Influence of different levels of linseed oil supplemented diet on growth performance, carcass quality, lipid profile and efficiency of immunity in broilers.

Hegazi, S. M(1), Sakr,O.A(2)., and Alkereedy, A.M., (3)

1- Professor and head of Nutrition and nutrition deficiency diseases and vice president of. kafr el sheikh University

2- Department of biochemistry, nutritional deficiency diseases and toxicology Animal Health research Institute kafr el sheikh

3- Department of biochemistry , nutritional deficiency diseases and toxicology Animal Health research Institute kafr el sheikh

Abstract

The present work was carried out to study the effect of supplementation of the broiler diets with three levels of linseed or sunflower oils (1.5%, 3%, 4.5%)on growth performance, carcass quality, lipid profile and immunity against Newcastle disease. The results revealed that final live body weight, body weight gain, relative growth rate and feed conversion ratio were improved significantly by using linseed oil. Carcass traits results showed that no significant difference between all groups in dressing percentage, Leg and breast muscles. However, there were significant decrease in abdominal fat by using linseed oil when compared with the groups received the same levels of sunflower oil. Serum traits demonstrated that serum total cholesterol, low density lipoprotein (LDL) and serum triglycerides were significantly reduced by using linseed oil. Haemagglutination inhibition test indicated that both of sunflower and linseed oil increased efficiency of immunity against Newcastle disease vaccine .

Key words: *Omega 3 , growth , carcass traits , lipids profile , immunity .*

Introduction

Polyunsaturated fatty acid (PUFA) rich oils play an important role in animal nutrition. Broiler chicken can provide an excellent alternative source of polyunsaturated fatty acid (PUFAs), because poultry meat is naturally low in fat content and rich in PUFAs. For this reason, many studies are directed towards the manipulation of the fatty acid composition of broiler chick diets. The best n^{-6} super script/n^{-3} ratio from a human health aspect was detected by the linseed oil and cod liver oil supplementation (**Bartos *et al*., 2004).** Linseed supplementation lowered the cholesterol content of broilers meat **(Szewczyk *et al*., 2006**). While, elevated plasma high-density lipoprotein (HDL) levels has been associated to a reduction in cardiovascular risk, dietary fish oils rich in omega-3 PUFAs may protect against this disease. The protective effect of HDL is associated to its participation in the reverse cholesterol transport pathway **(Morgado *et al*., 2005)**. The n^{-3} long chain PUFAS have been reported to have beneficial effects on cardiovascular functions, but their role in relation to immune functions is still controversial (**Turini *et al*., 2001)** and had the largest decrease in plasma triglycerides **(Schumann *et al*., 2000)**.

El-Yamany *et al*. (2008) studied the effect of using different levels and sources of oils (1.5, 2 or 3%) of (PUFA) from Linseed oil, sunflower oil and olive oil in growing Japanese quail diets. They found significantly higher ($P<0.05$) body weight, live weight gain, feed intake and higher economic efficiency (expressed as percentage net revenue/feed) cost compared to the control diet while an insignificant effect was recorded on both edible giblet (gizzard, liver and heart) and yield percentages. Moreover, **Osek *et al*. (2008)** used 2, 3, 4, 6% interchangeable mix of soybean and linseed oils in the diet of broiler chickens. They found that,

the highest final body weight in chickens fed oil mix contain 3% linseed oil and were characterized by the highest slaughter performance and their carcasses had the best fleshing and the least fat as well as there was an increase in the level of linolenic acid (by 4-14 times) in the muscles of chickens as compared with control.

Calder (2001) reported that the immunological effects of large amounts of omega 3 PUFAs might be useful as therapies for diseases characterized by immune dysfunction.

The main goal of our experiment was to investigate the influence of different levels of omega 3 rich source oil on growth performance, carcass quality, lipid profile and immune efficiency of broiler chicks.

Materials and Methods

2.1. Experimental Birds:

Total of 180 one day old Cub Chicks were obtained from the General Egypt Poultry Organization to be used in this experiment. They were divided into 6 equal groups,each group subdivided into 3 replicates. Each replicate housed in a separate compartment. Each compartment was bedded by fresh clean wood shave forming a deep litter of 4 cm depth and changed every week and provided with continuous lightening program, suitable feeder and drink and adjusted to the recommended temperature and humidity.

