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INFLUENCE OF DIETS SUPPLEMENTED WITH FISH OIL ON PRODUCTIVE AND REPRODUCTIVE PERFORMANCE OF GROWING MALE AND FEMALE LAMBS.

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ABSTRACT

Fifty-four crossbred weaned lambs(1/2 Finish Landrace x 1/2 Rahmani) were used to study the effect of fish oil supplementation on productive and reproductive performance of growing male and female lambs. Twenty-four male lambs and 30 female lambs have born from ewes fed the same tested diets, with average live body weight of 16.03+0.39 kg and 15.1+0.49 kg respectively, were randomly divided into three groups (8 and 10 in each group for male and female lambs, respectively).Male and female were fed separately in group feeding. The first group of each sex was fed a basal diet consisting of concentrate feed mixture (CFM) plus berseem hay 3rd cut ,while in group 2 and 3 fish oil was added to the basal diet at the rate of 2 and 4% of total DM intake, respectively.Daily gain, average total daily intake, feed efficiency, feed cost and blood constituents were recorded.

The obtained results showed that the average daily gain (ADG) of male lambs was the highest (P<0.05) in G3 followed by G2. Average daily total DM(kg/h/d) intake of male lambs by control group was the highest, while G3 recorded the lowest value. Feed efficiency (DM/ kg gain) of G2 and G3 of male lambs were better by about 13.2 and 27.4% than control group. The lowest feed cost/kg gain was recorded with G3,while the highest value was recorded with control group. Economical efficiency of diets 2 and 3 was higher than the control one. The concentration of total protein, albumin, glucose and total lipids in serum of ram lambs in G3 were higher (P<0.05) than those of G2 and control group. Also, concentration of globulin, AL/GL ratio, GOT GPT, GOT/GPT ratio, total cholesterol and triglycride were in the same trend, but without significant differences among the dietary treatments. Average body weight (ABW) at puberty of ewe lambs tended to slightly decrease with increasing fish oil level. Highest (P<0.05) ABW at conception was recorded by G3. However, ADG through the interval from initial (3 months of age) up to conception was the highest in G2 followed by those of G3. However, total feed intakes (kg /h/d) were nearly similar in all groups. Feed efficiency (DM/kg gain) of G2 and G3 of ewe lambs were better by about 21.3 and 24.2% than control group. The lowest feed cost /kg gain was with G2 which had the lowest value (best) feed conversion (kg DM/kg gain), while the highest feed cost/kg gain was recorded with control group.

Ram lambs in G3 reached puberty earlier (221.4 days) with higher ADG (167.1 g/day) comparing with those in G2 (242.8 days puberty age and 148.9 g/day ADG) and control group (264.8 days puberty age and 139 g/day ADG). Ram lambs in G2 and G3 were produced semen in higher(p<0.05) quality than those in control group. Ewe lambs in G2 reached puberty earlier (224 days) comparing with those in G3(228 days) and control group (261 days), subsequently mating and conception ages tended to be earlier in G2 being 259 and 260 days respectively, followed by G3 270 and 268 days, while the control group delayed at 307 and 304 days of age , respectively. Ewe lambs exhibited estrus (%),fertility(%)litter size and birth weight in G3 were higher than control and G2, without significant differences

Keywords: fish oil , productive .reproductive performance, male , female, lambs.

INTRODUCTION

Currently an increasing number of nutrition-reproduction studies are evaluating different dietary ingredients to determine how they affect ovarian function and postpartum reproduction. Fat is one of these nutrients and it apparently enhances postpartum reproduction either by increasing the energy status of the animal or by other processes independent of energy intake. In both cases, stimulation of ovarian follicular growth and luteal function have been reported (Lucy *et al.*, 1992; Thomas and Williams, 1996). The high content of polyunsaturated fatty acids (PUFA) in fish oil, especially the δ-3 fatty acids like eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), influence the stability and quality of the oil (Zuta *et al.*, 2003).

Improvement in fertility a part from improved energy status suggests that fat supplementation mediates its positive effect through other physiological mechanism such as: progesterone concentrations in plasma are enhanced by fat supplementation and may enhance embryo survival: certain (PUFA) such as linoleic acid and eicosapentanoic acids may reduce uterine secretion of prostaglandin William and Charles (2003).Also, Conquer *et al.* (2000) found that effect of supplementation with DHA from fish oil in diets of ram lambs improved sperm motility percentage and sperm livability percentage than unsupplemented diet. Feeding fish oil increased the proportion of spermatozoa with progressive motility and with a normal acrosome score and reduced the proportion of spermatozoa with abnormal morphologies (Roock *et al.*, 2001). Early onset of sexual maturity and in turn, early mating provides economical advantages through increased lifetime reproductive rate. However, little of work have been done on determine the response of growing lambs fed diets supplemented with fish oil in Egypt and more knowledge are required in this respect. Therefore, the main objective of this study was to investigate the influence of fish oil supplementation on productive and reproductive performance of growing male and female lambs.

MATERIALS AND METHODS

This study was conducted at Sakha Experimental Station, Animal Production Research Institute, Ministry of Agriculture, in cooperation with The Department of Animal Production, Faculty of Agriculture, El-Mansoura University, Egypt, during the Period from June, 2006 to March, 2007.

Fifty-four crossbred lambs(1/2 Finish Landrace x 1/2 Rahmani) after weaning. were used to study the effect of fish oil supplementation on productive and reproductive performance of growing male and female lambs. Twenty-four male lambs and 30 female lambs have born from ewes fed the same tested diets, with average live body weight of 16.03+0.39 kg and 15.1+0.49 kg respectively, were randomly divided into three groups (8 and 10 in each group for male and female lambs, respectively).Male and Female were fed separately in group feeding. The first group of each sex was fed a basal diet consisting of concentrate feed mixture (CFM), to cover 50% of crude protein (CP) requirements recommended by *NRC (1985)* for growing lambs. The rest of the requirements was cover for berseem hay (3rd cut) was

given *ad labitum*. In group 2 and 3 fish oil was added to basal diet at the rate of 2 and 4% of total DM intake, respectively. Feed intake was adjusted every two weeks according to the changes in animal body weight status according to *NRC (1985)*. All groups were offered the CFM allowances in two parts at 9 a.m. and 4 p.m. daily. Composite feedstuffs and fecal samples were taken and stored for laboratory proximate analysis purpose, which were analyzed according to the methods of the A.O.A.C. (1995).

