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Effect of different levels of flaxseed powder as a source of omega-3 on the carcasses compoistion of karadi lambs

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Abstract
The present experiment was conducted to study the effect of different levels of Flaxseed powder (FP) as source of omega-3 on the physical dissection 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. Carcasses were chilled for 24 h at 4 °C. Concerning the result of physical dissection, there were significant differences, in the major cuts, in half carcass (without tail fat, kidney and pelvic fat) and whole half carcass T1 treatment led to the higher percentage of meat (62.443%) and the lower percentage of fat (22.107%) in half carcass and contrary results were obtained in control treatment. But in the secondary cuts the results were irregular. Furthermore, higher (p<0.05) lean: fat ratio (4.383) and higher lean: bone ratio (2.699) of both dissected and whole carcass side was found in T1 as compared to other treatments. These results were led to improvement of efficiency of meat production in Karadi lambs.

Keywords: flax seed powder, physical dissection, karadi lambs

1. Introduction
Animal resource is the most important economical and agricultural sector in the world for its role in providing of red meat which is the most important source of animal protein of high nutritional value [1]. It contains high level of essential amino acid that our body cannot synthesize. It includes vitamins especially B complex, essential fatty acid and minerals in amount which our body needs to meet our nutritional requirements [2].
New studies and researches have focused on improving sheep production for better quality and quantity of red meat production through using new techniques in feeding like using medical herbs and plants in addition as feed supplementations, The primary approach to enrich meat with omega-3 fatty acids is by incorporation of omega-3 sources such as flaxseed and or oil and fish meal and or oil in the diet of animals. This strategy has been reported by several researchers in pigs [3], lamb [4]. 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 [5].
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. Inclusion in the initial ration seems to promote feed intake and in some instances reduced incidence of disease (bovine respiratory disease), feeding flaxseed may also improve carcass quality are observed [6]. Flaxseed has three major components making it beneficial in human and animal nutrition: first a very high content of alpha linolenic acid (omega-3 fatty acid) essential for humans; second a high percentage of dietary fiber, both soluble and insoluble, and third the highest content of plant "lignans" of all plant or seed products used for human food. Lignins appear to be anti-carcinogenic compounds [7]. Marinova *et al.* [8] found the subcutaneous fat content was significantly reduced in the loin in response to fish oil supplementation. The content of the subcutaneous fat in the half carcass was slightly reduced in the animals supplemented fish oil but it is unevenly distributed among the carcass cuts [8]. Therefore, the objective of this study was to investigate the effect of dietary supplementation of Flaxseed powder supplementation as a source of Omega-3 on the physical dissection for carcasses of Karadi lambs.

2. Materials and Methods

2.1 Housing and feeding trail experiment

Twenty male Karadi lambs purchased from unknown local contractor were individually housed in pens (1 × 1.5 m2) at the animal production farm, faculty of agriculture, University of Sulaimany for the periods from 23-3-2011 to 20-6-2011. 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 [7]

2.2 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. The left side was cut into standardized wholesale cuts shoulder, rack, loin, leg, neck, fore shank, breast and flank) After that the cuts were placed into polyethylene bags then closed tightly and stored in freezer at -18°C until the physical dissection was performed. While each cut was dissected into lean, bone and fat tissues by using knives and dissection tools, in a cold room according to Forrest *et al*. [2].

Half carcass (without tail fat, pelvic and kidney fat): this was basically measured by the total components of half carcass from lean, fat (subcutaneous fat and intermusclar fat) and bone. Whole half carcass: this was basically measured by the total components of half carcass from meat, fat (subcutaneous fat, inter muscle fat, tail fat, kidney and pelvic fat) and bone. Lean to fat ratio: this was measured by two ways: first represents lean to fat ratio of half carcass (Without tail fat, pelvic and kidney fat), second represents meat to fat ratio of complete half carcass. Lean to bone ratio: this was measured on the base of lean to bone ratio for half carcass (without tail fat, pelvic and kidney fat) and complete half carcass too [1].

2.3 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) [9].

