**Abstract:** This study was conducted to evaluate the dietary using of cumin as feed supplement on meat quality traits of the broiler chicken. Eight-day old broiler divided into 4 groups, 3 replicates (8 chicks/replicate) each for 45 days. Treatments included; (T1), basal diet without cumin or control, (T2), basal diet with 3 g cumin. kg^-1 of diet, (T3), basal diet with 6 g cumin. kg^-1 of diet, (T4), basal diet with 9 g cumin. kg^-1 of diet. At the end of this experiment after slaughtering all the chicks, samples were taken from breast and thigh meat. Results revealed that cumin supplementation did not significantly (p<0.01) affect moisture percentages of breast meat and protein percentages of thigh meat. Results also showed that use basal diet with 3 and 6 g cumin. kg^-1 of diet significantly (p<0.01) impact on meat water holding capacity and cooking loss percentages, while different cumin level impact on fat, ash percentages, pH value, TBA, TVB.N values, metmyoglobin, myoglobin value, copper, nickel, zinc, iron, magnesium, phosphorus and calcium concentrations of thigh meat, as well as iron, magnesium, phosphorus, sodium and calcium concentrations of breast meat. Results conclude that using cumin as feed supplement in 3, 6 and 9 g.kg^-1 level, improve most chemical and physical traits of meat.

**Keywords:** Cumin, feed additive, Broiler chicks, Meat traits.

**Introduction**

The source of cumin is the herb *Cuminum cyminum*, which grows in the eastern Mediterranean to South Asia. Ground-based, especially in India, in addition to dietary uses of cumin, it has traditional medicinal uses, especially in India, where it treats digestive disorders such as diarrhea and indigestion Srinivasan (2018). Studies conducted in several countries, including India, indicated that cumin oil has a high antioxidant effect because it contains flavonoids, especially monoterpene, apigenin and luteolin, which are found in seeds (Lassak, 1996; De Martino, *et al.*, 2009). Cumin oil is used in some cases as an internal or external sterilizer, pain reliever, inflammatory control, hemolysis, cessation of enzymes, stomach stimulant, and has been
widely used in ancient Iranian medicine, especially in the treatment of gastrointestinal disorders, gynecological diseases, respiratory system, toothache, diarrhea and epilepsy (Johri, 2011). The use of antibiotics to stimulate growth in poultry led to an increase in production, but the World Health Organization and for the purpose of maintaining public health and the absence of resistance to these antibiotics in the human body, has recommended to find alternatives to antibiotics, especially natural ones such as plant extracts that can add to broiler rations (Mahmood et al., 2015; Akyildiz & Denli, 2016; Diaz Carrasco et al., 2016). Some study showed that use cumin in feed effect on broiler performance (Rafiee, et al., 2014; Berrama, et al., 2017). This study was conducted to evaluate the use of cumin as feed supplement on some meat quality traits of the broiler chicken.

**Material & Methods**

This study was conducted at the high education lab, Department of Animal Science, College of Agricultural Engineering Sciences, Sulaimani University (the source of broiler meat sample from College farm (Ross 30), cumin source from local market, origin India, in broiler feed. Feed composition and calculated chemical composition of experiment treatments showed in table (1). Chemical composition of cumin (Moisture content: 8%, pH: 7.3, total ash: 7.5, acid insoluble ash: 18%, alcohol soluble extractive: 6.58%, water soluble extractive: 138% and ether soluble extractive: 11.44 and 12.36 % in the wet and dry fruits. Crude protein 18.40 and 19.88 %, crude fibres 21.82 and 23.57%, total carbohydrate 55.58 and 60.05% in the wet and dry fruits respectively) (Moawad, et al., 2015). Eight-day old broilers divided into four groups; each group contained three replicates (8 chicks per replicate) for 45 days. Treatments included; (T1), basal diet without cumin or control, (T2), basal diet with 3 g. cumin.kg\(^{-1}\) of diet, (T3), basal diet with 6 g. cumin.kg\(^{-1}\) of diet, (T4), basal diet with 9 g. cumin.kg\(^{-1}\) of diet. At the end of this experiment after the slaughtering all the chicks, samples were taken from the breast and thigh for some chemical and physical measurements.

**Chemical composition:**

Moisture, protein, fat and ash contents, estimated by method described by AOAC. & Helrich (1990).

**Physic-chemical traits:**

**pH**

pH of muscle sample was measured by method described by Ibrahim et al. (2010).

