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Effect of different oils on growth performance and carcass traits in growing rabbits

El-Medany, Sh. A.; W.H. El-Reffaei and Shereen. A. Nada
Regional Center For Food and feed, Agric. Res. Center, Giza, Egypt.

ABSTRACT

The present study was conducted to evaluate the effect of diet supplemented with different oils on growth performance carcass of growing rabbits. Total numbers of 50 weaned male growing New Zealand White rabbits, of four weeks old with an average initial body weight 455.6 g were used in this study. Rabbits were randomly distributed into five comparable groups of 10 growing rabbit. The animals were housed in cages provided with continues feeder and automatic water facilities during the experimental period, which lasted for 6 weeks. Rabbit groups were fed commercial rabbit diet without additive (control, group 1), with 10 g canola oil/kg diet (group 2), with 10 g rice barn oil /kg diet (group 3), with 10 g virgin olive oil /kg diet (group 4) with 10 g sunflower oil /kg diet (group 5). Growth was assessed by measuring body weight gain (BWG). At 10 weeks of age three animals from each group were slaughtered for carcass evaluation. Results showed that the effect of different diet supplemented oils on body weight gain was significant. The highest improvement in average daily gains during the study was 13.8% in Canola oil group as compared with control group followed by 11.3 %, 8.5 % and 3.9 % for Virgin olive oil, Rice barn oil and Sunflower oil respectively, as compared with control group. Treatment with different diet supplemented oils significantly increased the dressing percentage. The meat contents of vitamins E and A were enhancement by oil supplementation. Plasma cholesterol and Triglyceride were lowered significantly in oils supplemented groups as compared with control group. The differences between groups were significant in high-density-lipoprotein cholesterol (HDL-C) and low density lipoprotein cholesterol (LDL-C). Physical meat characteristics, as moisture and ash were nearly similar for the different groups. Virgin olive oil group showed significantly ($P<0.05$) highest protein content followed by canola oil, rice barn oil and sunflower oil while control group had the lowest protein content. Control group showed significantly ($P<0.05$) highest ether extract content, however virgin olive oil had the lowest content.

Keywords: Oils, Rabbits, Growth performance, Carcass characteristics and blood biochemistry

INTRODUCTION

Modern nutritional methods of altering the functional properties of meat include mainly the modification of the composition of fatty acids in depot and intramuscular fat aiming at increasing the proportion of mono- and polyunsaturated fatty acids (MUFA and PUFA) while reducing the share of undesirable saturated fatty acids (SFA). Dietary supplementation with different vegetable oils or animal fats has been investigated in previous studies, with varying results regarding, the performance and carcass quality (Benz *et al.*, 2011 and Olivares *et al.,* 2009). When growing animals are given vegetable oils rich in MUFA and PUFA, they use them to synthesize their own adipose tissue (Hanczakowski, 2003). It has been shown that fat deposition in the carcass may be influenced by the degree of fat saturation, genotype

and gender (Averette Gatlin *et al.,* 2003 ؛ Olivares *et al*., 2009). Vegetable oils sources, such as canola oil , virgin olive oil,rice barn oil and sunflower oil may clearly increase the n-3 FA content in the form of linolenic acid, which enhance the conversion to longer chain n-3 FA to increase the nutritional quality of poultry meat. The results of different insignificant related to effective recommendation that diet should contain about 30% of calories as fat made up of less than 10% saturated fatty acids, and they consider vegetable oils such as (Dupont *et al.,* 1989), virgin olive oil (Pharmaceutical index 1979) and Connoer *et al.,* (1986). Researchers found also that canola oil and virgin olive oil reduced total serum cholesterol, low-density lipoprotein and the ratio between low-density and high-density lipoprotein cholesterol to the same extent in hyperlipidemic patients. However, there was a slightly greater decrease in low-density lipoprotein cholesterol with the diet containing rapeseed (canola) oil than with the virgin olive oil diet, sunflower and soybean were rich also in n-6 fatty acid series (Pigot and Tucker,1990). Sunflower seed oil was found to be excellent source of essential fatty acids such as oleic acid and linoleic acid required by the human body (Flagella, *et al.,* 2002). The advantage of sunflower seed oil is its higher oxidative stability than oils low in oleic acid, which is desirable for refining and storage (Ansari *et al.*, 2009).Also Components of Rice bran oil were included fatty acids, triterpene alcohols, phytosterols, tocotrienols, and α-tocopherol (Cicero and Gaddi, 2001). Of these components, phytosterols including gamma oryzanol are thought to be responsible for changes in blood cholesterol concentrations (Vissers *et al*., 2000 However low-density lipoprotein cholesterol, and triglyceride concentrations decrease when Rice bran oil is added to the diet (Wilson *et al.,* 2000; Cicero and Gaddi, 2001; Berger *et al.,* 2004).

