GROWTH PERFORMANCE, FEED UTILIZATION, RUMINAL PARAMETERS, ECONOMIC EFFICIENCY AND CARCASS CHARACTERISTICS OF MALE ZARAIBI GOATS FED RATIONS CONTAINING LINSSED OR SUNFLOWER OILS.

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ABSTRACT

This study aimed to evaluate the effects of supplementing linseed or sunflower oils to the growing male kids diets on growth performance, feed utilization, ruminal fermentation, blood metabolites, economic efficiency and carcass characteristics. Fifteen Zaraibi kids (aged 5 months and had 17.62 ± 0.19 kg live weight) were divided into 3 groups (5 kids each), according to their live body weight. The control group (G1) fed a basal ration consisted of 60% concentrate feed mixture (CFM) plus 40% berseem hay (BH) according to NRC (1981) allowances. Linseed oil and sunflower oil added to the control diet at level 3% of total DM intake for G2 and G3, respectively. The feeding trail lasted 120 days.

The results of this study indicated that, the values of final live body weight of kids in tested groups (2 and 3) significantly higher than control group (G1), being 29.8 and 29.3 *vs.* 26.68 kg, respectively. These weights of G2 and G3 increased by 11.69 % and 9.82 % than weight of control (G1). Moreover, the results indicated that daily body gain (DBG)) recorded the highest value (101.67 g) with G2 followed by G3 (96.67 g) and lastly G1 (75.0 g) and the differences were significant. The DBG increased by 35.56 and 28.89% with G2 and G3, compared to control group (G1). The best-feed utilization efficiency, based on DM intake, was recorded with G2 (6.25) followed by G3 (6.62) in comparison with G1 (8.60), respectively. Moreover, the improvement in feed efficiency, based on CP, was 27.33 and 23.02 % for the two tested groups (G2 and G3), compared with control (G1). Thus, the feed economic efficiency was noticeably better by 4.89 % and 14.69% with adding linseed oil (G2) and sunflower oil (G3), at level 3% of total DM intake, respectively, compared with G1 (control). The obtained results showed that the daily DM intake decreased (63.09 vs. 60.06 and 59.12 g/kgw$^{0.75}$) due to adding oil types to goats rations (G1 vs. G3 and G2, respectively).

The experimental rations had no significant effect on ruminal pH values and total VFA's during 2, 4 and 6 hrs post-feeding. However, ammonia-N concentration and microbial protein, during 2, 4 and 6 hrs post-feeding, were significantly higher ($p<0.05$) with G2 and G3 compared to G1. The obtained results indicate that most tested blood profile parameters; serum glucose, total protein, albumin, globulin, triglycerides and cholesterol not significantly affected by tested experimental rations. Meanwhile, kids of tested groups (G2 and G3) had higher ($P<0.05$) HDL and lower LDL than G1 kids.

The tested groups (G2 and G3) had significant ($p<0.05$) better fasting weight, hot carcass and whole prime cuts, kg. Dressing percentages either for carcass with or without offal's increased with G2 and G3 compared to control (G1), but differences were not significant. Meanwhile, whole prime cuts, kg were significantly ($p<0.05$) higher with G2 and G3, being 10.91 kg and 9.96 kg, respectively compared to control diet (G1, 8.84 kg). Fat percentage in the carcasses increased by increasing slaughtering weight especially in tested groups fed oils types. Results showed no significant differences among the groups in percentages of most organs and offal's, but differences were less significant for head and feet of tested groups than control. Thus, no significant differences found between treatments and control diet in weight of organs and offal's of kids.

Moreover, lean % in tested groups 2 and 3 were higher, being 58.21 % and 56.29 % compared with the control group (55.68 %). The same trended was observed on fat % in ribs of tested groups 2 and 3 which tended to be higher, (being 12.93 % and 12.47 % compared with the control group 11.15 %). . On the other hand, bone % in the ribs decreased with tested groups (G2 and G3), being 28.85 % and 31.25 % compared with the control group (G1, 31.84 %). The chemical composition of *longismus dorsi* muscle tissues was similar across dietary treatments. The fat percentage (EE) on DM basis tended to increase in meat of animals fed oils diet (G2 and G3) compared to null-oil control (G1), while the CP, moisture and ash percentage tended to decrease.

Keywords*: linseed oil- sunflower oil-Zaraibi goats-growth performance-feed utilization- feed economic efficiency- carcass characteristics*

INTRODUCTION

Nutrition and management considered crucial factors in determining the quality and economic of meat production (Agnihotri *et al.*, 2006). Increasing profitability of small ruminant production is greatly dependent on reducing input costs and/or increasing production output. Any reduction in feed intake or increase in feed efficiency without compromising growth rate or carcass quality can have a significant positive economic impact on small ruminant (Snowder and Van Vleck, 2003). Feed is the most important cost item for livestock production, which represent 50-75% of production costs (Sarfari *et al.*, 2012). Protein and energy are the two most impotent constituents in animal diets that have vital role on their performance of growth, meat and milk production and reproduction (Shahzad *et al.*, 2011). The price of feed ingredients used in feedlot of small ruminant tends to influence by supply and demand. Thus, the use of oil seeds by-products as alternative source for animal feed could alleviate the big problem of feedstuffs shortage and consequently contribute in reducing feed prices. Among various alternatives available, linseed and sunflower oils by-products can work as good source of energy for ruminant animals.

The influence of vegetable oils fed to ruminants on metabolic processes of the rumen, nutrients digestibility, performance for cattle and production of fatty acids in the lipids of carcass may be modified by diet composition and form of fat that could included in the rations as oil, whole seeds, meals cakes or fatty acids calcium salts (Murphy *et al.*, 1990 and Kowalsk *et al.*, 1997). Saqhir *et al.* (2012) indicated improvement in final weight, total gain and daily gain when Black goat kids fed ration supplemented with sunflower oil.

Furthermore, Abuelfatah *et al.* (2013) reported that growth performance as final weight, total weight and feed intake were markedly higher in male kids fed ration supplied with 10% and 20% linseed oil compared to 0% linseed oil.

