

Effect of *Nigella sativa* or Curcumin on Daily Body Weight Gain, Feed Intake and some Physiological Functions in Growing Zaraibi Goats during Hot Summer Season

A. A. M. Habeeband A. A. El-Tarabany

Biological Applications Department, Radioisotopes Applications Division, Nuclear Research Centre, Atomic Energy Authority, P.No. 13759, Inshas, Egypt.

E-mail: alnaimy252011@hotmail.com

ABSTRACT

Twenty one Zaraibi kids, aged 4-5 months and weighed on average 9.5 ± 0.2 kg were divided into three groups, seven kids in each. The experiment was beginning after the end of weaning period and lasted 5 months (May, June, July, August and September). Kids in the 1st group were fed the basal ration (concentrate feed mixture plus Barseem hay without additives (Control), while those in the 2nd and 3rd groups were fed the same basal ration supplemented daily with crushed 2 gram from *Nigella* or Curcumin per one kg CFM, respectively.

Nigella sativa (*Nigella*) and Curcumin addition to the diet of kids during months of the hot summer season comparison with control group improved significantly the final LBW at the end of 5 months by 5.56 and 4.8 kg and increased significantly average daily body gain (DBG) of kids by 62.2 and 54.25 g, respectively.

Supplementation improved the animal immunity function i.e. total protein and globulin concentrations as well as thyroid hormonal levels (T_4 & T_3) and decreased the factor related to heart disease (total cholesterol and total lipids), glucose and cortisol levels in the blood plasma. At the same time, liver and kidney functions were not affected negatively by supplementation either with *Nigella* or Curcumin. Supplementation the diet of growing goats increased also significantly the Hb values and RBC'S count as well as the concentrations of Na, K, and Pi.

Key Words: Goats/ *Nigella* / Curcumin/ T_4 & T_3 / blood constituents.

INTRODUCTION

The antioxidant activity is high in medicinal plants and antioxidants play an important role in inhibiting and scavenging radicals which providing protection to humans against infectious and degenerative diseases ⁽¹⁾. Some medicinal plant extracts and pure forms of active compounds were evaluated for their potential application as modifiers of rumen microbial fermentation to produce VFA which represent the main supply of metabolizable energy for ruminant ⁽²⁾.

Nigella is contains over 100 valuable components, so it is a significant source of essential fatty acids, proteins, carbohydrates, vitamins A, B₁, B₂, C and niacin as well as minerals and carotene. Nutritional composition of black seed is protein 21%, carbohydrates 35% and fats 35-38%. In addition, *Nigella* reduces the toxicity of cisplatin that induced fall in leucocytes count, hemoglobin levels and mean osmotic fragility of erythrocytes ⁽³⁾. Black seed is rich in nutritional values like mono-saccharides and non-starch polysaccharide component which is a useful source of dietary fiber and also is rich in fatty acids, particularly, the unsaturated and essential fatty acids which cannot be manufactured by the body alone and therefore animals acquire these from food. Fifteen amino acids make up the protein content of the black seed, including eight of the nine essential amino acids ⁽⁴⁾. The

black seed is also a source of calcium, iron, sodium, and potassium as well as most of trace elements which act as essential cofactors in various enzyme functions ⁽⁵⁾.

Nigella seeds are a suitable protein source (30% or more) to be included in the diets of farm animals due to its cheap price compared with the traditional protein sources ⁽⁶⁾. Awadalla and Gehad⁽⁷⁾ reported that the composition of DM% of NSS is 25.51, 8.54, 43.33, 17.10 and 5.52% for CP, CF, EE, NFE and Ash, respectively. This indicates that NSS is a rich source of both CP and fat and therefore it can be used a good source of CP and energy in animal nutrition. From another point of view the Nigella oils can be used as antioxidant agent as it inhibited the non-enzymatic peroxidation which may increase the immunity and may help the animals to tolerate the heat stress ⁽⁸⁾.

Curcumin or Turmeric contains protein (6.3%), fat (5.1%), minerals (3.5%), carbohydrates (69.4%) and moisture (13.1%). Turmeric also essential for antioxidant activity comparable to that vitamins C and E and reduces cholesterol levels and increase good cholesterol, i.e. high-density lipoprotein ⁽⁹⁾. In addition, Manjunatha and Srinivasan⁽¹⁰⁾ found that turmeric volatile oil can diffuse into the sperm cells membrane and serve as an intracellular structure. The main yellow bioactive component of turmeric has a wide spectrum of biological actions include its antioxidant, anticoagulant, antibacterial, antifungal, antiprotozoal, antiviral and hypocholesteremic activities ⁽¹¹⁾. The antioxidant activity of Curcumin was due to it acts as a scavenger of oxygen free radicals and protect hemoglobin from oxidation. Curcumin lowers the production of reactive oxygen species like super oxide anions, H₂O₂ and nitrite radical generation ^(11,12).

