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ZINC-METHIONINE AND IT´S EFFECT ON CHICKEN MEAT QUALITY

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Abstract

Background and Objective: The supplementation in diet of chicken improves the amino acid balance and consequently increases protein synthesis and decreases fat synthesis. And the positive effects on meat quality. Essential elements are very necessary for the physiological functions of the human body and should be available through dietary intake, which supports regulation of cellular function, growth and maintenance of the body. The study provides original analytical data on the levels of zinc and methionine (ZeMet) in chicken meat (female) which are commonly consumed in Iraq. A total of three hundred and sixty (n = 360) of broiler chicks were weighed and classified in 3 groups, 0% ZnMet (Control T1), 0.5 gm/kg ZnMet (T2), 1 gm/kg ZnMet (T3).Carcass cuts (Breast, Whole Thigh, Wings, Back and Neck), Physical dissection(Lean, bone and skin), chemical analysis (moisture, protein, fat and ash), Cooking Loss, Drip Loss, TBA, PV and sensory evaluation (tenderness, juiciness, flavor, overall acceptance, acceptability, texture and general appearance) were steady. There were no significant differences between treatment in Carcass cuts (Breast, Back and Neck), Physical dissection (Lean, bone and skin), chemical analysis (moisture, protein, fat and ash), Cooking Loss, Drip Loss, TBA, PV. While there were a significant difference ($P \geq 0.05$) in Whole Thigh, Wings and sensory evaluation. The supplementation zinc and methionine (ZeMet) in diet of chicken improves the sensory evaluation of meat.

Key words: Zinc, Methionine, broilers, carcass cuts, Physical dissection, chemical analysis, Cooking Loss, Drip Loss, TBA, PV and sensory evaluation.

Introduction

The industry of chicken meat in Iraq has a long tradition and good quality. All kinds of meat and its products played a very important role in the daily diet of the Iraqi population, its a primary sources of nutrients and protein, and increasing interest in meat quality, their health and safety. The most Iraqi modern consumers, chicken meat is fresh or roasted. Although Iraqi consumers are accustomed to paying low prices for poultry meat, they are increasingly interested in products with good quality in recent decades. Meat quality is a complex trait that is influenced by environmental, and nutritional factors (Fletcher, 2002; Wen *et al*., 2017). Meat is providing essential nutrients such as omega-3 fatty acids, vitamin B12, and bioavailable forms of essential elements (McAfee *et al*., 2010; Williams and Droulez, 2010; Mann, 2013). The level of essential nutrients in meat depends on many factors, and the potential to modify meat composition differs markedly according to the nutrient considered. Due to change of production with time, it is a very important to update our knowledge of essential nutrients in meat.

The supplementation in diet of chicken improves the amino acid balance and consequently increases protein synthesis and decreases fat synthesis. And positively effects on meat quality (Lipinski *et al*., 2011).

Essential elements are very necessary for the physiological functions of the human body and should be available through dietary intake, which supports regulation of cellular function, growth and maintenance of the body (M³yniec *et al*., 2014). And the lack can cause improper metabolic function which causes of organ damage, chronic diseases and death (FAO/WHO, 2002), and many disease states such as sickle cell disease, cirrhosis of the liver and diabetes (Prasad, 1993).

Zn is present in most types of foods of plant origin and animal, high protein foods are rich in Zn, whereas carbohydrate-containing foods were found to be much lower in Zn (Osis *et al*., 1972), Zn levels (0.40 to 6.77 mg per 100g) in comparison to the breads and cereals (0.30 to 2.54 mg per 100g), vegetables (0.12 to 0.60 mg. per 100g) and fruits (0.02 to 0.26mg per 100g), (Haeflein and Rasmussen, 1977). Also, it has in cells at multiple biochemical functions and called the metal of life because it is necessary of more than 300 metalloenzymes (Maret, 2013; Kaur *et al*., 2014). Moreover, it plays an important role in the development of depression (McLoughlin and Hodge, 1990; Maes *et al*., 1997) and accumulation of cadmium in some human tissues and organs (Brzóska and Moniuszko-Jakoniuk, 2001).

Methionine (Met) is the first-limiting amino acid in corn-soybean based diet of poultry and plays an important role for growth, carcass yield and quality, which is very important economic trait for meat production (Zeng, 2015; Lemme *et al*., 2002; Vieira *et al*., 2004). Xie, *et al*., (2006) reported that the optimal Met requirement for male White Pekin ducks from 21 to 49 d age for maximum weight gain and breast meat yield were 0.377 and 0.379%. As various factors influence the methionine requirement, the requirements of new commercial strains are higher than those recommended by NRC (1994) (Gorman & Balnave, 1995; Nadeem & Khan, 1999; Schutte & Pack, 1995; Wallis, 1999), which affected growth performance and carcass traits of broilers (Hickling *et al*., 1990; Esteve-Garcia and Mack, 2000; Ahmed and Abbas, 2011; Wen *et al*., 2017).