Definitely, the extent of depression in fiber digestion depends on the amount, degree of saturation and form of fat supplements (free oil, free fatty acids and unprotected oil seeds vs. protected), type of the basal diet, method of feeding and animal species (sheep and dairy cows) (Huhtanen, 1991). Replacing starch of the diet by lipid supplementation sometimes even improve fiber digestibility (Palmquist and Conrad, 1978). Simas *et al.* (1998) found that adding fat to diets of ruminants could help provide the high-energy requirements for high milk yield of faster growth rate without causing metabolic disorders that often associated with a high intake of grains. Some investigators showed that supplementing the diets of ruminants by PUFA's were positively associated with ruminal function. In this respect, Morsy *et al.* (2015) indicated that feeding sunflower whole seeds or oil could decrease both ruminal pH and ruminal ammonia-N concentrations and increase concentrations of ruminal volatile fatty acids (VFA's). Moreover, Khalifa *et al.* (2016) concluded that addition of linseed or sunflower oils to a diet at 3% of DMI improved body weight of maternal Zaraibi goats during gestation. Also, El- Diahy *et al.* (2016) concluded that flaxseed oil supplementation at 2% of DMI eliminated heat stress and improved digestibility, productive performance and economical efficiency as well as immune response of cows.

The main objective of this study was to investigate the influence of linseed oil (rich in ω-3) or sunflower oil (rich in ω-6) on growth performance, feed utilization, ruminal parameters, economic efficiency, blood metabolites and carcass traits of growing male Zaraibi goats.

MATERIALS AND METHODS

This study conducted in El-Serw Experimental Research Station, Domietta Governorate, Animal Production Research Institute (*APRI*), Agriculture Research Center, Ministry of Agriculture, Egypt. The experimental work conducted during the period from May to September 2016.

Experimental animals and feeding:

Fifteen Zaraibi kids aged 5 months had 17.62 ± 0.19 kg live body weight were randomly divided into three equal groups, 5 kids each. All animals kept under similar management conditions in a semi-open shaded yard. Kids separated in groups feeding. The first group served as control, (G1) and fed a basal diet consisted of concentrate feed mixture (CFM) plus berseem hay (BH) without any supplement, while G2 and G3, supplemented with linseed or sunflower oils, mixed with CFM at rate 3 % of total DM intake, respectively. The nutrient requirements calculated according to NRC (1981) of goats. Zaraibi kids fed for 15 days as a transitional period on the experimental rations before the start of the experimental work. The feeding experimental period lasted 120 days where animals weighed at the beginning then biweekly.

CFM and BH offered at 60:40 ratio as reported by Soliman *et al.* (2010) for growing Zaraibi kids.

The CFM was consisted of undecorticated cotton seed meal (26%), yellow corn (40%), wheat bran (27%), molasses (3.5%), limestone (2%), common salt (1%) and minerals mixture (0.5%). Diets offered twice daily at 8:0 am and 3:0 pm and had free access to water and vitamin/minerals blocks.

The chemical composition of basic rations analyzed according to A.O.A.C (1995). The chemical approximate analysis of basal diets are given in Table (1).

Table 1. Chemical analysis of basic rations (% on DM basis).

Ingredients	DM	OM	CF	CP	EE	NFE	Ash
CFM	91.05	93.95	15.93	15.0	3.35	59.67	6.05
BH	88.3	87.3	30.0	11.3	2.4	43.6	12.7

Additionally, saturated and unsaturated fatty acid profiles of both oils (linseed and sunflower) are presented in Tables (2 and 3), according to Zambiazi *et al.* (2007).

Table 2. Saturated fatty acids profile of linseed and sunflower oils.

Oil types	*Saturated fatty acids						
	C14:0	C16:0	C17:0	C18:0	C20:0	C22:0	C24:0
Linseed	0.05	4.81	0.05	3.03	0.20	-	0.01
Sunflower	0.06	5.70	0.04	4.79	0.30	1.16	0.31

**C14:0 = myristic, C16:0 = palmitic, C17:0 = margaric, C18:0 = stearic, C20:0 = arachidic, C22:0 = behenic and C24:0 = lignoceric.*

Table 3. Unsaturated fatty acids profile of linseed and sunflower oils.

Oil types	*Unsaturated fatty acids						
	C17:1	C18:1	C18:2 (ω-6)	C18:3 (ω-3)	C20:1	C20:2	C24:1
Linseed	0.12	21.42	15.18	54.24	0.40	0.39	0.10
Sunflower	0.06	15.26	71.17	0.45	0.22	0.09	0.39

**C17:1 = miristoleic, C18:1 = oleic, C18:2 = linoleic, C18:3 = linolenic, C20:1 = gadoleic, C20:2 = eicosadienoic and C24:1 = nervonic.*

**The linseed as a source of omega3 whereas, sunflower as a source of omega 6 as reported by Dirandeh et al. (2013).*

Experimental parameters:

Growth performance

The growth performance included live body weights (LBW) that recorded fortnightly before offering the morning feeds and drinking, and daily body gain (DBG**).**

Dry matter intake recorded daily throughout the experiential period by weighing the offered diets and refusal from the previous day.

Feed conversion calculated as the ratio between DM intake and weight gain.

The economic efficiency calculated as the ratio between price of weight gain and cost of feeding.

Rumen samples:

Rumen fluid samples were taken from 3 animals of each experimental group using stomach tube before feeding (0 time) and at 2, 4 and 6 hrs post-feeding at the end of feeding trail. Samples were filtered through 3 layers of gauze and pH was immediately determined by pH meter. Ammonia nitrogen (NH_3-N) concentration measured according to Conway (1957). Microbial protein determined according to Schulz and Schultz (1970), while total volatile fatty acids (VFAs) were determined according to the technique described by Warner (1964).

Blood samples:

Blood samples were taken from G1, G2 and G3 groups (3 kids/treatment) before slaughtering. The blood samples collected through the jugular vein and centrifuged at 3500 *rpm* for 20 min. The blood serum separated into clean dried Eppendrof tubes and frozen in a deep freezer at -20°C until analysis. The concentrations of glucose, total protein, albumin, globulin, triglycerides, cholesterol and high-density lipoprotein (HDL) were determined using specific kits (Stanbio Laboratory, Boerne, TX, USA). Albumin/globulin ratio (A/G ratio) and low-density lipoprotein (LDL) were also calculated.

