Minufiya J. Agric. Res. Vol.39 No. 4(1): 1287-1315 (2014) "http://www.mujar.net"

EFFECT OF SUPPLEMENTATION OF NIGELLA SATIVA L., NATUZYME AND THEIR MIXTURE TO BROILER DIETS
1. PERFORMANCE AND CARCASS CHARACTERISTICS.

A.M.H. Abou-Ashour, S.A.A. Abd El-Rahman, G.A. Zanaty, Manal K. Abou El - Naga and Eman A. Hussein
Poult. Prod. Dept, Fac. of Agric., Minufiya Univ., Shebin El-Kom, Egypt.

(Received: May, 19, 2014)

ABSTRACT: *The objective of this investigation was to study the effects of different levels of Nigella sativa seeds powder (NS), Natuzyme (NZ, commercial multi enzyme) or their mixture supplementation to basal diet on growth performance and carcass characteristics of broiler chicks under Egyptian conditions. Two hundred and seventy (270) one – day old (Arbor – acres) broiler chicks were used. All birds were individually weighed and randomly assigned to nine treatment groups nearly similar in average body weight, (3 replicates of 10 birds each). Nigella sativa and /or Natuzyme were added to the basal diet (starter and finisher) as follows: T_1: basal diet (control, without any supplementation), T_2: basal diet + 2% Nigella sativa, T_3: basal diet + 4% Nigella sativa,T_4: basal diet + 0.03% Natuzyme,T_5: basal diet + 0.05% Natuzyme,T_6: basal diet + 2% Nigella sativa + 0.03% Natuzyme,T_7: basal diet + 2% Nigella sativa + 0.05% Natuzyme,T_8: basal diet + 4% Nigella sativa + 0.03% Natuzyme and T_9: basal diet + 4%, Nigella sativa + 0.05% Natuzyme. The experiment lasted for 49 days. Performance parameters and carcass characteristics were determined. Results indicated that birds fed the mixture of Nigella sativa powder with Natuzyme supplemented diets had significantly (P≤0.05) higher means of final live body weight and body weight gain. Feed conversion was significantly (P≤0.05) improved by mixed levels of Nigella sativa powder and Natuzyme mixture supplement. The best high feed conversion (1.88) was obtained for treatment 7, (2% Nigella sativa with 0.05% Natuzyme). The mixture of Nigella sativa powder with Natuzyme supplementation significantly (P≤0.05) increased the performance index (PI) in comparison with control treatment. There are highly significant beneficial effects of Nigella sativa, Natuzyme or their mixture on dressing and giblets percentages. The beneficial economical effect of Nigella sativa and / or Natuzyme supplementation, specially at level of 2% NS with 0.05% NZ was noticed.*

Key words: *Nigella sativa, Natuzyme, performance, carcass characteristics, broilers.*

INTRODUCTION

Phytogenic feed additives have received considerable attention as alternatives to traditional antibacterial feed additives such as antibiotics, probiotics and prebiotics. Feed antibiotics have been used for promoting growth in poultry, though; they have been banned and thus removed from diets in many countries. This may negatively affect the profitability of the poultry; feed industry will have to search for alternatives to those (Khan *et al.*, 2011). Possible alternatives to antibiotics may be represented by plant products. Indeed, plant products have been used for centuries as food and medicines. Natural medicinal products made with herbs and spices have also been used as feed additives for poultry (Guo *et al.*, 2004).

In view of the ban on antibiotic growth promoters (AGP) in the European Union and in Egypt and the expected expansion of this trend to the rest of the world, intensive research has been focused on the development of alternative strategies to maintain health and performance status in moden poultry production systems. Different substances, referred to as Natural Growth Promoters (NGP), have been identified as effective alternative to AGP. At present, a large number of NGP are available on the market, including organic acids, immune – modulators, probiotics, prebiotics, enzymes, phytobiotics and medical plants. All these products have the potential to beneficially affect gut microflora which protects the host against pathogenic invasion. In some cases, however, scientific reports are inconsistent regarding the efficacy of NGP.

*Nigella sativa L., (*NS, Black cumin seeds) is an example of natural feed additive. It is also known as aromatic plants grown in Asian and Mediterranean countries and it have been used for centuries in Asia, Northern Africa, Middle and Far East for the treatment of asthma in the presence of the anti-asthmatic compound nigellone (El-Tahir *et al.,* 1993), as digestive and appetite stimulant (Gilani *et al.,* 2004), hepato-protective (Janbaz *et al.,* 2003) and antitumor agent (Abuharfeil *et al.,* 2001). Black cumin seed is a major source of protein and energy. Most unsaturated fatty acids are linoleic and oleic acids, while saturated fatty acids are mostly palmitic acid. Amino acids are mostly represented as glutamic acid, arginine and aspartic acid, while cystine and methionine are least expressed (Saleh, 1992).

The effects of dietary NS on the performance of broilers have been investigated by Halle *et al*. (1999), Osman (2002) and Abbas and Ahmed (2010). Halle *et al.* (1999) showed an increase in body weight (LBW). Osman (2002) found that supplementing broiler chick diets with NS oil significantly (P ≤ 0.05) enhanced body weight gain (BWG) and feed conversion ratio (FCR) and decreased feed consumption. However, results of Abbas and Ahmed, (2010) reported that birds offered a diet supplemented with 1 or 2% NS significantly (P ≤ 0.05) showed lower BWG and unaffected FCR. Al-Beitawi *et al.* (2009) reported that NS have immune-stimulant effects, thus maintaining broiler chicks in good health. Also, no significant differences were observed for most carcass characteristics, with the exception of blood, liver, heart and intestine weight (Durrani *et al.,* 2007). The literature on the haemato-biochemical values of broiler chickens fed NS is still limited. Results of studies conducted on broilers, reported that NS had positive effect on weight gain and feed conversion ratio (Tollba and Hassan, 2003, Al–Beitawi and El–Ghousein, 2008, Al–Harthi 2006 and Guler *et al.,* 2006), on feed intake, dressing percentage, weight of different internal organs (Durrani *et al.,* 2007) and on the performance and survivability (Abu–Dieyeh and Abu–Darwish, 2008). It was reported that diet supplemented with 10% NS had no adverse effects on the performance (Al–Homidan *et al*., 2002).

Nowadays, most nutritionists formulate diets for poultry based completely on oil-seed meals, cereal grains and their by-products. Such plant feed ingredients naturally contain a variety of anti-nutritional substances that cannot be digested by mono-gastric animals, because of the lack or insufficiency of endogenous enzyme secretions. In addition to being unavailable to poultry, these components also lower the utilization of other dietary nutrients, leading to depressed performance. Recently, the inclusion of commercial enzymes into poultry diets has become a common practice, with different degrees of success depending upon the stress, health and nutritional status of the bird. The main targets for using feed enzymes are to increase digestibility or availability of nutrients, to break down the anti-nutritional factors, to achieve the least cost feed formulations and for environmental reasons (Bedford, 1996 and Bedford and Morgan, 1996).

Natuzyme in poultry is used a feed additive. It is cheap, safe, and capable of reducing anti-nutritional factors. *Natuzyme* (NZ) consists of a group of enzymes that have the ability to hydrolyze hemicellulose, in this case xylan or polymers of xylose and xilo-oligosacharides. Enzyme activity is decreased with increasing chain pf xilo-oligosaccharides (Reillyt 1991; Dekker 1983). It works efficiently to hydrolyze very complex chemical compounds from non-starch polysaccharides, by loosening the binding of nutrients to the non- starch polysaccharide matrix. Therefore, the nutrients that are bound to non-starch polysaccharides in the matrix are released to facilitate the works of endogenous enzymes.

Exogenous enzymes in poultry feeds to improve bird performance is not a new practice but has long been documented. In this regarded, Peric *et al.* (2008) investigated the effect of addition of an enzyme complex (containing protease, amylase, ß- glucanase, xylanase, pectinase, cellulose and phytase) to diets of different nutritive values on the performance of broiler chickens., and found that enzyme addition resulted in positive effects on gain and feed conversion. Ismail (2011), Hassan *et al.* (2011) and Khalaji *et al.* (2011) found that the growth performance of broiler chicks were significantly (P≤0.05) improved with enzyme complex addition to the diets.

The objective of the present work was to study the effects of different levels of *Nigella sativa*, *Natuzyme* and their mixture supplementation to basal diet on growth performance and carcass characteristics of broiler chicks under Egyptian conditions. The economical efficiency was also evaluated.

MATERIALS AND METHODS

The present study was conducted in the Poultry Research Farm and the Poultry Nutrition Laboratory, Faculty of Agriculture, Minufiya University, Shebin El-kom. The objective of this investigation was to study the effect of different levels of *Nigella sativa* (NS), *Natuzyme* (NZ, commercial multi enzyme) and their mixture on growth performance, carcass characteristics of broiler chicks under local environmental conditions.

Experimental diets: The National Research Council's nutrient values for ingredients (NRC, 1994) were used to formulate the basal diet (Tables 1 and 2). The basal corn–soybean meal starter diet contained approximately (calculated) 90% DM, 22.01% CP and ME of 3149 Kcal ME/kg diet. The basal corn–soybean meal finisher diet contained 90% DM, 19.89% CP and ME of 3193 Kcal/kg diet. Basal starter and finisher diets were supplemented with feed additives (*Nigella sativa L.* powder and *Natuzyme*) as follows: T_1: basal diet (control, without any supplementation). T_2: basal diet + 2% *Nigella sativa L.* T_3: basal diet + 4% *Nigella sativa L.*T_4: basal diet + 0.03% *Natuzyme*. T_5: basal diet + 0.05% *Natuzyme*.T_6: basal diet + 2% *Nigella sativa L.* +0.03% *Natuzyme.* T_7: basal diet + 2% *Nigella sativa L.* + 0.05% *Natuzyme.*T_8: basal diet + 4% *Nigella sativa L.* + 0.03% *Natuzyme.*T_9: basal diet + 4%, *Nigella sativa L.* + 0.05% *Natuzyme.* The control diet was formulated to meet nutrient requirements of Arbor acres growing broilers; while the other eight groups were fed the same control diet supplemented with *Nigella sativa* seeds* and *Natuzyme* **. The composition and chemical analysis of NS are shown in Table 3. Natuzyme enzyme is a complex preparation produced by fermentation of selected bacterial and fungal strains. The source of NZ is Bio proton PTY ltd/Australia. (*Natuzyme*, Sunnybank, Brisbane, Australia). Mixing of experimental diets was done weekly.

Chicks Assay Procedures: On the day of hatch, two hundred and seventy, mixed sex Arbor - acres chicks were used in the experiment. Chicks were wing banded, weighed, and randomly allotted to 9 treatment groups, 3 replicates of 10 chicks per each group. The average initial weights were 38.77, 38.63, 38.83, 38.60, 38.83, 38.84, 38.60, 38.77 and 38.80g for the 9 experimental groups, respectively. Groups were reared in pens with litter (wheat straw) from 1 day - old up to 42 day of age. Throughout the 6 – week's experimental period, chicks were given feed and water *ad libitum*. Florecent lights were used to provide 24 hours of illumination daily throughout the experimental period. All proper husbandry practices were followed.

* *Nigella sativa seeds*, purchased from a local market in Egypt were powdered and thoroughly mixed with the starter and grower diets.

** *Natuzyme* (added at 300 and 500 g/ton diets) is a multifunctional feed enzyme mixture containing cellousase, xylanase, ß- glucanase, α- amylase, protease, pectinase and phytase. The declared minimum activity of the following enzymes: Xylanase (10.000.000 U L Kg), Cellulase (4.200.000 U L Kg), Pectinase (50,000 U L Kg), Beta – Gluconase (700.000 U L Kg), Phytase (700,000 U L Kg), Alpha – Amylase (700.000 U L Kg) , in addition to activity of Proteases, Hemi – Celluases, Amino – Glycosidases and Phosphatases acorroding to BIOPROTON PTY LTD, A.c.n. 059093417, Australian Business Number 19 059 093417.

Table 1

Table 2

Table (3). The chemical analysis of *Nigella sativa L.*

Constituents	%
Dry matter (DM)	91.46
Organic matter (OM)	86.40
Crude Protein (CP)	28.69
Crude Fiber (CF)	9.33
Ether Extract (EE)	7.13
Ash	5.06
Nitrogen-free extract (NFE)	41.25
ME (Kcal / Kg DM)[1]	2678.5

[1]ME, calculated (digestible energy DE*80%) assuming 80% energy utilization.
DE, calculated (GE*80%) assuming 80% energy digestibility.
GE, calculated (CP*5.6 + EE*9 + CF*4.4 + NFE*3.7 kcal/g), NRC (1994).

The following parameters were measured:

1- **Body weight and body weight gain.** Individual body weights were recorded on the first day of the experiment and biweekly throughout the experimental periods. Mortality was calculated.

2- **Feed intake and feed conversion.** Total feed intake/dietary treatment group/day was recorded and expressed as feed (g)/ bird/ day. Feed conversion was expressed as feed (g)/ body weight gain (g).

3- **Performance index (PI) was calculated according to North (1984) as follows:**

PI = Live body weight gain (Kg) ×100 / feed conversion.

