# The effect of diets supplemented with different levels of vitamin E on growth performance, carcass quality, immune response, Liver and kidney functions, oxidative fat stability and economical evaluation of broiler chickens during summer season

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*Abstract*

The experiment was conducted to study the effect of different dietary levels of vitamin E supplementation at different levels on broiler chickens. The responses of broilers tested in this study were growth performance, weight gain, feed conversion, immune response, carcass quality, liver and kidney functions, some blood constituents, oxidative fat stability and economical evaluation between13 and 45 days of Age. A total of 30, day-old broiler chicks were used and distributed in 3 experimental groups designed to 3 dietary levels of vitamin E supplementation: basal diet, basal diet + 60 mg vitamin E / Kg diet and basal diet + 120 mg Vitamin E / Kg diet. Supplementation of broiler chick with α-tocopherol acetate had favorable effect on growth performance; antibody production against Newcastle disease virus, oxidative stability of meat and had no adverse effects on liver and kidney functions. From the nutritional and economical points of view: α – tocopherol acetate had beneficial effect during this study especially in heat stress. Carcass characters were not influenced by vitamin E supplementation in the diet. Vitamin E improved antioxidative status which was reflected in decreased TBA-reactive substances in tissue and liver of α-tocopherol supplemented chickens. It is apparent that the NRC recommended dietary vitamin E levels produce broiler meat tissues that are prone to oxidation than tissues taken from boilers that received elevated dietary α-tocopherol levels. Dietary vitamin E supplementation increased the α-tocopherol deposited in muscle and fat during the life of the bird and protects against meat oxidation after slaughter. The results of the present study indicated that vitamin E supplementation offers good nutritional, management and economical practices for broiler performance and minimize heat stress related reactions in broiler chicks.

## Introduction

High intensity of poultry production requires fast growing strains and rations of high energy density, so poultry rations are often supplemented with oils. Feeding diets with added fat to poultry can confer several economic advantages by providing increased energy levels at a lower cost and is becoming common practice **(31).** Fats added to the diet for fast growing broilers are generally rich in polyunsaturated fatty acids (PUFAs) **(28)**. An increase in the degree of unsaturation of carcass fat of broiler, due to dietary unsaturated fat supplements decreases the carcass lipid stability.

Lipid oxidation is a major cause of quality deterioration in meat and meat products and can give rise to rancidity and formation of undesirable odors and flavors, which affect the functional, sensory, and nutritive value of the meat products **(19)**. Under such condition, vitamin E supplementation even is effective in stabilizing these tissues from oxidation reactions.

The high stocking densities of broiler are highly susceptible to infectious agents either as a result of reduced immune potential **(46; 27)** or as a result of deteriorating environmental hygiene **(1; 24; 29).** One of several approaches to increase responsiveness in high intensity production is to supplement rations with micronutrients **(11).**

Vitamin E supplementation would increase immune responsiveness by reducing oxidation. Vitamin E is a fat soluble vitamin of plant origin, is essential for the integrity and optimal function of the reproductive, muscular, circulatory, nervous and immune systems. Vitamin E reduces free radicals which induced pathological influences during both normal metabolic status and inflammation.

The objective of this study was to determine the effect of supplemental dietary vitamin E provided throughout the experimental period for broiler chicks on their growth performance, immune response, liver and kidney functions, some blood metabolites, carcass quality, oxidative stability of lipids and economical evaluation.

## Materials and methods

### 1. Birds, housing and management

A total of 30 broiler chicks of the Hubbard strain obtained from a commercial source were reared conventionally in floor pens. For acclimatization, the chicks were started on a control starter diet for a period of 12 days.

The birds were distributed at random into three equal groups each of 10 chicks assigned to three experimental dietary treatments. Food and water were provided on ad libitum basis and continuous lighting was used .The experiment was conducted between August and September and with the average room temperature of 32°C. Birds were weighed at the start of the experiment and then weekly for five weeks later after a 12 h (over-night) fast, the daily feed intake for each group was recorded.

### 2. Diets

The basal diet (Table 1) was formulated from corn, soybean meal and broiler concentrate while the deficient nutrients were supplemented using DL-methionine, lysine, dicalcium phosphate and energy augmented by adding oil. The diet was mixed to contain 23% protein and 3200 Kcal, ME / kg and fed allover the experimental period. The first group was served as a control and fed the basal diet, whereas the other groups supplemented with vitamin E at the rate of 60 and 120 mg \ Kg diet respectively as shown in Table (2).

### 3- Experimental procedure:

- **Chicks** had free access to feed and water and were vaccinated according to the sanitary programs for this category and coccidiostats was applied at the prophylactic dose.
- **Feed consumption** was recorded for each treatment. Live body weight in grams was measured for all birds at the beginning of the experiment and was weekly repeated at the same time.

**Table (1): The composition of the experimental diets.**

| Ingredients | Percentage |
|---|---|
| Yellow corn | 50.338 |
| Soybean meal (44%) | 30.730 |
| *Broiler concentrate | 10 |
| Oil | 6.932 |
| **Mineral vitamin premix | 1 |
| Dicalcium phosphate | 0.90 |
| DL- Methionine | 0.10 |
| Lysine | 0.00 |
| Total | 100 |
| Calculated feeding value | |
| CP% | 23 |
| ME (Kcal/kg diet) | 3200 |
| Methionine % | 0.50 |
| Lysine% | 1.24 |
| Calcium% | 1.06 |
| Available phosphorus% | 0,536 |

**Composition:*

*Meat and bone meal 45%, corn gluten 60%, meat and bone meal 50%, fish meal 65%, Soybean meal 44%, salt, limestone, dicalcium phosphate, vitamin premix (7278), mineral premix + choline (7290), DL-methionine, and L-lysine hydrochloride. Company of Soya Egypt for feed production.*

