An-Najah National University

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PERFORMANCE AND COST EVALUATION OF BROILERS FED WITH VARYING LEVELS OF BLACK CUMIN SEED MEAL

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This Thesis was defended successfully on 9 / 1 / 2022 and approved by:

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Dedication

This thesis is dedicated to my father, the man who always picked me up and encouraged me chasing after my dreams,

To my mother, to my loving husband

My dear children

Brothers and sisters

To whom I love

Acknowledgement

I would like to express my deepest appreciations and gratitude to my advisor Dr. Maen Samara for his supervision, guidance, encouragement and support throughout the course of this study and reviewing this thesis. My appreciation is also extended to Dr. AhmadZaazaa and Dr. EyadBadran for their valuable criticism and time in reviewing this thesis. I would like to acknowledge the efforts of the Palestinian Agricultural Academic cooperation Project (PAAC) and ofPalestine Poultry Company and Abd – Nasser Ghannam Co. whom provided all help and facilities for success of this study. I would like to acknowledge the efforts of my brother Mohammad and my sisters Laila and najlaa, my children and my husband for their help, encouragement and patience throughout the years of my study.

Declaration

I, the undersigned, declare that I submitted the thesis entitled:

PERFORMANCE AND COST EVALUATION OF BROILERS FED WITH VARYING LEVELS OF BLACK CUMIN SEED MEAL

I declare that the work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

Student's Name: _____

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PERFORMANCE AND COST EVALUATION OF BROILERS FED WITH VARYING LEVELS OF BLACK CUMIN SEED MEAL

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Abstract

An experimentwith broiler chicks was carried out to determine the effect of black cumin seed meal (BCSM) on growth performance, dressing percentage, carcass characteristics and feed cost. A total of 336 day – old straight- run Ross (308) were used in this experiment from22 /6/2021 to 2/8/2021. Birds were divided into four experimental treatments of 84 birds in each. Each treatment was composed of 3 replicates with 28 birds in each replicate. The control group was fed a commercial starter and finisher diets. The second, third and fourth groups were supplemented with black cumin seed meal at the rate of 1.5, 2.5 and 3.5%, respectively. Results of this study showed feeding chicks on black cumin seed meal had no significant effects ($P > 0.05$) on broilers weight gain, feed consumption, feed conversion ratio, carcass cuts, visceral organs and feed cost. A significant ($P < 0.001$)improvement in dressing percentage was observed for birds fed black cumin seed meal regardless of the inclusion level. It could be concluded that inclusion of black cumin seed meal in rations did not result in adverse effects in performance of broilers chicks.

Key words: broilers, performance, black cumin seed meal (BCSM), dressing percentage, carcass characteristics, feed cost.

Chapter One
Introduction

Poultry farmers in Palestine describe this business in one single sentence "one day you are in and the next day you are out". This can be explained by the fact that farms are run by on-farmers who are not aware of the poultry production and management in one hand and absence of government policies and regulations in the other hand. In addition, feed cost accounts for more than 65% of broiler production in Palestine (MOA,2005). At the same time instability of ingredient cost makes the poultry industry less profitable. This circumstance compelled nutritionists to explore the use of non-conventional feed ingredients in poultry diets (FAO). This may contribute to reduce the cost of feed given to broiler.

The use of antibiotics with protective properties in poultry farming is beginning to emerge as a risk factor for human health, as there a chance of residual appearance in tissues and also through the potential induction of cross-resistance of pathogenic bacteria in humans (Costa et al., 2007), which can It generates public health problems. Thus, new restrictions and regulations regarding the use of these products in animal feed have arisen. In the European Union, the use of any growth-promoting antimicrobials in animal production has been banned since January 2006 (Brugalli, 2003). It is only allowed to be used for healing purposes. Therefore, it is necessary to develop new alternatives to repair or reduce the antimicrobial removal effect of growth promoters.

Herbal extracts have been used in broilers diets to enhance growth performance instead of using antibiotics, which effects on both sides performance and health (Tucker, 2002).

Black cumin (*Nigella sativa L*.) is widely grown in the Mediterranean region, and has long been used as a therapeutic and flavoring agent in human food, particularly bakery products. More recently, the herb has been introduced into poultry nutrition programs for therapeutic and nutritional purposes (Hashemi*et al.*, 2011).

