

## EFFECT OF L-TYROSINE ORAL ADMINISTRATION TO GROWING OSSIMI LAMBS

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### **Abstract**

The objective of this study was to determine the effect of L-tyrosine oral administration (100 mg/kg B.W.) on growing lambs performance from weaning till puberty. Growth performance till sexual activity, testes circumference, urethral process length, semen characteristics, testosterone and thyroid hormones levels were recorded. Thirty-two ram lambs and ewe-lambs were randomly divided into two equal groups, the first group (n=8♂ & 8♀) was treated by L-tyrosine, and the second group (n=8♂ & 8♀) was untreated and served as control. These animals were born in the lambing season of autumn (September/October 2007).

Ewe-and ram-lambs were weighed monthly. The ewe-lambs were kept with the ram lambs during the experimental period. Blood samples were collected at 0, 6, 8 and 10 months post-weaning from ram-lambs to determine levels of testosterone, triiodothyronine (T3) and thyroxine (T4) hormones concentrations in plasma. Also, blood samples were collected at the same time from ewe-lambs to determine levels of T3 and T4.

The results revealed that lambs treated with L-tyrosine attained puberty at younger ages and heavier body weights compared to the untreated ones. Total gain and daily gain in both ram-and ewe lambs were increased significantly in treated lambs compared to the control. Triiodothyronine (T3) concentration was increased significantly ( $P<0.05$ ), while, thyroxine (T4) concentration was increased insignificantly in blood plasma by administration of L-tyrosine. Also, thyroid hormones concentrations were increased significantly ( $P<0.01$ ) by progressing in age until they reached the highest concentrations at ten months old. Moreover, testes circumference and urethral process length were insignificantly increased, but, libido was improved significantly ( $P<0.01$ ) in treated ram-lambs compared to the control group. Testosterone hormone concentration was increased significantly ( $P<0.05$ ) in treated ram-lambs compared with the control group. Most of the physical semen properties were improved significantly ( $P<0.01$ ) in treated ram-lambs. Finally, L-tyrosine oral treatment was accompanied with better economic returns.

### **INTRODUCTION**

The sexual behaviour of females is synchronized by the ovarian activity (Hafez, 1987), as presence of developing follicles in the ovaries results in secretion of

estrogen, yet, heat signs in females. It has been found that tyrosine, which helps in synthesis of the cerebral catecholamine was shown to activate the hypothalamus to release GnRH, which stimulates pituitary gland to secrete gonadotrophins (FSH and LH) that activate the ovaries (Arthur, 1989).

El-Battawy (2006) studied the impact of melatonin or L-tyrosine administration on the onset of cycling in delayed pubertal ewe-lambs. The results concluded that the oral administration of melatonin or L-tyrosine played essential physiological roles to induce cycling in delayed pubertal ewe-lambs and improved their reproduction.

The purpose of the present study was to evaluate the effectiveness of L-tyrosine oral administration on growth performance and puberty of both ewe -and ram- lambs.

## **MATERIALS AND METHODS**

The present study aimed to evaluate the effect of oral administration of Alpha-amino-p-hydroxyhydrocinnamic acid (L-tyrosine) on growth performance and puberty of both ram-and ewe- lambs. These animals were born in autumn lambing season (September/October 2007) and used in this trial. Each ram or ewe- lamb was given monthly, until puberty, a single oral dose of L-tyrosine at the level of 100 mg/kg b.w. dissolved in 200ml water (Kamel, 1996, El-Battawy, 2006). Finally, an economical evaluation of using this material was managed.

### **Ram lambs**

Sixteen ram lambs weighed  $22.5 \pm 0.65$  kg and aged 2.5 months each at the starting of the experiment were used. Animals were divided into two groups, the first, (n=8) was treated with L-tyrosine, and the second, (n=8) was untreated and served as control. Sexual behaviour activity of ram-lambs was checked daily, early in the morning by introducing teaser ewe. The ram-lambs which showed erection and extrusion of the penis out of the sheath, were caught immediately and a smear of fluids secreted around the penile sheath was prepared for microscopic examination. The ram-lamb which produced sperm in the examined smears, was immediately trained for semen collection using an artificial vagina. One ejaculate/ram-lamb was collected to determine semen characteristics. The ram-lamb's ability to ejaculate in an artificial vagina was considered as a puberty criterion. The date of first ejaculation was recorded and the lambs were weighed. Testes circumference (cm), sexual libido (min) and urethral process length (cm) were measured.

