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EFFECT OF FEEDING VARIABLE ROCKET MEAL PERCENTAGES ON IMMUNE, BIOCHEMICAL AND GROWTH STATUS OF JAPANESE QUAIL

By

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Abstract: *The current study was carried out to investigate the effect of substitution soybean meal protein with different levels of dietary rocket meal protein on growth performance, immune responses, blood constituents and carcass characteristics of growing Japanese quail. Four isonitrogenous and isocaloric diets were formulated to meet the nutrient requirements of growing Japanese quail according to* ***NRC (1994).*** *Dietary levels of rocket meal protein were 0.00% (control group), 8.0%, 16.0% and 32.0% as a replacement of soybean meal protein. A total number of 300 unsexed birds of Japanese quail were randomly divided into four experimental groups, 75 birds each in three replicates.*

Methanol rocket meal extract showed antioxidant effect in concentrated manner by using (DPPH) assay as 1% gave 47.55% of activity

Achieved results indicated that insignificant differences were observed in live body weight at last 2 weeks of the experiment. Feed conversion ratio has no clear trend between all groups of tested materials. Results of blood constituents after 3rd and 5th week of the experiment illustrated that T_2 *group was significantly (P<0.05) best in total protein, albumin, globulin and A/G ratio while* T_3 *group was significantly (P<0.05) lower in cholesterol and triglycerides compared with control group.*

Antibody levels against NDV vaccine measured by ELISA and HI showed a gradual increase at post-vaccination at 3rd and 4th week post

vaccination all tested groups showed a slightly increase in antibody levels compared with control group, with the highest values were obtained with group fed on 16% rocket seed meal. Both 16 and 32% of rocket seed meals revealed significant increase in both phagocytic percentage and index of macrophage obtained from peripheral blood monocyte (PBM) isolated after 24 hrs of poster dose of NDV vaccine, the second group (16%) significantly higher than any other concentration. The amount of nitric oxide produced by macrophage isolated from quail feed on 16% and 32% rocket seed meal was significantly higher than that control and 8%.

The present results of carcass characteristics indicated that no significant effect was noticed on carcass characteristics except abdominal fat % was significantly (P<0.05) decreased as the level of substitution of rocket meal protein increased in quail diets.

Upon the obtained results of the present study it could be concluded that rocket meal can be successfully used in the growing Japanese quail diets as a cheap source of plant protein up to 32% to replace soybean meal protein without any adverse effects on growth performance, blood contents and carcass characteristics of broiler Japanese quail. From immunological point of view, the rocket seed meal can improve and preserve adequate function of immune cells due to its antioxidant activity.

INTRODUCTION

Rocket is herbaceous plant belonging to Brassicaceae family. Its production in Egypt has been steady increasing for the great demand to volatile oils for pharmaceutical purposes. Its by product after extracting oil can be used as a cheap source of plant protein and energy for poultry diets compared to soybean meal ***(Abdo, 2003)***. Rocket seed meal contain 7.27% moisture, 36.03% crude protein, 7.64% ether extract, 7.69% crude fiber, 11.83% ash and 36.81% nitrogen free extract ***(Osman et al., 2004)***. In addition rocket seeds contain a significant amount of glucosinolates (GER) and flavonoids ***(Bennett et al., 2006.*** The major GER in seeds is Erucin that extract from defatted seeds meal which possess a good direct and indirect antioxidant activity ***(Barillari et al., 2005)***. Glucosinolates are diverse groups of sulfur containing glycosides, which hydrolyzed by myrosinase enzyme to glucose, thiocyanates, isothiocyanate, nitrites and sulfate. Isothiocyanate and other breakdown products have several biological activities including anticarcinogen, antifungal, antibacterial and

antioxidant effect ***(Fenwick et al., 1983 and Kim et al., 2004)***. Also, flavonoids have many physiological activities including reduction of oxidative stress, inhibiting low-density lipoprotein (LDL) oxidation and platelet aggregation beside its immunomodulator to inflammatory activities and inhibit the different phases of tumour process ***(Lamuela-Raventos et al., 2005***). Recently, dietary antioxidants (as rocket seed meal) have beneficial effects for maintenance health and prevention of various diseases such as cancer, cardiovascular, arthritis and diabetes. So the suggested physiological action of dietary antioxidant is to protect living organism from oxidative damage by scavenge free radical which is byproduct of activated phagocytic cells, beside suppress lipid and LDL oxidation ***(Matsufuji et al., 2003)***. Subsequently antioxidants play a vital role in maintaining immune cell and protecting them from oxidative stress ***(De la Fuente and Victor 2000)***.

Use of rocket cake up to 25% as a partial replacement of soybean meal revealed a significant positive effects on live body weight, carcass characteristics and feed conversion ratio while 50% replacement decreased both body weight and body weight gain. This could be refer to that rocket cake contain anti-nutritive components such as Erucic acid which may have negative effects on improving the viability rate and broiler performance ***(Fernandez-Martinez et al., 2001).*** Negative effects of GER on animals are relative to its concentration in diet. The negative influence of dietary GER on animal growth and production may be attributed to bitter taste and the drastic endocrine disturbance induced by anti-nutritional factor. The reduced intake of GER containing diets is due to the presence of sinigrin and progoitrin, these both glucosinolates are associated with bitter taste ***(Tripath and Mishra, 2007)***.

The present study was undertaken to evaluate the partial replacement of soybean meal protein with different levels of rocket meal protein (8, 16 and 32%) on performance of Japanese quail during the growing period (growth rate, carcass quality, blood chemistry and immune response to Newcastle virus vaccine either humeral or cellular).

MATERIALS AND METHODS

This study was conducted at Poultry Experimental Station, Animal Production Department, Faculty of Agriculture, Al-Azhar University, Cairo, Egypt.

