the growing period (22 - 42 d of age) and through the whole experimental period (0 - 42 d of age), broilers fed PD T3 and T4 were significantly ($P \leq 0.01$) consumed the lower FI and significantly similar to those fed T1, however, they consumed significantly less FI ($P \leq 0.01$) comparison to those fed T2.

Overall results in Table 3 showed insignificant improvements in FCR for group fed T1 compared to those fed PD (T2, T3 and T4). Supplementation of taurine to PD (T3 and T4) during starting period (0-21d of age) significantly improved FCR as compared with those fed T2 and these groups had the best FCR (1.27 and 1.28 g feed/ g gain *vs.* 1.38 g feed/g gain, respectively, however these groups T3 and T4 were statistically equal to those fed T1. During the growing period (22 - 42 d of age) and for the whole experimental period (0 - 42 d of age), supplementation broiler PD with the highest levels of taurine (T4) significantly improved FCR and had the best ratio (1.96 and 1.73 g feed/ g gain) as compared those fed other experimental diets (Table, 3). ***Tufft and Jensen (1992)*** demonstrated that taurine supplementation significantly improved feed efficiency during the 1st wk. Lee *et al.* (2004) reported that feed consumption was not significantly reduced by taurine supplements (up to 0.4 %) during 0-3 and 0-6 weeks, while feed conversion ratio was improved during 0-3 weeks. However, ***Wang et al. (2009)*** indicated that dietary 0.05% taurine had no effect on feed intake during the starter phase (1 to 21 d), but significantly improved feed efficiency during the same period. Insignificant differences between FI and FCR for the broiler fed AD or PD were in agreements with the results of ***Khaled (2001)*** who found that feeding broiler chicks on diets containing animal protein sources has no superiority over diets containing vegetable protein sources in terms of feed conversion ratio. However, these results disagreed with those reported by ***Zewell et al. (2007)***.

Results of Table 3 showed insignificant differences in mortality rate among different treatments at the end of experimental period (42 days of age).

Carcass Traits:

Result of Table (4) show the effect of taurine supplementation to PD (T2) on some relative broiler carcass traits (expressed as g/100 g of LBW) at the end of experiment (42 d of age). Generally, eviscerated carcass relative weights were significantly ($P \leq 0.01$) increased for the broiler fed T3 and T4 as compared to those fed T1 or T2. Table (4). On the other hand, addition of both levels of taurine (0.025 or 0.050 %) to PD significantly ($P \leq 0.01$) increased relative eviscerated carcass weights by 3.6 and 4 % when compared T2. Total giblets (heart, gizzard and liver) relative weights were not significantly different among dietary treatments. Relative weights of abdominal fat dissected were significantly ($P \leq 0.01$) decreased for the broiler fed T3 and T4 diets, since it decreased by about 37.9 and 31.6 %, respectively, as compared to T2 group. Moreover, taurine supplementation in T2 showed more reduction in relative weights of abdominal fat as compared with those group fed T1, Table (4).

Chemical composition for chicks meat (Table 4) indicated that taurine supplementation to PD (T3 and T4) significantly ($P \leq 0.01$) increased CP% compared with those fed T1 and T2 diet with the highest CP% of meat (22.95 %) for T4 and the lowest percentages for those fed T1 and T2, 21.85 and 21.95 %, respectively. On the other hand, EE % of meat was significantly (P

≤0.01) reduces for broilers fed T2, T3 or T4 as compared with those fed T1. However, feeding broilers on T3 and T4 significantly (P ≤0.01) reduced broiler meat EE percentages compared to those fed T2 diet. Cholesterol concentration of the meat was significantly (P ≤ 0.01) decreased in all treatments fed PD as compared to the group fed AD, while there was insignificant difference between broilers fed PD only or those fed taurine-PD supplemented diets. Decreasing the relative weight of abdominal fat and the ether extract content of meat for the broiler fed T3 or T4 may be due to taurine playing an important role in energy and lipid metabolism. These finding were in line with the results of ***Ogawa (1996)*** who indicated that taurine has a hypolipidemic effect and may stimulate hepatic bile synthesis which is necessary for lipid metabolism.