*** Each 3 Kg contain: Vitamin A = 12,000,000 IU, D3 = 2,200,000 IU, E = 10,000 mg, K3 = 2,000 mg, B1 = 1,000 mg, B2 = 5,000 mg, B6 = 1,500 mg, B12 = 10 mg, Niacin = 30,000 mg, Biotin = 50 mg, Folic acid = 1,000 mg, Pantothenic acid = 10,000 mg, Zinc = 50,000 mg, Manganese = 60,000 mg, Iron = 30,000 mg, Copper = 4,000 mg, Iodine = 1,000 mg, Selenium = 100 mg, Cobalt = 100 mg, Calcium carbonate to 3 Kg. Purchased by Multivita for animal nutrition, 6th October city, Egypt registered by Adisseo company, France.*

*The chemical composition of the basal diet was calculated according to the NRC (36).*

**Table (2): Dietary treatments and levels of vitamin E supplementation.**

| Treatments | Supplementation level |
|---|---|
| Control | Basal diet |
| Vitamin E 60 | Basal diet + 60 mg vitamin E \ Kg |
| Vitamin E 120 | Basal diet + 120 mg vitamin E \ Kg |

- **Daily mortality** was recorded for each treatment, and the weekly mortality rate was calculated by subtracting the number of dead chicks from the number of live chicks.
- **Measurements of some blood constituents.**

  At the end of the experiment blood samples were collected during

slaughtering for separation of serum for the quantitative determination of aspartate transaminase (AST) and alanine transaminase (ALT) **(37)**, total serum protein **(18)**, serum albumin **(14)**, total serum cholesterol **(47)**, and serum uric acid **(9)** and total serum creatinine **(17)**. The serum was also used for determination of serum glucose **(44)** and serum triglycerides **(32)**.

- **Determination of immune response:**

The immune response was evaluated by measuring the humeral immunity using heamagglutination inhibition **(HI)** test against Newcastle disease **(5)**. The results of HI titer of the serum samples were recorded and were given titer reference number (TRN) according to **Kaleta (26)** and then they were subjected to data analysis to calculate the geometric mean HI antibody titer. The weights of spleen, thymus and bursa of fabricuius were determined (the responsible immune organs).

- **Carcass yield**

At the end of the experiment ($45^{th}$ day of age) three birds were taken from each group and slaughtered after 12 h fast for carcass yield measurements. The measures include the weight of slaughter, edible and oven carcass, edible organs and in special liver, heart and lymphoid organs.

- **Measuring lipid deterioration**
  - **Extraction of oil from meat and liver:** At the end of the trial, from the slaughtered birds' thigh, breast and liver were removed and frozen immediately at −20 °C, then thawed and ground. The fat extracted from the meat and liver according to the method of **Folch (16).** The extracted fat was used for:
  - **Determination of refractive index:**

    The refractive index was measured using Azeiss refractometer at 25 °C and the results were standardized at 40 °C **(3).**
  - **Determination of acid value:**

    The acid value was measured according to the tentative method **(4).**
  - **Determination of peroxide value**:

    The peroxide value was measured **(3).**
  - **Determination of thiobarbituric number:**

    This method is used for the determination of the volatile aldehydes which formed during rancidity of oils employing the reaction of

thiobarbituric acid (TBA) with these aldehydes, forming quantitative colored complex compound. The intensity of this color can be measured photometrically to be a useful guide to the degree of rancidity.

The method of **Sedlaceck (40)** was applied with some little modification. The TBA solution was prepared by weighing 1 g of TBA in 100 ml measuring flask then 50ml distilled water was added and 2 ml of 3 N NaOH. The flask was gently heated in a water bath until the TBA was completely dissolved. After cooling 0.4 ml of HCl 3 N was added and completed to the mark. Five gm of the oil was weighed in a round bottom flask of 500 ml, 50 ml HCl 3 N was added using some little glass balls to regulate boiling.

The flask was connected to distillation apparatus using water–bath and volatile oxidation products were condensed and collected in 100 ml cylinder. A stop watch was used to regulate the speed of distillation process to collect 30 ml of the distillate in 6 minutes, 20 ml of distillate was pipetted in a test tube 20 x 200 mm and one ml TBA reagent was added followed by one ml phosphoric acid (conc.).

The contents of the tube was thoroughly mixed and then gently heated in a water bath for 35 minutes. Blank experiment was carried under the same conditions and the intensity of the formed red color was measured spectrophotometrically are, 450 nm and established as extinction

- **Financial cost**

As broiler industry is based on momentary returns rather than maximal chick performance, the main purpose of this item is to investigate the economical possibility of using vitamin E supplementation in broiler chick diets. According to guide lines of economic evaluation, the production costs include: chick price, feed cost, management care, and final body weight.

The economical efficiency of the present study could be calculated from input-output analysis based mainly upon the total feeding cost and the prevailing selling price of live body weight.

- **Statistical analysis:** The data were subjected to ANOVA and t-test procedures. Statements of statistical significance were based on $P<0.05$

according to **KaleidaGraph™ (25)**.

## Results and discussion

### 1. Growth performance

Performance of broilers as affected by the addition of vitamin E to the diets at two levels (60 and 120 mg / kg diet) during the experimental period (13 - 45 days of age) is presented in Table (5). Averages of live body weight of all treatments at the beginning of the experiment were nearly similar.