Birds and Experimental Design

A total number of 300 unsexed birds (one week old) of Japanese quails were randomly distributed into four experimental groups (75 birds each). Each group was represented by three replicate pens containing 25 birds each. Birds of the first group was served as a control group that was fed on traditional ration while the second **(T_1),** third **(T_2),** and fourth **(T_3)** groups were fed on rations in which soybean protein were partially replaced by rocket meal protein at 8%, 16% and 32%, respectively. All birds were kept in two batteries containing 12 floors under the same conditions during the experimental time. All diets were formulated to meet fully nutrient requirements of growing Japanese quails according to ***NRC (1994)***. Feed and water were offered to birds ***ad libitum*** throughout the experimental period. The composition and chemical analysis of experimental diets are presented in Table (1).

After one week of receiving the experimental rations, all birds were vaccinated with Lasota vaccine followed by poster dose after 2 weeks.

Antioxidant Activity of Rocket Meal

The antioxidant activity of methyl extract of rocket meal was measured by indirect method using**,** 1,1-diphenyl-2-picryl hydrazyl radical (DPPH) according to ***Brand Williams et al., (1995)*** **and** ***Suja et al., (2005)*** with some modifications to evaluate the free radical scavenging activity in the diluted (1%) methanol extract of rocket meal which was allowed to react with a stable free radical DPPH then the free radical scavenging was measured using Electron spin resonance **(ESR).**

$$\text{Antioxidant activity percentage} = \frac{\text{activity of standard} - \text{activity of sample}}{\text{activity of standard}} \times 100$$

Sampling: -

1- Data Collection

Feed consumption and conversion were determined weekly.

2- Blood Samples

Blood samples were taken from all groups (6 samples for each group). At 1^{st}, 2^{nd}, 3^{rd}, and 4^{th} weeks post vaccination for serum

separation to determined antibody against Newcastle disease virus (NDV) vaccine by haemagglutination inhibition (HI) and Enzyme Linked Innumosorbant Assay (ELISA). Hepranized blood samples were taken at 1st day post the poster dose to determined phagocytic activities and nitric oxide (NO) production. After 3 weeks and at the end of experiment blood samples were taken from all groups to determined total protein, albumin, uric acid, triglycrides, cholesterol, createnine, aspirate aminotransferase(AST) and alanine aminotransferase (ALT).

3- Biochemical Parameters

Biochemical parameters were assayed by using of commercial diagnostic kits of total protein (**Weichselbaum, 1946),** albumin **(Doumas, 1971).** Globulin calculated by subtraction of plasma albumin from the total plasma protein. A/G ratio was calculated by divided the albumin value on globulin value. Cholesterol **(Watson, 1960),** triglycerides **(Fossati and Principe, 1962).** Aspartate aminotransferase (AST) and alanine aminotransferase (ALT), activities were determined colorimeterically according to the method of **(Retiman and Francle, 1957).** Creatinine **(Husdan and Rapaport, 1968),** uric acid **(Arliss and Entvistle, 1981).**

4. Evaluation of Immune Response

Humeral immune response was evaluated by measuring antibody against NDV vaccine using ELISA and HI while cell mediated immune response was measured by estimating the phagocytic percent and index of peripheral blood monocyte as well as determinate of nitric oxide secreted by macrophage.

5- Haemagglutination Inhibition (HI)

Anti NDV vaccine antibodies in vaccinated quails serum were determined by HI by the conventional microtiter methods according to ***King and Seal (1998)*** in U bottom microtitre, 25 micron of two fold dilution of inactivated serum (at 56ºC for 30 minutes) in PBS pH 7.2 were incubated with equal volume of ND virus antigen with concentration of 4 haemagglutination (HA) units (was prepared by performing HI test on antigen solution of unknown concentration ***(Anan, 1971)*** then 0.5% washed chicken blood cells was add to plate, after one hour, HI titre of serum is read as the highest serum dilution causing complete inhibition of haemagglutination of 4 HA units

6- ELISA Assay Procedure

ELISA was used to determine the antibodies against NDV vaccine in vaccinated quail, according to ***Snyder and Marquardt, (1989)***. Briefly, 96 wells flat bottom plates were coated with ND virus antigen in coating buffer (carbonate/ bicarbonate buffer pH 9.6). After 24 hrs 100µl of each serum samples were diluted 1:50 in (PBS-1%BSA) and added as well as negative and positive control sera, after incubation for 1 hr, 100µl volume of rabbit antichicken IgG peroxidase conjugate diluted 1/500 in (PBS -1% BSA) were added after another 1hr.100 µl of OPD substrate were added, the absorbance values were measured at 490 nmA using ELISA reader.

7- Phagocytosis of Peripheral Blood Monocyte (PBM)

Phagocytosis of PBM against Candida albican were carred out according to ***Boyum, (1968)*** after centrifugation of hepranized blood on ficol hypaque 1077 for 20 minutes at 2400 rpm. at 4ºC the blood mononuclure leukocytes were isolated, the glass adherent macrophage were obtain according to ***Anthony et al., (1985)*** by seeding blood mononuclure cells (MNC) (10^7/mL) in cell culture and staining chambers with cover slip for 1hr at 37ºC in 5% CO_2 and 90% humidity, the monolayer was washed to remove non adherent cells and reincubated over night in the same conditions, it turned to active macrophages, the culture media was removed and kept at –70 till used for determination of NO then 1ml of *candida albicans* (10^6/ml) were incubated for another one hour then the covers were washed, fixed and stained finally phagocytic percentage and phagocytic index were calculated.

8- Estimation of Nitric Oxide (NO) assay:

100 µl of culture media which isolated after 24 hrs of incubation of PBM was mixed with an equal volume of freshly prepared Greiss reagent, incubated for 10 min at room temperature and absorbency measured at 570 nm using a microtiter plate reader. The nitrite level in culture media was calculated by comparing the optical density against the nitrite standard curve of sodium nitrite in distilled water as previously described by ***Green et al., (1982)***.

