بسم الله الرحمن الرحيم

EFFECT OF BLACK SEED (*NIGELLA SATIVA*) SUPPLEMENTATION ON RABBITS PERFORMANCE AND SOME BLOOD PARAMETERS

By

Safa Mohammed El Mobasher Omar Saleh

B.Sc. Faculty of Animal Production
University of Khartoum (2004)

A Thesis submitted in partial Fulfillment for the requirements of the Degree of Master of science in Poultry Production

Supervisor

Dr. Khadiga Abbas Abdelatti

Faculty of Animal production
University of Khartoum

January 2008

DEDICATION

To my parents

My brother & sisters

I dedicate this work

ACKNOWLEDGEMENTS

I am indebted to "*Allah*" who granted me every thing including the mind, health and patience to accomplish this work.

I owe and grateful acknowledge an immeasurable debt to my supervisor Khadiga Abbas whose influence pervaded my work and my study.

I would like to express my sincere thanks and deep gratitude for her guidance, encouragement and continuous help during my study.

My appreciation and thanks are also extended to all those supported me during my study, my collegues, dear family and friends.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

This study was conducted to determine the response of local rabbits to dietary black seed (*Nigella sativa*). Thirty two male local rabbit age 35 – 45 days with approximately similar initial weight.

The Rabbits were distributed randomly to four treatment groups [8 rabbits/treatment with 4 replicates (2 animals/replicate)]. Four rations were formulated with different black seed (*Nigella sativa*) level (0, 0.25, 0.5 and 0.75%). Feed and water were provided *adlibitum*. Parameters measured were weekly feed intake, weight gain and body weight. At the end of experimental period blood samples were taken through the jugular vain to determine cholesterol, blood glucose triglyceride, total protein and urea. Results showed the treatment had no significant ($P \leq 0.05$) effect in feed intake, body weight gain and feed conversion ratio. However, there was a consistent numerical decrease in feed intake and body weight gain with increasing the level of seeds. Rabbits fed on diet containing 0.25 and 0.5% black seed (*Nigella sativa*) has shown numerical decrease in serum cholesterol level, however, rabbits fed on 0.75% black seed (*Nigella sativa*) have shown significant ($P \geq 0.05$) increase in serum cholesterol level. Increasing the level of black seed (*Nigella sativa*) in ration numerically decreased blood glucose level and numerically increase blood urea and total proteins level. Rabbits fed on diet containing 0.75% black seed (*Nigella sativa*) had 43% increase in triglyceride level compared to rabbits fed on control diets. The highest weight gain and the best feed conversion ratio was observed in rabbits supplemented with 0.25% black seed (*Nigella sativa*).

خلاصة الأطروحة

أجريت هذه الدراسة لتحديد مدي استجابة الارانب المحلية لبذور الحبة السوداء، استخدم عدد 32 ذكر أرنب محلي عمر 35 – 45 يوما متشابه تقريباً في الوزن الأبتدائي. وزعت الأرانب عشوائياً إلي 4 مجموعات معاملة (8 أرانب/معاملة) قسمت إلي 4 تكرارات (2 أرنب/تكرار). كونت اربعة علائق مزودة بمستويات متدرجة من الحبة السوداء (0، 0.25، 0.50 و0.75%). تم أعطاء العلف والماء بصورة مستمرة، تم اسبوعياً قياس استهلاك العلف، الوزن المكتسب ووزن الجسم وفي نهاية التجربة تم أخذ عينات من الدم عن طريق الوريد الودجي لقياس الكلسترول، الجلكوز، الجلسيريدات الثلاثية، البروتين الكلي واليوريا.

أظهرت النتائج أنه لا يوجد تأثير معنوي للمعاملات($P\leq0.05$) على استهلاك العلف والوزن المكتسب وكفاءة تحويل الغذاء لكن زيادة نسبة الحبةالسوداء في العليقة أدي إلي تقليل كمي في استهلاك العلف والوزن المكتسب.

الأرانب التي تغذت على عليقة تحتوي على 0.25 و0.50% حبة سوداء أظهرت تقليل كمي في مستوي الكلسترول لكن الارانب التي تغذت على 0.75% حبة سوداء أظهرت زيادة ملحوظة ($P\geq0.05$) في مستوي الكلسترول في الدم. زيادة مستوي الحبة السوداء في العليقة قلل كمياً مستوي الجلكوز في الدم وزاد كمياً مستويات اليوريا والبروتين الكلي.

الأرانب التي تغذت على عليقة تحتوي 0.75% حبة سوداء أدت إلي زيادة 43% في مستوي الجلسيريدات الثلاثية مقارنة مع الأرانب التي تغذت على عليقة الكنترول. اعلى وزن مكتسب وافضل كفاءة تحويليه للغذاء نجدها فى الارانب التى اعطيت0.25% حبه سوداء .

CHAPTER ONE
INTRODUCTION

Rabbit is a simple stomach animal, female rabbit gives birth 5-7 times/year, and the number of offspring/litter may reach 5-12 individuals depending on the breed (Hammad, 2003).

Different types of fur, colours, sizes and shapes, and types of ears ranging from very small to very large, have all been produced in an astonishing variety (Sandford, 1986).

The domestic rabbits are used for many purposes. They are an important source of food. Rabbits produce white meat that is fine, high in protein, low in fat, highly palatable low in cholesterol and that can be substituted for poultry.

Medical and cosmetic researches also require a large number of rabbits each year.

The acceptability of rabbit as a farm animal worldwide due to its comparative advantage over other livestock species suggests that increase in its production can help to bridge the gap in animal protein requirement for human consumption especially for developing countries. Although, rabbit makes efficient use of plant protein (Timon and Hamrahan, 1985), amino acids composition of the protein has the greatest influence on its value when fed to rabbit (Underwood, 1981).

Black seed (*Nigella sativa*) is a spice plant belonging to the family Ranunculaceae (Aqel and Shaheen, 1996), its seed oil contains thymouinone and many monoterpenes such as r-cymene, and a pinone, and it has a bronchodilator effect (El-tahir *et al*., 1999).

Black seed (*Nigella sativa*) is a good source of essential amino acids, in addition its seeds were found to be effective against many diseases including fever, common cold, headache, asthma, various microbial infections, and expel worms from the intestines. It is also used for scorpion and spider stings and bites of snake, cat and dog.

The multiple uses of black seed (*Nigella sativa*) in the flock medicine encouraged many investigators to isolate the possible active components and to conduct in vivo and *in vitro* studies on laboratory animal and human beings in order to understand its pharmacological actions. These include: immune stimulation,anti-cancer, anti-oxidant, etc (El Kadi and Kandil, 1986; Nair *et al*., 1991; El-Dakhakhany *et al*. ,2000) etc… objective of the present study was to assess the effect of black seed (*Nigella sativa*) on the performance of rabbits and its effect on blood cholesterol, glucose, total protein, triglyceride and urea.

CHAPTER TWO
LITERATURE REVIEW

2.1 Breeds of rabbits:

There are different types of rabbit bread worldwide raised for meat, skin or show. They are classified broadly into four breeds heavy, average, light weight and small breeds beside local strains (Abdel Gadir, 1991; Alam, 1988; Eissa, 1996; Elamin, 1978; Lebas *et al*., 1986; King, 1978 Sandford, 1986; MAFF, 1973).

2.1.1 Heavy breeds:

Adult weight exceeds 5 kg, these include:

2.1.1.1 French lop:

It's seen in several colour, adult weight is 7 kg, it is shorter ears than it's English counterpart, is a massive, almost cubic animal.

2.1.1.2 Bouscat giant white:

It is mostly crossed with Angora, Flemish and Argent. Its maximum adult weight is 5 kg. It has well for meat and pet.

2.1.1.3 Flemish giant:

The Flemish, or Flemish giant (known in France), it is the largest breed of rabbit recognized in this country; the weight range is 6-8 kg. The breed in its present from can be considered to be of entirely English origin.

2.1.2 Average breeds:

It is used for production meat, adult weight range 3.5 – 4.5 kg, they are of many types which include:

2.1.2.1 Californian:

It was first developed there (in the early 1920s) by crossed of New Zealand white and Himalayan with the further introduction of chinchilla. The purpose was a good meat rabbit with Fur qualities. It is to day possibly the second most important meat producing rabbit. Originally of white pelt with colouration on the ears, nose and extremities. Eye colour is pink.

2.1.2.2 Grand chinchilla:

Its adult weight average 2.3 – 3 kg on fattening it may reach 5 kg. Mainly bred for dense good quality coat with minor breeding for meat. It is an early maturing breed of grey or light blue pelt.

2.1.3 Light breeds:

Adult weight of these breed 2.5 – 3 kg, they can be crossed to produce a light meat carcass of 1.1 – 2 kg. The many types include:

2.1.3.1 Angora:

The Angora is one of the oldest known breeds of domestic rabbit. Famous for its good quality Fur. The breed weighs some (2.72 kg) and although twelve different colours are recognized, the majority of angoras bred are white (i.e. albinos).