## **Ewe-lambs**

Sixteen Ossimi ewe- lambs weighed  $19.75 \pm 0.82$  kg and aged 2.5 months at the starting of the experiment, were used. Animals were divided into two equal groups, the first group (n=8) was treated with L-tyrosine, and the second group (n=8) was untreated with L-tyrosine and served as control. Estrus behaviour of ewe- lambs was checked by active rams twice daily at 8 am and 4 pm. The lambs body weight and age were recorded when the first incidence of heat was observed,.

Growth rate was determined for ewe-and ram-lambs. The ewe-lambs were kept with the ram- lambs during the experimental period. This experiment was conducted during the period from January till September 2008. Blood samples were collected at weaning 6, 8 and 10 months post-weaning from ram -lambs to determine levels of testosterone, triiodothyronine (T3) and thyroxine (T4) hormone concentrations. Also, blood samples were collected at the same time from ewe- lambs to determine levels of T3 and T4. Testosterone levels were determined in plasma by the method of Jaffe and Behrman (1974) who performed the assessment of total testosterone concentration using Coat-A-count I<sup>125</sup> radioimmunoassay (RIA) by using kits. Triiodothyronine (T3) and Thyroxine (T4) were determined by radiimmunoassay procedures according to Chopra *et. al.* (1971), Irvin & Standeven (1968), respectively by using kits.

Data were statistically analyzed according to the General Liner Model (GLM) of the SAS program (SAS, 1999) and the differences between means were detected by Duncan's Multiple Range Test (Duncan, 1955).

## **RESULTS AND DISCUSSION**

The effect of L-tyrosine oral administration on some productive and reproductive performance of growing Ossimi ram-and ewe-lambs till puberty is presented in Table 1.

The present results show that the productive performance of both ewe and ram-lambs were improved as a result of L-tyrosine oral administration. Total gain and daily gain values were significantly ( $P < 0.05$  &  $P < 0.01$ ) increased in treated lambs compared to the control. Also, lambs pubertal weight and age in treated groups were significantly ( $P < 0.05$ ) heavier and younger than those in untreated groups (control). The percentages of improvements were 65.52 and 41.86% in total gain, 95.74 and 62.71% in daily gain, 22.73 and 14.75% in body weights at puberty and 14.81 and 14.21% in age at puberty in-ram and ewe-lambs, respectively compared to control

group (Table 1). It could be suggested that tyrosine acts as a growth promoting factor. Earlier reports showed that increasing the circulating tyrosine activates the hypothalamic catecholamine, dopamine, which in turn activates the release of growth hormone (Müller, 1973).

Table 1. Productive and reproductive performance of Ossimi ram and ewe-lambs as affected by L-tyrosine oral administration

Treatments	No. of animals	Ram lambs (LSM±SE)					Ewe-lambs (LSM±SE)				
		Initial weight (kg)	B.w. at puberty (kg)	Total gain (kg)	Daily gain (g)	Age at puberty (days)	Initial weight (kg)	B.w. at puberty (kg)	Total gain (kg)	Daily gain (g)	Age at puberty (days)
L-tyrosine	16	22.88	42.50 <sup>a</sup>	19.63 <sup>a</sup>	79.04 <sup>a</sup>	259.13 <sup>a</sup>	19.75	35.00 <sup>a</sup>	15.25 <sup>a</sup>	62.35 <sup>a</sup>	248.13 <sup>a</sup>
Control	16	22.75	34.63 <sup>b</sup>	11.88 <sup>b</sup>	40.38 <sup>b</sup>	297.50 <sup>b</sup>	19.75	30.50 <sup>b</sup>	10.75 <sup>b</sup>	38.32 <sup>b</sup>	283.38 <sup>b</sup>
±SE		0.64	1.30	1.59	7.77	10.27	0.86	1.24	1.09	5.04	9.97

<sup>a, b</sup>, Means in the same column under the same trait followed by the same superscript are not significantly different. NS = Not significant, \* = (P < 0.05), \*\* = (P < 0.01).

The results of El-Battawy (2006) support these findings. The present results indicated that body weight at puberty of ewe-lambs was less than body weights of ram-lambs. At the same time, age at puberty of ram-was more than that of ewe-lambs. Also, Ferial *et. al.* (1992) reported that Ossimi ewe-lambs reached puberty at ages round 288.2±0.4 day and weights 33.3±0.2 kg, while, Ossimi ram lambs reached puberty at ages round 296.8±5.4 days and weights 41.1±6.6 kg.

Thyroid hormone levels in Ossimi growing lambs as affected by the oral administration of L-tyrosine are summarized in Tables 2&3. It was noticed that triiodothyronine (T3) was increased significantly (P<0.05) in treated lambs, while, thyroxine (T4) was increased, but insignificant in treated lambs compared to the control ones. Additionally, post-treatment time had a positive effect on T3 and T4 concentrations.