Method of Statistical Analysis:

Data were subjected to analysis of variance using General Linear Model as described in SAS User's Guide **(SAS Institute, 1994).**

Differences among means were tested using Duncan's multiple range test **(Duncan, 1955).**

RESULTS AND DISCUSSIONS

Chemical compositions of rocket meal

The chemical compositions of rocket meal (*Eruca Sativa*) compared with soybean meal is presented in Table (2). The chemical analysis show that rocket meal has a good ratio of crude protein (30.20) compared to soybean meal. While rocket meal contained higher ratio in ether extract (5.65), crude fiber (10.20), ash (8.36), Nitrogen free extract (38.22) and calcium (0.45) compared to 0.8, 7.00, 6.82, 30.28 and 0.29 for ether extract, crude fiber, ash, Nitrogen free extract and calcium for soybean meal respectively. On the other hand, rocket meal has a higher content of calculated metabolizable energy (3265.96) according to equation of **Carpenter and Clegg (1956).** High energy level of rocket meal could be refer to that rocket contained a higher level of ether extract (5.65) compared with that (0.8) of soybean meal. These results are partially agreed with those reported by **Abdo (2003)** and **Osman *et al.*, (2004).**

The chemical analysis of tested material indicated that rocket meal (*Eruca Sativa*) can be used as a cheap source of plant protein in broiler Japanese quail diets which could lead to reduce the cost price of broiler Japanese quails feeding.

Antioxidant compositions of rocket meal

Methanol rocket meal extract showed antioxidant effect in concentrated manner by using (DPPH) assay as 1% gave 47.55% of activity **(figure 1).** These results agree with ***Barillari et al., (2005***) and ***Bennett et al., (2006)*** who detected that rocket seed meal contains several components as glucosinolates and flavonoids which have high antioxidant activity

Growth Performance

Data collected for growth performance of broiler Japanese quail such as live body weight, body weight gain, feed consumption and feed conversion ratio are presented in **Table (3).** Results indicated that insignificant differences were observed in the live body weight among the experimental groups during the experiment period except at 2^{nd} and 3^{rd}

weeks of age. It was observed that live body weight at 2nd week increased significantly (P<0.05) for the **T_2** group compared to control group. While at 3rd week of age, a significant (P<0.05) heaver live body weight was recorded for **T_1** group compared with the other experimental groups. No significant effect was observed at last 2weeks of the experimental period on the live body weight. However, live body weight was insignificant decreased with feeding Japanese quail on high level of rocket meal**. Abdo (2003)** found that feeding broiler chicken on diet contained 50% substitution with rocket meal decreased both body weight and body weight gain significantly when compared with control group**,** this could be refer to that rocket **(***Eruca Sativa)* seeds meal contains antinutritive components such as Erucic acid which may have negative effects on improving the viability rate and broiler performance. These results are in accordance with those of **Flanders and Abdulkarim (1985); Fernandez-Martinez*, et al.*, (2001) and Abdo (2003).**

Results of feed consumption and feed conversion ratio which are tabulated in Table **(3)** show that no significant effects among all experimental groups on feed consumption for the first 2 weeks of experimental time. While at 4th and 5th week of the experiment, **T_1** group was significantly (P<0.05) recorded less feed consumption compared with other **T_2** and **T_3** groups**.** These results are in accordance with those reported by **Fernandez-Martinez*, et al.*, (2001), Abdo (2003)**, **Osman, *et al.*, (2004) and Tripath and Mishra (2007).**

Feed conversion ratio indicates no clear trend between all groups of tested materials but, feed conversion ratio was significantly (P<0.05) improved with **T_2** group (3.55) compared with control group (4.26) at 2nd week of experiment whereas **T_1** group **(**3.83) was recorded better feed conversion but was not significant compared to the control group (4.66) at the 3rd week of the experiment. While **T_3** group at 4th week was significantly (P<0.05) lower in feed conversion ratio compared with control group, whereas **T_1** and **T_3** groups were significantly (P<0.05) lower in feed conversion ratio compared with control group at 5th week of experiment.

In general, overall means of live body weight, body weight gain, feed consumption and feed conversion ratio revealed that no significant effects were observed for all experimental groups due to feeding Japanese quails on diets contained different levels of rocket meal.

Biochemical Parameters:

Results of blood constituents for all experimental groups as affected by different treatments at different ages are given in Table **(4).** At the 3rd and 5th week post treated with rocket meal, total plasma protein was not significantly affected by replacing any ratio of rocket meal with soybean meal. While $\mathbf{T_2}$ group had a significantly ($P<0.05$) lower albumin value at 3rd and 5th week of the experiment compared with control and other group. However, globulin was significantly ($P<0.05$) increased with $\mathbf{T_2}$ group. It is well known that the changing in plasma albumin level reflects the change in liver function, where the liver is the site of albumin synthesis while the globulin formed by lymphatic tissues **(Jones and Bark, 1979).** The increase in globulin value reflected a good immune status which may attributed to the immunostimulant effect of rocket meal to the diets **(Aqel, 1993)** and **(Tollba and Hassan, 2003)**. A/G ratio was significantly ($P<0.05$) decreased with $\mathbf{T_2}$ group, lower A/G ratio may be attributed to either increase globulin values that due to improving immune status or lower albumin values.

Blood cholesterol and triglycerides were decreased significantly ($P<0.05$) in quail after 3 and 5 weeks of experiment when compared with the control group. These results are in agreement with those obtained by **Abou-Egla *et al.*, (2000) and Nofal *et al.*, (2006).** They attributed the reduction in plasma cholesterol level to high content of unsaturated fatty acids in Nigella sativa meal that may stimulate the cholesterol excretion into the intestine and oxidation of cholesterol to bile acids.