All animals were weighed at biweekly intervals till end of the experiment and daily gain was calculated. All animals were kept under equal management conditions and were kept in a semi-open shaded yard during the experimental period. Fresh water was available all times.

During the period from 3 to 12 months of ram lambs age blood samples were taken from five lambs from each group from the jugular vein at 15 days interval. On the day of sampling, blood was taken at 8.0 a.m. into vacutainer tubes then centrifuged at 2500 rpm for 20 minutes in order to separate blood serum using serological pipettes and serum was carefully decanted into labeled tubes and stored at -20°C until analysis. Biochemical blood parameters in serum were analyzed using commercial kits by diagnostic system laboratories, INC USA. Total protein (peters,1968) and albumin (Drupt, 1974) were determined. Globulin was calculated by the difference between total protein and albumin. The GOT and GPT concentrations were determined according to Reitman and Frankel (1957). Glucose was determined according to Trinder (1969), total cholesterol (Wastson, 1962), triglycerides (Schalm *et al*., 1975), total lipids (Zollner and Kirch, 1962) were measured .Feed conversion was calculated as the ratio between DM intake and weight gain. Feed efficiency was calculated as the ratio between weight gain and intakes of DM. The economical efficiency was calculated as the ratio between price of weight gain and cost of feeding.

Male lambs were subjected to observation to detect changes in sexual behaviour, once every 10 days interval during the period from 3 months of age till the onset of puberty (first successful ejaculate with motile sperm). libido test for each animal was measured within 20 minutes test period using a female sheep in induced oestrus, considering the following criteria: first mounting; first mounting with erection (1st penile protrusion) and puberty (age at first collected ejaculate containing motile sperm). To ensure the availability of at least two ewes in estrus at each time of libido test, five ewes were subjected to estrus synchronization by hormonal treatment, planned at a time suitable four the time of libido test. Age, weight, scrotal circumference and testosterone concentration were determined at 1st mounting, mounting with erection (1st penile protrusion) and puberty. Body weight, scrotal circumference measurements and blood sampling(for testosterone determination) were carried out biweekly. Scrotal circumference was measured to indicate testicular size for each lamb by a flexible plastic tape around the greatest diameter of the tested and scrotum according to Hahn *et al*. (1969). Direct radio-immuno-assay technique was conducted for serum testosterone level determination using Immunotech kits (I125) Immunotech, France. After the occurrence of puberty or the stage at which male ejaculated first motile sperm. Semen was collected by means of an

artificial vagina once weekly until 12 months of age. Seminal volume, Initial motility was estimated by procedure of Melrose and Loing (1970). Live and abnormal spermatozoa Percentage were estimated by the method of Hancock(1951). Sperm cell concentration (x 10^9/ml) was determined by the direct cell count using the Neubauer Haemocytometer. Sperm output (x 10^9/ejaculate) per ejaculate was calculated by multiplying sperm cell concentration by ejaculate volume. Sperm output live normal (x 10^9/ejaculate) was calculated according to the following equation: Total live normal sperm output in the ejaculate = Total sperm output x %live sperm x % normal sperm. Age of puberty was recorded when ewe lamb exhibited its first oestrus behaviour. While, mating age was recorded when ewe lamb was mated for the first time at live body weight 35 kg. At 5 months of age, teaser rams were introduced to the ewe lambs to detect the onset of the 1 oestrus, three times daily at 6 a.m., 12 a.m., 6 p.m. of each group for 20 minutes. Ewe lambs being receptive for teaser and standing for mounting by the teaser were considered in oestrus. The onset of first oestrus was used as an indicator for the onset of puberty. Date of onset of the first oestrus was recorded for each ewe lamb and considered as an indicator for achieving puberty. Mating was performed when reach live body weight to 35 kg. Age and live weight at first oestrus and conception was estimated as age and live body weight at puberty and mating.

Statistical analysis for the obtained data on reproductive trials as well as blood constituents were performed by method of analysis of variance for repeated measurements according to Winer (1971) using the general linear model procedures of SAS (1996). Duncan Multiple Range Test was used to test the differences among means (Duncan, 1955).

RESULTS AND DISCUSSION

Chemical composition:

Data in Table (1) showed chemical composition of ingredients and calculated composition of tested diets from the actual consumed of chemical nutrients of feed ingredient during digestion trials. The experimental diets were practically iso-caloric and iso-nitrogenous and had similar chemical nutrients. However, EE content was gradually increased from 2.39 to 4.27 and 6.12 for control, diet 2 and diet 3, respectively. This could be due to fatty acids in fish oil addition (Zuta *et al.* 2003).

Productive performance of ram lambs:

Average live body weight and average daily gain:

The results obtained revealed that the average monthly live body weights of all groups were tended to be gradually increased with advancing animals ages (Fig. 1). However, it is of interest to note that the values of live body weights of G3 were tended to be higher ($P<0.05$) than those of G2 and control group at all measuring time. Similar trend have been observed by Marinova *et al.* (2005).

Table (1): The chemical composition on DM basis (%)of tested ingredients and calculated composition of consumed diets.

Item	CFM*	BH	Diet 1	Diet 2	Diet 3
DM	89.25	88.65	88.47	88.63	88.83
OM	91.52	88.43	90.58	90.75	90.42
CP	16.31	14.12	15.27	15.06	14.83
EE	3.42	2.15	2.76	4.35	6.41
CF	11.56	23.29	18.56	17.84	17.25
NFE	60.23	48.87	53.99	53.51	51.93
Ash	8.48	11.57	9.42	9.25	9.58
GE MJ / Kg DM**	17.93	17.17	17.68	18.06	18.45

* The commercial concentrate feed mixture (CFM) used contained: undecorticated cottonseed meal (30%), wheat bran (20%), yellow maize (25%), soybean meal (5%), rice bran (10%), molasses (5%), limestone (3%) and common salt (1%).

** Gross energy (GE) calculated according to MAFF (1975) using the following equation: GE Mj/kg DM = 0.0226 CP + 0.0407 EE + 0.0192 CF + 0.0177 NFE.