This experiment is conducted to study the effect of Nigella or Curcumin in diet of growing goats to improve live body weight gain and feed intake and restoration the blood components and some physiological body functions during hot summer season.

MATERIALS AND METHODS

Experimental Animals:

The experiment was carried out in Goat's Farm, Nuclear Research Center, Atomic Energy Authority, Inshas on twenty one male Zaraibi goats after weaning, aged 4-5 months and averaged weight 9.5±0.2 kg. The experiment was beginning after the end of weaning period during hot summer season in May and continued 5 months until September (2011).

Meteorological Data and Temperature Humidity Index (THI) Estimation:

Air temperature (°F) and relative humidity (%) inside the farm building were measured once weekly four times at 12.00, 13.00, 14.00 and 15.00 hours using digital Thermo-hygrometer. Temperature-humidity index (THI) values were calculated according to Livestock and Poultry Heat Stress Indices for Cattle, Sheep and Goats ⁽¹³⁾ cited in the Agriculture Engineering Technology Guide, Clemson University, Clemson, SC 29634 USA, using the formula:

$THI = db^{\circ}F - (0.55 - 0.55 \times RH \%) (db^{\circ}F - 58)$ where $db^{\circ}F$ = dry bulb temperature in Fahrenheit, $RH = RH \% / 100$. Less than 72 = absence of heat stress (comfortable), 72 to <78 = moderate heat stress, 78 to <86 = severe HS and over 86 = very severe heat stress. The estimated average monthly air temperature (°F) were 93.5, 94.5, 95.0, 95.5, and 92.5 and relative humidity (%) were 52.0, 56.0, 59.0, 60.0 and 52.0 during May, June, July, August and September. The corresponding THI values were 84.13, 85.67, 86.64, 87.25 and 83.39 indicating that Zaraibi kids suffering from severe heat stress conditions during May, June and September months and very severe heat stress conditions during July and August months in Goats Experimental Farm at Inshas area.

Experimental Procedure:

The animals were healthy and clinically free of external and internal parasites and divided to three equal groups. Animals were fed 2-weeks, as a transitional period, on the tested rations before the start of the experimental work. Kids in the 1st group were fed the basal ration (concentrate feed mixture (CFM) plus Barseem hay (BH) without additives (Control) according to the feeding regime of the traditional farm system, while kids of the 2nd and 3rd groups were fed the same basal ration but supplemented daily with crushed 2 gram from Nigella seeds or Curcumin per one kg CFM, respectively. Nigella or Curcumin additives were mixed manually with CFM to satisfy one week and offered individually daily once at 10 .00 hr.

Animal Feeding and Housing:

Kids were fed a basal ration consisted of CFM plus BH on DM basis according to allowances of NRC⁽¹⁴⁾ of growing goats. The CFM composed of 37.5% wheat bran, 27% yellow corn, 12.5% soybean meal (44% CP), 10.0% undecorticated cottonseed cake, 5% rice bran, 4% sugarcane molasses, 3% limestone and 1% sodium chloride. Chemical analysis (on DM basis %) of CFM are 16.0, 14.0, 4.3, 53.7 and 12.0 % and of Berseem hay are 13.05, 25.51, 1.94, 48.69 and 10.81 for CP, CF, EE, NFE and Ash, respectively. The NDF, ADF and ADL% values were 39.0, 23.0 and 6.3 in CFM and 74.0, 55.1 and 8.7 in Berseem hay, respectively.

The experimental animals in three groups were housed under in a semi-roofed yard and kept under the same feeding and managerial conditions. Animals were weighed at the beginning and thereafter monthly intervals.

Blood Samples and Biochemical Analysis:

At the end of the experiment, blood samples were taken with anticoagulant (EDTA) to determine Ht%, Hb, RBCS and WBCS in the whole blood samples immediately after blood samples collection. The residual blood samples were centrifuged at 2000 x g for 25 minutes to obtain plasma. Immunity function (total protein, albumin and globulin), kidney function (creatinine and urea-N), glucose, total lipids, and cholesterol and some minerals (Na, K, Ca, Mg and Pi concentrations) were estimated in the plasma using commercial chemical reagent kits. In addition, liver function (AST, ALT and Alk-P enzyme activities) was also estimated in serum of blood samples collected without anticoagulant.