4- **Slaughter and carcass information.** At the end of 28 and 49 days of age, three birds from each dietary treatment were weighed and slaughtered, after feed withdrawal for 12 hours, to determine carcass traits: eviscerated carcass (without head, neck, and legs), total giblets (liver, gizzard and heart), total edible parts (carcass + total giblets) and abdominal fat. Weights were expressed relative to live body weight. The bursa of fabricius, spleen and thymus (all lobes from left side of the neck) were cut and weighed to the nearest milligram. Data obtained were used for the calculation of dressing percentage as follows:

Dressing percentage (%)= carcass weight ×100 / live weight of bird.

5- **Economical efficiency:** The economical efficiency under local conditions was calculated from the input-output analysis (Heady and Jensen, 1954), assuming that other head costs were constant, as follows:

{(price of Kg weight gain – feed cost / Kg gain) / (feed cost / Kg gain x 100)}.

6- **Statistical Analyses:** Data were statistically analyzed by the completely randomized design using statistical software of SPSS 11.0 (2011) program and the differences among means were determined using Duncan's multiple range test (Duncan 1955). Percentages were transformed to the corresponding arcsine values before performing statistical analysis. The following statistical model was applied:

$$Y_{ijr} = \mu + \alpha_i + ß_j + (\alpha ß)_{ij} + E_{ijr}$$

Where:

Y_{ijr} = Observed traits.
μ = Overall mean,
α i = Effect of treatment (i = 1,2,3) .
$ß_j$ = Effect of treatment (i = 4, 5) .
$\alpha ß_{ij}$ = Effect interaction between of treatments (i = 6,7…, 9), and
E_{ijr} = Experimental random error.

Data from the control treatment were compared with the data from any one feed additive

level using **Duncan** test at **α** = 0.05.

RESULTS AND DISCUSSION

1- Effect of *Nigella sativa* and/or *Natuzyme* Supplementation on Productive Performance of Broiler Chicks:

Data in Tables 4 and 5 show the effect of NS, NZ and their mixture on body weight (BW) and body weight gain (BWG) of broilers during different periods. The initial live body weight of chicks at one – day old showed nearly similar values with no significant differences among treatment groups. The results of the statistical analysis showed insignificant differences in BW at one week of age for all the experimental groups, which confirmed the random distribution of the birds among the different experimental groups; BW and BWG were affected by supplementing NS, NZ and their mixture. Significant differences among treatments were found for BW and BWG through out the experimental periods.

Results of body weight at 2 weeks of age (Table 4) showed a significant ($P \leq 0.05$) reduction of body weight in the treatments of NS at both levels applied (2% and 4% NS, T_2 and T_3) and NZ (0.03% and 0.05% NZ, T_4 and T_5) compared to the control group (un-supplemented diet, T_1), being 373.79, 394.96, 377.69, 389.52 g compared to 370.84g, respectively. During the next periods, the average body weight was significantly ($P \leq 0.05$) increased with the mixture of NS and NZ supplementation (T_6, 2%NS+0.03%NE), (T_7, 2%+0.05%), (T_8, 4%+0.03%) and (T_9, 4%+0.05%) being 383.60, 400.52, 403.68 and 407.37g, respectively compared to the other treatments. As for BWG (Table 5) values were 335.16, 356.13, 339.10, 350.69 for T_2 to T_5 and 344.76, 369.92, 364.9, 368.57g for T_6 to T_9 in comparison with 332.07g for T_1, respectively.

At 4 weeks of age, the average BW was significantly increased ($P \leq 0.05$) with the mixture of NS and NZ supplementation being 1119.92, 1199.82, 1193.22, 1201.13g for T_6, T_7, T_8 and T_9, respectively compared to the other dietary treatments T_1, T_2, T_3, T_4, T_5, (1035.67, 1052.43, 1087.03, 1047.32, 1074.42g, in a respective order. Chicks consuming the control diet had a BWG of 664.83g compared to 678.64, 669.62, 684.9, and compared to 389.52, 736.22, 718.38, 761.56 and 775.48g for T_2, T_3, T_4, T_5, T_6, T_7, T_8 and T_9, respectively.

In general, at 6 weeks of age, birds fed the NS-NZ mixture (4%NS+0.05%NZ, 4% NS+0.03%NZ and 2%NS+0.05%NZ), T_9, T_8, T_7, respectively had the heaviest body weight (1976.61, 1954.74 and 1938.27g) and the best total BWG (1937.81g) in comparison with the control group (T_1) being 1752.79 vs. for body weight and 1714.03 for BWG. These improvements in BW and BWG suggest that chicks could utilize their dietary nutrients more efficiently with NS and/or NZ supplementation.

The improvement of BW of broiler could be related to supplementation of NS; this may have been due to the enhancement of the metabolism in different ways: 1- Feeding diets supplemented with low levels of NS may increase thyroid hormones concentrations which lead to improve metabolic rate (Mandour *et al.*, 1998). 2- NS contains different components such as thymoquinone and thymohydroquinone which possess antimicrobial and pharmacological activities resulted in improved growth rate (Mahfouz *et al.,* 1962). 3- Some components of NS act as antibacterial, antifungal and reveal protective action against hepatoxity which lead to better nutrients utilization (Rathee *et al.,* 1982). 4- The high amount of unsaturated fatty acids in *Nigella* sativa oil (Üstun *et al.*, 1990), such as oleic, linoleic and linolenic acids which are considered essential for growth (Murray *et al.,* 1991). 5- Feeding diets supplemented with NS oil increases bile flow which play an important role in the digestion, absorption of fat and the absorption of fat- soluble vitamins throughout pancreatic lipase activation (Crossland, 1980).

Table 4

Table 5

In agreement with these results, Hernandez *et al.* (2004) reported that the supplementation of essential oils improved apparent whole-tract and ileal digestibility of the nutrients. Similarly, Ramakrishna *et al.* (2003) reported that the effects of pancreatic lipase and amylase were increased with the supplementation of essential oil. Also, Jang *et al.* (2004) reported that the supplementation of essential oil increased digestion of protein, cellulose and fat. These results confirm those reported by Abdel–Malak *et al.* (1995) and El–Gendi (1996) who observed such increase in body weight and body weight gain using herbal growth prompters. They attributed this increase as the herbal ingredients are essential for controlling and buffering the conditions of the gastro-intestine tract. Also Abdel-Majeed (1999) demonstrated that the birds received 0.25% NS recorded the highest body weight.

Similar improvement in BW and BWG of broiler chicks due to the nutritive value of NS for instant, fat content, minerals and amino acids composition (Al–Jassir, 1992 and Abdel-Majeed, 1999). Similar results were noticed by Afifi (2001); Siddig and Abdelati (2001) and El–Ghamry *et al.* (2002) who added 0.4% NS or 2% garlic to broiler diets and reported that the final body weight and gain weight were improved (P≤0.05). Tolba and Hassan (2003) reported that adding black cumin (1%) or garlic (1%) as natural feed additives to broiler diets increased live body weight than those of control group. The improvement in weight gain of the birds using kalongi (NS) in their diets may probably be due to the fact that ethyl ether extracts of NS inhibits growth of intestinal bacteria such as S. aureus and E. coli as reported by Hanafy and Hatam (1991). As a result, when the load of these bacteria in the intestine is low, birds may absorb more nutrients, thus leading to the improvement in weight gain of the birds fed diets supplemented with NS.

Many investigators reported that *Nigella sativa* powder can improve the performance of birds and had a significant effect on mean body weight, weight gain on broiler chicks (Abdel–Hady *et al.,* 2009; Mahmood *et al.,* 2009; Erener *et al.,* 2010 and Khalaji *et al.*, 2012).

Variance among reports of researchers could be related to differences in management and environmental conditions that exists in various experiments. It is suggested that under benefit management and/or environmental conditions, the effect of such feed additives may be worthless. The positive effect of NS- supplementation on performance may be due to rich nutrients content of unsaturated and essential fatty acids, essential amino acids and carotene. It is also a source of calcium, iron, sodium and potassium that are considered essential co-factors in various enzyme functions (Takruri and Dameh, 1998 and Rouhou *et al.,* 2007). In addition, there are other pharmacologically positive effects of black cumin seeds on growth performance of broiler birds, which may also be attributed to its content of volatile oil (Hay and Waterman, 1993) or essential oil (Oyen and Dung, 1999). It has been shown that, the essential oil of NS has certain biological functions that could act not only as antibacterial, anti–oxidants (Al–Harthi, 2006), but also as a stimulant of digestive enzymes in the intestinal mucosa and pancreas that improve the digestion of dietary nutrients and feed efficiency, subsequently increasing the growth rate (Lee *et al.,* 2004). Also, these confirm the idea that the use of various plant materials as dietary supplements, including herbs or extracts, may positively affect poultry health and productivity and subsequent production performance (Jamroz *et al.,* 2005; Cross *et al.,* 2007). Results of many studies (Halle *et al.,* 1999; Osman and Barody, 1999; Al-Homidan *et al.,* 2002; Durrani *et al.,* 2007) reported that, birds receiving 4% of black seed in the diet had a significantly (P ≤0.05) higher body weight gain.

A similar trend was found by El–Bagir *et al.* (2006) who showed that dietary black cumin supplementation at the level of 1% or 3% significantly (P<0.01) increased final BW of laying hens. Similarly, Shewita and Taha (2011) and Ismail (2011) showed that inclusion of *N. sativa* in the diets of broiler chickens improved body weight. Results reported herein are in good agreement with those found by Tollba *et al.* (2005) noted a significant increase in BW of broiler chicks fed diets supplemented with different levels of NS under hot climatic conditions. Abu-Dieyeh and Abu-Darwish (2008) mentioned that, broilers fed diets with 1 and 1.5% NS for a period of 4 weeks significantly (P≤0.05) increased the body weight gain. The addition of garlic powder, black seed and premix of both (Saeid *et al.,* 2013) to the diet resulted in significantly higher body weight, body weight gain compared to that of control group. It is known that most growth promoters act by modifying the intestinal flora, especially targeting gram–positive bacteria, which are associated with poorer health and performance of poultry. Steenfeldt *et al.* (1998) indicated that enzyme supplementation to barley or wheat–based diet improved broiler body weight gain. Most of the enzyme addition response is confined to the first four weeks of age because young chickens have more difficulty coping with high cereal content diets. The intestinal viscosity is increased by wheat, but enzyme supplementation improves digestion in young chickens (Veldman and Vahl, 1994 and Vranjes *et al.,* 1994). This might be due to the fiber–hydrolyzing enzymes from micro flora, which are induced by more polysaccharide intake during the growing periods. Other studies reported a positive growth performance response in corn–based diets supplemented with enzymes, either multi enzymes which contained xylanase, protease and amylase or a single protease enzyme (Zanella *et al.,* 1999; Ghazi *et al.,* 2002; Gao *et al.,* 2007; Yu *et al.,* 2007). Greenwood *et al.* (2002) showed that supplementation of a corn-soybean broiler starter diet with a mixture of xylanase, protease and amylase improved the BW at 14 and 42 days of age. Also, Gracia *et al.* (2003) and Lazaro *et al.* (2003) reported that fungal enzyme preparation significantly, improved the weight gain of birds fed barley, rye, wheat and corn based diets. They explained that inclusion of cereal grain in broiler diets without enzyme decreased performance due to increased viscosity of the intestine content of birds. Higher NS contained in the cereal grains might be responsible for the higher viscosity and consequent impairment in productivity. Broiler chicks fed diets supplemented with enzymatic growth promoters (Ronozyme) achieved the highest (P≤0.05) body weight and body weight gain at 6 week old (Osman *et al.,* 2007). Peric *et al.* (2008) investigated the effect of addition of an enzyme complex (containing protease, amylase, ß–glucanase, xylanase, pectinase, cellulose and phytase) to diets of different nutritive values on performance of broiler chickens, and found that enzyme addition resulted in positive effects on gain. On the other hand, Douglas *et al.* (2000); Günal *et al.* (2004); Sayyazadeh *et al.* (2006); El–Ghamry *et al.* (2002) and Sherif (2009) indicated that there were no significant differences in live body weight and weight gain of broilers by fed enzymes supplementation. Kocher *et al.* (2002) did not show significant improvements in BWG of broilers by supplementing a commercial enzyme containing mainly hemicellulase, pectinase, ß-glucanase and some protease activities. Studies with simi multienzyme preparation (Energex) also failed to bring about improvement in BWG (Mohamed and Hamza, 1991 and Marsman *et al.,* 1997).