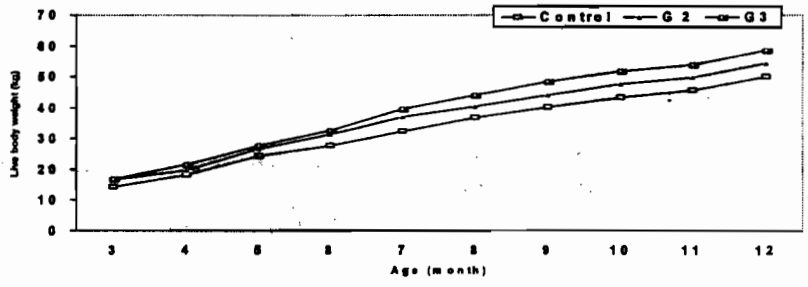

Fig. (1): Average live body weight (kg) of ram lambs of different groups.

Average daily gain (Fig. 2) of lambs through the whole experimental period (0-7 months) was the highest (P<0.05) for G3 (167.1 g) followed by those of G2 (148.1 g), while control group had the lowest value (139 g).The results obtained are in agreement with other studies that have compared linseed with fish oil in sheep (Demirel, 2000).

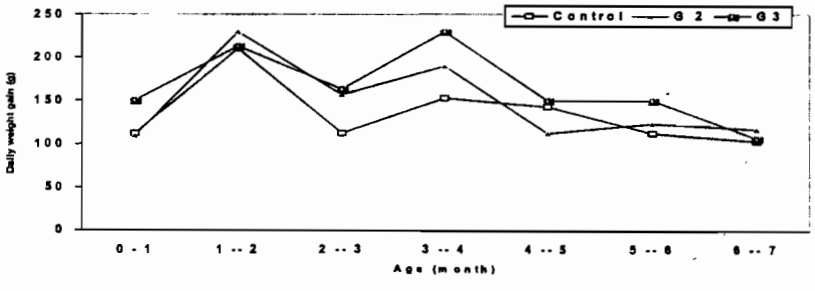

Fig. (2): Effect of feeding tested diets on daily weight gain (g) of ram lambs.

Animal performance:

Data in Table (2) cleared that total daily intake by control group was the highest (1.522 kg/h/d), while G3 recorded the lowest value (1.351 kg/h/d) which recorded the highest daily gain. However, feed efficiency (DM/ kg gain) of G2 and 3 was better by about 13.2 and 27.4% respectively than control group. Such superiority in improvement of feed conversion in G3 is mainly due to higher efficiency of the feed utilization as indicated by highest body weight gain, compared with other groups. These results are in agreement with those reported by Moustafa *et al.* (1995). The lowest feed cost/kg gain was recorded with G3 (7.41 LE) which had the lowest (best) feed conversion (kg DM/kg gain) and the highest daily body weight gain. While the highest feed cost/kg gain was recorded with control group (8.69 LE) but those of G2 was fell intermediate (8.28 LE). This finding indicated that G3 was more profitable than the other two groups in case of more daily body weight gain as well. Economical efficiency (EE) of G2 and G3 were higher being 1.95 and 2.12 for previous groups, respectively than the control one. Group 3 gave the highest EE value (2.12) followed by group 2 (1.95) then control group (1.85). Similar results were reported by Lubis *et al.* (1998) with sheep and Marinova *et al.* (2005) with kids.

Table (2): Animal performance of ram lambs and feed cost of the experimental diets.

	Experimental groups			±SE
	Control	Group 2	Group 3	
No. of animals	8	8	8	
Duration of trail (d)	210	210	210	—
Initial live weight (kg)	14.2	16.6	16.8	1.18
Market live weight (kg)	43.4^{b}	47.7^{a}	51.9^{a}	1.48
Total live weight gain (kg)	29.2^{b}	31.1^{ab}	35.1^{a}	1.36
Daily live weight gain (g)	139.0^{b}	148.1^{ab}	167.1^{a}	0.006
Daily feed intake DM basis (kg/h/d):				
BH (kg/h/d)	0.911	0.903	0.875	—
CFM (kg/h/d)	0.611	0.515	0.422	—
Total DM intake (kg/h/d)***	1.522	1.418	1.297	—
Feed utilization efficiency:				
DM intake /kg gain	10.94	9.57	7.76	—
Economical efficiency:				
Feed cost/h/d (LE)	1.21	1.25	1.29	—
Feed cost (LE/kg gain)*	8.69	8.28	7.41	—
Economical efficiency**	1.85	1.95	2.12	—

a, b Means within the same raw with different superscripts are significantly different at P<0.05.

- Price of kg live body weight is 16.5 LE

* Based on the market price at that time for hay, concentrate feed mixture and fish oil were (600, 1100 and 6000 LE/ton, respectively) in 2006.

** Economical efficiency = money output (price of weight gain)/ money input (price of feed consumed).

*** 0.026 and 0.054 g of fish oil was added and was not included in the total DM intake.

Blood constituents:

Concentrations of total protein and albumin in Table (3) were higher(P<0.05) in G3 than G2 and control group. The significant increase in albumin and in turn in total protein concentration may indicate the beneficial

effects of addition fish oil to diets on blood protein concentration. AL/GL ratio was highest in G3 compared with those of other groups without significant differences among the experimental groups. The present values of total protein and their fractions are nearly within the normal ranges reported by Birgele and Ilgaza (2003), who found that normal values of total protein in blood plasma of sheep were in a rang between 6 and 8 g/dl. These results are in accordance with Abo-Donia (2003) in sheep.

Ram lambs in G3 had higher concentration of serum GOT and GPT as well as GOT/GPT ratio followed by G2, while those fed control diet had lowest values, but the differences among groups were not significant. These results are in agreement with those obtained by Abo-Donia (2003) in sheep, who observed that concentration of serum GOT and GPT increased with addition of fat in diets of animals.The concentration of GOT and GPT were in the normal range given by El-Sayed (1991) for GPT (18.23 to 18.91) and GOT (38.63 to 49.93), and indicate that animals were generally in a good nutritional states, so their livers were in a normal pathological condition.

Glucose concentration was higher($P<0.05$) in G3 than G2 and control group. No significant differences among G2 and control group were observed. These results are in agreement with those obtained by Avila *et al.* (2000) who found that blood glucose concentration increased with increasing fat supplementation. The present values of glucose concentration in blood serum of all groups are within the normal range in sheep given by Williams (1997) being 40-80 mg/dl.

