J.Animal and Poultry Prod., Mansoura Univ., Vol.4 (7): 381 - 393 ,2013

EFFECT OF DIET SUPPLEMENTED WITH PUMPKIN (*Cucurbita moschata*) AND BLACK SEED (*Nigella sativa*) OILS ON PERFORMANCE OF RABBITS:
1- GROWTH PERFORMANCE, BLOOD HEMATOLOGY AND CARCASS TRAITS OF GROWING RABBITS.

Ragab, Ayat A.; K.F.A. El-Reidy and H.M.A. Gaafar
Animal Production Research Institute, Agricultural Research Center, Dokki, Giza. hamedgaafar@gmail.com

ABSTRACT

Eighty NZW weaned rabbits (40 males and 40 females at 5 weeks of age and 535.19±14.73 g LBW) were used in a complete randomized design of four treatments during feeding period from 5 to 12 weeks of age. Rabbits in the 1st group were fed commercial pelleted diet without additive (control, G1). Rabbits in the 2nd, 3rd and 4th groups were fed the control diet supplemented with 5 g pumpkin seed (PS) oil/kg diet (G2), 5 g nigella sativa seed (NS) oil/kg diet (G3) and 2.5 g PS oil plus 2.5 g NS oil/kg diet (G4), respectively. Results showed that dietary supplementation did not affect nutrients digestibility coefficients and nutritive values. Cecal pH value and NH_3-N concentration of were higher ($P<0.05$) in G1 than in supplemented groups (G2-G4). Concentration of TVFAs was lower in G1 and the highest concentration was in G4 ($P<0.05$). Hemoglobin concentration, PCV%, counts of red and white blood cells, percentage of differential white blood cells, concentrations of total proteins, albumin and globulin in blood serum were nearly similar in all groups. In blood serum, concentration of glucose increased ($P<0.05$), total lipids, triglycerides, total cholesterol, HDL and LDL as well as activity of AST and ALT decreased ($P<0.05$) by supplementation of PS , NS or their combination. Mortality rate decreased ($P<0.05$) in supplemented groups. Final body weight was higher ($P<0.05$) in G4 as compared to G1, G2 and G3. Total and daily weight gain were higher ($P<0.05$) for G4 compared with the other groups. Rabbits in G2 and G3 showed the highest ($P<0.05$) feed intake, followed by G1, while G4 had the lowest intake ($P<0.05$). Rabbits in G4 recorded the best ($P<0.05$) feed conversion ratio and performance index compared with other groups. Group 4 recorded the highest net revenue ($P<0.05$), followed by G1, while G2 and G3 had the lowest revenue ($P<0.05$). Groups 3 showed the highest ($P<0.05$) slaughter and carcass weights as well as dressing percentage. Groups 3 and 4 had ($P<0.05$) the highest abdominal and shoulder fat weight. Weight of liver, kidneys, heart, lungs, spleen, head and bile were nearly similar in all groups. Physical characteristics, moisture and ash contents in meat of all groups. Group 4 showed the highest ($P<0.05$) protein content in meat. G1 showed the highest ($P<0.05$) fat content in meat.

In conclusion, rabbits fed diets supplemented with combination of pumpkin and black seeds oils (2.5 and 2.5 g/kg diet) showed the best results concerning digestibility coefficients, cecal fermentation, blood parameters, growth performance, carcass quality and economic efficiency.

Keywords: Rabbits, pumpkin, *Nigella sativa*, digestibility, hematology, growth performance, carcass.

INTRODUCTION

Aromatic plants and their extracted essential oils are becoming more important due to their antimicrobial effects and the stimulating effect on animal digestive systems (Ciftci *et al*., 2005). Beneficial effects of botanical additives in farm animals may arise from activation of feed intake and digestive secretions, immune stimulation, antibacterial, coccidiostatical, antihelmintical, antiviral or antiinflamatory activities. Inplant tissues, pH values are dependent on the presence of poly-carboxylic acids, phosphate salts, fiber and proteins (Al-Dabbas *et al*., 2010).