Bursa of Fabricius and pancreas relative weight were significantly (P ≤0.01) increased due to addition the both levels of taurine T3 and T4 as compared with the relative weights recorded for broiler fed T1 or T2, Table (4). The stimulatory effect of the taurine treatment on growth and development of bursa (lymphoid organ) may be enhanced the immune system of broiler. The bursa of Fabricius is a key lymphoid organ that is responsible for the development and maturation of B-lymphocytes. Spleen relative weight insignificantly increased by addition of taurine to broiler PD diet, Table (4). The increase amounted up 3.5 and 4.3 % as compared to T2 group. Results reported herein are in agreement with the results reported by ***Wang et al. (2009)*** who indicated that bursa of Fabricius relative weight was greater in dietary 0.05% taurine compared with the control (P ≤ 0.05). Furthermore, spleen relative weight was not significantly influenced by dietary taurine (P ≤ 0.05) treatment. ***Zeng et al. (2009)*** indicated that addition of taurine up to 0.15 % level in broiler diets increased the index of spleen and thymus at 3 weeks of age, however, dietary taurine of 0.10 % increased the index of bursa at 6 weeks of age (P < 0.05). ***Liu and Liu (2008)*** found that addition of 0.1 and 0.2 % taurine improved the development of bursa and spleen significantly in 3 week-old broilers, and also improved the development of thymus but the effect was not significant. In 6 weeks old broilers, addition of 0.1 or 0.2 % taurine improved the development of thymus and spleen, the development of thymus was significant, but the development of bursa was inhibited. Using mice, ***Nandhini and Anuradha (2002)*** and ***Ribeiro et al. (2009)*** indicated that taurine supplementation improves glucose tolerance and insulin sensitivity, as well as insulin secretion from isolated islets. Also, ***El Idrissi et al. (2009)*** demonstrate that taurine administration during early development in the mouse causes an increase in the number and size of pancreatic islets of Langerhans and the endocrine function without affecting the exocrine portion of the organ.

Nutrients Digestibility:

Effects of feeding broilers on different taurine diets on nutrients digestibility percentages are presented in Table (5). Results indicated that digestibility coefficients of DM, CP, EE and NFE, except for CF were significantly (P ≤ 0.01) deteriorated by feeding T2, T3 and T4 as compared to T1. However, it is worthy to note that supplementation of taurine to PD significantly (P ≤ 0.01) increased digestibility percentages of CP, EE and NFE compared with values for broiler fed T2. Dry matter digestibility was significantly improved only in T4 as compared with in T2. Crude fiber digestibility was insignificantly affected by different treatments. Digestibility coefficients of CP, EE and NFE in the PD supplemented with taurine groups surpassed those fed AD. Improvement of digestibility percentages for all nutrients associated with the increasing of BW and BWG results (Tables 2) and the improvement of feed utilization which improves the FCR (Tables 3) was found for the broilers fed T3 or T4. The improvement

of nutrients digestibility may be due to the evident from many investigations which demonstrated that taurine had a benefit role on lipid metabolism and the improvement of pancreatic function ***(Ogawa, 1996, and Bouckenooghe et al., 2006).***

Blood Constituents:

Results presented in Table (6) showed that addition of taurine to broiler PD significantly ($P \leq 0.01$) decrease plasma total cholesterol and lipid concentration. Also, the concentration of total broiler meat cholesterol was significantly ($P \leq 0.01$) decreased for the broiler fed PD T2, T3 andT4 as compared with those fed T1diet. Total protein and transaminase enzymes activities ALT and AST activities were insignificantly affected by different dietary treatments. The value of serum malondialdehyde (MDA), a lipid peroxidation product, is a marker for oxidative stress and is related to all oxidative factors was significantly ($P \leq 0.01$) decreased by increasing taurine supplementation to PD. These results mean that, broilers receiving taurine supplementation displayed lower cholesterol and total lipids as compared to the groups treated with T2 or T3. The highest significant ($P \leq 0.01$) serum MDA concentration value was recorded for broilers fed T1 as compared to all other experimental groups. The improvement in lipids profiles was compatible with the finding of many researchers, ***Ogawa (1996)*** and ***(Choi et al., 2006)*** who reported that taurine supplementation can improve serum lipid profiles in rats and ***(Matsushima et al., 2003)*** for mice. Lee ***et al.*** (2004) indicated that total cholesterol was significantly lower ($P \leq 0.05$) in broilers receiving 0.75 % taurine compared with control group. Also, ***Park et al (2007)*** indicated that plasma and liver levels of total cholesterol were increased significantly ($P \leq 0.05$) in rats fed cholesterol diet compared to the control, and addition of taurine significantly decreased the elevated plasma level of cholesterol in rats fed cholesterol diet ($P \leq 0.05$). ***Chang et al. (2011)*** observed that drinking water containing 0.35 and 0.7% taurine improved ($P \leq 0.05$) the serum lipid profile.

