PRODUCTIVE AND REPRODUCTIVE PERFORMANCE OF RAHMANI MALE LAMBS FED RATIONS CONTAINING JATROPHA CAKE

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SUMMARY

The objective of this study was to determine the effect of 70% Jatropha cake replaces by soybean on feedlot and reproductive performance of Rahmani male lambs. Following weaning the lambs were divided into two groups control and trial (n=8 in each). All groups were received concentrate and roughage as 60:40 ratios, respectively. The control lambs were fed concentrate feed mixture (CFM) plus berseem hay (BH). The trial lambs were nourished tested diet consisted of Jatropha cake instead of 70% soybean which contained CFM plus BH. Detoxification Jatropha cake by Lactic acid bacteria at rate of 1g/100 kg Jatropha cake. Measurements of live body weight, body weight gain and animal performances were calculated during five months as fattening period. The testicular characteristics were taken from 95 to 275 days and blood samples for testosterone hormone were started from 115 up to 275 days of age. Semen was collected by artificial vagina after lambs appeared 3rd stage of puberty. The experimental result explained that values of live body weight, testicular diameter, testicular circumference, testicular length and testicular volume of ram lambs in Jatropha diet were higher than those in control diet. Moreover, results showed no significant differences among experimental rations on average daily gain. However, the highest average daily gain of growing lambs was recorded with Jatropha followed by control. The average daily total DM (g/h/d) intake of control lambs was 1250, but 1300 consumed by Jatropha lambs. The average daily gain (g/h/d) was rather in Jatropha lambs 204.6 than control lambs 199.3. The feed utilization efficiency was 10.14 % for Jatropha supplemented diet. The totally experimental measurements of lambs were affected positively (P<0.05) with advanced age during pubertal development. The lambs in Jatropha reached puberty earlier (241.45 days) than in control male (272.24 days). The Jatropha lambs were produced semen quality in higher (P<0.05) than those in control lambs. Jatropha groups had better (P<0.05) testosterone hormone concentration values than CFM group. It could be concluded that bacterial Jatropha meal could be replaced up to 70% of soybean meal in CFM without any adverse impact on body performance, puberty development and semen production of lambs.

Keywords: Male lambs, puberty, production and reproduction performance, Jatropha cake.

INTRODUCTION

In Egypt, the Jatropha cake remain after oil extraction contains high protein level approximately 45-50% yet it could be considered as feed supplement for livestock producers **(Aslani *et al.*, 2007)**. The major problem with using Jatropha cake its high content of someantinutritional compounds of inhibitor activities like trypsin, phytate, saponins and lectins. The lactic acid bacteria are the best method to reduce the antinutritional compounds in Jatropha cake. Jatropha meal has a high potential to complement and or substitute soybean meal as a protein source in ruminant diets (**Makkar *et al.*, 2008**). The levels of essential amino acids (except lysine) are higher in Jatropha seed cake than in the FAO reference protein for a growing animal (**Harinder *et al.*, 2008**). Moreover, **Nzikou *et al.* (2009)** reported that the major fatty acids found in the oil samples were oleic (41.5- 48.8%), linoleic (34.6- 44.4%), palmitic (10.5- 13.0%), and stearic (2.3-2.8%).

The protein plays a major role in many aspects of male properties including the

attainment of body weight, sexual maturity and onset of puberty (**Foruie *et al*., 2004**). In, Egypt, there is a problem of shortage of protein sources used for animal feed, which is caused by expensive importation of soybean meal. Thus there is a need to evaluate alternative protein sources that help to reduce the shortage problem. The Jatropha seeds are the oil seeds whose by-products are most frequently available

Consequently, this study was carried out in order to determine the effect of replacement 70% of soybean with treated Jatropha cake on fattening and reproductive performance of Rahmani male lambs.

MATERIALS AND METHODS

This research was conducted in EL-Serw Animal Production Research Station, Damietta Governorate, belonging to Animal Production Research Institute, Agriculture Research Center, Ministry of Agriculture, Egypt.

Detoxification method (Lactic acid bacteria treatment)

Jatropha meal was treated with *lactobacillus acidophilus* at rate of 1g/100kg and stored in plastic sacks for 21 days at room temperature then dried to reach about 6% moisture and was ground to pass a 2 mm screen.

