

## Growth Reproductive Traits Development and Blood Constituents of Male Rabbits as Affected by Post-weaning Duration of Feed Restriction and Age

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**T**HE effect of post-weaning duration of feed restriction (6 hr daily feeding for 2, 3, and 4 weeks ) on growth, reproductive traits development and some blood constituents of male rabbits were studied . Forty male californian rabbits at 5 weeks of age were divided randomly into four equal groups , of 10 males each . The 1st group was fed *ad. libitum* all through (control ) ; 2nd group fed 6 hr/day for 2 weeks; 3rd group fed 6 hr/day for 3 weeks and 4th group fed 6hr/day for 4 weeks . After the end of the feed restriction periods , all groups were fed *ad. libitum*.

Post-weaning duration of feed restriction did not affect final body weight at 18 weeks of age, however, at younger age (14 weeks ) differences among groups were significant ( $p < 0.05$  ). Third and fourth groups had small body weights . The significant ( $p < 0.05$  ) reduction in feed consumption and the insignificant differences in total gain resulted in an improvement of feed conversion in third and fourth groups .

Testicles descending, penis development were delayed ( $p < 0.05$  ) with longer periods of feed restriction. At 11 weeks of age, only 30% and 20% of the males had descended testicles in third and fourth groups , respectively , compared with 50% in first and second ones. Also, 80% and 60% of the males had undeveloped penis compared to 10% in the same order . Testes, epididymis and tunica vaginalis weights and testosterone level exhibited low values in third and fourth groups at younger age (14 weeks ). However , at older age (18 weeks ) their values were similar to those in the control group. Epididymal sperm reserve for both ages (14 and 18 weeks ) was lower in longer duration of feed restriction (3 and 4 weeks ), but the difference was not significant . Seminal volume was not significantly different among groups , however fourth group had the lowest volume and second group had the highest one . Semen pH and motility were significantly ( $p < 0.01$ ) different among groups , in which second one had the highest pH and the lowest motility. post-weaning duration of feed restriction had insignificant effect on blood packed cell volume , total protein , albumin and globulin at both ages . Older males (18 weeks ) had higher values of all studied parameters than younger ones (14 weeks ). it could be concluded that post-weaning feed restriction (6 hr feeding/day ) for more than two weeks did impair the performance of male rabbits especially at younger ages, however rabbits could compensate with the advance in age .

**Key words :** Rabbits , blood , growth, reproductitive traits , feed restriction .

Post-natal development of the animal is markedly affected by many factors including breed, age and nutritional status of that animal. Limiting the time of feeding is one technique, which may prevent feed wastage and over feeding without impairing the performance of growing rabbits. Szendro and Lacza-Szabo (1986) reported that, reducing daily eating time down to 9 hours for growing rabbits (4-12 weeks of age) resulted in decreasing feed intake and improved feed conversion without changing the average daily gain. On the other hand, nutritional deficiencies may impair reproductive traits development, delay puberty and inhibit testicular functions in the young male, but have much less effect on testicular functions in the adult (Frandsen, 1986; Hafez, 1987).

Therefore, this work was conducted to study the effects of post-weaning duration of severe feed restriction (6 hr daily feeding for 2, 3 or 4 weeks) and age on growth, reproductive traits development and some blood constituents of growing male californian rabbits.

### Material and methods

This work was carried out in the Experimental Farm of Animal production Department, Faculty of Agriculture, Minia University. Forty young male californian rabbits at 5 weeks of age were divided randomly into four equal groups of 10 males each, of almost the same average initial body weight (640 - 646 g). The 1<sup>st</sup> group was fed *ad libitum* all through; the 2<sup>nd</sup> was fed 6 hr daily for 2 weeks; the 3<sup>rd</sup> was fed 6 hr daily for 3 weeks; the 4<sup>th</sup> was fed 6 hr daily for 4 weeks restricted period. The restricted groups were fed from 8.00 a.m. to 2.00 p.m during the restriction periods, then *ad libitum* after the end of the restricted periods. Animals were housed individually in hutch and were fed a commercially pelleted diet of 17.7% protein and 2895 ME/kg. water were freely available all the time.

Averages of body weight, body weight gain, feed consumption and feed conversion were recorded and calculated weekly for each group till 18 weeks of age.

Testicles descending, penile development were weekly observed and recorded for each rabbit from 11 weeks of age till slaughtering at 14 weeks of age. At 14 and 18 weeks of age 4 males/treatment were randomly selected and deprived of feed for 12 hrs., weighed and slaughtered. Head weight, testes (w/o epididymis), epididymis, tunica vaginalis, accessory sex glands were weighed to the nearest gram. Sperm reserve per testis and per epididymis were measured by the direct count technique according to Amann and Almquist (1961) and Abd Elhakeam *et al* (1978), in which tissues were macerated, blended and homogenized with 6.0 ML of isotonic formal saline solution, then sperm were counted by a haemocytometer.