**Cooking loss**

Cooking loss was determined according to Murphy & Zerby (2004).

**Water holding capacity (WHC)**

Water holding capacity (WHC) was determined according to Wardlaw et al. (1973).

**Total volatile nitrogen (TVB.N)**

Estimated by method described by Malle & Poumeyrol (1989).

**Thiobarbituric acid (TBA) value**

The TBA value was determined according to the method described by Witte et al. (1970).

**Determination of met-myoglobin percentage and myoglobin concentration**

Pigment of meat extract from muscles of each treatment was estimated using a modified procedure of Krzywicki (1982).
### Table (1): Feed composition and calculated chemical composition of experiment treatments

| Feed Ingredients         | 1-7 days |                  |                  |                  |                  |
|--------------------------|----------|------------------|------------------|------------------|------------------|
|                          |          | % 100            | T1 (Control)     |                  |                  |
|                          |          | 6                |                  |                  |                  |
| Yellow Corn              |          | 51.7             |                  |                  |                  |
| Soybean Meal             |          | 29               |                  |                  |                  |
| Wheat                    |          | 10               |                  |                  |                  |
| Sun Flower Seed Oil      |          | 3                |                  |                  |                  |
| Salt                     |          | 0.3              |                  |                  |                  |
| Cumin                    |          | 0                |                  |                  |                  |
| Total                    |          | 100              |                  |                  |                  |
| Calculated chemical composition |        |                  |                  |                  |                  |
| Crude Protein            |          | 22               |                  |                  |                  |
| Energy Kcal. kg⁻¹        |          | 3151             |                  |                  |                  |
| % Methionine             |          | 0.64             |                  |                  |                  |
| % Lysine                 |          | 1.22             |                  |                  |                  |
| % Fat                    |          | 5.6              |                  |                  |                  |
| % Fibres                 |          | 3.5              |                  |                  |                  |
| % Calcium                |          | 0.47             |                  |                  |                  |

| Feed Ingredients         | 8-21 days |                  |                  |                  |                  |
|--------------------------|-----------|------------------|------------------|------------------|------------------|
|                          | T1 (Control) | T2              | T3              | T4              |
|                          | 5         | 5               | 5               | 5               |
| Yellow Corn              | 56.9      | 56.9            | 56.6            | 56.4            |
| Soybean Meal             | 24.8      | 24.5            | 24.5            | 24.4            |
| Wheat                    | 10        | 10              | 10              | 10              |
| Sun Flower Seed Oil      | 3         | 3               | 3               | 3               |
| Salt                     | 0.3       | 0.3             | 0.6             | 0.3             |
| Cumin                    | 0         | 0.3             | 0.6             | 0.9             |
| Total                    | 100       | 100             | 100             | 100             |
| Calculated chemical composition |        |                  |                  |                  |                  |
| Crude Protein            | 20        | 20              | 20              | 20              |
| Energy Kcal/Kg           | 3213      | 3207            | 3197            | 3188            |
| % Methionine             | 0.60      | 0.59            | 0.59            | 0.59            |
| % Lysine                 | 1.07      | 1.06            | 1.06            | 1.05            |
| % Fat                    | 5.8       | 5.8             | 5.8             | 5.7             |
| % Fibres                 | 3.4       | 3.4             | 3.4             | 3.3             |
% Calcium | 0.40 | 0.40 | 0.40 | 0.40
---|---|---|---|---
21 Days - Market Weight
Feed Ingredients | % 100 | T1 (Control) | T2 | T3 | T4
---|---|---|---|---|---
Protein Conc. | 5 | 5 | 5 | 5
Yellow Corn | 59.5 | 59.4 | 59.1 | 58.9
Soybean Meal | 22.2 | 22.0 | 22.0 | 21.9
Wheat | 10.0 | 10.0 | 10.0 | 10.0
Sun Flower Seed Oil | 3.0 | 3.0 | 3.0 | 3.0
Salt | 0.3 | 0.3 | 0.3 | 0.3
Cumin | 0.0 | 0.3 | 0.6 | 0.9
Total | 100 | 100 | 100 | 100

Calculated chemical composition
Crude Protein | 19.0 | 19.0 | 19.0 | 19.0
Energy Kcal/Kg | 3244 | 3236 | 3226 | 3217
% Methionine | 0.59 | 0.59 | 0.58 | 0.58
% Lysine | 1.00 | 0.99 | 0.99 | 0.99
% Fat | 5.9 | 5.8 | 5.8 | 5.8
% Fibre | 3.3 | 3.3 | 3.3 | 3.3
% Calcium | 0.39 | 0.39 | 0.39 | 0.39

Minerals contents
Mineral concentration estimated according to methods described by Hutton et al. (2014) and Rajib et al. (2016).