Results in Table (3) indicated that addition of vitamin E at any level during the growing period had no significant effect on body weight, but differences were observed on final body weight between treatments and control group. The highest body weight gain was obtained by chicks fed diet containing 120 mg Vitamin E followed by those fed 60 mg / kg. These results indicated that addition of Vitamin E to broiler diets improved weight gain.

The experiment was conducted with an average room temperature of 32 °C and inclusion of vitamin E in the diet caused improvement in the live weight gain, probably due to alleviating the negative effects of heat stress on broiler (32°C). Vitamin E used as anti-stress effects in high environmental temperature since high environmental temperature have deleterious effects, reducing the performance of poultry because high ambient temperature also reduces thyroid gland function in poultry (**15; 7**). Plasma T3 and T4 are important growth promoters and associated ambient temperature (**33**). The circulating concentrations of T3 and T4 are reduced at high temperature (**20; 8; 21**).

**Table (3): Means ± Standard error (SE) of live body weight change (grams/chick).**

| | The experimental groups | | |
|---|---|---|---|
| **Age / days** | **Control** | **Vitamin E 60 mg** | **Vitamin E 120 mg** |
| **At 13 days** | 304 ± 4 | 308 ± 10.2 | 312 ± 18.5 |
| **At 20 days** | 636 ± 18.3 | 618 ± 11.1 | 634 ± 29.2 |
| **At 27 days** | 1040 ± 24.5 | 1032 ± 20.6 | 1040 ± 40 |
| **At 34 days** | 1380 ± 101.9 | 1400 ± 44.7 | 1480 ± 66.3 |
| **At 41 days** | 1844 ± 21.3 | 1772 ± 48.4 | 1728 ± 62.8 |
| **At 45 days** | 1944 ± 56.3 | 2076 ± 52.9 | 2160 ± 67.8 |

Fig (1):Effect of vitamin E supplementation on growth changes of different experimental broiler chick groups.

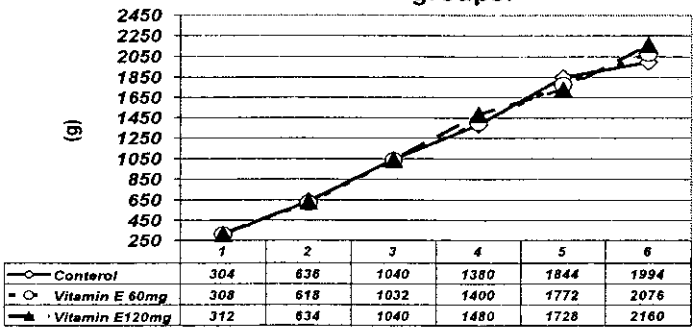


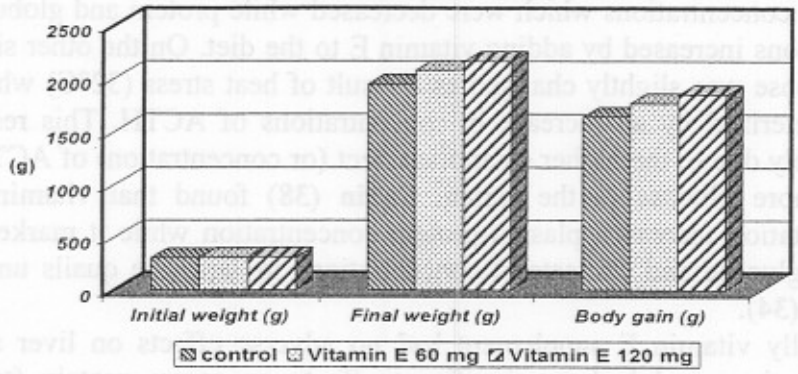

Table (4): Means ± Standard error (SE) of live body weight gain (grams/chick).

| | The experimental groups | | |
|---|---|---|---|
| Age / days | Control | Vitamin E60 mg | Vitamin E 120 mg |
| 13 - 20 | 332 ± 18.5 | 310 ± 6.3 | 322 ± 15.6 |
| 20 – 27 | 404 ± 16 | 414 ± 24.4 | 406 ± 9.7 |
| 27 – 34 | 340 ± 49 | 368 ± 30 | 440 ± 40 |
| 34 – 41 | 464 ± 49 | 372 ± 27.2 | 248 ± 38.2 |
| 41 – 45 | 100 ± 21.9 | 304 ± 28.7 | 432 ± 54.6 |
| 13 -45 | 1640 ± 52.9 | 1768 ± 53.9 | 1848 ± 57.5 |

Table (5): The effect of different dietary vitamin E levels on chick performance.

| | The experimental groups | | |
|---|---|---|---|
| Item | Control | Vitamin E 60 mg | Vitamin E 120 mg |
| Average daily feed intake (g) | 101.9 | 101.9 | 101.9. |
| Feed conversion ratio | 1.988 | 1.84 | 1.76 |
| Average daily body gain (g) | 51.25 | 55.25 | 57.75 |
| Total energy intake (kcal/day) | 326.08 | 326.08 | 326.08 |
| Energy (Kcal) /kg body gain | 6362.54 | 5901.9 | 5646.41 |
| Total protein intake (g/day) | 23.4 | 23.4 | 23.4 |
| Protein/kg body gain (g) | 456.59 | 423.53 | 405.19 |

**Fig (2):Effect of different levels of vitamin E on growth performance of broiler chicks from 13 - 45 days of age.**




Results of feed conversion (Table 5) indicated that dietary supplementation of vitamin E improved feed conversion of broiler chicks. This improvement may be attributed to the immunological effect of α-tocophorol, anti-stress characters against high temperature and the antioxidant actions.