Zinc-methionine (ZeMet) is an organic Zn which is devoid of free divalent cations for chelation in the intestinal lumen with phytic acid. Therefore, it is metabolized in different methods which facilitate enhanced absorption of Zn (Burrell *et al.,* 2004).

However, very few studies have been done to determine the (ZeMet) needs with improved meat quality. Therefore, the aim of the present study was to investigate the concentrations of Zn and methionine in meat, and suggest to consumers if the analysed meats are better sources of these elements. Moreover, for future studies the data are necessary on the total dietary intake of Zn and methionine by the Iraqi population.

However, In spite of advances made on the nutritional aspects, a lot of several aspects of the poultry nutrition still remain unsolved and continue to challenge to researchers. Substituting Zinc-methionine in poultry rations is one such effort to reduce the costs along with enhancement of nutritional quality of poultry meat. The aim of the current study was to examine the effect of supplemental levels of Zinc-methionine deficient diet on carcass quality of chicken meat.

Materials and methods

One hundred and eighty (n = 180) one day-old Cobb broiler chicks were obtained from a commercial hatchery and randomly placed in 9 floor pens bedded with wood shavings. The chicks were weighed and assigned to one of the three ZnMet meal basal diet containing 0% ZnMet (Control T1), 0.5 gm/kg ZnMet (T2), 1 gm/kg ZnMet (T3). Each treatment was replicated in three pens with sixty birds per each pen. The chicks were fed experimental diets (starter, day 1–10), (grower, day 11–22), and finisher, (day 23–42) (Table 1). The slaughter analysis was done after 4-hour fasting period, as per the protocol described by Genchev and Mihaylov (2002). Carcasses were identified by individual numbers and weighed on an ACB plus-300 balance. After slaughter, plucking and evisceration, Each carcass was separated into, breast, leg, wings, back and neck, and record the weight of cuts. Weighed labeled carcasses were arranged in polystyrene foam plates, packed with stretch wrap film and placed at 0-4^{0}C for 24 hours (Ribarski1 &. Genchev, 2013).

Their carcasses were dissected according to the method described by Zio³ecki and Doruchowski (1989). Chemical analysis (moisture, protein, fat and ash) was determined according AOAC (2005), cooking loss was estimated according to Rasmussen and Mast (1989). Drip loss was measured as described by Rémignon *et al.,* (1996), by removing from the bag 24h after slaughter, wiped, and weighed to evaluate drip loss and expressed as a percentage of initial carcass weight. Thiobarbituric Acid (TBA) and Peroxid Value (PV) was measured as described by Koniecko (1979).

Sensory properties of the meat were evaluated, Samples were cooked in a 0.6% table salt, until the internal temperature the meat reached 80°C. After cooking, the samples were chilled to 60°C (Wilkanowska and Kokoszyñsk, 2011) and subjected to taste panel evaluation by a standing committee of 10 evaluators accordance with a 7-point hedonic scale described by AL_Hajo *et al.*, (2012). A 7-point hedonic scale (7-like extremely, 1-dislike extremely) was used to evaluate the following attributes (tenderness, juiciness, flavor, acceptability, Texture and General appearance). Ten staff members of the college and graduate students most of whom had participated in previous consumer panels work as panelists, were given the details about this panel and we do a primary panel before the essential test which we adapted in this study. We depend the standard point to control on varieties which may affect the degree of panel: Time of the test in 11O'clock (A.M.), degree of

Table 2: Effect of the level of ZnMet in diet on weight of carcass cuts (gm).

Treatment	Breast	Whole Thigh	Wings	Back	Neck
T_1	7.50 ± 582.50	460.00 ±5.0 B	145.0 ±1.00B	322.5 ±2.5	47.50±2.50
T_2	602.0±62.0	446.50±12.50B	150.50 ±0.71 AB	329.5±24.50	73.90±18.90±
T_3	672.50±27.50	517.50±22.5 A	152.50±2.50 A	337.50±7.50 A	50.00±10.00
LSD	NS	*	*	NS	NS

Dissimilar superscripts at the same Columnn means significant (P<0.05).

cooking temperature, time between cooking and test, drinking water in 25°C between the test and another, finally the size of the pieces which we tested.

The data were analyzed using Complete Randomized Design. The calculation was performed by the SAS package programmers (SAS, 2012). Duncan (1955)was used to determine significant differences.