Carcass characteristics:

At the end of experiment, three kids of each group selected randomly and slaughtered after 24 hours fasting to evaluate carcass traits. Animals skinned; abdominal and thoracic organs were detached and weighed. The digestive tract weighed both full and empty to get the gut fill weight by subtraction, the empty body weight (EBW) was obtained by subtracting alimentary tract content from fasted live weight. Hot carcass weight without edible organs or with edible organs was determined immediately after evisceration and expressed as percentage of fasted to estimate of dressing percentage (Koch *et al.*, 1963 and Ahmed, 2003). The 9-11th ribs (*longismus dorsi*) were chilled, then separated to lean, bone and fat to estimate the physical and chemical composition beside measuring weights. Then, non-carcass components (i.e., head, pelt, feet, (lungs & trachea), heart, liver, kidneys, kidney fat, mesenteric fat and testes) were removed and weighed. After slaughtering, carcasses were cut into halves and further into four parts (i.e., shoulders, racks, loins, legs).

Statistical analysis:

Data statistically analyzed using One-Way Layout with Means Comparisons Procedures SAS (2003). Significant differences among means evaluated using Duncan's Multiple Range test (1955). The model used for analysis of parameters was:

$Y_{ij} = \mu + T_i + e_{ij}$

Where:

Y_{ij} = the observation

μ = overall mean

T_i = Effect of treatment

e_{ij} = Experimental error

RESULTS AND DISCUSSION

Growth performance:

Performance of growing Zaraibi kids fed the experimental dietary treatments presented in Table (4). Final live body weight of kids in groups 2 and 3 were significantly ($p<0.05$) higher, being 29.80 and 29.30 kg, compared to control group (26.68 kg). This increase measured as 11.69 and 9.82 % more than control (G1) group. This result support the finding of Silva *et al.* (2007) that covering energy requirement using oil additive is very important than energy supply from mobilization and catabolism of body reserves. Actually, Bhatt *et al.* (2013) stated that increasing energy sources might allow the production of more fermentable metabolic energy (ME) for rumen microorganisms, which lead to goodness in synthesis of microbial protein, therefore, the amount of protein available to the animal resulted in refinement of body weight. Meanwhile, Bompadre *et al.* (2014) demonstrated that adequate supplementation of energy is essential to maintain normal body function such as growth performance and major environmental factor affecting reproductive performance. Regarding daily gain over the experimental period, the two tested rations (G2 and G3) achieved significant higher values than control one (G1), being 101.67 and 96.67 vs. 75.00 g, respectively. Thus, DBG of kids fed tested rations increased by 35.56 and 28.89% than control (G1) group. This result agree with Zinn (1989) who showed linear increases in daily gain (P<0.05) by increasing level of fat in the diet of steers (0, 4 and 8%). Also, Abu El-hamed *et al.* (2015) concluded that flaxseed oil supplementation in milk of suckling Friesian calves (0.2 ml/kg LBW) during the suckling period improved growth performance and economic efficiency as well as immune response of calves without adverse effect on digestibility and hematological parameters. Additionally, Bendary *et al.* (1994) revealed that the protein of the concentrate ration of fatting buffers calves could partially replace with 5% palm oil, without adverse effect on growth performance.

Table (4): Growth performance of kids fed the experimental diets.

Items	Treatment diets		
	G1	G2	G3
Initial weight, kg	17.70 ± 0.26^a	17.60 ± 0.29^a	17.60 ± 0.29^a
Final weight, kg	26.68 ± 0.30^b	29.80 ± 0.34^a	29.30^a ± 0.20^a
Total body gain, kg	9.00 ± 0.16^b	12.20 ± 0.12^a	11.70 ± 0.20^a
Daily body gain (DBG), g	75.00 ± 1.32^b	101.67 ± 1.02^a	96.67± 1.56^a

a, b means within the same rows with different superscripts are significantly different (P < 0.05).

G1: ration without oil (control) G2: ration with linseed oil G3: ration with sunflower oil.

Feed utilization:

The obtained results showed that daily DM intake tended to decrease (63.09 vs. 60.06 and 59.12 g/kgw$^{0.75}$) due to addition of oils to goats' rations (G1 vs. G3 and G2). Feed conversion of the experimental rations shown in Table (5). The best-feed conversion as kg DM/kg gain recorded for G2 (6.25) followed by G3 (6.62) compared with the poorest one, control (G1, 8.60). Accordingly, feed efficiency of G2 and G3 improved by 27.33 % and 23.02 %, respectively due to linseed and sunflower oils supplementation than control ration. Such improvement of feed conversion in G2 and G3 mainly due to efficiency of feed utilization as indicated by the higher body gain (101.67 and 96.67 g/h/d) compared with control ration (G1, 75.0 g/h/d).

Similarly, the values of feed conversion as CP intake/kg gain was better in rations supplemented with oils (0.841 and 0.889 for G2 and G3, respectively) compared with control (G1, 1.164). Being 27.75% and 23.63 %, higher than the control, respectively. These results are in harmony with those obtained by Canbolat and Karabulut (2010) who reported that average body growth, daily weight gain and feed efficiency increased with increasing level of energy in feedstuffs. Moreover, the obtained values of feed utilization are in agreement with those reported by Gaber *et al.* (2015) who found that feed efficiency of growing Zaraibi kids ranged from, 8.51 to 9.4 kg DM intake/kg gain. Similar, results were found by El-Emam *et al.* (2016) who reported that feed utilization efficiency based on DM were 8.67 and 9.01 when fed sesame seeds at levels 10 and 20%, respectively compared with control (10.40 kg/feed /kg gain), for male Zaraibi goats. In addition, Zeenat *et al*. (2014) found on lactating buffaloes, significant better milking yield, feed efficiency, reproductive performance as well as improved economic efficiency when supplemented their diet with 3% vegetable oil based on DM intake in comparison with the un supplemented one.

Table (5): Feed utilization efficiency by kids as affected by the experimental diets.

Items	Treatment diets		
	G1	G2	G3
Daily body gain (DBG), g/h	75.00	101.67	96.67
Body weight, kg	22.19	23.70	23.45
Metabolic body size, $w^{0.75}$	10.22	10.74	23.45
Feed intake, DM/h, during the experimental period (120 days)			
CFM, g	385	380	382
BH, g	260	255	258
Total DM intake, g/h/d	645	635	640
Total DM intake, $g/kgw^{0.75}$	63.09	59.12	60.06
CP intake, g/h	87.13	85.82	86.15
CP intake, g/kg $w^{0.75}$	8.52	7.99	8.08
DM intake, % BW	2.91	2.69	2.75
Feed conversion:			
Kg DM/kg gain	8.60	6.25	6.62
Kg CP/kg gain	1.164	0.841	0.889

a, b means within the same rows with different superscripts are significantly different (P < 0.05).