2.1.3.2 Himalayan:

It's adult weight average 2 kg. Bred purposely for show and exhibitions, the breed is genetically an albino with the extremities, i.e. ears, nose, tail and feed, coloured black, blue, chocolate or lilac.

2.1.3.3 Stain:

It yields a good quality fur. Average weight 2.3 – 3 kg, it is a multi coloured type.

2.1.3.4 Rex:

The rex character consist of a shortening of the guard hairs until they are below or level with the under coat.

Rex Furs are the most valuable rabbit furs commercially, and the carcasses are also suitable for the meat trade. It is multi-coloured.

2.1.3.5 Dutch:

The Dutch rabbit, together with the English, are the most popular of the fancy breeds.

The breed, weighing under (2.25 kg), was used in many crosses with larger breeds, for meat production. It has also been used to a fair extent for work in laboratories, the type Alaska is considered with the light breeds.

2.1.4 Small breed:

These breed weight about 1 kg a maturity. These breed cannot be used for meat production. They are bred for show as their coats are multi coloured. They can also serve as laboratory animals. The type of these breed include:

2.1.4.1 Havana:

Average weight 1 kg, with brownish or chocolate coat. Bred purposely for Fur production.

2.1.4.2 Polish:

Coat colour is white, black or chocolate with blue or red eyes. Bred purposely for shows.

2.1.5 Local strains:

Most local strain rabbits raised for commercial meat production. Belong to populations which may resemble one breed or might not, having average characteristics. These are either light or small breeds according to live weight. The types in these strains include:

2.1.5.1 Egyptian baladi:

Mostly breed for meat production. It is of small size and multi-colourations. Average weight 1.5 – 2.5 kg.

2.1.5.2 Sudan baladi:

Purposely bred for meat production. It is of multi-colourations. Live weight ranges between 1.2 – 2 kg with a carcass yield of 0.9 kg.

2.2Nutrient requirement:

The fat content in the ration of rabbits comprise 2-3% (Ranjhan, 1980). During the process of digestion the microflora in the caecum synthesize vitamins B, C and K. These are then returned to the rabbit in the caecotrophes ingested during caecotrophy. Vitamins A, D and E are included in the pelleted ration. Concentrated ration should not be stored for longer than three months as the vitamin content will deteriorate overtime. Vitamin B and K supplementation must be considered for rabbits that are unable to practice caecotrophy (Richardson, 2000).

The rabbit requires all the essential mineral elements which are required by other animals except cobalt (Ranjhan, 1980).

The most important amino acids that most likely to be deficient in Rabbit are lysine and methionine.

Table (2-1) shows the nutrient requirements of rabbit according to NRC (1977).

2.2.1 Feeding of rabbit on berseem:

Berseem contains high nutrient components and it is a very rich legume, very rich in calcium which is about 1.5%.

Foreign breeds were recommended for producing meat as they grow faster than baladi rabbits even if they are fed on berseem only (Rafat, 1972).

Table 2.1: Nutrient requirements of rabbits

Protein	15-17%
Fiber	10-15%
Calcium	0.45%
Phosphorus	0.37%
Sodium	0.2%
ME	2500 (Kcal/kg)

Source: NRC (1977).

2.3 Coprophage:

The normal healthy rabbit forms two kinds of faecal pellets. One type is that normally seen on the floor of the hutch, the other type is never normally seen, for it is taken direct from the anus by the rabbit and swallowed , the residue of fresh food material passes into the caecum after digestion and absorption in the small intestine. After bacterial digestion in the caecum, the food passes through the colon, is swallowed by the rabbit and passes as coprophagous pellets into the stomach, this material, after being re-digested, passes through the large intestine and is excreted.

The coprophagous pellets contain 3½ times as much crude protein as do the normal pellets, but only a third of the fiber and it is contain considerable amount of B complex vitamins (Sandford, 1986)

2.4 Botanical description of black seed *Nigella sativa:*

Nigella sativa is a spice plant belonging to the family Ranunculaceae (Aqel and Shaheen, 1996); its seed oil contains thymoquinone and many monoterpenes such as r-cymene, and a-pinene, and it has bronchodilator (El-Thair *et al*., 1999), antibacterial (Hanfy and Hatem, 1991) hypotensive (Zaoui *et al*., 2000), and immunopotentiating (El-Kadi and Kandil, 1987) activities, and commonly grows in Europe, Middle East, and Western Asia. Coequal names of it's used in Arab countries are Al-Habbah Al-Sawada, Habbet El-baraka, Kamoun Aswad, Schuniz and Khodria. In Pakistan, India and Sri Lanka it is called a Kalvanji, Azmut, Gurat, Aof and Aosetta; and in English language is known as back seed, black cumin and black caraway, *Nigella sativa* is a pretty herb, seed which are commonly known as Kalonji (Blatter *et al*., 1984) there are three

species in this group *Nigella sativa* L., *Nigella damascene* and *Nigella arrensis* L. (Goutb, 1981), it is approximately 60 cm tall, erect herbaceous annual with blue-white flowers. The fruit has a capsule with numerous, angular, black seed, about 1-5 mm long.

The important producing countries are: India, Pakistan, Iran, Syria, Egypt and United States (Abu-Zeid, 1986).

The crop is successfully grown under low tempeature and high humidity climates, in Northern Africa and Mediterranean known as winter crop and cultivated in October and November (Gutb, 1980).
Black seed (*Nigella sativa*) volatile oil has recently been shown to possess 67 constituents, many of which are capable of inducing beneficial pharmacological effect in humans (Aboutabl *et al*., 1986).

2.5 Chemical composition:

Black seed (*Nigella sativa*) seed are rich in nutrients, organic compounds and minerals. The seed content of these compounds was investigated by Baboyan *et al*., (1978); Osman (1996); Elshiekh (1999) they reported the protein content is 18-21%, also Baboyan *et al.* (1978) showed that the seed component of amino acids were arginine, glutamic acid, leucine, lysine, methionine, tyrosine, proline and threonine, etc.

The unsaturated fatty acid represents linoleic, linolenic, arachidonic, eicosadienoic, oleic and almitoleic acid (Gad *et al*., 1963; Babayan *et al*., 1978). While saturated fatty acid represent plamitic, stearic and myristic acid (Gad *et al*., 1963; Menounos *et al*., 1986). Minerals (1.79 - 3.74%) calcium, phosphorus, potassium, sodium and iron (El-Zawahry, 1997; Babayan, 1978), moisture 7.43, ash 4.14%, fixed oil 37%, volatile oil 1.64, albumin 8.2%, mucilage 1.9%,

organic acid precipitated by copper 0.38%, metarabin 1.36%, melanthin 1.4%, cellulose 8.32%, sugar 2.75%, arabic acid 3.4% and other substance dissolved by soda 9.38% (Saeed, 1972).

Proximate chemical analysis of black seed (*Nigella sativa*), potassium, phosphorus, sodium and iron are the predominant elements present, zinc, calcium, magnesium, manganese and copper are found at lower level, cadmium and arsenic are not detected in the seeds (Al-Jasser, 1992)

The seed also contains triterpenes components of alpha-hedrin (Kumarass and Haut, 2001).

2.6 The oil extract:

Gad *et al*. (1963) investigated chemical and physical properties of the oil extract from black seed (*Nigella sativa*) cultivated in Egypt. They found that specific gravity was about 0.92, acid value 30.30, and oleic acid represent about 43.76.

Seeds of *Nigella sativa* are frequently used in flock medicine in the Middle East and some Asian countries for the promotion of good health and treatment of many ailments including fever, common cold, headache, asthma, rheumatic disease, various microbial infections and to expel worms from the intestines. It is also used for scorpion and spider stings and bites of snake, cat and dog. In addition, it is used as a flavoring additive to bread and prickles.

Moreover, black seeds are mixed with honey and the mixture is used early in the morning to stimulate the appetite (Yassin, 1987).

Gutb (1980) reported the seeds are also used as a remedy for cough.

It was used as powder and ethanolic extract in children under 12 years of age for anti nemtodal and anti cestodal effect and observed

significant anti nemtodal and anti cestodal effects (Akhtar and Riffat, 1991).

2.7 Uses of black seed (*Nigella sativa*) in medicine and pharmacology:

The multiple uses of black seed (*Nigella sativa*) in the flock medicine encouraged many investigators to isolate the possible active components and conduct in vivo and in vitro studies on laboratory animals and human beings, in order to understand its pharmacological action. These include immune stimulation, anti-inflammatory, anti-cancer, anti-microbial, anti-parasitic, anti-oxidant, and hypoglycemic effects, etc.

2.7.1 Effect on immune system:

As a natural remedy people take *Nigella sativa* seed or oil as a promoter of good health and for the prophylaxis of common cold and asthma. In view of that El Kadi and Kandil (1986) investigated the effect of black seed (*Nigella sativa*) on immune system and reported that the administration of 1 g twice daily in human volunteers enhanced immune functions as manifested by improved helper T cell (T4) to suppressor T cell (T8) ratio and an improved natural killer cell activity. There was a decrease in the immune globulin (IgA, IgG and IgM) levels. Moreover, Haq *et al*. (1995) noticed black seed (Nigella *sativa*) enhanced the production of interleukin-3 by human lymphocytes when cultured with pooled allogenic cells or without any added stimulator. They also observed an increase in interleukin-1 beta (IL-Iβ) as suggesting that black seed (*Nigella sativa*) has an effect on macrophages as well.