Animals and management

Sixteen single-born Rahmani male lambs were used after weaning at three months of age and average live body weight of 18.90±0.39. Lambs were housed in experimental pens and randomly assigned into two groups; control and treatment (8 lambs each). The quantity of concentrate feed mixture (CFM) and berseem hay (BH) were offered at rate 60:40 to both groups. The treatment group fed Jatropha cake in lieu of 70% of soybean presented in CFM. The amount of feed intake with control and treated lambs was adjusted every two weeks based on animal body weight according to **NRC (2007)**. All groups were kept under equal management condition and the basal diet was offered daily in two parts at 9 am and 4 pm. Fresh water and salt blocks were available continuously during the experimental period. Composition and analysis of feedstuffs were applied according to A.O.A.C**. (1995)**. At the end of feeding trials, nutrient digestibility was estimated by acid insoluble ash (AIA) according to **Van Keulen and Young (1977)**. The fecal samples were collected twice daily during 10 days from both groups (three lambs of each). The feces were analyzed according to **A.O.A.C. (1995)**.

Production performances

The lambs were weighed biweekly in the morning before feeding through five months as fattening period.

Reproduction parameters

Testicular characteristics through puberty days

Measurements of testicular characteristics (diameter, length, scrotal circumference and testis volume) were measured once every 20 days to detect changes in sexual behavior. Measurement was implemented for the first time when ram lambs were 95 days old. Testicular diameter was recorded with a caliper on the left and right testicles as the widest anteroposterior diameter. Testicular length was measured by a caliper both on the left and right testicles as the distance between the top of the tail and the head of the epididymis. Scrotal circumference was measured with a flexible plastic tape at the point of maximum circumference of paired testes. The volume of the testes was calculated by **Godfrey *et al*. (1998)** formula: Testes volume (cm^3) = 0.0396 x testicular length x (scrotal circumference) ^{2}.

Puberty development and semen characteristics

Lambs were observed to follow puberty stages (1^{st} mating without erection, 2^{nd} mating with erection and 3^{rd} mating with erection and ejaculation) two times weekly. When lambs were displayed 3^{rd} puberty stage semen was collected by artificial vagina in two ejaculates weekly up to two weeks. Semen was collected into a collection clean and sterile graduated tube. The semen ejaculates were immediately

transported to the laboratory and immersed in a water bath at 37°C to assay semen parameters (progressive motility, live spermatozoa, abnormal spermatozoa and sperm concentration $x10^9$). The volume of the ejaculates was red directly from a graduated collection tube to the nearest 0.1 ml scale. The methods of other semen parameters were described by **Marco-Jimenez *et al*. (2005).**

Blood testosterone assay through puberty days

Blood samples from each lamb were collected by jugular vein every 20 days starting from 115 to 275 days of age. Within 30 min of collection, the samples (7 to 10 ml) were centrifuged at 3000 rpm for 15 min. Plasma aliquots (500 µL) were then stored at -20 °C until assayed. Testosterone (T) concentrations were measured by radioimmunoassay using a commercial kit (DSL-4000, DSL, Texas, U.S.A). Assay sensitivity was 0.12 ng/mL serum with a coefficient of variation of <10%.

Statistical analysis

Data of mineral concentrations were analyzed using the general linear model (GLM) procedure in **SAS (2009).** Differences among means were assessed with **(Steel and Torrie, 1980).**

RESULTS AND DISCUSSION

Chemical composition of feedstuffs and experimental diets:

Chemical composition of ingredients and calculated composition of tested diets during digestion trials are presented in Table 1. It was clear that the experimental diets practically had similar chemical nutrients.

Table 1: The chemical composition on DM basis (%) of feedstuffs and experimental ration.

Item	Chemical composition of feedstuffs							
	DM	**OM**	**CP**	**CF**	**EE**	**NFE**	**Ash**	**Zinc**
***CFM**	90.50	92.3**0**	14.60	13.50	3.30	60.90	7.70	24.00 (ppm)
CFM+ Jatropha	90.00	92.10	14.9	14.00	3.80	59.40	7.90	33.00 (mg/kg)
BH	88.00	87.00	12.50	25.00	1.70	47.80	13.00	27.75 (mg/kg)
Jatropha supplemented diet	91.50	92.48	42.3	8.6	8.2	33.38	7.52	47.83 (mg/kg)
Calculated chemical composition of tested diet								
Control	89.40	90.00	13.70	18.50	2.60	55.20	-	-
Treated diet	89.10	89.90	13.80	18.80	2.90	54.30	-	-

*The commercial CFM contained: undecorticated cottonseed meal (22%), wheat bran (31%), yellow maize (28%), Soybean meal (10%), molasses (5%), limestone (2.5%) and common salt (1%), minerals mixture (0.5%).