Economical Efficiency:

Values of EE and RFE of different formulated diets are shown in Table (7). The results indicated that increasing the level of taurine in broiler diets increase the net return, EE and RFE. Incorporation taurine in the broiler PD at the highest level (T4, 0.050 g/kg) was superior for maximized the net return, EE (1.373) and RFE (103.32%) comparing with the other treatments.

In conclusion, as stated earlier taurine is a conditionally essential amino acid and it's nutritionally requirements in poultry seems to be little understood. Understanding taurine nutrition is essential to minimize or eliminate the need for animal or fish meals in poultry diets, a by-product which is the world supply is constrained. Addition investigations on nutritional requirements for taurine become even greater as the formulation of poultry diets recently depended on plant protein diets. This investigation clearly indicated that taurine supplementation has important role for improve broiler performance, blood lipids profiles and increasing the economical efficiency for broiler fed plant protein diets.

Table1: Composition and the nutritive value of the experimental diets.

Ingredients	Diets Composition %			
	Starter Diets 0-21 d		Grower Diets 22-42 d	
	Animal Diet	Plant Diet	Animal Diet	Plant Diet
Yellow corn	63.10	57.02	69.10	62.65
Wheat bran	2.20	0.00	2.31	0.80
Soybean meal (48%)	15.20	31.40	10.00	26.10
Corn gluten (60%)	13.00	4.60	12.00	3.40
Fish meal (72%)	0.80	0.00	0.80	0.00
Meat meal (50%)	2.50	0.00	2.50	0.00
Calcium Carbonate	1.10	1.41	1.30	1.40
Dicalcium Phosphate	1.00	1.70	1.00	1.70
Premix*	0.30	0.30	0.30	0.30
Soy oil	0.00	3.00	0.00	3.00
Table Salt (NaCl)	0.30	0.30	0.24	0.30
D L.Methionine	0.10	0.12	0.04	0.15
L. Lysine	0.30	0.05	0.31	0.10
Coxistate	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00
Pries/ton (LE)	2589	2591	2559	2537
Calculated chemical composition				
Crude protein %	22.65	22.65	20.00	20.00
ME k cal / kg	3060	3060	3100	3100
Ether Extract %	3.41	5.64	3.57	5.81
Crude fiber %	2.74	3.11	2.53	2.97
Calcium %	1.00	1.00	1.00	1.00
P. (available) %	0.46	0.46	0.45	0.45
Lysine %	1.01	1.05	0.98	0.98
Methionine+cysteine %	0.81	0.81	0.77	0.77

*Provided the following per kg of diet:Vit. A. 1200 IU; Vit. D. 3000 IU; Vit. E. 100 IU; Vit. C, 3 mg; Vit. K. 4 mg; VitB1. 3 mg; Vit B2. 3 mg; Vit B6. 5 mg; Vit B12. 0.03 mg; Bantothinic acid. 15 mg; Folic acid. 2 mg; Biotin. 0.20 mg; Cobalt. 0.05 mg; Copper. 10 mg; Iodin. 50 mg; Manganese. 90 mg; Selenium. 0.20 mg and Zinc. 70 mg.

Table 2: Effect of taurine supplementation on broiler body weight (BW) and , body weight gain (BWG).

Treatments	BW(g/chick)			BWG(g/chick)		
	Initial	21d	42d	0-21	22-42wk	0-42d
T1(AD)	55.18±4.60	733.62±15.44^{a}	2082.22±48.09^{ab}	678.44±15.17^{b}	1348.60±44.19	2027.04±49.94^{ab}
T2(PD)	55.90±4.43	691.61±11.36^{b}	2030.49±67.43^{b}	635.71±7.58^{c}	1338.83±71.13	1974.54±70.14^{b}
T3(PD+T1)	56.26±3.81	747.92±9.32^{a}	2069.33±26.63^{ab}	691.66±8.91^{ab}	1321.11±30.41	2013.07±27.13^{ab}
T4(PD+T2)	53.85±1.40	750.96±7.01^{a}	2123.89±22.18^{a}	697.11±7.55^{a}	1372.93±821.58	2070.04±22.91^{a}
Significant	NS	**	**	**	NS	**

Means within the same column with different superscript are significantly different.
*** Significantly at 0.01 NS: No significant. AD: Animal diet. T1: Taurine by 0.025%. T2: Taurine by 0.05%. PD: Plant diet*

Table 3: Effect of taurine supplementation on broiler feed intake (FI), feed conversion ratio (FCR) and mortality %.