Data describing the influence of *Nigella sativa L.* and/or *Natuzyme* feed intake (FI, g/bird/day) of broiler chicks during the period from 1–6 weeks of age are presented in Table 6. It is clear that the addition of *Nigella sativa* and/or *Natuzyme* to the basal diet of broiler chicks did not significantly affect the feed consumption of the treated-groups compared to the control one. However, the treatments which contain mixture of *Nigella sativa* x *Natuzyme*, T_6 (2%NS+0.03%NZ); T_7 (2%NS+ 0.05%NZ); T_8 (4%NS+0.03%NZ); T_9 (4%NS+0.05%NZ) significantly (p≤0.05) decreased feed intake of broiler chicks during the experimental period (2 – 4wks) of age. The same trend was observed during the periods 2-4 and 4-6 weeks of age. No significant response of feed intake was noticed between experimental periods being 79.86, 78.88 and 78.33g/bird/day for T_7, T_8 and T_9, respectively during 2-4 wks of age and 122.56, 123.90 and 126.21g during 4–6 wks

Table 6

of age compared to the control group being 93.00g and 136.87g for the same periods. The FI for other treatments T_2, T_3, T_4 and T_5 was 87.18, 77.81, 81.94 and 81.97 and 137.42, 121.14, 133.23 and 130.25g at (2-4 wks) and (4 - 6 wks), respectively. In general, during the entire experimental period from 0 - 6 wks of age, a significant (P≤0.05) decrease in feed consumption was observed for broilers of T_7 group being 84.16g/bird/d in comparison with the control group (89.78g); FI of the other experimental groups was 91.02, 96.52, 93.50, 89.31, 87.14, 89.21g/b/d, respectively.

It was reported that black cumin and its oil extract positively affected feed intake in broilers (Guler *et al.,* 2006; Durrani *et al.,* 2007; Ziad *and* Mohammad, 2008; Erener *et al.,* 2010 and Ismail, 2011). Attia *et al.* (2008), Abaza, *et al.* (2008), Talha and Ahmed (2010) and Shewita and Taha (2011) found that feed consumption was linearly reduced by increasing doses of black seed extract from one – day old to 12 weeks of age. This result is in harmony with that found by Ismail *et al.* (2011) who revealed that chicks fed diets supplemented with probiotics or enzymes significantly consumed less feed (P≤0.05) compared to their control counterparts. It was observed that the lowest (P≤0.05) amount of feed intake was recorded for birds fed the diet containing 0.75 g probiotics/ kg. On the other hand, the present results disagreed with those observed by Al-Homidan *et al.* (2002), Shewita and Taha (2011), Saeid *et al.* (2013) and Al-Mufarrej (2013) who reported that adding different levels of black cumin to the diet of broiler chicks did not have any effect on feed intake. However, Yaghobtar (2010); Hassanein, *et al.* (2011); Shirmohammad and Mehri (2011) and Masey *et al.* (2012) concluded that feed intake was significantly improved by the addition of enzyme during 0 to 35 d and 0 to 42 d compared to positive control, respectively. Results in Table 7 present the effect of dietary different levels of NS and/or NZ supplementation on feed conversion ratio (FCR) during different experimental periods from 0 to 6 weeks. At 2 weeks of age, the average FCR was significantly improved (P≤0.05) with NS+NZ mix supplementation. The same trend was more obvious at 6 weeks. Chicks consuming the basal control diet (T_1) had FCR of 1.96 during the period of 2-4 wks of age, 2.59 during the next two wks (4-6 wk) with an overall average of 2.20, but feed conversion ratio improved gradually as the level of NS and NZ levels for T2 and T3 (1.84, 1.57 and 2.10), (2.45, 2.31 and 2.14) for NS levels, T4 and T5 (1.70, 2.17 and 2.17), (1.67, 2.15 and 2.09) at NZ levels addition during different experimental periods (2-4 wks), (4–6 wks) and the entire experimental periods (0–6 wks). Average feed conversion ratio was significantly improved (P ≤ 0.05) as mixture between NS and NZ levels, especially that of 2%NS mixed with 0.05%NZ, T7 to the basal diets reached FCR values of 1.55, 2.15 and 1.88 at 4, 6 wks and the whole experimental period (0–6 wks). Improvement of FCR might be due to stimulation of digestive enzymes followed by better digestion and utilization of feed. In the life of broilers initial 2 – 3 weeks (starter phase) is a critical period. At this time immune system is not fully functional and there are more chances of adverse effects of pathogenic bacteria on health and subsequent performance during grower phase. NS seeds might have helped establishing better gut micro flora and reducing the colonization of gut by pathogenic bacteria, as NS seeds have been reported to show antibacterial and antifungal properties (Fedorus *et al.,* 1992 and El–Sayed *et al.,* 2000). Similar observations were noticed by Ziad *et al.* (2008); Ashayerizadeh, *et al.* (2009); Ismail (2011); Shewita and Taha (2011) and Al-Mufarrej (2013). However, Abu-Dieyeh and Abu-Darwish (2008) and Abaza *et al.* (2008) mentioned that, broilers fed diets with 1 or 1.5% NS seeds for a period of 4 weeks significantly (P≤0.05) improved feed conversion ratio. Zahid (2009) reported that birds diet supplemented with 1 or 1.5% NS seeds showed better FCR during the starter phase (0–14 d), while birds supplemented with 2% NS seeds showed better FCR during the grower phase (14–21d).Therefore, improvement in FCR might be related to the high oils contents of black

Table 7

cumin or increased nutrient digestibility because of increasing the digesta retention time in the gizzard. Also, Khan, *et al.* (2011) reported that FCR (weight gain/feed intake) was significantly influenced by the three treatments (1.25, 2.5 or 5.0%) of NS seeds used at both 28 and 42 days. At both ages, the feed efficiency was significantly improved ($P \leq 0.05$) in broilers fed diets with 2.5 or 5% NS compared to the 1.25% NS diet and the controls (both negative and positive). Similar observations were noticed by Francesch and Geraert (2009); Hassan *et al.* (2011); Ismail *et al.* (2011); Khalaji *et al.* (2011) and Masey *et al.* (2012). They concluded that addition of graded levels of Natuzyme significantly affected FCR at 7, 14, 21, and 28 d of age, respectively. Most of the enzyme addition response is confined to the first four weeks of age because younger chickens have more difficulty coping with high cereal content diets. The intestinal viscosity is increased by wheat, but enzyme supplementation improves digestion in young chickens (Veldman and Vahl, 1994 and Vranjes *et al.,* 1994). This might be due to the fiber-hydrolyzing enzymes from microflora, which are induced by more polysaccharide intake during the growing period. Such improvements in FCR may be due to the improvement in the digestion, absorption and utilization of nutrients in response to supplemental feed additives. It is well known that most growth promoters act by modifying the intestinal flora, especially targeting gram–positive bacteria, which are associated with poorer health and performance of poultry. Indeed, many so–called, non–pathogenic bacteria species improve feed conversion and growth in chickens due to competition with the host for the nutrients in the intestinal tract, degradation of host enzymes and increasing the absorptive surface area (Bedford and Pertridage, 2003). On the other hand, Talha and Ahmed (2010) and Khalaji *et al.* (2012) noted that NS at1% level decreased FCR throughout 21 and 42 d of age.

Results presented in Table 8 indicated that there were significant differences among treatments in performance index (PI) during the different experimental periods. PI of chicks fed diet supplemented with *Nigella sativa* seed followed by *Natuzyme* was higher than those obtained for the control diet. There was a significant interaction between NS and NZ on PI ($P \leq 0.05$) being 85.67, 86.84, 85.96 and 87.84 for T_6, T_7, T_8 and T_9, respectively compared to the control treatment (65.92). It may be attributed to the higher body weight gain and/or lower feed consumption. Similar results were found by El-Gendi *et al.* (2000) indicated that feeding chicks a diet containing 0.5 kg/ton of Bio-tonic (included of black seed oil) as a feed additive improved the performance index value. They also reported that Kemzyme performance index of chicks to be 75.87% followed by Zinc bacitracin and Bio-Tonic (74.58 and 74.25%, respectively). Al-Homidan *et al.* (2002) indicated that feeding chicks on diet containing 2 and 4% NS seeds improved the performance index value; Osman (2002) indicated that addition of black seed oil into broiler chick's diet significantly improved the performance index parameters. Abaza *et al.* (2008) indicated that there were significant differences among treatments in PI during the different experimental periods. Performance index of chicks fed diet supplemented with black seed oil (34.99) followed by Saccharomyces cerevisiae, virginamycin or *Bacillus S.* and *L.* were higher than those received the control diet and other treatments 31.36, 31.97, 33.04, 34.14 and 32.70, respectively.

The Effect of *Nigella sativa* and/or *Natuzyme* on Carcass Characteristics of Broiler Chicks:

Experimental results of the effect of NS and/or NZ supplementation on carcass characteristics at 28 and 49 days of age are shown in Tables 9 and 10. At the 28 days of age, percent of pre-slaughter weight and carcass weight were significantly ($P \leq 0.05$) increased with the mixture treatments of *Nigella sativa* and *Natuzyme* supplementation. All pre-slaughter weight and carcass weight values were 882, 914, 911 and 954g and 617, 640, 646 and 680g for T_6, T_7, T_8 and T_9, respectively. The same trend was obtained at 7 weeks. The difference in body weights between NS-

Table 8

Table 9

Table 10

treated and the control group were reflected in the dressed bird weights at slaughter. Discrepancies in feed intake, the amount of metabolizable energy and protein ingested by the birds may explain the differences observed in carcass yields. Similarly, Guler *et al.* (2006) reported that black cumin seed extract significantly affected carcass characteristics. On the other hand, Toghyani *et al.* (2010) reported that supplementation with black cumin seed did not have a significant affect on carcass characteristics.

Chicks fed the control diet through 4 weeks of age had a dressing percentage of 67.93; it is the lowest value compared to supplementation of the other treatments T_2, T_3, T_4, T_5, T_6, T_7, T_8, and T_9; values for 4 wks being 68.71, 71.84, 70.49, 70.48, 69.94,70.02%,70.84 and 71.33, respectively. On the other hand, results presented in Table 13 showed significant effects of dietary NS at 2 and 4% and NZ at 0.03 and 0.05% and their mixture on the dressing percentage compared to the un-supplemented group (73.59%). Values were 75.33, 75.81, 73.68, 73.67, 76.55, 75.16, 76.63 and 77.16%, respectively for the corresponding treatments at 7 weeks of age. The best values of a dressing percentage recorded (71.33 and 77.16) for treatment 9, (4%NS+0.05%NZ) at 4 and 7 weeks of age compared to the other treatments. The results of the present study support the findings of Al-Homidan *et al.* (2002) and El-Bagir *et al.* (2006). The positive effect of the black cumin seeds powder supplementation on the percent of broiler carcasses (Durrani *et al.,* 2007; Ashayerizadeh *et al.* 2009 and Ismail, 2011) confirm the findings of this study. On the other hand, Talha and Ahmed (2010) found that birds fed diet supplemented with 1% NS showed a significant ($P \leq 0.05$) reduction in dressing % when compared to those fed the control diet. No significant differences were found among different groups received different levels of either NS or NZ for some carcass traits including some internal organs such as (relative liver and heart - Tables 9 and 10). Similar results were obtained by Erener *et al.* (2010) who found that no significant effects of dietary black seed at 10g/ Kg diet were observed on edible organs of broiler chicks. On the other hand, relative weight of gizzard in treatment 7 (2.96g) showed higher value when compared to that of other treatments at 4 weeks. Also, at 49 days, relative weight was not significant ($P \leq 0.05$) between the NS+NZ mixture treatments (T_6, T_7, T_8 and T_9); being 3.96, 4.07, 4.04 and 4.10, respectively in comparison with other treatments. The effect of NS and/or NZ and their mixture on giblets percentage of broiler at 4 and 7 wks of age is shown in Tables 9 and 10. At 28 days, increasing dietary NS level supplementations significantly increased the giblets percent (T_3, 4%NS); being 6.55% compared to the un-supplemented treatment (T_1, 5.90%). Values of giblets% were decreased as the dietary *Natuzyme* levels increased; being 6.34 and 6.11%, respectively for chicks fed diet with 0.03 and 0.05% NZ. Hernandez *et al.* (2004) reported no difference in the mean weights of proventiculus, gizzard, intestine and pancreas in broilers fed two herbal plant extracts. Talha and Ahmed (2010) reported that the addition of 1% and 2% (NS) had no significant effect on liver, gizzard, heart and abdominal fat%. However, Durrani *et al.* (2007) found that the addition of 4% black seeds to broilers diets significantly ($P \leq 0.05$) increased liver weight and dressing percent. These results are in agreement with the findings of Alam *et al.* (2003) and Hajati *et al.* (2009). They reported that the increased carcass yield by addition of enzymes in diet is attributed to higher fat deposition in carcass and also for increased breast meat yield. The results obtained may be attributed to the biological effects of polyunsaturated fatty acids on their metabolism and incorporation into tissue lipids (Cunnane *et al.,* 1990). In addition, polyunsaturated fatty acids may affect muscle protein synthesis and protein deposition through prostaglandin dependent mechanism (Palmer, 1990). Giblets percent in treatment 9 (6.64%) was higher than that of the other treatments. In general, at 7 wks of age, chicks fed basal diet with 4% *Nigella sativa* had higher giblets (7.25%) than that of the control diet (7.06%). Difference was significant ($P \leq 0.05$). Increasing of the levels of *Natuzyme* decreased giblets percent value (7.16%)