Ruminal parameters:

Results of pH values (Table 6) illustrated that maximum pH values were recorded at 0 time with all treatments without significant differences among groups and then gradually decreased to the minimum values at 4 hrs. Post feeding and tended to increase again thereafter at 6 hrs post feeding with all groups. Similar results observed by Ibrahim *et al.* (2012) and El-Emam *et al*. (2016) on growing lambs and Zaraibi kids.

Moreover, ruminal ammonia –N concentration was greatly higher post-feeding than before feeding and the maximum values reached at 2 hrs. post-feeding without significant differences among groups. At 4 and 6 hrs. post-feeding NH3-N decreased with all groups and significantly increased with tested groups than control. Similar results observed by El-Emam *et al.* (2016) when used sesame seeds in goats' ration. Also, results here are in agreement with those obtained by Allam *et al*. (2012) who found that ammonia-N concentration significantly declined with incorporation of sunflower, linseed or soybean in the rations of lactating goats at 3.5% of their rations in comparison with control ration. The obtained results indicate that microbial proteins content during 2, 4 and 6 hrs. post-feeding was significantly higher (p<0.05) with G2 but insignificantly with G3 compared with control G1. While, over Zero sampling time the microbial protein concentrations did not affected by dietary treatments.

Concerning total VFA's, their concentrations over all sampling times insignificantly increased with tested rations than control ration. These results may related to the high energy content of oils as reported by El-Emam *et al*. (2016) when used sesame seeds in goats' ration. Similar results respecting T VFA's were recorded by Allam *et al.* (2012) when used different seeds or its oils (soybean, sunflower or linseeds) with dairy goats and the results of El-Diahy *et al.* (2016) who evaluated flaxseed oil supplementation into the diets of Friesian cows. The obtained data of rumen parameters are within the normal range reported by Ahmed and El-Kholany (2012), El-Sayed and Sadik (2015), Gabr *et al*. (2015) and El-Emam *et al*. (2016) with small ruminants (sheep and goats).

Blood metabolites:

The serum blood biochemical parameters of kids fed the experimental rations are shown in Table (7). Blood parameters are an index for several metabolic processes of the body

(Emami *et al.,* 2017). Results show that concentrations of serum glucose, total protein, albumin, globulin, triglycerides and cholesterol did not affected by dietary treatments. Meanwhile, kids fed tested rations (G2 and G3) had higher (P<0.05) HDL and lower (P<0.05) LDL than kids fed (G1) control ration.

Table (6): Some rumen liquor parameters of male goats fed the experimental rations.

Items	Hours	G1	G2	G3
pH value	0	6.86 ± 0.08[a]	6.70 ± 0.07[a]	6.65 ± 0.06[a]
	2	6.70 ± 0.10[a]	6.64 ± 0.09[a]	6.57 ± 0.08[a]
	4	6.63 ± 0.04[a]	6.26 ± 0.03[a]	5.63 ± 0.042[a]
	6	6.67 ± 0.06[a]	6.42 ± 0.05[a]	5.81 ± 0.04[a]
Ammonia-N (mg/100ml)	0	16.86 ± 0.13[a]	17.23 ± 0.11[a]	16.90 ± 0.12[a]
	2	24.00 ± 0.60[a]	28.60 ± 0.62[a]	26.92 ± 0.61[a]
	4	23.50 ± 0.23[c]	27.42 ± 0.25[a]	25.61 ± 0.24[b]
	6	21.52 ± 0.36[c]	24.85 ± 0.38[a]	23.33 ± 0.37[b]
Microbial protein (g/100ml)	0	0.335 ± 0.006[a]	0.340 ± 0.003[a]	0.338 ± 0.01[a]
	2	0.505 ± 0.007[b]	0.515 ± 0.008[a]	0.513 ± 0.007[ab]
	4	0.565 ± 0.008[b]	0.582 ± 0.001[a]	0.577 ± 0.008[ab]
	6	0.487 ± 0.007[b]	0.510 ±0.008[a]	0.505 ± 0.007[ab]
Total volatile fatty acids(mEq/100ml)	0	7.79 ± 0.28[a]	8.70 ± 0.29[a]	8.92 ± 0.30[a]
	2	8.52 ± 0.13[a]	9.72 ± 0.15[a]	9.22 ± 0.14[a]
	4	10.32 ± 0.20[a]	10.78 ± 0.22[a]	10.56 ± 0.21[a]
	6	10.12 ± 0.40[a]	10.21 ± 0.42[a]	10.21 ± 0.41[a]

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

The non-significant differences among the dietary treatments in glucose concentration may referred to that oils added might have no negative effects on insulin receptors or glucogenesis, glycolysis and glucose oxidation processes (Adeyemi *et al.,* 2016). In relation to this point, Antunović *et al.* (2017) indicated that increases in glucose concentration are considered as indicator of lipid metabolization and fatty acid oxidation. Hence, the former authors stated that if an animal is unable to consume enough feed to meet maintenance requirements, it uses body reserves, resulting in increase of serum non esterifies fatty acids (NEFA). Comparable results respecting the concentration of some blood metabolites (total protein, globulin, albumin, glucose …etc) were found between diet supplemented with 3% of mixed oils (palm oil, soybean oil and sunflower one) and the un supplemented diet (control) for lactating buffaloes (Zeedan *et al*., 2014). Cholesterol and triglycerides in the blood are good indicators of their energy supply. Also, results here related to the concentration of cholesterol HDL and LDL are in match with those reported by El-Diahy *et al.* (2016), using 2% of DMI of flaxseed oil vs. control diet free of oil for Friesian cows.

Contrarily, Roy *et al.* (2013) found a significant increase in blood triglyceride concentration in goats fed 4.5 % sunflower oil compared to those fed the control diet. The slight reduction in total cholesterol in kids received both oil types in their rations was primarily due to the change between HDL and LDL. Thus, an elevation in HDL is a desirable health related goal because HDL concentrations negatively correlated with coronary atherosclerosis (Falade *et al.,* 2017). Conversely, the previous authors confirmed that an elevation in serum LDL concentration could interpreted negatively because a positive correlation exists between serum LDL concentration and coronary atherosclerosis.

Table (7): Blood parameters as affected by different experimental diets.