Concerning liver function, data showed insignificant effect on both AST and ALT at 3 or 5 weeks of experiment. No deleterious effect on liver weights (Table 8) and non pathological or toxic effect observed between treated groups that reflect no adverse effect for tasted materials on the quail health. These results agree with those obtained by **Osman *et al.*, (2004)** which found that adding rocket meal with level of 5, 10 or 15% in broiler diets decreased the AST and ALT value without any adverse effect on the liver function.

Plasma creatinine and uric acid were insignificantly affected in all groups at 3 or at 5 weeks of experiment which indicated that no significant effect was observed for tested materials on creatinine and uric acid between all groups. **Newman (1971)** found that the decrease in plasma creatinine level was associated with loss of muscle mass. **Duckes**

(1960) reported that the direct proportionality between creatinine excretion and body weight is in conformity with all evidence that creatinine represents the muscular mass of the body, and also illustrated that creatinine excretion is an index of the metabolic activity of the tissues specially skeletal muscle. These results are in agreement with those obtained by **Abdel-Malak, *et al.*, (1995)** who reported that uric acid is known as the end product of protein metabolism which is mainly affected by the level of dietary protein content rather than any other factors.

Immunological Finding

A) Antibody levels against NDV vaccine were measured by ELISA (Table 5) and HI (Table 6). The antibody levels determined by both methods showed a gradual increase post-vaccination till the 3rd week followed by decline in the antibody levels. At 1st and 2nd week post vaccination, antibody levels in the three tested groups were fluctuated above and below the level of control group. While at 3rd and 4th week post vaccination all tested groups showed a slight increase in antibody levels compared with control group, whereas the highest values were obtained with group fed with 16% rocket seed meal **(T_2)**.

B) Both phagocytic percentage and index of macrophage which obtained from peripheral blood monocyte isolated after 24 hrs of poster dose of NDV vaccine were illustrated in Table (7) and Photo (1). Both 16 **(T_2)** and 32% **(T_3)** of rocket seed meals revealed a significant ($P<0.05$) increase in both phagocytic percentage and phagocytic index when compared with control group. Absence of any significant variation between both control and first group and between the third and first group were estimated. The second group (16%) was significantly ($P<0.05$) higher than any other concentration of rocket seed meal group and control.

C) Figure (2) illustrates the level of nitric oxide produced by macrophage which obtained from peripheral blood monocyte isolated after 24 hrs of poster dose of NDV vaccine. Statistical analysis revealed no significant variations between control group and group fed on 8% rocket seed meal, on the same time there was a significant ($P<0.05$) variation between them and other levels of rocket seed meal (16 and 32%) was noticed. There was a significant ($P<0.05$) variation between amount of nitric oxide produced by macrophage isolated from quail fed on 16% and 32% rocket seed meal with the highest value obtained with 16%. Nitric oxide is generated

during immune and inflammatory responses. It is involved in innate immunity as a toxic agent towards infectious organisms, but can induce or regulate death and function of host immune cells ***(Coleman, 2001)*** and produced at high levels by macrophages through its activation ***(Aouatef et al., 2002)*.**

The improvement of both humoral and cell mediate immune response expressed by increase antibody levels, phagocytic percentage, phagocytic index and nitric oxide production may be attributed to the high antioxidant contents of rocket seed meal.

The relationship between antioxidant and immune cells may be explained as the following, it is known that the immune cell function is linked to the release of reactive oxygen species (ROS) even though this ROS is involved in the microbicidal and cytotxic activity of immune cells, excessive amount of it is harmful for immune cells as it attack cellular components and lead to cell damage or death. This ROS can be scavenged by antioxidants leading to improving immune cell functions ***(Fuent and Victor, 2000; Victor et al., 2003; Hughes, 1999*** and ***Barillari et al., 2005).*** The later researcher added that, the major glucosinolates in rocket seeds is Erucin which is potentially capable of protecting cells against oxidative stress via three mechanisms: (i) induction of phase II enzymes, (ii) scavenging hydrogen peroxide and alkyl hydroperoxides accumulated in cells and peripheral blood, and (iii) acting as a precursor of sulforaphene, a potent inducer for detoxifying electrophiles and increase cellular antioxidant defenses.

The lower immune response of 32% of rocket seed meal comparing with the 16% level may be attributed to presence of harmful compounds in rocket seed meal appear with high level. The previous postulation supported by **West *et al.*, (2004)** who found that presence of some components of rocket seed meal that might have negative health implications if it used in high concentration such as certain indole-containing glucosinolates and erucic acid-containing lipid.

Carcass Data

Carcass data of growing Japanese quail fed on dietary replacement ratio of rocket meal protein instead of soybean meal protein at the end of the experiment are given in Table (8). The present study indicated that inclusion level of 8%, 16% and 32% of rocket meal protein to replace

soybean meal protein in growing Japanese quail diet did not affect body weight (g), carcass (g), liver, heart, dressing carcass, spleen and intestinal percentages when compared with those of control group. These results pointed that feeding Japanese quail on diets containing different percents of rocket meal had no adverse effects on carcass characteristics. The results of gizzard weights increased as the level of rocket meal protein increased in the diets of Japanese quail. These results are in agreement with those obtained by **Osman *et al.*, (2004)** which displayed that use of rocket meal protein with percent of 5, 10 and 15% instead of soybean meal protein in broiler diets did not affect the carcass characteristics. On the other hand, the abdominal fat percentage was significantly ($P<0.05$) decreased with increasing of tested material in growing Japanese quail diets when compared with the control group. The abdominal fat percentages were 1.38, 1.02, 0.063 and 0.057% for control, $\mathbf{T_1}$, $\mathbf{T_2}$ and $\mathbf{T_3}$ groups, respectively. The reduction observed in the abdominal fat percentages may be due to that rocket meal has several biological activities including anti-carcinogenic, anti-fungal, anti-bacterial and antioxidative effects **(Fenwick *et al.*, (1983); Bennett *et al.*, (2002) and Kim *et al.*, (2004).** The results agreed with those found by **Hopper and Satterlee, (1984**) who found that abdominal fat was depressed in chicks treated with mustard meal which belongs to the same family of *Eruca Sativa* (rocket). No significant effect was observed on intestinal or caeca length (cm) due to feeding growing Japanese quail on the dietary of rocket meal instead of soybean meal.