The levels of T₄, T₃ and cortisol hormonal levels were estimated by the radioimmunoassay (RIA) technique using the coated tubes kits, Diagnostic Systems Laboratories, Inc. Webster, Texas, USA and counting in the Laboratory of Biological Applications Department, Atomic Energy Authority, using computerized Gamma Counter. The tracer in the three hormones was labeled with iodine-125 (¹²⁵I).

Statistical Analyses

Data of present study were statistically analyzed using general linear model procedure by computer program of SAS⁽¹⁵⁾ and the statistical model was as follows: $Y_{ij} = \mu + T_i + e_{ij}$ where Y_{ij} = the observation, μ = overall mean, T_i = the fixed effect of treatments (1= control, 2= Nigella , 3= Curcumin), e_j = the random error. Duncan's Multiple Range Test⁽¹⁶⁾ was used for testing the significant differences between means.

RESULTS AND DISCUSSION

Effect of Nigella or Curcumin on LBW and DBG of Kids :

Nigella and Curcumin additives to the diet of Zaraibi kids during months of the hot summer

season improved significantly average final live body weight (LBW) from 25.2 kg to 33.5 and 32.0 kg, respectively (Table 1). LBW during 5 months of the hot summer season improved by 5.56 and 4.80 kg due to supplement the diet of kids Zaraibi goats with Nigella or Curcumin, respectively. The LBW values of Zaraibi kids were better with addition Nigella in their diet than with Curcumin by 0.760 kg / month. In addition, Nigella and Curcumin increased average daily body gain (DBG) in kids of goats by 62.2 and 54.2 g%, respectively (Table 2). The improvement in DBG was better with Nigella than with Curcumin by 8.0 g daily.

Table (1): Effect of Nigella or Curcumin on live body weight of growing male Zaraibi goats during hot summer conditions.

Experimental period	Live body weight (LBW, kg)				
	Group one	Group two		Group three	
	Without treatment	Treated with Nigella	Monthly increase	Treated with Curcumin	Monthly increase
Initial LBW	9.5 ^a ± 0.50	9.7 ^a ± 0.60	---	9.4 ^a ± 0.40	---
1 st month	12.1 ^b ± 0.62	14.7 ^a ± 0.20	+2.600	14.3 ^a ± 0.80	+2.200
2 nd month	15.5 ^b ± 0.65	19.9 ^a ± 0.63	+4.400	19.3 ^a ± 1.16	+3.800
3 rd month	18.7 ^b ± 0.76	24.5 ^a ± 0.81	+5.800	23.8 ^a ± 1.19	+5.100
4 th month	22.5 ^b ± 1.08	29.8 ^a ± 1.08	+6.700	28.6 ^a ± 1.04	+6.100
Final LBW at 5 th month	25.2 ^c ± 2.03	33.5 ^a ± 2.48	+8.300	32.0 ^a ± 2.05	+6.800
Overall mean			+5.56±0.33		+4.80 ±0.11

a, b,...Means for each parameter in the same raw with different superscript are significantly different (P<0.05)

Table (2): Effect of Nigella or Curcumin on daily body weight gain of growing male Zaraibi goats during hot summer conditions.

Experimental period	Daily live body weight gain (Gram)				
	Group one	Group two		Group three	
	Without treatment	Treated with Nigella	Daily increase	Treated with Curcumin	Daily increase
1 st month	86 ^b ± 2.2	167 ^a ± 2.5	81.0	163 ^a ± 3.2	77.0
2 nd month	113 ^b ± 5.4	173 ^a ± 4.2	60.0	167 ^a ± 3.1	54.0
3 rd month	106 ^b ± 5.0	153 ^a ± 4.2	47.0	150 ^a ± 2.0	44.0
4 th month	87 ^c ± 4.2	177 ^a ± 5.4	90.0	160 ^b ± 3.5	73.0
5 th month	90 ^c ± 3.4	123 ^a ± 3.0	33.0	113 ^b ± 2.4	23.0
Overall mean			+62.2±2.3		+54.2±2.1

a, b,...Means for each parameter in the same raw with different superscript are significantly different (P<0.05)