3. Results and Discussions

3.1 Physical Dissection for carcass cuts

3.1.1 Major cuts

Table 2 shows the effect of FP feeding on physical dissection of major carcass cuts (leg, loin, rack and shoulder). Results revealed significant (P<0.05) differences among treatments in lean percentages. The highest percentages of lean in leg, loin, rack and shoulder cuts were found in T1 (67.847, 54.480, 56.143 and 67.343%) respectively. Meanwhile the lowest percentages of lean in leg, loin, rack and shoulder cuts were found in C group (58.467, 51.007, 48.463 and 61.286%) respectively. While the lean percentages of other treatments grading from high to low were found in T2 and T3 for leg, loin and rack cuts, with the exception of shoulder which were found in T3 and T2. These results agree with [10] decreased the weight of the meat in the half carcass and the separate cuts. On the other hand, fat content of the major carcass cuts was significantly affected (P<0.05) by FP supplementation (Table 2). The lowest percentages of leg and shoulder cuts were observed in T1 (9.990 and 10.217%) respectively and the highest percentages were found in C group (20.600 and 19.127%). These results agree with [11] observed increased the thickness of the subcutaneous fat at the 11th rib (33.16%).

In loin cut the lowest percentages (20.230%) of fat were found in T3 and the highest percentages (28.800%) found in C group. While the fat percentages of other treatments grading from high to low, were found in T1 and T2.

In rack cut the lowest percentage of fat (18.347%) was found in T2 and the highest percentages 25.993 found in C group. These results agree with [12, 13] observed decreased subcutaneous fat over the loin after fish oil supplementation. While the fat percent of other treatment grading from high to low found in T3 and T1. As well as (Table 2) shows no significant differences (P<0.05) among treatments in bone percentages except that loin cut was significantly affected by FP. However, the percentage of bone in main cuts as follows in leg cut the highest percent (23.486%) of bone was found in T2 and the lowest percentages (20.832%) found in C group.

While the bone percentages of other treatments, grading from high to low, were found in T1 and T3. In loin cut the highest percentage (26.513%) was found in T3 and the lowest percentages (20.193%) found in C group. While the bone percentages of other treatment grading from high to low, was found in T2 and T1.In rack cut the highest percentage (26.400%) was found in T2 and the lowest percentage (22.544%) was found in C group. While the bone percentages of other treatment grading from high to low found in T3 and T1. In shoulder cut the highest percentage (22.440%) was found in T1and the lowest percentage (19.587%) was found in C group. While the bone percentage of other treatments grading from high to low found in T2 and T3.

Table 2: Effect of flaxseed powder supplementation on physical dissection in major carcass cuts (Mean ± standard error).

Treatments	Leg			Loin			Rack			Shoulder		
	Lean%	Fat%	Bone%	Lean%	Fat%	Bone%	Lean%	Fat%	Bone%	Lean%	Fat%	Bone%
C	58.567^{b} ± 4.429	20.600^{a} ± 0.471	20.832^{a} ± 0.529	51.007^{b} ± 0.043	28.800^{a} ± 0.488	20.193^{c} ± 0.531	48.463^{b} ± 1.286	25.993^{a} ± 0.653	25.544^{a} ± 0.636	61.286^{b} ± 2.592	19.127^{a} ± 0.266	19.587^{a} ± 2.301
T1	67.847^{a} ± 1.622	9.990^{b} ± 2.027	22.163^{a} ± 0.404	54.480^{a} ± 0.176	23.010^{ab} ± 0.182	22.510^{b} ± 0.006	56.143^{a} ± 2.959	21.303^{bc} ± 1.092	22.554^{a} ± 1.864	67.343^{a} ± 0.376	10.217^{d} ± 0.546	22.440^{a} ± 0.922
T2	62.057^{ab} ± 0.872	14.457^{b} ± 0.924	23.486^{a} ± 0.052	54.460^{a} ± 0.222	22.597^{bc} ± 0.321	22.943^{b} ± 0.117	55.253^{a} ± 1.671	18.347^{c} ± 1.579	26.400^{a} ± 0.746	65.457^{ab} ± 0.543	12.553^{b} ± 0.243	21.990^{a} ± 0.300
T3	58.760^{b} ± 0.208	19.570^{a} ± 2.019	21.670^{a} ± 2.412	53.257^{a} ± 1.086	20.230^{c} ± 1.273	26.513^{a} ± 0.185	51.227^{ab} ± 0.654	22.616^{b} ± 0.402	26.157^{a} ± 0.774	66.673^{a} ± 1.296	11.403^{c} ± 0.225	21.923^{a} ± 1.522

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

It is concluded from what mentioned above that T1 has given best result in relation to increase of lean mass in the four main cuts in comparison with the other treatments especially with C group, this indicates excellent importance in meat production efficiency in the mentioned group as compared with other groups, following by T2 in the second grade then the 3rd grade T3 comes and at the end of this sequence C group comes. As, revealed from the results; the importance of studying the pattern of muscle distribution and the pattern of fat distribution that provides more information and clarify the different percentages of tissues in cuts.