Results and Discussion

The effects of the level of ZnMet on the weight of carcass cuts(Breast, Whole Thigh, Wings, Back and Neck) are given in Table 2. A significant difference(P ≥ 0.05) between the treatments was observed only for the whole thigh and wings, showing the highest value in T_3 followed by T_2 and control(T_1) respectively, that was desirable from the Iraqi marketing point of view. These results were agreed with the results of Halder and Roy (2007) who observed breast percentage did not vary significantly due to supplementation of HerboMethionine groups than DL-methionine supplemented group, but the thigh muscle percentage varied significantly (P ≥ 0.05) among various experimental groups. Also, these results were not agreed with the results of Ojano-Dirain and Waldroup (2002) who observed significant improvement (P ≥ 0.05) in breast meat yield between the broilers fed NRC Methionine level and those fed higher levels. While there was no significant difference between the others carcass cuts. Similarly, Kiran *et al*., (2012) reported that percentage of breast yield was more when DL-methionine and herbal methionine was added to the diet.

Table 1: Ingredients and chemical composition of the experimental diet.

Composition(%)	(1-10) Days	(11-30) Days	(31-42) Days
Corn	56.95	57.93	54.70
Soybean meal (44% protein)	38.00	31.50	32.60
Protein concentration	---	5.00	5.00
Premix	2.50	---	---
Dicalcium phosphate	---	0.30	---
$CaCO_3$	0.85	1.55	1.40
Oil plant(Sun flower oil)	0.70	3.70	6.00
NaCl	---	0.02	0.30
Total	100	100	100
Nutrient Concentrations (%)			
Metabolizable energy (Kcal/ kg)	3026	3151	3275
Crude protein (%)	23.51	22.04	22.29
Crude fiber (%)	3.97	3.59	3.48
Methionine (%)	0.56	0.50	0.48
Methionine+cystine (%)	0.92	0.84	0.81
Lysine (%)	1.30	1.19	1.21
Ca (%)	1.11	0.91	0.87
P (%)	0.48	0.45	0.36

Premix (WAFI) provided the following per kilogram of diet: Vitamin A,440000 IU; vitamin D_3, 120000 IU; vitamin E (DL-_-tocopheryl acetate), 1200 mg;K_3 100 mg; B_1/ Thiamin 120mg ; B_2/ Riboflavin 280mg; B_6/Pyridoxine 160mg ;B_{12} 1400 mg; Folic acid 40mg; Biotin/Vitamin H 100 ìg ; Iron 2000 ìg; Copper 400ìg;Mg 3200 ìg; Zinc 2400 ìg; Selenium 10 ìg; Colin Chloride 1200mg. And provided Lysine 1.6%; Methionine 6%; Methionine+cystine 6%;Ca 23.2%; Available phosphorous 9.3%;Na 4.9%.

Physical dissection results are presented in Table 3.,there were no significant differences between treatments in Physical dissection (Lean, bone and skin) (gm). To date, no information has been published about the effects of ZnMet in the diet on Physical dissection (Lean, bone and skin) of chicken meat.

Moisture, protein, fat and ash levels of meat did not change in all treatments (Table 4). Similarly, To date, no information has been published about the effects of ZnMet in the diet on chemical analysis (moisture protein, fat and ash)(%) chicken meat.

Table 5 shows no difference (p<0.05) between treatments in terms of Cooking Loss, Drip Loss, TBA and PV. No information has been published about the

Table 3: Effect of the level of ZnMet in diet on weight of Physical dissection(Lean, bone and skin) (gm).

Treatment	Lean	Bone	Skin
T_1	968.00±12.50	345.50±18.50	169.10±20.30
T_2	915.00±135.00	372.85±53.85	186.35±7.65
T_3	1059.50±62.50	386.50±37.50	169.20±1.60
LSD	NS	NS	NS

Dissimilar superscripts at the same Columnn means significant (P<0.05).

Table 4: Effect of the level of ZnMet in diet on chemical analysis(moisture, protein, fat and ash)(%).

Treatments	Moisture	Protein	Fat	ASH
T_1	73.98±0.88	20.76±0.57	1.49±0.41	3.77±0.10
T_2	74.08±0.59	21.33±0.46	1.17±0.02	3.41±1.03
T_3	74.66±0.16	20.07±0.07	1.46±0.41	3.80±0.51
LSD	NS	NS	NS	NS

Dissimilar superscripts at the same Columnn means significant (P<0.05).

Table 5: Effect of the level of ZnMet in diet on Cooking Loss, Drip Loss, TBA and PV.

Treatments	Cooking Loss	Drip Loss	TBA	PV
T_1	27.18±2.25	1.09±0.77	0.26±0.05	2.23±0.08
T_2	23.71±1.03	3.59±0.54	0.37±0.02	2.54±0.36
T_3	20.12±1.46	1.98±0.33	0.27±0.02	2.15±0.07
LSD	NS	NS	NS	NS

Dissimilar superscripts at the same Column means significant (P<0.05)

effects of ZnMet in the diet of Cooking Loss, Drip Loss, TBA and PV.