At 15 weeks of age five collections of semen at different days (5 days interval) were collected from each feeding regime (4 males/treatment) by using an artificial vagina. Semen volume (ml), semen pH and percentage of progressive motility were recorded for each ejaculate. Ejaculate volume excluding the gelatinous material was recorded to the nearest 0.1 ml using a graduated collecting tube. Initial pH, using Whatman pH indicator paper and progressive motility, using a microscope with warm stage, were recorded immediately after collection. After the last semen collection (H5), four males/treatment were slaughtered at 18 weeks of age. Epididymal sperm reserve for each slaughtered male in each treatment was also recorded.



Two blood samples, w/and w/o heparin, were collected from each male during slaughter. Blood plasma was obtained by centrifugation of whole blood at 300 r. p. m for 20 min. and was kept at - 20°C for analysis. Packed cell volume (PCV %) was determined. Plasma total protein, albumin were determined by using commercial kits (Bio- Merieux, France). Globulin concentration was obtained by subtracting the albumin values from the protein values. Testosterone concentration was measured by the radioimmunoassay (R. I. A) technique, against a standard curve of pure hormones, as specified by the manufacture of the kits. Frozen plasma samples were thawed and warmed up for 10 min. in water bath before analysis. Serum testosterone level was determined using coat-A-count<sub>1</sub> 125 RIA kits purchased for DPC, Ca 90045, U. S. A. The radio activity was measured by a gamma counter. Data were subjected to statistical analysis according to Steel and Torrie (1980).

### Results and Discussion

#### 1- Growth performance:

The results in Table (1) show that post-weaning feed restriction of 6 hr/day for 2, 3 and 4 weeks did not affect final body weight (18 wks). It was observed that 4th group (4 wks restriction period) had a similar body weight as the *ad. libitum* group, but the third group had the lowest final body weight. The heaviest final body weight was recorded for 2 wks restriction period. However at younger age (14 wks) the differences

TABLE 1. Growth performance of growing male californian rabbits as affected by post-weaning duration of feed restriction.

Parameter	Treatments			
	Ad. libitum	6hr/day for 2 wks	6hr/day for 3 wks	6hr/day for 4 wks
<u>Body weight (kg):</u>				
Initial (5 wks)	0.646±0.04	0.641±0.04	0.646±0.04	0.640±0.05
14 weeks	2.143±0.09 <sup>a</sup>	2.181±0.05 <sup>a</sup>	2.086±0.02 <sup>ab</sup>	1.937±0.08 <sup>bc</sup>
Final (18 wks)	2.700±0.15	2.978±0.11	2.440±0.09	2.703±0.19
<u>Total gain (kg):</u>				
	2.054±0.09	2.337±0.07	1.794±0.06	2.063±0.10
<u>Feed consumption (kg):</u>				
	9.868±0.26 <sup>a</sup>	9.919±0.25 <sup>a</sup>	8.271±0.23 <sup>c</sup>	8.896±0.35 <sup>b</sup>
<u>Feed conversion:</u>				
	4.80±0.33	4.24±0.17	4.61±0.24	4.31±0.24

<sup>a-c</sup> Means in the same row followed by different superscript are significantly different (P<0.05).

among groups were significant ( $p < 0.05$ ), in which the fourth group had the smallest body weight compared with the other groups (Table 1). Similar trend was observed in total gain. males restricted for 2 wks (second group) gained more than those fed *ad libitum* by 13.78%. It was realized that, with advance in age rabbits had compensated for body weight and became similar to the control group, as demonstrated in this study (Table 1). Similar finding was reported by Smerha *et al.* (1964), who reported that the growth was retarded of the younger bulls on the lower plane of nutrition, but that of the older bulls was not affected.

Feed consumption for rabbits feed restricted for 2 wks was approximately similar to that of the control. However, in the other two feed restricted groups (3 and 4 wks of feed restriction) it was less ( $p < 0.05$ ) by 16.19% and 9.986%, respectively, than that of the control group. The optimal feed conversion was recorded in 2 wks feed restriction period, but the differences among groups were not significant. The significant ( $p < 0.05$ ) reduction in feed consumption and the insignificant differences in total gain resulted in improvement in feed conversion representing 11.67%, 3.96% and 10.21% from that of the control for 2, 3 and 4 wks feed restriction periods, respectively. these findings in are agreement with those reported by Szendro and Lacza-Szabo (1986), who reported that reducing daily feeding time to 9 hrs from 4 to 12 weeks of age had reduced daily feed intake by 6 to 15% but feed conversion was improved by 7 to 13%, while daily gain was unchanged in growing rabbits.