3.1.2 Secondary cuts

Table 3 clarifies the effect of FP supplementation on physical dissection of secondary carcass cuts (breast, fore shank, neck and flank). Results showed significant differences (P<0.05) across treatments in lean percentage for all secondary cuts except that breast cut showed highest percentage (48.003%) inT3 and the lowest percentages (38.307%) in C group. While the lean percentages of other treatments grading from high to low found in T1 and T2. The highest percentage (57.147%) of fore shank cut was found in T3 and the lowest percentage (50.890%) in C group. While, the lean percentages of other treatments were grading from high to low in T1 and T2.Meanwhile in neck cut T1 and T2 recorded the highest percentages of lean (68.393%) while lowest percent (56.253%) was recorded in C group. Furthermore, the lean percentages of other treatments grading from high to low were found in T3 and T2. Then followed in flank cut as the highest percentage was (72.277%) in T2 and the lowest percentage was (56.250%) in C group. While, the lean percent of other treatments grading from high to low has been found in T3 and T1.In relation to fat content also significant differences(P<0.05) were found among treatments (Table 3). T1 recorded lowest percentage in breast and fore shank cut was19.577 and 7.080% whereas T2 recorded the highest percentages in breast and fore shank (32.853 and 9.450%) respectively. On the other hand, the fat percentages of other treatments grading from high to low found in T3 and C group .In neck cut the lowest percentage (11.230%) was found in C group and the highest percentage (15.360%) found in T3. While, the fat percentages of other treatments grading from high to low have been recorded by T2 and T1. In flank cut the lowest percentage (27.723%) was observed in T2 and the highest percentage (43.750%) was found in C group. While the fat percentages of other treatments grading from high to low found in T1 and T3. It is worth mentioning that results in (Table 3) also observed significant (P<0.05) differences which were found between treatments in relation to bone content.

In breast cut the highest percentage (35.600%) was found in C group and the lowest percentage (21.540%) was found in T3. Meanwhile, the bone percent of other treatments grading from high to low has been found in T1 and T2. It is observed that the fore shank cut has the highest percentages (41.423%) in T1 and the lowest percentages (34.093%) in T3. While the bone percentages of other treatments grading from high to low found in C group and T2. In neck cut C group has given the highest percentages (32.517%) while the lowest percentage (19.350%) was in T1. Furthermore, the bone percent of other treatments grading from high to low was found in T2 and T3. It is revealed that the conclusion which summarized the relative importance of the meat production among the treatments is similar in the special section of the physical dissection for the major cuts.

Mandell *et al*. [14] who observed that Lean meat yield was lower in steers fed 5% FM than in those fed 10% Fish meal (FM).

Also Borys *et al*. [15] observed the percentages and form of oilseeds in the diets did not affect live lamb conformation or muscling, and there was a tendency towards an increased proportion of front and/or middle parts in the lambs of experimental groups, at the expense of the proportion of rump (2.06 percentage units higher than in group C on average). The greater fatness of lambs given oilseeds was reflected in the higher slaughter yield, in group E2 also significantly greater than in C (by 6.4 percentage units, (P<0.05).

3.2 Physical composition of half carcass (Without fat tail, kidney and pelvic fat)

The results in (Table 4) summarized the effect of supplementation FP on physical composition of half carcass (without fat tail, kidney and pelvic fat). Table 4 revealed significant differences (p<0.05) among treatments in physical composition of half carcass (without fat tail, kidney and pelvic fat). The highest lean percentage was found in T1 (diet that contains 3% of FP) (62.443%), and the lowest percentage was found in C group (55.140%). And lean percentages in T2 and T3 were recorded 59.560 and 59.083% respectively.