Possibly, results of the research will be available for use by other feed mills. The replacement of this agro-industrial by products instead of more expensive feed ingredient (soybean) will contribute to producing less costly broiler diet (Ravindranand

Blair). It is also anticipated that the use of this agro-industrial by-product will relatively minimize environmental pollution.

The objective of this study to investigate the effect of inserting black cumin seed meal (BCSM) in different levels 1.5, 2.5 and 3.5% respectively, on growth performance, carcass characteristics, dressing percentage and feed cost in broiler chickens.

Chapter Two

Literature Review

2.1 Broiler Nutrition

Broiler meat is the main source of protein to human in developed as well as less developed countries. Therefore poultry nutrition received considerable attention from researchers as well as producers. Short life cycle for broilers, the progressin broiler management and the availability of feed ingredients all facilitate researchers work and make much more progress in a short period time in the poultry sector.

Poultry rations consists mainly of a mixture of several feed ingredients such as cereal grains, soybean meal, animal by product meal, fat ,vitamin and mineral premixes. These feed ingredients along with water, provide energy and nutrients necessary for the growth of broiler chicks. These nutrients include proteins, carbohydrates, fats, minerals and vitamins. Cereal grains provide the energy needed for growth and production of meat and eggs, whereas oil seed meal (soybean meal) provide proteins required for growth (NRC, 1994). Vitamins and minerals premixes are usually added to poultry rations. These premixes also contain non- nutritive feed additives that enhance performance and meat quality such as pigments, growth promoters, antimicrobial and anticoccidial agents which are necessary for ideal growth of broilers.

Growth rate of broiler chickens has been greatly improved over the past 50 years. The use of antibiotics as growth promoters is one of the key factors that has an impact in broilers growth. However, the ban imposed in the use of antibiotics (Castannon, 2007) in Europe as well as North America has brought a tremendous pressure on the broiler industry to look for alternatives that improve growth and performance of chicken. At the present, there is a large body of research on limiting the use of antibiotics as growth enhancers for broilers (Yegani and Korver,2008).

Medical plants and their products including plant extracts or essential oils are presented as alternatives for use in broiler feed as phytogenic feed additives (Mountzouris*et al* .2011). Such compounds influence poultry productivity and health mainly by stabilization of normal gut flora and prevention of pathogens colonization (Si *et al*.2006, Tekeli*et al.* 2006).

2.2 Prebiotics and Probiotics in Broiler Nutrition

Prebiotic are described as “a non-digestible food ingredient that beneficially affects the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon, and thus improves host health”. This definition has not been changed for more than 15 years (Glenn and Roberfroid, 1995).

There are many types of prebiotics, the most common in poultry diets are nondigestible oligosaccharides, including fructooligosaccharides and inulin type,mannan oligosaccharides, xylooligosaccharides,galactooligosaccharides,isomaltooligosaccharide and some structural carbohydrate components of non-starch polysaccharides (Józefiak *et al*, 2008; Pourabedin and Zhao, 2015; Slawinska *et al*,2019).

The main aims of using these prebiotics are to make the intestinal microbial population more beneficial to the host animal and to enhance productive parameters such as body weight and feed conversion ratio (Sims *et al*, 2004; Piray *et al* ,2007*).* Prebiotics have been shown to be promising in controlling pathogens such as *Escherichia coli* and *Salmonella* and stimulate the growth of Lactobacilli and Bifidobacteria.

Probiotics are defined as” live microorganisms which when administered in adequate amount gives health benefit to the host” (FAO/WHO, 2002). Probiotics enhance health and growth in all ages and classes of poultry, improving a healthy balance of bacteria in the gastrointestinal tract, promoting the gut integrity and maturation, enhance the immune response and preventing inflammation, improve feed intake and digestion by increasing the action of digestive enzyme and decreasing activity of bacterial enzyme as well as decreasing ammonia production, neutralize enterotoxins and stimulate immune function (Kabir, 2009; Alagawany *et al*, 2016; Soomro *et al*, 2019).