2.7.2 Anti-inflammatory and analgesic effect:

In Saudi Arabia and neighboring countries black seed (*Nigella sativa*) oil is used as topical treatment for pain and stiffness in joints. This indication together with its use in bronchial asthma suggested for the investigation of analgesic and anti-inflammatory effects of black seed (*Nigella sativa*).

Mutabagani and El-Mahdy (1997) using black seed (*Nigella sativa*) volatile oil and Al-Ghamdi (2001) using aqueous suspension of *Nigella sativa* crushed seeds. In both studies formation of edema in rat paw was inhibited and these effects were comparable to those of indomethacin and aspirin, respectively. Al-Ghamdi (2001) also reported an analgesic effect of aqueous suspension of *Nigella sativa* seeds, comparable to aspirin, as measured by hot plate test conducted in rats. However, the suspension did not relieve yeast-induced pyrexia in rats.

2.7.3 Anticancer effect:

The anticancer activity of black seed (*Nigella sativa*)was first revealed by El-Kadi and Kandil (1986) who observed enhancement of natural killer (NK) cell activity ranging from 200-300% in advanced cancer patients receiving multimodality immunotherapy programme in which black seed (*Nigella sativa*) was one component, moreover El-Khadi and Kandil (1986) discussed the effect of *Nigella sativa* seeds on enhancing the natural immunity where as, the extract of seeds after boiling in water relief pain from patient of oral cancer.

Nair *et al*. (1991) reported that the anticancer drugs eisplatin and cyclophosphamide are toxic to kidney, liver, peripheral nerves and bone marrow. Anticancer principles isolated from *Crocus sativus* and *Nigella sativa* when given to swiss albino mice, along with

eisplatin or cyclophosamide. Life span was increased from 150-200%, reduction in leukocytes and haemoglobin and serum enzyme transaminases were prevented. Also there was no toxin in the treated mice urine.

Later on, the anticancer effect of black seed (*Nigella sativa*) was investigated both *in vitro* using cancer cell lines and *in vivo* using animal models.

Ethyl-acetate column chromatographic fraction (CC-5) of ethanolic effect of black seed (*Nigella sativa*) also showed cytotoxic effect against different classes of cancer cell lines, such as, Hep G2, molt4 and lewis lung carcinoma cells (Swamy and Tan, 2000).

Ethanolic extract was used in malignant ulcers of check in hospitalized patients, and it healed ulcers (Panikar *et al*., 1989).

2.7.4 Antimicrobial and anti-parasitic actions:

The antibacterial effect of the phenolic fraction of black seed (*Nigella sativa*) oil was first reported by Topozada *et al*. (1965). Thymohydoquinone was later isolated by El-Fatatry (1975) from the volatile oil of black seed (*Nigella sativa*) and found to have high activity against gram-positive microorganisms. Hanafi and Hatem (1991) studied the antimicrobial effect of diethyl-ether extract of black seed (*Nigella sativa*) and reported that it had a concentration dependent inhibition of gram-positive bacteria (represented by Staphylococcus aureus) and gram-negative bacteria (represented by Pseudomonas aerogeosa and Escherichia coli). It also showed synergistic effect with streptomycin and gentamycin and additive effect spectinomycin, erythromycin, tobramycin, doxycycline, chloramphenicol, nalidixic acid, ampicilin, lincomycin and co-

trimoxazole. In addition, the extract was found to have a concentration dependent inhibitory effect against pathogenic yeast, candida albicans.

Crude extract of black seed (*Nigella sativa*) were reported to have a promising effect on multi-antibiotic resistant organism including Gram-positive and Gram-negative bacteria (Morsi, 2000).

Akhtar and Riffat (1991) investigated the anti-cestodal effect of *Nigella sativa* seeds and its ethanolic extract when given orally to infected children. Both were effective in reducing the percentage of faecal eggs per gram counts and the effect was comparable to niclosamide. More over, black seed (*Nigella sativa*) menthol extract (1 ml/kg) and powder (200 mg/kg) showed high efficacy, comparable to Hapadex (netobimin, 20 mg/kg), against rumin fluke (paramphi-stomum) in sheep (Korshom *et al*., 1998) and black seed (*Nigella sativa*) oil also prevented liver damage induced by schistosoma mansoni infection in mice (Mahmoud *et al*., 2002).

2.7.5 Anti-oxidant activity:

Black seed (*Nigella sativa*) extract and some of its active principles, like thymoquinone, have been shown to posses protective effect against haematological, hepatic, renal and other toxicities induced by anticancer drugs and some toxins. For example, black seed (*Nigella sativa*) extract prevented the decrease in haemoglobin level and leukocyte count caused by cisplatin in mice (Nair *et al*., 1991). Thymaquinon and fixed oil of black seed (*Nigella sativa*) were also reported to inhibit non-enzymatic per-oxidation in ox brain phospholipids liposomes (Houghton *et al*., 1995).

Black seed (*Nigella sativa*) along with cysteine, vitamin E and *Crocus sativus* protected cisplatin. Induced haematolgoical, hepatic and renal toxicities (El-Daly, 1998). Thymoquinone showed

hepatoprotective effect against CCl4-induced toxicity in mice (Nagi *et al*., 1999).

El-Dakhakhany *et al*. (2000) have also reported the protective effect of black seed (*Nigella sativa*) oil against CCl4 and D-galctosamine induced hepatic toxicity in rats. Furthermore, Burits and Bucar (2000) found that black seed (*Nigella sativa*) essential oil and its four constituents (thymoquinone, carvacrol, t-anethol and 4-terpineol) had anti-oxidant effect in different chemical assays, like diphenylpicrylhydracy assay for non-specific hydrogen atom or electron donating activity. They also observed OH-radical scavenging property in the assay for non-enzymatic lipid peroxidation in liposomes and the deoxy-ribose degradation assay.

Turkdogan *et al*. (2001) reported the protective action of black seed (*Nigella sativa*) for carbon tetrachloride induced liver fibrosis and cirrhosis in rabbits, as well as El-Sherbeny (2001) reported the protective effect of black seed (*Nigella sativa*) against the genotoxic action of an herbicide, 2,4-D.

2.7.6 Anti-histaminic action:

The antihistaminic effect was first investigated by El-Dakhakhany (1982) who reported the protective action of thymoquinone and carbonyl fraction of black seed (*Nigella sativa*) against histamine-induced bronchospasm in guinea pigs. Furthermore, in an *in vitro* study, Chakarvarti demonstrated that nigellone, isolated from black seed (*Nigella sativa*), effectively inhibited the release of histamine from mast cells, possibly through decrease in intracellular calcium and inhibition of protein kinases. These effects together with analgesic and anti-inflammatory action, perhaps, can be correlated with the use of black seed (*Nigella sativa*) in eczema and asthma, for scorpion and

spider stings and for the bites of cat, dog and snake, recommended in the flock medicine (Al-Jishi, 2000). active principles thymoquinone and poly thmoquinone were used in rats, dogs and guinea pigs to observe its uricosuric, anti-histamine and choleratic activity and it was concluded that it is good uricosuric, strong anti-histamine and increased bile excretion (El-Dakhakhany, 1982).

2.7.7. Effect of respiratory system:

In Saudi Arabia and neighboring countries *Nigella sativa* seeds and oil are commonly used for the treatment of asthma. Nigellone (a carbonyl polymer of thymoquinone) proved to be an excellent prophylactic agent for both bronchial asthma and asthmatic bronchitis and was more effective in children than adults (Badar El-Din, 1960; Mahfouz and El-Dakhakhany, 1960). El Sayed *et al*. (1994) has also reported the use of black seed (*Nigella sativa*) in asthma in the traditional medicine.

However, El-tahir *et al*. (1993) observed that black seed (*Nigella sativa*) volatile oil induced dose dependent increase in the respiratory rate and the intra-tracheal pressure which were antagonized by mepyramine, atropine and reserpine but not indomethacin, diethyl-carbamazine or hydrocortisone. A central mechanism was suggested for these effects. Moreover El-tahir (1993) showed that volatile oil induced respiratory effect were mediated via histamine release with direct involvement of histaminergic mechanism and direct activation of muscarinic cholinergic mechanism. Moreover thymoquione removal may provide a potential acting respiratory stimulant.

Apparently, these observations seem to be in contrary to the anti-histaminic effect reported by El-Dakhakhany (1982) and

Chakarvarti and its use in flock medicine for asthma. However, in later study, aqueous extract of black seed (*Nigella sativa*) competitively and the macerated extract non-competitively antagonized metha-choline induced contractions of isolated guinea-pig tracheal chain (Boskabady and Shahabi, 1997). Similarly crude extract of black seed (*Nigella sativa*) has also been shown to cause relaxation of carbachol, histamine, and K+ induced contractions of guinea-pig trachea (Gilani *et al*., 2001).