**2. Effect of different dietary vitamin E levels on some blood constituents**

Data in Table (6) summarized the effect of feeding diet supplemented with different levels of vitamin E as feed supplement on some blood constituents. No significant effects were detected attributable to vitamin E supplementation on liver enzymes (ALT and AST) and kidney function (creatinine and urea).

On the other hand vitamin E supplementation significantly decreased serum cholesterol and triglycerides compared to the control group. This effect may be due to vitamin E as antioxidant protects high amount of unsaturated fatty acids from oxidation which may stimulate the cholesterol excretion into the intestine and the excretion of cholesterol to the bile acids.

Review recorded that in heat stress serum concentration of Adrenocorticotropic hormone (ACTH) was lower with dietary supplemental vitamin E probably indicating a lowered response to heat stress by supplementation of this vitamin. Similarly, **Sahin (38)** found that heat stress tended to elevate plasma ACTH concentrations which were significantly reduced by vitamin E supplementation in Japanese quails. The effects of vitamin E on blood parameters of broilers under heat stress are related to

serum concentration of ACTH.

However, the results of the present study showed similar trends for the effects of vitamin E on serum glucose, uric acid, triglyceride, and cholesterol concentrations which were decreased while protein and globulin concentrations increased by adding vitamin E to the diet. On the other side, serum glucose was slightly changed as a result of heat stress (32°C) which was characterized by an increase in concentrations of ACTH. This result was probably due to the higher catabolic effect (or concentration) of ACTH, yielding more glucose in the serum. **Sahin (38)** found that vitamin E supplementation increased plasma protein concentration while it markedly decreased glucose and cholesterol concentrations in Japanese quails under heat stress **(34).**

Generally vitamin E supplement had no adverse effects on liver and kidney functions and had no significant effects on serum protein (total protein, albumin, globulin and A / G ratio) and supplementation decreased significantly serum triglycerides and cholesterol, numerically as compared to the control group.

**3. Immune response and weight of lymphoid organs**

The lymphatic tissues (spleen, thymus, and bursa of fabricuius) have a considerable role in bird's immunity **(23)**. The effect of vitamin E supplementation on lymphoid organs and antibody titer are presented in Table (7).

Results showed that the value of antibody titer increased significantly by vitamin E supplementation to broilers diet as compared to the control group. The improvement in antibody titer may be due to that vitamin E is necessary for mitochondria and microsomes of the liver against oxidative stress **(12; 39).** Vitamin E could modify the overall balance of antioxidants in cell, resulting in different pools of antioxidants in cell that carry different immmunoregulatory properties.

In summary, the present study demonstrated that dietary vitamin E enhances the antibody response to Newcastle disease virus. Vitamin E supplementation may have different effects on the cellular free radicals, antioxidant balance events and activation states of the immune cells. The increased IgG production is probably due to first; the increased cellular multiplication by vitamin E, rather than to the increased antibody production of single vitamin E could modify the overall balance of antioxidants in cell

(43). Second; high levels of vitamin E also cause an increase in phagocytosis, during the first few hours after antigen stimulus (43). Third; vitamin E stimulates the helper activity and cooperation between T-cells and B- cells in immunoglbulin production, particularly when the animal already has an immunologic memory.

**Table (6): Effect of vitamin E supplementation on some blood serum constituents of broiler chicks.**

| Item | Unit | Experimental groups | | |
|---|---|---|---|---|
| | | Control | Vitamin E 60 mg | Vitamin E 120 mg |
| **Liver function:** | | | | |
| ✓ **Total protein** | g / dL | 7.01±0.0 | 7.01 ± 0.17 | 7.38 ± 0.22 |
| ✓ **Albumin** | g / dL | 2.76±0.23 | 2.86 ± 0.16 | 2.48 ± 0.23 |
| ✓ **Globulin** | g / dL | 4.24±0.23 | 4.33±0.15 | 4.9±0.23 |
| ✓ **A\G ratio** | | 0.66±0.09 | 0.62±0.05 | 0.51±0.07 |
| ✓ **ALT** | U / L | 4.8 ± 0.9 | 3.2 ± 0.23 | 3.2 ± 0.34 |
| ✓ **AST** | U / L | 13.0 ± 0.0 | 19.0 ± 2.31 | 13.0 ± 0.28 |
| **Glucose:** | mg/dL | 155.18±0.23 | 154.74±3.86 | 153.95±4.96 |
| **Lipid profile:** | | | | |
| ✓ **Cholesterol** | mg/dL | 118± 2.88 | 99±4. 6 | 87±1.15 |
| ✓ **Triglycerides** | mg/dL | 103.5±0.0 | 89.66±1.38 | 96.55±2.42 |
| **Kidney function:** | | | | |
| ✓ **Creatinine** | mg/dL | 0.1±0.005 | 0.10±0.006 | 0.10±0.011 |
| ✓ **Uric acid** | mg/dL | 3.6 ± 0.23 | 2.5±0.17 | 2.2±0.11 |

For this reason, vitamin E seems to facilitate the shift of antibody production from IgG, which is typical of the initial stage of the immune response to IgG production (42).This results agree with that of **Younis (45).** They showed that HI titer to Newcastle disease virus (NDV) vaccine one week post immunization was significantly higher ($p \leq 0.05$) in broiler breeder receiving 60 and 120 mg vitamin E \ kg diet.

On the other hand, the effect of vitamin E on lymphoid organs weights indicated that the spleen, thymus and bursa weight was not affected by addition of vitamin E at any level.