Items	Treatment groups		
	G1	G2	G3
Glucose, mg/dL	65.54 ± 0.66[a]	66.32 ± 0.19[a]	67.41± 0.74[a]
Total protein, g/dL	6.42 ± 0.06[a]	6.53 ± 0.08[a]	6.58 ± 0.06[a]
Albumin, g/dL	3.32 ± 0.08[a]	3.45 ± 0.04[a]	3.46 ± 0.05[a]
Globulin, g/dL	2.93 ± 0.04[a]	2.97 ± 0.06[a]	3.11 ± 0.04[a]
Triglycerides, mg/dL	184.28 ± 0.44[a]	182.00 ± 0.83[a]	182.25 ± 0.64[a]
Cholesterol, mg/dL	188.43 ± 0.51[a]	187.60 ± 0.45[a]	186.48 ± 0.44[a]
HDL, mg/dL	70.34 ± 0.60[b]	73.82 ± 0.5[a]	73.72 ± 0.55[a]
*LDL, mg/dL	81.23 ± 0.55[a]	77.38 ± 0.46[b]	76.31 ± 0.4[b]

a and b: Means within the same row with different superscripts are significantly different at P<0.05.

**Formula: LDL = Total Cholesterol - HDL - (Triglycerides/5).*

Economic efficiency:

Economic efficiency data of dietary treatments presented in Table (8). The price of total feed consumed by kids of different experimental groups (G2 and G3) were markedly higher than control (G1), being (1.575, 1.772 ***vs.*** 2.026, respectively). However, addition of vegetable oils to diets reduced feed cost/kg gain to be 18.31 L.E. and 19.97 L.E. for G3 and G2 compared with control ration (G1) (21.0 L.E). , respectively. So, the economic efficiency was better (3.28, 3.0 ***vs.*** 2.86) as a result of supplemented oils (sunflower and linseed) at level 3% of DM intake in diets of growing male Zaraibi goats. Generally, the economic efficiency was improved by 4.89 % and 14.69% with supplement sunflower oil (G3) and linseed oil (G2), respectively, compared with G1 (control).

Table (8): Economical efficiency of kids fed different experimental diets.

Items	Treatment groups		
	G1	G2	G3
Daily body gain, g/h	75.00± 1.32[b]	101.67 ± 1.02[a]	96.67 ± 1.56[a]
Daily feed intake (g/h) as fed:			
From CFM	423	417	420
From BH	295	289	292
Economic efficiency:			
Price of CFM /h /d, (LE)	1.354	1.334	1.344
Price of BH /h /d, (LE)	0.221	0.217	0.219
Price of oil /h /d, (LE)	-	0.475	0.209
Price of total feed consumed (LE)[A]	1.575	2.026	1.772
Feed cost/kg gain	21.0	19.97	18.31
Price of kg gain (LBW×ADBG)[B], (LE)	4.50	6.10	5.80
*****Economic efficiency, % **(B÷A×100)**	2.86	3.00	3.28
******EE relative,	100.00	104.89	114.69

a, b means within the same rows with different superscripts are significantly different (P < 0.05). The prevailing prices, per kg, at time of the study were 3200 L.E. CFM, .750 L.E BH, sunflower 11 L.E/kg and linseed 25 L.E/kg. The selling price was 60 L.E live body weight.

**Economic efficiency (%) = money out put (price of live body weight) ÷ money input (total price of feed consumed) ×100.*

*** EE (%) relative to control with G2 or G3= EE amount of G2 or G3– EE amount of G1÷ EE amount of G1×100 +100 (conceder EE of T1 is 100%).*

Carcass characteristics:

Dressing percentage

The effect of different dietary treatment on hot carcass weight and dressing percentage presented in Table (9). Results show that tested groups (G2 and G3) had significant ($p<0.05$) better performance than control group (G1) in fasting weight, hot carcass and whole prime cuts. Dressing percentages either for carcass with or without offal markedly increased with tested groups (G2 and G3) compared to the control ration (G1), but differences were not significant. Taie *et al*. (1998) and Ahmed (2003) reported that increasing energy content in sheep and goats diet improved dressing percentage. There were significant higher weights and percentages of fasting body, hot carcass and total internal fat for kids fed G2 and G3 than G1.

Meanwhile, whole prime cuts (weight) were significantly ($p<0.05$) higher with tested groups G2 and G3, being 10.91 kg and 9.96 kg, compared with control diet (G1, 8.84 kg), while, prime cuts as a percentage of hot carcass weight were not significantly differed among all experimental diets (Table, 9).

Fat weight in the carcasses significantly increased according to increase of slaughtering weight, meanwhile fat percentages also increased significantly in tested groups compared with those of control one. Regarding fat weights in the carcasses, abdominal fat and total internal fat, and percentage of total internal fat, all were higher ($P<0.05$) in G2 and G3 rations (oil additive) than G1 ration. Some authors reported that conjugated linoleic acid (available in linseed and sunflower oils) identified as a potent modulator and repartitioning agent for fat metabolism. Meanwhile, it can synthesized in the rumen by the biohydrogenation of linoleic and linolenic acids.

Table (9): Carcasses characteristics of slaughtered Zaraibi kids fed the experimental diets.

Items	Treatment groups		
	G1	**G2**	**G3**
Fasting weight, kg	25.67 ± 0.73^{b}	29.17 ± 2.27^{a}	27.83± 1.17^{a}
Empty body weight, kg	21.85 ± 0.42^{b}	26.03 ± 2.15^{a}	23.86 ± 0.81^{a}
Hot carcasses weight, kg*	10.83 ± 0.27^{b}	13.62 ± 0.87^{a}	12.57 ± 0.39^{a}
Hot carcasses weight, kg**	12.08 ± 0.28^{b}	14.94 ± 0.87^{a}	13.93± 0.39^{a}
Dressing percentage % [1]	42.31 ± 1.97^{a}	47.01 ± 1.71^{a}	44.55 ± 0.06^{a}
Dressing percentage % [2]	47.16 ± 1.97^{a}	51.49 ± 1.63^{a}	50.12 ± 0.83^{a}
Prime Cuts, kg	8.84 ± 0.23^{b}	10.91 ± 0.74^{a}	9.96± 0.32^{a}
Prime Cuts, %	81.66 ± 2.36^{a}	80.09 ± 2.14^{a}	79.26 ± 2.06^{a}
Kidney Fat, kg	0.10 ± 0.02^{a}	0.22 ± 0.06^{a}	0.19 ± 0.02^{a}
Abdominal fat, kg	0.19 ± 0.01^{b}	0.53± 0.13^{a}	0.59± 0.06^{a}
Total internal fat, kg	0.29 ± 0.03^{b}	0.75± 0.18^{a}	0.78 ± 0.04^{a}
Total internal fat, %	2.70 ± 0.23^{b}	5.48 ± 1.27^{a}	6.23 ± 0.49^{a}