Table (3): Effect of feeding the experimental diets on blood constituents of ram lambs.

Item	Experimental groups			±SE
	Control	Group 2	Group 3	
Total protein (g / dl)	6.04^{c}	6.27^{b}	6.62^{a}	0.12
Albumin (g / dl)	2.99^{b}	3.12^{b}	3.41^{a}	0.03
Globulin (g / dl)	3.05	3.15	3.21	0.04
Al / Gl ratio	0.98	0.99	1.06	0.02
GOT (IU / dl)	41.51	43.57	45.42	0.54
GPT (IU / dl)	17.83	17.23	17.87	0.71
GOT / GPT ratio	2.41	2.56	2.55	0.11
Glucose (mg / dl)	56.77^{b}	58.11^{b}	60.61^{a}	1.08
Total lipids (mg / dl)	464.3^{b}	482.7^{ab}	504.7^{a}	19.15
Triglycerides (mg / dl)	60.92	62.21	65.12	1.13
Total cholesterol (mg / dl)	150.2	155.6	162.8	5.72

a, b Means within the same raw with different superscripts are significantly different at $P<0.05$

Fish oil addition resulted in significant ($P<0.05$) increase in the concentration of total lipids in ram lambs. Moreover, ram lambs in G3 had the highest concentration of total lipids (504.7 mg/dl) followed by G2 (482.7 mg/dl), while the lowest value (464.3 mg/dl) was recorded in ram lambs fed control diet. These results are in accordance with those obtained by Cant *et al.* (1993) in sheep, who observed that concentration of total lipids in blood serum or plasma was increased with fat supplementation in diets.

Triglycrides concentration was the highest in G3 (65.12 mg/dl) followed by G2 (62.21 mg/dl), while the lowest value (60.92 mg/dl) was

recorded in ram lambs fed control diet. These results are in agreement with those obtained by Thomas *et al.* (1997) who found that serum concentration of triglycrides was higher in group fed on the added fish oil than soybean oil and control group.

As occurred in concentration of triglycrides also concentration of total cholesterol was higher in G3 than those in G2 and control groups. These results are agreement with those obtained by El-Bedawy (1995) in sheep, Petit *et al.* (2001) in cows, observed that concentration of total cholesterol in blood serum increased with fat supplementation in diets of sheep and cows. Generally, physiological levels of all tested blood parameters in this study were within the normal range for blood constituents of sheep (Salem *et al.*, 2000).

Productive performance of ewe lambs:

Average live body weight and average daily gain:

Average live body weight of ewes lambs at the 3rd , 6th months of age, puberty, mating and conception as affected by fish oil level (2% and 4%) are presented in Table (4). Groups fed on fish oil (G2 and G3) had higher body weight than control one at 6 months of age, but did not differ significantly. This positive effect of feeding fish oil may be mediated through high digestibility of nutrients of fish oil diets and improve their ruminal fermentation as well as TDN and energy intake (Jones *et al.* 2003).This is in agreement with those of Marinova *et al.* (2005) .Compared to control group, fish oil groups (G2 and G3) did not significantly differ on average body weight at puberty. However, average body weight at puberty tended to slightly decrease with increasing fish oil level. The decrease was due to earlier in puberty for tested groups (G2 and G3) than control one. In this respect, Bathaei and Lerog (1997) reported a significant correlation between body weight at puberty and average daily gain from weaning to puberty. Also, Chilikani *et al.* (2003) revealed that average daily gain and body weight together contributed to 96% of the variation in attaining puberty. Bathaei and Lerog (1997) found that ewe lambs that grew most rapidly after weaning tended to be heavier at puberty.

Body weight at mating was practically similar in all groups. Compared to control group, fish oil groups (G2 and G3) had higher ($p<0.05$) body weight value at conception without significant differences between the later groups (G2 and G3). The reason for increase body weight of G2 and G3 at conception could be due to increasing in their average daily gain as will be discussed later on. Similar results have been reported by Marinova *et al.* (2005).

Animal performance:

Data concerning growth performance for ewe lambs fed different diets are presented in Table (5). Highest ($P<0.05$) body weight (37.4 kg) at conception was recorded in G3 compared with ewe lambs in G2 and control one. However, average daily gain through the interval from initial (3 months of age) up to conception was the highest in G2 (123 g) followed by those in G3 (119 g), while ewe lambs fed control diet had the lowest (100 g) value. Total feed intakes (kg /h/d) were practically similar in all groups. However, feed efficiency (DM/kg gain) of groups 2 and 3 was better by about 21.3 and

24.2% than control group. Such superiority in improvement of feed conversion in G3 is mainly due to high efficiency of the feed utilization as indicated by highest body weight gain, compared with other groups. These results are in agreement with those reported by Moustafa *et al.* (1995).

The lowest feed cost /kg gain was in G2 (7.72 LE) which had the lowest (best) feed conversion (kg DM/kg gain), while the highest feed cost/kg gain was recorded with control group (9.26 LE) but those of G3 was fell intermediate (8.57 LE). This finding indicated that diet 2 (2%fish oil) was more profitable than the other two diets. Similar results were reported by Lubis *et al.* (1998) with sheep .

Table (4): Average live body weight (kg) of ewe lambs as affected by the experimental diets at puberty, mating and.conception.

Item	Experimental groups			±SE
	Control	Group 2	Group 3	
Live body weight (kg) at:				
The 3rd month of age	14.1	15.3	16.2	0.87
The 6th month of age	24.7	26.6	29.1	1.47
Puberty	34.6	33.5	34.5	1.04
Mating	36.5	36.1	36.8	0.98
Conception	35.5^{b}	36.3^{ab}	37.4^{a}	0.83

a, b Means within the same raw with different superscripts are significantly different at P<0.05.

Table (5): Animal performance of ewe lambs and feed cost of the experimental diets.