Robbins *et al.,* (2003) concluded that tenderness, juiciness, and flavor were the most important factors with respect to consumer eating satisfaction. Many factors can affect sensory evaluation of meat; especially, nutrition, postmortem (PM) and deboning time can have a large influence (Lyon *et al*., 1983; Stewart *et al*., 1984; Lyon and Wilson, 1986; Cavitt *et al.*, 2004, 2005; AL-Hajo *et al*., 2016). Fig. 1, show the effect of the level of ZnMet in the diet on sensory evaluation (Tenderness, Juiciness and Flavor).

Tenderness is a major quality determinant and also an important sensory characteristic of meat. Result in Fig. 1 illustrates that T, and T_3 got the highest ($P < 0.05$) degrees of sensory qualities of the tenderness, which ranged from tender to very tender, when compared with result in control. Data in Fig.1, indicates that T, and T_3 had a higher ($P < 0.05$) degrees of sensory qualities (Juiciness) ranged from juiciness to very juicy, when compared with result in control. The flavor (Fig. 1), T, and T_3 rang from the strong flavor with very strong, when compared with result in control. Abdullah and Matarneh (2010) suggest that breast fillet weight may influence both sensory flavor and texture quality of meat.

Acceptability (Fig. 2) illustrates that T, and T3 were also accepted into high(P<0. 05)degree of score when compared with result in control. Texture and flavor are important sensory characteristics of meat, which can strongly influence overall consumer acceptance and choice of meat, Fanatico *et al*., (2007) reported that either growth rates or live bird weights affected the sensory flavor intensity or acceptance of breast meat.

Data in Fig. 2, indicates that T, and T_3 had a higher ($P < 0.05$) degrees of sensory qualities (Texture), ranging from the soft texture to very soft texture when compared with result in control. Without any explanation of the causes for the texture differences, Pragati *et al.,* (2007) concluded that use of broilers of heavy weight (>2000g live weight) would benefit the quality of further-processed chicken products. Shear force has been widely used as an indicator for sensory texture quality attributes tenderness, hardness, and cohesiveness for both red meat and poultry breast fillets due to the strong and significant correlations between WB shear force values and the sensory evaluation scores (Dikeman *et al*., 2005; Xiong *et al.,* 2006).

General appearance illustrated in Fig. 2, that T, and T_3 had a significant increased, ranged from medium to be desired appearance when compared with result in control. The genotypes, slaughter ages, or further processing techniques by themselves can significantly affect the sensory quality and functionality of chicken meat (Northcutt, 2006; Fanatico *et al.*, 2006, 2007a; Alvarado and McKee, 2007; Saha *et al.*, 2009).

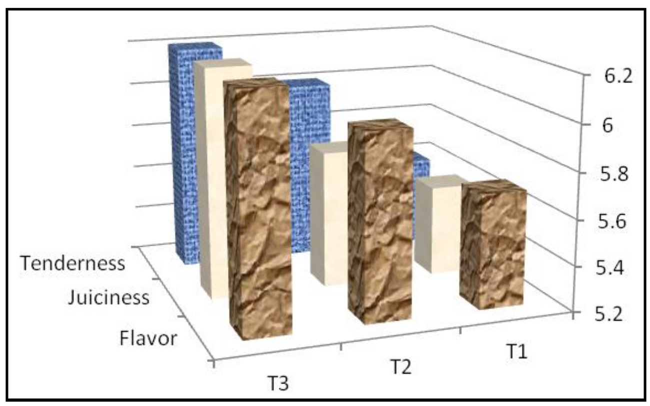

Fig. 1: Effect of the level of ZnMet in diet on sensory evaluation(Tenderness, Juiciness and Flavor)

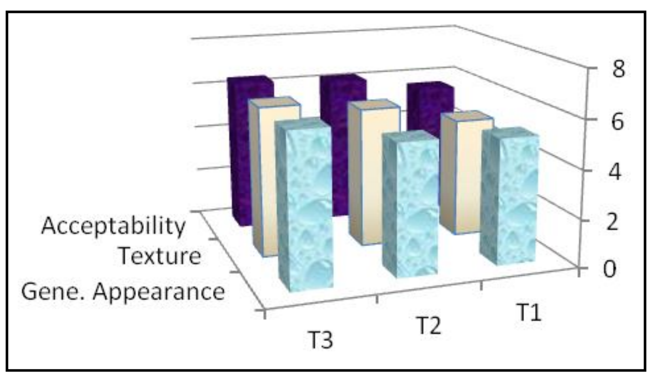

Fig. 2: Effect of the level of ZnMet in diet on sensory evaluation (Acceptability, Texture and General Appearance).

No reports of similar research in sensory evaluation of chicken meat have been published.

The percentages of ZnMet used in the study did not affect any of the qualities of meat, but it had a clear effect on the sensory characteristics of meat, and this an important point for the consumer, which increases the proportion of sales of this type of meat.

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