Effect of Testosterone Enanthate Injection and Castration on some Productive Traits of Karadi Lambs

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Abstract:

This study was conducted to investigate the influence of testosterone enanthate injection on some productive characteristics of Karadi lambs. This experiment was carried out at the Sheep Farm, belong to the Faculty of Agricultural Sciences, University of Sulaimani, Bakrajo. Thirty six Karadi ram lambs, aged 3-4 months and average live weight of 28.7±3.8 kg were randomly divided into three equal groups. Six ram lambs from each group were castrated using elastrator and rubber ring, two weeks before beginning of the experiment. First group was left as control group without treatment (T1). The second group (T2) was injected weekly with 200 mg of testosterone enanthate (TE)/ram lamb. The third group (T3) was injected with 400 mg TE/ram lamb weekly until the termination of the experiment. The TE injections as anabolic agent were given weekly to each treated lamb to investigate its effect on some productive and physiological traits as well as their residual effect, over the period from 18th May to 30th August 2010. Lambs were fed as (3%) of live body weight. The allowance was readjusted at weekly intervals according to live weight. Live body weight (LBW)(Kg), live weight gain(LWG)(%), average daily gain (ADG) (gm/day), dry matter intake (DMI)(gm/day) and feed conversion ratio (FCR)(gm DMI/gm gain) were determined. Results indicated that ADG of intact lambs in the control group, low and high level of TE groups, were higher than the castrated lambs at 4 months of age. The castrated lambs in T2 had higher ADG at 4, 5, 6, 7 and 8 months of age as compared with castrated lambs in T1 and T3 groups. Higher DMI was recorded for the intact lambs of the control, low and high level of TE in comparison with castrated lambs. Results revealed that castrated lambs of the control group had higher FCR at 4,5,6 and 8 months of age as compared to intact lambs (4.06 vs. 3.46, 6.56 vs. 6.41 , 6.96 vs. 5.85 and 5.96 vs. 5.27 gm DMI /gm gain), while the FCR increased in the intact lambs treated with 200 mg TE as compared to castrated lambs at 4,5,6 and 8 months of age (4.00 vs. 3.69, 4.94 vs. 3.93, 5.62 vs. 4.14 and 6.47 vs. 5.44 gm DMI/gm gain), respectively. We concluded that castrated lambs treated with 200 mg TE have higher ADG as compared with other experimental groups.

Keywords: Karadi ram; castrated lambs; intact lambs; TE; ADG; DMI.

I. Introduction:

Anabolic androgenic steroids (AAS) is an official definition for all male sex steroids hormones, the gross effect of these products are increase in rate of feed intake, daily weight gains, feed conversion efficiency and improve meat production [1]. Meat and meat products, which play an important role in human nutrition, should be safe and not contain any factors or substances harmful for human health. The AAS is belong to the steroid super-family and are potent stimulators of skeletal muscle growth. Steroidogenic enzymes are responsible for the biosynthesis from cholesterol of various steroid hormones includingglucocorticoids,mineralcorticoids , progestins, androgens, and estrogens [2)]. AAS is an official definition for all male sex steroid hormones, their synthetic derivatives and their active metabolites are synthetic derivatives of the male testosterone originally designed for therapeutic uses to provide enhanced anabolic potency with negligible androgenic effects [3]. Anabolic agents are given to food-producing animals to improve meat production and feeding efficiency [1]. AAS have potent anabolic activity, increase muscle mass and aggression in animals [4].