2.7.8 Effect on cardiovascular system:

In Arabian folk medicine whole seeds of *Nigella sativa* alone are in combination with honey or garlic are promoted for the treatment of hypertension, which drew the attention of El-tahir *et al*. (1993) to investigate the effects of black seed (*Nigella sativa*) on the cardiovascular system, volatile oil and thymequinone produced a dose dependent decrease in the arterial blood pressure and the heart rate.

An oral dose of 0.6 ml/kg/day of black seed (*Nigella sativa*) extract produced a significant hypotensive effect in spontaneously hypertensive rats comparable to that of 0.5 mg/kg/day of oral nifedipine (Zaoui *et al*., 2002; Zaoui *et al*., 2000). This effect was concluded to be partially due to the diuretic effect of black seed (*Nigella sativa*), which was comparable to 0.5 mg/kg/day furosemide or by other mechanisms as mentioned above.

2.7.9 Effect of genito-urinary system:

In Unani medicine black seed (*Nigella sativa*) is promoted for the treatment of oligomenorrhoea, to induce menstruation and to treat infertility Al-jishi (2000). El-Naggar and El-Deib (1992) reported that black seed (*Nigella sativa*) crude oil induced uterine contractions both *in vivo* in pregnant rabbits and *in vitro* of non-pregnant rat uteri.

Similarly, Keshri *et al*. (1995) found that the hexane extract of black seed (*Nigella sativa*) exhibited mild uterotropic activity and prevented pregnancy in rats when given on day 1 – 10 post-coitum. On the contrary, Aqel and Shaheen (1996) reported that volatile oil of black seed (*Nigella sativa*) inhibited spontaneous contraction of rat and guinea pig uterine smooth muscle and those induced by oxytocin. Similarly, treatment of pregnant rats with fixed oil of black seed (*Nigella sativa*) for 2 weeks significantly suppressed PGE2 and oxytocin-induced contraction of isolated rat uteri treated with diethylstilboesterol, suggesting the potential use of black seed (*Nigella sativa*) oil in the uterine disturbances associated with prostaglandin and oxytocin induced increased contractility e.g. some dysmenorrhoeas, premature deliveries and habitual abortions (El Tahir *et al*., 1999). These differences may be due to the different doses, preparation and the animal species used.

2.7.10 Effect on Gastro-intestinal tract:

In Unani medicine black seed (*Nigella sativa*) is used for stomachache and as a digestive, carminative, laxative and anti-jaundice (El-Kadi and Kandil, 1986). Oral black seed (*Nigella sativa*) powder was reported to relieve flatulence by Chopra *et al*. (1956), while Nigellone, an active principle of *Nigella sativa* was found to antagonize histamine induced contractions of guinea pig intestine. In addition, Mahfouz *et al*. (1960) and El-Dakhakhani (1965) reported a choleretic effect of black seed (*Nigella sativa*) oil and its active principles (thymoquinone, thymohydro-quinone and dithymoquinone) respectively.

El-Dakhakhany *et al*. (2000) investigated the effect of black seed (*Nigella sativa*) oil on gastric secretion and ethanol-induced ulcer

in rats. Significant increase in mucin content, glutathione level as well as a significant decrease in mucosal histamine content and ulcer formation, with a protection ratio of 53.56%, was found in the black seed (*Nigella sativa*) oil pretreated group. Recently, the crude extract of black seed (*Nigella sativa*) was shown to cause a dose-dependent (0.1 – 3.0 mg/ml) relaxation of spontaneous contraction of rabbit jejunum as well as inhibition of K+- induced contraction in a similar dose range, suggestive of calcium channel blockade (Gilani *et al*., 2001).

2.8 Hypoglycemic effect:

Alwadi and Gumma (1987) have reported the use of a plant mixture containing black seed (*Nigella sativa*), myrr, gum olybanum, gum Asafetida and Aloe by diabetics in Kuwait. They confirmed the blood glucose lowering effect of black seed (*Nigella sativa*), in combination with other herbs in rats. The mechanism of action was later investigated and appeared to be due to the inhibition of hepatic gluconeogenesis (Al-Awadi *et al*., 1991). The volatile of black seed (*Nigella sativa*) alone also produced a significant hypoglycemic effect on normal and alloxan-induced diabetic rabbits without changes in insulin level (Al-Hader *et al*., 1993). The hypoglycemic effect of black seed (*Nigella sativa*) in combination with other herbs on alloxan induced diabetic rats was also reported El-Sharawy and Nada (1996).

2.9 Effect on blood:

In Kuwait some people use extract of black seed (*Nigella sativa*) with natural fat for epistaxis. In view of that the petroleum ether extract of black seed (*Nigella sativa*) was studied for its action on blood coagulation and was reported shortening of the whole blood clotting time, plasma clot time and kaolin-cephalin clotting time of

male rabbits when compared to control. In addition, a significant shortening of bleeding time in rats was also observed. However, there were no significant effects on the thrombin time or prothrombin time but the partial thromboplastin time was shortened while euglobulin time was prolonged (Gheneim *et al*., 1982).

In contrast, black seed (*Nigella sativa*) fixed oil suppressed adenosine diphosphate-induced platelet aggregation in both normal and diabetic rats (El-Tahir *et al*., 1999). Similarly, in a recent study it was observed that the menthol soluble component of black seed (*Nigella sativa*) oil including 2-(2-methoxypropyl)-5-methyl-1, 4 benzenediol, thymol and carvacrol as well as eight other related compounds had very strong inhibitory effect on arachidonic acid-induced platelet aggregation. This platelet aggregation inhibitory effect was more potent than that of aspirin (Sayed, 1980). Black seed (*Nigella sativa*) was found to have a potential reducing effect on blood level of both glucose and cholesterol (Bamosa *et al*., 1997). The only study which has been done on human reported a significant decrease in blood glucose level after 7 weeks of oral ingestion of black seed (*Nigella sativa*) powder at a dose of 2 g/day (Bamosa *et al*., 1997). Also he reported a pattern of decreased levels of cholesterol and triglycerides (on days 7 and 14) of healthy human volunteers treated with 1 gm of black seed (*Nigella sativa*) capsules twice daily.

This effect was later confirmed by El-Dakhakhani *et al*. (2000) using black seed (*Nigella sativa*) oil (800 mg/kg orally for 4 weeks) in rats showing a significant decrease in serum total cholesterol, low density lipoprotein and triglycerides and elevation of serum high density lipoprotein level. Moreover, black seed (*Nigella sativa*) extract

was reported to prevent falls in hemoglobin levels and leukocyte count in mice (Nair *et al*., 1991).

Furthermore in 1985 Al-Wadi *et al*. reported a significant decrease in blood glucose produced by a plant mixture containing black seed (*Nigella sativa*) in normal and streptozotoon-induced diabetic rats. However, when black seed (*Nigella sativa*) was used alone it produced no effect on the blood glucose level of both normal and diabetic rats (Al-Awadi and Gumaa, 1987). Also El-Nagger and El-Dieb (1992) reported that oral administration of powdered black seed (*Nigella sativa*) seeds for three weeks produced insignificant reduction in blood glucose in normal and alloxan-induced diabetic rats. a plant mixture containing black seed (*Nigella sativa*) administered once daily at does of 0.5 – 1.5 ml/kg body weight for one month to normal and diabetic rats produced significant reduction in serum glucose level only in diabetic rats (El-Shabrawy and Nada, 1996). In study conducted at Egypt to detect the influence of thymoquinone (active ingredient of *Nigella sativa* seeds) on Doxorubicin-induced hyperlipidemic nephropathy in rats, results showed rats treated with thymoquinone (10 mg/kg/day) for five days significantly lowered serum urea, triglycerides and total cholesterol (Badary *et al*., 2000).

Recently, black seed (*Nigella sativa*) oil in rats has been shown to decrease the serum cholesterol, triglycerides and glucose levels as well as the counts of leukocytes and platelets by 15.5, 22, 16.5, 35 and 32% respectively, while haemotocrit and haemoglobin levels increased by 6.4 and 17.4% respectively (Zaoui *et al*., 2002). However, Al-Jishi (2000) did not find any changes in blood cells when black seed (*Nigella sativa*) was given to normal rats.

CHAPTR THREE
MATERIALS AND METHODS

3.1 Experimental animal:

Thirty two healthy male rabbits, aged 35 – 45 days were selected from a local breeder at Shambat area. All animals were of local type with predominant colours: white, brown, grey and black. The initial body weight was 434 ± 15 g.

Rabbits were then transported to the animal house, farm in Shambat area where the experiment was conducted. All animals were apparently in healthy condition. The study was conducted in the period from March - May 2007.

All experimental groups were given the control ration (treatment A) for one week (adaptation period) before starting experimental feeding, animal then distributed and allocated randomly to four treatment groups A, B, C and D (each of eight heads, divided into four pens).