The chemical composition of the extracted fixed oil (total fatty acid composition) and volatile oil of *Nigella sativa* (NS) L. seeds included eight fatty acids (99.5%) and thirty-two compounds (86.7%) have been identified in the fixed and volatile oils, respectively. The main fatty acids of the fixed oil were linoleic acid (55.6%), oleic acid (23.4%), and palmitic acid (12.5%). The major compounds of the volatile oil were trans-anethole (38.3%), p-cymene (14.8%), limonene (4.3%), and carvone (4.0%) as reported by Nickavar *et al*. (2003). Concerning the effect of NS on animal performance, Omar *et al.* (2002) stated that use of diet supplemented with NS seed oil improved growth performance, feed conversion efficiency, immune response and increased economic return of chickens. Meral *et al.* (2004) found that oral treatment of *Nigella sativa* L. might decrease the diabetes-induced disturbances of heart rate and some hematological parameters of alloxan-induced diabetic rabbits.

The saturated fatty acid content of pumpkin oil was 27.73% and comprises of 16.41% palmitic acid and 11.14% stearic acid. The unsaturated fatty acid value was 73.03% and consisting mainly of 18.14% oleic acid and 52.69% linoleic acid. The oil obtained from the pumpkin seed kernels had a refractive index of 1.4656, specific gravity of 0.913, iodine value of 105.12 (gI2/100g oil), saponification value of 185.20 (mg KOH/g oil), acid value of 0.53 (mg KOH/g oil), and peroxide value of 0.85 (meq peroxide/kg oil) as reported by (Alfawaz, 2004). Up to 60.8% of the pumpkin seed (PS) oil is from the fatty acids, oleic (up to 46.9%), linolenic (up to 40.5%) and palmitic and stearic up to 17.4%, while the ratio of monounsaturated to polyunsaturated acids ranged from 0.60 to 0.75 g (Nakiae *et al*., 2006). Regarding the effect of PS on animal performance, Hajati *et al.* (2011) indicated that supplementation of diets with 5 g PS/kg DM in corn-soybean meal-wheat based diet can be profitable because it reduced broiler chicken's mortality and it did not have any adverse effect on bird's performance.

Therefore, the objective of this study was to investigate the effect of dietary supplementation of pumpkin and black seed oils on digestibility coefficients, cecal activity, blood parameters, growth performance, carcass traits and economic sufficiency of growing New Zealand White rabbits (NZW).

MATERIALS AND METHODS

The current work was carried out at Sakha Animal Production Research Station, Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture during the period from November to December 2012.

Experimental rabbits and diets:

Total of 80 weaned NZW weaned rabbits (40 males and 40 females at 5 weeks of age and 535.19±14.73 g LBW) were used in a complete randomized experimental design of four treatments. Rabbits in the 1st group were fed commercial pelleted diet without additive (control, G1). Rabbits in the 2nd, 3rd and 4th groups were fed the control diet supplemented with 5 g PS oil/kg diet (G2), 5 g NS oil/kg diet (G3) and 2.5 g PS oil plus 2.5 g NS oil/kg diet (G4), respectively. The experimental feeding period lased 7 weeks up to 12 weeks of age. Rabbits in all groups were fed to cover their requirements according to NRC (1977). Ingredients and chemical composition of the control diet are presented in Table (1).

Table (1): Ingredients and chemical composition of the control diet.

Ingredient %:			
Berseem hay	30	Molasses	2
Wheat bran	16	Limestone	1
Soybean meal	20	Common salt	0.5
Yellow corn	20	Premix*	0.5
Barley grain	10	**Total**	**100**
Chemical composition %:			
DM	88.06	EE	2.25
OM	90.57	NFE	59.45
CP	16.54	Ash	9.43
CF	12.33	**Total**	**100**

*** Each one kg of premix (minerals and vitamins mixture) contains vit. A, 20000 IU; vit. D3, 15000 IU; vit. E, 8.33 g; vit. K, 0.33 g; vit. B1, 0.33; vit. B2, 1.0 g; vit. B6, 0.33 g; vit. B5, 8.33 g; vit. B12, 1.7 mg; pantothenic acid, 3.33 g; biotine, 33 mg; folic acid, 0.83 g; choline chloride, 200**

Housing and management:

Rabbits were housed in galvanized wire cages (40 x 50 x 60 cm) and fresh water was automatically available at all time. All rabbits were kept under the same managerial, hygienic and environmental conditions.