Hormonal growth promotants are the natural sex hormones which are administered to animals in order to improve an animal's ability to use nutrients efficiently. Synthetic derivatives of the natural hormones may also be used instead of the natural hormones themselves [5]. Testosterone is a steroid hormone which mainly produced by the testes, not only influences male reproductive physiology and development, but also plays an important role in modulating male behavior [6, 7, 8]. The last 30 years has witnessed a surge in studies that attempt to identify relationships between circulating testosterone concentrations and social behaviors in males of many species [9]. In addition, [10] stated that its metabolic effect as a protein anabolic steroid exceeds that of any other naturally occurring steroid and that testosterone also promotes the muscular and skeletal growth that accompanies puberty. Researchers [11; 12; 13; 14; 15] have attempted to use various forms of testosterone to improve rate of gain and feed efficiency in lambs. Testosterone could exert an effect on muscle growth through the IGF-I axes. Locally produced IGF-I is an important growth regulator acting in an autocrine and paracrine manner [16], but different muscles may possess different IGF-I sensitivities [17] and (or) IGF-I synthesis rates [18; 19; 20] and, therefore, may exhibit different growth rates. Second, testosterone action is mediated by the androgen receptor (AR), which transduces the steroid signal within cells. Therefore, receptor density could account for the relatively higher sensitivity to testicular steroids in the neck muscles [21]. Testosterone stimulates muscle growth by affecting the rate of protein synthesis, protein breakdown and the net gain or loss of muscle protein [22]. When testosterone increases muscle protein synthesis, intramuscular mRNA concentrations of IGF-I are increased and concentrations of the inhibitory IGF binding protein 4 are decreased [23]. The response to testosterone differs among muscle groups and this differential response may be explained by the variation of AR number among skeletal muscles [24]. Thus, sexual dimorphism can be explained partly by higher androgen sensitivities in muscles with pronounced growth under androgen stimulation [21]. Testosterone enanthate is a testosterone with a 7 carbon group (--CO(CHe)~--CHa) attached by means of an ester bond to the 17-position of testosterone. This esterified form of testosterone is thought to be active over a sustained period. [25] Stated that when testosterone esters are injected into an animal they are initially absorbed by adipose tissue, hydrolyzed and then gradually released as testosterone into the circulatory system.

[26] reported that, the effect of anabolic steroids on muscle mass is caused in at least by two ways : first, they increase the production of proteins; second, they reduce recovery time by blocking the effects of stress hormone cortisol on muscle tissue, so that catabolism of muscle is greatly reduced. It has been hypothesized that this reduction in muscle breakdown may occur through anabolic steroids inhibiting the action of other steroid hormones called glucocorticoids that promote the breakdown of muscles [27]. Anabolic steroids also affect the number of cells that develop into fat storage cells, by favoring cellular differentiation into muscle cells instead [28]. Anabolic steroids can also decrease fat by increasing basal metabolic rate (BMR), since an increase in muscle mass increases BMR. The mode of action of some of these agents is reviewed by [29] and it would seem that differences in the mechanism of action in naturally occurring and synthetic androgens appear to exist [30]. [31] Refer that androgens increase protein synthesis and decrease fat deposition in adipose tissue. Anabolic steroids increase the retention of dietary nitrogen as body protein and increase muscle mass through hypertrophy rather than hyperplasia. Increased body protein can be the result of increased protein synthesis or decreased protein degradation. In study of [32], the growth rate was reduced ($P<0.05$) by castration, but this effect was partly offset by exogenous testosterone. Although rate of gain increased in a dose dependent manner for wethers implanted with low and intermediate levels of testosterone, two slow-growing wethers implanted with a high level of testosterone caused that group to perform poorly. Efficiency of feed utilization showed a trend similar to that of average daily gain. Intact rams were most efficient, requiring only 3.8 kg feed/kg gain; wethers were least efficient, requiring 4.3 kg feed/kg gain, and testosterone implanted wethers required an intermediate amount of feed. Intake of metabolizable energy, like intake of dry feed, was higher for wethers than for rams and was decreased by testosterone. Metabolizable energy requirement per unit gain was similarly affected too. The similar performance of intact lambs and wethers implanted with the high dosage of testosterone indicates that this single steroid possesses most if not all the anabolic effects that the testes provide. Results of previous investigations with wethers injected [33] or subcutaneously implanted [11; 12; 13] with testosterone support the hypothesis that this hormone promotes anabolism in market lambs and produces leaner carcasses more efficiently. Interpretating of these earlier reports are more difficult, however, because of the low and discontinuous administration of testosterone. However, the untreated rams gained significantly ($P<0.05$) faster than the treated wethers [33]. So, this study was conducted to evaluate the effect of testosterone injection and castration on some production traits of Karadi lambs.