Table (7): The effect of different levels of Vitamin E on immune response and lymphoid organ weights of broiler chicks.

| Item | The experimental groups | | |
|---|---|---|---|
| | Control | Vitamin E 60 mg | Vitamin E 120 mg |
| Haemagglutination inhibition (HI) titer* | 3.3 ± 0.6 | 16 ± 0.0 | 51.6 ± 12.3 |
| Weight of lymphoid organs (% of live weight at slaughter): | | | |
| • Spleen | 0.109± 0.02 | 0.082±0.005 | 0.108±0.017 |
| • Thymus | 0.25±0.046 | 0.14±0.035 | 0.20±0.039 |
| • Bursa of fabricuius | 0.085±0.01 | 0.07±0.007 | 0.10±0.022 |

*HI test with 8 HA units and 1% chickens RBCs

Fig (3) : Effect of vitamin E supplementation on HI titer of different experimental groups of broiler chicks.

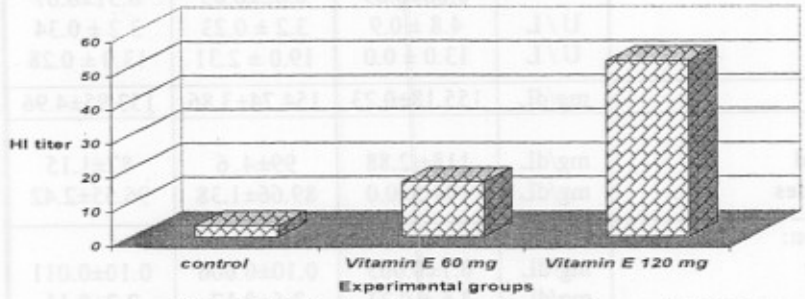
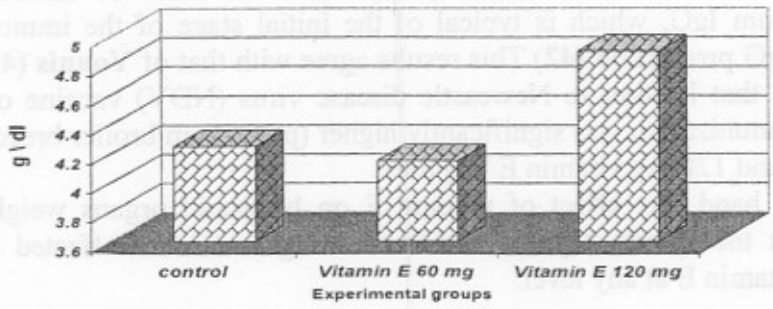



Fig (4):Effect of vitamin E supplementation on serum globulin content of different experimental groups of broiler chicks.



## 4. Carcass characters:

Data present in Table (8) showed that broilers fed diets supplemented with Vitamin E showed non significant effects of carcass parameters compared to the control group.

**Table (8): The effect of different dietary levels of vitamin E on carcass yield of broiler chicks**

| Item | Experimental groups | | |
|---|---|---|---|
| | Control | Vitamin E 60 mg | Vitamin E 120 mg |
| • Live body weight (g) | 1966.6±85.1 | 2160±23.9 | 2100±152.7 |
| Items as % of live body weight | | | |
| • Slaughtered carcass | 86.16±0.81 | 83.94±1.74 | 85.34±0.55 |
| • Oven ready carcass | 71.2±0.95 | 88.8±1.2 | 72.4±1.19 |
| • Edible organs | 2.92±0.04 | 2.74±0.28 | 2.35±0.06 |
| • Liver | 2.34±0.085 | 2.21±0.23 | 1.82±0.06 |
| • Heart | 0.466±0.02 | 0.44±0.04 | 0.416±0.01 |
| • Gizzard and crop | 2.69±0.17 | 2.46±0.09 | 2.25±0.2 |
| • Pancreas | 0.208±0.01 | 0.21±0.03 | 0.21 ± 0.009 |
| Intestinal length (cm) | 163.67±1.3 | 186.66±3.33 | 168.66±9.4 |
| Intestinal width (cm) | 1.2±0.046 | 1.33±0.08 | 1.2 ± 0.03 |

## 5. Influence of dietary vitamin E on the oxidative stability and quality of broiler meat:

The physicochemical characters of previously refrigerated and frozen meat at -20°C are shown in Table (9). In the broiler diets, fat was added to the diet for fast growing broilers are generally rich in polyunsaturated fatty acids (PUFAs) **(28)**. Increasing in the PUFA content in the diet results is an increase in the degree of unsaturation of meat and other edible parts, thereby increasing susceptibility to oxidation and leading to development of off-flavors and off odors and lower consumer acceptability **(10).**

Incorporation of PUFA into meat lipids is also favored for human health reasons. The Food and Agriculture Organization promote increasing the ratio of polyunsaturated to unsaturated fatty acids in the human diet to prevent arteriosclerosis and coronary heart disease **(13)**.

Lipid oxidation is an important determinant of shelf life of meat and meat products. Post-slaughter biochemical changes involved in the conversion of

muscle to meat are accompanied by a loss of cellular antioxidant defenses and an increased propensity of meat lipids to undergo oxidation. Poultry meat and meat products are susceptible to oxidative deterioration, and oxidation often determines the shelf life of poultry meat.

The degree of oxidation of meat is generally assessed by measuring the content of primary oxidation [i.e., through the measurement of lipid hydroperoxide value] or secondary oxidation [i.e., through the measurement of malondialdehyde, or cholesterol oxidation products (COP). The analytical methods used in this study to determine liberated products were the physicochemical characters especially thiobarbituric acid (TBARS value) as a measure of the degree of this oxidation. A higher TBARS value indicates a greater degree of oxidation of meat. Table (9) revealed that the TBARS, acid , peroxide and refractive index values obtained from previously refrigerated and frozen meat samples ( breast and thigh) were influenced by the concentration of α-tocopherol in the diet (Table 2).