Statistical Analysis
All data were statistically analyzed by the Completely Randomized Design (CRD) by the SAS (Allison, 2010) system and the differences between the means of groups were estimated by Duncan Multiple Range Test (Duncan, 1955), statements of statistical significance are basing on (P≤0.01).

Results & Discussion
The results in tables (2 and 3) revealed that supplementation with cumin did not significantly affect (P≤0.01) moisture and protein percentages of breast meat. However, moisture and protein percentages of thigh meat were significantly (P≤0.01) differed due to different treatments. Both lipids and ash percentages of were also significantly (P≤0.01) influenced by different supplement. The breast meat of chicks fed basal diet and 9 g cumin.kg⁻¹ of diet recorded lowest protein percentage (15.07%), while the meat of broiler chicks fed basal diet without cumin recorded highest percentage (15.76%). The highest lipids and ash percentages recorded in breast and thigh meat of broiler chicks fed basal diet with 9 g cumin.kg⁻¹ of diet (7.54, 9.39, 3.33 and 3.35% respectively) while the lowest lipid and ash percentages recorded in
breast and thigh meat of broiler chicks fed basal diet without cumin (3.01, 2.75, 2.97 and 2.53%) respectively. The use of cumin not only improves the effectiveness and stimulation of bile acid production, also has led to a good increase in enzymes secreted by the pancreas and intestines such as amylase, trypsin, chymotrypsin and lipase (Rao et al., 2003; Muthamma et al., 2008). These positive secretions from the use of cumin seeds may improve the composition of carcass meat (Madhukar, 2013).

**Table (2): Effect of supplementing cumin on moisture and protein composition of broiler chicks’ breast and thigh meat (Mean ± standard deviation).**

| Treatments | Moisture % | Protein% |
|------------|------------|----------|
|            | Breast     | Thigh    | Breast | Thigh |
| T1         | 72.72 ± 0.07 a | 67.64 ± 1.36 c | 15.76 ± 0.01 a | 15.71 ± 0.01 a |
| T2         | 73.99 ± 0.34 a | 71.00 ± 2.92 b | 15.72±0.01 a | 15.68± 0.009 a |
| T3         | 74.48 ± 0.13 a | 73.52 ± 0.02 a | 15.54±0.004 a | 15.5 ± 0.001 a |
| T4         | 74.80 ± 0.07 a | 74.65 ± 0.07 a | 15.07 ± 0.57 b | 15.38± 0.003 a |

*Mean with different letter (a, b) among columns (treatment) are significantly differ (P≤0.01).

**Table (3): Effect of supplementing cumin on lipid and ash composition of broiler chicks’ breast and thigh meat (Mean ± standard deviation).**

| Treatments | Lipid% | Ash% |
|------------|--------|------|
|            | Breast | Thigh | Breast | Thigh |
| T1         | 3.01± 0.004 d | 2.75 ± 0.02 d | 2.97 ± 0.003 d | 2.53 ± 0.004 d |
| T2         | 3.69± 0.02 c | 3.81 ± 0.10 c | 3.19 ± 0.001 c | 2.86 ± 0.001 c |
| T3         | 5.72 ± 0.04 b | 5.97 ± 0.05 b | 3.29 ± 0.001 b | 3.17 ± 0.001 b |
| T4         | 7.54±0.009 a | 9.39 ± 0.13 a | 3.33 ± 0.001 a | 3.35 ± 0.002 a |

*Mean with different letter (a, b) among columns (treatment) are significantly differ (P≤0.01).

The results in table (4) showed that broiler chicks fed cumin impact significantly (P≤ 0.01) meat physical traits. The pH value of breast and thigh meat from broiler chicks that’s fed with basal diet with 9 g. cumin.Kg⁻¹ of diet recorded highest values (7.25 and 7.47 respectively), while the lowest values were recorded in meat of broiler chicks fed basal diet without cumin, control groups (6.35 and 6.50 respectively).