II. Materials and Methods:

This study was conducted at the Sheep Farm, Research Station, Faculty of Agricultural Sciences / University of Sulaimani at Bakrajo, during the period from 18th April to 30th August 2010. A total of thirty six Karadi ram lambs of about 3-4 months old and average live weight of 28.7±3.8 kg were used in this study. Ram lambs were randomly divided into three main equal groups (12 ram lamb each). First group was left without treatment and considered as control group (T_1). The second group (T_2) was injected weekly with 200mg of testosterone enanthate (TE) /ram lamb. The third group (T_3) was injected with 400mg TE/Ram lamb weekly until the termination of the experiment. Thereafter, each main group was sub-divided into two equal groups, six ram lambs were castrated using Elastrator and rubber ring, two weeks before the beginning of the treatments and the remaining animals (n=6) were left as intact. Each ram lamb was housed in individual pen during the experimental period. The concentrate diet ingredients were consisting of barley, yellow corn, soybean meal, salt and minerals (Table I).The barley straw was available *ad libitum* as basal diet. The diet was offered once daily at 8:00 a.m. as 3% of live body weight. The allowance was readjusted at biweekly intervals according to live weight and feed refusals were collected and re-weighed daily. The live body weight (LBW)(kg), live weight gain (LWG=initial live weight/final live weight x100)(%), average daily gain (ADG) (gm/day), dry matter intake (DMI) (gm/day) and feed conversion ratio (FCR) (gm DMI/gm gain) were estimated. The statistical analysis system-XLstat 7.5.2 [34] program was used for data analysis. The 3x2 factorial completely randomized design (CRD) was used to study the effect of three levels of testosterone enanthate (0, 200 and 400 mg / head) and two groups of ram lambs (intact and castrated). Duncan multiple range test [35] was used to determine the significance differences among means. The statistical model for analysis of variance of LBW, LWG, ADG, DMI, and FCR was:

$$Y_{ijk} = \mu + A_i + B_j + (AB)_{ij} + e_{ijk}$$

Where:- Y_{ijk} = observation of the k^{th} lamb in level i of factor A and level j of factor B (k=1,..., 6)

μ = the overall mean

A_i = the effect of level i of factor A (levels of Testosterone Enanthate, i = 1, 2, 3). B_j = the effect of level j of factor B (Intact and Castrated, J = 1, 2).

$(AB)_{ij}$= the effect of interaction of level i of factor A with level j of factor B.

e_{ijk} = random error associated with means = 0 and variance δ2e.

Table.I: Formulation And Chemical Composition Of Concentrate Diet On A Dry Matter Basis.

Source of feed additives	Ingredients (gm/kgDM)
Barley grain	490
Yellow corn	390
Soybean meal	100
Salt	10
Minerals and vitamins mixture	10
Chemical Composition /kg Dry matter	
Dry Matter (gm/kg fresh)	949
Organic matter (OM)(%)	918
Total nitrogen (TN)(%)	21.3
Crude fibers (CF)(%)	50.8
Ether extract (EE)(%)	34
Nitrogen free extract (NFE)(%)	700

III. Results and Discussion:

A. Live Body Weight (LBW) of lambs:

The LBW of intact and castrated lambs during different ages presented in Table (II). The LBW of the intact lambs at 4th and 5th months of age were significantly ($P<0.05$) heavier than the castrated lambs. Differences in the intact lambs thereafter started to disappear from 6 months of the age up to the end of the experiment. This tendency was also noticed in the final LBW, which revealed no significant differences between the intact and the castrated lambs in all experimental groups.