An inverse relationship was observed between values and dietary α-tocopherol concentration. Birds fed basal diet supplemented with 60 mg α-tocopherol had significantly lower breast and thigh tissue values and thus greater oxidative stability than samples taken from birds of other experimental groups. On the same side, the acid values were lowers by 24.61 to 28 % for 120 and 60 mg vitamin E supplementation respectively. Also the finding from this analysis demonstrates that vitamin E supplementation decease peroxide values of fat extracted from broiler chick groups fed diet supplemented with vitamin E. Similar results were recorded with the TBA values of fat extracted from liver samples. They were influenced by the concentration of tocopherol in the diet (Table 2).

The results of this study indicated that dietary vitamin E concentration can influence the oxidative stability of muscle and liver of broiler chicks, since antioxidants characters of vitamin E occur by trapping free radicals; protecting fatty acids and cholesterol from oxidation. In this process, vitamin E releases a hydrogen atom, which is captured by a peroxyl radical which is thereby reduced to form a hydroperoxide.

Vitamin E radicals are extremely stable and do not react with polyunsaturated fatty acids. This study showed that vitamin E supplementation improves the oxidative stability of broiler carcasses under frozen and refrigerated storage, so carcasses of broilers fed non-supplemented diets could only be refrigerated for short periods and frozen

for periods less than supplemented groups. Supplementation of as little as 60 mg vitamin E / kg feed improved frozen storage time, whereas 120 mg vitamin E / kg feed extended less results in refrigerated carcasses.

The time-course of TBARS values in meat and the effect of vitamin E in preventing oxidation may have important economic implications for the retail industry. This investigation showed that feeding poultry a higher level of α-tocophreol provides the poultry industry with a simple method for improving oxidative stability, sensory quality, shelf life, and acceptability of poultry meats. In addition to the stabilizing effect on meat and meat products, a raised vitamin E level (**30; 22; 41**) significantly enhances net income per bird.

Many review found that Supplementation of the diet with vitamin E increases the concentration of α-tocopherol in membranes, especially those of mitochondria and microcosms, and thus significantly reduces the susceptibility of membranes to lipid oxidation **(35; 2; 34)**.and the absence of α-tocopherol, cholesterol which is present in cellular membranes is susceptible to oxidative processes initiated by free radicals. Concern about the presence of cholesterol oxidation products (COPs) has increased in recent years.

Scientific opinion has linked the presence of these compounds **(7-ketocholesterol, 25-hydroxycholesterol, cholestane triol, etc.)** to the development of atherosclerotic lesions. Also the vitamin E has a role on the meat organoleptic qualities through the following facts, deposition of vitamin E in cellular membranes increases the α-tocopherol content of muscle, and this has very important consequences in terms of the organoleptic qualities of the meat.

In frozen meat, some catalysts and antioxidants remain trapped in the solid (frozen) phase and the antioxidant activity of the cytosolic phase does not function optimally. In addition, free lipid radicals are soluble in the lipid fraction and more stable at low temperatures. This allows them to diffuse over considerable distances and thus extend the oxidation reaction.

Being lipid-soluble, vitamin E acts as the first line of antioxidant defense and can thus be consumed rapidly. A problem of great economic importance in the marketing of meat is formation of PSE meat (pale, soft, and exudative). By increasing metabolic rate, stress prior to slaughter causes accumulation of lactic acid and thus a fall in the pH of muscle.

Tenderness of meat diminishes as final pH diminishes, and color is also

affected. The occurrence of PSE meat in chickens is due to an over-reaction of the birds to stress. Birds deficient in vitamin E have high plasma levels of pyruvate kinase and creatine kinaseas as result of damage to cellular membranes by free radicals. Increased deposition of α-tocopherol in cellular and sub cellular membranes of muscle as a result of increased dietary supplementation not only improves the integrity of membranes, but also influences the degree to which PSE meat is formed.

The improvement in the meat quality obtained by adding vitamin E was significant, there being a significant reduction in losses due to discoloration, the allover results concerning the relation between α-tocopherol shows the benefit that such supplementation brings to the meat producer and trader. The producer is able to supply meat of higher quality that should fetch a higher price, while the trader benefits from the smaller losses due to exudation and discoloration of the meat and is able to market a product of higher organoleptic and nutritional quality.

*Generally, broiler fed diet supplemented with α-tocopheryl acetate lead to α-tocopherol–enriched meat (6) and had several economic advantages by increasing oxidative stability of broiler meat, increasing the ratio between PUFA and saturated fatty acids in broiler meat through decreasing the oxidation of PUFA and improving storage quality of the meat as compared to the control group..*

**Table (9): The physicochemical properties of broiler fat of different experimental groups**

| Item | Experimental groups | | |
|---|---|---|---|
| | Control | Vitamin E 60mg | Vitamin E 120mg |
| **Tissue fat:** | | | |
| ✓ **Acid value** | 9.67±0.04 | 6.9±0.075 | 7.29±0.098 |
| ✓ **Peroxide value** | 2.95±0.023. | 2.27±0.13 | 2.29±0.11 |
| ✓ **Thiobarbituric acid** | 4.37±0.21 | 4.29±0.09 | 4.64±0.075 |
| ✓ **Refractive index** | 1.34±0.001 | 1.34±0.0013 | 1.34±0.0017 |
| **Liver fat:** | | | |
| ✓ **Thiobarbituric acid** | 2.65±0.30 | 2.65±0.37 | 2.14±0.064 |
| ✓ **Refractive index** | 1.35±0.0007 | 1.35±0.0018 | 1.35±0.0016 |

Fig (5):Effect of vitamin E supplementation on peroxide number of tissue fat of different experimental broiler chick groups.