These results are in agreement with those of who stated that supplements of medicinal plant mixture including Black seeds improved daily body weight gain for different farm animals ^(17 - 24). Abdel-Azeem *et al.*⁽²⁵⁾ found that supplementation of rabbit rations with NSS improved live body weight and daily body weight gain. Awadallah⁽⁸⁾ reported that Friesian calves under heat stress condition fed diets supplemented daily with NSS at the rate of 100 mg/kg body weight improved body weight gain. Awadallah and Gehad ⁽⁷⁾ found that supplementing growing sheep ration with NSS improved significantly average daily gain, feed conversion ratio as kg DM intake /kg gain. Sheep fed rations supplemented with NSS had a significantly higher average daily gain (179.7 g/daily in control vs. 200.9 and 212.9 g/daily, supplemented with 1 and 2% with NSS, respectively). Allam *et al.*⁽²⁶⁾ found that ration of lactating goats supplemented with 0.25 g NSS powder / kg LBW /day improved significantly litter size and litter weight during suckling period and at weaning in Zaraibi kids.

Khatab *et al.* ⁽²⁷⁾ showed that calves of buffaloes fed on black seed oil diet grew faster than those of buffaloes fed on diet without black seed oil. Moreover, calves of black seed oil had significantly the highest weaning weight and significant highest total gain. It is clear that calves of black seed oil treated buffaloes showed the highest ($P<0.05$) daily gain. Khatab *et al.* ⁽²⁷⁾ concluded that the effect of treating buffaloes before parturition was transferred to offspring and consequently led to more gain for calves received black seed oil treatment.

Effect of Nigella or Curcumin on Dry Matter Intake:

Nigella additive to the diet of Zaraibi kids increased significantly DMI during months of hot summer season by 4.42 and 0.18 g/kg LBW in CFM and berseem hay, respectively. The corresponding increase values with Curcumin additive were 3.3 and 0.16 g/kg LBW (Table 3).

Table (3): Effect of Nigella or Curcumin on voluntary daily dry matter intake (g/kg LBW/head) from feed stuffs in growing male Zaraibi goats during hot summer conditions.

Experimental period	DMI, (g/kg LBW) from feed stuffs	Average dry matter intake from feed stuffs (g/kg LBW/head)		
		Group one	Group two	Group three
		Without treatment	Treated with Nigella	Treated with Curcumin
1 st month	CFM	22.4 ^b ±0.30	26.9 ^a ±0.50	26.0 ^a ±0.40
	Berseem hay	2.2 ^B ±0.20	2.5 ^A ±0.20	2.5 ^A ±0.10
2 nd month	CFM	34.4 ^b ±0.30	40.9 ^a ±0.30	39.9 ^a ±0.30
	Berseem hay	2.7±0.10	2.9±0.10	2.8±0.10
3 rd month	CFM	46.4 ^b ±0.50	51.9 ^a ±0.30	49.9 ^a ±0.30
	Berseem hay	2.9±0.20	3.0±0.20	3.0±0.20
4 th month	CFM	55.9 ^c ±0.70	60.6 ^a ±0.40	58.7 ^b ±0.30
	Berseem hay	3.4±0.30	3.4±0.20	3.4±0.20
5 th month	CFM	59.1±0.90	60.0±0.50	60.2 ±0.30
	Berseem hay	3.5 ^B ±0.20	3.8 ^A ±0.20	3.8 ^A ±0.30
Overall mean	CFM	43.64 ^b ±1.82	48.06 ^a ±1.48	46.94 ^a ±1.05
	Berseem hay	2.94±0.12	3.12±0.13	3.10 ±0.10

a, b,...or A, B, ...Means for each parameter in the same raw with different superscript are significantly different ($P<0.05$); CFM= Concentrate feed mixture.

Allam *et al.* ⁽²⁶⁾ observed that using black seed in dairy goat diets had a positive effect on feed efficiency. Abdel-Azeem *et al.* ⁽²⁵⁾ found that supplementation of rabbit rations with NSS improved nutrient digestibility and feed conversion ratio. El-Gendy *et al.* ⁽²⁸⁾ found that DM, OM, CF and GE digestibility of rations containing Nigella in Rahmany rams were significantly higher than for other rations. In addition, the DE and TDN of rations containing Nigella were higher than control and the authors concluded that Nigella could be used successfully in ruminant rations to improve its nutrients digestibility coefficients and nutritive values. Awadallah and Gehad⁽⁷⁾ reported that the growing sheep fed the 2% NSS supplemented ration had the lowest significantly conversion ratio calculated as kg DM intake/ kg body weight gain (8.04 in control vs. 6.97 and 6.25 in rations supplemented with 1 and 2 %, respectively). From the metabolism trial, Awadallah and Gehad⁽⁷⁾ reported that supplementation caused significant increase in nutrients digestibility, nitrogen utilization, nitrogen retention and increase the nutritive values (TDN and DCP) of the supplemented rations. Mohammed *et al.* ⁽²⁹⁾ reported that supplementation feeds by 100 mg NSS /kg LBW of ewes improved significantly the feed intake and the digestibility coefficient of DM, OM, CP, CF and NFE and