while the lowest level of NZ supplementation increased giblets percent value to 7.62%. There was significant interaction between NS and NZ on giblets percent ($P \leq 0.05$). Birds fed the dietary mixture of 2% NS+0.05%NZ showed the highest value of giblets percent. No significant differences were observed among different treatments received different levels of *N. sativa* and *Natuzyme* for spleen Tables 9 and 10. On the other hand, the relative weights of bursa and thymus increased and the highest values were reported for NS+NZ mixture (T_9); being (0.20 and 0.26%) at 4 wks of age and (0.19 and 0.29%) at 7 wks of age for bursa and thymus; this may result in higher immune response of the chicks. These results agreed with those reported by Abd El-Aal and Attia (1993), James *et al.* (1994) and Hedaya (1995) who found that NS has immune-stimulant effect and maintaining good health. Also these results were typically recorded by Toghyani *et al.* (2010) who reported that black seed supplementation caused a marked ($P \leq 0.05$) increase in the weight of lymphoid organs. The increase in lymphocyte percentage may be attributed to the production of specific or non–specific antibodies against different antigens; since lymphocyte, eosinophil and heterophil are responsible for achieving the defense mechanism and immune response introduced into body (El–Feki, 1987). Shewita and Taha (2011) disagreed with the present results which showed improved dose dependant bursa and thymus weight. The results of the present experiment reported herein are also in agreement with those of Osman and Barody (1999) and Soliman *et al.* (1999) who reported that black seed in broiler diets improved immunity. The results of the present experiment also support the findings of Salem and Hussain (2000) who reported that *Nigella sativa* oil possess antiviral properties. Similarly, Swamy and Tan (2000) reported that *Nigella sativa* oil possess immune-potentiating activities. But disagreed with Tollba and Hassan (2003) who found that adding *N. sativa* had no effect on weights of bursa of fabricus. El-Deek *et al.* (2009) reported no significant difference in lymphoid organs as an indication of immune response due to feeding different dietary levels of NS whether in the spleen or bursa of fabricus weight percentage which agrees with our finding. It was obvious that fat percentage recorded the highest significant value for control group compared to all groups received different levels of NS. In addition, increasing the level of *N. sativa* resulted in decreasing the level of fat percentage in carcass of broiler (1.32 and 1.26%) for groups T_2 and T_3, respectively compared to the control group (1.61%). The same results were obtained by Abdel-Majeed (1999) and Tollba and Hassan (2003) who found that supplementation of 2.0% black seed was accompanied by a decrease of total fat percentage. In a study by Abaza *et al.* (2008), adding 0.1% black cumin seed oil to the birds' diet, decreased the percent of abdominal fat; this may indicate that *Nigella sativa* has a role in lipid metabolism. However, our findings on carcass fat parentage were in contrast to those of El-Gendi (1996), Durrani, *et al.* (2007), Javandel *et al.* (2008) and Abdel-Hady *et al.* (2009).

2- The Effect of *Nigella sativa* and/or *Natuzyme* on Economic efficiency:

Data pertaining to dietary *Nigella sativa*, *Natuzyme* and their mixture supplementation on the relative economical efficiency (REE) are presented in Table 11. In comparison with the control treatment (100%), the supplementation of *Nigella sativa* and *Natuzyme* mixture improved REE by about 11% for T_7 which was supplemented with 2%NS+0.05%NZ). This may be due to better feed conversion obtained in birds received the experimental diets. The low values of economical efficiency were obtained for chicks fed diet supplemented with 4%NS+0.03%NZ (T_8) and 4%NS+0.05%NZ (T_9), respectively compared to control and other treatments. This may be due to the increase in the price of *Nigella sativa* and *Natuzyme* in the markets. Abou El-Soud (2000) observed that the economic efficiency was increased by using *Nigella sativa* oil at 1% level. Abaza *et*

Table 11

al. (2003), Durrani *et al.* (2007), Abaza *et al.* (2008) and Mahmood *et al.* (2009) found that the use of *Nigella sativa* seeds in broiler diets was more economic than the control diet. Abdo (2004) indicated that 25% *Nigella sativa* meal substitution gave the best economic value and the least cost per Kg body weight as compared to the control. On the other hand, Mikulski *et al.* (1999) reported that enzyme supplementation decreased the relative cost of broiler feeds by 4% to 18% compared to that of enzyme un-supplemented feed. Also, Khan *et al.* (2006) indicated that enzymes supplementation is more feasible and economical to obtain maximum profitability from broiler production.

Conclusion:

In general, based on the obtained experimental results reported herein, from the nutritional and economical point of view, it may be concluded that there are some beneficial effects of using mixture of *Nigella sativa* plus *Natuzyme* supplementation, especially at the level of 2% NS+0.05%NZ supplementation to broiler diets under our local environmental conditions in Egypt; as it showed the best productive performance and improved the carcass characteristics.

REFERENCES

Abaza, I. M., M. A. Shehata, M. S. Shoieb and I. I. Hassan (2008). Evaluation of some natural feed additive in growing chicks' diets. International Journal of Poultry Science, 7 (9): 872 – 879.

Abaza, I.M., M.A. Asar, G.E. Elshaarrawi and M.F. Hassan (2003). Effect of using *Nigella* seeds, Chamomile flowers, Thyme flowers and Harmala seeds as feed additives on performance of broiler. Egyptian Journal. of Agriculture, 81(2):735-750.

Abbas, T.E.E. and M.E. Ahmed (2010). Effect of supplementation of *Nigella sativa* seeds to the broiler chicks' diet on the performance and carcass quality. International Journal Agriculture Science, 2:9-13.

Abd El-Aal, E. S. and R. S. Attia (1993). Characterization of black cumin (*Nigella sativa*), chemical composition and lipids. Alexandria Journal Science, 14 (4): 467-481.

Abdel – Malak, N. Y., Abdel – Malak, M. S., EL – Gendi, G. M. and Emily, F. Nagub 1995. Effect of feedung different levels of herbal feed additive on performance in relation to some metabolic functions. Egyptian Poultry Science, 15: 111 – 139.

Abdel Majeed, L. H. (1999). Response of broiler chick to dietaiy *Nigella sativa*. M. Sc. Thesis, Faculty of Agriculture Alexandria University, Egypt.

Abdel-Hady, A. A., F. A. Abdel-Azeem, A. A. Abdel-Rafea and A.G. Gamal (2009). Effect of replacement of soybean meal protein by *nigella sativa* meal protein on performance of growing Japanese quail. Egyptian Poultry Science, 29 (I): 407-422.

Abdo, Zeinab M. A. (2004). Effects of phytase supplementation on the utilization of *Nigella sativa* seed meal in broiler diets. Egyptian Poultry Science, 24 (1): 143-162.

Abou–El–Soud, S. B. (2000). Studies on some biological and immunological aspects in Japanese quail fed diets containing some *Nigella sativa* seeds preparations. Egyptian Poultry Science, 20: 757 – 776.

Abu – Dieyeh, Z. H. M. and M. S. Abu – Darwish (2008). Effect of feeding powdered black seeds (*Nigilla sativa L.)* on growth performance of 4 – 8 week old broilers. Journal of Animal Science, 3: 286 – 290.

Abuharfeil, N. M., S. Maher and S.V. Kleist (2001). Augmentation of natural killer cell activity in vivo against tumor cells by some wild plants from Jordan. Phototherapy, 15:109-113.

Afifi, O. S. (2001). Effect of different level of different level of freshly crushed *Nigella sativia* seeds on performance, organ weights and blood constituents of broiler chickens reared under hot climatic conditions. Egyptian Poultry Science, 21 (II): 567-583.

Al – Beitawi, N. and S. S. Fl – Ghousein (2008). Effect of feeding different levels of *Nigella sativa* seeds (black cumin) on performance, blood constituents and carcass characteristics of broiler chicks.

International Journal of Poultry Science, 7 (7): 715 – 721.

AL-Beitawi, N. A., S. S. EL-Ghousein and A. H. Nofal (2009). Replacing bacitracin methylene disalicylate by crushed *Nigella sativa seeds* in broiler rations and its effects on growth, blood constituents and immunity. Livestock Science,125: 304 - 307.

Al – Harthi, M. A. (2006). Impact of supplemental feed enzyme, condiments mixture or their combination on broiler performance, nutrients digestibility and plasma constituents. International Journal of Poultry Science, 5 (8): 764–771.

Al – Homidan, A., A. A. Al – Qarawi, S. A. Al – Waily and S. E. I. Adam (2002). Response of broiler chicks to dietary Rhazya stricta and *Nigella sativa.* British Poultry Science, 43: 291 – 296.

Al – Jassir, (1992). Chemical composition and microflora of black cumin (*Nigella sativa L.)* seeds growing in Sudia Arabia. Food Chemistry, 45:239.

Alam, M.J., M.A.R. Howlider, M.A.H. Pramanik and M.A. Haque (2003). Effect of exogenous enzyme in diet on broiler performance. International of Journal of Poultry Science, 2: 168-173.

Al-Mufarrej, S.I. (2013). Immune-responsiveness and performance of broiler chickens fed black cumin (*Nigella Sativa L.)* powder. Journal of the Saudi Society of Agricultural Sciences, 30: 01 – 06.

Ashayerizadeh, A., O. B. Dastar, M. Shams, A. Shargh, E. Rahmatnejad and S. M. R. Hossain (2009). Use of galric (Allium sativum), black cumin seeds (*Nigella sativa* L.) and wild mint (Mentha longifolia) in broiler chickens diets. Journal of Animal and Veterinary Advances 8 (9):1860 – 1863.

Attia, Y. A., A. E. Tag El-Din, H. S. Zeweil and A. S. Hussein (2008). The effect of supplementation of enzyme on laying and reproductive performance in Japanese quail hens fed *Nigella seed* meal. Journal of Poultry Science, 45:110-115.

Bedford, M.R. (1996). Interaction between ingested feed and the digestive system in poultry. Journal of Applied Poultry Research, 5: 86-95.

Bedford, M.R. and A.J. Morgan (1996). The use of enzymes in poultry diets. Word's Journal of Poultry Science, 52: 61-68.

Bedford, M.R. and G. G. Partridage (2003). Enzymes in farm in Animal Nutrition. CAB international publishing, finn feeds Marlborough Wiltshire, UK.

Cross, D. E., R. M. Devitt, K. Hillman and T. Acamovic (2007). The effect of herbs and their associated essential oils on performance, dietary digestibility and gut microflora in chickens from 7 to 28 days of age. British Poultry Science, 48: 496 – 506.

Crossland, J. (1980). Lewis's Pharmacology. 5th Ed. Chuchill Livingstone, London and New York, 656 - 657.

Cunnane, S. C., P.A. Stitt, S. Ganguli and J. K. Armstrong (1990). Raised omega – 3 fatty acid level in pigs fed flax. Poultry Science, 70: 1411 – 1430.

Dekker, R.F.H. (1983). Bioconversion of hemicellulose: Aspect of hemicellulose Biotechnol Bioeng, 25: 1127- 114.

Douglas, M. W., C. M. Parsons and M. R. Bedford (2000). Effect of various soybean meal sources and Avizyme on chick growth performance and ileal digestible energy. Journal of Applied Poultry Research, 9: 74 – 80.

Duncan, D. B. (1955). Multiple ranges and multiple F test. Biometrics, 11:1-42.

Durrani, F. R., N. Chand, K. Zaka, A. Sultan, F. M. Khattak and Z. Durrani (2007). Effect of different levels of feed added black seed (*Nigella sativa L.)* on the performance of broiler chicks. Pakistan Journal of Biological Science, 10 (22):4164-4167.

El Bagir, N. M., A.Y. Hama, R.M. Hamed, A.G. Abd-El- Rahim and A.C. Beynen (2006). Lipid composition of egg yolk and serum in laying hens fed diets containing black cumin (*Nigella sativa*). International Journal of Poultry Science, 5: 574 -578.

El-Deek, A. A., M. H. Saffa, Y. A. Attia and M. M. Khalifah (2009). *Nigilla sativa* seed oil meal as a source of plant protein in broiler diets. Egyptian Poultry Science, 29 (I): 39-52.

El-Feki, M. A. (1987). Studies on

hosparasite interaction between carp and saprolegnia. Ph. D. Thesis, Aston Univirisity Birmingham U. K.

El- Gendi, G. M. (1996). Effect of feeding dietary herbal feed additives on productive and metabolic responses of broiler chicks. Egyptian Poultry Science, 19 (III): 619-634.

El- Gendi, G. M., A. F. Soliman and A. G. El – Habib (2000). Evaluating four feed additives for improving productive and metabolic performance of broiler chicks. Egyptian Poultry Science, 20: 103 – 133.

El – Ghamry, A. A., G. M. El – Mallah and A. T. El – Yamny (2002). The effect of incorporating yeast culture, *Nigella sativa* seeds and fresh garlic in broiler diets on their performance. Egyptian Poultry Science, Vol., 22 (II): 445 - 459.

El – Sayed, E. M. and M. E. Hashim (2000). Effect of *Nigella sativa* on the immune response to Eimeria vaccination in chicken. Egyptian Journal Agriculture Research, 78: 231 – 239.

El-Tahir, K.E.H., M.M. Ashour and M.M. Al-Harbi (1993). The respiratory effects of the volatile oil of the black seed (*Nigella sativa L.*) in guinea pigs: elucidation of the Mechanism of action. Genetics Pharmacology, 24:1115-1122.