Table 2. Triiodothyronine (T3) level in Ossimi growing lambs as affected by the L-tyrosine oral administration

Time (months)	Treatments (LSM±SE)		Overall means
	L-tyrosine	Control	
Ewe lambs			
At weaning	129.98±9.52	124.29±9.52	127.14±6.86 <sup>b</sup>
6	135.57±9.52	125.24±9.52	128.76±6.86 <sup>b</sup>
8	141.66±9.52	128.47±9.52	135.07±6.86 <sup>b</sup>
10	170.18±9.52	151.30±9.52	157.99±6.86 <sup>a</sup>
Overall means	142.98±4.85 <sup>a</sup>	131.50±4.85 <sup>b</sup>	137.24±5.86
Ram lambs			
At weaning	104.95±9.52	101.20±9.52	103.07±6.61 <sup>c</sup>
6	130.30±9.52	121.94±9.52	127.77±6.61 <sup>b</sup>
8	140.22±9.52	125.64±9.52	132.93±6.61 <sup>b</sup>
10	164.69±9.52	145.16±9.52	157.67±6.61 <sup>a</sup>
Overall means	136.41±4.67 <sup>a</sup>	124.31±4.67 <sup>b</sup>	130.36±5.64

<sup>a-c</sup>, overall means in the same columns and rows followed by the same superscript are not significantly different.

Table 3. Thyroxine (T4) level in Ossimi growing lambs as affected by the L-tyrosine oral administration

Time (months)	Treatments (LSM±SE)		Overall means
	L-tyrosine	Control	
Ewe lambs			
At weaning	3.73±1.02	3.51±1.02	2.15±0.73 <sup>b</sup>
6	4.17±1.02	3.57±1.02	3.37±0.73 <sup>ab</sup>
8	4.23±1.02	4.03±1.02	4.07±0.73 <sup>ab</sup>
10	7.80±1.02	5.92±1.02	5.61±0.73 <sup>a</sup>
Overall means	4.19±0.51	3.41±0.51	3.80±0.62
Ram lambs			
At weaning	2.28±1.02	2.02±1.02	3.65±0.72 <sup>b</sup>
6	3.97±1.02	2.57±1.02	3.74±0.72 <sup>b</sup>
8	4.11±1.02	3.46±1.02	3.84±0.72 <sup>b</sup>
10	6.21±1.02	5.01±1.02	6.86±0.72 <sup>a</sup>
Overall means	4.93±0.51	4.12±0.51	4.53±0.61

<sup>a, b</sup>, overall means in the same columns and rows followed by the same superscript are not significantly different.

The present results indicated the importance of L-tyrosine administration in formation of thyroxine and protein synthesis. Harper *et. al.* (1980) reported that L-

tyrosine is utilized by the thyroid gland for the production of thyroxine which is considered a vital hormone involved in regulating growth, metabolism, skin health and mental state. The improvement in growth rate and enhancement of puberty in both ram-and ewe-lambs could be reported as due to increasing the secretions of T3 and T4. Thyroid activity was positively related to growth rate in sheep (Lovell *et. al.*, 1987). Additionally, the thyroid hormones play an important role in regulating the process of growth, lactation, reproduction and general health (Jainudeen *et. al.*, 2000).

The reproductive traits and testosterone level of Ossimi ram lambs treated with L-tyrosine and control group are summarized in Tables 4&5. The results illustrated that, testes circumference and urethral process length were insignificantly increased, but, libido was significantly ( $P>0.01$ ) improved in treated group compared to control group. Table 4 showed also that, control ram-lambs reached their first ejaculation at older age, while they still had lighter weight ( $P<0.05$ ), which is due to slower growth rate (Table 1) compared to the treated ram lambs.

Table 4. Some reproductive traits of Ossimi ram-lambs at puberty as affected by L-tyrosine oral administration

Treatments	No. of lambs	Reproductive traits (LSM±SE)				
		Testes circumference (cm)	Urethral process (cm)	Libido (min)	Body weight at puberty (kg)	Age at puberty (day)
L-tyrosine	8	NS 21.50	NS 1.34	** 15.63 <sup>a</sup>	* 35.63 <sup>a</sup>	* 259.13 <sup>a</sup>
Control	8	19.38	1.11	18.75 <sup>b</sup>	30.50 <sup>b</sup>	297.50 <sup>b</sup>
±SE		0.80	0.09	0.89	1.30	10.27

<sup>a, b</sup>, Means in the same column followed by the same superscript are not significantly different. NS = Not significant, \* = ( $P < 0.05$ ), \*\* = ( $P < 0.01$ ).