Treatments	FI(g/chick)			FCR(g feed/g Gain)			Mortality %
	0-21	22-42wk	0-42d	0-21	22-42wk	0-42d	0-42d
T1(AD)	907.34±39.57	2721.03±56.92^{ab}	3628.57±79.23^{ab}	1.34±0.07^{ab}	2.03±0.04^{ab}	1.80±0.07^{ab}	2.23±0.19
T2(PD)	905.00±39.21	2751.22±66.03^{a}	3656.03±62.15^{a}	1.38±0.07^{a}	2.08±0.12^{a}	1.85±0.08^{a}	2.12±0.13
T3(PD+T1)	880.68±22.24	2686.82±35.14^{b}	3567.50±42.36^{b}	1.27±0.03^{b}	2.04±0.06^{ab}	1.77±0.03^{ab}	2.46±0.31
T4(PD+T2)	893.88±16.81	2686.54±25.25^{b}	3580.42±24.57^{b}	1.28±0.02^{b}	1.96±0.04^{b}	1.73±0.02^{b}	2.24±0.11
Significant	NS	**	**	**	*	**	NS

Means within the same column with different superscript are significantly different.
*** Significantly at 0.01. * Significantly at 0.05. NS: No significant. AD: Animal diet. T1: Taurine by 0.025%. T2: Taurine by 0.05%. PD: Plant diet*

Table 4: Effect of taurine supplementation on relative weights of carcass traits (g/100g LBW) and carcass meat analysis .

Treatments	Carcass traits (g/100g LBW)						Carcass meat analysis		
	Carcass	Giblets	Abdominal Fat	Bursa	Spleen	Pancreas	Crude protein %	Ether extract %	Cholesterol (mg/100g)
T1(AD)	67.73±2.45^{c}	5.53±0.19	29.78±5.21^{a}	0.093±0.002^{b}	0.197±0.02	0.204±0.02^{b}	21.85±0.35^{c}	3.89±0.19^{a}	1.48±0.05^{a}
T2(PD)	69.68±1.18^{b}	5.12±0.13	27.60±7.77^{a}	0.092±0.002^{b}	0.199±0.05	0.209±0.01^{b}	21.90±0.25^{c}	3.40±0.03^{b}	1.39±0.05^{b}
T3(PD+T1)	72.19±0.73^{a}	5.46±0.31	17.15±2.79^{b}	0.095±0.001^{a}	0.206±0.04	0.241±0.01^{a}	22.19±0.24^{b}	3.19±0.06^{c}	1.40±0.01^{b}
T4(PD+T2)	72.47±0.43^{a}	5.64±0.11	18.88±4.72^{b}	1.28±0.02^{b}	1.960±0.04	1.73±0.02^{b}	22.95±0.28^{a}	3.09±0.02^{c}	1.40±0.01^{b}
Significant	**	NS	**	**	NS	**	**	**	**

Means within the same column with different superscript are significantly different.
*** Significantly at 0.01 NS: No significant. AD: Animal diet. T1: Taurine by 0.025%. T2: Taurine by 0.05%. PD: Plant diet*

Table 5: Effect of taurine supplementation on broiler digestibility coefficients percentages of dry mater (DM), crude protein (CP), ether extract (EE), crude fiber (CF) and nitrogen free extract (NFE).

Treatments	DM %	CP %	EE %	CF %	NFE %
T1(AD)	84.48±0.77[a]	76.91±0.98[b]	72.39±0.38[c]	19.76±0.26	73.46±0.81[a]
T2(PD)	81.39±0.93[b]	72.15±0.83[c]	70.07±0.52[d]	20.44±0.40	69.69±0.52[c]
T3(PD+T1)	83.39±0.51[a]	80.23±0.55[a]	73.63±0.81[b]	20.21±0.24	72.83±0.54[b]
T4(PD+T2)	82.41±0.46[ab]	80.88±0.30[a]	74.85±0.24[a]	20.03±0.49	73.94±0.21[a]
Significant	**	**	**	NS	**

Means within the same column with different superscript are significantly different.
** *Significantly at 0.01.* NS: No significant. AD: Animal diet.
T1: Taurine by 0.025%. T2: Taurine by 0.05%. PD: Plant diet

Table 6: Effect of taurine supplementation on plasma total cholesterol (T.Ch), lipids (T. Lip), protein (T. Protein), serum malonaldhyde (MDA) concentration and plasma transaminase enzymes activities (AST and ALT).