Erener, G., N. Altop, H. Ocak, S. Aksoy and E. Ozturk (2010). Influence of black cumin seed (*Nigella sativa L.*) and seed extract on broilers performance and total coliform bacteria count. Asian Journal Animal, 5: 128-135.

Fedorus, A. J., S. N. Islam, M. Ahsan, C. M. Hasan and Z.U. Ahmad (1992). In – vitro antibacterial activity of the volatile oil of *Nigella sativa* seeds against multiple drug resistant isolates of shigella species and isolates of Vibrio cholerae and Escherichia coli. Photother apy Research, 6: 137 – 140.

Francesch, M. and P. A. Geraert (2009). Enzyme complex containing carbohydrases and phytase improves growth performance and bone mineralization of broilers fed reduced nutrient corn-soybean-based diets. Poultry Science, 88:1915-1924.

Gao, F., Y. J., G. H. Zhou and Z. K. Han (2007). The effects of xylanase supplementation on performance, characteristics of the gastrointestinal tract, blood parameters and gut microflora in broilers fed on wheat – based diets. Animal Feed Science Technology, 142: 173 – 184.

Ghazi, S., J. A. Rooke, H. Galbraith and M. R. Bdford (2002). The potential for the improvement of the nutritive value of soya – bean meal by different proteases in broiler chicks and broiler cockerels. British Poultry Science, 43:70 – 77.

Gilani, A.H., Q. Jabeen and M. A. U. Khan (2004). Areview of medicinal uses and pharmacological activities of *Nigella sativa.* Pakistan Journal Biological Science, 7:441-451.

Gracia, M. I., M. J. Aranibar, R. Lazaro, P. Medel and G. G. Mateos (2003). Alfa – amylase supplementation of broiler diets based on corn. Poultry Science, 82: 436 – 442.

Greenwood, M. W., C. A. Fritts and P. W. Waldroup (2002). Utilization of Avizyme 1502 in corn-soybean meal diets with and without antibiotics. Poultry Science,1: 81- 91, 25 (Abstract).

Guler, T., B. Dlkilic, O. N. Ertas and M. Ciftci (2006). The effect of dietary black cumin seds (*Nigella sativa L.*) on the performance of broilers. Asian – Australian Journal of Animal Sciences, 19 (3): 425 – 430.

Günal, M., S. Yasar and J. M. Forbes (2004). Performance and some digesta parameters of broiler chickens given low or high viscosity wheat-based diets with or without enzyme supplementation. Journal Animal Science, 28: 323-327.

Guo, F.C., B. A.Williams, R. P. Kwakkel, H.S., Li, X. P. Luo and M. W. A. Verstegen (2004). Effects of mushroom and herb polysaccharides, as alternatives for an antibiotic, on the cecal microbial ecosystem in broiler chickens. Poultry Science, 83:175-182.

Hajati, H., M. Rezaei and H. Sayyahzadeh (2009). The effects of multi-enzyme addition on performance of broiler chicks. Journal of Sari Agricultural and Veterinary Sciences. Mazandaran, Islamic of Iran, 9 (3): 77-83.

Halle, I.R., R. Thomann and G. Flachowsky

(1999). Effect of ethereal (essential) oil and oil seeds on the growth of broilers. Journal of Vitamins Feed Additives, 7: 469 - 472.

Hanafy, M. S. and M.E. Hatam (1991). Studies on the anti-microbial activity of *N. sativa* seed (Black cumin). Journal of Ethno pharmacology, 34: 275–278.

Hassan, H. M. A., M. A. Mohamed and T. M. El-Afifi (2011). Effect of phytase or lysine supplementation on performance of broilers fed lysine deficient diet from 21 to 42 days of age. Egyptian Poultry Science, 31 (I): 111-120.

Hassanein, H. H. M., Z. S. H. Esmail and A. A. A. Abdel – Wareth (2011). Effects of fasting period and enzyme supplementation on performance and some physiological responses of broiler chickens. Egyptian Poultry Science, 31 (III): 453-464.

Hay, R. K. M. and P.G. Waterman (1993). Volatile oil crops, their biology, biochemistry and production.Longman Scientific and Technical, Essex.

Heady, E. O. and H. R. Jensen (1954). Farm Management Economics. Pentice – Hall Inc. Englewood Cliffs Nutration of Journal United States of American.

Hedaya, S. (1995). Effects of *Nigella sativa* (balck seeds) extracts on some hematological and biochemical parameters in rats. Alexandria Journal Veterinary Science, 11(2): 95-99.

Hernandez, F., J. Madrid, V. Garcia, J. Orengo and M. D. Megias (2004). Influence of two plant extract on broiler performance, digestibility, and digestive organ size. Poultry Science, 83:169-174.

Ismail, Z. S. H. (2011). Effect of dietary black cumin growth seeds (*Nigilla sativa L.)* or its extract on performance and total caliform bacteria count on broiler chicks. Egyptian Poultry Science, 31 (I): 139-147.

James, W. A., E. J. Amy and R. M. Susan (1994).Ten different dietary fibers have significantly different effects on serum and liver lipids of cholesterol-fed rats. Journal of Nutrition, 124: 78-83.

Jamroz, D. A. W., T. Wertelecki, J. Orda and J. Skorupinska (2005). Use of active substances of plant origin in chicken diets based on maize and locally grown cereal. British Poultry Science. 46 (4):485-493.

Janbaz, K. H., S. A. Saeed, A. H. Gilani and M. K. Ashfaq (2003). The in vitro effect of aqueous extract of *Nigella sativa* seeds on nitric oxide production. Phototherapy. Research, 17: 921-924.

Jang, I. S., Y. H. Ko, H. Y. Yang, J. S. Ha, J. Y. Kim, J. Y. Kim, S. Y. Kang, D. H. Yoo1, D. S. Nam1, D. H. Kim and C. Y. Lee (2004). Influence of Essential Oil Components on Growth Performance and the Functional Activity of the Pancreas and Small Intestine in Broiler Chickens. Asian-Australian of Journal Animal Science, 17: 394-400.

Javandel, F., B. Navidshad, J. Seifdavati, G. H. Pourrahimi and S. Baniyaghoub (2008). The favorite dosage of garlic meal as a feed additive in broiler chickens ratio. Pakistan Journal Biological Science, 11 (13):1746 – 1749.

Khalaji, S., M. Zaghari and M. Shivazad (2011). Estimation of standardized ileal threonine equivalency values of a multi – enzyme and its effects on chicks performance. Italian Journal of Animal Science, 10: 21 – 30.

Khalaji, S., M. Zaghari, K. H. Hatami, S. Hedari-Dastjerdi, L. Lotfi and H. Nazarian (2012). Black cumin seeds, Artemisia leaves (Artemisia sieberi), and Camellia L. plant extra ct as phytogenic products in broiler diets and their effects on performance, blood constituents, immunity, and cecal microbial population. Poultry Science, 11: 2500-2510.

Khan, S. H., A. M. Atif, N. Mukhtar, A. Rehman and F. Ghulam (2011). Effects of supplementation of multi-enzyme and multi-species probiotic on production performance, egg quality, cholesterol level and immune system in laying hens. Journal of Applied Animal Research, 39:386-398.

Khan, S. H., R. Sardar and B. Siddique (2006). Influence of enzymes on performance of broilers fed sunflower-corn based diets. Pakistan Veterinary Journal, 26(3): 109-114.

Kocher, A., M. Choct, M. D. Porter and J. Broz (2002). Effects of feed enzymes on nutritive value of soybean meal fed to broilers. British Poultry Science, 43: 54-63.

Lazaro, R., M. Garcia, P. Medal and G. G. Mateos (2003). Influence of enzymes on performance and digestive parameters of broilers fed rye – based diets. Poultry Science, 82: 132 – 140.

Lee K. W., H., Evarts and A. C. Beynen (2004). Evaluation the effect of several non – antibiotic additives on growth performance of broiler chickens. International of Journal Poultry Science, 3: 738 – 752.

Mahfouz, M., M. El-Dakhakhny, A. Gemel and H. Moussa (1962). Chloretic action of *Nigella sativa* seed oil. Egyptian Pharmacological Bullet Science, 44: 225-229.

Mahmood, S., M. Hassan, M. Alam and A. Fawwad (2009). Comparative efficacy of *Nigella sativa* and Allium sativum as growth promoters in broilers. International Journal of Agriculture and Biology, 6: 775–778.

Mandour, A. A., K. M. Ashry and S. A. Hedya (1998). Biochemical profile of serum constituents of broiler chicken supplemented with different levels of *Nigella sativa* (black seed) with special reference to its effects on hormonal and mineral concentration. Egyptian Poultry Science, 18: 429 – 439.

Marsman, G. J., H. Gruppen, A. F. Van, R. R. Kwakkel, M. W. Verstegen and A. G. Voragen (1997). The effect of thermal processing and enzyme treatments of soybean meal on growth performance, ileal nutrient digestibility's and chime characteristics in broiler chicks. Poultry Science, 76: 864 – 872.

Masey, V. A., G. Mathis, B. S. Lumpkins and M.R. Bedford (2012).The effect of reduced calorie diets, with and without fat, and the use of xylanase on performance characteristics of broilers between 0 and 42 days. Poultry Science, 91:1356 – 1360.

Mikulski, D., J. Jankowski, S. B. A. El – soud, A. Farvga and A. E. Abou – Zeid (1999). Effect of enzyme supplemented triticale – barely diets on broiler chicken performance. Egyptian Poultry Science, 19 (3): 607 – 608.

Mohamed, M.A. and A. S. Hamza (1991). Using enzyme preparation in corn soybean meal broiler rations. Egyptian Journal Animal Productive Science, 28: 245 – 254.

Murray, R. K., D. K. Granner, P. A. Mayes and V. W. Rodweel (1991). The text book of Harper's Biochemistry, 22 edition, Appleton and Large. New York, Connecticut, Las Altos California.

National Research Council (NRC) (1994). Nutrient requirements of Poultry. 9th Rev.ed Ed., National Academy Press, Washington, DC.

Natuzyme, Sunnybank, Brisbane, Australia. Company production by :(Bioproton Pty Ltd 38/141 Station Road Sunny bank Qld 4109, Brisbane, Australia.

North, M. O. (1984). Commercial chicken production manual. 3 rd., the AVI, Publishing. Conversance, Inc., West. Port, Connecticut, Unitited States of American.

Osman, A. M. A. and M. A. A. El- Barody (1999). Growth performance and immune response of broiler chicks as affected by diet density and *Nigella sativa* seeds supplementation. Egyptian Poultry Science, 19 (III): 619-634.

Osman, A. M. A., M. A. H. Soliman, H. H. Hassanein and A. A. A. Abd El – Warth (2007). Evaluation of the growth performance of broiler chicks fed on plant diets supplemented with some feed additives. Journal of Agriculture Science, Mansoura University, 32: 133 – 150.

Osman, Mona (2002). Beneficial effects of black seed oil inclusion in broiler diet on performance and carcass characteristics. Egyptian Poultry Science, 22: 839 – 853.

Oyen, L.P.A. and N. X.Dung (1999). Essential – oil plants. Backhuys Publishhers, Leiden.

Palmer, R. J. (1990). Prostaglandins and the control of muscle protein synthesis and degradation. Prostaglandin's Leukotienes Essential Fatty acids. 39(2):95-104.

Perić, L., N. Milošević, M. Dukić-Stojčić, S. Bjedov and V. Rodić (2008). Effect of enzymes on performances of broiler chickens. Biotechnology in Animal Husbandry, 24 (5): 45-51.

Ramakrishna, R. R., K. Platel and K. Srinivasan (2003. In vitro influence of species and spice-active principles on digestive enzymes of rat pancreas and small intestine. Nahrung, 47:408-412.

Rathee, P. S., S. H. Mishra and R. Kaughal (1982). Antimicrobial activity of essential oil, Fixed oil and unsaponifiable matter of *Nigella sativa Linn.* Indian Journal Pharmacological Science, 44: 8-10.

Reillyt, P.J. (1991). Xylanase: Structure and function. In Hollander. A. (Ed.). Proceeding of A symposium onTrend in Biotechnology of Fermentation for fuels and chemicails. Plenum Press, New York.

Rouhou, S. C., B. Souhail, H. Basma, B. Christophe, D. Cloude and A. Hamadi (2007). *Nigella sativa* Chemical composition and physicochemical characteristics of lipid fraction. Journal Food Chemistry, 101: 673 – 681.

Saeid, M. J., A. B. Mohamed and M. A. AL-Baddy (2013). Effect of adding garlic powder (Allium sativum) and black seed (*Nigella sativa*) in feed on broiler growth performance and intestinal wall structure. Journal of Natural Sciences Research 3 (1) 13 - 20.

Saleh, Al. M. (1992). Chemical composition and microflora of black cumin (*Nigella sativa L.*) seeds growing in Saudi Arabia. Food Chemistry, 45:241-245.

Salem, M. L. and M. S. Hossain (2000). Protective effect of black seed oil from Nigella sativa against murine cyto megalovirus, International Journal Pharmacological, 22(9): 729-740.

Sayyazadeh, H., G. Rahimi and M. Rezaei (2006). Influence of enzyme supplementation of maize, wheat and barley-based diets on the performance of broiler chickens. Pakistan Journal Biological Science, 9(4): 616-621.