B. Average Daily Gain ADG:

The ADG achieved by intact and castrated lambs were presented in Table (III). The ADG of intact lambs in the control (T_1), T_2 and T_3 were higher as compared with castrated lambs at 4 months of age (223.16 vs. 163.33, 197.45 vs. 193.96 and 201.93 vs. 193.11 gm/day) respectively (Table III). Regarding castrated lambs, no significant response was noticed due to TE treatments. However, heavier ($P<0.05$) LBW was recorded at 6 months of age due to low level of TE as compared with control and high level (50.30 vs. 40.20 and 45.40 kg, respectively (Table III). The Live weight gain (LWG) was numerically greater (62.63 %) in T_2 lambs as compared with other treatments. Regarding castrated lambs at 5 months of age injected with low level of TE had significantly ($P<0.05$) higher ADG as compared to castrated lambs in the control group (275.98 vs. 143.75 gm/day). Simultaneously, the intact lambs injected with 400mg TE had higher ADG values as compared with the intact lambs of the control group (274.36 vs. 175.11 gm/day)(Table III).

The average ADG of the castrated lambs in the control group was significantly ($P<0.05$) lower than the castrated lambs of the T_2 and T_3 groups (133.31 vs. 233.78 and 211.76 gm/ day, respectively)(Table III). In general, the castrated lambs in T_2 had higher ADG values at 4, 5, 6, 7 and 8 months of age as compared with the castrated lambs in T_1 and T_3 groups (Table III).

C. Dry matter intake (DMI):

DMI (gm/day) for intact and castrated lambs were showed in Table (IV). Results clearly revealed that DMI increased with increasing body weight and age for both intact and castrated lambs with little differences among treatments during the 8th month of age. Excluding data of 8th month which did not exhibits differences between the intact and castrated lambs (1425.5 vs. 1286.3 gm/day), the intact lambs of the control group consumed higher ($P<0.05$) DMI as compared with the castrated lambs during the 4th, 5th, 6th and 7th months of age. Similar trend was found in T_3 group, but 4th and 5th months of age. Whereas, no such trend was shown in lambs injected with low level of TE (Table IV). Results clearly revealed that hormone injection enhanced DMI by both intact and castrated lambs. Higher DMI was recorded by intact lambs in the control and treated groups as compared with castrated lambs (Table IV).

D. Feed Conversion Ratio (FCR):

The FCR values obtained by dividing DMI on ADG of intact and castrated lambs are given in Table (VI). FCR decreased as lambs grow up, this is mainly due to increased DMI with proceeding lamb's age. However, the changes among months were not steady in both intact and castrated lambs, though there was a clear consistent tendency in the increased of DMI.

Table.II: Effect Of Injection Different Levels Of Testosterone Enanthate On Live Body Weight (LBW) And Live Weight Gain (LWG) (Mean ± SE) Of Karadi Ram Lambs.

Treatments		LBW (Kg) Age (months) 4	5	6	7	8	LWG (%)
T_1 (Control)	Intact	37.35 ± 0.62a	42.53 ± 0.79bc	47.85 ± 0.86bc	52.10 ± 0.70a	58.10 ± 0.90abc	56.35 ± 4.04a
	Castrate	32.28 ± 1.16b	36.86 ± 1.21e	40.20 ± 1.63d	44.00 ± 2.00a	48.80 ± 2.60bc	60.65 ± 5.17a
T_2 (200 mg)	Intact	39.35 ± 1.12a	44.81 ± 1.75ab	50.20 ± 1.96b	55.00 ± 3.80a	59.50 ± 4.10ab	62.63 ± 3.84a
	Castrate	32.95 ± 1.34b	41.43 ± 0.98cd	50.30 ± 1.58b	55.80 ± 1.00a	58.10 ± 1.90abc	57.23 ± 5.52a
T_3 (400 mg)	Intact	38.41 ± 1.13a	46.18 ± 1.48a	54.10 ± 2.04a	57.00 ± 2.60a	59.90 ± 4.50a	56.70 ± 3.31a
	Castrate	32.53 ± 2.33b	39.26 ± 2.82de	45.40 ± 4.95c	44.30 ± 9.90a	47.80 ± 10.20c	56.73 ± 3.46a

Table. III: Effect Of Injection Different Levels Of Testosterone Enanthate On Average Daily Gain (ADG) (Mean ± SE) Of Karadi Ram Lambs