**Without edible organs* ***With edible organs*

1- (Hot Carcass weight/Fasting body weight) x 100

2-(Hot Carcass weight with edible organs/Fasting body weight) x 100

$^{a--c}$ *Means in the same row with different superscripts differ significantly at ($p<0.05$).*

Carcass cuts

Data of carcass cuts weights (shoulder, legs, loin, rack, neck, brisket and flank) presented in Table (10). The major cuts weights, shoulder, legs and prime cuts, were significantly ($P<0.05$) higher for tested rations (G2 and G3) than control one (G1). Whereas, not all other cuts had significantly affected by experiential rations. Similar trends among treatments found in respect of carcass cuts, as percentage of hot carcass weight.

Actually, shoulder and legs known to have the highest proportion of muscle and the description of the meat potential can done via the muscle/bone ratio (Naziha *et al.*, 2016). The weight of shoulder or legs were close to those reported by Abuelfatah *et al.* (2013) in kids had final body weight of 25.89, 26.21 and 26.00 kg with rations supplemented with linseed oil at 0, 10 and 20 % of dry matter intake. The shoulder tissue composition is a reasonable predictor for carcass tissue composition in kids, thus, in some cases slaughter weight is the main factor influencing carcass composition (Bonvillani *et al.,* 2010). In this study**,** kids fed different levels of oils in rations showed that either shoulder, legs or prime cuts had been affected, which reflected on growth performance and carcass traits. These findings are consistent with study of Roy *et al.,* (2013) conducted on kids and Ferreira *et al.,* (2014). on lambs. Furthermore, Ata *et al.* (2017) concluded that increasing energy level in lambs' diets, during a short fattening period, resulted in increasing growth performance, body length measurements and carcass traits and reduced cost of gain of lambs.

Table (10): Carcass cuts of slaughtered kids fed the experimental diets.

Items	Treatment groups		
	G1	G2	G3
Carcass cuts weights(kg):			
Shoulder	2.46 ± 0.04^{b}	2.90± 0.19^{a}	2.73 ± 0.05^{a}
Legs	3.40 ± 0.09^{b}	4.18 ± 0.25^{a}	3.88 ± 0.09^{a}
Loin	0.62 ± 0.04a	0.78 ± 0.09a	0.68 ± 0.02a
Rack	2.35 ± 0.15^{a}	3.05 ± 0.28^{a}	2.67 ± 0.24^{a}
Neck	1.35 ± 0.04^{a}	1.77 ± 0.20^{a}	1.53 ± 0.05^{a}
Brisket	0.53 ± 0.09^{a}	0.59 ± 0.10^{a}	0.48 ± 0.04^{a}
Flank	0.53 ± 0.09^{a}	0.67 ± 0.13^{a}	0.72 ± 0.16^{a}
Prime Cuts	8.84± 0.23^{b}	10.9 ± 0.74^{a}	9.96 ± 0.32^{a}
Carcass Cuts, as % from hot carcass weight:			
Shoulder	22.75± 0.92^{a}	21.3 ± 0.35^{a}	21.76 ± 0.35^{a}
Legs	31.46 ± 0.66^{a}	30.7 ± 0.21^{a}	30.88 ± 0.31^{a}
Loin	5.75 ± 0.51^{a}	5.7 ± 0.43^{a}	5.41 ± 0.03^{a}
Rack	21.71±1.08^{a}	22.38 ± 1.64^{a}	21.22 ± 1.94^{a}
Neck	12.5 ± 0.39^{a}	12.98 ± 1.10^{a}	12.23 ± 0.61^{a}
Brisket	4.88 ± 0.84^{a}	4.43 ± 0.92^{a}	3.81 ± 0.22^{a}
Flank	4.91±1.02^{a}	4.82 ± 0.62^{a}	5.66 ± 1.10^{a}
Prime Cuts	81.66 ± 2.36^{a}	80.09 ± 2.14^{a}	79.26 ± 2.06^{a}

[a--c] Means in the same row with different superscripts differ significantly at ($p < 0.05$).

The effect of dietary treatments on weights of carcass offal's and organs presented in Table (11). Despite, the fasting weight of kids was significantly higher with treatment diets than control diet; all offal's and organs weights did not significantly affected by treatments. The obtained percentage of all offals (heart, liver, kidney, lungs, spleen and testes) and organs, non-edible parts (head, pelt and feet) presented in Table (12). Results showed that, there are no significant differences among the groups in most organs and offals percentages, but differences lowered significantly for head and feet of tested groups than control. These results are in agreement with those recorded by Ahmed *et al.* (2011); Almintairy *et al.* (2011) and Mona Mohammady *et al.* (2013) who reported that, no significant differences were found between the tested diets and control one in respect of weights of organs and offals of lambs.

Table (11): Weight of different carcasses offals and organs of Zaraibi kids fed the experimental diets.

Items	Treatment groups		
	G1	G2	G3
Head, kg	1.97 ± 0.09[a]	1.87 ± 0.14[a]	2.0 ± 0.08[a]
Pelt, kg	1.91± 0.14[a]	1.99 ± 0.20[a]	1.77 ± 0.06[a]
Feet, kg	0.713 ± 0.035[a]	0.753 ± 0.085[a]	0.727 ± 0.024[a]
Full digestive tract, kg	5.627 ± 0.29[a]	4.980 ± 0.97[a]	6.027 ± 0.75[a]
Empty digestive tract, kg	1.813 ± 0.05[a]	1.84 ± 0.23[a]	2.05 ± 0.35[a]
Heart, kg	0.113 ± 0.007[a]	0.127 ± 0.018[a]	0.120 ± 0.031[a]
Liver, kg	0.420 ± 0.050[a]	0.503 ± 0.048[a]	0.533 ± 0.048[a]
Kidney, kg	0.093 ± 0.007[a]	0.107 ± 0.007[a]	0.093 ± 0.013[a]
Lungs, kg	0.360 ± 0.02[a]	0.373 ± 0.06[a]	0.360 ± 0.03[a]
Spleen, kg	0.033 ± 0.007[a]	0.047 ± 0.007[a]	0.04 ± 0.00[a]
Testes, kg	0.227 ± 0.027[a]	0.160 ± 0.07[a]	0.213 ± 0.018[a]
Total offals, kg[1]	1.25 ± 0.06[a]	1.32 ± 0.16[a]	1.36 ± 0.04[a]

[a--c] Means in the same row with different superscripts differ significantly at (p <0.05).
[1]Total offals (heart, liver, kidney, lungs, spleen and testes) 2-Non-edible parts (head, pelt and feet)

Table (12): Influence of experimental diets on offal of Zaraibi kids as a percentage of fasting weight.