Sharifi, Kh. El. (2009). Effect of using probiotics and enzymes with plant protein diets in broiler performance. Journal of Agriculture Science, Mansoura University. 34 (5): 4493 – 4505.

Shewita, R. S. and A. E. Taha (2011). Effect of dietary supplementation of different levels of black seed (*Nigella Sativa L.)* on growth performance, immunological, hematological and carcass parameters of broiler chicks. World Academy of Science, Engineering and Technology 53.

Shirmohammad, F. and M. Mehri (2011). Effects of dietry supplementation of multi – enzyme complex on the energy utilization in rooster and performance of broiler chicks. African Journal of Biotechnology, 10 (38): 7541 – 7547.

Siddig, R. M. and K. Abdelati (2001). Effect of dietary vitamin A and *Nigella sativa* on broiler performance. Proceedings of the 10th International conference of the Association of Institutions for Tropical Veterinay Medicine Livestock, Community and Environment Copenhagen, Denmark.

Soliman, A. Z. M., A. A. Sh. Gahzalah, A. M. Atta and Z. M. A Abdo (1999). The synergistic effect of either black seeds or garlic with fat on broiler performance and immunity. Egyptian Journal Nutrition, 2: 603-602.

Soltan, M. E. and Z. Kusainova (2012). Performance of broiler chickens in different farming with different feed conversion under Egyptian conditions. Minufiya Journal Agriculture Research, 37 (5): 1155 – 1159.

SPSS. (2011). SPSS 11.0 for Windows. SPSS Inc., Chicago. Standardization administration of china. 2005. National feed Industry Standards for Enzyme Assays in China.

Steenfeldt, S., A. Mullertz and F. J. Jensen (1998). Enzyme supplementation to wheat – based diets for broilers. 1. Effects on growth performance an intestinal viscosity. Animal Feed Technological Science, 75: 27–43.

Swamy, S. M. K. and B. K. H. Tan (2000). Cytotoxic and immunopotentiating affects of ethanolic extractof *Nigella sativa* L. seeds. Journal Ethnopharmacol, 70: 1–7.

Takruri, H. M. H. and M. E. F. Dameh (1998). Study of the nutritional value of black cumin seeds (*N. sativa L.).*Journal Food Agriculture Science, 76: 404 – 410.

Talha, E. E. A. and E. A. Ahmed (2010). Effect of supplementation of *Nigella sativa* seeds to the broiler chicks diet on the performance and carcass quality. International Journal of Agriculture Sciences, 2: 9 -13.

Toghyani, M., T. Majid, G. Abdasali, G. Gholamreza and M. Mohammed (2010). Growth performance, serum biochemistry and blood hematology of broiler chicks fed different levels of broiler chicks fed different levels of black seed (*Nigella sativa*) and peppermint (Mentha piperita). Live Stock Science, 129: 173 – 178.

Tolba, A. A. H. and M.S. H. Hassan (2003). Using some natural additives to improve physiological and productive performance of broiler chicks under high temperature condition. 2- Black cumin (*Nigella sativia*) or garlic (Allium sativum). Egyptian Poultry Science, 23 (II): 327 – 340.

Tolba, A. A. H., M. A. Abd El-Galyl and M. H Abd El-Samad (2005). The effect of using some herbal additives on physiological and productive performance of two Egyptian chicken strains during winter and summer seasons. Egyptian Poultry Science, 25: 107-123.

Üstun, G., L. Kent, N. Cekin and H. Civelekoglu (1990). Investigation of the technological properties of *Nigella – sativa L.* (Black Cumin) seed oil. JAOCS, 67(12): 958-960.

Veldman, A. and H. A. Vahl (1994). Xylanase in broiler diets with differences in characteristics and content of wheat. British Poultry Science, 35:537-550.

Vranjes, M. V., H. P. Pfirter and C. Wenk (1994). Influence of processing treatment and type of cereal on the effects dietary enzymes in broiler diets. Animal Feed Science Technology, 46:261-270.

Yaghobtar, A. (2010). The effect of *Natuzyme* plus multi enzyme on ME of diet and broiler performance. Animal science Research institute – ASRI, Karaj (Iran), 11: 1-39.

Yu, B., S. T. Wu, C. C. Liu, R. Gauthier and P. W. S. Chiou (2007). Effects of enzyme inclusion in a corn – soybean diet on broiler performance. Animal u Feed Science Technology, 134: 283 – 294.

Zahid, N. (2009). Comparison of effects of Echinacea purpurea juices and *Nigella sativa* seeds on performance, some blood parameters, carcass and meat quality of broilers. (Dr.sc.agr. / Ph. D. in Agricultural Sciences) Department of Farm Animal Ethology and Poultry Science, University of Hohenheim.

Zanella, I., N. K. Sakomura, F. G. Silversides, A. Fiqueirdo and M. Pack (1999). Effect of enzyme supplementation of broiler diets based on corn and soybeans. Poultry Science, 11(78): 561 – 568.

Ziad, H. M. Abu-Dieyeh and S. A. Mohammad (2008). Effect of feeding powdered black cumin seeds (*Nigella Sativa L.*) on growth performance of four weeks of old broilers. Journal of Animal and Veterinary Advances, 7 (3): 286-290.

تأثير اضافة حبة البركة والناتوزيم وخليطهما فى علائق دجاج التسمين.
١- الأداء الإنتاجى وصفات الذبيحة

عاطف محمد حسن أبو عاشور، سيد عبد الفتاح عبد الرحمن ، جمال عبد الستار زناتى، منال كمال أبو النجا، إيمان عاشور محمد حسين

قسم إنتاج الدواجن – كلية الزراعة – جامعة المنوفية – مصر

الملخص العربى

تم إجراء هذه التجربة فى مزرعة أبحاث الدواجن . قسم إنتاج الدواجن – كلية الزراعة . جامعة المنوفية ، لدراسة تأثير مستويات مختلفة من إضافات الأعلاف (حبة البركة المطحونة أو الناتوزيم أو خليطهما) على أداء دجاج التسمين تحت الظروف المصرية.

استخدم فى هذه الدراسة عدد ٢٧٠ كتكوت تسمين اربورايكرز Arbor–acres غير مجنس عمر يوم، قسمت الكتاكيت عشوائياً إلى 9 مجموعات تجريبية متماثلة تقريباً فى وزن الجسم (٣٨±٠,٣٢ جم) ، قسمت كل مجموعة إلى ٣ مكررات بكل منها ١٠ كتاكيت. المجموعة الأولى غذيت على عليقة المقارنة (كنترول – بدون أى إضافة)، المجموعة الثانية غذيت على(عليقة الكنترول + ٢ % حبة البركة المطحونة)، المجموعة الثالثة غذيت على (عليقة الكنترول + ٤ % حبة البركة المطحونة)، المجموعة الرابعة غذيت على (عليقةالكنترول + ٠,٠٣ % ناتوزيم)، المجموعة الخامسةغذيت على (عليقة الكنترول + ٠,٠٥ % ناتوزيم)، المجموعة السادسة غذيت على (عليقة الكنترول + ٢ % حبة البركة المطحونة +٠,٠٣ % ناتوزيم)، المجموعة السابعة غذيت على(عليقة الكنترول + ٢ % حبة البركة المطحونة +٠,٠٥ % ناتوزيم)، المجموعة الثامنة غذيت على (عليقة الكنترول + ٤ % حبة البركة المطحونة +٠,٠٣ % ناتوزيم)، المجموعة التاسعة غذيت على (عليقة الكنترول + ٤ % حبة البركة المطحونة +٠,٠٥ % ناتوزيم). واستمرت التجربة حتى عمر ٤٩ يوم وتم تقدير أداء الطيور, معدل تحويل الغذاء وصفات جودة الذبيحة وكذلك معدل كفاءة الإنتاج الأوربى والكفاءة الإقتصادية.

وفيما يلى أهم النتائج: حققت الطيور المغذاة على العلائق المضاف إليها خليط الاضافات (حبة البركة المطحونة مع الناتوزيم) أعلى المتوسطات بالنسبة لوزن الجسم الحى ومعدل الزيادة فى وزن الجسم. كما أظهرت النتائج تحسن فى معدل تحويل الغذاء معنوياً بإضافة كل من حبة البركة المطحونة والناتوزيم. كما لوحظ أن الإضافة عند مستوى ٢% من حبة البركة المطحونة مع ٠,٠٥% ناتوزيم (المعاملة السابعة) حققت أفضل معدل تحويل للغذاء (١,٨٨) ، وارتفع دليل الكفاءة الانتاجية فى الكتاكيت التى غذيت على علائق مضاف اليها خليط كل من حبة البركة والناتوزيم مقارنة بالكتاكيت المغذاة على العليقة الأساسية (الكنترول). وازدادت الأجزاء المأكولة وبعض مقاييس جودة الذبيحة الاخرى زيادة معنوية بتأثير الاضافات مقارنة بالكنترول عند عمر ٢٨ و ٤٩ يوم. وتحسن معدل كفاءة الإنتاج الأوربى والكفاءة الاقتصادية عند إضافة ٢% من حبة البركة المطحونة مع ٠,٠٥% ناتوزيم إلى عليقة الكنترول. وبناءً على النتائج المتحصل عليها من التجربة ودراسة الكفاءة الإقتصادية يتضح أن اضافة حبة البركة المطحونة والناتوزيم بمستوى (٢% +0.05%) الى علائق كتاكيت التسمين (Arbor – acres) أدى الى تحسن الأداء الإنتاجى وصفات الذبيحة والكفاءة الاقتصادية تحت ظروف التجربة.

Table (1). Composition and chemical analysis of the experimental broiler diets fed during starter periods (1 - 21) day of age.

Ingredients	Starter diets[1]									Price / 1000 Kg (LE)
	T_1 (control)	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	
Ground yellow corn (8.5%)	49.82	49..35	48.36	49.83	49.81	49.32	49..30	48.33	48..31	2200
Soybean meal (44%)	40.40	39.09	38.00	40.40	40.40	39.09	39.09	38.00	38.00	3870
Vegetable oil (8800 Kcal)	6.58	6.40	6.48	6.58	6.58	6.40	6.40	6.48	6.48	5000
Nigella sativa L.	__	2.00	4.00	–	–	2.00	2.00	4.00	4.00	19000
Natuzyme	__	–	–	0.03	0.05	0.03	0.05	0.03	0.05	75000
Limestone , ground	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	500
Di-calcium phosphate	0.30	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	1500
Vitamins and minerals mixture [2]	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	8300
DL-methionine[3]	0.20	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	40000
Sodium choloride (salt)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	500
Total	100	100	100	100	100	100	100	100	100	–
Calculated values[4]:										
Crude protein ,%	22.01	21.99	22.02	22.01	22.01	21.99	21.99	22.02	22.02	–
ME, Kcal/kg diet	3149	3142	3145	3149	3149	3142	3142	3145	3145	–
C/Pratio	143.07	142.88	142.82	143.07	143.07	142.88	142.88	142.82	142.82	–
Lysine,%	1.20	1.24	1.26	1.20	1.20	1.24	1.24	1.26	1.26	–
Methionine,%	0.55	0.56	0.57	0.55	0.55	0.56	0.56	0.57	0.57	–
Calcium,%	0.95	0.96	0.98	0.95	0.95	0.96	0.96	0.98	0.98	–
Total phosphorus ,%	0.70	0.69	0.71	0.69	0.68	0.70	0.71	0.70	0.71	–
Price / 1000 Kg (LE)[5]	3110	3420	3730	3140	3160	3440	3460	3750	3760	

[1]T_1, control; T_2, control + 2% *Nigella seeds*; T_3, control + 4% *Nigella seeds*; T_4. control + 0.03% *Natuzyme* ;T_5 ,control +0.05% *natuzyme*,T6,control +2% *Nigella seeds*+ 0.03% *Natuzyme* , T7,control +2% *Nigella seeds*+ 0.05% *Natuzyme* , T8,control +4% *Nigella seeds*+ 0.03% *Natuzyme* , T9,,control +4% *Nigella seeds*+ 0.05% *Natuzyme* .

[2]Vitamin and Mineral mixture at 0.30%of the diet supplies the following per kilogram of the diet: vit.A, 1200 IU; Vit.D3, 2500 IU; Vit. E, 10 mg; Vit .K3, 3mg; Vit.B1, 1mg; Vit.B2, 4mg; pant othenic acid, 10 mg; Nicotinic acid, 20 mg; Folic acid, 1 mg; Biotin, 0.05 mg; Niacin , 40 mg; Vit.B6, 3 mg, Vit. B12, 20 mcg; Choline Chloride, 400 mg; Mn, 62 mg; Fe,44 mg; Zn, 56 mg; I, 1 mg; Cu, 5 mg and Se, 0.01mg.

[3]Dl-Methionine:98% feed grade (contains 98% methionine)

[4]Calculate according to NRC(1994)

[5]Based on prices of Egyptian market, 2011.

Table 2. Composition and chemical analysis of the experimental broiler diets fed during finisher periods (22 - 42) day of age.