The water holding capacity (WHC) results in table (3) revealed that chicks fed cumin showed significantly (P≤0.01) higher WHC % of breast and thigh meat, the highest percentages recorded in breast and
thigh meat of chicks from T4 groups (basal diet plus 9 g. cumin.Kg\(^{-1}\) of diet) which were (55.40 and 64.28%) respectively. The lowest percentages recorded in breast and thigh meat of chick from T1 group (fed basal diet without cumin) which were (40.17 and 40.43%) respectively.

The results of cooking loss percentages (CL) (Table 4), showed that breast and thigh meat of chicks fed feed supplement with cumin recorded lower CL\%, specifically in T4 group (basal diet plus 9 g. cumin.Kg\(^{-1}\) of diet) (36.84 and 36.32%) respectively, which differ significantly with other treatment groups. The highest percentages recorded in breast and thigh meat of chicks from T1 groups (fed basal diet without cumin) (56.60 and 51.06%) respectively.

Warriss (2000) described that high pH increases the water-binding because it affects the shrinkage of the contractile fibres, which might be the case in the present study, that meat sample has higher pH causes higher water holding capacity and lower cooking loss.

| Traits | Treatment | T1     | T2     | T3     | T4     |
|--------|-----------|--------|--------|--------|--------|
| Breast | pH        | 6.35 ± 0.09 | 6.68 ± 0.002 | 6.96 ± 0.06 | 7.25 ± 0.02 |
| Thigh  |           | 6.50 ± 0.006 | 6.89 ± 0.009 | 7.13 ± 0.02 | 7.47 ± 0.19 |
| Breast | WHC\%     | 40.17 ± 0.03 | 44.07 ± 0.42 | 50.15 ± 0.16 | 55.40 ± 2.03 |
| Thigh  |           | 40.43 ± 0.23 | 49.51 ± 0.02 | 51.69 ± 1.25 | 64.28 ± 2.20 |
| Breast | CL\%      | 56.60 ± 3.68 | 50.02 ± 0.39 | 42.52 ± 0.74 | 36.84 ± 0.19 |
| Thigh  |           | 51.06 ± 0.56 | 45.65 ± 1.13 | 39.80 ± 0.90 | 36.32 ± 0.32 |

*Mean with different small letter (a, b) among rows (treatment) are significantly differ (P≤0.01).*

The results of thiobarbuteric acids (TBA) and total volatile basic nitrogen (TVB.N) showed in table (5), Results revealed that fed broiler chicks feed supplemented with cumin significantly affect (P≤0.01) TBA and TVB.N values. Results of TBA showed that breast and thigh meat from treatments contain cumin recorded lowest values particularly meat from T4 group (basal diet plus 9 g. cumin.kg\(^{-1}\) of diet) which were 0.47 and 0.56 mg MDA.kg\(^{-1}\) muscle in breast and thigh meat respectively., Breast and thigh meat from broiler chicks fed basal diet (T1 group) recorded highest TBA values (0.70 and 0.81 mg MDA.kg muscle\(^{-1}\)) respectively. The results of TVB-N values in table (5), revealed that breast and thigh meat of treatments contain cumin recorded better TVB-N values than meat from T1 (control...
group), the TVB-N values in meat from T4 group were (14.04 and 12.58 mgN.100⁻¹ g muscle) in breast and thigh meat TVB-N were 19.26 and 18.10 mg N.100⁻¹ g muscle respectively. Gagandeep et al. (2003) mentioned that uses of cumin seed (2.5 and 5% of diet) in mice tended to increase superoxide dismutase, catalase and reduced glutathione. Foods containing biologically active compounds that specialize in action against free radicals’ help protect against cancer and may also help reduce cardiovascular and brain diseases in human (Miraliakbari & Shahidi, 2008).

The results of metmyoglobin and myoglobin represented in table (6). Results demonstrated that the use of cumin in chicks diet effect (P≤0.01) met-myoglobin percentages and myoglobin values. The highest met-myoglobin percentage recorded in breast and thigh meat of broiler chicks from T1 group (basal diet) which were (49.64 and 58.65%) respectively. In contrast the lowest percentages recorded in breast and thigh meat of chicks from T4 group (basal diet plus 9 g. cumin.kg⁻¹ of diet) which were (30.82 and 36.16%) respectively.