Experimental procedures:

Live body weight and feed intake weekly were recorded throughout the experimental feeding period. Then, daily weight gain, feed conversion ratio and economic efficiency were calculated. Also, performance index (PI) was calculated according to North (1981) as given below:

PI = [final body weight (kg)/feed conversion ratio] × 100

Digestibility trials:

Digestibility trial was undertaken at the end week of the experimental period (12 weeks of age) on four animals from each group. Rabbits were housed individually in metabolic cages. The experimental diets were offered daily and fresh water was provided all the time. Individual daily feed intake was accurately determined and feces was collected for 5 days as a collection period. Feces of each animal was mixed, dried at 60 ^{o}C for 24 hours, then representative samples were ground for chemical analysis. Chemical analysis of different diets and feces was determined according to **AOAC (1995).** Then nutritive values as TDN, DCP or digestible energy were calculated for the experimental diets.

Cecal activity:

Cecal contents of slaughtered rabbits were taken for determination of pH value using Bechman pH meter. However, samples from the cecal contents were taken for determination of NH_3-N concentration according to the method of AOAC (1995) and TVFA's concentration according to Warner (1964).

Blood sampling:

At the end of the experimental period, blood was collected from sacrificed rabbits (6 animals in each group) in two clean sterile tubes for each animal immediately after slaughtering. The 1st blood samples were let to coagulate and centrifuged at 3500 rpm for 15 min, and then serum was separated and stored at -20 °C till analysis. Concentration of total proteins, albumin, glucose, total lipids, triglycerides, total cholesterol, high density lipoproteins (HDL). However, concentration of globulin and low density lipoprotein (LDL) were obtained by difference. Also, activity of aspartate (AST) and alanine (ALT) aminotransferases was determined. All biochemicals were determined using spectrophotometer (Spectronic 21 DUSA) and commercial diagnostic kits (Combination, Pasteur Lap.).

The 2nd blood samples were collected in heparinized tubes to obtain whole blood samples for determined hematological parameters including paked cell volume (PCV%) using microhaematocrit centrifuge (Mitruka and Rawnsley, 1977), hemoglobin concentration using the cyanmethemoglobin technique (Mitruka and Rawnsley, 1977). Also, count of red blood cells (RBC) and white blood cells (WBC) was determined based on the dilution of obtained blood with diluting fluids (Hayem & Turk) using haemocytometer according to Mitruka and Rawnsley (1977). Giemsa staining method was used for the differential count of WBC.

Carcass traits:

At the end of experiment, 3 male rabbits were taken randomly from each group. Animals were fasted for 18 hours before slaughtering, weighed and manually slaughtered. Weight of carcass plus head, kidneys, liver and heart was determined according to Blasco *et al*. (1993). pH value was determined in fresh meat samples using Orian digital pH meter. Tenderness and water holding capacity of meat and color intensity of meat extract were determined according to Yamazake (1981). Meat samples were subjected to chemical analysis of moisture, crude protein, ether extract and ash (AOAC, 1995).

Statistical analysis:

Data were statistically analyzed using General Linear Models (GLM) procedures adapted by SPSS (2008) for user's guide with one-way ANOVA. Duncan test within SPSS program was done to determine the degree of significance among means.

RESULTS AND DISCUSSION

Nutrients digestibility and nutritive values:

Nutrients digestibility and nutritive values of the experimental diets are shown in Table (2). Results show that the effect of dietary treatments (PS, NS or their combination oils) on nutrients digestibility coefficients and nutritive values was not significant. However, there was a slight increase in the digestibility of DM, OM, CP, CF, EE and NFE and subsequently nutritive values in terms of TDN, DCP and DE in treatment groups (G2-G4) as compared to the control one (G1). These results agreed with those obtained by Ferreira *et al.* (2011) who found that soybean oil additive for growing rabbit had no effect on the coefficients of digestibility of DM, OM, CP and GE.

Table (2): Nutrients digestibility and nutritive values of the experimental diets.