Item	Experimental groups			±SE
	Control	Group 2	Group 3	
No. of animal	10	10	10	
Duration from initial to conception	214	170	178	–
Initial live body weight (kg)	14.1	15.3	16.2	0.87
Final live body weight (kg) at conception	35.5^{b}	36.3^{ab}	37.4^{a}	0.83
Total gain (kg)	21.4	21	21.2	1.21
Daily gain (g/d) "average daily gain" initial : conception	100	123	119	0.03
Daily feed intake DM basis (kg/h/d)				
BH (kg/h/d)	0.537	0.541	0.501	–
CFM (kg/h/d)	0.518	0.481	0.452	–
Total DM intake (kg /h/d)	1.055	1.021	0.953	–
Feed utilization efficiency:				
Kg DM intake /kg gain	10.55	8.31	8.01	–
Feed cost/h/d (LE)	0.88	0.97	1.02	–
Feed cost (LE/kg gain)**	9.26	7.72	8.57	–

a, b Means within the same raw with different superscripts are significantly different at P<0.05.

*** 0.022 and 0.039 g of fish oil was added and was not included in the total DM intake.**

**** Based on the market price at that time for hay, concentrate feed mixture and fish oil were (600, 1100 and 6000 LE/ton, respectively) in 2006**

Reproductive performance of ram lambs:

The development in reproductive performance of the experimental animals used during the pre-pubertal period and up to stage of puberty are presented in Table (6).Mean ages of three groups at 1st mounting were 173.4, 164.1 and 151.3 days, at 1st mounting with erection their were 214.8, 193.4 and 183.3 days and 1st ejaculation or puberty their were 264.8, 242.8 and 221.4 days, respectively. Differences among tested groups were significant.

The results obtained concerning the age of puberty are in agreement with the those of El-Badawy (2003). Ram lambs in G3 expressed first ejaculation (puberty) younger by 43.4 and 21 days than those in control group and G2, respectively. These results are in agreement with the results of (Ali and El-Saidy, 2003) ,they reported that crossbred ram lambs reached puberty at age ranged between 211 and 253 days when they used first ejaculation for determining the age at puberty. Also, El-Ashry *et al.* (2000) found that Rahmani ram lambs reached puberty at age ranged between 286 and 311 days. Tharwat(1985) reported that the age of puberty for Barki ram lambs was 243 days when the testicular histology used method for determination. However, Castrillejo *et al.* (1995) found that onset of puberty (expressed as morphologically established spermatogenesis) in corriedul ram lambs is attained at 180-216 days of age when they reach 23 cm of scrotal circumferences and 191 g of testis weight. Crossbred ram lambs (1/2 Romanove x ½ Rahmani) reached puberty at age ranged between 211 and 263 day (El-Shamaa, 2002).

Ram lambs in G3 reached puberty earlier (221.4 days) with higher ADG (167.1 g/day) comparing with those in G2 (242.8 days puberty age and 148.9 g/day ADG) and control group (264.8 days puberty age and 139 g/day ADG). These results indicated that age at puberty was affected by ADG.

Table (6): Pre-pubertal characters of reproductive performance of ram lambs of different experimental groups.

Character	Experimental groups			±SE
	Control	Group 2	Group 3	
1st mounting:				
Age (d)	173.4^{a}	164.1^{ab}	151.3^{b}	6.17
Body weight (kg)	26.8	29.1	27.1	1.3
Scrotal circumference (cm)	16.1	16.2	15.3	1.1
Testosterone concentration (ng/ml)	1.05	1.13	1.16	0.26
1st mounting with erection:				
Age (d)	214.8^{a}	193.4^{b}	183.3^{b}	5.54
Body weight (kg)	34.4^{a}	34.3^{a}	32.1^{b}	1.30
Scrotal circumference (cm)	20.3	20.1	19.8	1.20
Testosterone concentration (ng/ml)	1.63^{b}	1.81^{ab}	2.35^{a}	0.29
1st ejaculation (puberty):				
Age (d)	264.8^{a}	242.8^{ab}	221.4^{b}	9.9
Body weight (kg)	37.7	39.4	39.7	1.4
Scrotal circumference (cm)	24.7	25.5	25.3	1.4
Testosterone concentration (ng/ml)	2.81^{b}	3.12^{ab}	3.52^{a}	0.36

a, b, c Means within the same raw with different superscripts are significantly different at P<0.05.

Data in Table (6) showed that average scrotal circumferences was increased from 15.7 cm at first mounting to 20.1 cm at first mounting with erection to reache the highest value (25.2 cm) at first ejaculation (puberty). Changes in scrotal circumferences among tested groups at all stages were not statistically differed. In general, testicular growth increased with body weight more than age in all treated groups, which come in the same line with the results of El-Saidy *et al.* (2004) on ram lambs. Serum testosterone concentrations were low at early stages (Table 6) of sexual development (stage of 1st mounting) in all tested groups and gradually increased as age

advanced. The present trend of increase in testosterone concentration at all stages such as first mounting, first mounting with erection and first ejaculation (puberty) were significantly higher in G3 than the two other groups. The present values of testosterone concentration in blood serum of all groups at puberty are within the ranges 0.8 and 3.4 ng/ml in Suffolk ram lambs (Schanbacher and Crouse,1980) and (2.56 and 3.02 ng/ml) in Crossbred ram lambs (Ali and El-Saidy, 2003) .

Results in Table (7) and Fig.(3) showed that the ram lambs in G3 was reached significantly ($P<0.05$) high scrotal circumferences (23.2 cm), followed by G 2 (21.8 cm) and control group (19.9 cm). These are in agreement with those reported by Sutama and Edey (1986). Also, the increase nutrients intake was associated with increase in testicular weight (size) and secretory output of accessory sex glands (Cupps, 1993). In this respect, Walkden-Brown *et al.* (1994) suggested that testicular mass appears to be primarily dependent on changes in voluntary feed intake and growth.The results in the present study indicate that scrotal circumferences were correlated with body weight and age. These are in agreement also with those reported by Madani *et al.* (2000).

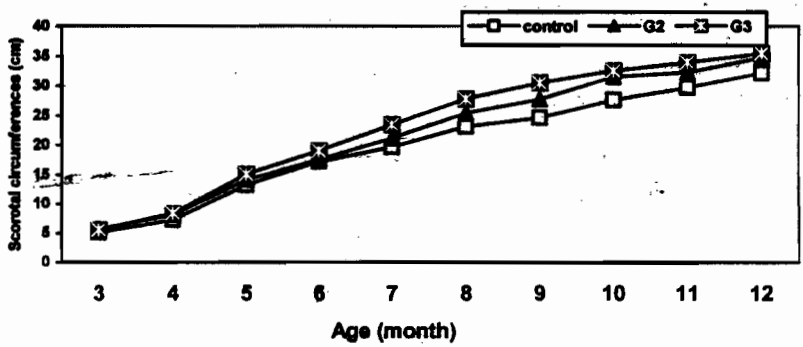

Fig. (3): Effect of feeding the experimental diets on scrotal circumferences (cm) of ram lambs.