There for the present study was condected to determine the effect of adding each of canola oil, virgin olive oil, Rice barn oil and sunflower oil to the diet on growth performance and carcass traits of growing rabbits

MATERIALS AND METHODS

Animals and diets

Fifty male New Zealand white rabbits, of four weeks of age and 455.6 gm average live body weight were randomly distributed into five comparable groups; each of 10 kids. All experimental animals were housed in individual cages provided with continues feeders and automatic waters during the experimental period lasted for 6 weeks. Rabbits groups were fed commercial rabbit diet without additive (control, group 1), or with 10 g canola oil/kg diet (group 2), or with 10 g rice barn oil /kg diet (group 3), or with 10 g virgin olive oil /kg diet (group 4) or with 10 g sunflower oil /kg diet (group 5). Chemical analysis showed that the commercial diet contained 7.65% moisture, 16.85% crude protein, 2.5 ether extract, 12.9% crude fiber, 51.4% nitrogen free extract (NFE) and 8.7% ash. The experimental diet covered nutrients requirements for growing rabbits as recommended by NRC (1977). Oils sprayed over the pellets, in every other day interval .During the 42-day growth trial period, animals were weighed individually at weekly intervals.

Blood samples were withdrawn from the ear vein of animal in a heparinzed syringe and put in a vacatainer tube under cooling until reaching to the laboratory. The plasma was carefully separated after centrifugation and stored at -20 ^{o}C for biochemical analysis. Total cholesterol and Triglyceride were determined according to Rifai *et al.,* (1999). Cholesterol LDL was determined according to Nauck *et al.,* (2002) and Cholesterol HDL was determined according to Grove *et al.,* (1979)

Slaughter and Carcass Traits:

At the end of the experimental period (at 10 weeks of age) three animals from each experimental group selected at randam and slaughtered according to the Islamic rols using the procedure described by Abou-Ashour and Ahmed (1983). Rabbits were weighed just before slaughter and carcass after complete bleeding, then head, giblets (heart, liver and kidneys) and hot carcasses were weighed. And the dressing percentage was calculated. For meat composition traits, all carcasses were divided longitudinal to two similar halves. Lean samples from different carcass parts as a percentage of the carcass in the animal are mixed for chemical analysis.

Determination of vitamin E and TBARS

Vitamin E(α –tocopheryl) in rabbit meat were assayed using HPLC, according to leth and sondergaro (1983). For determining the rate of lipid peroxidation of meat, the thio-barbituric acid-reactive substance (TBARS) test was carried out using three meat samples of each treatment according to AOAC (1990).

Statistical analysis

Data were subjected to a one-way analysis using SAS (1996). Variables having significant differences were compared using Duncan's Multiple Range Test (Steel and Torrie, 1960).

RESULTS AND DISCUSSION

Growth Performance Traits:

Data in table (1) and figure (1) represent the rabbit performance as affected by supplemented oils. Differences between the body weights of the experimental groups statistically were significant. The final body weights were 1608, 1766, 1706, 1736 and 1644 gm for control group, Canola oil, Rice barn oil, Virgin olive oils and Sunflower oil respectively. It could be noticed that average daily gains followed the same trend of the body weight being higher for rabbits treated with oils supplemented than control group. The highest improvement in average daily gains during the present study was 13.8% in Canola oil group followed by 11.3 %,8.5 % and 3.9 % for Virgin olive oil, Rice barn oil and Sunflower oil, respectively, as compared with control group .For comparison , similar results were recorded by Kannan *et al.,* (2013) that broilers fed with diet containing 2% or 4% sunflower had better body weight gain than control group .Also, Frank *et al.,* (2005) found that body weight increased ($p< 0.014$) by 5% Rice bran oil supplemented to mare. Morover, Youcef *et al.,* (2013) reported that diet supplemented with virgin olive oil increased body weight in rats .Morover Dewitt *et al*., (2009) Rahimi *et*

