Some carcass traits and meat chemical characteristics of karadi lambs injected with testosterone enanthate

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Abstract. This study aimed to investigate the effect of different injection doses of testosterone enanthate (TE) on some carcass traits and meat chemical characteristics of karadi lambs. Twenty-seven male lambs in weaning age and average live weight 28.5±3.4 kg of Karadi breed were allocated randomly by weight into three treatments (six lambs for each treatment), T1 (control) treatment, T2 was treated with 200 mg of TE injection (IM/week) and T3 was treated with 400 mg (IM/week) of it. All animals were fed with unified concentrate diet (table1) once a day (3% of lamb's weight), ad libitum barley straw was provided and the water for all lambs was free. Each lamb was isolated in a separate pin. Three lambs of each treatment were chosen randomly and weighted then slaughtered humanly at the last of three different rearing periods (60, 90 and 120 days) from the study beginning. Several measurements have been taken such as hot, cold carcass weight, carcass length, carcass thorax circumference, thickness of fat, rib eye area, carcass cuts weight, offal weight, carcass and offal fat weight, longissimus dorsi approximate analysis. Results showed an increase in each: live, carcass, carcass cuts weights, rib eye area, carcass cuts weight, offal weight, carcass and offal fat weight, longissimus dorsi approximate analysis. Results showed an increase in each: live, carcass, carcass cuts weights, rib eye area, carcass and offal fat, kidney, liver and lunge weight. Also there was a decrease in each: fat thickness, fat tail and testis weight with increased TE injection dose (between 200-400 mg).

1. Introduction
Small ruminant plays an important role in food security of Iraq and region countries, where peoples depends on their meats to get the basic daily nutritional needs such as essential amino acids, fatty acids, vitamins and minerals. Sheep are consider a major source of red meat which is relied on by the people due to its ease and widespread ranching and ability to resist the acute environmental conditions characterized by the region [1], in addition to the reduction of capital required for the projects of that ruminant breed comparing with the other meat sources projects such as calves [2, 3]. Karadi is the native sheep breed at Iraqi north region, rams and ewes are characterized as they have no horns, and their body is longitudinal with shorter legs than Awassi, average rams weight is between 80-100kg and ewes are between 60-70kg, it reared to produce meat, milk and wool [4].
In Iraq as in other countries there are many researches in animal production field aims to get quality and quantity enhancements in different animal products, as an example in meat production, the use of different types of growth promoters such as androgenic hormones [5, 6]. Using of hormones with animal has been subjected to many criticisms, and in some countries importers and marketers have been prevented from dealing with that kind of products, while it still allowed in others. Researches continue in this direction to study the effects of using those promoters on animals and consumers [7, 8, 6]. Testosterone enanthate is a form of androgen which is known as a natural hormone, or anabolic steroids (anabolic-androgenic steroids) as a medication [9]. All forms of androgen play a main role in the virilizing effects such as skeletal muscle volume and protein synthesis [10, 11]. Several studies have been conducted on different spices to investigate the effects of using androgen forms on body muscle mass and growth rate due to its effect as a growth promoters compound [12] or stimulation of voluntary feed intake [13]. The aim of this study was to test the effect of testosterone enanthate injection on some Karadi lambs carcass traits and meat chemical characteristics.

2. Materials and Methods

This experiment was conducted in research station- Faculty of Agriculture Sciences-University of Sulaimani. Where Twenty seven male lambs in weaning age and average live weight 28.5±3.4 kg of Karadi breed were allocated randomly by weight into three treatments (six lambs for each treatment), T1 was control treatment, T2 was treated with 200 mg of testosterone enanthate injection (IM/week) and T3 was treated with 400 mg (IM/week) of it. All animals of treatments were feed with unified concentrate diet (table1) once a day (3% of lamb's weight), ad libitum barley straw was provided and the water for all lambs was free. Each lamb was isolated in a separate pin. Three lambs of each treatment were chosen randomly and weighted then slaughtered humanly at the last of three different rearing periods (60, 90 and 120 days) from the study beginning. Several measurements have been taken such as hot, cold carcass weight, carcass length, carcass thorax circumference, thickness of fat, rib eye area, carcass cuts weight [14], eaten and uneaten offal weight, carcass and offal fat weight, also longissimus dorsi approximate analysis [15]. SAS program [16] with 3x3 factorial Completely Randomized Design (CRD) was used to evaluate the effect of testosterone enanthate levels and slaughtering age periods, then Duncan [17] tests were used to study means significant differences.