Average monthly blood serum testosterone concentration for each tested group is presented in Fig. (4).Lambs of the three tested groups had the same gradual trend of serum testosterone concentration. The lower values of testosterone concentration at puberty may be due to the increased utilization of hormone by the target organs and not due to the decrease of testosterone production. The present findings are in agreement with those recorded by El-Ashry *et al.* (2000), they found lower values of testosterone concentration in blood plasma at puberty in Rahmani ram lambs compared with the control.

The results of the present study (Table 7) showed that ram lambs in (G3) had significantly greater mean serum testosterone concentration (2.96 ng/ml) than the ram lambs in (G2) and control group (2.69 and 2.47 ng/ml, respectively). The present findings are in agreement with those recorded by Martain *et al.* (1994).

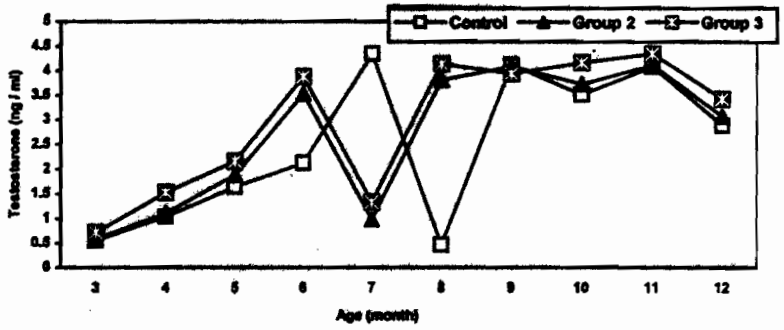

Fig. (4): Effect of feeding the experimental diets on testosterone concentration (ng / ml) of ram lambs

Significant differences among treatments ($p<0.05$) as well as among months within each treatment were found in all seminal characteristics examined (Table, 7and Fig, 5). Ram lambs in G3 and G2 were produced semen in better ($p<0.05$) quality (volume, initial motility, live spermatozoa, abnormal spermatozoa; sperm cell concentration, sperm output and live normal sperm output) than those in control group. These findings are in agreement with that reported by Nissen and Kreysel (1983) who[found that there was significant linear correlation between docosahexaenoic acid (DHA) and motile normal sperm, these findings suggest that the process of lipid peroxidation is probably one of the biochemical causes of the low DHA content in poorly motile sperm. Also, Conquer *et al.*(2000) found that effect of addition of DHA form of fish oil in ram lambs diets improved sperm motility and live sperm percentage. Most of the mean values for the semen characteristics of the three groups (Table, 7) lie within the range reported by previous studies (El-Shamaa, 2002 and Ali and El-Saidy, 2003). All semen characteristics were improved ($p<0.05$) significantly with age advance in all groups (Fig. 6). These findings are in agreement with those reported by other workers (El-Shamaa, 2002 and Ali and El-Saidy, 2003).

Table (7): Semen characteristics for ram lambs as affected by the experimental diets.

Item	Experimental groups			±SE
	Control	Group 2	Group 3	
Ejaculate volume (ml)	0.54^{b}	0.62^{a}	0.66^{a}	0.02
Initial motility (%)	66.7^{b}	71.3^{a}	71.4^{a}	1.41
Live sperm (%)	63.4^{b}	66.9^{a}	67.1^{a}	1.12
Abnormal sperm (%)	13.5^{a}	11.3^{b}	11.5^{b}	0.43
Sperm concentration ($x10^{9}$/ml)	1.81^{b}	2.11^{a}	2.16^{a}	0.07
Sperm output ($x10^{9}$/ejac.)	1.12^{b}	1.43^{a}	1.65^{a}	0.05
Live normal sperm output($x10^{9}$/ej.)	0.72^{b}	0.98^{a}	1.11^{a}	0.04
Scrotal circumference (cm)	19.9^{c}	21.8^{b}	23.2^{a}	0.34
Testosterone concentration (ng/ml)	2.47^{c}	2.69^{b}	2.96^{a}	0.22

a, b, c Means within the same raw with different superscripts are significantly different at P <0.05.