Recently, Abd Elmoty (1991) reported that reducing eating time for 8 or 6 hrs/day decreased feed consumption and improved feed conversion, while there were insignificant effects on body weight and total gain.

#### *II-Reproductive Traits Development:*

**Tasticles descending :** Table (2) shows that descending of testicles in male rabbits is occurred at post-weaning and progressed with age. It was markedly affected by feeding systems, in which post-weaning feeding restriction (6 hr. feeding/ day) for 3 or 4 wks resulted in 30% and 20% only, of the males had descended testicles compared with the *ad libitum* or the 2 wks restriction groups (50%). This significant ( $p < 0.05$ ) difference was found at earlier age (11wks). Descending of testicles advanced progressively with age, and by 12 wks of age all males in all groups had descended testicles (Fig. 1).

#### *Penile development*

Development of the copulatory organ (penis) of male rabbits followed the descending of the testicles, but it occurs lately post-partum and with slower rate. Feeding system had a significant ( $p < 0.05$ ) effect on penis development. at 11 wks of age 10% of males had undeveloped penis in the *ad libitum* or 2 wks feed restricted groups as compared to 80% and 60% in the 3 and 4 wks feed restricted ones, respectively (Table 2). All males (100%) in the *ad libitum* and the 2 wks restriction groups had complete developed penis at 12 wks of age, while only 44% and 55% were found in 3 and 4 wks restriction groups, respectively. The last two groups had all males (100%) with complete developed penis two weeks later (14 wks of age) as shown in Fig. (1).

Penis development was slower in rate compared with testicle descending and it was markedly related to age and body weight. percentages of males with developed penis were 60.0, 76.4, 97.4 and 100% at 11, 12, 13 and 14 wks of age, respectively (Table 2). penis length (m.m) followed, also, the same trend and it was affected ( $p < 0.05$ ) by duration of post-weaning feed restriction and age. The lowest value of length (0.75



m.m) was observed in 4 wks restriction group at 11 wks age. penis length of males in all 4 groups increased gradually with age, but it was shorter in 3 and 4 wks restriction periods till 13 wks of age, then was similar to that of the control and the 2 wks restriction groups (Table 2).

It has been reported that sexual maturity was delayed in younger bulls, which were on lower plane of nutrition (Smerha *et al.*, 1964). Sutama *et al.* (1985) stated that the most sequence of events in sexual development at both low and high feeding levels was testes descent, then mounting activity, then complete resolution of penile adhesions, then presence of spermatozoa in the ejaculate. Also, they concluded that the group of ram lambs on high plane of feeding reached puberty at younger age and heavier bodyweight than the other group.

TABLE 2. Descending of testes and penis development in male californian rabbits as affected by post-weaning duration of feed restriction and age.

Parameter	Treatment	Age (weeks)			
		11	12	13	14
<u>Testes descending:(No. of males with descended/total males)</u>					
	Ad.libitum	5/10 (50%) <sup>a</sup>	10/10(100%)	100%	100%
	6hr/day-2wks	5/10 (50%) <sup>a</sup>	10/10(100%)	100%	100%
	6hr/day-3wks	3/10 (30%) <sup>b</sup>	9/9 (100%)	100%	100%
	6hr/day-4wks	2/10 (20%) <sup>c</sup>	9/9 (100%)	100%	100%
Overall *		15/40 (37.5%) <sup>b</sup>	38/38(100%) <sup>a</sup>	100% <sup>a</sup>	100% <sup>a</sup>
<u>Penis developed:(No. males with developed penis/total males)</u>					
	Ad.libitum	9/10 (90%) <sup>a</sup>	10/10(100%) <sup>a</sup>	100% <sup>a</sup>	100%
	6hr/day-2wks	9/10 (90%) <sup>a</sup>	10/10(100%) <sup>a</sup>	100% <sup>a</sup>	100%
	6hr/day-3wks	2/10 (20%) <sup>c</sup>	4/09 (44%) <sup>b</sup>	89% <sup>b</sup>	100%
	6hr/day-4wks	4/10 (40%) <sup>b</sup>	5/09 (56%) <sup>b</sup>	100% <sup>a</sup>	100%
Overall *		24/40 (60%) <sup>c</sup>	29/38(76%) <sup>b</sup>	37/38(97%) <sup>a</sup>	100% <sup>a</sup>
<u>Penis length (mm):</u>					
	Ad.libitum	2.00 <sup>a</sup>	2.90 <sup>ab</sup>	5.30 <sup>a</sup>	6.00 <sup>a</sup>
	6hr/day-2wks	2.44 <sup>a</sup>	4.00 <sup>a</sup>	5.40 <sup>a</sup>	6.30 <sup>a</sup>
	6hr/day-3wks	2.00 <sup>a</sup>	2.00 <sup>c</sup>	4.00 <sup>ab</sup>	6.30 <sup>a</sup>
	6hr/day-4wks	0.75 <sup>b</sup>	2.80 <sup>ab</sup>	3.70 <sup>b</sup>	6.30 <sup>a</sup>
Overall *		1.80 <sup>d</sup>	2.90 <sup>c</sup>	4.60 <sup>b</sup>	5.90 <sup>a</sup>

<sup>a-c</sup> Means in the same column within the same parameter followed by different superscripts are significantly different (P<0.05).