al.,(2011) and Habib *et al.,* (2011) reported significant effect of feeding canola oil on body weight in birds .The improvement in body weight of groups supplemented with oil than control group explained by Lesson and Atteh (1995) that may be oils supplementation that increase the absorption and the digestion of lipoproteins, significance necessary amount of fatty acids and assist vitamin A, vitamin E and Ca absorption. Also supplemented diet with sunflower oil lead to improve feed conversion (Dewitt *et al*., 2009). However , the highest improvement found in feeding canola oil may be due to its contains of free fatty acids, unsaturated fatty acids (such a linolenic acid) and omega-3 fatty acids with has main effect on optimum lipid metabolism and subsequent body weight (Taylor, 2000). Moreover, Rahimi *et al*.,2011 found that the highest level of essential fatty acids, unsaturated fatty acids and mal absorption of fatty acids in canola oil can play a major role in feed conversion ratio with reduces the rate of feed passage through the digestive system, which allows a better absorption of all nutrients in the diet .

Table (1): Effect of oils supplemented rations on body weight and daily gain in male NZW rabbits

All values are means of ten values, Values in each raw bearing different letters are significantly (p<0.05) different

Items	Control group	Canola oil group	Rice barn oil group	Virgin olive oil group	Sunflower oil group	SE	probability
Animal number	10	10	10	10	10		
Initial Body weight (gm) (4^{th} weeks of age)	456.8	455.5	457	455	454	23.4	NS
Final body weight(gm) (10^{th} weeks of age)	1608^{d}	1766^{a}	1706^{b}	1736^{ab}	1644^{c}	60.3	P<0.05
Total body gain (from 4^{th} to 10^{th} week)	1151.2^{d}	1310.5^{a}	1249.0^{b}	1281^{ab}	1190^{c}	38.2	P<0.05
daily gain (gm)	27.4^{d}	31.2^{a}	29.73^{b}	30.5^{ab}	28.33^{c}	1.2	P<0.05

Blood plasma biochemical response of rabbits supplemented oils

The results of biochemical blood plasma of New Zealand white male rabbits are presented in table (2) .Plasma cholesterol level was significantly decreased by 30.5, 15.2 , 29.1 and 16.6 % in canola oil, rice barn oil , virgin olive oil and sunflower oil related to control group. The improvement cholesterol level in feeding rice barn oil (group 3) explained by the effect of to components of rice barn oil including fatty acids, triterpene alcohols, phytosterols, tocotrienols, and *α*-tocopherol (Cicero and Gaddi, 2001). In addition to these components, the phytosterols including gamma oryzanol are thought to be responsible for changes in blood cholesterol concentrations (Vissers *et al.,* 2000). The result reported by Kannan *et al.,* (2013) showed that diet containing 2% or 4% sunflower oil lead to decrease broilers plasma cholesterol level. Also Jose *et al.,* (2000) found that, the administration of dietary virgin olive oil to rabbits reduced serum cholesterol. Also It diet with rice bran oil is recommended for the treatment of hyperlipemia in humans due to itseffect in reduce plasma total cholesterol (Frank *et al.,* 2005) .Generally the blood plasma triglyceride concentration followed the same trend of cholesterol concentration to be lower for rabbits fed diet with supplemented oils than control group.

Table (2): Effect of oils supplemented rations on blood parameters of NZW rabbits

Plasma parameters	Control	Canola oil group	Rice barn oil group	Virgin olive oil group	Sunflower oil group	SE	probability
Triglyceride (mg/dl)	76^{a}	56^{c}	65^{b}	57^{c}	63^{b}	2.52	P<0.05
Total Cholesterol (mg/dl)	72^{a}	50^{c}	61^{b}	51^{c}	60^{b}	1.74	P<0.05
HDL (mg/dl)	27^{c}	34.6^{a}	31^{b}	33^{a}	29^{c}	0.74	P<0.05
LDL(mg/dl)	41.5^{a}	12^{c}	25.4^{b}	14.3^{c}	27.5^{b}	0.96	P<0.05
VLDL(mg/dl)	3.5	3.4	3.6	3.7	3.5	0.11	Ns

