Scientific Papers. Series D. Animal Science. Vol. LVII, 2014
ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN-L 2285-5750

EFFECT OF DIFFERENT LEVELS OF FLAXSEED POWDER AS A SOURCE OF OMEGA-3 ON THE WEIGHT MUSCLES AND FAT DISTRIBUTION FOR CARCASSES OF KARADI LAMBS

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Abstract

This experiment was conducted at College of Agriculture, University of Sulaimany to study the effect of different levels of Flaxseed powder (FP) as a source of omega-3 on the on the weight muscles and Fat partitioning and distribution for carcasses of Karadi lambs.It used 20 male Karadi lambs, with an average live-weight of 28 ± 0.398 kg and 4-5 months. They were randomly distributed to 4 treatments. FP was supplemented at the levels of 3%, 6% and 9% compared with the control group for 88 days. At the end of the experiment 12 lambs were slaughtered after overnight fasting of feed. Carcasses were chilled for 24 h at 4°C. Then, several measurements of carcass characteristics were taken.
The results showed: higher ($p<0.05$) weights of the individual weight muscles located in different carcass region (pelvic limb, dorsal region and thoracic limb) were observed in Flax seed powder supplementation treatments. There were significant differences ($p<0.05$) in the carcass fat, offal and total fat in half animal body partitioning and distribution among treatments. Also it is noticed that the results of these traits were various. It can be concluded that using Flax seed powder (FP) as a source of omega-3 supplementation was increased muscles weight and reduced of carcass fat . These results were led to improvement of efficiency of meat production in Karadi lambs.

Keywords: *Flax seed powder, muscles weight, fat carcass, Karadi lambs*

INTRODUCTION

Today, one of the principal concerns of animal scientists is to determine the possibility of improving the health quality of animal food products. Among the most effective ways to do this is to use vegetable oils in nutrition (Bas and Morand-Fehr, 2000). In light of many studies conducted mainly with beef cattle, its essential to the efficient use of vegetable oils by ruminants is prevention of polyunsaturated fatty acids (PUF) in feeds from biodegradation in the rumen. The simplest and cheapest way of achieving this is to feed whole oilseeds (Oprządek and Oprządek, 2003). Many scholars think this requires supplementing the feeds with antioxidants, vitamin E being the most efficient and natural one (Barowicz, 2000). The previous studies have shown that Omega-3 source has affected some carcass characteristics, such as carcass weight, rib eye area, 12th rib fat thickness, and muscle weight fat distribution and carcass cuts. As well as, some studies have shown that carcass traits, marbling scores, and quality grade have been affected by flaxseed supplementation for instant (Ponnampalam et al., 2001b;Wistuba et al., 2006; Marinova et al., 2007.)

Flaxseed can be effectively used in feedlot rations. Several studies have demonstrated the use of up to 20% flaxseed in the diet without negatively affecting performance (Newkirk, 2008). Flaxseed has high levels of energy and protein and promotes feed intake and weight gain. Flaxseed has also been shown to offer additional benefits over its nutritional value alone, however flax is a highly palatable feed ingredient and contains high levels of nutrients (Drouillard et al., 2002). Ground flaxseed increased marbling and grade scores when the finishing diet was supplemented with ground flaxseed (Newkirk, 2008). Flaxseed is the richest land-based source of the omega-3 fatty acid α-linolenic acid, or ALA (Connor, 1999). However flaxseed is unique among oilseeds because of its exceptionally high content of ALA (18:3, n-3), contains 35 to 45% oil, of

which 45 to 52% is ALA (Bhatty, 1995). The deposition and distribution of body fat observed in the study of Marinova et al. (2007) suggested that the polyunsaturated fatty acids from the fish oil could be a repartitioning factor for carcass fats in lambs and could have a favorable effect on the carcass fatness and the quality of lamb meat. Therefore, the objective of this study is to investigate the effect of dietary supplementation of Flaxseed powder supplementation as a source of Omega-3 on the weight muscles and Fat partitioning and distribution for carcasses of Karadi lambs.