Digestion coefficient

Results in Table 2 show insignificant differences between the control and tested diet in all nutrients digestibility. TDN of treated diet was significantly higher ($P<0.05$) compared with control, while DCP was more but insignificantly.

Productive performance

Live body weight

It was noticed that lambs fed Jatropha had more body weight during the age from 4 to 6 months (Fig 1) but difference in body weight was decreased at age 7 months. The marketing live body weight for lambs fed either Jatropha or control rations were 49.70 ± 1.33 kg and 48.70 ± 1.54 kg, respectively. These results are in agreement with **Abo El-Fadel *et al*. (2011)** who suggested that lambs fed Jatropha had similar live body weight compared to lambs fed ration without Jatropha. However, **Belewu *et al.* (2010)** reported that feeding Jatropha meal to goat improved rumen bypass of protein which make it available to animal for

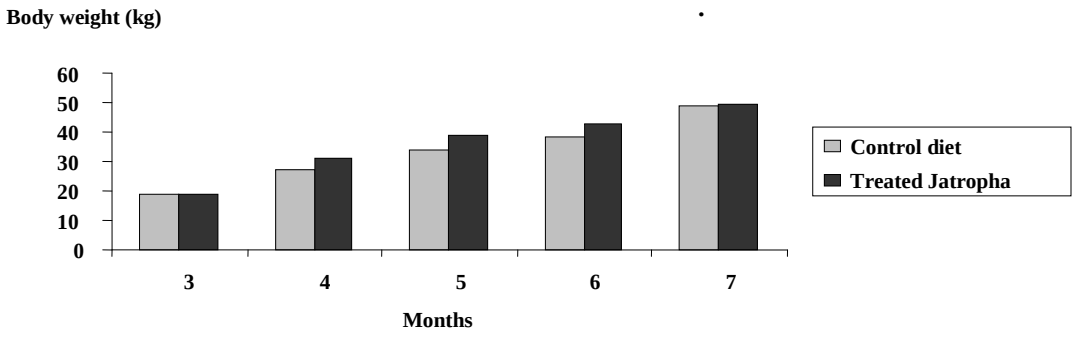
production purposes. Moreover, Jatropha was rich in zinc that plays an important role in body performance. The study of **Humann-Ziehank *et al.* (2008)** highlighted that zinc is based on its influence on enzymes activities, metabolism of essential fatty acids, carbohydrate metabolism, free radical destruction and protein synthesis that related to positive change in live body weight.

Table 2: Digestion coefficient and nutritive values of experimental diets.

Ingredients	Experimental diets	
	Control ration	Treated Jatropha ration
DM	69.73	71.40
OM	73.13	75.17
CP	71.60	72.50
CF	63.53	65.07
EE	78.62	79.30
NFE	72.70	73.68
Nutritive values		
TDN	66.24^{b}	67.4^{a}
DCP	9.80	10.00

a, b . Means within rows with different superscripts are significantly different ($P < 0.05$).

Fig .1 : Average of live body weight (kg) of lambs fed different protein sources



Daily body gain

The average daily weight gain (g/h/d) of lambs through the trial period (4 months) show inconsiderable faster growth with Jatropha diet (204.6) than standard diet (199.3) (Fig 2).

Animal performance

Data in Table 3 show non-significant differences in animal performance and parameters measured due to experimental rations. Both economic return and economic efficiency was slightly improved by 6.5% and 10.14%, respectively due to Jatropha supplement than control ration. This result is in agreement with **Belewu, *et al.* (2010)** who reported that Jatropha meal has positive effect on daily gain, feed intake and feed utilization efficiency. Lambs had Jatropha contained zinc that participates in formation and action of thyrotropin-releasing hormone (TRH). The TRH hormone has indirect effect on thyroid function and decrease energy release which encourages consumption of high amount of diet **(EL-Sisy *et al.*, 2008).** Concerning feed conversion efficiency, it was better with Jatropha fed lambs (6.7:1) than control (7.48:1). The feed cost per kg gain was lower for

Fig.2: Average of daily weight gain of lambs fed control and treated Jatropha.