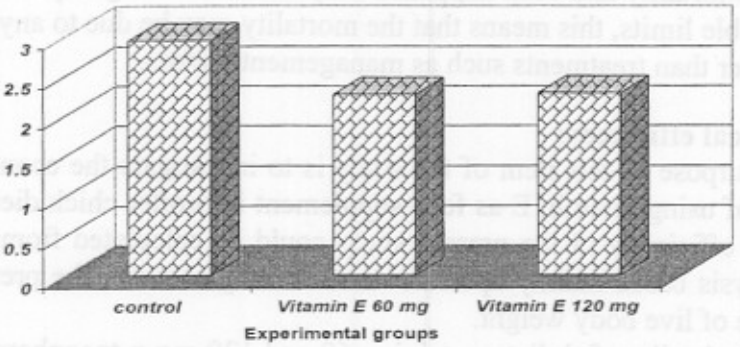



Fig (6):Effect of vitamin E supplementation on acid value of tissue fat of different experimental broiler chick groups.

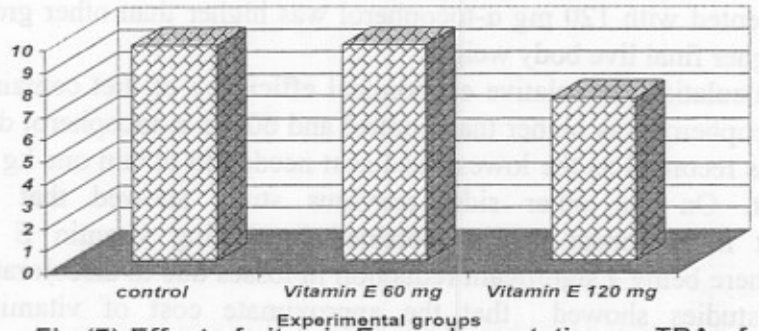
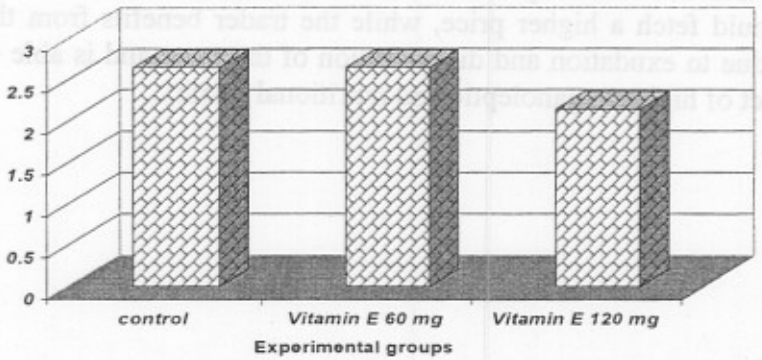



Fig (7):Effect of vitamin E supplementation on TBA of liver fat of different experimental broiler chick groups.



**6. Mortality:**

The mortality had been happened only in the control group within the permissible limits, this means that the mortality may be due to any reasons rather than treatments such as management factors.

**7. Economical efficiency:**

The main purpose of this item of the study is to investigate the economical possibility of using vitamin E as feed supplement in broiler chick diets. The economical efficiency of the present study could be calculated from input-output analysis based mainly upon the total feeding cost and the prevailing selling price of live body weight.

Feed cost for broilers fed diet containing 60 and 120 mg α-tocopherol were 6.21 and 6.23LE /chick, being higher than that of the control group which was 6.2 L.E / chick (Table 11 and fig 8). On the other side, the total revenue values were calculated (Table 11) and the values of experimental groups fed diet supplemented with 120 mg α-tocopherol was higher than other groups due to the higher final live body weight.

Finally by calculation the relative economical efficiency of diet containing 120 mg α-tocopherol was higher than control and 60 mg α-tocopherol diets. Such diet was recorded as the lowest feed cost needed to obtain one kg live body weight. On the other side, previous study showed that The improvement in the meat quality obtained by adding vitamin E was significant, there being a significant reduction in losses due to discoloration, and recent studies showed that the approximate cost of vitamin E supplementation and the benefit that such supplementation brings to the meat producer and trader. The producer is able to supply meat of higher quality that should fetch a higher price, while the trader benefits from the smaller losses due to exudation and discoloration of the meat and is able to market a product of higher organoleptic and nutritional quality.

ɔle (10): Price list of different ingredients used in the diet formulation (year 2006).

| Diet ingredients and additives | Price L.E. / Kg |
|---|---|
| Yellow corn | 0.966 |
| Soybean meal 44% | 1.695 |
| Concentrate mixture 52% protein | 3.066 |
| Dicalcium phosphate | 3.33 |
| Oil | 4.00 |
| Mineral-vitamin premix | 7.33 |
| DL. Methionine | 24.00 |
| α-tocopherol | 60 |
| Price per chick at hatch | 3.25 |
| Management per chick | 0.5 |
| Selling price | 8.5 |

ble (11): Economic evaluation of different experimental diets.

| Item | Unit | Experimental groups | | |
|---|---|---|---|---|
| | | Control | 60 mg vitamin E | 120 mg vitamin E |
| 'inal body weight | g | 1944 | 2076 | 2160 |
| 'rice / chick | LE | 3.25 | 3.25 | 3.25 |
| Management /chick | LE | 0.5 | 0.5 | 0.5 |
| 'eed cost up to 13 days | LE | 0.64 | 0.64 | 0.64 |
| 'eed cost from 13-45 lays | LE | 5.56 | 5.57 | 5.59 |
| Total feed cost /chick | LE | 6.2 | 6.21 | 6.23 |
| Total cost /chick | LE | 9.95 | 9.96 | 9.98 |
| Total revenue/chick | LE | 16.524 | 17.646 | 18.360 |
| Net revenue / chick | LE | 6.574 | 7.686 | 8.38 |
| Economic efficiency | LE | 0.661 | 0.772 | 0.840 |
| Relative economic efficiency | LE | 0.00 | 1.17 | 1.27 |
| Total feed cost (kg \ LBW) | LE | 3.19 | 2.99 | 2.88 |

Fig (8):Effect of different levels of vitamin E on economical evaluation of different experimental diets.