MATERIALS AND METHODS

Housing and Feeding Trail Experiment

Twenty male Karadi lambs purchased from unknown local contractor were individually housed in pens (1 × 1.5 m^2) at the animal production farm, faculty of agriculture, University of Sulaimany. The ration was gradually introduced to the lambs over a period of 2 weeks as adaptation period. Four treatments of FP (Fat partitioning) supplementation on voluntary feed intake were conducted with 20 male Karadi lambs (live body weight 28 ± 0.398 kg and 4-5 months old) at the start of the experiment. The lambs were randomly allocated into four treatments to receive either control ration no FP, T1 or ration containing 3% FP, T2 or diet containing 6% FP, T3 or ration containing 9% FP. All the lambs were received an equal daily allowance of concentrate ration (3% of the body weight). The formulation and approximate chemical composition of concentrate diet are presented in Table 1. The lambs were randomly penned individually indoors on dry earth bedding and the concentrate was supplied once daily (9:00 am). The straw was given *ad libitum*. Each ration treatment was tested for 2 weeks adaptation and 13 weeks of feeding periods respectively. Daily feed intake and refused were measured and sampled for 13 weeks. The lambs were weighed once a week from the beginning till the end of the experiment.

Table 1. Formulation and chemical composition of concentrate diets

Ingredients (%)	Control	T1	T2	T3
Barley	40	40	40	40
Wheat bran	27	27	27	27
Corn	15	15	15	15
Soybean meal	15	12	9	6
Flaxseed powder	0	3	6	9
Mineral &Vitamin mixture	2	2	2	2
Salt	1	1	1	1
Urea		0.2	0.4	0.6
Chemical composition				
CP %	15.38	15.31	15.23	15.14
ME (MJ/KG)*	12.77	11.63	11.82	12.01

***ME (MJ/ kg DM) = 0.012 CP +0.031 EE+0.005 CF +0.014 NFE (MAFF, 1977)**

Slaughtering and Carcass Characteristics

At the end of feeding trial (13 weeks), from each treatment three lambs were randomly slaughtered after feed was withdrawn overnight**.** The lambs were weighed immediately before slaughter to provide slaughter body weight (SBW). The slaughtering was performed according to Islamic law by severing the jugular vessels, esophagus and trachea without stunning. The lambs were slaughtered in an experimental abattoir. The carcasses were longitudinally split into two equal sides, right and left, after removing the tail fat from the carcasses.

Selected groups of muscle were dissected from three main regions of the right half of carcass which represent pelvic limb, dorsal region and thoracic limbs, using special dissection method according to (Butterfield et al., 1983). Then each muscle was weighed separately by electronic balance. After that the surfaces of muscles are cleaned from all fats and connective tissues. Fat deposition was conducted from left half carcass which included (subcutaneous fat, intermuscular fat, kidney and pelvic fat, tail fat) also offal fat which included (omental fat, mesenteric fat, and heart fat). After that all the mentioned fat was weighed by balance. But also percentages of these mentioned fats were measured on the base of total fat from left half carcass.

Statistical Analysis

Data were analyzed using XL Stat, version 7.5, 2005. The significant differences between means of traits included in this study were determined using Duncan's multiple range tests under the probability (P<0.05) (Duncan, 1955).

RESULTS AND DISCUSSIONS

Major muscles in pelvic limbs

The effect of flaxseed powder supplementation on the muscles growth in pelvic limbs in lambs is presented in Figure 1. The results in figure 1 revealed that significant differences (P<0.05) in muscles weight pelvic limbs among treatments as affected by the supplementation of FP. It is noticed that adding FP led to increase (P<0.05) muscles weight of *Semitendinosus* (ST), *Semimembranosus* (SM), *Biceps femoris* (BF), *Rectus femoris* (RF), *Adductor* (AD), *Gracilis* (G), *Vastus medialis* (VM) and *Vastus intermedialis* (VI) in T1. While the mean weight in C group were recorded, decrease in muscles weight. It can be observed that T2 achieved the highest weight in both RF and VL muscles (172.667 and 142.667 g) respectively. Also, the weight of muscles in other treatments (T2 and T3) were recorded significant differences (P<0.05).