Treatments		ADG (gm/day) Age (months) 4	5	6	7	8	Average
T_1	Intact	223.16 ± 22.46a	175.11 ± 22.48b	216.77 ± 21.10ab	216.55 ± 57.15b	270.70 ± 9.50a	184.86 ± 12.25cd
(Control)	Castrate	163.33 ± 20.63b	143.75 ± 27.74b	145.85 ± 58.46b	203.70 ± 25.00b	215.55 ± 28.55b	133.31 ± 19.53d
T_2	Intact	197.45 ± 17.02a	237.23 ± 30.40ab	232.40 ± 46.42ab	235.3 ± 25.00ab	234.30 ± 14.30ab	207.26 ± 13.14abc
(200 mg)	Castrate	193.96 ± 26.44ab	275.98 ± 23.39a	322.75 ± 26.34a	289.30 ± 3.60a	250.55 ± 12.85a	233.78 ± 17.62ab
T_3	Intact	201.93 ± 28.70a	274.36 ± 18.44a	295.85 ± 31.26a	247.15 ± 7.15ab	230.10 ± 90.50ab	245.23 ± 5.83a
(400 mg)	Castrate	193.11 ± 27.33ab	244.48 ± 31.04ab	318.35 ± 32.90a	242.15 ± 14.25ab	231.33± 38.10ab	211.76 ± 10.09bc

-a,b,c,d Means in the same column with different superscripts are significantly different ($P < 0.05$).

Lower FCR values were almost observed by castrated lambs as compared with intact lambs injected with low and high levels of TE. At 4 month of age, castrated lambs treated with low level of TE had lower FCR as compared with intact lambs (3.69 vs. 4.00 gm DMI/ gm gain). The lambs given high level of TE (3.70 vs. 3.99 gm DMI/ gm gain) as well (Table VI). It seems that the castrated lambs consumed their diet more efficiently. Lower FCR values were obtained by lambs injected with high level of TE during the first three months of the experiment, but it increased thereafter. Results revealed that castrated Karadi lambs of control group had higher ($P<0.05$) FCR at the 4, 5, 6 and 8 months of age as compared with intact lambs namely 4.06 vs. 3.46, 6.56 vs. 6.41, 6.96 vs. 5.85 and 5.96 vs. 5.27 gm DMI/ gm gain, respectively (Table VI). The TE increased FCR of the intact lambs in T_2 group in comparison with castrated lambs at 4, 5, 6 and 8 months of age. These values were

4.00 vs. 3.69, 4.94 vs. 3.93, 5.62 vs. 4.14 and 6.47 vs. 5.44 gm DMI/ gm gain, respectively. Similar trend was noticed in the intact lambs treated with 400 mg TE as compared with castrated lambs at 4, 6, 7 and 8 months of age (Table VI).

Discussion: The gross effect of anabolic hormones are to increase feed intake, daily weight gains, improving feed efficiency, storing protein and decreasing fatness (36 and 37). LBW of the intact lambs recorded at initial period, 4th and 5th months of age were significantly ($P<0.05$) heavier than the castrated lambs for the control and treated groups with low and high levels of TE is in agreement with the results of (38) who observed that LBW of intact animal grew faster than castrated lambs. It seems that castration had negative effect on LWB, but this case has been exceeded when those lambs were injected with low levels of TE. In general, the TE has been shown to improve rate of gain and feed efficiency (32). The ADG achieved by intact lambs of the three experimental groups (control, T_2 and T_3), were higher than the castrated lambs of the counterpart groups (Table III). On the other hand, the ADG of the castrated lambs of the control group was significantly ($P< 0.05$) lower than the castrated lambs of T_2 and T_3 groups (133.31 vs. 233.78 and 211.76 gm/day respectively). Ram lambs grew faster and yield leaner carcass than do wethers. These beneficial responses are assumed to be attributable to testicular hormones (39). Exogenous testosterone has been shown to improve rate of gain and feed efficiency of lambs (32). In animals, testosterone or testosterone propionate, alone or in combination with other hormonally active substance, is used primarily to improve the weight gain and feed efficiency which is in contrast to the finding of (40), who found that castration did not affect ADG, cold carcass weight or dressing percentage of Awassi lambs, therefore, due to local consumer preference of leaner carcass with minimum subcutaneous fat, castration of Awassi lambs to be slaughtered approximately 130 days is not recommended under on intensive feeding system. Castrated ram lambs have a lower feed efficiency than intact males. Androgens increase ADG and carcass quality lambs, steers and heifers (41; 28 and 42). In general, anabolic hormonal treatment increase ADG (10-15%) and improves the efficiency of feed conversion as well as the quality of the carcass and increasing in proportion of red meat / fat, and this is reflected in the good economic performance in animal production as a result of decreasing the amount of energy required to produce a weight unit of protein (43).