\* overall values in the same row under the same parameter followed by different letter are significantly different (P>0.05).

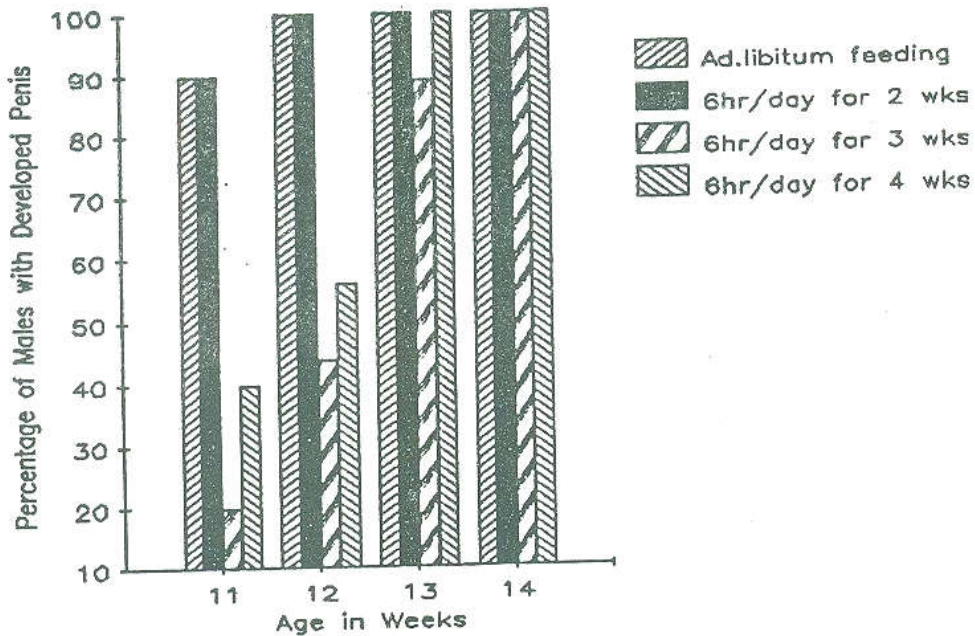
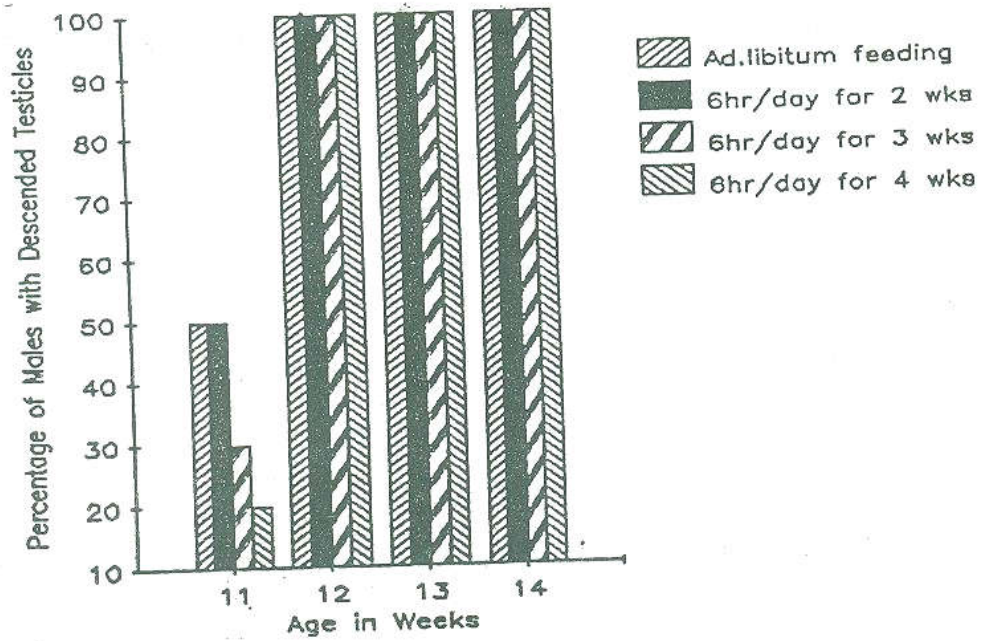


Fig. 1. Testicles descending and penis development in californion rabbits as affected by age and postweaning duration of feed restriction.