Upon the obtained results of the present study it could be concluded that rocket meal can be successfully used in the growing Japanese quail diets as a cheap source of plant protein up to 32% to replace soybean meal protein without any adverse effects on growth performance, blood contents and carcass characteristics of broiler Japanese quail. From immunological point of view, the rocket seed meal can improve and preserve adequate function of immune cells due to its antioxidant activity.

Table (1): Composition and calculated analysis of experimental diets of broiler Japanese quail supplemented with different replacement ratios of rocket meal.

Ingredients %	Control	T_1 (8 %)	T_2 (16 %)	T_3 (32 %)
Yellow Corn	**56.00**	**55.10**	**54.00**	**50.00**
Soybean Meal (44%)	**32.00**	**29.44**	**26.88**	**21.76**
Broiler Concentrate (52%)*	**10.00**	**10.00**	**10.00**	**10.00**
Rocket Meal	**0**	**3.73**	**7.46**	**14.92**
Corn Gluten (62%)	**0.15**	**0.10**	**0.10**	**0.22**
Wheat Bran	**0.15**	**0.40**	**0.70**	**2.50**
Sunflower Oil	**1.20**	**0.725**	**0.36**	**0.10**
Sodium Chloride (NaCl)	**0.15**	**0.15**	**0.15**	**0.15**
Vita. and Min Mix. **	**0.25**	**0.25**	**0.25**	**0.25**
DL- Methionine	**0.10**	**0.10**	**0.10**	**0.10**
Total (Kg)	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis:				
Crude Protein %	**24.32**	**24.24**	**24.20**	**24.20**
Metabolizable Energy Kcal/ Kg	**2910.23**	**2904.40**	**2904.06**	**2904.51**
Calcium (%)	**0.93**	**0.92**	**0.94**	**0.95**
Available Phosphorus (%)	**0.44**	**0.43**	**0.44**	**0.43**
Methionine (%)	**0.56**	**0.55**	**0.55**	**0.54**
Lysine (%)	**1.30**	**1.29**	**1.29**	**1.29**
Methionine and Cystein	**0.85**	**0.81**	**0.78**	**0.72**
Analyzed:				
Crude Protein %	**24.22**	**23.97**	**23.96**	**23.91**

* **Broiler concentrate contain:** 52% crude protein, 2075 ME (Kcal/Kg), 8.29% calcium, 3.12 % avail. Phosphorus, 8.2% crude fat, 1.6% crude fiber, 2.3% lysine, 1.4% methionine, 2.4% methionine + cyctine and 1.76% sodium chloride.

Broiler concentrate made of meat and bone meal 60%, fish meal 72%, corn glutein meal 60%, sodium chloride, calcium carbonate, D-L Methionine, dicalcium phosphate, vitamins and minerals mixture.

** **Each 3 kg from vitamins and minerals mixture contains:** Vit. A 100000 IU, Vit. D_3 200000 ICU, Vit. E 10000 IU, Vit B_1 1000 mg, Vit. B_2 5000mg, Vit B_6 1500 mg, Vit. B_{12} 10mg, Pant. acid 1000mg, Folic acid 1000mg, Biotin 50mg, Niacin 3000mg, Fe. 30000mg, Mn 6000mg, Cu 40000mg, Zn 50000mg, Io.300mg, Co. 100mg and Selenium 100mg.

Table (2): Proximate analyzed of Rocket meal (***Eruca Sativa***).

Item	Rocket Meal*	Soybean Meal***
Moisture %	7.37	11.00
Crude Protein %	30.20	44.00
Ether Extract %	5.65	0.8
Crude Fiber %	10.20	7.00
Ash %	8.36	6.82
Nitrogen Free Extract (NFE) %	38.22	30.38
Metabolizable Energy (ME Kcal/Kg)**	3265.96	2230
Calcium %	0.45	0.29
Total Phosphorus %	0.60	0.65
Methionine %	0.35	0.62
Lysine %	1.93	2.69
Cystine %	0.19	0.69

***** Analyzed by Central Laboratory for food and feed, Agric. Res. Center, Giza, Egypt.
****** Calculated according to **Carpenter and Clegg e**quation **(1956).**
ME (Kcal/Kg) = 35.3x %CP+ 79.5 x %EE + 40.6 x % NFE + 199
******* According to **NRC (1994)**.

Table (3): Effect of dietary replacement ratio of Rocket meal on growth performance of growing Japanese quail (Means ±S.E).