Treatments	T. Ch. (mg/dl)	T. Lip (mg/dl)	T. Protein (g/dl)	MDA (mg/ml)	ALT U/L	AST U/L
T1(AD)	86.41±0.79[a]	4.322±0.13[a]	5.46±0.40	5.29±0.04[a]	16.75±0.19	128.63±0.41
T2(PD)	83.39±1.57[b]	3.965±0.09[b]	5.24±0.46	4.14±0.06[b]	16.67±0.29	129.25±0.37
T3(PD+T1)	81.99±0.27[c]	3.748±0.15[c]	5.20±0.09	3.91±0.07[c]	16.52±0.21	128.71±0.63
T4(PD+T2)	80.08±0.22[c]	3.701±0.03[c]	5.23±0.05	3.77±0.03[d]	17.09±0.08	129.18±0.16
Significant	**	**	NS	**	NS	NS

Means within the same column with different superscript are significantly different.
** *Significantly at 0.01.* NS: No significant. AD: Animal diet.
T1: Taurine by 0.025%. T2: Taurine by 0.05%. PD: Plant diet

Table (7): Feed Economical Efficiency of the eight dietary treatment

Trait	T1	T2	T3	T4
Average feed intake, Kg/chick/42d.(a)	3.629	3.656	3.567	3.580
Total feed cost LE (b)*	9.835	9.835	9.702	9.845
Body weight (42 d) kg (c)	2.082	2.030	2.069	2.124
Market Price/kg LBW , LE (d)	11.00	11.00	11.00	11.00
Total revenue (c x d = e)	22.902	22.33	22.759	23.364
Net revenue (e – b = f)	13.067	12.495	13.057	13.519
Feed Economical efficiency (EE) (f/e)	1.329	1.270	1.346	1.373
Relative feed economical efficiency (REE)**%	100	95.56	101.26	103.32

*Total feed costs were estimated by calculate the accumulation of the feed cost weekly.
**Relative feed economical efficiency (REE) % for plant diets were assuming that relative EE of animal diet (T1) =100 %.
The price of each kg of the experimental diets was calculated according to the price of the ingredients in the local market at the time of the experiment (January, 2011). The price of taurine was calculated by 120 LE/kg.

REFERANCES

Abou El-Wava, S. (2003). *Total versus digestible protein and amino acids in formulated broiler diets containing plant or animal protein sources. Egypt. Poult. Sci. 23:581-600.*

Anderson, J. O.; Warnick, R. A.; and Dalai, R. K. (1975). *Replacing dietary methionine and cystine in chick diets with sulfate or other sulfur compounds. Poult Sci. 54: 1122–1128.*

AOAC. (1995). *Association of Official Analyical Chemists Official Methods of Analysis 16th ed. Published the A.O.A.C. Washington D.C.*

Arnold, K. E.; Ramsay, S. L.; Donaldson, C.; Adam, A. (2007). *"Parental prey selection affects risk-taking behavior and spatial learning in avian offspring" (PDF). Proceedings of the Royal Society B: Biological Sciences 274: 2563–2569.*

Balakrishnan S. D; Anuradha C. V; and Anitha Nandhini A. T. (2002). *"Taurine Modulates Antioxidant Potential and Controls Lipid Peroxidation in the Aorta of High Fructose-fed Rats." J Biochem Mol Biol Biophys. 6:129-133*

Bouckenooghe, T.; Remacle, C.; and Reusens, B. (2006). *"Is taurine a functional nutrient?" Curr Opin Clin Nutr 9 : 728–733.*

Chang, Y. Y; Chou, C. H; Chiu, C. H; Yang, K. T; Lin, Y. L; Weng, W. L; and Chen, Y. C. (2011). *Preventive effects of taurine on development of hepatic statuses induced by a high-fat/cholesterol dietary habit. J Agric Food Chem. 59:450-457.*

Choi, M.; Kim, J.; and Chang, K. (2006). *The effect of dietary taurine supplementation on plasma and liver lipid concentrations and free amino acid concentrations in rats fed a high-cholesterol diet. Adv Exp Med Biol. 583:235–242.*

Charles, C. A.; and Richmond, W. (1974). *Enzymatic determination of total cholesterol. C. Dlin. Chem. 20:470-475.*

Duncan, D. B. (1955). *Multiple range and multiple F tests. Biometrics, 11:1-42.*