From the above results, it was found that duration of post-weaning feed restriction (6 hr/day) markedly affected the development of the external male sex characters, and these characters were delayed if the duration of feed restriction was more than 2 wks. Male sex characters are related to each other; testicle descending is completed first, followed by penis development, which might depend upon testosterone level (Hafez, 1987) and age of male, in addition to nutritional status in the early days post-partum, that might affect body weight and consequently testes weight (Frandsen, 1986 and Abd Elmoty, 1991).

Head size and weight is considered as one of the external sexual criteria of male vigour, usually good males have bigger heads than those of females. It was observed that head weight was significantly ( $p < 0.05$ ) affected by duration of feed restriction and age. Post-weaning feed restriction for more than 2 wks resulted in smaller head weights (120.1 and 114.9 g for 3 and 4 wks feed restricted groups, respectively), especially at younger age (14 wks) as compared with *ad lib.* feeding (127.2g) and the two weeks group (135.7g). As shown in Table (3), male rabbits could compensate for head weight with advance in age. Average head weight of 4 wks feed restricted group at 14 week of age was lower by 9.69% ( $p < 0.05$ ), while at 18 week of age it was lower, only, by 5.51% than that of *ad lib.* group.

Testes, epididymis and tunica vaginalis weights at 14 weeks of age followed the same trend. They had the lowest values in group 3 and 4 and the highest values in group 1 and 2, however, the differences among groups were not significant (Table 3). At older age (18 wks), testes, epididymis and tunica vaginalis of feed restricted groups increased in weights and reached those of the control group, even, they were heavier in 2 wks feed restricted group as shown in Table (3). Also it was observed that post-weaning duration of feed restriction did not affect weights of accessory sex glands at 18 weeks of age. Sutama and Edey (1986) reported a significant difference in body weight and testes diameter among groups of rams fed low, medium and high levels of nutrition, while, when the rams were given a common plane of nutrition, the differences among them quickly decreased and were not significant within 6 months.

Testosterone is considered the major secretory hormonal product of the mature testis. It acts locally to maintain spermatogenesis and support maturation and function of the accessory reproductive structures and the development of the male type of behaviour (Martin, 1978 and Hafez, 1987). Also, it is needed to maintain the functional integrity of the tunica dartos muscle and the epididymis and general body metabolism (Salisbury *et al.*, 1978). At younger age (14 wks), it was observed that testosterone level was the lowest (1.24 ng/ml) in 4 wks feed restricted group, while it was the highest (2.75 ng/ml) in the same group at older age (18 wks). A wide range exists for plasma testosterone concentration in male rabbit. The values in adult males were 270 ng/100ml (Ewing *et al.*, 1975), 50-1000 ng/100ml (Moor and Younglai, 1975) and 0.98-3.45 ng/ml (Mahmoud, 1984). Testosterone level is closely related to testes weight (Hafez, 1987) and decreasing plasma testosterone was attributed to the observed decrease in testes weight (Mahmoud 1984 and Moustafa, 1990).

Total sperm reserve at 14 week of age followed the same trend, as it was the lower ( $1.7 \times 10^6$ ) in 4 wks feed restricted group compared with the control group ( $3.2 \times 10^6$ ). However, at older age (18 wks) total sperm reserve was  $420 \times 10^6$  and  $457.5 \times 10^6$  for the same groups, respectively (Table 3). It was observed that at older age (18 wks) 3 wks restricted group had the lowest total sperm reserve ( $322 \times 10^6$ ) and the same group had

the smallest testicle weight (6.9 g) and also the lowest testosterone level (2.53 ng/ml) as shown in Table (3). Yarney and Sanford (1990) concluded that testicular size and spermatogenic function in yearling rams relate to serum LH and (or) testosterone concentrations in the neonatal period and at puberty.

TABLE 3. Effects of post-weaning duration of feed restriction and age on male reproductive traits development and epididymal sperm reserves in californian rabbits.