On the other hand, the result of fat content, in physical composition of half carcass (without fat tail, kidney and pelvic fat), was summarized in (Table 4). The results indicate the opposite direction of what appeared in the percentages of lean. T1 significantly (p<0.05) decreased in fat percentages as compared with other treatments, while C group was recorded higher percentages (%22.107), the fat percentages in T2 and T3were found17.320 and 18.540% respectively. The results indicated no significant differences in bone percentages among treatments.

Table 3: Effect of flaxseed powder supplementation on physical dissection in secondary carcass cuts (Mean ± standard error)

Treatment	Breast			Fore shank			Neck			Flank	
	Lean%	Fat%	Bone%	Lean%	Fat%	Bone%	Lean%	Fat%	Bone%	Lean%	Fat%
C	38.307^{a} ± 6.617	26.093^{c} ± 0.280	35.600^{a} ± 6.900	50.890^{b} ± 0.173	8.280a^{b} ± 0.029	40.830^{a} ± 0.202	56.253^{c} ± 1.418	11.230^{b} ± 0.448	32.517^{a} ± 1.875	56.250^{b} ± 0.679	43.750^{a} ± 0.679
T1	47.753^{a} ± 0.165	19.577^{d} ± 0.396	32.670^{ab} ± 0.228	51.497^{b} ± 0.280	7.080^{b} ± 0.289	41.423^{a} ± 0.456	68.393a ± 0.947	12.257^{b} ± 0.543	19.350^{c} ± 1.488	60.733^{ab} ± 5.671	39.267^{ab} ± 5.668
T2	42.024^{a} ± 0.372	32.853^{a} ± 0.393	25.123^{ab} ± 0.768	51.263^{b} ± 1.074	9.450^{a} ± 1.048	39.287^{a} ± 0.029	61.250^{b} ± 2.132	13.143^{b} ± 0.831	25.607^{b} ± 2.724	72.277^{a} ± 4.194	27.723^{b} ± 4.194
T3	48.003^{a} ± 0.358	30.457^{b} ± 0.278	21.540^{b} ± 0.101	57.147^{a} ± 2.570	8.760^{ab} ± 0.122	34.093^{b} ± 2.451	62.857^{b} ± 0.973	15.360^{a} ± 0.644	21.783^{bc} ± 0.329	70.987^{a} ± 4.022	29.013^{b} ± 4.022

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

Table 4: Effect of flaxseed powder supplementation on physical composition in half carcass (without fat tail, kidney and pelvic) (Mean ± standard error).

Treatments	physical composition		
	Lean %	Fat %	Bone %
C	55.140 ± 0.015^{c}	22.107 ± 0.202^{a}	22.753 ± 0.188^{a}
T1	62.433 ± 0.947^{a}	14.434 ± 1.077^{c}	23.133 ± 0.126^{a}
T2	59.560 ± 0.137^{b}	17.320 ± 0.265^{b}	23.120 ± 0.233^{a}
T3	59.083 ± 1.234^{b}	18.540 ± 0.575^{b}	22.377 ± 0.683^{a}

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

It can be concluded from what mentioned that there was positive effect of supplementation of FP on gain and enhanced the animals ability to deposit protein and thus increased the percentages of lean and decreased the percentages of fat, this is may be due to two possible reasons, first improve utilization of nutrients present in the diets and second act or activity of some enzymatic system with unknown mechanism.