3.2 Housing:

The animal house was 3 x 6 m. Roof was slant, at 2 m height and secured all-round with a wire-mesh and adequately ventilated.

The house was provided with battery cages each block of battery cages was over a half meter brick and divided into four pens (50 x 60 cm), each pen contained two rabbits and provided with one feeder and drinker, water and feed were given *adlibitum*.

Cleaning and sanitization of the house had been done before the introduction of rabbits.

3.3 Experimental rations:

Four experimental rations were formulated and designated A, B, C and D respectively to meet the nutrient requirements of rabbits. The calculated analysis of the diets was made according to the table of the nutrient composition of Sudanese Animal Feeds, Central Animal Nutrition Research Laboratory, Kuku.

Black seed (*Nigella sativa*) was first mixed with NaCl, multi-vitamins, dicalcium phosphate, & groundnut cake and then added to the mixture of wheat bran and sorghum grains.

The proximate analysis of the diets was made according to the procedure of the (AOAC, 1980), to determine the crude protein, ether extract and crude fiber of the diet.

The Metabolizable energy (ME) content of the diet was calculated according to the equation of Lodhi *et al*. (1976) based on values obtained by the determined proximate analysis of the diet.

Lodhi equation was as follows:

ME(Kcal/Kg)=1.549+0.102(CP%)+0.02759(EE%)+0.0148(NFE%)-0.0034(CF%)×239.

CP: crude protein.

EE: Ether Extract.

NFE: Nitrogen Free Extract.

CF: Crude Fiber.

The ingredients composition, calculated analysis and proximate analysis of the experimental diets are shown in the Tables 3.1 and 3.2 respectively.

Four hundred gm of fresh berseem were provided twice a week as roughage for each pen. Animals were fed *adlibitum* for eight weeks.

Table (3.1): Ingredients composition of the experimental rations

Ingredients	Level of *Nigella sativa* (%)			
	0	0.25	0.5	0.75
Sorghum grains	40.31	40.6	40.9	41.23
Groundnut cake	3.00	3.00	3.00	3.00
Wheat bran	55.00	54.46	53.91	53.32
Dicalcium phosphate	1.19	1.19	1.19	1.20
NaCl	0.25	0.25	0.25	0.25
Multi-vitamins	0.25	0.25	0.25	0.25
Total	100	100	100	100

Table (3.2): Proximate analysis and calculated analysis of the experimental rations.

Component (%)		Level of *Nigella sativa* (%)			
		0	0.25	0.5	0.75
Calculated analysis	Crude protein	16.92	16.92	16.91	16.50
	Crude fiber	8.97	8.90	8.84	8.77
	Phosphorus	0.47	0.47	0.47	0.47
	ME/ kcal/ kg	2664.63	2664.28	2664.07	2664.1
Proximate analysis	Dry matter	96.86	95.93	97.13	97.88
	Fat	2.38	3.32	3.19	3.12
	Crude protein	14.35	15.93	14.93	15.93
	Crude fiber	6.89	10.38	10.19	7.10
	Ash	4.83	5.37	5.46	5.53

3.4 Experimental procedure:

Animal were weighed on the first day of the experimental feeding as initial weight, then weekly weighing was systematic until the end of the eighth week where the final weight was recorded.

Feed intake was determined weekly for each replicate by weighing feed that was supplied minus the residue feed. The feed conversion ratio was calculated also for individual replicate of each treatment by dividing the weekly feed intake by the respective body weight gain of each replicate.

At the end of the experiment, blood samples were taken from the jugular vein of one rabbit/ replicate to assay serum cholesterol, glucose, triglycerides, total proteins and urea.

3.5 Chemical methods:

Five ml of blood were withdrawn from the jugular vein of one rabbit/replicate and kept in a separate test tube. The serum was obtained by centrifugation. All samples were stored at $20^{o}C$ for later serum analysis.

3.5.1 Estimation of serum total cholesterol:

Principle of the method:

Serum cholesterol level was determined by an enzymatic-Spectrophotometric method according to Allain *et al*. (1974); Sevnsson (1982) and meiattini *et al*. (1978).

Free and esterified cholesterol in the sample originates, by means of coupled reactions, a coloured complex that can be measured by spectrophotometry.

3.5.2 Estimation of serum glucose level:

Principle of the method:

Serum glucose was determined according to an enzymatic colorimetric method using (CHOD – PAP) according to Tirinaer (1969) where red colour was read by spectrophotometer.

3.5.3 Estimation of serum triglycerides:

Principle of the method:

The principle method for estimation of serum triglycerides according to Bucolo and David (1973); Fossati and Prencipe (1982).

Triglycerides in the sample originate by means of the coupled reaction, a coloured complex that can be measured by spectro-photometry.

3.5.4 Estimation of serum total proteins:

Principle of the method:

Serum total proteins concentration was determined by the colorimetric method according to Gornall *et al*. (1949) and Peters (1968).

3.5.5 Estimation of serum urea:

Principle of the method:

Urea was determined by enzymatic colorimetric according to Kaplan *et al*. (1984); Tabacco *et al*. (1979); Fawcett *et al*. (1960).

3.6 Statistical analysis:

Data obtained was subjected to analysis of variance according to SPSS computer program using completely randomized block design, the difference among treatment means were tested using Duncan's multiple range test.

CHAPTER FOUR

RESUTLS

4.1 Feed intake:

The results of average feed intake (g/rabbit/week) are shown in Table (4.1); there was no significant (P≤ 0.05) effect of the dietary treatments on weekly feed intake for rabbits throughout the experiment, except at week seven that showed significant (P≥0.05) effect.

4.2 Growth performance:

Live body weight is exhibited in Fig 4.1. There was no significant (P≤ 0.05) effect of the dietary treatments on weekly body weight for rabbits throughout the experiment (Appendix 1).

Highest weight gain was noticed in the first week for rabbits fed on diet containing 0.25% black seed (*Nigella sativa)* while, the lowest weight gain was noticed in the seventh week for the rabbits fed on diet containing 0.5% black seed (*Nigella sativa)*),Weight gain was not significantly (P≤0.05) influenced by dietary black seed (*Nigella sativa)*. Weekly weight gain of rabbits shown in (Appendix 2).

Table (4.2) shows the effect of dietary level of black seed (*Nigella sativa)*) on the performance of the rabbits. Inclusion of black seed (*Nigella sativa)* showed no significant difference (P≤0.05) on overall performance, however, there was a consistent numerical decrease in total feed intake and total weight gain by increasing the level of seeds. Rabbits that consumed 0.25% black seed (*Nigella sativa)* showed the highest total weight gain and the best feed conversion ratio.

4.3 Effect of dietary black seed (*Nigella sativa)*) on serum constituents:

Effect of dietary black seed (*Nigella sativa*) on serum constituents of rabbits is exhibited in the Table (4.3).

Rabbits fed on diet containing 0.25 and 0.5% black seed (*Nigella sativa)* had shown numerical decrease in serum cholesterol level, however rabbits fed on 0.75% black seed (*Nigella sativa)*) had shown significant ($P \geq 0.05$) increase in the serum cholesterol level. Increasing the level of black seed (*Nigella sativa)*) in diet numerically decreases blood glucose level.

Rabbits received 0.75% black seed (*Nigella sativa)*) had shown 43% increase in serum level of triglycerides, 12% increase in urea level, and 14% increase in total proteins level compared to rabbits fed the control diets.

Table 4.1 effect of dietary black seed (*Nigella sativa)*) on weekly feed intake (g) of local rabbits

Weeks	**Dietary level of black seed (*Nigella sativa)*) %**				**±SEM**
	0	**0.25**	**0.5**	**0.75**	
1	222.50[a]	252.75[a]	223.13[a]	243.25[a]	21.32
2	243.63[a]	262.00[a]	276.63[a]	257.50[a]	12.55
3	244.25[a]	276.50[a]	243.38[a]	252.25[a]	17.08
4	241.25[a]	298.38[a]	255.75[a]	288.25[a]	21.14
5	321.00[a]	312.88[a]	311.25[a]	279.50[a]	20.78
6	306.75[a]	311.50[a]	316.63[a]	278.50[a]	11.89
7	325.50[ab]	356.75[b]	335.25[b]	289.25[a]	12.62
8	397.75[a]	325.25[a]	320.25[a]	344.13[a]	25.07

a,b: Means in the same raw with the different superscript are significantly different ($P \leq 0.05$)