Parameter	Age (week)	Feed restriction regime				Mean for Age
		Ad- libitum	6hr/day 2 weeks	6hr/day 3 weeks	6hr/day 4 weeks	
<u>Head weight:(g)</u>						
	14	127.2±5.1 <sup>b</sup>	135.7±1.7 <sup>a</sup>	120.1±1.2 <sup>c</sup>	114.9±5.0 <sup>d</sup>	124.5±3.8 <sup>B</sup>
	18	166.9±10.8	168.7±4.1	158.4±5.2	157.7±10.7	162.9±8.3 <sup>A</sup>
<u>Testes (T.) weight w/o epididymes: (g)</u>						
	14	1.9±0.3	2.3±0.2	1.8±0.2	1.6±0.2	1.9±0.2 <sup>B</sup>
	18	3.7±0.7	4.4±0.5	3.3±0.4	4.2±0.5	3.9±0.5 <sup>A</sup>
<u>Epididymes(E.) weight: (g)</u>						
	14	1.2±0.2	1.2±0.1	1.0±0.1	1.1±0.1	1.1±0.1 <sup>B</sup>
	18	2.1±0.1	2.2±0.2	1.7±0.1	2.1±0.3	3.9±0.5 <sup>A</sup>
<u>Tunica vaginalis weight:(g)</u>						
	14	1.6±0.2	1.6±0.0	1.4±0.0	1.4±0.1	1.5±0.2 <sup>B</sup>
	18	2.5±0.1	2.6±0.2	1.9±0.1	2.4±0.4	2.4±0.2 <sup>A</sup>
<u>Accessory sexglands at 18 weeks of age : (g)</u>						
		1.9±0.5	1.9±0.2	1.6±0.2	2.1±0.1	
<u>Testosterone:(ng/ml)</u>						
	14	1.56±0.23	1.43±0.14	1.53±0.21	1.24±0.16	1.44±0.19 <sup>B</sup>
	18	2.63±0.11	2.66±0.14	2.53±0.12	2.75±0.09	2.64±0.13 <sup>A</sup>
<u>No. of sperm/T. w/o E. (X10<sup>6</sup>):</u>						
	14	2.6± 1.1	2.8± 1.3	1.6± 0.5	1.8± 0.2	2.2± 1.2 <sup>B</sup>
	18	105.0±25.5	142.5±22.5	127.5±25.6	120.0±27.4	123.8±25.4 <sup>A</sup>
<u>No. of sperm/E. (X10<sup>6</sup>):</u>						
	14	0.6± 0.4	1.2± 0.5	0.4± 0.2	0.6± 0.6	0.7± 0.5 <sup>B</sup>
	18	352.5±81.1	322.5±117.0	195.0±58.1	300.0±106.2	292.5±93.7 <sup>A</sup>
<u>Total sperm inT.+E. (X10<sup>6</sup>):</u>						
	14	3.2± 1.4	3.9± 1.5	2.6± 0.7	1.7± 0.7	2.9± 1.1 <sup>B</sup>
	18	457.5±93.5	465.0±115.3	322.5±73.8	420.0±97.2	416.3 ±91.3 <sup>A</sup>

a-d Means in the same row followed by different letters are significantly different (P<0.05).

A,B Means in the last column followed by different letters are significantly different (P<0.05).



Indeed, post-weaning feed restriction (6 hr feeding/ day ) for 2-4 wks duration affected the performance of male rabbit. This effect was more detectable at younger ages and rabbits can compensate with advancing in age . Feed restriction at younger age resulted in smaller body weight, delay of testicle descending and penile development, associated with smaller head, testes weights that were accompanied by lower testosterone level and lower sperm reserve. However , with advancing in age all these parameters of performance were similar to those of the control and showed that feed restricted rabbits could compensate with age. It has been reported that testes weight, testosterone levels and total sperm reserve in rabbits increased with the progress of age (Miros, *et al.*, 1980 ; Mahmoud, 1984 and Abd El-Moty, 1991 ).

Effect of post-weaning duration of feed restriction on some seminal parameters of male Californian rabbits at 18 week of age is presented in Table (4). Sexual libido of

TABLE 4. Effect of post-weaning duration of feed restriction on some seminal characteristics of californian male rabbits.

Parameter	Feed restriction regime			
	Ad-libitum	6hr/day 2 weeks	6hr/day 3 weeks	6hr/day 4 weeks
<u>Number of ejaculates collected:</u>				
collection no.1	4	5	6	7
collection no.2	4	5	6	10
collection no.3	5	4	6	6
collection no.4	5	7	5	8
collection no.5	5	5	4	5
Total	23	26	27	36
<u>Average ejaculate volume (ml):</u>				
collection no.1	0.58	0.83	0.38	0.43
collection no.2	0.73	0.90	0.78	0.68
collection no.3	0.70	0.90	0.75	0.50
collection no.4	0.75	0.73	0.78	0.70
collection no.5	0.85	1.25	0.88	0.98
Overall average	0.73±0.09ab	0.92±0.12a	0.71±0.08ab	0.66±0.07b
<u>Average sperm-cell motility (%):</u>				
collection no.1	82.5	53.8	85.0	51.3
collection no.2	83.8	76.3	77.5	76.3
collection no.3	62.5	26.5	53.8	48.8
collection no.4	61.3	57.5	66.3	71.3
collection no.5	60.0	28.8	78.8	46.3
Overall average	70.0±5.16a	49.7±7.01b	72.3±3.43a	58.8±5.31ab
<u>Average semen pH:</u>				
collection no.1	7.40	7.68	7.48	7.23
collection no.2	7.35	7.65	7.48	7.25
collection no.3	7.53	8.03	7.35	7.10
collection no.4	7.63	8.08	7.35	7.30
collection no.5	7.53	8.13	7.45	7.35
Overall average	7.49±0.07ab	7.91±0.13a	7.42±0.12ab	7.25±0.10b