Probiotics species are *Lactobacillus bulgaricus, Lactobacillus plantarum, Streptococcusthermophils, Bifidobacterimbifdum* and *Aspergillusoryzae. (*Khaksefidi and Rahimi, 2005).Probiotics do not leave residues in meat, milk and eggs when used in the animal feed but improve animal’s health and performance (Patterson and Burkholder, 2003). It has been reported that probiotics modulate the intestinal microflora, reduce number of pathogens and improve the sensory-immune properties of broiler meat (Pelicano *et al*., 2005). It has also been reported (Kabir, 2009) that

probiotics improved broilers meat quality in terms of microbiological criteria. Other studies (Soomro *et al,* 2019) showed that probiotics supplementation has a significant effect on carcass yield, live weight gain, immune response and distinguished cut meat parts of broiler chicken. However, colonization of probiotics in the gut depends on many factors including availability of the fermentation substrates (prebiotics), the specificity of the strain relative to the host, dose and frequency of supplementations, age, health, genetics and nutritional status of the host, intestinal PH and stress (Bomba *et al*, 2002).

Using of both probiotics and prebiotics together in appropriate percentages shows the powerful effect of each supplement shown by the probiotics or prebiotics separately. Prebiotics are used for multiplication and continuance of probiotics in the lower gut in a symbiotic mode of action (Hanamanta *et al*, 2011).

2.3 Herbal Extracts Properties

Medical plants and there extracts are used in feed industry due to the urgent need for alternatives to antibiotics due to the concerns from there antibiotics residues and due to satisfied results from analyzing and studying the effects of using herbal extracts in diets (Azeem *et al*, 2014).

Plant extracts consists mainly of proteins, peptides, oligosaccharides, fatty acids, vitamins, micro minerals. Plant extracts have a wide range of activities and their secondary metabolites typically belong to the classes of isoprene derivatives and flavonoids (Tajodini et al., 2015). A great number of plant extracts contain chemical compounds exhibiting antioxidant (Kähkönen et al., 1999; Hashemi et al., 2009), antimicrobial (Hammer et al., 1999; Hsieh et al., 2001), anti-inflammatory (Pradeep and Kuttan, 2004), anticoccidial (Arab et al., 2006) and anthelmintic (Hoste et al., 2006) properties.

The type of soil, climatic conditions, vegetation phase, genetic modifications and others are factors affecting herbal plants chemical and biological diversity (Miliauscas et al., 2004). The properties of plant extract are mainly due to the bioactive compounds such as flavonoids and glucosinolates isoprene derivatives (Kutlu and Erdogan, 2010). Additionally, the presence of the bioactive substances are probably the major

mechanisms by which plant has positive effects on the growth performance and health of animals (Hashemi and Davoodi, 2011). They can exhibit their effects through stimulating feed intake and endogenous secretions or having antioxidant and antimicrobial activities.

Various plant or herbal extracts are commonly included in poultry diets to promote growth performance and animal health especially when animals undergo health challenge conditions. Several research have documented the benefit effects of plant extracts on the performance of poultry (Jamroz and Kamel, 2002; Tucker, 2002; Alçiçek*et al*., 2003; Jahan *et al.*,2018; Demirci*et al*., 2019). These authors reported that the supplementation of plant extracts or oils into broilers diets increased the body weight gain, feed intake and improved feed conversion rate. The main action of plant extracts or oils as feed additives is aimed at improving the ecosystem of gastrointestinal microbiota through controlling potential pathogens and digestive capacity in the small intestine (Hashemi and Davoodi, 2011).

Attia et al., (2017) used five different levels of mixture of plant extracts as a natural growth promoter ((100, 200, 500, 1000 and 2000 ppm) to investigate the effect of supplementing broiler diets with a mixture of plant extracts on growth performance, blood lipid properties, and humoral immune response against Newcastle disease virus vaccines and carcass traits. Based on their results the tested extract mixture can be added at a level of 200 ppm as an alternative to antibiotic growth promoters and to improve broiler performance and immune response.

Tucker (2002) demonstrated a significant improvement in performance, livability of broilers fed diet with many kinds of plant extracts. Beneficial actions of herbal extracts or their active compounds in animal nutrition may include the stimulation of appetite and feed intake and the improvement of endogenous digestive enzyme secretion (Rahimi et al., 2011).