All values are means of ten values, Values in each raw bearing different letters are significantly (p<0.05) different

Similar result showed that the triglyceride concentration was decreased if oil was added to the diet (Wilson *et al*., 2000; and Berger *et al*., 2004). Increasing dietary fat intake lowers plasma triglyceride concentrations (Geelen *et al.,* 1999, 2001; Frank *et al.,* 2004). Blood plasma LDL concentrations (table 2) were 40, 12, 26, 15 and 27 mg /dl for control group, canola oil, rice barn oil, virgin olive oils and sunflower oil respectively. Similar results showed that rice bran oil cause decreased low-density lipoprotein cholesterol concentrations in human when this oil is added to the diet (Cicero and Gaddi, 2001). The highest decrease of LDL cholesterol concentration in blood plasma in the case of feeding diet with canola oil group 2, to the effect of canola oil in prevent the accumulation of LDL cholesterol by enriching the monounsaturated fatty acid (oleic acid) as well the unsaturated fatty acids (61%)which consider to heart-friendly acids (Denekbasi and Karayücel, 2010). The effect feeding diets with examined on HDL were significant (table 2) , the highest value of 35 mg/ dl was found in canola oil group was followed by 33, 31 , 29 and 27 mg /dl for virgin olive oil , Rice barn oil ,

Sunflower oil and control, respectively. In this respect Jose *et al.,* (2000) who found that rabbit fed with diet supplemented virgin olive oil increased HDL-cholesterol. Also Frank *et al.,* (2005) recorded similar results with mares fed diet with rice barn oil to improve plasma HDL concentration by 15% as compared with control group. However , the present results showed that The difference between groups was insignificant in the case of VLDL cholesterol content (table 2)

Carcass characteristics and chemical analysis

Carcass traits of rabbits for different groups are shown in Table (3). There were significant differences (P<0.05) in the final live body slaughter and carcass weights among the different groups. It could be noticed that The canola oil group showed the highest final live body slaughter and carcass weights (1760 and 1128.2 gm, respectively), in the other side the control group showed the lowest final live body slaughter and carcass weights (1600 and 985.6 gm respectively) .Also , the carcass traits of Fore part, Middle part , Hind part, liver, kidneys, hearts, lungs and heads were nearly similar for the different groups. The dressing percentage revealed the same trend of final live body slaughter and carcass weight, when showed significantly (P<0.05) highest dressing percentage of canola oil group followed by Virgin olive oil , Rice barn oil and Sunflower oil groups in the same trend the control group had the lowest percentage . nearly similar results were obtained by Ali *et al.,* (2011) that dietary supplementation with different levels of sunflower oil, canola oil and soybean oil improved the performance, carcass traits and amount of meat vitamin E content in broiler chicks. They reported that in canola oil improvet feed intake and feed conversion ratios in the broiler chicks

Table (3): Effect of oils supplemented rations on carcass traits in male NZW rabbits

Carcass traits	Control	Canola oil group	Rice barn oil group	Virgin olive oil group	Sunflower oil group	SE	probability
Animal number Slaughters body weight (g)	3 1600 ^{c}	3 1760 ^{a}	3 1700 ^{b}	3 1730 ^{ab}	3 1620 ^{c}	56.1	P<0.05
Hot carcass weight (g)	985.6 ^{c}	1128.2 ^{a}	1067.6 ^{b}	1093.4 ^{ab}	1009.3 ^{c}	44.3	P<0.05
Dressing (%)	61.6 ^{c}	64.1 ^{a}	62.8 ^{c}	63.2 ^{ab}	62.3 ^{c}	1.06	P<0.05
Fore part (%)	15.6	16.4	16.0	16.35	15.8	0.52	Ns
Middle part (%)	12.0	12.6	12.21	12.2	12.3	0.22	Ns
Hind part (%)	19.0	20.07	19.52	19.3	19.08	0.6	Ns
Head (%)	10.0	10.1	10.05	10.3	10.06	0.3	Ns
Liver (%)	3.1	3	3.06	3.02	3.05	0.11	Ns
Kidney (%)	0.71	0.78	0.77	0.82	0.77	0.02	Ns
Heart (%)	0.34	0.32	0.33	0.37	0.36	0.01	Ns
Lung (%)	0.85	0.83	0.86	0.84	0.88	0.03	*Ns*