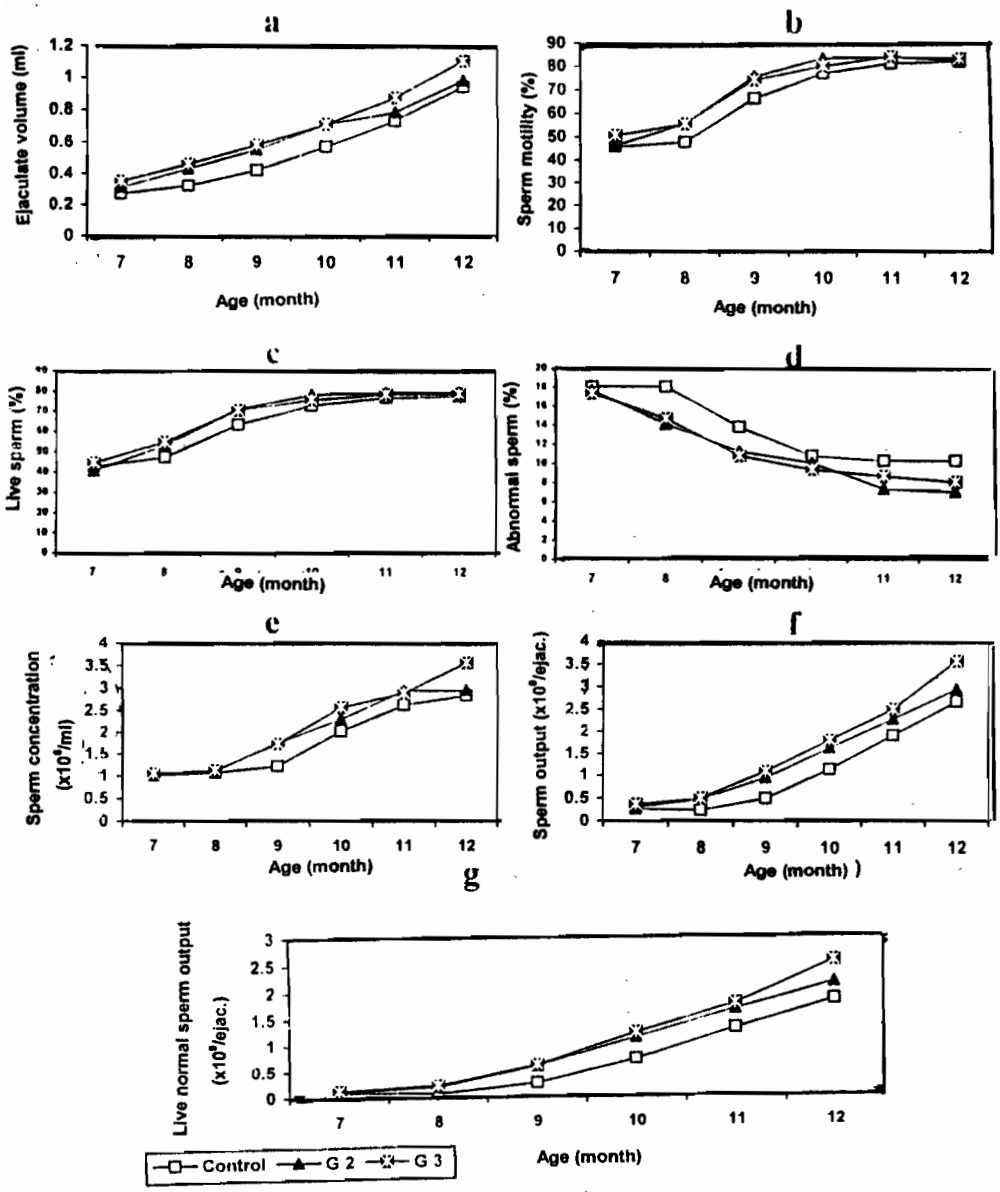

Fig. (5): Effect of feeding the experimental diets on (a) ejaculate volume (ml); (b) sperm motility (%) ; (c) live sperm (%) and (d) abnormal sperm (%); (e) sperm concentration ($x10^6$/ml); (f) sperm output ($x10^9$/ejac.) and (g) live normal sperm output ($x10^9$/ejac.).

Reproductive performance of ewe lambs:

Age at puberty was 261, 224 and 228 day for control, G2 and G3, respectively. These results (Table 8) showed significant beneficial effect of fish oil addition on earlier age of puberty in ewe lambs in G2 by about 37 day followed by ewe lambs in G3 by about 33 day, compared with the control group which delayed puberty age (261 day). Similar results on ewe lambs were reported by Suttie *et al.* (1991).

Subsequently, mating and conception ages tended to be earlier in ewe lambs in G2 (259 and 260 day, respectively), followed by ewe lambs in G3 (270 and 268 day, respectively), while the control group delayed at 307 and 304 day of age respectively. Differences were significant among all groups at mating and conception ages (Table 8).

Table (8) : Average age (day) of ewes lambs as affected by the experimental diets.

Item	Average age (day) at :		
	puberty	mating	conception
Control	261 [a]	307 [a]	304 [a]
Group 2	224 [b]	259 [b]	260 [b]
Group 3	228 [b]	270 [b]	268 [b]
±SE	10.3	5.39	6.21

a, b Means within the same raw with different superscripts are significantly different at P<0.05.

It was clear that effect of fish oil addition on earlier age of mating in ewe lambs in G3 was about 37 day followed by ewe lambs in G2 about 48 day compared with the control group. Also, age of conception was earlier in ewe lambs in G3 by about 36 day followed by ewe lambs in G2 by about 44 day compared with the control group. The reason for earlier age of puberty, mating and conception could be due to highest average daily gain, subsequently reaching faster to body weight at puberty, mating and conception in earlier age (Mukasa and Lahlou, 1995).

Table (9) showed the reproductive performance of ewe lambs mated at 9-10 months of age .Average body weight at mating of ewe lambs was nearly similar in all experimental groups, being not significantly differ. Ewe lambs mated (%)in G2 and G3 had higher percentage (90% and 90%, respectively) than control group (60%), without significant differences among the experimental groups. These results are in agreement with those obtained by William and Charles (2003).

Litter size tended to be gradually increased with increasing fish oil level in the experimental diets without significant differences among groups. This was in consistent with those reported by Yoel-Zeron *et al.* (2002) they found that ewes which fed a diet supplemented with fish oil increased number of follicles and oocytes found on the ovaries of ewes supplemented with PUFA more than compared with those in control ewes.

As for average birth weight, it was higher (P<0.05) in G2 and G3 than control group. This was in consistent with the results of Toteda *et al.* (2004) who pointed that lambs born from ewes offered fish oil added diets had higher (P<0.05) birth weight than lambs born from ewes fed control diet. This is may be to the improvement of feed utilization during late-pregnancy period and increasing feed intake (energy) (Schinckel and Short, 1991).

Table (9): Reproductive performance of ewe lambs during the 1st breeding season as affected by the experimental diets.

Item	Experimental groups			
	Control	Group 2	Group 3	±SE
No. of ewe lambs	10	10	10	-
Body weight at mating (kg)	36.5	36.1	36.6	0.98
No. of ewe lamb mated	6	9	9	0.13
Ewe lambs mated (%)	60	90	90	0.11
No. of ewes lambs lambed	5	7	8	-
Fertility as (%) from mated ewe lambs	83.3	77.8	88.9	0.12
Fertility as (%) from total ewe lambs	50	70	80	0.15
Body weight at lambing (kg)	41.2	44.7	45.8	1.46
No. of lambs born alive	5	8	10	-
Average birth weight (kg)	2.86[b]	3.56[a]	3.45[a]	0.21
Litter size	1.00	1.14	1.25	0.11

a, b Means within the same raw with different superscripts are significantly different at P<0.05.

According to the results obtained in this study, it could be concluded that the effects of diets supplemented with 2&4 % fish oil on productive and reproductive performance of growing male and female lambs was beneficial, since it improved feed conversion, economical efficiency, average daily live weight gain and improvement in reproductive performance of growing male and female lambs.