Item	Experimental group				MSE
	G1	G2	G3	G4	
Digestibility coefficients %					
DM	69.45	70.14	69.94	70.49	0.36
OM	70.80	71.51	71.30	71.86	0.37
CP	71.20	71.70	71.91	72.27	0.37
CF	64.65	65.30	65.10	65.62	0.34
EE	76.90	77.60	78.75	79.15	0.47
NFE	72.50	73.23	73.01	73.59	0.38
Nutritive values %					
TDN	66.74	67.89	67.84	68.33	0.38
DCP	11.78	11.80	11.84	11.90	0.06
DE (Kcal/kg)	2942.70	2993.20	2991.20	3012.80	16.64

Cecal activity:

Cecal activity in terms of pH value, and concentration of VFAs and NH_3-N of rabbits in the different groups is presented in Table (3). Cecal pH value of control group (G1) was significantly ($P<0.05$) lower in all treatment groups than in the control group. Concentration of TVFAs was the lowest in G1 and G3 (8.60 and 8.76 meq/dl) and the highest in G4 (9.05 meq/dl), while G2 did not differ significantly from that in both G1 and G4. However, concentration of NH_3-N showed an opposite trend to pH values.

These results indicated that dietary supplementation of PS, NS or their combination improved the cecal microbial fermentation by increasing utilizing ammonia nitrogen and FVAs and reducing pH values as compared to the control diet. Cecal pH value is one of the most important factors which affect bacterial fermentation. Cecum pH value depends on many factors such as the amount and composition of the diet. Fluctuations in pH value reflect the changes of organic acids accumulated in the ingesta.

In rabbits, the use of organic acids appears interesting, even though scientific data concerning their effect on microflora population, mucosal immunity and growth performance are few and often contradictory (Falcao-e-Cunra *et al*., 2007). The mode of action of these products (PS or NS) on cecal microflora is not completely understood, although it is demonstrated that organic acids play a direct action on the bacterial cell integrity (Maertens *et al*., 2006).

Table (3): Cecal fermentation parameters in the experimental groups.

Item	Experimental group				MSE
	G1	G2	G3	G4	
pH value	6.73^{a}	6.33^{b}	6.27^{b}	6.43^{b}	0.08
TVFA's (meq/dl)	8.60^{b}	8.83^{ab}	8.76^{b}	9.05^{a}	0.06
NH3-N (mg/dl)	16.08^{a}	15.77^{b}	15.73^{b}	15.65^{b}	0.06

a, b, c: Values in the same row with different superscripts differ significantly (P<0.05).

Blood parameters:

Results of all hematological parameters in whole blood presented in Table (4) showed insignificant effect of dietary treatments on all parameters studied. Concerning the biochemical concentration in blood serum, the differences in concentration of total protein, albumin and globulin among groups were not significant. Meanwhile, serum glucose concentration significantly (P<0.05) increased in treatment groups as compared to the control, being the highest in G2. However, concentration of total lipids, triglycerides, total cholesterol, HDL and LDL as well as activity of AST and ALT significantly (P<0.05) decreased in treatment groups as compared to the control one.

Table (4): Hematological and biochemical parameters in blood serum of rabbits in the experimental groups.