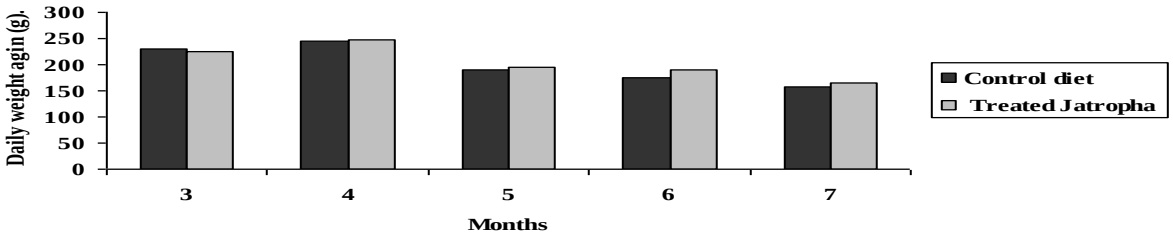


Table 3: Productive performance of growing Rahmani lambs fed experimental diets.

Items	Experimental diets	
	Control diet	Treated Jatropha
No. of lambs	8	8
Duration of trial post-weaning (months)	5	5
Initial live weight (kg)	18.8	19.00
Market live weight (kg)	48.70	49.70
Total live weight gain (kg)	29.9	30.7
Daily live weight gain (g)	199.3	204.6
Daily feed intake DM basis		
CFM (g)	697	720
Berseem hay (g)	553	580
Total DM intake (g/h/d)	1250	1300
Feed utilization efficiency		
Feed conversion efficiency		
Kg DM /kg gain	6.27	6.35
Kg TDN intake /Kg gain	4.15	4.25
Kg DCP intake /Kg gain	0.61	0.63
Economical efficiency		
***Cost of consumed feed (L.E/kg)**	1.44	1.34
Price of weight gain (L.E)	4.98	5.11
Feed cost / kg gain (L.E)	7.22	6.54
Economic return	3.54	3.77
The economic efficiency%	3.45	3.8

* The cost of ton CFM was 1500 LE of control and 1300 LE of treatment group, Berseem hay was 800 LE, Soybean meal was 2800LE and Jatropha cake was 900 LE.

Jatropha diet (L.E 6.54) than control diet (L.E 7.22). Thus, the economic efficiency was more by 10.14% for Jatropha diet than control. These results are in agreement with those obtained by **Belewu, *et al*. (2010).Testicular characteristics till puberty**

The development of reproduction parameters testis measures and testicular volume through age 95 to 275 days are presented in Fig. 3 & 4, respectively. Measurements of testis were greater with Jatropha supplement than control, but differences were insignificant unless for testicular volume ($P<0.05$). It was noticed that testis parameters increased by progress of age till puberty. Similarly, **Karakus (2010)** reported that age and body weight had significant effect on testicular length, testicular diameter, scrotal circumference and scrotal length. The improved testicular characteristics accompanied Jatropha replacement of soybean in basal diet might be due to the increased zinc provided in treatment diet. This result is in agreement with **Underwood and Somers (2011)** who reported

that lambs consuming diet containing zinc showed significantly greater testicular development and sperm production than lambs had zinc deficiency in intake.

Fig.3:Changes in testis measures due to Jatropha supplement by progress of age.