3.3 Physical composition of the whole half carcass

The effect of flaxseed powder (FP) supplementation on physical composition in whole half carcass is presented in (Table 5). The statistical analysis revealed that both lean and fat percentages were significantly affected (p<0.05) by FP supplementation to diets. It is obvious from (Table5) that the highest percentage of lean was found in T1 (49.013%) and the lowest percentage was found in C group (43.630%) while the lean percentages in other treatments were 47.667 and 46.490% in T2 and T3 respectively. As well as the results clarified that fat content was significantly (p<0.05) different among treatments. The lowest percentages of fat was recorded in T1 (32.833%) and the highest percentage was observed in C group (38.363%), while the fat percentages in T2 and T3 were found (33.840 and 35.893%) respectively. The results indicated no significant differences in bone percentages among treatments. It could be concluded from what mentioned that the composition of the whole half carcass in T1 was improved towards lean production than fat deposition. It is worth mentioning that better physical composition of the complete carcass in T1 which has improved in increasing lean percentage by (5.383%) and decreasing fat percent by (5.53%) as comparison with C group in physical composition, which gives superiority to this treatment. It is also figure out that the relative importance for physical dissection in major and secondary cuts and in the half carcass (without fat tail, kidney and pelvic fat) and in the whole half of carcass was not similar to each treatment (C group, T1, T2 and T3). This indicates differences occurrence in the pattern of dissection and distribution of fat in the carcasses which were reflecting to differences occurring in leanmass among the mentioned groups. Meanwhile, relative importance for physical dissection was identical between (C group, T1, T2 and T3).The increasing in the content of lean and decreasing the content of fat may belong to differences in pattern of growth and distribution different tissue in the body which oriented towards increasing in lean efficiency and decreasing in fat deposition in the carcasses.

Table 5: Effect of flaxseed powder supplementation on physical composition in whole half carcass (Mean ± standard error)

Treatment	physical composition		
	Lean %	Fat %	Bone %
C	43.630 ± 0.323^{b}	38.363 ± 0.385^{a}	18.007 ± 0.139^{a}
T1	49.013 ± 0.387^{a}	32.833 ± 0.355^{b}	18.154 ± 0.038^{a}
T2	47.667 ± 0.747^{a}	33.840 ± 0.942^{b}	18.493 ± 0.224^{a}
T3	46.490 ± 1.517^{ab}	35.893 ± 1.665^{ab}	17.607 ± 0.692^{a}

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

3.4 Lean to fat ratio in half carcass with or without fat tail, kidney and pelvic fat

Effect of flaxseed powder supplementation on lean to fat ratio in half carcass with or without fat tail, kidney and pelvic fat are presented in (Fig. 1 and 2). And revealed that there were significant differences (*P*<0.05) in lean: fat ratio among the treatments. FP Supplements caused significant changes in lean: fat ratio thus leading to a significant increase in lean percentages. The highest lean: fat ratio in half carcass (without fat tail, kidney and pelvic fat) was found in T1 (4.383) and the lowest ratio was found in C group (2.495). While the ratio in T2 and T3 were 3.438 and 3.198, respectively. Meanwhile, the highest ratio of lean: fat in whole half carcass was observed in T1 (1.493) and the lowest ratio were in C group (1.138), as well as, the ratio in T2 and T3 was 1.412 and 1.304, respectively. This increase in the percentage of meat may be due to the increase in the percentage of lean in the carcass cuts and low percentage of fat has also been referred to previously section.

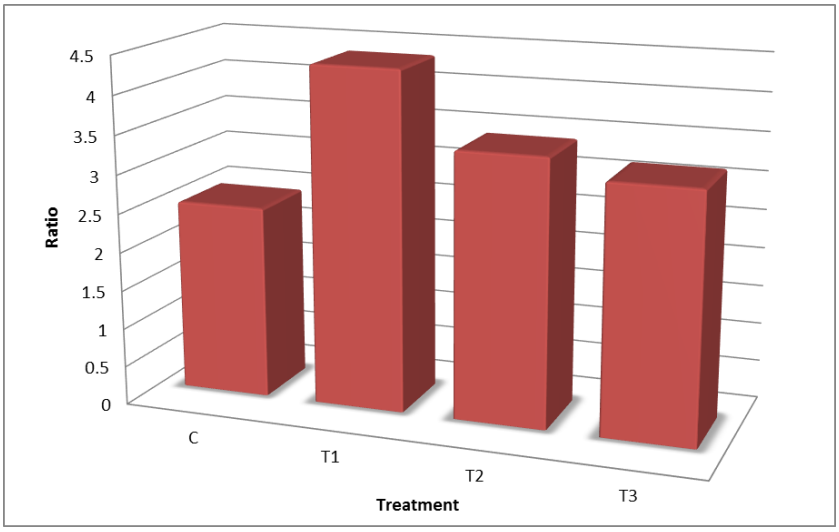

Fig 1: Effect of flaxseed powder supplementation on lean: fat ratio in half carcass (without fat tail, kidney and pelvic fat).