<sup>a, b</sup> Overall means in the same row followed by different letters are significantly different (P<0.05).

male is mainly depend upon adequate amounts of circulating testicular androgen (Davidson, 1977). Number of successive ejaculates within certain period of time is one way to express about this sexual libido. From Table (4), it can be observed that, the total number of ejaculates (5 collections at different days ) was the highest in 4 wks restricted group. In fact, this trend was in close relation with that of testosterone level (Table 3 ). It has been reported that, testosterone reverses the effects of castration on sexual behavior (Sachs and Meisel, 1988); increasing levels of testosterone produce a greater level of copulatory behavior (Davidson, 1966 ; Henney *et al.*, 1990). However, average ejaculate volume (ml) was the lowest in 3 wks (0.71ml) and 4 wks (0.66ml) restricted groups compared with the 2 wks (0.92ml) restricted and control (0.73ml) groups ( $p > 0.05$ ). Henney *et al.* (1990) reported that semen volume and sperm concentration were not related to libido. At the same time, it was observed that, seminal volume increased with subsequent collection in all treatments.

Average percentage of motile cells was found to be significantly ( $P < 0.05$ ) lower in group 2 (49.7%) compared to the control and group3, but the differences among groups3 and 4 the control were not significant. The decrease in semen motility observed in the second group was related to higher semen pH in that group compared to the others (Table 4). Recently, Sutama and Edey (1986) found insignificant differences among low, medium and high levels of nutrition in ram semen characters except in sperm density, which was lower in low level of nutrition.

Generally, values of seminal characteristics of California male rabbits obtained in this study were comparable to those reported previously (Abd Elhakeam *et al.*, 1992).

It could be concluded from this study that, the reproductive traits development in male Californian rabbits are markedly affected if more than two weeks of post-weaning feed restriction (6 hr feeding/day ) is applied, which is more detectable at younger age (11-14 week ) and males can compensate with advancing in age.

#### IV- Blood constituents :

Mean values of PCV (%), total protein (g%), albumin (g%), globulin (g%) and pH of blood as affected by age and duration of post-weaning feed restriction are presented in Table (5). All tested blood parameters were not significantly affected by different duration of feed restriction, but the lowest values of these parameters were recorded for 3 and 4 wks restriction groups. This trend was observed to be more at younger age (14 weeks ) than at older one (18 weeks ). It seems likely that, male rabbits could compensate with advance in age as shown in this study (Table, 5 ). At 14 wks of age the mean values of blood parameters were : PCV 40.0, 39.1, 38.4 and 38.5% ; total protein (g%) 6.63, 6.57, 6.41 and 6.40; albumin (g%) 4.13, 4.02, 3.91 and 3.89 for *ad-libitum*, 2 wks, 3 wks and 4 wks restriction periods, respectively. The trend of this results was paralel to that of the growth performance results at 14 wks of age, in which 3 and 4 wks of post-weaning feed restriction had the lowest body weight (Table 1) associated with the lowest testes weight and testosterone level (Tables 2 and 3 ).

Age of animals markedly affected blood constituents . Mean values of all tested parameters increased significantly ( $p < 0.01$ ) with age, and they were higher at 18 wks than at 14 wks of age. These results are in agreement with those reported by Bolos (1977), Drangev *et al.*, (1988), and Abd El-Moty (1991), who reported a significant elevation of PCV and total protein with advanced age of rabbits.



TABLE 5. Blood constituents of male californian rabbits as affected by age and post-weaning duration of feed restriction.

Parameter	Age	Feeding restriction regime			Mean for age	
	(wks)	Ad. lib.	6hr/day for 2 wks	6hr/day for 3 wks		6hr/day for 4 wks
<u>Packed cell volume (%)</u>						
	14	40.0±0.5	39.1±0.4	38.5±0.2	38.5±0.8	38.0±0.3**
	18	43.6±0.2	42.8±0.6	42.4±0.6	42.5±0.7	42.8±0.3
<u>Total protein (g%)</u>						
	14	6.63±0.1	6.57±0.1	6.41±0.2	6.40±0.2	6.50±0.1**
	18	7.60±0.1	7.63±0.1	7.46±0.1	7.55±0.1	7.56±0.1
<u>Albumin (g%)</u>						
	14	4.13±0.1	4.02±0.1	3.91±0.1	3.89±0.2	3.98±0.1*
	18	4.58±0.1	4.65±0.1	4.53±0.1	4.54±0.1	4.57±0.1
<u>Globuline (g%)</u>						
	14	2.51±0.1	2.55±0.1	2.50±0.1	2.51±0.1	2.52±0.1*
	18	3.02±0.1	2.97±0.1	2.93±0.1	3.01±0.1	2.98±0.1

\* P&lt;0.05

\*\* P&lt;0.01

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## النمو وتطور الصفات التناسلية ومكونات الدم في الأرناب وتأثرها بالعمر وفترة التحديد الغذائي بعد الفطام

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تأثير فترة التحديد الغذائي بعد الفطام ( ٦ ساعة تغذية يوميا لفترة ٢، ٣، ٤ أسابيع ) والعمر على النمو - تطور الصفات التناسلية وكذلك بعض مكونات الدم في ذكور الأرناب .