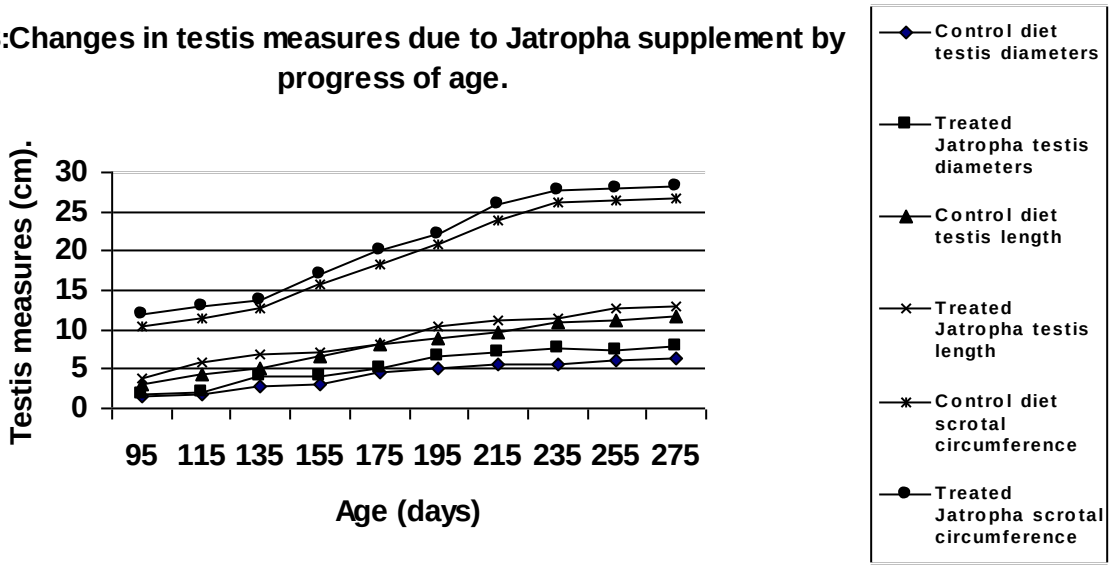
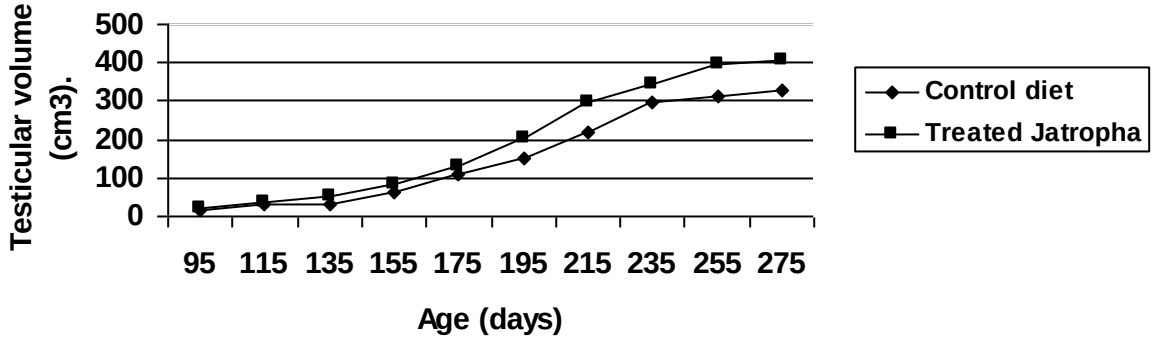


Fig.4:Changes in testicular volume due to Jatropha supplement by progress of age.



Puberty development and semen characteristics

There were significant decrease ($P<0.05$) in days to develop puberty and improve in semen quality between Jatropha supplemented and control lambs (Fig 5 and Table 5). The Jatropha group was presented 1st mounting without erection at 156.29 days compared to control group (177.91 days). The same trend was recorded until puberty for mating with erection and mating with erection and ejaculation (198.25, 225.82 days and 241.45, 272.24 days, respectively). Puberty age recorded conform to that reported by **El-Ashry *et al*. (2000)** for local ram lambs (286 - 311 days). Also, **EI-Saidy et al. (2008)** indicated that puberty stages of crossbred lambs (1/2 Finish Landrace x 1/2 Rahmani) were 173 days (1st mating without erection), 214 days (1st mating with erection) and 266 days (1st mating with ejaculation). Semen quality and quantity were affected by final testis size, pattern of circulating testosterone and diet. **Fernández *et al*. (2004)** recorded that supplementing diets with protein enhanced performance and accelerated testis growth that led to increase semen quality and

quantity. Supplementing diet with Jatropha means providing diet with trace elements specially zinc. This element is essential for production of sex hormones, gonadotrophin hormone and production of specific antibacterial compound that released from the prostate gland into the semen **(Stefanidou *et al*., 2006)**. Zinc is also essential for testicular growth, spermatogenesis development, increasing daily sperm production, reduces the proportion of abnormal spermatozoa **(Vázquez-Armijo1 *et al*., 2011 and Underwood & Somers, 2011).**

Fig.5: Development of puberty stage of lambs fed control and treated Jatropha diets.