The results of myoglobin value in table (6), displayed that breast and thigh meat of chicks fed basal diet plus 9 g. cumin.kg⁻¹ of diet (T4 group) recorded highest value, which were (4.67 and 4.39 mg.g⁻¹ muscle) respectively, in contrast the lowest value recorded in breast and thigh meat of chicks from T1 group (basal diet) which were 3.16 and 2.90 mg.g⁻¹ muscle) respectively. The colour of the product is very important in the purchase, especially when trading singular, and the colour of meat comes from the pigment of myoglobin which resulting from the oxidation of metaglobin (Hernández et al., 2015). Adding cumin as feed additive improved pigment stability compared with the control which may be due to their antioxidant activity and presence of some

| Treatment | TBA (mg MDA.kg⁻¹ muscle) | TVN (mg N.100⁻¹ g muscle) |
|-----------|--------------------------|-----------------------------|
|           | Breast                   | Thigh                       | Breast | Thigh |
| T1        | 0.70 ± 0.03 a            | 0.81 ±0.005 a               | 19.26 ± 0.06 a | 18.10 ± 0.26 a |
| T2        | 0.63 ± 0.001 b           | 0.64 ± 0.001 b              | 16.00 ± 0.009 b | 15.74 ± 0.01 b |
| T3        | 0.55 ± 0.1 c             | 0.57 ± 0.006 c              | 15.28 ± 0.30 c | 14.91 ± 0.02 c |
| T4        | 0.47 ± 0.008 d           | 0.56 ± 0.03 c               | 14.04 ± 0.84 d | 12.58 ± 0.58 d |

*Mean with different letter (a, b) among columns (treatment) are significantly differ ( P≤ 0.01).
Table (6): Effect of supplementing cumin on metmyoglobin and myoglobin value of broiler chicks’ breast and thigh meat (Mean ± standard deviation).

| Treatments | Metmyoglobin % | Myoglobin (mg.g\(^{-1}\) muscle) |
|------------|----------------|----------------------------------|
|             | Breast | Thigh | Breast | Thigh |
| T1         | 49.64 ± 0.70 a | 58.65 ± 0.99 a | 3.16 ± 0.05 d | 2.90 ± 0.07 d |
| T2         | 44.69 ± 0.20 b | 46.97 ± 0.24 b | 3.65 ± 0.05 c | 3.57 ± 0.04 c |
| T3         | 39.44 ± 0.54 c | 43.00 ± 1.50 c | 3.99 ± 0.007 b | 3.89 ±0.01 b |
| T4         | 30.82 ± 0.60 d | 36.16 ± 0.33 d | 4.67 ± 0.16 a | 4.39 ± 0.05 a |

*Mean with different letter (a, b) among columns (treatment) are significantly differ (P≤ 0.01).

bioactive principles in cumin (Madhukar, 2013). As seen in table (7), the cumin supplementation affect (P≤0.01) copper, nickel, zinc, iron, magnesium, phosphorus and Calcium concentrations in thigh meat. It also affect iron, magnesium, phosphorus, sodium and calcium concentrations in breast meat. For copper concentration, the highest concentration (0.099 ppm) recorded in thigh meat fed cumin (9 g. cumin.kg\(^{-1}\) of diet), while the lowest concentration recorded by T1 (control, 0.085 ppm). Iron metabolism depends on the presence of copper and its deficiency leads to anaemia (McDowell, 2003). The highest nickel concentration recorded in thigh meat from broiler chicks of T4 (9 g. cumin.kg\(^{-1}\) of diet) treatment, 0.099 ppm, While the lowest concentration recorded in meat from broiler chicks of T1 (control, 0.085 ppm), zinc concentration recorded in thigh meat from broiler chicks of T4 (9 g. cumin.kg\(^{-1}\) of diet) highest concentration (3.150 ppm), in contrast the meat from chicks of T2 (3 g. cumin.kg\(^{-1}\) of diet) recorded lowest concentration (2.850 ppm), protein and carbohydrate metabolism, cell growth, and cell division in cell need Zinc (Lo et al., 2020). The highest iron concentration recorded in breast and thigh meat from chicks of T4 (9 g. cumin.kg\(^{-1}\) of diet, 0.625 and 0.600 ppm) respectively, and lowest concentration recorded in breast and thigh meat of T2 (3 g cumin.kg\(^{-1}\) of diet, 0.505 and 0.405 ppm) respectively, the iron is important element for health, and iron deficiency is the common medicinal diseases (Abbaspour, et al., 2014). The highest magnesium concentration recorded in T2 (3 g cumin.Kg\(^{-1}\) of diet) breast meat and T1 (control) thigh meat (17.64 and 19.23 ppm) respectively, and lowest concentration recorded in T3 (6 g cumin.kg\(^{-1}\) of diet) breast meat and T2 (3 g cumin.kg\(^{-1}\) of diet) thigh meat (14.01 and 12.54 ppm ppm) respectively. The highest phosphorous concentration recorded in T2 (3 g cumin.kg\(^{-1}\) of diet) breast meat and T4 (9 g. cumin.kg\(^{-1}\) of diet) thigh meat (22.95 and 22.73 ppm) respectively and lowest concentration recorded in T1 (control) breast and thigh meat (16.12 and 14.48 ppm) respectively. The highest breast sodium concentration recorded in meat of T1 (control, 83.23 ppm), while the lowest concentration recorded in T2 (3 g cumin.kg\(^{-1}\) of diet, (55.03 ppm). Calcium concentration recorded in breast
and thigh meat from broiler chicks of T4 (9 g cumin.kg⁻¹ of diet) highest concentration (9.26 and 8.27 ppm) respectively. In contrast the meat from chicks of T1 (control) recorded lowest concentration (4.45 and 4.17 ppm) respectively. The bone formation and neuromuscular function need calcium and phosphorus, blood clotting depends on calcium, while phosphor play important role in some function of blood (Zomrawi, 2013). Cumin consists of minerals such as potassium, sodium, calcium, iron, phosphorous and nutritional vitamins like thiamine, riboflavin, niacin, vitamins A and C (Moawad et al., 2015), this may causes different minerals concentration in meat from broiler feed with cumin in contrast to control groups.