Items	Treatment groups		
	G1	G2	G3
Head, %	1.82 ± 1.12[a]	1.38± 0.67[c]	1.59± 0.46[b]
Pelt, %	1.77 ± 1.69[a]	1.45 ± 0.63[a]	1.41 ± 0.11[a]
Feet, %	6.58 ± 0.26[a]	5.50 ± 0.29[b]	5.78± 0.18[b]
Full digestive tract, %	21.89 ± 0.53[a]	16.89 ± 2.04[a]	21.54 ± 2.12[a]
Empty digestive tract, %	7.08 ± 0.33[a]	6.35 ± 0.65[a]	7.33 ± 1.93[a]
Heart, %	1.05 ± 0.07[a]	0.93 ± 0.12[a]	0.96 ± 0.26[a]
Liver, %	3.86 ± 0.37[a]	3.69 ± 0.20[a]	4.23 ± 0.29[a]
Kidney, %	0.86 ± 0.07[a]	0.78 ± 0.03[a]	0.74± 0.08[a]
Lung, %	3.33 ± 0.27[a]	2.72 ± 0.32[a]	2.87 ± 0.25[a]
Spleen, %	0.31 ± 0.06[a]	0.53 ± 0.05[a]	0.32 ± 0.01[a]
Testes, %	2.11 ± 0.29[a]	1.13 ± 0.49[a]	1.71 ± 0.19[a]
Total offals, %	4.85 ± 0.18[a]	4.49 ± 0.14[a]	4.89 ± 0.21[a]

[a--c] Means in the same row with different superscripts differ significantly at (p <0.05).

Carcass quality and chemical analysis

Data of carcass quality and chemical analysis of the *longismus dorsi* muscle (LD) presented in Table (13). The differences among the experimental rations in respect of weight of ribs cut, percentage of meet fat, bone of rib, bone: fat ratio, meat: fat ratio, meat: bone ratio and LD area were not significant. Moreover, lean % in tested groups 2 and 3 tended to be higher, being 58.21 % and 56.29 % compared with the control group 55.68 %, respectively. So, meat % in ribs of tested groups (G2 and G3) had higher values, 4.5 and 2.2 % more than the control (G1) group. The same trend was observed on fat % among treatments, being 11.15, 12.93 and 12.47 % for G1, G2 and G3, respectively. So that, fat % in ribs of tested groups (G2 and G3) increased by 16.0 % and 11.84 %, respectively than the control (G1) group. On the other hand, bone % in the ribs slightly decreased with tested groups (G2 and G3), being 28.85 % and 31.25 % compared with control group (G1), 31.84 %, respectively. Thereafter, bone % in the ribs decreased with tested groups (G2 and G3), being 9.39 % and 1.85 % less than control rations. Similar results observed by Taie *et al*. (1998) and Ahmed et al. (2011) on sheep and Ahmed (2003) on goats, as they reported that dressing percentage and dissectible fat weight increased with increasing level of energy while bone percentage in carcass decreased.

The chemical compositions (moisture, CP, fat and ash) of longismus dorsi muscle tissues (Table 13) were similar across dietary treatments. The fat percentage (EE), on DM basis, tended to increase in meat of animals fed oils diet (G2 and G3) compared to null-oil control (G1), while CP, moisture and ash percentage slightly decreased (Table, 13). The values of chemical composition of meat in the present study were approximately similar with that reported by Ahmed *et al*. (2011). In this respect, as a rule, goats deposit more visceral fat and less subcutaneous, inter and intra muscular fat compared with sheep and cattle (Roy *et al.*, 2013). They also revealed that the low intramuscular fat in goat meat is concordant with the present day consumers' demands as it responsible of the low juiciness and tenderness of goat meat. This observation is in tandem with previous studies on goats (Roy *et al.,* 2013) and sheep (Ferreira *et al.*, 2014) who identified that most abundant fat in muscle followed dietary oil supplementation. Though fat % of LD muscle were nearly similar, the dietary supplementation of linseed and sunflower oils alter the deposition and distribution of fat in the adipose tissues. These findings could attribute to the similar metabolisable energy content of the diets (Abubakr *et al.,* 2015) which indicate that the muscle fatty acid profile in ruminants is less affected by the dietary fatty acids compared to non-ruminants, thus the different type of diets can affect the fatty acid profile of the meat.

Moreover, the antecedent authors explained that enhancing muscle lipids, the proportion of saturated fatty acids (SFA) are often higher and the poly-unsaturated fatty acids (PUFA)/SFA ratio is lower, because dietary unsaturated fat is hydrogenated in the rumen by the action of rumen microbes. At all events, energy supplied in excess of the basal requirement can increase fat deposition in animals (Naziha *et al.,* 2016). They observed that the major substrate for *de novo* fatty acid synthesis in tissues is glucose thus, energy of the diets capable of promoting glucose supply to the tissues that might increase fat deposition by a gluconeogenic precursor. Generally, dietary fat is a popular mean represent the increase in energy density of diet in ruminant nutrition and can influence adipose depots, improve growth rate and carcass composition (De Brito *et al.,* 2017).