Prophylactic antibiotics and vaccination program against the most common infectious bacterial and viral diseases were carried out.

Table (1). Vaccination program of broiler chicks against Newcastle disease .

Age of bird (Days)	Vaccine	Route of vaccination
7	Hitchner	Eye drop
18	Lasota	Eye drop
28	Lasota	Eye drop

2.2 Experimental diets and feeding design:

The diets for different experimental groups were formulated as two phase program (starter and grower) according to NRC (1994) for broiler (table 2), and the applied experimental feeding design according to the level and oil source (table 3).

Table (2). Experimental feeding program :

Physical composition	(0 - 3) weeks			(3 - 6) weeks		
	Diet 1	Diet 1	Diet 3	Diet 4	Diet 5	Diet 6
Oil	1.5	3	4.5	1.5	3	4.5
Yellow corn	60.968	57.159	53	67.503	63.721	59.5
Soybean meal 44%	16	22.5	29.227	15	21.5	29
Corn glutine 62%	17	13	9	12	8	3.427
Dicalcium phosphate	1.9	1.8	1.8	1.4	1.3	1.3
Lime stone	1.3	1.3	1.3	1.4	1.4	1.3
Lysine	0.336	0.212	0.08	.297	.172	.029
Methionine	0.0355	0.069	0.1	-	.007	.044
Choline 50%	0.26	0.26	0.26	0.2	0.2	0.2
Common salt	0.4	0.4	0.4	0.4	0.4	0.4
Premix	0.3	0.3	0.3	0.3	0.3	0.3

Chemical composition %						
ME Kcal/kg*	3192.95	3211.22	3205.34	3200.69	3208.91	3220.7
Crude protein	23.179	23.09	23.09	20.125	20	20.03
Calcium	1	1	1	.9	.9	.9
Available phosphorus	0.45	0.45	0.45	0.35	0.35	0.35
Lysine	1.1	1.1	1.10	1	1	1
Methionine + cystine	0.9	0.9	.9	.72	.72	.72
Choline	1300mg/kg	1300mg/kg	1300mg/kg	1000mg/kg	1000mg/kg	1000mg/kg

The diets were formulated according to **N.R.C. (1994)**

** The used premix (*Multivita Co.*) composed of vitamin A 12000000 IU, vitamin D_3 2200000 IU, vitamin E 10000 mg, vitamin K_3 2000 mg, vitamin B_1 1000 mg, vitamin B_2 5000 mg, vitamin B_6 1500 mg, vitamin B_{12} 10 mg, Niacin 30000 mg, Biotin 50 mg, Folic acid 1000 mg, Pantothenic acid 10000 mg, Iron 30000 mg, Manganese 60000 mg, Copper 4000 mg, Zinc 50000 mg, Iodine 1000 mg, Cobalt 100 mg, Selenium 100 mg, calcium carbonate ($CaCO_3$) carrier to 3000g .

Table (3). The applied experimental design during the experimental period

Group	Diet
1	diet contain 1.5% sun flower oil
2	diet contain 3% % sun flower oil
3	diet contain 4.5% sun flower oil
4	diet contain 1.5% linseed oil
5	diet contain 3% linseed oil
6	diet contain 4.5% linseed oil

2.3 Experimental Parameters:

2.3.1 Growth performance measurements: Body weight **(Vohra and Roudybush, 1971)**. Relative growth rate **(Brody,1968)**. Feed conversion ratio **(Lambert *et al*., 1936)** *a*nd body weight gain was calculated by the difference between two successive weeks or periods weights.

2.3.2. Dressing percentage, Total edible carcass %: Abdominal fat, skin plus subcutaneous fat, breast muscle, leg muscle, organ weight and their relative weights to body weight were recorded.

2.3.3. Serum cholesterol **(Schettler *et al*., 1975)**, Serum triglycerides **(Fossatip, 1982)**. Serum HDL (high density lipoprotein) and serum LDL (Low density lipoprotein), **(Young, 1995)**

2.3.4. Immune stimulant measurements:

Blood samples were taken at days 7,14,28 and 42 for Newcastle disease antibodies . Blood samples were left without anticoagulant to clot. The serum was separated by centrifugation at 3000 rpm for 10 minutes . Micro technique of haemagglutination inhibition test **(Takatasy, 1955)** and geometric mean titre (GMT) **(Brugh, 1978).**

2.4 Statistical analysis:

The analysis of variance for the obtained data was performed using statistical analysis system: **(SAS, 1987)** to assess significant differences.