nutritive values as TDN, SE and DCP. Allam *et al.* ⁽²⁹⁾ found that ration of lactating goats supplemented with 0.25 g NSS powder / kg LBW /day improved significantly feed efficiency as g gain/ g DM or g TDN. Khattab *et al.* ⁽²⁷⁾ found that buffalo calves fed supplemented ration with black seed oil had higher nutrient digestibility values than those of the non supplemented groups. The same authors reported that feed conversion values expressed as DM, TDN and DCP intakes per gain were significantly better for calves of buffaloes supplemented by black seed than the control. This may reflect the improvement of average daily gain as a result of black seed supplementation.

Effect of Nigella or Curcumin on Hormonal Levels:

Nigella additive to the diet of Zaraibi kids increased significantly T₄ and T₃ during months of the hot summer season by 20.3 and 1.3 ng ml⁻¹ with percentages increase of 39.26 and 28.26, respectively. The corresponding increase values with Curcumin additive were 11.1 and 1.0 ngml⁻¹ with percentages increase of 21.47 and 21.74, respectively. On the other hand, Nigella or Curcumin additive to the diet of Zaraibi kids decreased significantly cortisol level during months of the hot summer season by 3.0 or 2.0 ngml⁻¹ with percentage decrease of 23.44 or 15.63, respectively. T₄/T₃ ratio increased from 11.24 to 12.20 due to addition of Nigella due to the increase in T₄ level was higher than the increase in T₃ level (Table 4). Nigella can be used as antioxidant agent as it inhibited the non-enzymatic peroxidation which may increase the immunity and may help the animals to tolerate the heat stress ⁽⁸⁾. The antioxidant activity of Curcumin was due to it acts as a scavenger of oxygen free radicals and protect hemoglobin from oxidation. Curcumin lowers the production of reactive oxygen species like super oxide anions, H₂O₂ and nitrite radical generation ^(11,12).

Table (4): Effect of Nigella or Curcumin on Thyroxin (T₄), Triiodothyronine (T₃), T₄/T₃ ratio and cortisol concentrations in growing male Zaraibi goats during hot summer conditions.

Hormones	Hormonal levels		
	Group one	Group two	Group three
	Without treatment	Treated with Nigella	Treated with Curcumin
T ₄ (ng ml ⁻¹)	51.7 ^c ± 3.0	72.0 ^a ± 4.0	62.8 ^b ± 3.0
T ₃ (ng ml ⁻¹)	4.6 ^b ± 0.07	6.9 ^a ± 0.86	6.6 ^a ± 0.53
T ₄ /T ₃ ratio	11.24	10.43	9.97
Cortisol (ng ml ⁻¹)	12.8 ^a ± 0.93	9.8 ^c ± 0.93	10.8 ^b ± 0.93

a, b,...Means for each parameter in the same raw with different superscript are significantly different (P<0.05)

Effect of Nigella or Curcumin on Blood Picture:

RBC'S count and Hb values in blood of Zaraibi kids goats during months of the hot summer season increased significantly by 1.33x10⁶ and 1.34 g/dl, respectively, due to supplement Nigella to the diet of Zaraibi kids. Curcumin also improved significantly RBC'S count and Hb values in blood of Zaraibi kid's goats during months of the hot summer season by 1.03x10⁶ and 0.94 g/dl, respectively. However, WBC'S count and heamatocrit ratio was not affected due to additive of Nigella or Curcumin (Table 5).

Table (5): Effect of Nigella or Curcumin addition to diet on blood picture parameters in growing male Zaraibi goats during hot summer conditions.