Table (7): Effect of Supplementing cumin on mineral concentration (ppm) of broiler chicks breast and thigh meat (Mean ± standard divation).

| Minerals | Meat type | T1         | T2         | T3         | T4         |
|----------|-----------|------------|------------|------------|------------|
|          | Breast    | 0.085 ± 0.007 a | 0.099 ± 0.001 a | 0.099 ± 0.001 a | 0.120 ± 0.029 a |
|          | Thigh     | 0.085 ± 0.007 a | 0.099 ± 0.001 a | 0.099 ± 0.001 a | 0.099 ± 0.001 a |
| Cr       | Breast    | 0.085 ± 0.007 a | 0.099 ± 0.001 a | 0.099 ± 0.001 a | 0.099 ± 0.001 a |
|          | Thigh     | 0.085 ± 0.007 a | 0.099 ± 0.001 a | 0.099 ± 0.001 a | 0.099 ± 0.001 a |
| Cu       | Breast    | 0.085 ± 0.007 b | 0.099 ± 0.001 a | 0.099 ± 0.001 a | 0.099 ± 0.001 a |
|          | Thigh     | 0.085 ± 0.007 b | 0.099 ± 0.001 a | 0.099 ± 0.001 a | 0.099 ± 0.001 a |
| Cd       | Breast    | 0.045 ± 0.007 a | 0.049 ± 0.000 a | 0.049 ± 0.001 a | 0.049 ± 0.001 a |
|          | Thigh     | 0.045 ± 0.007 a | 0.049 ± 0.001 a | 0.049 ± 0.001 a | 0.049 ± 0.001 a |
| Pb       | Breast    | 0.085 ± 0.007 a | 0.099 ± 0.001 a | 0.115 ± 0.021 a | 0.099 ± 0.001 a |
|          | Thigh     | 0.085 ± 0.007 a | 0.099 ± 0.001 a | 0.099 ± 0.001 a | 0.099 ± 0.001 a |
| Ni       | Breast    | 0.085 ± 0.007 a | 0.099 ± 0.001 a | 0.115 ± 0.021 a | 0.099 ± 0.001 a |
|          | Thigh     | 0.085 ± 0.007 a | 0.099 ± 0.001 a | 0.099 ± 0.001 a | 0.099 ± 0.001 a |
| Zn       | Breast    | 3.250 ± 0.212 a | 3.40 ± 0.424 a | 3.100 ± 0.566 a | 2.800 ± 0.424 a |
|          | Thigh     | 3.00 ± 0.282 ab | 2.850 ± 0.707 b | 3.050 ± 0.495 a | 3.150 ± 0.919 a |
| Fe       | Breast    | 0.535 ± 0.077 ab | 0.505 ± 0.120 b | 0.520 ± 0.085 a | 0.625 ± 0.064 a |
|          | Thigh     | 0.425 ± 0.028 ab | 0.405 ± 0.078 b | 0.590 ± 0.099 a | 0.600 ± 0.007 a |
| Mg       | Breast    | 14.26 ± 0.89 bc | 17.64± 0.79 a | 14.01± 0.06 c | 15.85± 0.28 bc |
|          | Thigh     | 19.23± 0.43a | 12.54± 0.65c | 16.42± 0.87ab | 14.71± 2.19bc |
| P        | Breast    | 16.12± 1.03 b | 22.95± 1.91a | 19.73± 2.01ab | 17.83± 0.37b |
|          | Thigh     | 14.48± 0.02 c | 18.57± 1.23b | 19.48± 0.12b | 22.73± 0.79a |
| Na       | Breast    | 83.23± 0.94a | 55.03± 1.34b | 77.88±8.51 a | 77.94± 5.71a |
|          | Thigh     | 90.92± 4.27a | 68.59± 13.43a | 73.78± 6.03a | 79.03± 4.17a |
| Ca       | Breast    | 4.45± 0.79 b | 6.45± 1.80 ab | 7.39± 1.01ab | 9.26± 0.78a |
|          | Thigh     | 4.17± 0.29b | 4.53± 0.62b | 8.18± 0.171a | 8.27± 1.84a |
| K        | Breast    | 285.0± 80.61a | 261.0± 39.60a | 284.5± 2.12a | 315.0± 24.04a |
|          | Thigh     | 317.0± 21.21a | 286.0± 8.48.a | 269.5± 55.86a | 299.0± 14.14a |