Results and Discussion

3.1. Growth Performance :

Live body weight, body weight gain, relative growth rate and feed conversion ratio data are summarized in Table (4).

Table (4). Summary of Influence of different levels and sources of dietary oils on growth performance during experimental period.

Age (week)	Group					
	1	2	3	4	5	6
Cumulative initial body weight	48.36±0.46[a]	48.32±0.50[a]	48.31±0.54[a]	48.23±0.54[a]	48.35±0.47[a]	48.04±0.46[a]
Cumulative final body weight	2151.77±31.05[d]	2074.93±21.00[e]	2263.60±35.37[c]	2159.40±34.86[d]	2349.87±37.73[b]	2414.33±40.56[a]
Cumulative total body gain	2103.41±30.62[d]	2026.62±20.66[e]	2215.29±34.86[c]	2111.17±34.35[d]	2301.52±37.51[b]	2366.29±40.15[a]
Relative growth rate (RGR)	191.20±9.21[b]	190.9±9.19[c]	191.6±9.16[b]	191.30±9.30[b]	191.90±8.91[b]	192.2±9.22[a]
Cumulative average F.C.R.	2.10±0.21[a]	2.0±0.22[b]	1.9±0.19[c]	1.90±0.22[c]	1.80±0.13[d]	1.80±0.14[d]

Means within the same row of different letters are significantly different at ($P < 0.05$)

The analysis of variance of growth performance indicated positive effect of dietary supplementation of line seed oil on growth performance represented by the final live body weight, body weight gain, relative growth rate and feed conversion ratio. All parameters were increased significantly as the concentration of both linseed and sunflower oil increased. Also, the results demonstrated that the groups fed on diets contain 3% and 4.5% linseed oil increased significantly in final body weight, body weight gain and relative growth rate when compared with the groups fed on the same levels from sunflower oil while the difference in feed conversion ratio was significantly better at all levels in groups fed on diets contain linseed oil when compared with the groups fed on diets contains same levels from sunflower oil.

This result agree with those obtained by **Abou El-Wafa *et al.* (2000)** who reported that sunflower oil improved growth rate and feed conversion ratio of broiler chicks. The results confirmed by those obtained by **Crespo and Esteve-Garcia (2001)** who found that sunflower and line seed oil showed better feed efficiency in all cases ($P<0.05$).

Also our results in harmony with those obtained by **Lopez-Ferrer *et al.* (2001)** who found that increase in weight /bird/day, feed intake and final body weight were higher in the group fed higher concentration of linseed oil ($P<0.05$).

This results are similar with those obtained by **El-Yamany *et al.* (2008).** Using different levels and sources of oil in growing Japanese quail, they found superiority ($P<0.5$) body weight, live weight gain and feed intake in the groups of quail fed on diets containing different levels (1.5, 2 or 3%) of PUFAS from Linseed oil, sunflower oil and olive oil. Also they recorded a higher economic efficiency (expressed as percentage net revenue/feed) cost compared to the control diet.

3.2. Carcass Characteristics :

Table (5). Influence of different levels and sources of dietary oils on Carcass traits at the end of experimental period

Age (week)	Group					
	1	2	3	4	5	6
Dressing %	72.25±2.49[a]	71.95±0.28[a]	72.07±0.66[a]	72.12±1.76[a]	72.79±1.62[a]	72.34±1.32[a]
Head %	2.76±0.13[a]	2.77±0.12[a]	2.79±0.06[a]	2.72±0.11[b]	2.69±0.24[b]	2.78±0.11[a]
Liver %	2.12±0.10[a]	2.14±0.14[a]	2.14±0.10[a]	2.11±0.15[a]	2.10±0.11[a]	2.18±0.31[a]
Heart %	0.47±0.04[a]	0.48±0.03[a]	0.49±0.04[a]	0.46±0.02[a]	0.47±0.04[a]	0.49±0.02[a]
Gizzard %	1.67±0.08[a]	1.69±0.09[a]	1.66±0.24[b]	1.64±0.10[a]	1.63±0.02[b]	1.70±0.18[a]
Breast muscle %	17.02±0.31[a]	17.07±0.69[a]	17.20±0.46[a]	17.16±0.53[a]	17.16±0.42[a]	17.15±1.31[a]
Leg muscle %	16.24±0.91[a]	16.15±0.28[a]	16.12±0.51[a]	16.05±0.32[a]	16.11±0.64[a]	16.26±0.75[a]
Abdominal fat%	2.53±0.53[a]	1.94±0.28[b]	1.84±0.59[b]	1.59±0.16[c]	1.80±0.05[b]	1.49±0.15[c]
Skin + Sub-cut Fat %	10.16±0.86[a]	9.83±0.12[b]	9.39±0.14[b]	9.06±0.22[c]	9.05±0.62[c]	9.12±0.90[d]