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تأثير إضافة زيت السمك علي الأداء الإنتاجي والتناسلي لحوالى وحوليات الأغنام.

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أجريت هذه الدراسة فى محطة بحوث الإنتاج الحيواني بسخا التابعه لمعهد بحوث الإنتاج الحيواني – وزارة الزراعة بالتعاون مع قسم إنتاج الحيوان – كلية الزراعة جامعة المنصورة خلال الفترة من يونيو٢٠٠٦ حتى مارس ٢٠٠٧ ، ولقد استهدفت هذه الدراسة معرفة تأثير إضافة زيت السمك بمستوي ٢&٤% على الأداء الانتاجى والتناسلي للمواليد من ذكور وإناث الأغنام. حيث استخدم في هذه الدراسة ٥٤ حولي وحولية خليطة (٢/١ رحماني × ٢/١ فنلندي) بعد الفطام . ٢٤حولي و٣٠ حولية من نعاج غذيت على نفس العلائق , بمتوسط وزن ١٥,١،١٦,٠٣كجم على التوالي وقسمت إلى ثلاث مجموعات(١٠،٨ في كل مجموعة على التوالي) على أساس الوزن وغذيت طبقا للمقررات الغذائية لـ NRC (1985) .وتم اضافة زيت السمك في المجموعتين الثانية والثالثة بمعدل ٢&٤% على أساس المادة الجافة مقارنة بمجموعة المقارنة وقد كانت العليقة تقدم يوميا (العلف المركز) بمعدل ٥٠% من الاحتياجات البروتينية وكان الدريس(الحشة الثالثة) يغذى حتى الشبع .تم اخذ القياسات الآتية: معدل النمو, كمية المأكول,الكفاءة الغذائية وبعض مقاييس الدم.

ويمكن تلخيص أهم النتائج المتحصل عليها كآلاتي:

- بالنسبة للذكور أعطت المجموعة الثالثة أعلى معدل نمو يومي وبفروق معنوية ويليها المجموعة الثانية بينما مجموعة المقارنة سجلت اقل القيم كما كانت أعلى قيم للكفاءة التحويلية للمجموعة الثالثة بينما كانت مجموعة المقارنة اقل القيم وكانت اقل تكلفة غذاء /كجم زيادة وزنية قد سجلتها المجموعة الثالثة (٧,٤١ جنية مصري) بينما أعلى تكلفة كانت للمجموعة المقارنة (٨,٦٩ جنية مصري).
- بالنسبة للإناث كان وزن الجسم عند البلوغ للمجموعات الثلاث هو ٣٤,٦ ، ٣٣,٥ ، ٣٤,٥ كجم في المجموعة المقارنة والثانية والثالثة على التوالي مع عدم وجود فروق معنوية بين المعاملات.كما وجد أن وزن الجسم عند الإخصاب للمجموعة الثالثة كان أعلى معنويا بالمقارنة بالمجموعتين الثانية والمقارنة. كما أن معدل النمو اليومي كان أعلى في حوليات المجموعة الثانية ويليها المجموعة الثالثة بينما سجلت حوليات المجموعة المقارنة اقل القيم. تفوقت قيم الكفاءة التحويلية للغذاء للمجوعتين الثانية والثالثة بنسبة ٢١,٣ ، ٢٤,٢% عن المجموعة المقارنة.وأدى ذلك إلى أن اقل تكلفة غذاء /كجم زيادة وزنية سجلتها المجموعة الثانية بينما أعلى تكلفة سجلتها المجموعة المقارنة.
- أعطت حملان المجموعة الثالثة أول قذفة منوية (البلوغ) عند عمر ٢٢١,٤ يوم مبكرا ب ٢١, ٤٤ يوما عن المجموعة الثانية والمقارنة على التوالي. وأيضا أظهرت حملان المجموعة الثالثة ارتفاعا معنويا في تركيز هرمون التستستيرون عند أول قذفة منوية (البلوغ) مقارنة بالمجموعة المقارنة والثانية.
- أظهرت المجموعين الثانية والثالثة تفوقا معنويا فى جميع قيم خصائص السائل المنوي الطبيعية خلال فترة التجربة عن المجموعة المقارنة فيما عدا نسبة الحيوانات المنوية الشاذة . كما أظهرت المجموعة الثالثة أعلى تركيزبالبلازما لهرمون التستستيرون معنويا (٢,٩٦ نانوجرام/مل) عن المجموعتين الثانية والمقارنة (٢,٦٩ ، ٢,٤٧ نانوجرام/مل) على التوالي خلال فترة التجربة .
- أشارت النتائج إلى إن التأثير المعنوي لإضافة زيت السمك على التبكير فى عمر البلوغ بحوالى ٣٧ يوم للمجموعة الثانية ويليها المجموعة الثالثة بحوالى ٣٣ يوما بالمقارنة بالمجموعة المقارنة التي تأخرت في الوصول للبلوغ حتىعمر ٢٦١ يوما وبالتالي العمر عند كل من التلقيح والإخصاب اخذ اتجاه التبكير في حوليات المجموعة الثانية ٢٥٩ ، ٢٦٠ يوم على التوالي ويليها المجموعة الثالثة ٢٧٠ و ٢٦٨ يوما بينما تأخرت المجموعة المقارنة في الوصول إلى التلقيح والإخصاب حتى عمر ٣٠٧ ، ٣٠٤ يوم على التوالي مع وجود اختلافات معنوية بين المعاملات عند عمر كل من التلقيح والإخصاب. كما وجد أن نسبة الحوليات الملقحة و نسبة الإخصاب و نسبة التوأمية و وزن الجسم عند الولادة فى المجموعتين الثانية والثالثة كانت أعلى بالمقارنة بالمجموعة المقارنة مع عدم وجود اختلافات معنوية و بالنسبة لمتوسط وزن الميلاد كان أعلى معنويا في المجموعتين الثانية والثالثة بالمقارنة بالمجموعة المقارنة.
- نستنتج من هذه الدراسة أن إضافة زيت السمك بمعدل ٢&٤% في علائق حملان الأغنام من الذكور والإناث كان له تأثير ايجابي على الأداء الإنتاجي والتناسلي مع عدم وجود أي تأثيرات سلبية على مقاييس مكونات الدم أو الصحة العامة للحيوانات.