. Tollba et al (2007) reported that at two, four and six week of age, the broiler receiving varying levels of black pepper showed better body weight gain. Glaib et al., (2011), study the effect of adding black pepper (*Piper nigrum*) to broilers diet in order to investigate the impact on broiler performance. They used five levels of black pepper at the rate of 0.00%, 0.25%, 0.50%, 0.75% and 1% were inserted into the control diet of

broilers for six weeks. Higher body weight gain, feed intake and feed conversion ratio were noticed on birds fed on diets contain 0.50, 0.75 and 1%. They concluded that the use of black pepper as feed additive could enhance the overall performance of broiler chicks.

Studies were conducted to determine and prove the positive effect of these herbs on broiler performance. Aikpitanyi et al., (2019), they conducted an experiment to investigate the effect of ginger (*Zingiberofficinale L*) and black pepper (*Piper guineenseSchum&Thonn*) as feed additives. Their results reveled that average feed intake was highest in the ginger containing diet against the control diet. Significant difference were recorded on feed conversion ratio also. They concluded that the addition of the natural plant additives improved the measured parameters in comparison to the control diet.

Herbs like cinnamon, nishyinda and black pepper has been reported to have promising growth promoter effects without exhibiting side effects in broilers (Chowdhury et al., 2009; Mode et al., 2009). Curry leaves were studies to determine their impact on broilers performance, according to Nuwan et al. (2016) birds fed diet supplemented with curry leaf powder had higher weight ($P < 0.05$), improved feed conversion rate ($P < 0.05$) and lower mortality rates ($P < 0.05$) compared to birds in the control group. Despite this, there was no difference ($P > 0.05$) in feed intake between other treatments.Mehala and Moorthy (2008) studied the effect of inclusion of Aloe vera and Curcuma longa and its combinations on production performance. Even though their results revealed that there is no significant effect between treatment groups. The average return on feed cost differed significantly ($P < 0.01$) between the treatment groups up to six weeks of age, mainly due to the difference in the feed cost of inclusion of aloe vera and curcuma longa in the broiler feed.

Rosemary (*Rosmarinus officinalis*) an aromatic perennial plant of the Lamiaceae family, containing resin, tannin and small amounts of saponins. The antimicrobial and antioxidant activity of rosemary is well known, and it has been confirmed by many authors (Mathlouthi et al., 2012). Positive effects of using rosemary in the diet of broiler chickens on production performance, immune status, and meat quality have been determined by Ghazalah and Ali (2008). Researchers reported that inclusion rosemary

leaves meal in broilers diet (0.5 %) showed higher body weights, greater weight gain, and better feed conversion during the trial period as well as better physical properties of chicken meat.

Yesilbag et al., (2011) concluded that dietary supplementation with rosemary and its volatile oil improved the quality of broiler meat. Moreover, growth performance was positively affected by volatile rosemary oil supplementation.

By using three sources of phytogenic plants *Moringa oleifera* leaves meal, *Rosmarinus officinalis* leaves meal and *Olea europaea* leaves meal with two levels of plant addition (1or2%) Hassan (2019) conducted an experiment to compare with the commercial diet (control). The author concluded that the highest final body weight, the best feed conversion ratio and the highest digestion coefficient of crude protein being 80.13% was achieved by the group fed 2% *Moringa oleifera* leaves meal vs. control (74.44%). Ducklings fed diet supplemented with natural additives recorded the highest values of edible giblets% and digestive tract length (cm) but lowest digestive tract weight % compared to the control group. Also the highest values of albumin (g/dl) and albumin/globulin ratio were recorded by the groups fed natural feed additives. Results also showed the highest economic efficiency were recorded by the groups fed with natural feed additives.

The effect of using different levels of coriander seed powder or extract on selected blood factors, intestinal microflora and immune response of broiler chickens was studied by Zadeh et al., (2014). These authors reported that inclusion of 2.0% coriander powder in broiler diets lowered total cholesterol. Furthermore, there were no treatment effects on Lactobacillus bacteria; however, the population of E. coli was significantly higher in the ileum of chickens fed control group.