Ingredients	Finisher diets[1]									Price / 1000 Kg (LE)
	T_1 (control)	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	
Ground yellow corn (8.5%)	56.81	55.66	54.87	56.78	56.76	55.63	55.61	54.84	54.82	2200
Soybean meal (44%)	34.05	33.21	32.03	34.05	34.05	33.21	33.21	32.03	32.03	3870
Vegetable oil (8800 Kcal)	6.03	6.02	5.99	6.03	6.03	6.02	6.02	5.99	5.99	5000
Nigella sativa L.	—	2.00	4.00	—	—	2.00	2.00	4.00	4.00	19000
Natuzyme	—	—	—	0.03	0.05	0.03	0.05	0.03	0.05	75000
Limestone,ground	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	500
Di-calcium phosphate	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	1500
Vitamin and mineral mixture [2]	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	8300
DL-methionine[2]	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	40000
Sodium choloride (salt)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	500
Total	100	100	100	100	100	100	100	100	100	
Calculated values[4]:										
Crude protein,%	19.89	19.92	19.90	19.89	19.89	19.92	19.92	19.90	19.90	—
ME,Kcal/kg diet	3193	3189	3188	3193	3193	3189	3189	3188	3188	—
C/Pratio	160.53	160.09	160.20	160.53	160.53	160.09	160.09	160.20	160.20	—
Lysine,%	1.09	1.10	1.10	1.09	1.09	1.10	1.10	1.10	1.10	—
Methionine,%	0.36	0.37	0.37	0.36	0.36	0.37	0.37	0.37	0.37	—
Calcium,%	0.91	0.94	0.96	0.91	0.91	0.94	0.94	0.96	0.96	—
Total phosphorus ,%	0.69	0.70	0.72	0.69	0.70	0.68	0.71	0.72	0.70	
Price / 1000 Kg (LE)[5]	2930	3210	3520	2920	2970	3240	3250	3540	3550	—

[1] T_1, control; T_2, control + 2% *Nigella seeds*; T_3, control + 4% *Nigella seeds*; T_4. control + 0.03% *Natuzyme* ;T_5 ,control +0.05% *natuzyme*,T6,control +2% *Nigella seeds*+ 0.03% *Natuzyme* , T7,control +2% *Nigella seeds*+ 0.05% *Natuzyme* , T8,control +4% *Nigella seeds*+ 0.03% *Natuzyme* , T9,,control +4% *Nigella seeds*+ 0.05% *Natuzyme* .

[2] Vitamin and Mineral mixture at 0.30%of the diet supplies the following per kilogram of the diet : vit.A,1200 IU; Vit.D3, 2500 IU; Vit. E, 10 mg; Vit .K3, 3mg; Vit.B1, 1mg; Vit.B2, 4mg; pantothenic acid, 10 mg; Nicotinic acid, 20 mg; Folic acid, 1 mg; Biotin, 0.05 mg; Niacin , 40 mg; Vit.B6, 3 mg, Vit. B12, 20 mcg; Choline Chloride, 400 mg; Mn, 62 mg; Fe,44 mg; Zn, 56 mg; I, 1 mg; Cu, 5 mg and Se, 0.01mg.

[3] Dl-Methionine: 98 % feed grade (contains 98% methionine).

[4] Calculate according to NRC (1994).

[5] Based on prices of Egyptian market, 2011.

Table (4). Effect of different levels of *Nigella sativa L., Natuzyme* or their mixture on average live body weight of growing broilers during experimental periods (Mean ± S. E) .

Periods	Dietary treatments[1]								
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
	------ g ------								
IBW[2]	38.77± 0..34	38.63± 0.29	38.83± 0.34	38.60± 0.27	38.83 ± 0.34	38.84± 0.34	38.60 ± 0.27	38. 77 ± 0.34	38.80± 0.34
2 Wks	370.84 ± 9.15^{d}	373.79 ± 5.28^{c}	394.96 ± 11.24^{b}	377.69 ± 9.15^{c}	389.52 ± 9.15^{b}	383.60 ± 9.59^{ab}	400.52 ± 6.66^{a}	403.69 ± 10.44^{a}	407.37 ± $15.32^{a3,4}$
4Wks	1035.67 ± 19.29^{d}	1052.43 ± 11.14^{c}	1087.03 ± 23.11^{b}	1047.32 ± 19.29^{c}	1074.42 ± 29.25^{b}	1119.92 ± 32.71^{ab}	1199.82 ± 37.8^{a}	1193.22 ± 37.80^{a}	1201.13 ± 33.08^{a}
6Wks	1752.85 ± 13.59^{d}	1799.61 ± 7.85^{c}	1822.20 ± 12..56^{c}	1904.34 ± 23.20^{b}	1917.20 ± 7.13^{b}	1911.35 ± 33.12^{b}	1938.27 ± 18.80^{ab}	1954.74 ± 19.62^{a}	1976.61 ± 21.91^{a}

[1] $T_{1,}$ control; T_2, control + 2% *Nigella seeds*; $T_{3,}$ control + 4% *Nigella seeds*; T_4. control + 0.03% *Natuzyme* ;$T_{5\,,}$control +0.05% *natuzyme*,T6,control +2% *Nigella seeds*+ 0.03% *Natuzyme* , T7,control +2% *Nigella seeds*+ 0.05% *Natuzyme* , T8,control +4% *Nigella seeds*+ 0.03% *Natuzyme* , T9,,control +4% *Nigella seeds*+ 0.05% *Natuzyme .*

[2] *Intinal body weight*

[3, 4] means ± S.E. of 3 replicates / treatment.

[4] a, b, c ….etc: means within the row with each different superscripts are significantly different (P ≤ 0.05).

Table (5). Effect of different levels of *Nigella sativa L., Natuzyme* or their mixture on body weight gain (BWG) of growing broilers during experimental periods (Mean ± S. E).

Periods	Dietary treatments1								
	T1	T2	T3	T4	T5	T6	T7	T8	T9
	------------------ g ------------------								
0 - 2 wks	332.07 ± 9.14^{c}	335.16 ± 5.28^{c}	356.13 ± 5.31^{ab}	339.10 ± 9.14^{b}	350.69 ± 9.14^{ab}	344.76 ± 10.28^{b}	369.92 ± 8.24^{a}	364.96 ± 8.61^{a}	368.57 ± $6.14^{a2,3}$
2 - 4 Wks	664.83 ± 20.73^{d}	678.64 ± 11.97^{c}	692.07 ± 20.73^{c}	669.62 ± 20.73^{c}	684.90 ± 9.15^{c}	736.22 ± 13.00^{a}	718.38 ± 12.8^{b}	761.56 ± 15.32^{a}	775.48 ± 23.15^{a}
4 - 6 Wks	717.13 ± 20.67^{d}	784.87± 12.00^{ab}	735.22 ± 20.67^{c}	856.93 ± 20.67^{b}	843.19 ± 2 9.25^{b}	791.51 ± 34.17^{a}	797.30 ± 34.31^{a}	789.30 ± 15.25^{a}	793.76 ± 20.16^{a}
0 - 6 Wks	1714.03 ± 1 3.61^{d}	1761.01± 17.85^{c}	1783.40± 13.60^{c}	1865.65± 13.60^{ab}	1878.78± 7.13^{ab}	1872.49± 13.61^{ab}	1879.60± 13.60^{ab}	1915.95 ± 19.60^{b}	1937.81± 25.06^{a}

[1] T_1, control; T_2, control + 2%*Nigella seeds*; T_3 \,control + 4% *Nigella seeds*; T_4. control + 0.03% *natuzyme*;T_5 ,control +0.05% *natuzyme*,T6,control +2% *Nigella seeds*+ 0.03% *Natuzyme* , T7,control +2% *Nigella seeds*+ 0.05% *Natuzyme* ,T8, control +4% *Nigella seeds*+ 0.03% *Natuzyme* , T9,,control +4% *Nigella seeds*+ 0.05% *Natuzyme* .

[2] means ± S.E. of 3 replicates / treatment.

[3] a, b, c…etc: means within the row with each different superscripts are significantly different (P<0.05).

Table (6). Effect of different levels of *Nigella sativa L., Natuzyme* or their mixture on average feed intake of growing broilers during experimental periods (Mean ± S. E) .

Periods	Dietary treatments[1]								
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
	------------------------- g/ bird/ day -------------------------								
0 - 2 wks	42.70 ± 0.28^{a}	41.05 ± 0.26^{a}	37.97 ± 0.16^{ab}	39.02 ± 0.28^{b}	38.81 ± 0.28^{b}	37.37 ± 0.45^{ab}	36.19 ± 0.16^{c}	35.42 ± 0.21^{d}	36.22± $0.13^{c2,3}$
2 - 4 Wks	93.00 ± 0.68^{a}	87.18 ± 0.39^{b}	77.81 ± 0.40^{c}	81.94 ± 0.68^{ab}	81.97 ± 0.68^{ab}	82.52 ± 0.12^{ab}	79.86 ± 0.17^{c}	78.88 ± 0.23^{c}	78.33± 0.17^{c}
4 - 6 Wks	136.87 ± 0.70^{a}	137.42± 0.70^{a}	121.14 ± 0.40^{d}	133.23± 0.70^{ab}	130.25 ± 0.70^{ab}	126.64 ± 0.36^{c}	122.56 ± 0.19^{d}	123.99 ± 0.14^{d}	126.21± 0.36^{c}
0 - 6 Wks	89.78 ± 0.54^{ab}	91.40 ± 0.31^{b}	91.02 ± 0.32^{b}	96.52 ± 0.54^{a}	93.50 ± 0.54^{a}	89.31 ± 0.35^{ab}	84.16 ± 0.28^{d}	87.14 ± 0.35^{c}	89.21± 0.56^{ab}

[1]T_1, control; T_2, control + 2% *Nigella seeds*; T_3 control + 4% *Nigella seeds*; T_4. control + 0.03% *natuzyme*;T_5 ,control +0.05% *natuzyme*,T6,control +2% *Nigella seeds* + 0.03% *natuzyme*,T7,control +2% *Nigella seeds* + 0.05% *natuzyme*,T8,control +4% *Nigella seeds* + 0.03% *Natuzyme* , T9,,control +4% *Nigella seeds* + 0.05% *Natuzyme* .
[2]means ± S.E. of 3 replicates / treatment.
[3] a, b, c ….etc: means within the row with each different superscripts are significantly different ($P<0.05$).

Table (7). Effect of different levels of *Nigella sativa L., Natuzyme* or their mixture on average feed conversion ratio of growing broilers during experimental periods (Mean ± S. E) .

Periods	Dietary treatments[1]								
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
	---------- g feed / g gain ----------								
0 - 2 wks	1.80 ± 0.05^{a}	1.63 ± 0.03^{b}	1.49 ± 0.03^{bc}	1.61 ± 0.05^{b}	1.55 ± 0.03^{c}	1.52 ± 0.03^{c}	1.39 ± 0.01^{d}	1.39 ± 0.01^{d}	1.37 ± 0.01^{d2,3}
2 - 4 Wks	1.96 ± 0.05^{a}	1.84 ± 0.05^{b}	1.57 ± 0.03^{d}	1.70 ± 0.05^{c}	1.67 ± 0.05^{c}	1.57 ± 0.03^{d}	1.55 ± 0.03^{d}	1.45 ± 0.02^{e}	1.41 ± 0.02^{e}
4 - 6 Wks	2.59 ± 0.07^{a}	2.45 ± 0.04^{b}	2.31 ± 0.04^{ab}	2.17 ± 0.07^{bc}	2.15 ± 0.07^{d}	2.24 ± 0.04^{c}	2.15 ± 0.04^{d}	2.15 ± 0.04^{d}	2.22 ± 0.04^{c}
0 - 6 Wks	2.20 ± 0.03^{a}	2.10 ± 0.04^{b}	2.14 ± 0.04^{ab}	2.17 ± 0.07^{b}	2.09 ± 0.0.03^{c}	2.00 ± 0.01^{c}	1.88 ± 0.02^{e}	1.91 ± 0.02^{d}	1.93 ± 0.02^{d}

[1]T_1, control; T_2, control + 2% *Nigella seeds*; T_3 control + 4% *Nigella seeds*; T_4. control + 0.03% *natuzyme*;T_5 ,control +0.05% *natuzyme*,T6,control +2% *Nigella seeds* + 0.03% *natuzyme*,T7,control +2% *Nigella seeds*+ 0.05% *natuzyme*,T8,control +4% *Nigella seeds*+ 0.03% *Natuzyme* , T9,,control +4% *Nigella seeds*+ 0.05% *Natuzyme* .

[2]means ± S.E. of 3 replicates / treatment.

[3] a, b, c…etc: means within the row with each different superscripts are significantly different (P<0.05).

Table (8). Effect of different levels of *Nigella sativa L., Natuzyme* or their mixture on performance index (PI) of growing broilers during experimental periods (Mean ± S. E) .