Item	Experimental group				MSE
	G1	G2	G3	G4	
Hematological parameters in whole blood:					
Hemoglobin (g/dl)	8.90	9.43	8.97	8.87	0.28
PCV (%)	28.33	30.00	28.67	28.33	0.79
Red blood cells (10^6/mm^3)	3.43	3.67	3.47	3.49	0.10
White blood cells (10^3/mm^3)	7.38	7.33	6.22	6.87	0.36
Segmented neutrophils (%)	48.33	47.67	45.33	48.33	0.84
Lymphocytes **(%)**	43.33	43.67	45.33	41.67	0.88
Monocytes (%)	3.67	4.00	4.67	5.00	0.28
Eosinophils (%)	3.33	3.67	4.00	3.67	0.22
Basophils (%)	0.67	0.33	1.00	0.67	0.14
Steff (%)	0.67	0.67	0.67	1.00	0.24
Blood biochemicals:					
Total proteins (g/dl)	7.10	7.19	6.95	7.28	0.21
Albumin (g/dl)	3.11	3.12	3.04	3.25	0.09
Globulin (g/dl)	3.99	4.07	3.92	4.04	0.21
Glucose (g/dl)	70.00^{c}	104.76^{a}	101.32^{a}	84.13^{b}	4.58
Total lipids (mg/dl)	393.65^{a}	371.43^{b}	357.14^{c}	307.94^{d}	35.63
Triglycerides (mg/dl)	69.32^{a}	59.16^{b}	47.73^{c}	68.54^{a}	6.36
Total cholesterol (mg/dl)	79.01^{a}	62.61^{c}	52.73^{d}	67.55^{b}	6.62
HDL (mg/dl)	52.18^{a}	43.95^{b}	35.21^{c}	45.27^{b}	4.77
LDL (mg/dl)	26.83^{a}	18.66^{c}	17.53^{c}	22.28^{b}	3.54
Activity of AST (IU/ml)	44.58^{a}	41.39^{ab}	36.18^{c}	40.53^{b}	1.01
Activity of ALT (IU/ml)	37.74^{a}	29.07^{b}	29.58^{b}	31.37^{ab}	1.37

a, b…..d: Values in the same row with different superscripts differ significantly (P<0.05).

The obtained hematological and biochemical parameters of rabbits in this study are nearly similar to those reported by several authors who analyzed the blood profile of young rabbits (Olayemi and Nottidge, 2007; Archetti *et al*., 2008).

Based on the present results, dietary supplementation of PS, NS or their combination had no adversely effects on the healthy status of growing rabbits. Differential white cell counts were typical and comparable to the findings of Archetti *et al*. (2008). Also, Miraghaee *et al.* (2011) reported that count of RBC and WBC were not affected by diet supplemented with NS.

In accordance with the present results, Hassan *et al.* (2007) and Al-Beitawi *et al.* (2009) recorded that *N. sativa* significantly decreased serum levels of total cholesterol and triglycerides. Also, Hajati *et al.* (2011) and Miraghaee *et al.* (2011) found that PS oil supplementation in broiler chicken diet decreased cholesterol and triglycerides concentrations in plasma and serum.

Growth performance, mortality rate, feed and economic efficiency:

Data in Table (5) revealed that rabbits in G4 fed diet supplemented with PS and NS combination showed significantly (P<0.05) the heaviest final LBW, the highest gain (total and daily) with the lowest feed intake (total and daily), which reflected in the best feed conversion ratio, the highest performance index and the lowest mortality rate as compared to dietary supplementation of PS or NS and the control diet.

These results agreed with those obtained by Abou El-Soud (2000), who found that feed conversion was better for quails receiving diet supplemented with NS seeds. Also, Miraghaee *et al.* (2011) showed that supplementing 1% of NS improved feed conversion ratio of broilers. However, Nworgu (2007) reported that birds served fluted pumpkin leaf extract stimulate feed intake.

In agreement with the present results, Abou-Egla *et al*. (2001) reported that mortality rate was lower in quails feed diets containing NS meal. Also, Hajati *et al.* (2011) found that PS oil supplementation decreased mortality rate of birds.

Economic efficiency expressed as total feed cost, price of total weight gain and net revenue was affected significantly (P<0.05) by dietary supplementation (Table 5). Rabbits in G2 showed significantly (P<0.05) the highest total feed cost followed by G3 and G4, while G1 had the lowest cost. However, feed cost per kg weight gain was significantly (P<0.05) higher in G2 and G3 as compared to G1 and G4.

The price of total weight gain was significantly (P<0.05) higher in G4 compared with other groups. Also, G4 recorded significantly (P<0.05) the highest net revenue, followed by G1, while G2 and G3 had the lowest revenue (Table 5).

These results agreed with those obtained by Nworgu (2007), who reported that the cost of feed out of the total cost of production was least for birds served fluted pumpkin leaf extract unlike control. He added that the net profit and cost of feed per kilogram live weight gain were higher for birds served fluted pumpkin leaf extract as compared to control.

Table (5): Growth performance parameters, mortality rate and economic feed efficiency of rabbits in experimental groups.