IV. Conclusion:

In conclusion castrated lambs treated with 200 mg TE have higher ADG as compared with other experimental groups. Results clearly showed that TE treatment enhanced DMI in both intact and castrated lambs.

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Table IV. Effect Of Injection Different Levels Of Testosterone Enanthate On Dry Matter Intake (DMI) (Mean ± SE) Of Karadi Rams Lambs.

		DMI (gm/day)					
		Age (months)					
Treatments		4	5	6	7	8	Average
T_1	Intact	762.5 ± 22.3ab	1122.8 ± 24.2ab	1279.4 ± 27.8a	1408.1 ± 27.8a	1425.5 ± 42.8a	1114.3 ± 28.9ab
(Control)	Castrate	664.3 ± 33.0c	949.4 ± 50.3c	1010.3 ± 58.6b	1146.3 ± 37.2b	1286.3 ± 131.2a	941.5 ± 28.3c
T_2	Intact	790.9 ± 17.3ab	1171.1 ± 56.0ab	1319.1 ± 69.9a	1378.7 ± 125.4a	1517.9 ± 137.1a	1150.1 ± 45.1ab
(200 mg)	Castrate	714.8 ± 21.5bc	1081.6 ± 29.9b	1336.3 ± 33.4a	1533.0 ± 45.5a	1361.6 ± 128.2a	1106.1 ±45.4ab
T_3	Intact	802.1 ± 19.8a	1213.9 ± 40.0a	1409.8 ± 56.1a	1519.5 ± 79.7a	1426.5 ± 105.0a	1206.6 ± 29.2a
(400 mg)	Castrate	715.8 ± 32.6bc	1086.1 ± 16.7b	1330.2 ± 26.8a	1431.1 ± 71.5a	1388.0 ± 211.3a	1064.9 ± 36.7b

-a,b,c Means in the same column with different superscripts are significantly different (P < 0.05).

Table VI. Effect Of Injection Different Levels Of Testosterone Enanthate On Feed Conversion Ratio (FCR) (Mean ± SE) Of Karadi Ram Lambs.

		FCR (gm DMI/gm gain)					
		Age (months)					
Treatments		4	5	6	7	8	Average
T_1	Intact	3.46 ± 0.35b	6.41 ± 0.61a	5.85 ± 0.43ab	6.50 ± 2.48a	5.27 ± 0.01b	6.05 ± 0.41ab
(Control)	Castrate	4.06 ± 0.37a	6.56 ± 1.02a	6.96 ± 1.55a	5.63 ± 1.07a	5.96 ± 0.13ab	7.04 ± 1.29a
T_2	Intact	4.00 ± 0.20ab	4.94 ± 1.26bc	5.62 ± 1.20ab	5.86 ± 0.05a	6.47 ± 0.17a	5.55 ± 0.35ab
(200 mg)	Castrate	3.69±0.29b	3.93 ± 0.32c	4.14 ± 0.22b	5.28 ± 0.17a	5.44 ± 0.11b	4.73 ± 0.22b
T_3	Intact	3.99 ± 0.34ab	4.43 ± 0.20bc	4.77 ± 0.29b	6.12 ± 0.09a	6.20 ± 0.87ab	4.93 ± 0.13b
(400 mg)	Castrate	3.70 ± 0.17b	4.45 ± 0.39bc	4.18 ± 0.29b	5.90 ± 1.70a	6.00 ± 0.87ab	5.00 ± 0.11b

-a,b,c,d,e Means in the same column with different superscripts are significantly different (P<0.05).

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