Means within the same row of different letters are significantly different at ($P < 0.05$)

The analysis of variance of present data showed that no significant difference between all groups in dressing percentage of leg muscle or breast muscle. However there were significant decrease in abdominal fat as the concentration of linseed and sunflower oil increased. It was noticed that the groups fed on diets contain 1.5% and 4.5% linseed oil showed significant decrease in abdominal fat when compared with the groups received the same levels from sunflower oil.

These results are in agreement with those obtained by **Crespo and Esteve-Garcia (2001)** who stated that sunflower and line seed oil caused lower percentage of abdominal fat. Also, these results are in harmony with those obtained by **Lopez-Ferrer *et al.* (2001)** who found that carcass yield was not significantly differ by linseed oil supplementation.

Moreover, **Hassan (2001)** found that no significant effect in dressing percentage due to sunflower and line seed oil supplementation.

Also, our results are similar with those obtained by **El-Yamany *et al.* (2008)** who reported that non significant effect was recorded by using different levels or sources of oil on both edible giblet (gizzard, liver and heart) percentages.

3.3. Lipid profile :

Table (6). Influence of different levels and sources of dietary oils on Lipid profile at the end of experimental period

Age (week)	Group					
	1	2	3	4	5	6
Cholesterol	110.00±4.04[a]	110.00±4.00[a]	107.33±11.87[a]	88.33±5.90[c]	95.33±13.68[b]	89.67±10.84[c]
HDL	72.33±0.88[b]	78.00±6.51[a]	74.33±12.39[ab]	73.67±4.67[b]	72.33±10.17[b]	74.00±8.89[b]
LDL	13.67±1.45[a]	11.67±3.76[b]	13.67±1.45[a]	3.00±1.00[c]	12.67±4.37[b]	4.67±1.45[c]
Triglycerides	120.00±11.55[a]	101.67±27.28[b]	96.67±6.67[c]	58.33±4.41[d]	51.67±4.41[f]	55.00±10.00[e]

Means within the same row of different letters are significantly different at ($P < 0.05$)

The present data revealed that serum total cholesterol and serum triglycerides were reduced significantly in all groups received linseed oil when compared with the groups received the same levels from sunflower oil. LDL was reduced significantly in the groups fed on diets containing 1.5% and 4.5% linseed oil while HDL showed non significant effect except the group received 3% linseed oil which revealed significant decrease in same groups when compared with the group received the same level of sunflower oil.

Our results are in agreement to those obtain by **Schumann *et al.* (2000)** who found that feeding diets with dry n^{-3} oils to layer diets had the largest decrease in plasma triglycerides suggesting that longer chain n^{-3} may be responsible for this decrease. Also, our results are similar to those obtained by **Celbi *et al.* (2006)** who found that LDL was significantly lower in groups fed 4% flaxseed oil than other groups without any adverse effect. Moreover, **Szewczyk *et al.* (2006)** reported that Linseed supplementation lowered the cholesterol content of broilers meat.

3.4. immune efficiency:

Table (7). Influence of different levels and sources of diet on immune efficiency during experimental period.

Age (week)	Group					
	1	2	3	4	5	6
HI at 7 days	4.00 ± 0.58^{c}	6.67 ± 0.88^{a}	5.00 ± 0.00^{b}	5.67 ± 0.33^{ab}	5.67 ± 0.33^{ab}	5.67 ± 0.33^{ab}
HI at 14 days	4.00 ± 0.00^{c}	5.33 ± 0.33^{b}	5.67 ± 1.20^{ab}	6.00 ± 0.00^{a}	6.00 ± 0.00^{a}	5.33 ± 0.33^{b}
HI at 28 days	6.33 ± 0.67^{a}	5.00 ± 0.58^{d}	$0.5.33\pm0.67^{c}$	5.33 ± 0.33^{c}	5.67 ± 0.33^{b}	6.00 ± 0.00^{ab}
HI at 42 days	5.00 ± 0.58^{b}	5.33 ± 0.88^{ab}	5.33 ± 0.67^{ab}	5.33 ± 0.67^{ab}	5.67 ± 0.33^{a}	5.33 ± 0.67^{ab}

Means within the same row of different letters are significantly different at ($P < 0.05$)
Values are Log 10.