| Ingredient                  | %  |
|-----------------------------|----|
| Yellow corn                 | 39 |
| Barley grain                | 49 |
| Soybean meal                | 10 |
| Salt                        | 1  |
| minerals and vitamins mixture| 1  |

| Chemical composition / kg dry matter |   |
|-------------------------------------|--|
| Dry matter                          | 94 |
| Organic matter                      | 91 |
| Total nitrogen                      | 21.3 |
| Crude fibers                        | 50.8 |
| Ether extract                       | 34 |
| Nitrogen free extract               | 700 |
| Metabolisable energy MJ/Kg          | 12.7 |
3. Results and Discussion

Table 2 show the effect of different treatments on live weight and carcasses traits. Data from the table show that there is a significant (P≤0.05) effect of testosterone enanthate injection treatments (T2 and T3) comparing with control treatment T1 within slaughtering periods on each live weight, hot carcass weight and cooled carcass weight. That effect can be observed clearly in second period (90 days). Data also show no effects of treatments on each shrink percentage, carcass length and Carcass thorax circum.

Table 2. Effect of different treatments on live weight and carcasses traits

| Characteristics | Treatments | 60 days | 90 days | 120 days |
|-----------------|------------|---------|---------|---------|
|                 |            | T1      | T2      | T3      | T1      | T2      | T3      |
| Live weight (kg)| Control    | 50.3 ±0.3 a | 53.2 ±0.2 a | 56.2 ±2.8 a | 53.8 ±0.6 b | 57.6 ±2.4 ab | 62.45 ±2.1 a | 58.1 ±0.9 a | 59.5 ±4.1 a | 63.9 ±4.5 a |
| Hot carcass     | (200mg)   | 22.50 ±0.50 b | 23.75 ±0.25 ab | 24.75 ±0.25 a | 25.25 ±1.25 b | 26.62 ±0.37 b | 29.25 ±1.25 a | 27.60 ±0.50 b | 28.50 ±1.60 ab | 29.17 ±0.77 a |
| weight (kg)     | Tes. enanthate | 22.05 ±0.49 b | 23.27 ±0.24 ab | 24.25 ±0.24 a | 24.74 ±1.22 b | 26.09 ±0.37 b | 28.66 ±1.22 a | 27.05 ±0.49 a | 27.93 ±1.54 a | 28.59 ±0.72 a |
| cooled carcass  | (400mg)   | 38.09 ±1.80 a | 38.53 ±0.87 a | 38.62 ±0.32 a | 37.82 ±0.40 a | 35.30 ±0.64 a | 39.25 ±0.13 a | 37.39 ±2.51 a | 35.51 ±0.60 a | 38.09 ±1.03 a |
| weight (kg)     | Tes. enanthate | 83.5 ±0.5 a | 86.0 ±5.0 a | 85.0 ±1.0 a | 81.5 ±4.5 a | 82.5 ±4.5 a | 86.0 ±3.0 a | 79.5 ±0.5 a | 83.0 ±3.0 a | 84.5 ±1.5 a |
| Shrink (%)      | Control    | 37.90 ±1.80 a | 38.53 ±0.87 a | 38.62 ±0.32 a | 37.82 ±0.40 a | 35.30 ±0.64 a | 39.25 ±0.13 a | 37.39 ±2.51 a | 35.51 ±0.60 a | 38.09 ±1.03 a |
| carcass length  | (200mg)   | 40.0 ±1.0 a | 40.0 ±2.0 a | 39.5 ±0.5 a | 41.5 ±0.5 b | 44.5 ±2.5 a | 46.0 ±3.0 a | 44.0 ±1.0 a | 42.5 ±1.5 a | 43.5 ±2.5 a |
| (cm)            | Tes. enanthate | 40.0 ±1.0 a | 40.0 ±2.0 a | 39.5 ±0.5 a | 41.5 ±0.5 b | 44.5 ±2.5 a | 46.0 ±3.0 a | 44.0 ±1.0 a | 42.5 ±1.5 a | 43.5 ±2.5 a |

Different letters horizontally within period refer to significant differences (P≤0.05) between means.