Major muscles in dorsal region

The effect of flaxseed powder supplementation on the muscles growth in dorsal region in lambs is shown in Figure 2. The results revealed that there was significant differences (P<0.05) in main muscles weight in dorsal region. T2 recorded the highest weight (545.000, 72.500 and 35.000 g) in *Longissimus dorsi* (LD), *Psoas major* (Pj) and *Psoas minor* (PM), respectively. The C group recorded the lowest weight (462.500, 61.653 and 25.167 g) in LD, Pj and Pm respectively. As well as, the weight of muscles in other treatments (T2 and T3) recorded significant differences (P<0.05).

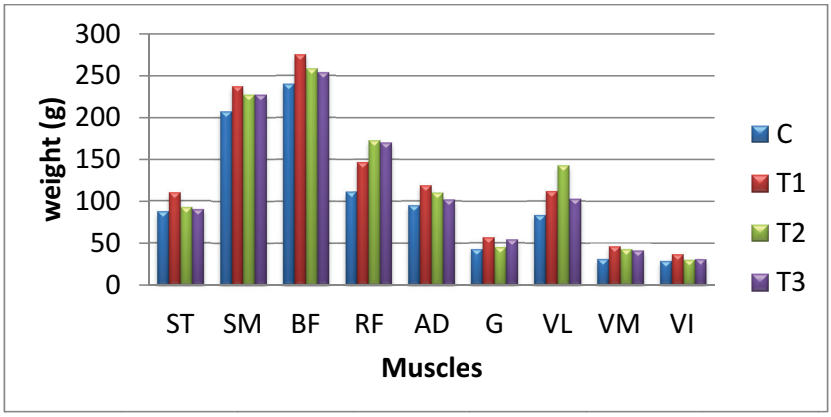

Figure 1. Effect of flaxseed powder supplementation on major muscles in pelvic limbs

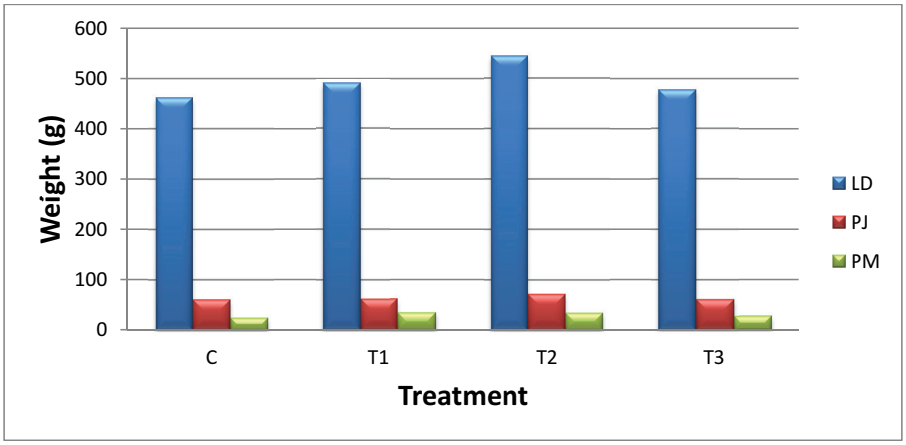

Figure 2. Effect of flaxseed powder supplementation on major muscles in dorsal region

Major muscles in thoracic limbs

Figure 3 showed the effect of FP on the muscles growth in thoracic limbs. The data revealed significant differences ($P<0.05$) among treatments in main muscles weight in thoracic limbs, except for SC muscle which is not different. The highest weight of *Infraspinatus* (IS), *Supraspinatus* (SP) and *Brachialis* (B) muscles respectively, were found in T2, while the highest weight *Subscapularis* (SC) and *Triceps brachii* (TB) muscles respectively, were found in T1, finally the highest weight of *Biceps brachii* (BP) muscle was found in T3. On the other hand, the lowest weights were recorded in C group.

It can be concluded that there is a difference in the rate of growth of muscles in lambs affected by supplementation of the FP that was reflected in the differences of muscles weight. This response may contribute to improve mass of lean and point to the importance of the FP supplementation in increasing meat efficiency through increasing muscle production and decreasing fat deposition in the carcasses. These results confirm data referred to previously about increasing the percentages of meat in the main cuts and whole half carcass and the full effect of the positive effect of the FP to add to the diets of lambs (Zahir, 2012).