Parameter	Age (w) / Treat	Initial (1 week age)	2Week	3Week	4Week	5Week	Overall Mean
Live body weight (g)	Control	37.57±0.73	68.19±1.41^{b}	100.33±1.78^{b}	138.71±2.29	176.60±2.91	120.95±2.12
	T_1 *	37.67±0.44	70.28±0.91^{ab}	108.92±1.46^{a}	142.81±1.51	173.81±1.90	123.96±1.46
	T_2 **	37.80 ±0.50	73.45±1.34^{a}	103.78±1.58^{b}	140.40±2.05	178.93±2.47	124.14±1.89
	T_3 ***	37.23±0.46	71.03±0.90^{ab}	103.17±1.34^{b}	137.88±0.97	172.06±2.04	121.04±1.35
Body weight gain (g)	Control		30.62±1.63^{b}	32.14±2.34^{ab}	38.38±1.92^{a}	37.89±1.21^{a}	34.76±1.80
	T_1		32.61±0.55^{ab}	38.64±1.62^{a}	33.89±0.75^{b}	31.00±1.19^{b}	34.04±1.05
	T_2		35.65±0.99^{a}	30.33±1.79^{b}	36.62±0.40^{ab}	38.53±2.88^{a}	35.28±1.55
	T_3		33.80±0.1^{ab}	32.14±1.93^{ab}	34.71±1.35^{ab}	34.18±1.26^{a}	33.71±1.19
Feed consumption (g)	Control		130.48±0.37	149.80±0.41	171.00±3.21^{ab}	168.68±1.20^{b}	154.99±1.33
	T_1		129.13±2.16	147.92±3.02	165.60±0.69^{b}	166.80±0.92^{b}	154.36±1.72
	T_2		126.68±1.01	152.53±1.74	174.00±1.00^{a}	176.00±0.46^{a}	157.30±1.10
	T_3		128.26±0.46	154.00±2.30	173.73±1.88^{a}	177.73±0.93^{a}	158.43±1.43
Feed conversion ratio	Control		4.26±0.24^{a}	4.66±0.46^{ab}	4.46±0.14^{b}	4.45±0.12^{b}	4.46±0.25
	T_1		3.95±0.03^{ab}	3.83±0.09^{b}	4.88±0.11^{ab}	5.38±0.20^{a}	4.51±0.11
	T_2		3.55±0.11^{b}	5.03±0.29^{a}	4.75±0.07^{ab}	4.56±0.34^{b}	4.47±0.22
	T_3		3.79±0.005^{b}	4.79±0.26^{ab}	5.01±0.14^{a}	5.20±0.14^{a}	4.69±0.16

Means with the different litter in the same column are significantly different (P<0.05).
T_1 was fed diet containing 8% as replacement of soybean meal protein with rocket meal protein.
T_2 was fed diet containing 16 % as replacement of soybean meal protein with rocket meal protein.
T_3 was fed diet containing 32 % as replacement of soybean meal protein with rocket meal protein.

Table (4): Effect of dietary replacement ratio of Rocket meal with soybean meal on blood characteristics of growing Japanes quail (Means ±S.E).

Treat.	Age	Total protein g/dL	Albumin g/dL	Globulin g/dL	A/G Ratio	Cholest. mg/dL	Triglyce. mg/dL	AST U/L	ALT U/L	Creatin. mg/dL	Uric acid mg/dL
Control	After 3 weeks	4.40±0.30	2.50±0.11^{a}	1.90±0.13^{c}	1.31±0.15^{a}	110.00±2.58^{a}	100.00±3.12^{a}	40.20±2.22	24.00±1.10	0.20±0.050	8.44±1.92
T_1		4.45±0.21	2.40±0.12^{b}	2.05±0.19^{b}	1.17±0.11^{b}	106.10±2.40^{a}	90.90±2.11^{b}	40.10±2.11	23.73±1.23	0.20±0.054	8.35±1.25
T_2		4.65±0.22	2.30±0.13^{c}	2.35±0.15^{a}	0.97±0.13^{c}	105.10±2.31^{a}	90.00±2.41^{b}	40.00±2.18	23.55±1.15	0.19±0.011	8.30±1.22
T_3		4.50±0.32	2.40±0.12^{b}	2.10±0.12^{b}	1.14±0.14^{b}	100.30±1.01^{b}	85.00±2.31^{c}	40.05±2.13	23.90±1.12	0.20±0.044	8.40±1.10
Control	After 5 weeks	4.28±0.22	2.28±0.25^{a}	2.00±0.20^{c}	1.14±0.09^{a}	115.93±3.20^{a}	102.21±5.18^{a}	42.20±2.22	25.15±1.65	0.42±0.05	8.54±1.92
T_1		4.30±0.59	2.10±0.41^{b}	2.20±0.23^{b}	0.95±0.09^{b}	114.88±2.43^{a}	95.20±4.12^{b}	42.14±2.11	25.18±1.93	0.44±0.05	8.54±1.21
T_2		4.30±0.57	1.95±0.49^{c}	2.35±0.51^{a}	0.82±0.10^{c}	108.00±2.24^{b}	93.10±3.61^{b}	41.70±2.28	25.00±1.61	0.40±0.11	8.50±2.11
T_3		4.32±0.62	2.10±0.33^{b}	2.22±0.50^{b}	0.94±0.15^{b}	109.79±4.22^{b}	90.40±3.30^{c}	41.80±2.44	25.13±1.60	0.44±0.14	8.52±2.13

Means with the different liters in the same column are significantly different (P<0.05).

Table (5): Effect of different levels of rocket cakes on Japanese quail immune response to ND vaccine estimated by ELISA (optical density).

Time / Groups	1st W. P. V.	2nd W. P. V.	3rd. W. P. V.	4th W. P. V.
Control	**0.660±0.053^{a}**	**0.939±0.149^{ab}**	**1.281±0.169^{b}**	**1.094±0.0079^{b}**
T1	**0.606±0.0503^{a}**	**1.093±0.1098^{b}**	**1.375±0.1768^{b}**	**1.138±0.1705^{b}**
T2	**0.653±0.0581^{a}**	**0.818±0.0938^{a}**	**1.386±0.0621^{b}**	**1.229±0.109^{b}**
T3	**0.668±0.0477^{a}**	**0.9113±0.0711^{a}**	**1.356±0.190^{b}**	**1.015±0.1099^{ab}**

Means with different superscripts in the same column are significantly different ($P<0.05$) **W. P. V.** = Week of post-vaccination.

Table (6): Serum antibody geometric mean titres of ND vaccinated quail by Haemagglutination inhibition (HI) test in different groups.

Time / Groups	1st W. P. V.	2nd W. P. V.	3rd W. P. V.	4th W. P. V.
Control	**53.82**	**215.27**	**512.0**	**128**
T1	**38.05**	**215.27**	**430.54**	**152.22**
T2	**45.25**	**181.02**	**861.08**	**304.44**
T3	**53.82**	**256**	**608.87**	**181.02**

W. P. V. = Week of post vaccination.

Table (7): Phagocytosis of peripheral blood monocyte.