Table 3 show the effect of different treatments on carcass cuts weight, fat tail, rib eye area and fat thickness. We can notice that most of carcass cuts weight within slaughtering period did not affected significantly by the injection treatments and for all slaughtering periods, but it can be observed that there was an insignificant effect of injection treatments means (T2 and T3) through the high weight of it comparing with T1 for all periods and for all cuts. Results of rib eye area was in the same direction, where there was a significant (P<0.05) superiority of injection treatments means (T2 and T3) to control treatment T1 at the second and third slaughtering periods. Results of both fat tail and fat thickness were opposite; control treatment mean was significantly (P<0.05) superior to injection treatments means in all slaughtering periods.
Table 3. Effect of different treatments on carcass cuts weight, fat tail, rib eye area and fat thickness

| Characteristics | Treatments | 60 days | 90 days | 120 days |
|-----------------|------------|---------|---------|----------|
|                 | T1         | T2      | T3      | T1        | T2      | T3      | T1        | T2      | T3      |
| Neck (gm)       | control    | ±57.5 b | ±66.5 a | ±41.0 a  | 729.0 ±11.0 a | 901.5 ±21.5 a | 993.0 ±70.0 a | ±107.5 a | ±21.0 a | ±88.5 a |
| Shoulder (kg)   | 2.04 ±0.112 b | 2.74 ±0.099 a | 2.36 ±0.343 b | 2.23 ±0.162 a | 1.99 ±0.940 a | 2.55 ±0.415 a | 2.29 ±0.080 b | 3.03 ±0.072 a | 2.14 ±0.255 b |
| Breast (gm)     | 675.9 ±30.0 a | 837.5 ±17.5 a | 777.0 ±152.5 a | 887.5 ±27.5 a | 1160.0 ±80.0 a | 1145.0 ±5.0 a | 1222 ±22.5 a | 1082.5 ±14.2 a | 1310.0 ±33.0 a |
| Rib (gm)        | 4857.5 ±87.5 b | 1245.0 ±30.0 a | 1202.5 ±82.5 a | 1205.0 ±75.0 a | 1367.5 ±62.5 a | 1405.0 ±16.0 a | 1282.5 ±72.5 a | 1212.5 ±62.5 a | 1467.5 ±17.2 a |
| Fore shank (gm) | 510.0 ±25.0 a | 547.5 ±32.5 a | 670.0 ±50.0 a | 482.5 ±52.5 a | 557.5 ±37.5 a | 637.5 ±52.5 a | 547.5 ±22.5 a | 622.5 ±32.5 a | 640.0 ±65.0 a |
| Flank (gm)      | 317.5 ±72.5 a | 265.0 ±55.0 a | 362.5 ±42.5 a | 317.5 ±5.0 c | 415.0 ±65.0 b | 500.0 ±45.0 a | 532.5 ±47.5 a | 515.0 ±85.0 a | 545.0 ±35.0 a |
| Loin (gm)       | 727.5 ±32.5 a | 802.5 ±2.5 a | 762.5 ±17.5 a | 620.5 ±5.0 c | 737.5 ±2.5 a | 895.0 ±40.0 a | 700.0 ±30.0 a | 740.0 ±70.0 a | 707.0 ±37.5 a |
| Leg (kg)        | 3.578 ±0.073 b | 3.883 ±0.113 b | 4.040 ±0.250 a | 3.650 ±0.075 b | 4.263 ±0.32 a | 4.618 ±0.40 a | 4.003 ±0.083 a | 4.038 ±0.468 a | 4.100 ±0.300 a |
| Fat tail (kg)   | 2.335 ±0.205 a | 1.735 ±0.105 b | 1.584 ±0.359 b | 3.168 ±0.418 a | 2.208 ±0.37 b | 1.978 ±0.240 c | 3.099 ±0.161 a | 2.869 ±0.076 ab | 2.510 ±0.280 b |
| Ribeye area (cm²) | 47.0 ±4.0 a | 51.0 ±3.0 a | 46.5 ±7.5 a | 36.0 ±2.0 b | 45.7 ±5.5 a | 49.5 ±4.5 a | 37.5 ±2.5 b | 45.0 ±3.0 a | 49.5 ±1.5 a |
| Fat thickness (mm) | 1.4 ±0.3 a | 0.6 ±0.3 b | 1.3 ±0.4 a | 2.8 ±0.3 a | 1.7 ±0.3 b | 1.3 ±0.1 b | 3.0 ±0.4 a | 2.5 ±0.4 a | 1.9 ±0.6 b |