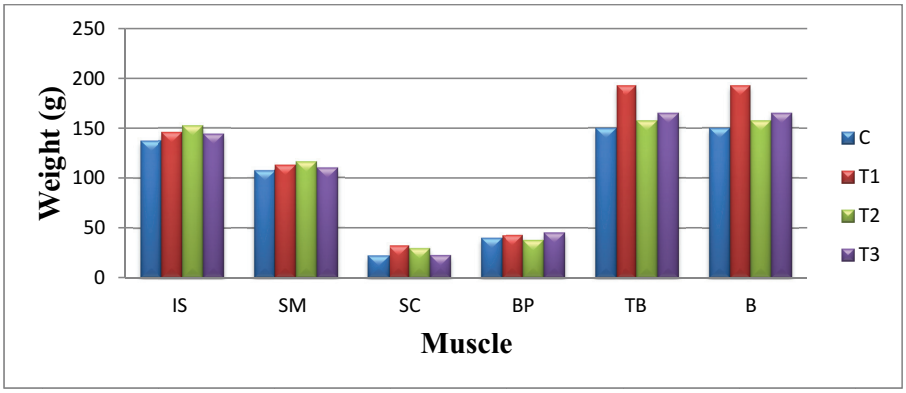

Figure 3. Effect of flaxseed powder supplementation on major muscles in thoracic limbs

Table 2. Effect of flaxseed powder supplementation on weight precipitating* and percentages of (subcutaneous fat, intermuscular fat, kidney and pelvic fat, tail fat and total carcass fat in half carcass (Mean ± standard error)

Treatment	Subcutaneous fat		Intermuscular fat		Kidney &Pelvic fat		Tail fat		Carcass fat	
	(g)	%	(g)	%	(g)	%	(g)	%	(g)	%
C	1565.833^{a} ± 16.729	33.389^{a} ± 0.702	305.500^{ab} ± 0.289	6.515^{a} ± 0.140	37.500^{b} ± 15.877	0.786^{b} ± 0.321	2621.250^{a} ± 82.994	55.828^{ab} ± 0.663	4530.083^{a} ± 101.405	96.518^{a} ± 0.155
T1	1100.000^{b} ± 46.188	25.519^{b} ± 0.669	305.000^{ab} ± 37.528	7.058^{a} ± 0.760	86.250^{ab} ± 7.939	2.009^{ab} ± 0.216	2655.000^{a} ± 24.537	61.695^{a} ± 1.547	4146.250^{a} ± 51.240	96.281^{a} ± 0.335
T2	1459.167^{a} ± 23.467	30.688^{a} ± 0.694	365.833^{a} ± 5.833	7.713^{a} ± 0.418	137.500^{a} ± 30.311	2.945^{a} ± 0.752	2541.250^{a} ± 235.992	53.128^{b} ± 2.920	4503.750^{a} ± 223.058	94.473^{a} ± 1.057
T3	1465.000^{a} ± 50.083	31.867^{a} ± 1.331	292.500^{b} ± 12.990	6.387^{a} ± 0.502	85.000^{ab} ± 8.660	1.863a^{b} ± 0.251	2520.000^{a} ± 213.620	54.540^{ab} ± 2.802	4362.500^{a} ± 201.168	94.658^{a} ± 0.891

Means having different letters at the same column are significantly different (P<0.05).
*It was measured on the total fat of half animal body

Fat partitioning and distribution

Fat partitioning in half carcass

The effect of FP supplementation on weight and percentage of fat (calculated by the total fat content in the half of animal body), Fat deposition in half carcass including (subcutaneous fat, intermuscular fat, kidney and pelvic fat and tail fat), are summarized in Table 2. The supplementation of FP decreased ($P<0.05$) fat deposition, the lowest weight and percentage of subcutaneous fat were found in T1 as compared with other treatments, while oppositely were recorded in C group the highest weight and percentage of subcutaneous fat. However, intermuscular fat in T2 has given the highest weight and percentages as compared with other treatments, T3 has given opposite results in intermuscular fat; it recorded lowest weight and percentages. The highest weight and percentages in kidney and pelvic fat were found in T2, while the lowest weight and percentages fat recorded in C group.