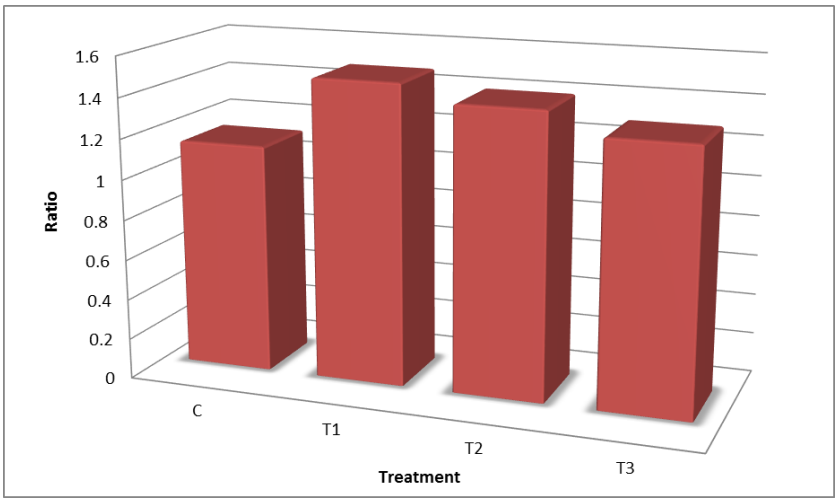

Fig 2: Effect of flaxseed powder supplementation on lean: fat ratio in whole half carcass.

3.5 Lean to bone ratio in half carcass with or without fat tail, kidney, and pelvic fat

Effect of flaxseed powder supplementation on lean: bone ratio in half carcass with or without fat tail, kidney and pelvic fat are presented in (Figure 3), lean: bone ratio significantly differences (P<0.05) was affected by supplementation of FP. It can be observed that lean: bone ratio in C group was the lowest (2.423) while the highest ratio was recorded in T1, (2.699) the ratio in other treatments was 2.577 and 2.649 in T2 and T3 respectively. It can be concluded ,from the results mentioned above ,that there is a difference in the rate of growth of muscles and bones received in supplementation the impact of FP, which was reflected in the variation ratio of the meat to the bone among the treatments. However, it was reported that muscle, fat and bone weights and percentages were not significantly affected by fish meal (FM) feeding also carcass adiposity was not affected by dietary treatment [4].

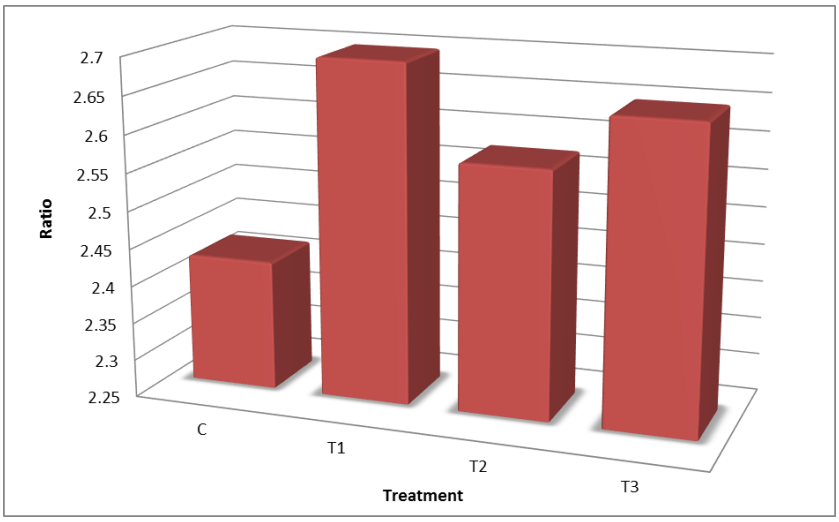

Fig 3: Effect of flaxseed powder supplementation on lean: bone ratio in half carcass with or without fat tail, kidney and pelvic fat

4. Conclusion

According to the present experimental results the flaxseed powder supplementation recorded significantly increased meat percentage and decreased in fat percentage in major and secondary cuts also in half carcass (without tail fat, kidney and pelvic fat) and whole half carcass, while the results with relation to carcass cuts (Whole and secondary) and carcass weight were fluctuated, however no significant differences in dressing percentage.

5. Acknowledgement

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