Item	Experimental group				MSE
	G1	G2	G3	G4	
Initial weight (g)	540.50	542.25	544.75	533.25	9.73
Final weight (g)	1518.05^{b}	1558.51^{b}	1531.12^{b}	1672.99^{a}	22.87
Total weight gain (g)	977.55^{b}	1016.26^{b}	986.37^{b}	1139.74^{a}	21.20
Average daily gain (g)	19.95^{b}	20.74^{b}	20.13^{b}	23.26^{a}	0.43
Total feed intake (g)	3365.94^{b}	3562.74^{a}	3492.90^{a}	3267.75^{c}	20.85
Average daily feed intake (g)	68.69^{b}	72.71^{a}	71.28^{a}	66.69^{c}	0.43
Feed conversion ratio (kg/kg gain)	3.44^{a}	3.51^{a}	3.54^{a}	2.87^{b}	0.10
Performance index (%)	44.13^{b}	44.40^{b}	43.25^{b}	58.29^{a}	1.42
Mortality rate (%)	15^{a}	5^{ab}	0^{b}	0^{b}	2.45
Total feed cost (L.E.)	8.41^{c}	10.51^{a}	9.78^{b}	9.39^{b}	0.10
Feed cost(L.E.)/kg weight gain	8.60^{b}	10.34^{a}	9.92^{a}	8.24^{b}	0.11
Price of total weight gain(L.E.)	19.55^{b}	20.33^{b}	19.73^{b}	22.79^{a}	0.42
Net revenue (L.E.)	11.14^{b}	9.82^{c}	9.95^{c}	13.40^{a}	0.43

a, b and c: Values in the same row with different superscripts differ significantly ($P<0.05$).
Price of one kg commercial rabbit diet = 2.5 L.E., pumpkin seeds oil = 90 LE, black seeds oil = 60 LE and live body weight = 20 LE.

Carcass traits:

Carcass traits of rabbits in the experimental groups are shown in Table (6). Results revealed significant ($P<0.05$) differences in slaughter and carcass weights among groups. Rabbits in G3 showed the highest preslaughter and carcass weights (1613 and 913 g, respectively), but G2 had the lowest slaughter weight (1445 g) and G1 had the lowest carcass weight (693 g).

Table (6): Carcass traits of rabbits in the experimental groups.

Item	Experimental group				MSE
	G1	G2	G3	G4	
Preslaughter weight (g)	1520^{ab}	1445^{b}	1613^{a}	1540^{ab}	35
Carcass weight (g)	693^{b}	782^{ab}	913^{a}	836^{ab}	34
Liver (g)	56.00	57.77	59.63	53.33	1.57
Kidneys (g)	12.20	11.97	12.87	12.30	0.61
Heart (g)	7.17	6.93	7.90	5.77	0.43
Lungs (g)	10.40	10.90	11.87	10.70	0.52
Spleen (g)	1.23	1.47	1.20	1.33	0.24
Head (g)	104.03	103.37	96.70	105.80	1.66
Bile (g)	1.23	1.43	1.30	1.30	0.25
Abdominal fat (g)	7.90^{b}	6.47^{b}	12.70^{a}	11.93^{a}	0.43
Shoulder fat (g)	1.20^{d}	1.80^{c}	3.40^{a}	2.80^{b}	0.16
Dressing (%)*	50.58^{b}	59.73^{ab}	61.56^{a}	58.81^{ab}	1.78

a, b and c: Values in the same row with different superscripts differ significantly ($P<0.05$).
*** Dressing % = [Weight (g) of carcass+liver+kidneys+heart/preslaughter weight (g)] x 100.**

Weights of liver, kidneys, heart, lungs, spleen, head and bile were nearly similar for different groups. However, dietary supplementation of NS oil in G3 or in combination with PS in G4 resulted in significant ($P<0.05$) increase in abdominal fat weight (12.70 and 11.93 g, respectively) and shoulder fat weight (3.40 and 2.80 g, respectively).

Finally, in association with preslaughter weight of rabbits in all groups, rabbits in G3 showed significantly (P<0.05) the highest dressing percentage, followed by G2 and G4, while G1 had the lowest dressing percentage. These results agreed with the results of Fernandez and Fraga (1996), who reported that the increase in slaughter weight improved all the desirable carcass characteristics measured and increased fat depots.