Table 5. Testosterone level of Ossimi ram-lambs as affected by L-tyrosine oral administration and different time post-treatment

Time (months)	Treatments (LSM±SE)		Overall Means
	Treated	Control	
At weaning	131.87±48.55	72.71±48.55	102.30±34.33 <sup>b</sup>
6	174.50±48.55	110.75±48.55	142.63±34.33 <sup>b</sup>
8	255.69±48.55	145.44±48.55	200.56±34.33 <sup>a</sup>
10	298.98±48.55	192.04±48.55	245.51±34.33 <sup>a</sup>
Overall means	215.26±24.28 <sup>a</sup>	130.24±24.28 <sup>b</sup>	172.75±2931

<sup>a, b</sup>, overall means in the same columns and rows followed by the same superscript are not significantly different.

Results in Table 5 show that the overall mean of testosterone level was significantly ( $P < 0.05$ ) higher for treated ram-lambs compared with the control. Advance of time (month) post-treatment led to significant ( $P < 0.01$ ) increase in testosterone concentration level as a result of continual monthly oral administration of L-tyrosine (102±34.33 at zero time to 245.51±34.33 at 10 months of treatment). L-tyrosine might induce early puberty in male sheep (El-Battawy, 2006). In addition, L-tyrosine was considered as a growth promoting factor and led to stimulate the gonadotrophin releasing factor, which potentiates the testicular function (Kamberi *et al.*, 1971, Müller, 1973).

The sexual behaviour of females is synchronized by the ovarian activity (Hafez, 1987), since presence of developing follicles in the ovaries is followed by secretion of estrogen which results in standing female position to be mated by the male. This supports the hypothesis that tyrosine has a function on the synthesis of cerebral catecholamine and led to activate the hypothalamus to release GnRH (Hammerl and Rüsse, 1987 and Arthur, 1989).

Table 6 illustrates that treated ram-lambs showed significant improvement in most semen characteristics. Also, the results indicated that there were insignificant differences between first and second ejaculates in all physical semen characteristics studied. The amounts of improvement in semen characteristics due to L-tyrosine oral administration, were 36.11% in semen motility, 64.29% in sperm concentration /Ejc, and 102% in motile sperm /Ejc compared to the control.

Table 6. Some physical semen characteristics of Ossimi ram lambs at puberty as affected by L-tyrosine oral administration and ejaculate sequence

Factors	No. of samples	Semen characteristics					
		Ejc. / Vol. (ml)	Motility (%)	Conc. / ml x 10 <sup>9</sup>	Sperm output / Ejc.(10 <sup>9</sup> )	Motile sperm / ml (10 <sup>9</sup> )	Motile sperm output/Ejc.
<u>Treatments</u>		*	**	**	**	**	**
L-tyrosine	8	0.75 <sup>a</sup>	61.25 <sup>a</sup>	2.13 <sup>a</sup>	1.61 <sup>a</sup>	1.30 <sup>a</sup>	0.99 <sup>a</sup>
Control	8	0.57 <sup>b</sup>	45.00 <sup>b</sup>	1.73 <sup>b</sup>	0.98 <sup>b</sup>	0.77 <sup>b</sup>	0.49 <sup>b</sup>
±SE		0.05	3.24	0.09	0.12	0.07	0.09
<u>Ejaculate sequence</u>		Ns	Ns	Ns	Ns	Ns	Ns
First	16	0.66	50.00	1.90	1.26	0.96	0.69
Second	16	0.67	56.25	1.96	1.38	1.11	0.79
±SE		0.05	3.24	0.09	0.12	0.07	0.09

<sup>a, b</sup>, Means in the same column under the same factor followed by the same superscript are not significantly different. NS = Not significant ( $P > 0.05$ ), \* = ( $P < 0.05$ ), \*\* = ( $P < 0.01$ ).

The present results are confirmed with those reported by El-Sayed *et. al.* (1992) who found that there was significant improvement in semen quality for rams treated with tyrosine administration. The ejaculate volume, the sperm concentration, the sperm motility and the sperm alive were significantly ( $P < 0.01$ ) higher in the treated group than in the control. These differences may be due to the variations in testicular size (Ferial *et. al.*, 1992). L-tyrosine caused a significant increase in semen volume which is correlated to increased sperm concentration. Increased sperm motility in consequence of treating males with L-tyrosine may be reflected on increased semen fructose concentration and increased live sperm percentage in the L-tyrosine treated groups compared to the control group (El-Sayed *et. al.*, 1992).