Ellefson, R. D.; and Caraway, W.T. (1976). *Fundamental of clinical chemistry .Ed Tietz NW. p 506*

El Idrissi, A.; Boukarrou, L.; and L'Amoreaux, W. (2009). *Taurine supplementation and pancreatic remodeling. Adv Exp Med Biol. 643:353-358.*

Folch, J.; Lees, M. E.; and Stanley, G. H. S. (1957). *A simple method for the isolation and purification of total lipids from animal tissues. J. Bio. Chem. 226: 407-409.*

Fraps , G. S.(1946). *Relation of the protein, fat and energy of ration to the composition of chickens . Poult. Sci., 25: 421- 424.*

Jakobsen, P. E.; Kirston, S. G.; and Nielsen, H. (1960). *Digestibility trails with poultry. 322 bretning fra foprsgs labratriet udgivest statens .Husdybug sudvalg kobenhann.*

Jacobsen, J. G.; and Smith, L. H. (1968). *Biochemistry and physiology of taurine and taurine derivatives. Physiol. Rev. 48:424–511*

Khaled, O. (2001) *Effect of various protein containing diets on performance and immunity of broiler chicks. Poultry Middle East and North Africa, 160:10.*

Lambert, I. H. (2004). *Regulation of the cellular content of the organic osmolyte taurine in mammalian cells. Neurochem. Res. 29:27–63.*

Lee, D.; Cheng, Y.; Chuang, Y.; Shive, J.; Lian, Y.; Wei, H.; and Weng, C. (2004). *Effects of Dietary Taurine Supplementation on Growth Performance, Serum Constituents and Antibody Production of Broilers. Asian-Aust. J. Anim. Sci. 17 : 109- 115.*

Liu. Y.; and Y. Liu (2008). *Effect of taurine on broiler performance and immunity. Journal of Yangzhou University 4: 13*

Monson, W. J., (1969). *Evidence that taurine may be one of the elusive unidentified factors. Poultry Sci. 48:2069–2074.*

Nandhini, A. T.; And Anuradha, C. V. (2002). *Taurine modulates kallikrein activity and glucose metabolism in insulin resistant rats. Amino Acids 22:27-38*

Ogawa, H. (1996). *Effect of dietary taurine on lipid metabolism in normcholesterolemic and hypercholesterolemic stroke-prone spontaneously hypersensitive rats. Advances in Expermintal Biology.V: 359. Taurine in Health and Disease. Ed. R.J. Huxtable and D. Michalk. Plenum Press. MY. Chapter 52:481-490.*

Park, I. S.; Young, H. K.; and Jung, S. K. (2007). *Effects of taurine on plasma and liver lipids, erythrocyte ouabain sensitive Na efflux and platelet aggregation in Sprague Dawley rats. Nutr Res Pract. 1: 200–205.*

Peters, T. (1968). *Determination of total protein in serum. Clinical Chemistry. 14:1147.*

Roig-Pe´rez, S.; Moreto, M.; and Ferrer, R. (2005). *Transepithelial taurine transport in caco-2 cell monolayers. J. Membr. Biol.204:85–92.*

Ruiz-Feria C. A; Beers, K. W., Kidd, M. T. and Wideman, R. F. (1999). *Plasma Taurine Levels in Broilers with Pulmonary Hypertension Syndrome Induced by Unilateral Pulmonary Artery Occlusion. Poult. Sci. 78:1627–1633.*

Refik-Mas, M.; Comert, B.; Oncu, K.; Vural, S. A.; Akay, C.; Tasci, I.; Ozkomur, E.; Serdar, M.; Mas, N.; Alcigir, G.; and Yener, N. (2004). *The effect of taurine treatment on oxidative stress in experimental liver fibrosis. Hepatol. Res. 28:207–215.*

Reitman, S.; and Frankel, S. (1957). *Coloric determination of GOT or GPT activity. Am. J. Clin. Path., 28-56.*

Ribeiro, R. A.; Bonfleur, M. L.; Amaral, A. G.; Vanzela, E. C., Rocco, S. A.; Boschero, A. C.; And Carneiro, E. M. (2009). *Taurine supplementation enhances nutrient-induced insulin secretion in pancreatic mice islets. Diabetes Metab Res Rev. 25:370-379.*

SAS (1996). *SAS/STAT User's Guide, Version 6. 5th ed. SAS Inst. Inc., Cary, NC.*