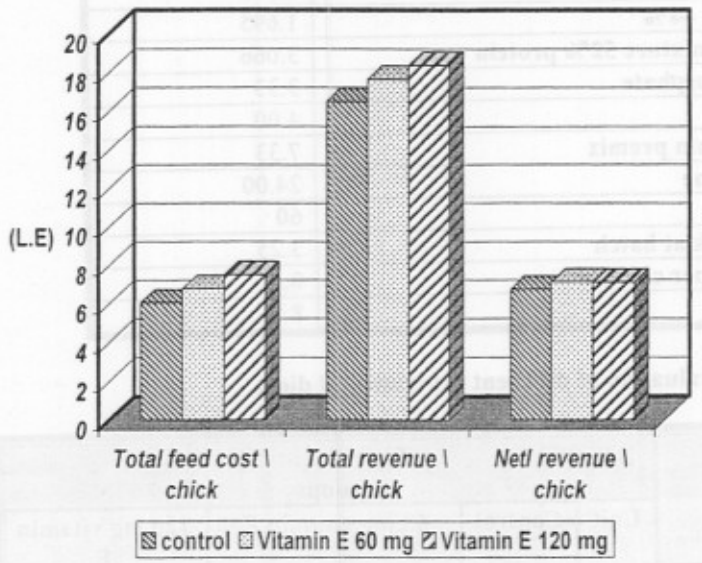
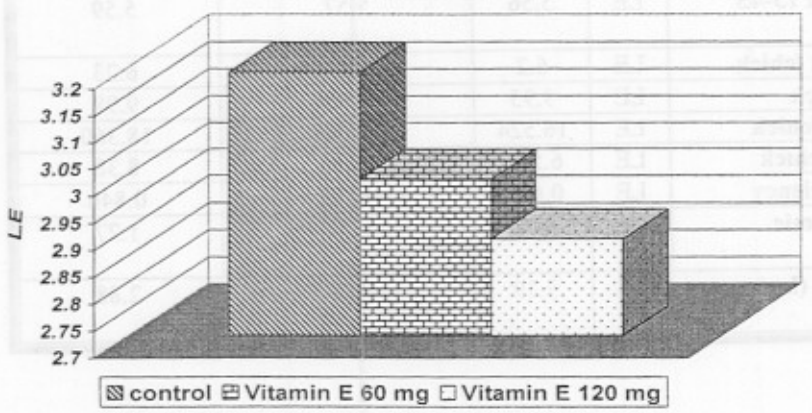



Fig (9) : Effect of vitamin E supplementation on price of feed cost to produce 1 Kg live body weigh of broiler chicks.



***Generally the results in this study indicated that supplementation of broiler chick with α-tocopherol acetate has favorable effect on growth performance; antibody production oxidative stability of meat and had no adverse effects on liver and kidney functions. From the nutritional and economical points of view: 60 mg α–tocopherol acetate is successful level under condition of this study especially in heat stress (32°C).***

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# الملخص العربى

## تأثير الغذاء المحتوى على مستويات مختلفة من فيتامين ه على النمو وخواص الذبيحة والإستجابة المناعية ووظائف الكبد والكلى ودرجة ثبات الدهن ضد الأكسدة والتقييم الإقتصادىلكتاكيت التسمين خلال فصل الصيف

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أجريت هذه التجربة الغذائية بكلية الطب البيطري بمشتهر وقد صممت هذه التجربة لتقييم تأثير إستخدام إضافة فيتامين ه بمستوى (صفرو ٦٠ و ١٢٠ ملليجم لكل كجم من العليقة) علىالنمو وخواص الذبيحة والإستجابة المناعية ووظائف الكبد والكلى ودرجة ثبات الدهن ضد الأكسدة والتقييم الإقتصادى وقد أستخدمت كتاكيت تسمين هبردعمر ١٣ يوم وتم تقسيمها بصورة عشوائية الى ثلاث معاملات الأولى غذيت على عليقة لم تزود بكيات إضافية من فيتامين ه كعليقة كنترول والمعاملتين الآخريين غذيتا على عليقة الكنترول مضاف اليها ٦٠ و ١٢٠ ملليجم فيتامين ه لكل كجم من العليقة على الترتيب.إستمرت التغذية لمدة ٣٢ يوم وأوضحت النتائج المتحصل عليها على الأتى : كان هناك تأثير إجابى على النمو والإستجابة المناعية ضد مرض النيوكاسل و درجة ثبات الدهن ضد الأكسدة ومن الجانب الإقتصادى أدى إضافة فيتامين ه إلى زيادة الناتج الربحى النهائى وعلى الجانب الآخر لم يكن هناك أى تأثير عكسى على وظائف الكبد والكلى وإنخفضت نسبة الكلستيرول فى الدم وفى النهاية يمكن القول بأن إضافة فيتامين ه إلى كتاكيت التسمين فى فصل الصيف أدى إلى نتائج جيدة على التغذية والرعاية وإقتصاديات التربية وجودةاللحم والإقلال من تأثير الإجهاد الحرارى.