Data in Table 7 indicated that the net revenue in both ram and ewe lambs recorded better return as a result of L-tyrosine oral administration compared to the control group. Improvement of economic gain in both ram-and ewe-lambs is due to increase of total body weight gain, and at the same time, decrease of total cost of these animals as a result of L-tyrosine oral administration.

Table 7. Economical evaluation of L-tyrosine oral administration for Ossimi growing lambs.

Items	Ram-lambs		Ewe lambs	
	Ty	CO	Ty	CO
Experimental period (day)	169.13	207.50	158.13	193.38
Avg. feed consumed (kg) / day / lamb	1.35	1.26	1.15	1.04
Total feed consumed (kg) / lamb till puberty	228.33	261.45	181.85	201.12
Price of ration fed (LE) <sup>1</sup>	285.41	326.81	227.31	251.39
Avg. amount of L-tyrosine consumed (g) / lamb.	16.29	0.00	6.06	0.00
Price of L-tyrosine consumed /lamb (LE) <sup>2</sup>	6.52	0.00	2.42	0.00
Total cost (LE)	291.92	326.81	229.74	251.39
Total body weight obtained up to puberty (kg)	42.50	34.63	35.00	30.50
Net revenue (LE) <sup>3</sup>	558.08	365.79	470.26	358.61

<sup>1</sup>, [Total feed consumed x 1.25 (price of one kg ration, LE)]

<sup>2</sup>, [Avg. amount of L-tyrosine consumed (g) x 0.4 (price of one gm L-tyrosine, LE)]

<sup>3</sup>, [Total body weight x 20 (price of one kg weight, LE)] – Total cost

Ty = L-tyrosine treated, CO = Control.

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## تأثير تجريع التيروزين على أداء الحملان الأوسيمي النامية

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استهدفت هذه الدراسة تحديد التأثيرات الايجابية لتجريع التيروزين (100 ملجم/ كجم وزن حي) على أداء الحملان الأوسيمي النامية عقب الفطام وحتى البلوغ الجنسي. تم تسجيل وزن الحملان من الفطام حتى البلوغ الجنسي ، الوزن والعمر عند البلوغ الجنسي ، معدل النمو ، النشاط الجنسي ، صفات السائل المنوي ، مستويات هرمون التستستيرون وكذلك هرمونات الغدة الدرقية. أستخدم في هذه التجربة 32 من الحملان الذكور والاناث الأوسيمي وزعت عشوائيا إلي مجموعتين متساويتين في العدد (ثمانية حملان من الذكور والاناث) أخذت أحدهما جرعة واحدة من التيروزين شهرياً وحتى الوصول إلي البلوغ الجنسي وظلت الأخرى كضوابط. تم وزن هذه الحملان الذكور والاناث شهرياً لتقييم معدل النمو. ثم أخذت أربع عينات من الدم من كل نوع من الحملان (عند اول التجربة و عند عمر ستة وثمانية وعشرة أشهر) وذلك لتقدير هرمونات الدرقية وأيضاً تقدير هرمون التستستيرون في عينات الحملان الذكور .

وأوضحت النتائج أن حملان الذكور والاناث المعاملة بالتيروزين قد بلغت إلى مرحلة البلوغ الجنسي عند أعمار مبكرة وأوزان ثقيلة عند مقارنتها بغير المعاملة. وكذلك ارتفع معدل نمو الحملان الذكور والاناث بشكل ملحوظ كنتيجة للمعاملة بالتيروزين . لوحظ أيضاً زيادة معنوية في تركيز هرموني T<sub>4</sub>,T<sub>3</sub> في كل من الحملان الذكور والاناث كنتيجة للمعاملة بالتيروزين وخاصة عند عمر عشرة أشهر. علاوة على ذلك كانت هناك زيادة غير معنوية في حجم الخصيتين وكذلك في طول الزائدة الدودية كما تميزت وتحسنت الرغبة الجنسية عند الحملان الذكور المعاملة بالتيروزين مقارنة بالضوابط. ايضاً أزداد تركيز هرمون التستستيرون في الدم معنوياً في الحملان كنتيجة للمعاملة بالتيروزين . كما أوضحت النتائج أن هناك تحسناً ملحوظاً في جميع الصفات الطبيعية للسائل المنوي في الحملان المعاملة بالتيروزين مقارنة بالضوابط.

وعليه فإن معاملة الحملان بالتيروزين كانت مصحوبة بعائد اقتصادى جيد .