Physical characteristics of meat:

Results presented in Table (7) showed that the differences in physical characteristics of rabbit meat including pH value, color, tenderness and water holding capacity were not significant among the experimental groups. These findings indicated that dietary supplementation of PS, NS or their combination had no effect on characteristics of rabbit meat because pH value represents a key role in the maintenance of the meat quality during storage and depends on the balance of muscle energy metabolism. The pH value of meat determines the environmental microbial balance, because of the bacteriostatic effect of low pH on meat (DalleZotte, 2002).

Also, pH value of meat affects many its properties such as water holding capacity, muscle fat content, and carcass color (brightness). Losses of water in meat decreases pH value, because of the muscle proteins are closer to the isolelectric point which results in a lower hydration level (DalleZotte *et al.,* 1995).

Meat color is one of most parameters which are strictly related to pH value, influencing muscle texture and the oxidation of haempigments. At high pH levels, oxymyoglobin is rapidly turned into reduced myoglobin with dark red color (Ouhayoun and DalleZotte, 1993). It is known, that meat lightness increases with muscle myofibrillar protein shrinkage, which is itself negatively correlated to pH value, e.g. the lower pH, the higher lightness (DalleZotte and Ouhayoun 1998).

Table (7): Physical characteristics and chemical composition of meat rabbits in the experimental groups.

Item	Experimental group				MSE
	G1	G2	G3	G4	
Physical characteristics:					
pH value	5.50	5.56	5.60	5.53	0.03
Color intensity	0.310	0.307	0.313	0.320	0.004
Tenderness (cm)	2.50	2.53	2.60	2.47	0.03
Water holding capacity (cm)	5.83	5.80	5.70	5.73	0.04
Chemical composition (%):					
Moisture	76.53	76.23	75.57	74.54	0.37
Protein	18.93^{b}	20.05^{ab}	20.41^{ab}	21.29^{a}	0.33
Ether extract	2.79^{a}	1.90^{c}	2.16^{bc}	2.37^{b}	0.37
Ash	1.52	1.57	1.62	1.55	0.03

a, b, c: Values in the same row with different superscripts differ significantly (P<0.05).

Chemical composition of meat:

Chemical composition of meat (Table 7) showed that moisture and ash contents were nearly similar for all groups. However, there were significant differences (P<0.05) in the contents of protein and ether extract in meat among different groups. In this respect, G4 showed significantly (P<0.05) the highest protein content (21.29%), followed by G2 and G3, while G1 had the lowest content (18.93%). While, ether extract content was significantly (P<0.05) the highest in G1 (2.79%) and the lowest content (1.90%) in G2.

Generally, values of meat composition are within those obtained by Pla *et al*. (2004), who found that meat of rabbits had 70-76% moisture, 18-22% protein and 1.5-3% fat. Also, Baiomy and Hassanien (2011) reported that rabbit meat had high protein and low fat contents.

CONCLUSION

Based on the foregoing results, it could be concluded that rabbits fed diets supplemented with combination of pumpkin and black seeds oils (2.5 and 2.5 g/kg diet) showed the best results concerning digestibility coefficients, cecal fermentation, blood parameters, body weight gain, feed conversion, economic efficiency and carcass traits in addition to the lowest mortality rate.

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تأثير اضافة زيوت بذور اليقطين وحبة البركة فى العليقة على أداء الأرانب:
1- أداء النمو، مكونات الدم وصفات الذبيحة فى الأرانب النامية

آيات عبدالمقصود رجب، قطب فتح الباب عبداللطيف الريدى و حامد محمد جعفر
معهد بحوث الانتاج الحيوانى، مركز البحوث الزراعية، الدقى، مصر0