Parameter / Group	24 hours p. poster dose of vaccine	
	Phagocytic percentage	**Phagocytic index**
Control	59.83±1.376^{a}	0.5983±0.014^{a}
T1	61.833±1.249^{ab}	0.6333±.01764^{ab}
T2	70.50±1.204^{c}	0.767±0.0180^{c}
T3	64.67±1.174^{b}	0.657±0.016^{b}

Means with different superscripts in the same column are significantly different at ($P<0.05$).

Table (8): Effect of dietary replacement ratio of Rocket meal on carcass characteristics of growing Japanese quail at the end of experiment (Means ± S.E).

Item	Control	T_1	T_2	T_3
Body weight, g.	218.88±19.43	202.26±18.01	202.81±18.20	208.40±20.33
Carcass, g.	124.31±6.11	116.28±12.10	125.13±13.31	120.11±13.39
Liver weight, %.	2.55±0.19	2.80±0.19	2.66±0.19	2.60±0.19
Heart weight, %.	0.831±0.064	0.834±0.064	0.852±0.064	0.899±0.064
Gizzard weight, %.	$1.41±0.10^{b}$	$1.60±0.10^{ab}$	$1.65±0.10^{ab}$	$1.80±0.10^{a}$
Dressing carcass, %.	56.79±1.36	57.49±1.36	61.69±1.36	57.63±1.36
Spleen weight, %.	0.080±0.01	0.078±0.01	0.079±0.01	0.080±0.01
Abdominal fat %.	$1.38±0.09^{a}$	$1.02±0.09^{b}$	$0.63±0.09^{c}$	$0.57±0.09^{d}$
Intestinal weight, %.	5.70±0.43	5.73±0.43	5.68±0.43	5.71±0.43
Intestinal Length, cm.	62.83±3.06	65.83±3.06	62.66±3.06	67.66±3.06
Caeca Length, cm.	8.91±0.59	8.83±0.59	8.86±0.59	10.36±0.59

Overall means within each row with different litter are significantly different at least at P<0.05.

Figure (1): Indirect method for antioxidant determination by ESR (DPPH).

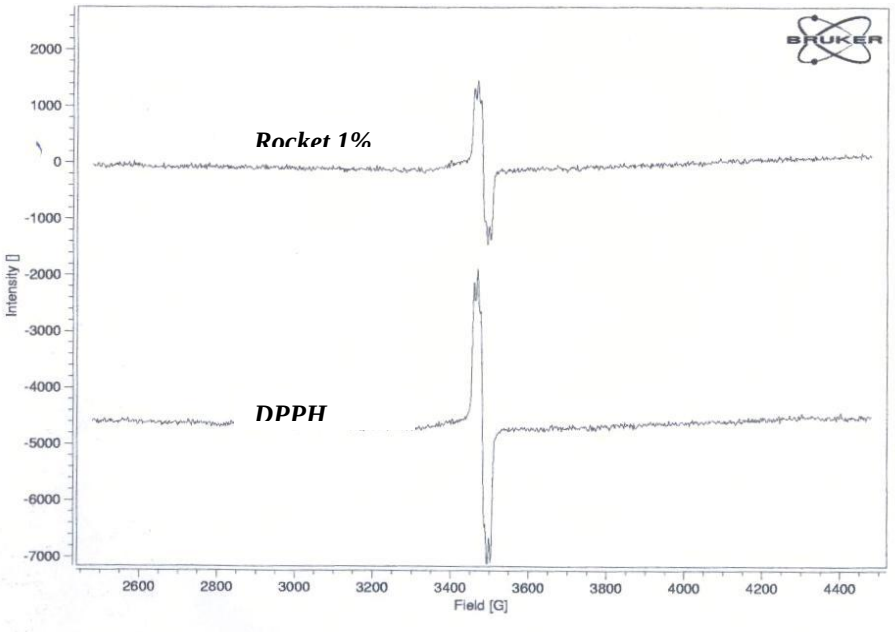
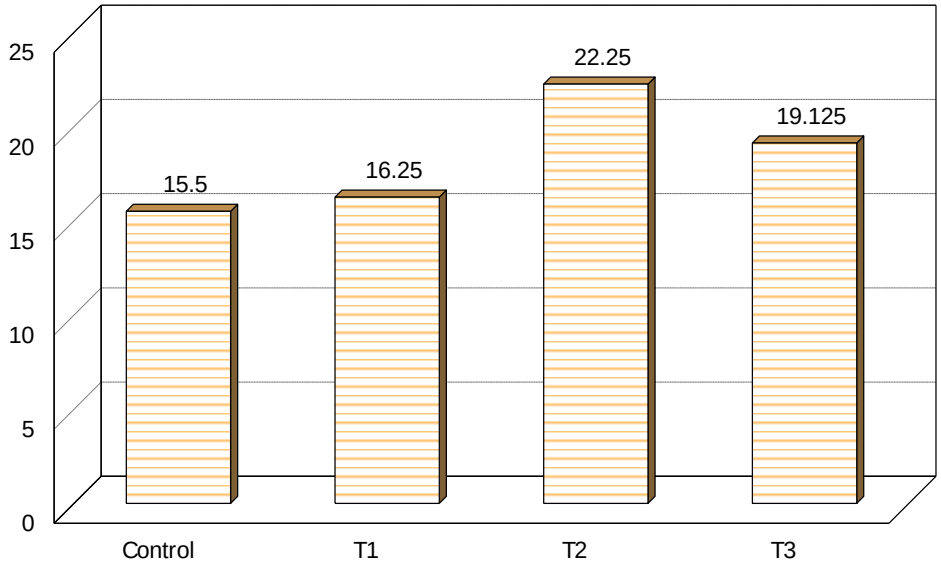