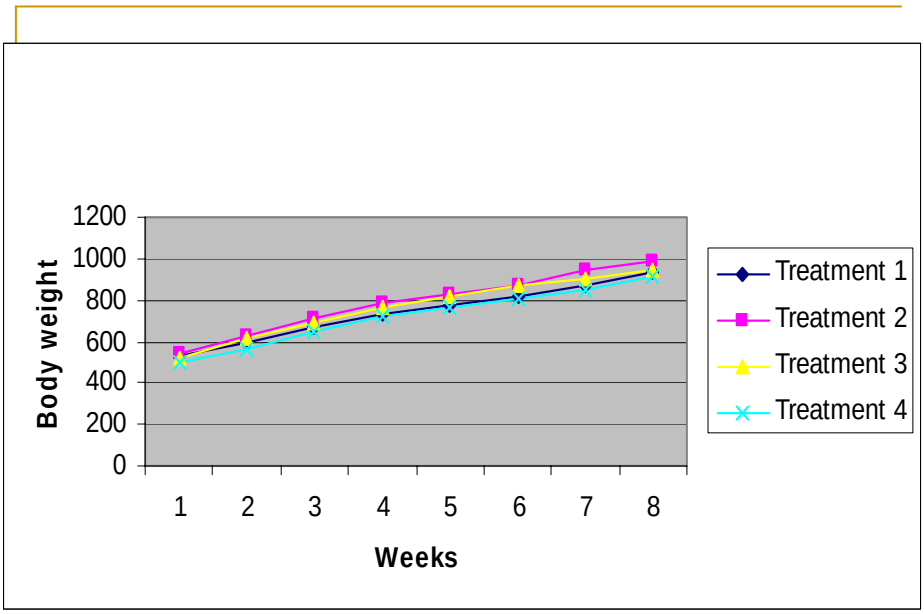

Fig. (4.1): Effect of dietary black seed (*Nigella sativa*) on weekly body weight of local rabbits (gm).

Table 4.2: Effect of dietary black seed (*Nigella sativa*) on over all performance of local rabbits (8weeks)

Parameters	**Dietary level of (*Nigella sativa)* %**				**±SEM**
	0	**0.25**	**0.5**	**0.75**	
Total feed intake (g/animal)	2302.63	2397.00	2282.25	2232.63	75.13
Total weight gain (g/animal)	487.75	544.63	520.88	498.00	39.34
Total FCR (intake/gain)	4.66	4.39	4.51	4.56	0.40

SEM: Standard Error of the Means

Table 4.3: effect of dietary black seed (*Nigella sativa)*) on some serum constituents of local rabbits

Parameters	Dietary level of black seed (*Nigella sativa*) %				±SEM
	0	0.25	0.5	0.75	
Cholesterol (mg/dl)	122.88[a]	119.80[a]	104.15[a]	163.10[b]	11.43
Glucose (mg/dl)	107.76[a]	90.43[a]	78.43[a]	78.70[a]	11.21
Triglyceride (g/dl)	53.70[a]	50.93[a]	56.50[a]	76.88[a]	8.55
Total protein (g/dl)	10.67[a]	10.18[a]	11.95[a]	12.15[a]	1.35
Urea (mg/dl)	134.30[a]	137.15[a]	138.55[a]	150.40[a]	29.20

a,b: Means in the same raw with the different superscript are significantly different ($P \leq 0.05$)

CHAPTERT FIVE
DISCUSSION

In the present study the experimental rabbits looked apparently healthy and no mortality was recorded.

Inclusion of black seed (*Nigella sativa*) in the rabbits ration showed no significant effect in feed intake and body weight gain and feed conversion ratio. However, there was a consistent numerical decrease in feed intake and body weight gain by increasing the level of the seeds. This results are Similar to the findings reported by Abd Elmageed (1999) .

In the current study Rabbits fed diets containing 0.5% black seed had shown numerical decrease about 15% in serum cholesterol level, these results are similar to those reported by (Bamosa *et al*., 1997). On the other hand Results findings reported by El-Dakhakhani *et al*. (2000) using *Nigella sativa* oil at 0.08% orally for 4 weeks in rats that showing a significant decrease in serum cholesterol. Moreover,in an other study it was Found that the addition of black seed (*Nigella sativa*) had asignificant effect ($P \leq 0.05$) on serum cholesterol (sideeg,1999). Although, In the present experiment the rabbits that consumed 0.75% black seed (*Nigella sativa)* showed significant ($P \leq 0.05$) increase in serum cholesterol level. This effect may be attributed to the level of saturated and unsaturated fatty acids present in the seed that may enhance that absorption and/or cholesterol synthesis (Gad *et al*., 1963; Babayan *et al*., 1978; Menounos *et al*., 1986).

In this study results also had shown that the inclusion of black seed (*Nigella sativa*) in rabbits ration has numerically decrease blood glucose level, and this result confirms that finding by El-Nagger and El-Dieb (1992). Moreover, similar results demonstrated by Al-Awada and Gumaa (1987) who found that when black seed (*Nigella sativa*) supplemented to normal and diabetic rats it produced no effect on the blood glucose level . However, in the current study rabbits fed on 0.75% black seed (*Nigella sativa*) had shown 43% increase in serum level of triglycerides and this effect could be due to oil content of the seeds that may increase serum triglycerides.Moreover, treatment containing 0.75% black seed increased the total serum protein and urea about 14% and 12% respectivly. On the other hand, the study conducted in rats, showed that rat treated with thymoquinone (active ingredient of black seed), 10 mg/kg/day for five days significantly lowered serum urea and triglycerides (Badary *et al*., 2000).

CONCLUSIONS

1. Inclusion of black seed (*Nigella sativa*) showed no significant difference in feed intake and body weight gain and feed conversion ratio of rabbits. However there was a consistence numerical decreases in feed intake and body weight gain by increasing the level of seeds.
2. Inclusion of 0.25% (*Nigella sativa*) in diet showed highest body weight gain and best feed conversion ratio.
3. Rabbits fed diet containing 0.75% black seed (*Nigella sativa*) showed significant increase in serum cholesterol level.
4. Increasing the level of black seed (*Nigella sativa*) in ration numerically decreased blood glucose level and numerically increase urea and total protein levels.
5. Rabbits fed diet containing 0.75% black seed (*Nigella sativa*) had 43% increase in triglyceride level compared to rabbits fed on control diet.

REFERENCES

Abd El-Gadir, H.A. (1991). Potential study of rabbit meat production under Sudan condition. M.Sc. Thesis, University of Khartoum.

Abdel Mageed, H.A. (1999). Response of broiler chick to dietary *Nigella* sativa. M.Sc. Thesis, University of Khartoum, Sudan

Aboutabl, E.A.; El Ezzouny, A.A.and Hammerschimidt, F.J. (1986). Aroma volatiles of *Nigella sativa* seeds. In: Brunkel, E.J. editor, Progress in Essential Oil Research. Proceeding of the International Symposium on Essential Oils. 44-55.

Abu Zeid, S.N. (1986). Medicinal plant and herbs. Arabic Ed., Elhilal Library and House, Beirut, Lebanon.

Akhtar, M.S. and Riffat, S. (1991). Filed trial of saussrea lappa roots against nematodes and *Nigella sativa* seed against cestides in children. J. Pakistan Med. Assoc. 41 (8): 185-7.

Al Jasser (1992). Chemical composition and micro flora of black cumin (*Nigella sativa* L.) seeds growing in Saudi Arabia Food Chemistry, 45: 239.

Alam, S. (1988). Rabbits breeding and health. 2nd edn, Anglolibrary, Cairo, A.R.E.

Al-Awadi, F.M. and Gumma, K.A. (1987). Studies on the activity of individual plants of an anti-diabetic plant mixture. Acta, Diabetol Lat. 24 (1): 37-41.

Al-Awadi, F.M.; Fatania, H. and Shamte, U. (1991).The effect of plant mixture extract on liver gluconeogenesis in strepto-zotocin-induced diabetic rats. Diabetes, Res. 18 (4): 163-8.

Al-Awadi, F.M.; Khatter, M.A. and Gumma, K.A. (1985). On the mechanism of the hypoglycemic effect of a plant extract. Diabetologia, 28: 432-4.

Al-Ghamdi, M.S. (2001). Anti-inflammatory, analgesic and anti-pyretic activity of *Nigella sativa*. J. Ethanophamacol. 76: 45-8.

Al-Hader, A.; Aqel, M. and Hassan, Z. (1993). Hypoglycemic effect of volatile oil of *Nigella sativa* seeds. Int. J. Pharmacog. 31 (2): 96-100.

Al-Jishi, S.A.A. (2000). A study of *Nigella sativa* on blood hemostatic function. M.Sc. Thesis, King Faisal University, Dammam, Saudi Arabia.

Allaian, C.C. (1974). Determination of serum cholesterol by enzymatic method. Clin. Chem. 20: 470-475.

AOAC (1980). Official Methods for analysis 13th .ed; association of official analytical chemists, Washington.

Aqel, M. and Shaheen, R. (1996). Effect of volatile oil of *Nigella sativa* seeds on the uterine smooth muscle of rat and guinea pig. Journal of Ethnopharmacology, 52: 23-26.

Baboyan, V.K.; Kootungal, D. and Halaby,J.A. (1978). Proximate analysis, fatty acid and amino acid composition of *Nigella sativa* seed. J. Food. Sci., 43: 1314.

Badary, O.A.; Abdel Nain, A.B.; Abdel Wahab, M.H. and Hamada, F.M. (2000). Induced hyperlipidermic nepharopathy in rats: Toxicology, 143 (3): 219-26.