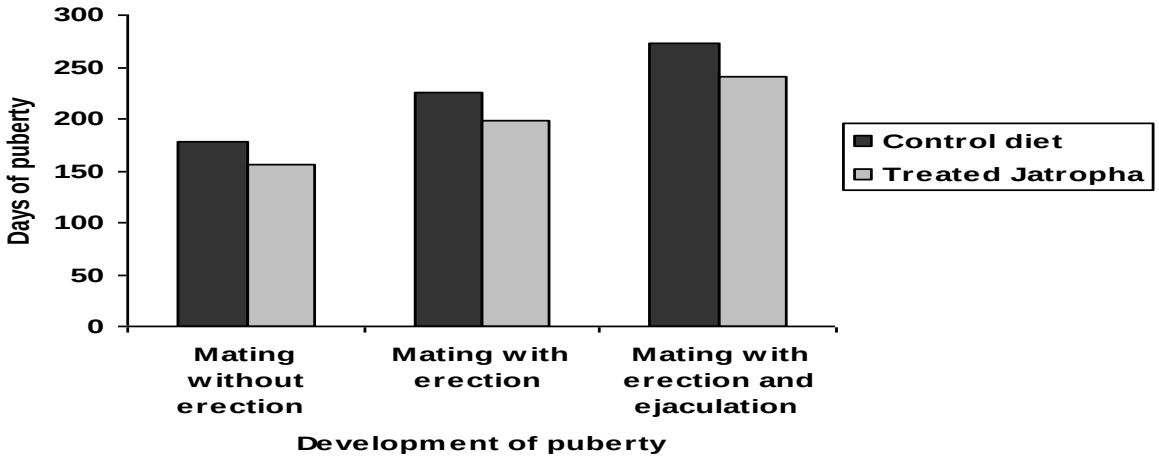


Table 5: Semen characteristics with experimental diets for lambs display puberty.

Items	Experimental diets	
	Control diet	Jatropha supplemented diet
Ejaculate volume (ml)	0.72±0.39 [b]	1.07±0.41 [a]
Progressive motility (%)	75.31±6.45 [b]	82.78±7.54 [a]
Live sperm (%)	71.93±7.57 [b]	80.57±5.97 [a]
Abnormal sperm (%)	16.65±3.11 [a]	11.31±2.24 [b]
Sperm concentration ($x10^9$/ml)	1.85±0.45 [b]	2.16±0.66 [a]

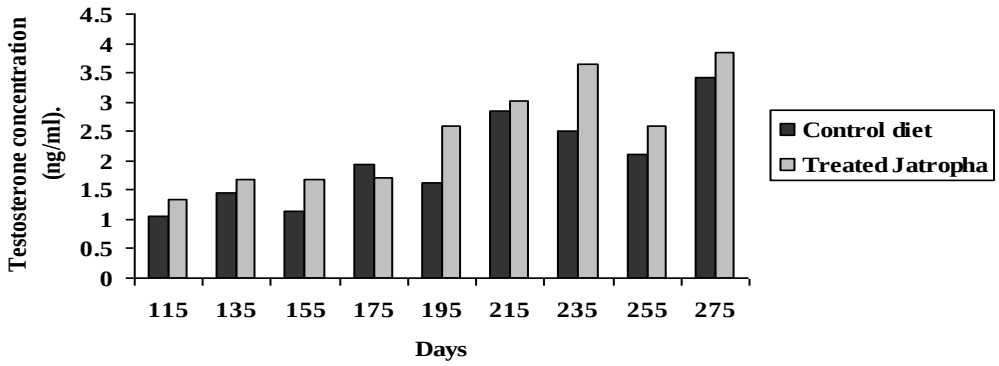
a and b means within the same row with different superscripts are significantly different at ($P < 0.05$).