In broilers, Tollba and Hassan (2003) reported that adding garlic as a natural feed additive in diet improved growth and feed conversion ratio (FCR), and decreased mortality rate. Thyme (Thymus vulgaris) and Sage (Salvia officinalis) cause a significant improvement in body weight, feed conversion, and mortality rate of broilers (Tollba, 2003 and Gibbons, 2005).The medical activities of some natural plants as garlic (Allium sativum) and thyme (Thymus vulgaris) are well known and well-studied.

Extracts from certain herbs have been reported and proved to be good growth promoter (Stanley et al., 2004; Czech et al., 2009).

Fadlalla et al., (2010) studied adding garlic (*Allium sativum*) in different levels to the basal diet of broilers to investigate their effect on growth performance and immune response. They added (0.15, 0.45, .0.3 and 0.6%) results showed that using 0.3% was significantly higher in feed conversion ratio and mortality rate was the lower in this treatment. the total white blood cell count of birds fed with 0.3% garlic was significantly ($p < 0.05$) higher compared to those fed other treatments. Rahimi et al., (2011) added 0.1% garlic powder to broiler ration, and showed that the HDL-cholesterol level increased while total cholesterol level decreased.

Issa and Abo Omar (2012). Conducted an experiment to investigate the effect of garlic powder feeding on performance digestibility, digestive system, and carcass cut. The results of this study showed that Garlic powder had no significant effect on broiler weight gain, feed intake, feed conversion ratio, carcass and visceral organs.

The effect of garlic powder on the performance of broiler chickens has been studied by Elagib et al., (2013) using (0.3 and 5%) garlic powder inserted to the control diet, their results indicated that diet with 3% level of garlic significantly ($P <0.05$) increased feed intake (3051.6 g), body weight gain (1688.7 g), body weight (1733.8 g) and achieved the best feed conversion ratio (1.81 kg feed for one kg meat). Dressing percentage were not affected by using garlic powder. The highest breast weight was reported by feeding 3% of garlic (250g) and the lowest weight was also when feeding 5% level (155g). They concluded that the supplementation of garlic as feed additive at 3% level significantly enhanced growth and performance of broiler chicks without any side effects.

Other researchers have pointed out the importance of using garlic powder as prebiotic, Borgohain et al., (2017), they used (0.5%, 1% and 1.5%) garlic powder. They reported that there was a significant improvement of body weight for birds fed with 1% garlic powder followed by the group which fed with 1.5%. They also indicate feed conversion ratio which was improved in groups fed with garlic powder.

Al-Rabadi et al., (2020) studied the effect of periodic use of garlic powder on some productive performance (mortality, feed intake, live body weight gain, feed consumption, and feed conversion ratio). These authors reported that feeding garlic powder with a higher inclusion rate (i.e., 1.5%) significantly reduced feed intake compared to broilers fed garlic powder with a lower inclusion level (0.5%) and broilers in the control group. Even though, feeding garlic powder at higher inclusion level (i.e., 1.5%) significantly increased average gain and improved feed conversion ratio among the other feeding treatments

Abdel-Ghaney et al., (2017), conducted a study to determine the immune status, antioxidants, and performance of broiler chickens fed diets supplemented with thyme leaf powder (*Thymus vulgaris*) (0, 5, 10 and 15 g/kg), as an alternative growth promoter. Their results showed that incorporation of thyme into the diet of broilers improved the immune status and antioxidant activities of broilers.

Some researchers have studied two types of medicinal herbal extracts together in order to study their effect on the performance of birds, Attia (2018) inserted 0.25, 0.50, 0.75 and 1.0% rosemary leaves, 0.50 and 1.0% black seed powder, as natural feed additives to study their effect on growth performance, carcass traits and some blood plasma constitutes of broiler chicks. the author reported that supplementation of rosemary leaves up to 0.5% and black seed powder up to 1.0% increased body weight at all stages versus other treatments. Results showed that birds supplemented with rosemary leaves and black seed powder were significantly higher in livability rates, enhanced performance and European production efficiency factor.