Sass, N. L.; and Martin, W. G. (1972). *The synthesis of taurine from sulfate. 3. Further evidence for the enzymatic pathway in chick liver. Proc. Soc. Exp. Biol. Med. 139:755–761*

Satoh, H.; and Sperelakis, N. (1998). *Review of some actions of Taurine on ion channels of cardiac muscle cells and others. Gen. Pharmacol. 30:451-463.*

Stapleton, P. P.; O'Flaherty, L.; Redmond, H. P.; and Bouchier-Hayes, J. D. (1998). *"Host defense--a role for the amino acid taurine?". Journal of Parenteral and Enteral Nutrition 22:42–48.*

Sturman, J. A.; and Hayes, K. C. (1980). *The biology of taurine in nutrition and development. Adv. Nutr. Res. 3:231 299.*

Suarez, E. C.; Marie, D. R.; Salazar, M. T.; Lopez. M. G. N.; David, A. V. C.;

and Ortega, A. C. (2006). *Taurine: an amino acid rich in fish meal. A vances en Nutricion Acuicola VIII. VIII Simposium Inernacional de Nutricion Acuicola. 15-17 Noviembre. Universidad Autonoma de Nuevo Leeon, Monterrey, Nuevo Leon, Mexico. ISBN 970-694-33-5.*

Tiedemann, F.; and Gmelin,L. (1827). *"Einige neue Bestandtheile der Galle des Ochsen". Annalen der Physik 85:326–337.*

Tsuboyama, N.; Y. Hosokawa, M.; Totani, J.; Oka, A., Matsumoto, T.; and Kodama, H. (1996). *Structural organization and tissue-specific expression of the gene encoding rat cysteine dioxygenase. Gene 181:161–165.*

Tufft, L. S.; and Jensen L. S. (1992). *Influence of dietary taurine on performance and fat retention in broilers and turkey poults fed varying levels of fat. Poult. Sci. 71:880–885.*

Wang, F. R.; Dong, X. F.; Tong, J. M.; Zhang, X. M.; Zhang,Q.; and Wu, Y. Y. (2009). *Effects of dietary taurine supplementation on growth performance and immune status in growing Japanese quail (Coturnix coturnix japonica. Poult. Sci. 88:1394-1398.*

Warskulat, U.; Flogel, U.; Jacoby, C.; Hartwig, H.G.;Thewissen, M.; Merx, M.W.; Molojavyi, A.; Heller-Stilb, B.; Schrader, J.; and Haussinger, D. (2004). *"Taurine transporter knockout depletes muscle taurine levels and results in severe skeletal muscle impairment but leaves cardiac function uncompromised". Faseb J. 3: 496.*

Yagi, K. (1984). *Assay for blood plasma or serum. Methods Enzyme. 105:328-331.*

Zeng, D.; Gao, Z.; Zhao, J.; Huang, X. L.; Duo, L.; Tian, Y. (2009). *Effects of taurine on growth performance, immune organ development and antioxidative ability of broilers. Chinese Journal of Veterinary Science 29 : 774-778*

Zeweil, H. S.; Ahmed, M. H.; Zaitoun, M.; and El Sheikh H. (2007). *Effect of probiotic supplementation to broiler diets on performance, carcass and sensory evaluation. XVIII European Symposium on the Quality of Poultry Meat, 2-5 September, Prague, Czech Republic.*

Zhao, X.; Jia, J.; and Lin Y. (1998). *Taurine content in Chinese food and daily intake of Chinese men. Adv. Exp. Med. Biol. 442:501 - 505.*

Zollner, N.; and Kirsch, K. (1962). *Z. Ges. Exp. Mes. 135:545.*

الملخص العربى

تأثير أضافة التورين على الأداء الأنتاجى وجودة الذبيحة ونمو الأجهزة المناعيةوصفات الدم لكتاكيت اللحم.

حسن صابر زويل – احمد عبد العزيز عبد اللة – محمد بسيونى .