Blood testosterone assay through puberty days

The development of serum testosterone concentrations during puberty from 115 to 275 days is presented in Fig 6. A significant increase ($P < 0.05$) has been observed on the testosterone hormone levels in ram lambs with Jatropha group (2.45ng/ml) compared to control group (1.99ng/ml). In general, the increase in serum testosterone concentration is linear during the pre-pubertal period and reaches a maximum value between the ages of 215 to 235 days for the two groups. Changes in testicular size, caused by increase or decrease of protein supply, were positively correlated with changes in secretion of gonadotrophins and testosterone **(Tjondronegoro *et al*., 1998).** Also, **El-Saidy *et al*. (2004)** found that serum testosterone concentrations were low at early stages of puberty (stage of 1st mounting) in all tested groups and gradually increase with chronological age. The testosterone hormone

concentration had a fluctuating trend independent of the diet type. Similarly, **Fernández *et al*. (2004)** reported that testosterone hormone concentration had fluctuations for rams fed with protein diets. Also, zinc in Jatropha meal activated synthesis of testosterone hormone **(Rubio *et al*., 2007).**

Fig. 6: Average of serum testostrone concentration (ng/ml) of lambs fed control and treated Jatropha diets.



CONCLUSION

It could be concluded that Jatropha cake can replace up to 70% of soybean meal in CFM without any adverse effect on lambs performance. Jatropha supplement succeeded improve puberty premature and early of semen collection. Feed conversion efficiency and feed economics also improve by Jatropha supplement

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الملخص العربى

الأداء الإنتاجى والتناسلى لذكور الحملان الرحمانى المغذاه على علائق تحتوى على كسب الجاتروفا

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الهدف من هذه الدراسة هو تحديد تأثير اضافة 70 ٪ من كسب الجاتروفا المعامل محل فول الصويا الموجود فى العلف المركز على الأداء الأنتاجى و التناسلي لذكور الحملان الرحماني. قسمت الحملان المفطومة الى مجموعتين (ن = 8 في كل منهما). وقدغذيت كل مجاميع التجارب على العلف المركز و دريس البرسيم بنسبة 60:40 ، على التوالي. تم تغذية حملان الكنترول على خليط من العلف المركز (CFM) ، بالإضافة إلى دريس البرسيم (BH). وغذيت الحملان المختبرة على كسب الجاتروفا بنسبة 70 ٪ ليحل محل فول الصويا الموجود فى CFM مع دريس البرسيم. وتم إزالة السموم الجاتروفا ببكتيريا حمض اللاكتيك. حسبت قياسات وزن الجسم ، ومعدل النمو اليومى خلال فترة خمسة أشهر. وقد اتخذت خصائص الخصية بين 95-275 يوما ، وعينات من الدم لهرمون التستوستيرون ، والتي بدأت من يوم 115 إلى 275 من العمر. وقد تم جمع المني بواسطة المهبل الاصطناعي بعد وصول الحملان مرحلة البلوغ. وأوضح أن النتائج العملية أن القيم من وزن الجسم الحي ، قطرها الخصية ، محيط الخصية ، والخصية طول وحجم الخصية الحملان الكبش في النظام الغذائي مع كسب الجاتروفا كانت أعلى من تلك الموجودة في النظام الغذائي مع علائق المقارنة. ، سجلت أعلى زيادة فى متوسط النمو اليومي لحملان الجاتروفا تليها الحملان المقارنة. وكان متوسط مجموع DM (جم / رأس / يوم) اكل من حملان المقارنة وكسب الجاتروفا 1250 ، 1300 على التوالى. وكان المتوسط اليومي لكسب الجاتروفا (جم / رأس / يوم) 204.6 مقارنة 199.3. وكفاءة استخدام العلف 14،10 ٪ مع الجاتروفا. تأثرت القياسات التجريبية تماما من الحملان إيجابيا بمقدار (0.05) مع تقدم سن الجملان خلال التنمية البلوغ. وصلت حملان الجاتروفا إلى مرحلة البلوغ مبكرا (241.45 يوما) مقارنة بالمجموعة الغير معاملة (272.24 يوما). نوعية السئل المنوى لحملان كسب الجاتروفا افضل بمعنوية أعلى(0.05) من تلك الموجودة في الحملان المقارنة. وكانت حملان الجاتروفا أفضل بمعنوية (0.05) فى تركيز هرمون التستوستيرون. ويمكن أن نخلص إلى أنه يمكن الاستعاضة بنسبة 70% من كسب الجاتروفا بفول الصويا الموجود فى العلف المركز دون أي تأثير سلبي على الأداء الأنتاجى ، وتطوير البلوغ وإنتاج المني من الحملان