Offal fat deposition

The effect of flaxseed powder supplementation on weight deposition and percentages of (Omental fat, Mesenteric fat, Heart fat, Offal fat in half carcass) are presented in Table 3. The results showed that significant differences ($P<0.05$) were generally found among all treatments in relation to omental fat and offal fat while, no significant differences ($P>0.05$) were found in mesenteric and heart fat as response to FP supplementation (Table 3). The highest weight and percentages of omental fat were found in T3 and the lowest weights with the lowest percentages were found in C group. However, the highest weight and percentages of mesenteric fat were found in T2, while the lowest weight and percentages were found in T1. It is also observed from the results that the highest weight and percentages of heart fat were found in T1 and the lowest weight with the lowest percent was found in T2. The results also denoted that highest weight of fat deposition on offal slaughtering and percentages were found in T2. Then the weight and percentages gradually decreased in other treatments.

Generally, in the current study there was observed from the results decreasing in percentages and amounts of deposition fats in the carcasses from lambs were fed on FP and increasing in percentages and amounts on offal fats. This is expressed as a positive tendency in pattern of fat distribution and muscle production which reflected to efficiency of meat production and this is what the scientists want to achieve now in decreasing fat percent in the carcasses and increasing in the offal fat because of being so easy to separate and get rid of it. As shown from the results of the positive role of flaxseed powder added to diets to improve utilization of nutrients present in the diets and to increase the formation of protein and deposited at the expense of lower deposition of fat in the carcasses.

Total fat deposition

The effect of flaxseed powder supplementation on weight deposition and percentages of total fat in half empty body weight are presented in Table 4. The results reveal that there were no significant differences in weight and percentages of total fat in half empty body weight. But, results indicate that there is a mathematical decrease in weight and percentages of total fat in half empty body weight due to FP supplementation. It is noticed that the lowest weight (4306.875) and lowest percentage (19.775%) of total fat were found in T1, while the highest weight (4763.125) and highest percentages (21.098%) were in T2. It can be concluded that T1 was the best one in meat production efficiency and also it is the best one in relation to produced carcass quality as compared to other treatments.

CONCLUSIONS

These results indicate that the low level (3%) of flaxseed powder is the best to improve and increase the efficiency of meat production and reduce the deposition of fat in the animal's body.

Table 3. Effect of flaxseed powder supplementation on weight deposition* and percentages of (Omental fat, Mesenteric fat, Heart fat, Offal fat in half carcass (Mean ± standard error)

Treatment	Omental fat		Mesenteric fat		Heart fat		Offal fat	
	(g)	%	(g)	%	(g)	%	(g)	%
C	62.500^{b} ± 15.877	1.319^{b} ± 0.311	81.875^{a} ± 17.681	1.761^{a} ± 0.411	18.750^{a} ± 2.165	0.402^{a} ± 0.054	163.125^{b} ± 3.969	3.482^{a} ± 0.155
T1	70.625^{b} ± 10.464	1.633^{ab} ± 0.217	70.625^{a} ± 9.743	1.633^{a} ± 0.200	19.375^{a} ± 3.248	0.452^{a} ± 0.083	160.625^{b} ± 16.960	3.719^{a} ± 0.335
T2	131.250^{a} ± 10.825	2.781^{ab} ± 0.335	113.125^{a} ± 29.950	2.431^{a} ± 0.725	15.000^{a} ± 0.722	0.315^{a} ± 0.003	259.375^{a} ± 40.054	5.527^{a} ± 1.057
T3	135.000^{a} ± 28.868	2.982^{a} ± 0.724	90.625^{a} ± 4.691	1.980^{a} ± 0.170	17.500^{a} ± 0.722	0.380^{a} ± 0.005	243.125^{ab} ± 32.837	5.342^{a} ± 0.891

*Was measured on the total fat of half animal body
Means having different letters at the same column are significantly different ($P<0.05$).

Table 4. Effect of flaxseed powder supplementation on weight deposition and percentages of total fat in half empty body weight (Mean ± standard error)

Treatments	Total fat	
	(gm.)	%
C	4693.208±97.492[a]	21.384±0.508[a]
T1	4306.875±68.200[a]	19.775±0.530[a]
T2	4763.125±183.016[a]	21.098±0.573[a]
T3	4605.625±169.559[a]	21.725±1.008[a]

Means having different letters at the same column are significantly different (P<0.05).

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