Blood picture	Blood picture in experimental groups		
	Group one	Group two	Group three
	Without treatment	Treated with Nigella	Treated with Curcumin
WBC count	5605 ± 111	5598 ± 130	5534 ± 118
RBCx10 ⁶ count	10.55 ^b ± 0.55	11.88 ^a ± 0.60	11.58 ^a ± 0.60
Hb, g/dl	11.56 ^b ± 0.41	12.90 ^a ± 0.52	12.50 ^a ± 0.60
Hematocrit ratio	36.50 ± 1.00	36.00 ± 1.00	35.80 ± 2.00

a, b,...Means for each parameter in the same raw with different superscript are significantly different (P<0.05)

Nair *et al.* ⁽³⁾ reported that Nigella reduces the toxicity of cisplatin that induced fall in leucocytes count, hemoglobin levels and mean osmotic fragility of erythrocytes and also prevented the increase in haematocrit. El-Saadany *et al.* ⁽³⁰⁾ reported that supplementation the diet of lactating goats with Nigella increased significantly the Hb values and RBC'S count by 34.4 and 25.3%, respectively. Habeeb *et al.* ⁽³¹⁾ found that supplementation the diet of lactating Zaraibi goats during hot summer months with Curcumin increased significantly Hb values as well as RBC'S count.

Effect of Nigella or Curcumin on Protein profile :

Plasma total proteins and globulin concentrations increased significantly during months of hot summer season by 1.03 and 0.80 g/dl due to supplement Nigella to the diet of Zaraibi kids and increased significantly by 0.51 and 0.60 g/dl due to supplement Curcumin to the diet of Zaraibi kids, respectively. Albumin concentrations were not affected by Nigella or Curcumin addition (Table 6). These results found that Nigella or Curcumin addition to the diet of Zaraibi goats improved the animal immunity function and restored physiologically-relevant levels of protein function. Globulin is the main components of antibodies; an increase in the globulin levels indicates a good immune status of the animal.

Table (6): Effect of Nigella or Curcumin on immunity, liver and kidney functions in growing male Zaraibi goats during hot summer conditions.

Immunity, liver and kidney functions	Physiological functions in experimental animal groups		
	Group one	Group two	Group three
	Without treatment	Treated with Nigella	Treated with Curcumin
Immunity function			
Total protein (g/dl)	7.65 ^c ± 0.28	8.68 ^a ± 0.20	8.16 ^b ± 0.23
Albumin (g/dl)	3.55 ± 0.20	3.78 ± 0.11	3.46 ± 0.09
Globulin (g/dl)	4.10 ^c ± 0.08	4.90 ^a ± 0.07	4.70 ^b ± 0.09
Liver function			
Alkaline- P (iu/l)	0.40 ± 0.01	0.44 ± 0.01	0.45 ± 0.01
ALT (u/l)	60.50 ± 2.50	61.50 ± 2.20	66.25 ± 2.30
AST (u/l)	40.25 ± 2.30	39.50 ± 2.20	35.50 ± 2.10
Kidney function			
Urea-N (mg/dl)	58.53 ± 4.38	66.85 ± 5.35	62.70 ± 5.22
Creatinine (mg/dl)	0.80 ± 0.01	0.87 ± 0.01	0.84 ± 0.01

a, b,...Means for each parameter in the same raw with different superscript are significantly different (P<0.05)

Al-Gaby⁽³²⁾ found that when Nigella was supplement to diet of goats caused significant increase in serum total protein and serum phosphatases within normal ranges. Salem and El-Mahdy⁽⁶⁾ found significant increase in globulin concentration and insignificant differences in total protein and albumin concentrations in the blood plasma of the Ossimi lambs due to supplement the ration with NSS. On the other hand, Awadallah⁽⁸⁾ reported that concentrations of total protein, albumin and globulin were not affected significantly due to NSS supplement at the rate of 100 mg/kg body weight in Friesian calves under heat stress condition. Mohammed⁽³³⁾ reported that serum total protein, globulin and its fractions ($\alpha_1, \beta_1, \beta_2$ and γ_2 globulins) concentrations increased significantly due to NSS supplemented the ration of the ewes. Awadallah and Gehad⁽⁷⁾ found that supplementing growing sheep rations with 2% NSS increased significantly total protein and globulin concentrations while albumin and cholesterol concentrations were not affected significantly by NSS. In addition, Allam *et al.*⁽²⁹⁾ found that ration of lactating goats supplemented with 0.25 g NSS powder / kg LBW /day increased significantly the concentrations of total protein, albumin and globulin and reduction in cholesterol and total lipid values in plasma of zaraibi kids. El-Saadany *et al.*⁽³⁰⁾ reported that supplementation improved the animal immunity function i.e. total protein and globulin concentrations⁽³¹⁾ reported that supplementation of diet with Curcumin increased significantly total proteins and globulin concentrations. Khattab *et al.*⁽²⁷⁾ found that total protein, albumin, GPT, GOT, and plasma immunoglobulin for lactating buffaloes tended to be higher significantly in group supplemented with black seed oil than those of control but no significant differences were observed in total protein, albumin, urea, total lipids, glucose, glutamate pyruvate transaminase, glutamate oxaloacetate transaminase and triglyceride in buffalo calves.