Table (13): Effect of experimental diets on carcasses traits and chemical composition of *longissimus dorsi* muscle

Items	Treatment groups		
	G1	G2	G3
Weight of 9-11 ribs cut, g	262.0 ± 28.92^{a}	244.67 ± 21.11^{a}	264.0 ± 17.01^{a}
Meat % of ribs sample	55.68 ± 0.78^{a}	58.21 ± 4.25^{a}	56.29 ± 3.48^{a}
Fat % of ribs sample	11.15 ± 0.71^{a}	12.93 ± 3.00^{a}	12.47 ± 3.29^{a}
Bone % of ribs sample	31.84 ± 0.14^{a}	28.85 ± 1.81^{a}	31.25 ± 1.63^{a}
Meat: Fat ratio of ribs	5.16 ± 0.39^{a}	5.13 ± 1.43^{a}	5.58 ± 2.09^{a}
Meat: Bone ratio of ribs	1.79 ± 0.03^{a}	2.05 ± 0.28^{a}	1.82 ± 0.16^{a}
L.D area, cm^2	11.87 ± 0.96^{a}	10.69 ± 2.11^{a}	12.27 ± 0.77^{a}
Chemical composition of L.D. (%)			
Moisture	69.15 ± 0.14^{a}	67.21 ± 1.16^{a}	68.07 ± 1.08^{a}
CP	72.67 ± 0.90^{a}	69.98 ± 4.31^{a}	69.62 ± 4.74^{a}
Fat	19.33 ± 2.76^{a}	26.48± 3.49^{a}	25.34 ±4.89^{a}
Ash	4.33 ± 0.64^{a}	3.27 ± 0.17^{a}	3.1 ± 0.25^{a}

$^{a--c}$ *Means in the same row with different superscripts differ significantly at (p <0.05).*

CONCLUSION

It could conclude that adding linseed or sunflower oils, at level 3% of DM intake to ration, could have a positive effect on improving daily body gain of Zaraibi male goats. Moreover, feed utilization and economic efficiency could noticeably improve, without any adverse effects on metabolic parameters (of rumen and blood). Meanwhile, these additions could improve fasting weight, hot carcass, dressing % and whole prime cuts.

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الملخص العربى

أداء النمو وكفاءة تحويل الغذاء وبعض قياسات الكرش والدم والكفاءة الاقتصادية وصفات الذبيحة في ذكور الماعز الزرايبى المغذاة على علائق تحتوى على زيت بذور الكتان ودوار الشمس.

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أجريت هذه الدراسة في محطة بحوث الإنتاج الحيواني بالسرو- التابعة لمعهد بحوث الإنتاج الحيواني - مركز البحوث الزراعية.

واستهدفت هذه الدراسة معرفة تأثير إضافة زيت بذور الكتان وزيت دوار الشمس بمستوى 3% من مقدار المادة الجافة المأكولة لكل منهما في علائق الماعز الزرايبى على أداء النمو وكفاءة تحويل الغذاء وبعض قياسات الكرش والدم والكفاءة الاقتصادية وصفات الذبيحة في ذكور الماعز الزرايبى.

ولتحقيق هذا الهدف تم استخدام عدد 15 ذكر ماعز زرايبى نامي بمتوسط وزن 17062± 0.19 كجم وعمر 5 شهور قسمت تبعا للوزن إلى ثلاثة مجموعات متساوية (5 لكل مجموعة). غذيت المجموعة الأولى على (عليقه المقارنة) والتي تتكون من 60 % من العلف المركز + 40 % دريس البرسيم طبقا لمقررات NRC (1981) ، أما المجموعة الثانية فغذيت على عليقه المقارنة مضاف إليها 3% زيت بذور الكتان من مقدار المادة الجافة الكلية المأكولة بينما المجموعة الثالثة فغذيت على عليقه المقارنة مضاف إليها 3% زيت دوار الشمس من مقدار المادة الجافة الكلية المأكولة واستمرت معاملات تغذية التجربة لمدة 120يوم وكانت أهم النتائج المتحصل عليها كالتالي:-

أظهرت المجوعتين الثانية (29.80 كجم) ، والثالثة (29.30 كجم) ارتفاعا في وزن الجسم الحي عند مقارنتها بمجموعة الكنترول (26.68 كجم) في نهاية التجربة وبنسبة زيادة حوالي 11.69% ، 9.82% للمجموعة الثانية والثالثة على التوالي عن مجموعة الكنترول. وعليه فقد حققت المجموعة الثانية والثالثة اعلي معدل نمو يومي 101.67 ، 96.67جم/يوم على التوالي وبفروق معنوية عن مجموعة الكنترول 75.0 جم/يوم وبقدر تحسين حوالي 35.56 % ، 28.89 % لمجموعتي المعاملة الثانية والثالثة مقارنة بمجموعة الكنترول.

وبالنسبة لكفاءة التحويل الغذائي محسوبة أساس المادة الجافة كانت أفضل مع المجموعة الثانية (6.25) ، ثم المجموعة الثالثة (6.62) بينما سجلت الأسوأ مع مجموعة الكنترول (8.60) على التوالي. أيضا بالنسبة لكفاءة التحويل الغذائي محسوبة أساس البروتين الخام كانت أفضل مع المجموعة الثانية والمجموعة الثالثة وحققت تحسين تقريبا بحوالي 27.75 % ، 23.63 % على التوالي مقارنة مع مجموعة الكنترول.

لذلك كانت الكفاءة الاقتصادية الأفضل للمجموعتين الثالثة والثانية وبنسبه 4.89% ، 14.89%مقارنة بمجموعة الكنترول.

أظهرت النتائج انخفاض المأكول اليومي عندما كان منسوبا لحيز الجسم التمثيلي مع مجموعتي إضافة الزيت وسجلت القيم 63.09 ، 60.06 & 59.12 جم /كجم حيز جسم تمثيلي للمجموعة الأولى والثالثة والثانية على الترتيب.

فيما يتعلق بقياسات سائل الكرش، فقد لوحظ أن تأثير العلائق التجريبية الثلاثة على حموضة سائل الكرش الأحماض الدهنية الطيارة كان غير معنويا، في حين ارتفع معنويا كلا من آمونيا سائل الكرش والبروتين الميكروبي بعد الأكل مع المجموعة الثانية والثالثة مقارنة بالكنترول.

أما فيما يتعلق بتأثير العلائق التجريبية الثلاثة على صفات الذبيحة فوجد تأثير معنوي لمجموعتي المعاملة المجموعة الثانية والثالثة على وزن الذبيحة والوزن الساخن والقطعيات الرئيسية بالمقارنة بمجموعة الكنترول.كما لوحظ زيادة في نسبة التشافى ومعظم قياسات وتركيب الذبيحة.

وعلى ضوء النتائج المتحصل عليها من الدراسة يستنتج أن إضافة زيت بذور الكتان وزيت دوار الشمس بمعدل 3% من المادة الجافة المأكولة له تأثير معنوي وتحسن على أداء النمو والكفاءة التحويلية للغذاء والكفاءة الاقتصادية وبعض صفات وجودة الذبيحة وان زيت دوار الشمس حقق كفاءة اقتصادية أفضل من زيت الكتان وذلك في ذكور الماعز .