All values are means of three values, Values in each raw bearing different letters are significantly (p<0.05) different

The chemical analysis(table 4) showed that oils supplemented had effect on CP and EE% in rabbit meat. Similar results were observed by Kannan *et al.,* (2013) that, the lowest abdominal fat yield was recorded in broilers fed with sunflower oil based diet. Also results of Fouladi *et al.,* (2011) showed that canola at in levels of 4% and 2% significantly decrease the abdominal fat deposition ($p<0.0001$) in Japanese quail .This enhancement decrease carcass fat reduction might be due to Omega-3 fatty acids present in the canola oil, in other word docosahexaenoic (DHA) and eicosapentaenoic acids (EPA) which reduce fat deposition by reduction of circulating very low density lipoprotein levels and is effective for decrease of fat accretion in arteries, tissues and carcass (Yang *et al*., 2000). Moreover, Lopez-Ferrer *et al*. (2001) added that reduction in fat deposition , it might be related to synergistic effects of fatty acid content of these oils, and the higher amount of metabolizable energy present in unsaturated fatty acids of oil sources, furthermore, it seems that the lower fat deposition was due an increased rate of lipid catabolism and a decrease rate of fatty acid synthesis.

Vitamins E content of the meat

Table (4) showed the vitamin α-tocopherol concentrations in rabbit meat. Rabbits fed diet supplemented with different oils had increased significant accumulation of α-tocopherol in meat comparable with control group. The highest improved of α-tocopherol in meat was 47.8 % in Canola oil group followed by 39.1 % , 34.7 % and 21.7 % for Virgin olive oil, Rice barn oil and Sunflower oil groups respectively, as compared with control group. This improvement of α-tocopherol concentration in meat rabbits of supplemented with oils coud be explained by the rich in sources of fat soluble vitamins,in the oils . The increase of α-tocopherol concentration of the muscles depends on the increase in the α-tocopheryl acetate level of the diet (Lopez-Bote *et al*., 1997, Castellini *et al*., 1998, Botsoglou *et al*., 2004 and Lo Fiego *et al.,* 2004)

Lipid oxidation of the rabbit muscle (TBARS)

The present results inducated to a significant effect due to fat inclusion in the diet was found. Muscles from rabbits fed diets not enriched with fat had higher susceptibility to lipid oxidation (P <0.05) and higher concentration of (n-3) fatty acids in polar lipids (*P.* 0.04) than those from rabbits fed fat-enriched dietsLipid oxidation of the rabbit muscle (TBARS) is illustrated in Table 4. It was found that TBARS values were lowered ($P<0.01$) by the supplementation of oils, especially in canola oil and olive oil groups. Similar results were reported by Youcef *et al,* (2013) Virgin olive oil as an antioxidant agent, ameliorated oxidative injury in the tissues and functional deterioration. Rabbits that received sunflower oil had higher concentrations of thio-barbituric acid reactive substances than rabbits that consumed virgin olive oil ($P<0.05$).. Inclusion of oils rich in oleic (virgin olive oil) or linoleic acid (sunflower oil) in rabbit diets reduces lipid oxidation in muscles (Clemente *et al*., 1997). Moreover dietary supplementation with olive oil reduced lipid peroxidation and favored tissue antioxidant defense mediated by the glutathione system (Jose *et al*., 2000). The negative correlation between the α-tocopherol content of the muscle and the rate of lipid oxidation (TBARS value) as was found in present study is supported by previous studies of

Lopez-Bote *et al*. (1997), Castellini *et al*., (1998), Oriani *et al*. (2001), Botsoglou *et al*. (2004), and Lo Fiego *et al*. (2004), where vitamin E increased the oxidative stability of muscular lipids, or in other terms, delayed lipid oxidation. The effect of vitamin E was possible due to quenching of free radicals originating from lipid oxidation (Machlin and Bendich, 1987).