Nigella seed increases immune function as stimulates bone marrow and immune cells and raises the interferon production, protects normal cells against cell destroying effects of viruses, destroys tumor cells and raises the number of antibodies producing B cells. In addition, black seed contains valuable unsaturated fatty acids, for example Linoleic and gammalinolen acids get into the organism. By that it possible to reach a synthesis of important immune regulating substances derived as from Prostaglandin E₁⁽⁸⁾.

Effect of Nigella or Curcumin on liver and kidney functions:

Each of liver function as presented in AST, ALT and Alk-P enzymes activities as well as kidney function as presented in creatinine and urea-N concentrations were not affected significantly by supplementation the diet of growing male Zaraibi goats during months of hot summer season either with Nigella or Curcumin. From these results, it is well established that supplementation the diet of kids either with Nigella or Curcumin not affect the important body physiological functions, especially liver and kidney (Table 7).

Table (7): Effect of Nigella or Curcumin on glucose and lipid fractions concentrations in growing male Zaraibi goats during hot summer conditions.

Glucose and lipid fractions	Experimental animals groups		
	Group one	Group two	Group three
	Without treatment	Treated with Nigella	Treated with Curcumin
Glucose levels			
Glucose (mg/dl)	50.5 ^a ± 3.55	41.9 ^b ± 2.77	42.5 ^b ± 2.55
Lipid fractions concentration			
Cholesterol (mg/dl)	126.6 ^a ± 3.63	101.2 ^b ± 3.1	100.6 ^b ± 3.6
Triglyceride (mg/dl)	100.9 ± 3.0	99.5 ± 3.0	104.9 ± 3.0
Total lipids (mg/l)	755.0 ^a ± 21.0	709.0 ^b ± 42.0	695.0 ^b ± 21.0

a, b, ... Means for each parameter in the same raw with different superscript are significantly different (P<0.05)

Nigella combinations with cisplatin partially prevented many changes in the activities of serum enzymes⁽³⁴⁾. Mohammed *et al.*⁽³⁵⁾ reported that AST enzyme activity increased significantly due to NSS supplemented the ration of the ewes. Awadallah and Gehad⁽⁷⁾ found that supplementing growing sheep rations with 1 or 2% NSS was not affected significantly ALT and AST activities. The authors indicated that the supplementation with NSS did not adversely affect the liver function. El-Saadany *et al.*⁽³⁰⁾ reported that liver and kidney functions were not affected negatively by supplementation with Nigella . Moreover, Habeeb *et al.*⁽³¹⁾ reported that liver and kidney functions were not affected significantly by supplementation the diet of lactating Zaraibi goats during months of the hot summer season with Curcumin.

Awadallah⁽⁸⁾ reported that concentration of urea was not affected significantly due to NSS supplement at the rate of 100 mg/kg body weight in Friesian calves under heat stress condition. In addition, Salem and El-Mahdy⁽⁶⁾ reported that creatinine concentration in the blood plasma of the Ossimi lambs was not affected significantly due to supplement the ration with NSS and there was also reversal in the enhancement of blood urea nitrogen and serum creatinine. On the other hand, Mohammed *et al.*⁽³⁵⁾ reported that urea-N level increased significantly due to NSS supplemented the ration of the ewes.

Effect of Nigella or Curcumin on Glucose and Cholesterol and Total Lipid:

Glucose concentration decreased significantly due to Nigella and Curcumin supplementation to the diet of growing Zaraibi goats during months of the hot summer season by 8.6 and 8.0 mg/dl.

Awadallah⁽⁸⁾ reported that concentration of glucose was not affected significantly due to NSS supplement at the rate of 100 mg/kg body weight in Friesian calves under heat stress condition.

Concerning with lipid fractions, Nigella supplementation decreased significantly total cholesterol and total lipids concentrations by 25.4 and 46.0 mg/dl while Curcumin supplementation decreased significantly total cholesterol and total lipids concentrations by 26.0 and 60.0 mg/dl respectively. However, triglycerides concentration was not affected by treatment.

Khattab *et al.*⁽²⁷⁾ found that plasma cholesterol concentration was decreased while plasma immunoglobulin concentration was increased in treated buffalo calves during the suckling period.