استخدام في هذه الدراسة ٤٠ ذكر أرناب كاليفورنيا قسمت الى أربعة مجموعات متساوية العدد غذيت الأولى منها لحد الشبع ( كونترول) والثانية غذيت لمدة ٦ ساعات يوميا ولفترة أسبوعين اما الثالثة فغذيت لمدة ٦ ساعات يوميا ولفترة ٢ أسابيع والمجموعة الرابعة غذيت ٦ ساعات يوميا ولفترة ٤ أسابيع . بعد انتهاء فترة التحديد الغذائي . تم تغذية الجاميع كلها تغذية لحد الشبع مثل الكونترول .

طول فترة التحديد الغذائي بعد الفطام لم تؤثر معنويا على الوزن النهائي عند عمر ١٨ أسبوع ولكن عند العمر الأصغر (١٤ أسبوع ) الاختلافات بين مجاميع التغذية كانت معنوية . المجموعتين الثالثة والرابعة سجلت أقل الأوزان . الانخفاض المعنوي في كمية الغذاء المستهلكه في مجاميع التحديد الغذائي وعدم الاختلاف في الأوزان النهائية عن الكونترول والزيادة الكلية في وزن الجسم أدت إلى تحسين معامل التحويل الغذائي في المجموعتين الثالثة والرابعة بالمقارنة بالكونترول والمجموعة الثانية .

نزول الخصيتين في كيس الصفن وتطور العضو الذكري (القضيب ) تأخرت معنويا مع طول فترة التحديد الغذائي حيث

وجد عند عمر ١١ أسبوع وجد ٢٠٪ و ٢٠٪ فقط من الذكور أتمت نزول الخصيتين فى كل من المجموعة الثالثة والرابعة على التوالى مقارنة بمقدار ٥٠٪ من أجمالى الذكور فى المجموعتين الثانية والكونترول . أيضا وجد أن ٨٠٪ و ٦٠٪ فقط من أجمالى الذكور لم يتطور عضوها الذكري وظل مفتوحا مقارنة ب ١٠٪ فقط فى كل من المجموعتين الثانية والكونترول على الترتيب السابق . سجل وزن كل من الخصية والبربخ وكذلك التيونيكافاجيناليزبالإضافة إلى مستوى هرمون التستوسترون قيما منخفضة فى المجموعتين الثالثة والرابعة عند العمر الصغير (١٤ أسبوع ) ومع ذلك عند العمر الأكبر ( ١٨ أسبوع ) كانت قيمتها متماثلة مع مجموعة الكونترول .

مخزون البربخ من الحيوانات المنوية عند كلا العمرين (١٤ أو ١٨ أسبوع ) كان أقل مع زيادة طول فترة التحديد الغذائى ٢ أو ٤ أسابيع ) ولكن الفروق كانت غير معنوية بالمقارنة بكل من المجموعة الثانية والكونترول .

الصفات الطبيعية للسائل المنوى من حيث حجم القذف لم تتأثر معنويا لطول فترة التحديد الغذائى ولكن المجموعة الرابعة سجلت أقل قيمة لها فى حين تأثرت درجة الحموضة والحيوية للسائل المنوى حيث سجلت المجموعة الثانية أعلى قيمة لدرجة الحموضة وأقل قيمة لدرجة حيوية السائل المنوى مقارنة ببقية مجاميع التحديد الغذائى والكونترول .

طول فترة التحديد الغذائى بعد الفطام لم تؤثر تأثيرا معنويا على الحجم النسبى لمكونات الدم الخلوية وكمية البروتين الكلية - كذلك كمية الالبيومين والجلوبولين عند كلاالعمرين (١٤ و ١٨ أسبوعا ) . سجلت ذكور الكاليفورنيا الأكبر عمرا (١٨ اسبوع ) قيما أعلى لكل تقديرات الدم عنها عند العمر الصغير ( ١٤ أسبوع ) .

من هذه الدراسة يمكن القول بأن زيادة فترة التحديد الغذائى (٦ ساعات تغذية يوميا ) عن أسبوعان بعد الفطام اعاق أداء ذكور الأرانب الكاليفورنيا خاصة عند العمر الصغير ومع ذلك فيمكنها التعويض مع التقدم فى العمر .