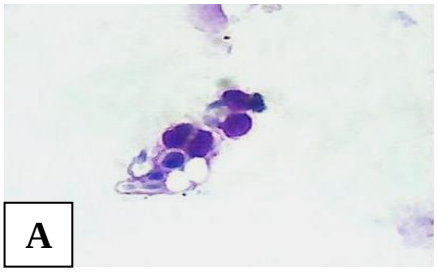
Figure (2): Nitric oxide level in supernatant of phagocytic media

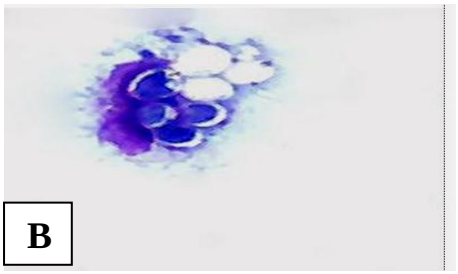


Group	Control	T1	T2	T3
Nitric oxide level	15.50±0.64[a]	16.25±1.05[a]	22.25±0.25[b]	19.13±1.20[c]

Means with different superscripts are significantly different (P<0.05).

Photo (1): Phagocytic activity (activated macrophage engulf candida spores).





A: Phagocytic cell engulf two Candida.

B: Phagocytic cell engulf four Candida.

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الملخص العربي

تأثير استخدام نسب مختلفة من كسب الجرجير على حالات المناعة وكيمياء الدم الحيوية و النمو للسمان الياباني

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أجريت هذه الدراسة بقسم الإنتاج الحيواني– كلية الزراعة– جامعة الأزهر ومعهد بحوث صحة الحيوان التابع لوزارة الزراعة بهدف معرفة تأثير إحلال نسب من بروتين كسب الجرجير محل بروتين فول الصويا في علائق السمان الياباني النامي علي معدل النمو والاستجابة للمناعة واستهلاك الغذاء ومكونات الدم ونسبة التصافي. استخدم في هذه الدراسة

300 كتكوت سمان عمر أسبوع وتم تقسيم الطيور إلي أربع مجموعات متساوية هي مجموعة الكنترول، المعاملة الأولي تمت تغذيتها علي 8% من بروتين كسب الجرجير بدلا من 8% من بروتين فول الصويا. المعاملة الثانية غذيت على 16 % من بروتين كسب الجرجير بدلا من 16% من بروتين فول الصويا والمعاملة الثالثة غذيت على 32 % من بروتين كسب الجرجير بدلا من 32% بروتين فول الصويا. ويمكن تلخيص النتائج المتحصل عليها من هذه الدراسة في مايلى:

١ -تم قياس التاثير المضاد للاكسدة فى المستخلص الميثانولى لكسب الجرجير بنسبة 1% باستخدام تحليل مادة DPPH ووجد انها تساوى 47.55%.

٢ -لم توجد أي اختلافات معنوية بين المعاملات أو مجموعة الكنترول في وزن الجسم و معدل استهلاك وتحويل الغذاء.

٣ -لم تلاحظ هناك أي اختلافات معنوية في بروتينات البلازما الكلية عند الأسبوع الثالث أو الخامس وسجلت المعاملة الثانية T_2 أفضل النتائج معنوياً في نسبة الالبيومين و الجلوبيولين و النسبة بينهما، بينما سجلت المجموعة الثالثة T_3 أقل معنوية في نسبة الكولسترول والجليسريدات الثلاثية. وكذلك لم تلاحظ اى اختلافات معنوية في وظائف الكبد AST و ALT وكذلك في نسبة الكرياتينين وحمض اليوريك بين جميع المعاملات.

٤ -تم قياس مستوى الاجسام المضادة لفيروس النيوكاسل باستخدام كل من اختبار الاليزا واختبار التلزن الدموي ووجد أن مستوى الأجسام المضادة يتزايد تدريجيا مع الوقت حتى الاسبوع الثالث ثم يبدا فى النزول في الاسبوغ الاول والثانى بعد التحصين، مستوى الاجسام المضادة فى المجموعات الثلاثة كان يتارجح حول مستواه فى المجموعة الضابطة ولكن في الأسبوع الثالث والرابع بعد التحصين كان مستوى الاجسام المضادة فى المجموعات المعاملة اعلى من مستواه فى المجموعة الضابطة وكانت اعلى زيادة فى المجموعة التى غذيت على 16% من كسب الجرجير.

٥ -كل من المجموعتين التى حصلت على 16 و 32% من كسب الجرجير كانت بها زيادة معنوية فى كل من نسبة الابتلاع ومعدل الابتلاع للخلايا المناعية المعزولة من الدم بعد 24 ساعة من الجرعة الثانية من تحصين النيوكاسل.

٦ -نسبة غاز اوكسيد النيتريك المنتج من الخلايا المناعية المعزولة من السمان الياباني كانت فى اعلى مستوياتها فى المجموعة التى حصلت على 16% من كسب الجرجير مقارنة بكل من المعاملات الاخرى او المجموعة الضابطة.

٧ -لم تلاحظ أي اختلافات معنوية في صفات الذبيحة بين المعاملات المختبرة والكنترول في حين زادت وزن القونصة معنوياً بزيادة معدل إحلال كسب الجرجير محل كسب فول الصويا. بينما انخفضت النسبة المئوية لدهن البطن معنوياً بزيادة معدل إحلال كسب الجرجير محل كسب فول الصويا في علائق السمان الياباني النامي.

٨ -أوضحت هذة الدراسة أنة يمكن استخدام كسب الجرجير بدلا من كسب فول الصويا حتى 32% دون أضرار على أداء السمان الياباني النامي وان كان وزن الجسم يقل بدون معنوية مع زيادة مستوى كسب الجرجير في علائق السمان الياباني. كذلك استخدام كسب الجرجير في علائق السمان الياباني النامي يحسن ويحمى الخلايا المناعية لتقوم بوظيفتها الكاملة والملائمة نتيجة لاحتوائه على مضادات الأكسدة النشطة.