Data concerned with efficiency of immunity represented in table (7) indicated significant increase due to increased concentration of both of sunflower and linseed oils . However, using linseed oil increased immune efficiency when compared with the groups received the same levels from sunflower oil.

These results are in agreement with those obtained by **Parmentier *et al.*, 1997** who reported that inclusion of n^{-6} PUFA in the diet has enhancing effects on antibody responses and antibody-mediated inflammatory responses. On the other hand, supplementation of n^{-3} PUFA, as its elongated metabolites with decreased antibody and inflammatory responses. **Korver and Klasing (1997)** proposed that altering dietary ration between n^{-6} and n^{-3} PUFA influence the magnitude and type of immune response.

It could be concluded that feeding the broiler chicks on diets containg line seed oil (1.5%, 3%, 4.5%) resulted in significantly better growth performance, lower serum total cholesterol, LDL cholesterol , abdominal fat and positively improvement in immunity efficiency.

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تأثير إضافة مستويات مختلفة من أوميجا 3(زيت بذرة الكتان) على كفاءة النمو ومواصفات الذبيحة وصورة محتوى الدهون والكفاءة المناعية فى بدارى التسمين

أ.د/السد محمد حجازي[1] د/أسامة عطية يوسف صقر[2] د/عبير محمد شحاتة الكريدى[3]

1- رئيس قسم تغذية الحيوان والدواجن وأمراض سوء التغذية بكلية الطب البيطرى جامعة كفر الشيخ

2- قسم الكيمياء الحيوية والنقص الغذائى والسموم معهد بحوث صحة الحيوان معمل كفر الشيخ الفرعى

الملخــص العربــي

- نظرا للاحتياج المتزايد للحوم بسبب التزايد المستمر فى عدد السكان . وبالنظر إلى أن الدواجن تساهم فى سد حاجة الناس من اللحوم . لذا اتجهت أنظار الباحثين فى جميع أنحاء العالم لتحسين مواصفات لحوم الدواجن وذلك بالسعى لخفض محتواها من الدهون والكوليسترول بما ينعكس إيجابياً علي صحة الإنسان .
- أجريت هذه التجربة على 180 كتكوت عمر يوم من سلالة كب تم تقسيمهم إلى ست مجموعات حيث غذيت المجموعة الأولى والثانية والثالثة على عليقة تحتوى على زيت عباد الشمس بنسب 1.5% و3% و4.5% على الترتيب وغذيت المجموعة الرابعة والخامسة والسادسة على عليقة تحتوى على زيت بذرة الكتان بنسب 1.5% و3% و4.5% على الترتيب ولقد تم تحصين الدواجن ضد الأمراض الوبائية وتم وزن الطيور وكمية العلف المستهلكة أسبوعيا لكل مجموعة وذلك لحساب متوسط الوزن ومتوسط الزيادة فى الوزن ومعدلات النمو ومعدلات التحول الغذائى.
- وقد أظهرت نتائج البحث زيادة فى متوسط معدل النمو ومتوسط الزيادة فى الوزن ومعيار التحول الغذائى كلما زاد تركيز كل من زيت دوار الشمس وزيت بذرة الكتان وكانت الزيادة معنوية عند مقارنة المجموعات التى غذيت على عليقة تحتوى على زيت بذرة الكتان بمثيلاتها التى غذيت على عليقة تحتوى على زيت عباد الشمس .
- وأظهرت النتائج أن دهن البطن انخفض معنويا بإضافة زيت بذرة الكتان وكذلك انخفضت نسبة الكوليسترول والجلسيريدات الثلاثية بالمصل معنويا بإضافة زيت بذرة الكتان .
- كما دلت النتائج على أن استخدام زيت بذرة الكتان وعباد الشمس يرفع من الكفاءة المناعية فى بدارى التسمين كلما زادت نسبتهم فى العليقة .