-Different letters horizontally within period refer to significant differences (P ≤ 0.05) between means.

Table 4 show the effect of different treatments on fat adipose tissue. From the data of this table we can observe that there are no linear trends of carcass and offal fat of injection treatments means comparing with control, but in general there was a significant (P ≤ 0.05) changes of those treatments means (T2 and T3) for different periods comparing with control.

Table 5 show the effect of different treatments on offal weight. Letters shows no significant differences between means in all periods.

Table 6 show the effect of different treatments on edible organs weight. No significant differences between means for each heart, liver and spleen, although there was an increase in liver weight with increase enanthate dose for all periods comparing with control treatment. There were superiority (P ≤ 0.05) of kidney means for T3 to control treatment for all periods, and the same for lung, there was a significant (P ≤ 0.05) superiority of T3 to T1 and T2 for the first period (60 days), but insignificant for second and third periods (90 and 120 days). Testis data shows a significant (P ≤ 0.05) decline in means of injection treatments means (T2 and T3) comparing with control treatment T1 for all periods.

Table 7 show the effect of different treatments on chemical composition of longissimus dorsi. No differences can be observed between means. Table 7 show the effect of different
treatments on chemical composition of *longissimus dorsi*. We can't notice any effects of injection treatments on chemical composition.

**Table 4. Effect of different treatments on fat adipose tissue**

| Characteristics | 60 days | 90 days | 120 days |
|-----------------|---------|---------|----------|
| T1              | T2      | T3      | T1       | T2      | T3      | T1       | T2      | T3      |
| Intestine fat (gm) | 315.0 ±5.0 a | 275.0 ±10.0 a | 260.0 ±5.0 a | 375.0 ±6.0 ab | 215.0 ±6.5 b | 530.0 ±7.0 a | 399.0 ±3.4 b | 430.0 ±13.0 ab | 495.0 ±9.5 a |
| Omental fat (gm) | 366.0 ±26.0 a | 369.5 ±35.5 a | 355.0 ±5.0 a | 437.5 ±17.5 b | 650.0 ±95.0 b | 1552.5 ±47.5 a | 747.5 ±21.5 b | 995.0 ±35.0 a | 945.0 ±65.0 a |
| Heart fat (gm)   | 43.0 ±3.0 a | 54.5 ±8.5 a | 61.0 ±1.0 a | 47.5 ±4.5 a | 47.5 ±0.5 a | 59.0 ±3.0 a | 83.5 ±4.5 a | 54.0 ±7.0 b | 70.0 ±19.0 ab |
| Kidney fat (gm)  | 81.0 ±24.0 b | 165.0 ±31.0 a | 138.5 ±5.5 a | 137.5 ±46.5 b | 166.5 ±51.5 b | 273.0 ±60.0 a | 197.5 ±9.5 c | 297.0 ±46.0 b | 367.0 ±9.0 a |
| Pelvic fat (gm)  | 14.5 ±0.5 b | 35.0 ±6.5 ab | 49.5 ±10.0 a | 29.0 ±4.0 b | 33.0 ±8.0 b | 92.0 ±19.0 a | 53.5 ±3.0 b | 66.0 ±9.5 ab | 88.0 ±2.0 a |

-Different letters horizontally within period refer to significant differences (P≤0.05) between means.