Table (4): Effect of oils supplemented rations on chemical analysis of meat, α tocopherol and TBARS in rabbit meat

All values are means of three values, Values in each raw bearing different letters are significantly (p<0.05) different

Conclusion

It was concluded that dietary supplementation of canola oil, rice barn oil, olive oil and sunflower oil can improve the growth performance, carcass traits, blood biochemistry and amount of meat Vitamin E content in growing rabbit.

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تأثير الزيوت المختلفة على أداء النمو و صفات الذبيحة والكمياءالحيويـــة للـــدم في الأرانب النامية

شوقى احمد الميدانى – وائل حلمى موسى الرفاعي – شيرين عباس صادق
المركز الإقليمي للأغذية والأعلاف ، مركز البحوث الزراعية، الجيزة، مصر .

قد إجريت هذه الدراسة لتقييم تأثير الزيوت المختلفة على أداء النمو و وصفات الذبيحة والكمياءالحيوية للدم في الأرانب النامية وتم إستخدام عدد ٥٠ارنب ذكرمفطوم من النوع النيوزيلاندى الابيض ،على عمر أربعة أسابيع من العمر بمتوسط وزن الجسم الأولي ٤٥٥.٦ جرام. وتم توزيع الأرانب عشوائيا إلى خمس مجموعات مماثلة من ١٠ارانب. الحيوانات الموجودة في مكان متوفر لها التغذية باستمرار ومزود لها نظام مائى اتوماتيكى للشرب خلال فترة التجربة والتي استمرت لمدة ٦ أسابيع. المجموعة الاولى غذيت على العليقة التجارية بدون أى إضافات وإستخدمت للمقارنة والمجموعة الثانية غذيت على العليقة التجارية مزودة 10جرام زيت الكانولا / كيلو جرام علف و المجموعة الثالثة غذيت على العليقة التجارية مزودة 10جرام زيت جنين الارز / كيلو جرام علف والمجموعة الرابعة غذيت على العليقة التجارية مزودة 10جرام زيت الزيتون البكر / كيلو جرام علف و المجموعة الخامسة غذيت على العليقة التجارية مزودة 10جرام زيت دوار الشمس / كيلو جرام علف خلال فترة التجربة .

وإجرى تقييم النمو من خلال قياس وزن الجسم المتزايد (BWG)اسبوعيا خلال فترة التجربة . وعند عمر ١٠ أسابيع تم اخذ ثلاثة حيوانات من كل مجموعة لتقيم صفات الزبيحة . وأظهرت النتائج أن تأثير إضافة الزيوت على الزيادة في وزن الجسم كان معنوى . كان متوسط الزيادة اليومية أثناء الدراسة ٢٧.٤ و ٣١.٢ ، ٢٩.٧٣ و ٣٠.٥ و ٢٨.٣٣ جم للمجموعة ١ ، المجموعة ٢ ، المجموعة ٣ ، ٤ المجموعة و المجموعة ٥ على التوالي . المعاملة بالزيوت حسنت نسبة التصافي مقارنة مع مجموعة المقارنه (المجموعة الاولى). محتوي اللحوم من الفيتامينات E زاد بالتغذية على الزيوت .وكذالك. يتم خفض الكوليسترول و الترايجلسريد بنسبة كبيرة مع مجموعات ٢،٣،٤ ، و ٥ بالمقارنة مع مجموعة المقارنه. و تأثير المعاملة بالزيوت على الكولسترول العالى الكثافةHDL- C وكوليسترول منخفض الكثافة LDL- C ، ومنخفضة جدا كثافة الكوليسترول (VLDL -C) كبيرة. , كانت الخصائص الفيزيائية للحوم مثل الرطوبة و الرماد في اللحوم كانت مماثلة تقريبا لمختلف المجموعات . وأظهرت المجموعة ٢ معنويا (P < ٠.٠٥) أعلى محتوى البروتين تليها G4 و G5 ، بينما كان G1 محتوى أقل . وأظهرت المجموعة ١ معنويا (P < ٠.٠٥) أعلى محتوى مستخلص الأثير ، ومع ذلك كان G2 أقل المحتوى.

قام بتحكيم البحث

أ.د / فايق حسنى حسين فراج — كلية الزراعة –جامعة المنصورة
أ.د / فاروق عبد الله السيد خليل — كلية الزراعة –جامعة عين شمس