استخدم فى هذه الدراسة 80 أرنب نيوزيلندى مفطوم (40 ذكر و 40 أنثى عمر 5 أسابيع ووزن 535,19±14,73 جم) فى التصميم كامل العشوائية وقسمت الى 4 مجموعات متماثلة خلال الفترة من 5 الى 12 أسبوع من العمر0 غذيت أرانب المجموعة الأولى على عليقة الأرانب التجارية بدون اضافة (مجموعة المقارنة، ج1)0 أما الأرانب فى المجموعات الثانية، الثالثة والرابعة غذيت على عليقة المقارنة مع اضافة 5 جم زيت بذور اليقطين/كجم عليقة (ج2)، 5 جم زيت حبة البركة/كجم عليقة (ج3) و 2,5 جم زيت بذور اليقطين + 2,5 جم زيت حبة البركة /كجم عليقة (ج4) على التوالى0

توضح النتائج أن الاضافة الغذائية لم تؤثر على معاملات هضم العناصر الغذائية والقيم الغذائية0 ارتفاع قيمة درجة الحموضة وتركيز نيتروجين الأمونيا فى محتويات الأعور فى مجموعة المقارنة عن مجموعات الاضافة0 انخفض تركيز للأحماض الدهنية الطيارة فى المجموعة الأولى وارتفع فى المجموعة الرابعة0 تماثل تركيز الهيموجلوبين، الهيماتوكريت، عدد خلايا الدم الحمراء والبيضاء، النسب المئوية لأنواع خلايا الدم البيضاء، تركيز بروتينات الدم، الألبيومين والجلوبيولين فى سيرم الدم للمجموعات المختلفة0 بينما ارتفع تركيز الجلوكوز وانخفض تركيز الدهون الكلية، الجليسريدات الثلاثية، الكوليسترول الكلى، الكوليسترول العالى والمنخفض الكثافة ونشاط أنزيمات الكبد (AST and ALT) فى سيرم الدم مع اضافة زيوت بذور اليقطين وحبة البركة أو خليطهما0

انخفاض معدل النفوق معنويا عند مستوى 0,05 فى مجاميع الاضافة0 ارتفاع الوزن النهائى فى المجموعة الرابعة معنويا عند مستوى 0,05 عنه فى المجموعات الأولى والثانية والثالثة0 كذلك ارتفاع الزيادة الكلية واليومية فى الوزن معنويا عند مستوى 0,05 فى المجموعة الرابعة بالمقارنة بالمجموعات الأخرى0 ارتفاع كمية الغذاء المأكول معنويا عند مستوى 0,05 فى المجموعتين الثانية والثالثة تلتهما المجموعة الأولى، بينما كان أقل مأكول فى المجموعة الرابعة0 سجلت الأرانب فى المجموعة الرابعة معنويا عند مستوى 0,05 أفضل معدل تحويل غذائى ودليل الأداء بالمقارنة بالمجموعات الأخرى0 سجلت المجموعة الرابعة معنويا عند مستوى 0,05 أعلى عائد صافى تلتها المجموعة الأولى، بينما كان أقل عائد فى المجموعتين الثانية والثالثة0

أظهرت المجموعة الثالثة أعلى وزن عند الذبح وكذلك وزن الذبيحة وكذاك نسبة التصافى0 أظهرت المجموعتين الثالثة والرابعة أعلى وزن لدهن البطن والكتف0 كانت أوزان الكبد، الكليتين، القلب، الرئتين، الطحال، الرأس والمرارة متماثلة تقريبا للمجموعات المختلفة0 كذلك كانت الصفات الطبيعية ومحتوى الرطوبة والرماد فى اللحم متماثلة تقريبا للمجموعات المختلفة0 أظهرت المجموعة الرابعة معنويا عند مستوى 0,05 أعلى محتوى للبروتين فى اللحم، بينما أظهرت المجموعة الأولى أعلى محتوى للمستخلص الأثيري فى اللحم0

نستخلص من هذه الدراسة أن المغذاة على العليقة مع اضافة مخلوط زيوت بذور اليقطين وحبة البركة (2,5 جم و 2,5 جم) أظهرت أفضل النتائج من حيث معاملات الهضم، تخمرات الأعور، مكونات الدم، معدل النمو، صفات الذبيحة والكفاءة الاقتصادية وتقليل معدل النفوق0

قام بتحكيم البحث

أ.د / عبد الخالق السيد عبد الخالق	**كلية الزراعة – جامعة المنصورة**
أ.د / سعيد احمد محمود	**كلية الزراعة – جامعة كفر الشيخ**