Bader El-Din, M.K. (1960). Anti asthmatic activity of the active principle of *Nigella sativa* (Nigellone). Gazette Egypt Paediatr. Assoc. 8 (4): 864-7.

Bamosa, A.O.; Ali, B.A. and Sowayan, S.A. (1997). Effect of oral ingestion of *Nigella sativa* seed on some blood parameters. Saudi Pharm. J. 5 (2-3): 126-9.

Blatter, E.; Caiusj, F. and Mhaskarks (eds). (1984). Indian medicinal plant. 2nd ed. Allahabad, India: Lalit Mohan Basu, 11-12.

Boskabady, M.H. and Shahabi, M. (1997). Bronchodilatory and anticholinrgic effects of *Nigella sativa* on isolated guinea pig tracheal chain. Irnj Med.Sci. 22 (3 & 4): 133.

Bucolo, G. and David, H. (1973). Quantitative determination of serum triglyceride by use of enzymes. Clin. Chem. 19: 476-482.

Buits, M. and Bucar, F. (2000). Antioxidant activity of *Nigella sativa* Essential oil. Phytother Res. 14 (5): 323-8.

Chakarvarti, N. Inhibition of histamine release from most cells by nigellone. An nallergy, 70 (3): 237-242.

Chopra, R.N.; Nayyer, S.L. and Copra, I.C. (1956). Glossary of Indian medicinal plants (India): C.S.I.R. 176-88.

Eissa, M. (1996). Use of molasses. Based rations for fattening rabbitlets. M.Sc. Thesis, University of Khartoum, Sudan.

El-amin, F.M. (1978). Rabbit husbandry in the Sudan. In provisional Report No. 4, Rabbit Husbandry, Morogoro, Tanzania.

El-Dakhakhany, M.; Barakat, M.; El-Halim, M.A.and Aly, S.M. (2000). Effect of *Nigella sativa* oil on gastric secretion and ethanol-induced ulcer in rats. J. Ethnopharmacol. 72 (1-2): 299-304.

El-Dakhakhany, M. (1982). Some pharmacological properties of some constituents of *Nigella sativa* L. seeds: The carbonyl fraction of essential oil. Proceeding of the 2nd International Conference on Islamic Medicine, Kuwait, 426-31.

El-Dakhakhany, M.; Mady, N.I. and Halim, M.A. (2000). *Nigella sativa* L. oil protects against CCl4 and D-galctosamine induced hepatotoxicity and improves serum lipid profile in rats. Arzeimittleforschung, 50 (9): 832-6.

El-Dakhkhany, M. (1965). Studies on the Egyptian *Nigella sativa* L. some pharmacological properties if it's seed's active principle in comparison to its dihydro-compound and its polymer. Arzeim Forsch. Drug Res. 15: 1227-9.

El-Daly, E.S. (1998). Protective effect of cysteine and vitamin, E, crocus sativus and *Nigella sativa* extracts on cisplatin-induced toxicity in rats. J. Pharm. Belg. 53 (20): 87-95.

El-Fatatry (1975). Isolation and structure assignment of an anti-microbial principle from the volatile oil of *Nigella sativa* L. seeds. Pharmazie, 30 (2): 109-11.

El-Kadi, A. and Kandil, O. (1986). Effect of *Nigella sativa* (the black seed) on immunity proceeding of the 4th International Conference on Islamic Medicine, Kuwait Bull. Islamic Medl, 4: 344-8.

El-Kadi, A. and Kandil, O. (1987). The black seed (*Nigella sativa*) and immunity: Its effect on human T cell subset. Federation Proceeding, 46: 1222.

El-Naggar, A.M. and El-Deib, A.M. (1992). A study of some biological activities of *Nigella sativa* (black seed) "Habat El Baraka". J. Egypt. Soc. Pharmacol. Expther, 11:781-99.

El-Nagger, A.R.M. and El-Deib, A.E.M. (1992). A study of some biological activities of *Nigella sativa* (black seeds) "habbat el-Barka". J. Egypt.Soc. Pharmacol. Expther, 11 (2): 781-800.

El-Sayed, M.M.; El-Banna, H.A. and Fathy, F.A. (1994). The use of *Nigella sativa* oil as a natural preservative agent in processed cheese spread. Egypt J. Food Sci. 22 (3): 381-96.

El-Shabrawy, O.A. and Nada, S.A. (1996). Biological evaluation of multi-component tea, used as hypoglycemic, in rats, Fitoterapial 67 (2): 99-102.

El-Sherbeny, K.M (2001). Genotoxic effect of herbicide 2, 4-D on mitosis and meiosis of the mouse and the protective effect of *Nigella sativa* (var. Balady). Bull. Faculty of Agriculture, Cairo University, 52 (3): 497-509.

El-Shiekh, A.A. (1999). Use of herbal *Nigella sativa* seeds for laying hens. M.Sc. Thesis, University of Khartoum, Sudan.

El-tahir, K.E.; Al-tahir, A.Y. and Ageel, A.M. (1999). Pharmacological studies on sesame and *Nigella sativa* fixed oils: Effect on the sensitivities of the adrenoceptors, baroreceptors, platelets and the uterus of the rat. Saudi Pharmaceutical J. 7 (9): 205-15.

El-tahir, K.E.; Ashour, M.M. and Al-Harbi, M.M. (1993). The cardio-vascular effects of the volatile oil of black seed (*Nigella sativa*) in rats: elucidation of the mechanism(s) of action. Gen. Pharmacol. 24 (5): 1123-31.

El-tahir, K.E.H.; Ashour, M.M.S. and Al Harbi, M.M. (1993). The respiratory effects of the volatile oil of the black seed (*Nigella sativa*) in guinea pigs: Elucidation of the mechanism (s) of action. General Pharmacology, 24: 1115-1122.

El-Zawahry, B.H. (1997). Chemical composition of *Nigella sativa* linn seed: In: Effect of *Nigella sativa* on certain aspects of metabolism after feeding normal and hyperlipedemic diet in adult and old animals (MD Thesis in medical basic sciences). Cairo, Egypt: Al-Azhar University, 16-28.

Fawcett, J.K. (1960) Detrmination of serum urea. J. Clin. path. 13: 156-169.

Fossati, P. and Prenciple, L. (1982). Serum triglycerides determined calorimetrically with an enzyme that produces hydrogen peroxide. Clin. Chem. 28: 2077-2080.

Gad, A.M.; El-Dakhakhany, M. and Hassan, M.M. (1963). Studies on the chemical constitution of Egyptian *Nigella sativa* oil. Plant med. 11 (2): 134-8.

Ghoneim, M.T.; El-Gindy, R.A.; El-Alami, R.; Shoukry, E. and Yassein, S. (1982). Possible effect of some extract of *Nigella sativa* L. seeds on blood coagulation system and fibrinolytic activity. Proceeding of 2nd International Conference on Islamic Medicine, Kuwait, 528-35.

Gilani, A.H.; Aziz, N.; Khurram, I.M.; Chaudhary, K.S. and iqbal, A. (2001). Bronchodilator, spasmolytic and calcium antagonistic activities of *Nigella sativa* seed (Kalonji): a traditional herbal product with multiple medicinal uses. J. Pakistan Med. Assoc. 51 (3): 115-20.

Gornall, A.G. (1949) Determination of total proteins by colorimetric method. J. Biol. Chem. 177:751.

Goutb, H.T. (1981). Agricultural and constituents of medical plants Dar Elmerikh (cited by Osman, 1996).

Gutb, F.T. (1980). Medical plants, cultural practices and chemical constituents. Emarikh House, Saudi, Elriyad.

Hammad, A.F. (2003). The economical advantages of rearing rabbits. Nature, 12. Bremway Ltd. Int. Trading & Media-London.

Hanafy, M.S.M. and Hatem, M.E. (1991). Studies on the antimicrobial activity of *Nigella sativa* seed (black cumin). Journal of Ethonopharmacology, 34 (2-3): 275-8.

Haq, A.; Abdullati, F.M.; Lobo,PI.; Khabarks, Sheth, K.V. and Al-Sedairy, S.T (1995). *Nigella sativa*: effect on human lymocytes and polymorphoclear leukocyte phagocytic activity. Immuno-pharmacology, 30 (2): 147-50.

Houghton, P.J.; Zarka, R.; de Las Heras, B. and Hoult, J.R. (1995). Fixed oil of *Nigella sativa* and derived thymoquinone inhibit Eicosanoid generation in leukocytes and membrane lipid peroxidation. Planta Med. 61 (1): 33-6.

Kaplan, A.; and Urea Kaplan, A. (1984). Clin. Chem. The C.V. mosby Co. St Louis Toronto. Princeton, 1257-1260 and 437 and 418.

Keshri, G.; Singh, M.M.; Lakshami, v. and Kamboj, V.P. (1995). Post-coital contraceptive effect of the seeds of *Nigella sativa* in rats. Indian J. Physiol. Pharmacol. 39 (1): 59-62.