Periods (wks of age)	Dietary treatments[1]								
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
	------------------	------------------	------------------	------------------	%	------------------	------------------	------------------	------------------
2	21.43± 1.27^{c}	22.25 ± 0.73^{c}	26.78 ± 074^{b}	24.01 ± 1.27^{ab}	25.51 ± 0.36^{b}	25.717 ± 0.47^{b}	26.62 ± 0.57^{b}	30.1± 1.20^{a}	29.93 ± 0.79^{a2,3}
4	53.98 ± 3.12^{e}	60.36 ± 1.80^{d}	68.23 ± 1.81^{bc}	61.99 ± 3.12^{d}	64.83 ± 3.12^{bc}	71.95 ± 0.83^{c}	81.06 ± 2.02^{b}	85.80 ± 1.40^{a}	86.75 ± 0.63^{a}
6	65.92 ± 2.44^{d}	79.69± 1.41^{bc}	79.69 ± 1.42^{bc}	87.78± 2.44^{a}	87.74.± 2.44^{a}	85.67 ± 2.00^{b}	86.84± 1.41^{a}	85.96± 1.42^{b}	87.84 ± 0.836^{a}

[1]T_1, control; T_2, control + 2% *Nigella seeds*; T_3 control + 4% *Nigella seeds;* T_4. control + 0.03% *natuzyme*;T_5 ,control +0.05% *natuzyme*,T6,control +2% *Nigella seeds* + 0.03% *natuzyme*,T7,control +2% *Nigella seeds*+ 0.05% *natuzyme*,T8,control +4% *Nigella seeds*+ 0.03% *Natuzyme* , T9,,control +4% *Nigella seeds*+ 0.05% *Natuzyme* .

[2]means ± S.E. of 3 replicates / treatment.

[3] a, b, c …etc: means within the row with each different superscripts are significantly different (P<0.05).

Table (9). Effect of different levels of *Nigella sativa L.*, *Natuzyme* or their mixture on carcass characteristics of growing broilers at 28 days of age (Mean ± S. E) .

Items	Dietary treatments[1]								
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
Preslaughter weight (g)	847 ± 35.52[c]	850 ± 20.51[ab]	876 ± 26.48[b]	836 ± 35.52[c]	857 ± 35.52[ab]	882 ± 35.37[b]	914 ± 16.25[a]	911 ± 18.06[a]	954 ± 16.55[a2,3]
Carcass weight (g)	575 ± 19.69[d]	585 ± 11.37[bc]	629 ± 14.67[c]	589 ± 19.69[bc]	604 ± 19.69[c]	617 ± 19.69[c]	640 ± 22.19[b]	646± 19.23[b]	680 ± 15.96[a]
Dressing percentage (%)	67.93 ± 1.54[ab]	68.71 ± 0.89[ab]	71.84 ± 1.14[a]	70.49 ± 1.54[b]	70.48 ± 1.54[b]	69.94 ± 0.85[ab]	70.02 ± 0.46[b]	70.84 ± 1.59[a]	71.33 ± 1.54[a]
Liver percentage (%)	2.56 ± 0.25[a]	2.75 ± 0.08[a]	2.79 ± 0.11[a]	2.81 ± 0.14[a]	2.68 ± 0.14[a]	2.72 ± 0.14[a]	2.84 ± 0.14[a]	2.82 ± 0.14[a]	3.00 ± 0.14[a]
Heart percentage (%)	0.63 ± 0.03[a]	0.71 ± 0.03[a]	0.84 ± 0.04[a]	0.60 ± 0.05[a]	0.58 ± 0.05[a]	0.72 ± 0.05[a]	0.69 ± 0.05[a]	0.73 ± 0.05[a]	0.73 ± 0.05[a]
Gizzard percentage (%)	2.72 ± 0.09[ab]	2.75 ± 0.06[b]	2.93 ± 0.09[a]	2.93 ± 0.09[a]	2.84 ± 0.09[b]	2.87± 0.09[a]	2.96 ± 0.19[a]	2.80 ± 0.09[b]	2.90 ± 0.19[a]
Giblets percentage (%)	5.90 ± 0.36[b]	6.20 ± 012[b]	6.55 ± 0.16[a]	6.34 ± 0.21[a]	6.11 ± 0.21[b]	6.31 ± 0.21[a]	6.49 ± 0.14[a]	6.36 ± 0.23[a]	6.64 ± 0.16[a]
Spleen percentage (%)	0.08 ± 0.0[a]	0.09 ± 0.0[a]	0.08 ± 0.00[a]	0.08 ± 0.00[a]	0.07 ± 0.00[a]	0.09 ± 0.00[a]	0.10 ± 0.00[a]	0.09 ± 0.00[a]	0.11± 0.00[a]
Bursa percentage (%)	0.17 ± 0.0[b]	0.18 ± 0.0[b]	0.20 ± 0.00[a]	0.17 ± 0.00[b]	0.16 ± 0.00[a]	0.18 ± 0.00[b]	0.18 ± 0.00[b]	0.20 ± 0.00[a]	0.20 ± 0.00[a]
Thymus percentage (%)	0.14 ± 0.0[c]	0.20 ± 0.0[b]	0.25 ± 0.00[a]	0.15 ± 0.00[c]	0.14 ± 0.00[c]	0.21 ± 0.00[b]	0.22 ± 0.00[b]	0.25 ± 0.00[a]	0.26 ± 0.00[a]

[1]T_1, control; T_2, control + 2% *Nigella seeds*; T_3 control + 4% *Nigella seeds*; T_4. control + 0.03% *natuzyme*;T_5 ,control +0.05% *natuzyme*,T6,control +2% *Nigella seeds*+ 0.03% *natuzyme*,T7,control +2% *Nigella seeds* + 0.05% *natuzyme*,T8,control +4% *Nigella seeds*+ 0.03% *Natuzyme* , T9, control + 4% *Nigella seeds*+ 0.05% *Natuzyme* .

[2]means ± S.E. of 3 replicates / treatment.

[3] a, b, c …etc: means within the row with each different superscripts are significantly different (P<0.05).

Table (10). Effect of different levels of *Nigella sativa L. or Natuzyme* or their mixture on carcass characteristics of growing broilers at 49 days of age (Mean ± S. E) .

Items	Dietary treatments[1]								
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
Preslaughter weight (g)	1920 ± 53.29^{d}	1917 ± 53.29^{e}	1980 ± 77.60^{c}	2071 ± 65.29^{b}	2085 ± 49.16^{a}	2051 ± 32.80^{b}	2067 ± 16.32^{b}	2114 ± 40.33^{a}	2088 ± 47.13^{a2,3}
Carcass weight (g)	1413 ± 28.14^{e}	1444 ± 16.25^{d}	1501 ± 20.97^{c}	1526 ± 28.14^{ab}	1536 ± 28.14^{ab}	1570 ± 39.03^{b}	1553 ± 28.14^{ab}	1618 ± 48.74^{a}	1611 ± 27.74^{a}
Dressing percentage (%)	73.59 ± 0.99^{d}	75.33 ± 0.57^{ab}	75.81 ± 0.74^{b}	73.68 ± 0.99^{b}	73.67 ± 0.99^{b}	76.55 ± 0.11^{a}	75.16 ± 0.92^{c}	76.63 ± 0.11^{a}	77.16 ± 1.71^{a}
Abdominal fat (%)	1.61 ± 0.05^{a}	1.32 ± 0.03^{b}	1.26 ± 0.03^{c}	1.58 ± 0.05^{a}	1.60 ± 0.05^{a}	1.27 ± 0.03^{c}	1.28 ± 0.03^{c}	1.26 ± 0.03^{c}	1.29 ± 0.03^{a}
Liver percentage (%)	2.98 ± 0.11^{a}	3.27 ± 0.06^{a}	3.53 ± 0.08^{a}	3.45 ± 0.11^{a}	3.09 ± 0.11^{a}	2.97 ± 0.16^{a}	3.45 ± 0.14^{a}	3.42 ± 0.14^{a}	3.31 ± 0.14^{a}
Heart percentage (%)	0.48 ± 0.03^{a}	0.59 ± 0.02^{a}	0.49 ± 0.02^{a}	0.53 ± 0.03^{a}	0.51 ± 0.03^{a}	0.54 ± 0.03^{a}	0.56 ± 0.03^{a}	0.46 ± 0.03^{a}	0.45 ± 0.03^{a}
Gizzard percentage (%)	3.59 ± 0.10^{b}	3.27 ± 0.06^{c}	3.22 ± 0.07^{c}	3.62 ± 0.10^{b}	3.57 ± 0.10^{b}	3.96 ± 0.08^{a}	4.07 ± 0.19^{a}	4.04 ± 0.19^{a}	4.10 ± 0.09^{a}
Giblets percentage (%)	7.06 ± 0.16^{d}	7.06 ± 0.16^{d}	7.25 ± 0.12^{c}	7.62 ± 0.16^{b}	7.16 ± 0.16^{c}	7.47 ± 0.21^{b}	8.08 ± 0.27^{a}	8.00 0.28^{a}	7.98 ± 0.26^{a}
Spleen percentage (%)	0.08 ± 0.00^{a}	0.07 ± 0.00^{a}	0.08 ± 0.00^{a}	0.10 ± 0.00^{a}	0.08 ± 0.00^{a}	0.09 ± 0.00^{a}	0.10 ± 0.00^{a}	0.11 ± 0.00^{a}	0.10 ± 0.00^{a}
Bursa percentage (%)	0.15 ± 0.00^{b}	0.17 ± 0.00^{a}	0.20 ± 0.00^{a}	0.15 ± 0.00^{b}	0.14 ± 0.00^{b}	0.17 ± 0.00^{a}	0.18 ± 0.00^{a}	0.19 ± 0.00^{a}	0.19 ± 0.00^{a}
Thymus percentage (%)	0.20 ± 0.01^{ab}	0.25 ± 0.01^{b}	0.28 ± 0.01^{a}	0.21 ± 0.01^{ab}	0.20 ± 0.01^{ab}	0.24 ± 0.01^{b}	0.25 ± 0.01^{b}	0.28 ± 0.01^{a}	0.29 ± 0.01^{a}

[1]T_1, control; T_2, control + 2% *Nigella seeds*; T_3 control + 4% *Nigella seeds*; T_4. control + 0.03% *natuzyme*;T_5 ,control +0.05% *natuzyme*,T6,control +2% *Nigella seeds*+ 0.03% *natuzyme*,T7,control +2% *Nigella seeds*+ 0.05% *natuzyme*,T8,control +4% *Nigella seeds*+ 0.03% *Natuzyme* , T9,,control +4% *Nigella seeds*+ 0.05% *Natuzyme* .

[2]means ± S.E. of 3 replicates / treatment.

[3] a, b, c …etc: means within the row with each different superscripts are significantly different (P<0.05).

Table (11). The economical efficiency as affected by different levels of *Nigella sativa L., Natuzyme* or their mixture supplementation.

Items	Dietary treatments[1]								
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
Chicks total number at the beginning of the experimental	30	30	30	30	30	30	30	30	30
Initial body weight, (g)	38.77	38.63	38.83	38.6	38.83	38.84	38.6	38.77	38.8
Final body weight, (Kg)	1.75	1.79	1.82	1.9	1.92	1.91	1.94	1.95	1.98
Mortality Values (%)	6.67	5	3.33	1.67	1.67	3.33	1.67	1.67	1.67
Chicks total number at the end of the experimental	28	28.5	29	29.5	29.5	29	29.5	29.5	29.5
Body weight gain ,Kg	1.71	1.75	1.78	1.86	1.88	1.87	1.9	1.91	1.94
Revenue from gain, (L. E)	20.5	21	21.36	22.32	22.56	22.44	22.8	22.92	23.28
Feed intake, (Kg)	3.76	3.82	3.81	4.04	3.93	3.56	3.57	3.65	3.74
Price of Kg feed, (L. E.)	3.02	3.31	3.47	3.05	3.07	3.34	3.36	3.63	3.66
Feed cost, (L. E)	11.36	12.64	13.22	12.32	12.07	11.89	12	13.32	13.69
Net revenue[2], (L.E.)	9.14	8.36	8.14	10	10.49	10.55	10.8	9.6	9.59
Economical Effeciency[3], (E.E, %)	80.46	66.14	61.57	81.17	86.91	88.73	90	72.07	70.05
Relative Economical Efficiency, (%)	100	82.2	76.52	100.88	108.02	110.28	111.86	89.57	87.06
European Productive Effeciency[4], (EPE, %)	176.76	185.73	195.75	204.99	215.08	219.81	241.59	239.02	240.18

[1]T_1, control; T_2, control + 2% *Nigella seeds*; T_3 control + 4% *Nigella seeds*; T_4. control + 0.03% *Natuzyme* ;T_5 ,control +0.05% *Natuzyme* , T6, control +2% *Nigella seeds*+ 0.03% *natuzyme*,T7,control +2% *Nigella seeds* + 0.05% *Natuzyme* , T8,control + 4% *Nigella seeds*+ 0.03% *Natuzyme* , T9, control +4% *Nigella seeds*+ 0.05% *Natuzyme* .

[2]Net revenue: Revenue from gain - Feed cost.

[3]Economical Efficiency = (net revenue / feed cost) x 100.

Price of one Kg live body weight was 12 L. E. , Price of one Kg Nigella sativa L. and Natuzyme enzyme 19 and 75 L. E.

[4] %EPE= (Mean body weight (Kg) × livability % × 100) / feed conversion × marketing age, days), cited by Soltan and Kusainova, 2012.