**Table 5. Effect of different treatments on offal weight**

| Characteristics | 60 days | 90 days | 120 days |
|-----------------|---------|---------|----------|
| T1              | T2      | T3      | T1       | T2      | T3      | T1       | T2      | T3      |
| Feet (kg)       | 1.128 ±0.04 | 1.135 ±0.13 | 1.313 ±0.01 | 1.100 ±0.02 | 1.273 ±0.08 | 1.398 ±0.1 | 1.300 ±0.2 | 1.345 ±0.1 | 1.295 ±0.01 |
| Head (kg)       | 2.663 ±0.08 | 2.823 ±0.08 | 3.258 ±0.05 | 1.888 ±0.8 | 2.825 ±0.3 | 3.068 ±0.2 | 2.700 ±0.1 | 2.985 ±0.2 | 2.940 ±0.04 |
| wool with skin (kg) | 6.29 ±0.19 | 7.91 ±1.43 | 6.71 ±1.38 | 6.54 ±0.63 | 7.59 ±1.2 | 7.76 ±0.45 | 8.03 ±0.85 | 7.59 ±1.30 | 6.87 ±0.71 |
| empty rumen (kg) | 1.770 ±0.03 | 1.888 ±0.03 | 1.568 ±0.35 | 1.938 ±0.05 | 1.465 ±0.23 | 1.635 ±0.07 | 1.675 ±0.04 | 1.758 ±0.18 | 1.680 ±0.10 |
| Empty intestine (kg) | 1.165 ±0.09 | 1.028 ±0.03 | 1.430 ±0.17 | 1.188 ±0.15 | 1.090 ±0.11 | 1.400 ±0.13 | 0.975 ±0.13 | 1.098 ±0.03 | 1.018 ±0.17 |
CARCASS CUTS WEIGHT. HEIGHT IN RIB EYE AREA AND IN THE OTHER HAND FAT THICKNESS DECREASE MAY BE DUE TO INCREASE IN TESTOSTERONE ENANTHATE INJECTION DOSE (BETWEEN 200-400 MG). INCREASE IN EACH: LIVE WEIGHT, HOT AND COOLED CARCASS WEIGHT, CARCASS CUTS WEIGHT, RIB EYE AREA, CARCASS AND OFFAL FAT, KIDNEY, LIVER AND LUNGE WEIGHT. ALSO THERE WAS A DECREASE IN EACH: FAT THICKNESS, FAT TAIL AND TESTIS WEIGHT.

Generally we can summarize the results with the experiment circumstances as follow: with the increase of testosterone enanthate injection dose (between 200-400 mg) there was an increase in each: live weight, hot and cooled carcass weight, carcass cuts weight, rib eye area, carcass and offal fat, kidney, liver and lunge weight. Also there was a decrease in each: fat thickness, fat tail and testis weight.

Increase of treatments T2 and T3 live and carcass weights may due to injected hormone, where [18, 19, 20, 21] reported that there was an increase in feed consumption and decrease in maintenance energy requirement and enhance feed conversion ratio when using androgenic hormones, which led to that enhancement in live and carcass weight and then as a result in carcass cuts weight. Height in rib eye area and in the other hand fat thickness decrease may.

### Table 6. Effect of different treatments on edible organs weight

| Characteristics | 60 days | 90 days | 120 days |
|-----------------|---------|---------|---------|
|                 | T1      | T2      | T3      | T1      | T2      | T3      | T1      | T2      | T3      |
| Heart (gm)      | 188.0 ±8.0 a | 203.5 ±11.5 a | 203.0 ±4.0 a | 214.5 ±13.5 a | 199.5 ±17.5 a | 225.0 ±16 a | 208.0 ±22.0 a | 222.5 ±13.5 a | 215.0 ±11.0 a |
| Kidney (gm)     | 119.0 ±7.0 b | 127.5 ±4.5 ab | 148.5 ±0.5 a | 122.5 ±8.5 b | 138.5 ±3.5 ab | 158.5 ±11.5 a | 120.5 ±6.5 b | 125.0 ±11.0 b | 140.5 ±5.5 a |
| Liver (gm)      | 821.5 ±30.5 a | 846.5 ±53.5 a | 892.5 ±8.5 a | 816.5 ±31.5 a | 868.5 ±78.5 a | 905.5 ±28.5 a | 724.5 ±59.5 a | 687.5 ±33.5 a | 951.0 ±76.0 a |
| Lung (gm)       | 538.5 ±3.5 b | 537.5 ±5.5 b | 633.0 ±4.3 a | 559.5 ±35.5 a | 554.0 ±39.0 a | 605.0 ±16.0 a | 564.0 ±10.1 a | 614.0 ±40.0 a | 563.0 ±31.0 a |
| Spleen (gm)     | 98.0 ±140.0 a | 120.0 ±57.0 a | 102.5 ±14.5 a | 79.0 ±19.0 a | 91.5 ±6.5 a | 87.5 ±5.5 a | 66.5 ±4.5 a | 79.5 ±5.7 a | 72.0 ±7.0 a |
| Testis (gm)     | 96.0 ±3.0 a | 46.5 ±3.5 b | 44.0 ±2.0 b | 308.0 ±7.3 a | 86.5 ±12.5 b | 112.5 ±23.5 b | 282.0 ±0.0 a | 155.5 ±46.5 ab | 91.0 ±15.0 b |