تهدف الدراسة الى تقدير القيمة الغذائية لأضافة التورين الى العلائق التى محتواها من البروتين ذا مصدر نباتى وذلك على الأداء الأنتاجى لكتاكيت اللحم. قسم عدد ٢٠٠ كتكوت روص غير مجنسة عمر يوم عشوائيا الى اربع معاملات متساوية فى العدد ولها وزن جسم متساوى تقريبا. تم تمثيل كل معاملة بعدد ٥٠ كتكوت وذلك فى خمسة مكررات وبكل مكررة 10 كتكوت وربيت تحت ظروف متماثلة من الرعاية البيطرية والبيئية فى اعشاش ارضية. تم تكوين عليقتين مختلفتين ، الأولى تحتوى فى تركيبها على مسحوق السمك واللحم (عليقة حيوانية) وغذيت بها المعاملة الأولى (T1) و العليقة الثانية (عليقة نباتية) تحتوى فى تكوينها كمصدر للبروتين وغذيت بها المعاملة الثانية (T2). وكلا من المعاملة الثالثة والرابعة (T3 و T4) غذيتا على العليقة النباتية للمعاملة الثانية مع اضافة التورين وذلك بمعدل٠,٠٢٥ و ٠,٠٥٠ % على التوالى.جميع العلائق التى استخدمت خلال فترات التجربة (البادئ و النامى) كانت متماثلة فى محتواها من البروتين والطاقة وذلك لكل فترة من فترات التجربة.

أوضحت نتائج هذة الدراسة أن فى نهاية فترة البادئ(٢١ يوم من العمر) ان كلا من المستويين من التورين المضافين الى العليقة النباتية أدى الى زيادة معنوية لكلا من وزن الجسم والزيادة فى وزن الجسم لكلا من المعاملتين الثالثة والرابعة مقارنة بالكتاكيت التى غذيت على العليقة النباتية للمعاملة الثانية بدون اضافة التورين او التى غذيت على العليقة الحيوانية بالمعاملة الأولى. وبصورة عامة فأنه فى نهاية فترة التجربة (٤٢ يوم من العمر) فأن الكتاكيت التى غذيت على العليقة النباتية المضاف اليها المستوى الأعلى من التورين (المعاملة الرابعة، ٠,٠٥٠ %) سجلت أعلى وزن جسم وزيادة فى وزن الجسم (٢١٢٣,٨٩ و ١٠٧٠,٠٤ جم على التوالى) مقارنة بالمعاملات الأخرى. أضافة التورين الى العليقة النباتية لكلا من المعاملتين الثالثة والرابعة (T4 ، T3) خلال فترة النمو (٢٢-٤٢ يوم) وكذلك طوال فترة التجربة (٠-٤٢ يوم) تؤدى الى تحسن معنوى فى الكفاءة التحويلية للعلف مقارنة بالطيور التى غذيت على عليقة نباتية بدون اضافة التورين. أضافة كلا من مستويين التورين الى العلف النباتى زاد معنويا الوزن النسبى للذبيحة و غدة البرسا و البنكرياس. الوزن النسبى للدهن البطنى أنخفض معنويا عند مستويات التورين المستخدمة وذلك لكلا من المعاملتين الثالثة والرابعة (T4 ، T3) مقارنة بالطيور التى غذيت على عليقة نباتية او حيوانية بدون اضافة التورين (T2، T1) . التحليل الكيميائى للحم الكتاكيت يوضح ان اضافة التورين الى العلف النباتى بكلا من المعاملتين T4 ، T3 يؤدى الى انخفاض معنوى للنسبة المئويةلمحتوى لحم الكتاكيت من المستخلص الأثيرى مقارنة بالكتاكيت التى غذيت على عليقة حيوانى او نباتية بدون اضافة التورين ، بينما النسبة المئوية لمحتوى لحم الكتاكيت من البروتين الخام فانها أوضحت عكس النتائج السابقة. اضافة التورين الى العليقة النباتية خفضت معنويا تركيز بلازما الدم من الكوليستيرول و الدهون الكلية و كذلك تركيز الكوليستيرول الكلى المقدر فى لحم الكتاكيت. اضافة التورين الى العلف النباتى أدى الى تحسن وزيادة فى قيم معاملات الهضم للبروتين الخام و المستخلص الأثيرى و الألياف الخام و المستخلص الخالى من النيتروجين مقارنة بمعاملات الهضم للكتاكيت التى غذيت على عليقة نباتية بدون اضافة التورين. اضافة التورين فى علائق كتاكيت اللحم بالمستوى الأعلى (T4 ، ٠,٠٥٠ %) يعظم من العائد الصافى (١,٣٧٣) والكفاءة الأقتصادية(١٠٣,٣٢%) مقارنة بالمعاملات الأخرى.

الخلاصة:- أوضحت الدلراسة ان اضافة التورين الى علائق كتاكيت اللحم المغذاة على علائق نباتية له دور هام فى تحسين كفاءة الأداء وصورة دهون الدم وزاد من الكفاءة الأقتصادية.