Curcumin reduces low density lipoprotein and very low density lipoprotein significantly in plasma and total cholesterol level in liver along with an increase of *I*-tocopherol level in rat plasma, suggesting in vivo interaction between Curcumin and α -tocopherol that may increase the bioavailability of vitamin E and decrease cholesterol levels⁽³⁶⁾. Patil and Srinivasan⁽³⁷⁾ found that hypocholesteremic effect of Curcumin in induced-hypercholesteremic rats.

Effect of Nigella or Curcumin on plasma content of minerals:

Each of Na, K and P_i and concentrations increased significantly by supplementation the diet of kids during months of the hot summer season with either Nigella or Curcumin. Nigella increased significantly concentrations Na (10.7 m mol/l), K (1.02 m mol/l) and P_i (1.30 mg/l) and Curcumin increased significantly concentrations Na (7.00 m mol/l), K (0.81 m mol/l) and P_i (1.20 mg/l). Ca and Mg concentrations were not affected due to addition Nigella or Curcumin to the diet (Table 8).

Table (8): Effect of Nigella or Curcumin on some plasma minerals concentration in growing male Zaraibi goats during hot summer conditions.

Minerals	Experimental groups		
	Group one	Group two	Group three
	Without treatment	Treated with Nigella	Treated with Curcumin
Na (m mol/l)	132.7 ^b ± 11.00	143.4 ^a ± 10.00	139.7 ^a ± 11.00
K (m mol/l)	3.09 ^b ± 0.29	3.99 ^a ± 0.19	3.90 ^a ± 0.29
Ca (mg/dl)	10.22 ± 0.46	10.44 ± 0.39	10.55 ± 0.48
Mg (mg/dl)	3.86 ± 0.15	3.92 ± 0.11	3.78 ± 0.14
Pi (mg/l)	6.32 ^b ± 0.15	7.62 ^a ± 0.20	7.52 ^a ± 0.19

a, b,...Means for each parameter in the same raw with different superscript are significantly different (P<0.05)

El-Saadany *et al.*⁽³⁰⁾ reported that supplementation the diet of lactating goats with Nigella increased significantly the concentrations of Na, K, Ca, P_i and Zn. However, Salem and El-Mahdy⁽⁶⁾ found insignificant differences due to supplement the ration with NSS in Ca and P_i concentrations in the blood plasma of the Ossimi lambs. Habeeb *et al.*⁽³¹⁾ mentioned also that Na, K, Ca, Mg and P_i concentrations were not affected significantly by the supplementation the diet with Curcumin.

CONCLUSION

It can be concluded that better utilization of the absorbed nutrients when Nigella or Curcumin was incorporated in the diet of farm animals and at the same time, the profit above feeding cost was higher with Nigella or Curcumin supplemented ration than that not supplemented by 31.06 and 28.41 %, respectively (Table 9).

Table (9): Economical gain/head during experimental period (5 months) due to Nigella or Curcumin supplemental to ration of Zaraibi kids during summer season.

Particulars income	Experimental Groups		
	Control	Nigella	Curcumin
Total gain (kg)	15.70	23.80	22.60
Total income from gain(L.E)	518.10	785.40	745.80
Concentrate feed mixture (CFM) (kg)	113.04	188.73	175.03
Barseem hay (BH)(kg)	8.09	12.80	12.08
Cost of feed stuff (L.E)	266.46	444.31	412.16
Cost of Nigella in 5 months (L.E)	-----	11.28	-----
Cost of Curcumin in 5 months	-----	-----	10.50
Total expenditure	266.46	455.59	422.66
Net income =Total income –Expenditure	251.64	329.81	323.14
Percent monetary gain over control	100.00	131.06	128.41

Price of kg live body weight=33 Egyptian pound (L.E.). Price of kg from Nigella and Curcumin= 30 and 30 L.E., respectively. Price of feed stuffs, CFM and BH =2.3 and 0.80 L.E., respectively, according to the price in Egypt during 2011.

This may be explained by:

- 1- Black seeds or Curcumin may be having a stimulating effect on the rumen proper functions and digestion.

- 2- The higher digestibility that was recorded particularly for groups supplemented by Black seed or Curcumin which led to increase the absorbed nutrients from small intestine, consequently increased body weight gain.
- 3- Black seeds or Curcumin supplementation increased efficiency of nutrient utilization and consequently led to more gain.
- 4- Increased protein anabolism due to an increase in thyroid activity, as well as higher protein digestibility which led to higher blood plasma total protein and albumin concentration that increase protein biosyntheses.

From the obtained results it could be concluded that adding black seeds or Curcumin to rations of farm animal's improved nutrient digestibility, enhanced the immune responses and productive performance, especially, under hot summer conditions of Egypt.

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