-Different letters horizontally within period refer to significant differences (P≤0.05) between means.

### Table 7. Effect of different treatments on chemical composition of longissimus dorsi

| Characteristics | 60 days | 90 days | 120 days |
|-----------------|---------|---------|---------|
|                 | T1      | T2      | T3      | T1      | T2      | T3      | T1      | T2      | T3      |
| Moisture (%)    | 74.22 ±0.18 | 73.87 ±0.32 | 74.17 ±0.19 | 73.65 ±0.07 | 73.76 ±0.10 | 73.88 ±0.20 | 74.24 ±0.30 | 74.18 ±0.43 | 74.14 ±0.11 |
| Protein (%)     | 20.00 ±0.01 | 19.96 ±0.09 | 20.04 ±0.05 | 19.87 ±0.01 | 19.93 ±0.03 | 19.96 ±0.05 | 20.06 ±0.08 | 20.04 ±0.11 | 19.62 ±0.37 |
| Fat (%)         | 3.50 ±0.23 | 3.30 ±0.08 | 3.12 ±0.25 | 3.50 ±0.03 | 3.30 ±0.13 | 3.12 ±0.28 | 2.69 ±0.38 | 2.77 ±0.54 | 3.24 ±0.33 |
| Ash (%)         | 1.23 ±0.14 | 1.55 ±0.15 | 1.48 ±0.17 | 1.19 ±0.06 | 1.70 ±0.17 | 1.62 ±0.30 | 1.42 ±0.36 | 1.20 ±0.06 | 1.48 ±0.36 |
due to the effect of testosterone enanthate on lipid and protein profile [5]. Herbst and Bhasin [11] had pointed out that testosterone increase lean and decrease fat (by promote the commitment of mesenchymal pluripotent cells into myogenic lineage and inhibit adipogenesis through an androgen receptor mediated pathway). Regarding to the enhancement of kidney and liver weight with increase injection dose, it could be a result of testosterone enanthate effect on metabolism of basic body nutritional materials which led to increase kidney, liver and lunge activity and then increase their weight. That increase in different body organs activity may be the reason of abdominal fat increase as a reflection of that activity. On the other hand, the decrease in testis weight with increase injection dose may be a result of leydig cells deactivation, which is responsible of testosterone secretion, as a reflection of increase hormone blood level with injection treatments which led to leydig cell feedback inhibition and drop in testis weight [22, 23]. Those results agreed with the results of [6] who refer to the positive effects when using testosterone enanthate with castrated karadi lambs which was increase in live, carcass, carcass cuts weights and rib eye area, also decrease in fat tail weight, and conclude that the increase in weight refer to body energy turned to synthesis lean. Also results agreed with [24] who refer to increase in carcass weight and rib eye area when using implant hormone. In the same direction [25] pointed out that there was an increase in lean and decrease in fat with anabolic implant. The same was with [26] who reported increase in muscle size with using of androgens. Also present study results agreed with [27] who noticed positive effects of using that type of hormones with livestock.

4. Conclusions
As a conclusions we can say that testosterone enanthate injection with that dose enhance live and carcass weight, carcass cuts weight, as well as rib eye area, carcass and offal fat. In the same time it decreases fat thickness and fat tail.

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