*Mean with different small letter (a, b) among rows (treatment) are significantly differ ( P≤ 0.01).
Conclusion

Cumin supplementation did not significantly affect moisture and protein percentages, and negatively effect on fat percentage and pH value, while impact positively on meat ash, water holding capacity and cooking loss percentages, TBA, TVBN values, metmyoglobin, myoglobin value, copper, nickel, zinc, iron, magnesium, phosphorus and calcium concentrations of thigh meat and iron, magnesium, phosphorus, sodium and calcium concentrations of breast meat.

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تأثير إضافة الكمون (Cuminum cyminum L.) في بعض صفات لحوم افراخ دجاج اللحم

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المستخلص: أجريت هذه الدراسة لتقييم استعمال الكمون كمكمل غذائي في بعض صفات جودة لحم دجاج اللحم. في عمر ثمانية أيام، تم تقسيم الافراخ بالتساوي على 4 مجموعات، تحتوي كل مجموعة على 3 مكررات (8 افراخ لكل منها). تم تقسيم المعاملات إلى المعالمة الأولى استعمال نظام غذائي أساسي خالي من الكمون (معالمة مقارنة)، المعالمة الثانية، باستعمال نظام غذائي أساسي بالإضافة إلى 3 غم كمون كغم من النظام الغذائي، المعالمة الثالثة، باستعمال النظام الغذائي الأساسي بالإضافة إلى 6 غم كمون/كغم من النظام الغذائي. في نهاية هذه التجربة بعد ذبح الدجاج، تم أخذ العينات من لحوم الصدر والفخذ. أوضحت النتائج أن مكملات العلف بالكمون لم تؤثر بشكل معنوي (p <0.01) في نسب الرطوبة في لحوم الصدر، ونسب البروتين في لحوم الفخذ، كما أظهرت النتائج أن تغذية دجاج التسمين على الكمون بمستويات النظام الغذائي الأساسي بالإضافة إلى 3 و 6 غم كمون/كغم من النظام الغذائي، أثر بشكل معنوي (p <0.01) في نسب الدهن، والرماد، قيمة الاس الهيدروجيني، قيمة حامض النتريبوبروتريك، والنتريتيين الكلي،تركيزات النحاس، النيكل، الزئبق، الحديد، المغنيسيوم، الفوسفور والكالسيوم في لحم الصدر. خلصت النتائج إلى أن استخدام الكمون كمكمل غذائي بمستويات 3 و 6 و 9 غم/كغم يحسن معظم الصفات الكيميائية والفيزيائية للحوم.

الكلمات المفتاحية: الكمون، اضافة غذائية، افراخ اللحم، صفات اللحم.