King, J.O.L. (1978). An introduction to animal husbandry. Blackwell Scientific Publications, U.K.

Korshom, M.; Moghney, A.A. and Mandour, A. (1998). Biochemical and parasitological evaluation of *Nigella sativa* against rumen fluke (paramphistomum) in sheep as compared with trematocide "Hapadex" Assuit Veterinary Med. J. 39 (78): 238-44.

Kumarass, (2001). Huat B+, extraction, isolation and characterization of anti-tumour principle, alpha-hedrin, from the seeds of *Nigella sativa*. Plantamed, 67 (1): 29-2.

Lebas, F.; Coudert, P.; Rouvier, R. and de Rochambean, H. (1986). The rabbit husbandry, health and production. Food and Agriculture Organization of the United Nations (FAO), Rome, Italy.

Lodhi, G.N.; Singh, D. and I Chpanani, J.S. (1976). Variation in nutrient content of feeding stuffs rich in protein of reassessment at the chemical method for metabolizable energy estimation for Poultry J. Agric. Sci. Camb. Vol. 85, 1976, pp 293-303.

M.A.F.F. (1973). Commercial rabbit production, Ministry of Agriculture, Fisheries and Food. Bulletin No. 30, London, U.K.

Mahfouz, M. and El-Dakhakhany, M. (1960). Some chemical and pharmacological properties of the new anti-asthmatic drug (Nigellone). Egypt Pharmacol. Bull. 42: 411-24.

Mahmoud, M.R.; El-Abhar, H.S. and Salah, S. (2002). The effect *Nigella sativa* oil against the liver damage induced by schistosoma mansoni infection in mice. J. Ethnopharmacol. 79 (1): 1-11.

Meiattini, F. (1978) Determination of serum cholesterol. Clin. Chem. 24: 2161-2165.

Menounos, P.; StaPhylakis, K. and Gegiou, D. (1986). The sterols of Niella sativa seed oil phyto-chemistry, 25: 761-3.

Morsi, N.M. (2000). Antimicrobial effect of crude extracts of *Nigella sativa* on multiple antibiotic resistant bacteria. Acta Microbiol Pol. 49 (1): 63-74.

Mutabagani, A. and El-Mahdy, S.A.M. (1997). A study of the anti-infammatory activity of *Nigella sativa* L. and thymoquinone in rats. Saudi Pharm. J. 5 (2): 110-3.

Nagi, M.N.; Alam, K.; Badary, O.A.; Al-Shabanaho, A.; Al-Sawaf, H.A. and Al Bakairy, A.M. (1999). Thymoquinone protect against carbon tetracholide hepatotoxicity in mice via an antioxidant mechanism. Biochm. Mol. Biol. Int. 47 (1): 153-9.

Nair, S.C.; Salmoi, M.J. and Panikkar, K.R. (1991). Moulatory effect of crorcus sativus and *Nigella sativa* extracts on cisplation-induced toxicity in mice. J. Ethnophamacol, 31 (1): 75-83.National Institute of Health Consensus Development Conference. Lowering blood cholesterol to prevent heart disease. JAMA 1985; 253: 2080-6.

NRC (1977). Nutrient requirement of rabbit,7th ed., National Research council, Nutritional Academy of Science, Washington, DC, USA.

Osman, U.A. (1996). Study on extraction and characteristics of *Nigella sativa* (L.) seeds oil. M.Sc. Thesis, University of Khartoum, Sudan.

Panikar, K.R.; Salomi, M.J.; Kesven, M.; Dorata, S.R.and Rajgopalam, K. (1989). Anticancer activity of *Nigella sativa*. Ancient Science of Life, 8: 262-78.

Peters, T.J. (1968) Determination of total proteins by colorimetric method. Clin. Chem. 14: 1147.

Rader, D.J.; Ikewaki, K. and Duverger, A. (1993). Very low high density lipoprotein without coronary altherosclerosis. Lancent, 342: 1455-8.

Rafat, M. (1972). Fundamental nutrition for farm animals and poultry Arabic edit., Anglo. Egyptian Library, Cairo, Egypt.

Ranjahan, S.K. (1980). Animal nutrition in tropic, Vikas publishing house Ltd., India, pp. 332-335.

Richardson, V.C.G. (2000). Rabbit's health, husbandry and disease, 7-10.

Saeed, H.M. (1972). Pharmacography Indica Hamdard, 15: 218-29.

Sanford, J.C. (1986). The domestic rabbit. 4th ed. 8, Grafton Street, London, W1, 95-100.

Sayed, M.D. (1980). Traditional medicine in health care. J. Ethnopharmacol. 2 (1): 19-22 saying of prophet Muhammad (Peace be upon him), 2nd ed Ankara, Turkey, Hilal Yayinlari.

Sevensson (1982). Scand J. Clin. Lab. Invest. 42: 99-105.

Shepherd, J.; Packard, C.V. and Grundy, S.M. (1980). Effect of saturated and polyunsaturated fat diets on the chemical composition and metabolism of low density lipoproteins in man. J. Lipid. Res. 21: 91-9.

Sideeg, R.M. (2000). Effect of dietary vitamin A and *Nigella sativa* on the performance of broiler chicks. M.Sc. Thesis, University of Khartoum.

Swamy, S.M. and Tan, B.K. (2000). Cytotoxic and imunopotentiating effect of ethanolic extract of *Nigella sativa* L. seeds. J. Ethnopharmacol, 70 (1): 1-7.

Tabacco, A. (1979). Determination of serum urea. Clin. Chem. 25: 336-337.

Timon, V.M. and Hamrahan, T.P. (1985). Small ruminant production in developing countries. Proceeding of an expert consultation held in Sofia, Bulgaria, pp. 58.

Tirinaer, P. (1969). Glucose determination. Ann. Clinic. Biochem. 6: 24.

Topozada, H.H.; Masloum, H.and El-Dakhakhany, M. (1965). The antibacterial properties of *Nigella sativa* seeds: Active principle with some clinical application. J. Egypt Med. Assoc., 48 (Suppl): 187-202.

Turkdogan, M.K.; Agaoglu, Z.; Yerner, Z.; Ekeroglu, R.; Akkan, H.A. and Auci, M.E. (2001). The role of antioxidant vitamins (C and E), selenium and *Nigella sativa* in the prevention of liver fibrosis and cirrhosis in rabbits: New hopes. DtW Dtsh tierarztl wochenschr, 108 (2): 71-3.

Underwood, E.J. (1981). The mineral nutrition of livestock.2nd edition Commonwealth Agricultural Bureaux Farnham Rayalslaugh, U.K.

Yassin, O.E. (1987). Poultry industry in the Sudan. First Arab Conference on animal and Poultry Production, Rabat, Morocco.

Zaoui, A.; Cherrah, Y.; Lacaille-Dubois, M.A.; Settaf, A.; Amarouch, H. and Hassar, M. (2000). Diuretic and hypotensive effects of *Nigella sativa* in the spontaneously hypertensive rat. Therapie, 55 (3): 379-382.

Zooui, A.; Cherrah, Y.; Alouik, Mahassine, N. Amarouch, H. and Hassar, M. (2002). Effect of *Nigella sativa* fixed oil on blood homeostasis in rat. J. Ethnopharmacol. 79 (1): 23-6.

Appendix-1
Effect of dietary black seed (*Nigella sativa)*) on
weekly body weight (g) of local rabbits

Weeks	**Dietary level of (*Nigella sativa)* %**				**±SEM**
	0	**0.25**	**0.5**	**0.75**	
1	528.25	544.00	525.50	497.50	65.48
2	591.25	622.00	610.88	565.00	59.89
3	664.00	711.00	691.25	650.75	64.29
4	730.25	784.00	767.25	719.75	61.04
5	772.25	833.25	815.25	762.25	53.29
6	815.50	873.75	868.75	806.25	51.01
7	868.00	946.00	900.25	853.00	53.75
8	938.00	989.75	946.00	916.25	51.79

SEM: Standard Error of the mean

Appendix-2
effect of dietary black seed (*Nigella sativa)*) on weekly weight gain (g) of local rabbits

Weeks	**Dietary level of black seed (*Nigella sativa)*) %**				**±SEM**
	0	**0.25**	**0.5**	**0.75**	
1	79.25[a]	98.88[a]	91.13[a]	79.25[a]	11.82
2	62.75[a]	78.00[a]	85.38[a]	67.50[a]	15.02
3	73.00[a]	89.00[a]	82.13[a]	85.75[a]	7.42
4	66.25[a]	73.00[a]	76.00[a]	69.00[a]	9.81
5	42.00[a]	49.25[a]	48.00[a]	42.50[a]	11.17
6	40.00[a]	40.50[a]	61.00[a]	44.00[a]	9.56
7	52.50[b]	72.25[b]	31.50[a]	46.75[a]	7.72
8	70.00 [a]	43.75 [a]	45.75 [a]	63.25 [a]	10.44

a, b: Means in the same raw with the different superscript are significantly different ($P \leq 0.05$)