Yesuf et al., (2017) conducted a study to investigate the effect of black cumin seeds (Nigella sativa L.), fenugreek (Trigonellafoenum graecum L.) and turmeric (Curcuma longa L.) As a natural feed additives on the characteristics of broiler carcass. The treatments consisted of the basal diet as the control group, black cumin seeds, fenugreek and turmeric powder (1 and 2 g kg-1 of the total ration). The results showed that the commercial carcass yield was significantly ($P< 0.05$) affected by the natural feed additive treatments compared to the control birds. There was a significant difference ($P< 0.05$) in the edible carcass yield among the treated groups. Supplementation with natural feed additives significantly enhanced breast meat production ($P< 0.05$).

However, there was no significant change (P> 0.05) in the yield of thigh meat + drumsticks, flank and back between the treatments and the control group. There was no significant difference (P> 0.05) in the relative weight of the liver, heart and gastrointestinal tract between the treatment groups. However, adding fenugreek powder at a level of 1 and 2 g/kg had a significant effect (P< 0.05) on gizzard and giblet ratio compared to the control group. The abdominal fat percentage decreased significantly (P< 0.05) as a result of adding turmeric at (1 to 2 g/kg).

Black cumin and fenugreek have no effect on the characteristics of the carcass. However, turmeric can be included as a feed additive at a level (1 and 2 g/kg in the total ration) for better and positive results on carcass production and breast meat production.

The use of black cumin, garlic powder and thyme powder in poultry feed has received considerable attention in recent years, mainly due to their high nutritional and therapeutic values. Studies on *Nigella sativa* seeds show promising results that can provide a suitable alternative to antibiotics as a growth promoter and various health protections for human and animal issues (Abd El-Hack et al., 2016).

2.4 Black Cumin Seed in Broiler Nutrition

Nigella sativa is one of the 3 species that belong to the genus *Nigella*andof the family Ranuculaceae (Malhotra, 2012).*Nigella sativa L* (black cumin), an aromatic plant used as a natural remedy due to the presence of antimicrobial, antioxidant and other pharmacological properties (Hashemi*et al.,* 2011).

2.4.1 The chemical composition of black cumin seed and its components

Black cumin seeds, due to their aromatic flavor and strong hot peppery taste, are extensively used as a flavoring agent in curry, a constituent in vinegar and substitute of pepper in cooking and bakery foods (Babayan et al.,1978). The seeds are small and black in color and possess a scented odor which is pungent and has bitter in taste with a crunchy texture. Its plant is an annual herbaceous which belongs to the family of Ranunculaceae. It is indigenous to Mediterranean regions but also cultivates in Saudi Arabia, Africa, and Southwest Asia. The seeds are extensively sold in markets to be used as a spice and native medicine. In the Middle East, Northern Africa and India, it has been used traditionally for centuries for the treatment of asthma, cough, bronchitis,

headache, rheumatism, fever, influenza and eczema and for its antihistaminic, antidiabetic and anti-inflammatory activities (Burits and Bucar 2000). The seeds oil is also considered as one among newest sources of edible oils (Cheikh-Rouhou et al., 2007).

The interest in black cumin seed and their chemical components has received a considerable attention by researchers. Al-Jassir (1992) preformed proximate analysis of black cumin seeds grown in Saudi Arabia. Results revealed that cumin seed contain 20.85% protein, 38.20% fat, 4.64% moisture, 4.37% ash, 7.94% crude fibre and 31.94% total carbohydrates.

Black cumin seeds (BCS) are considered to be a good source of protein, crude fat, crude fiber and macro minerals. BCS contain a fixed oil (28-42%), proteins (23 to 37%), ash (4.41 to 4.86%), total carbohydrate (33 to 40%) and different phytochemicals (Ramadan, 2007; Cheikh- Rouhou et al., 2007). The major unsaturated fatty acids are linoleic acid (49.2-50.3%), followed by oleic acid (23.7-25.0%), while the main saturated fatty acid is palmitic acid (17.2-18.4%) (Cheikh-Rouhou et al., 2007).(Dinagaran*et al.,* 2016) used soxhlet hexane extraction process by to isolate oil of *Nigella sativa* oil in an attempt to identify its chemical compounds, fatty acids composition and antioxidants activity. These authors reported that *Nigllea Sativa* seed contains fixed oils that ranges between 28-36% and composed of unsaturated fatty acids that are arachidonic, eicosadienoic, linoleic, linolenic and saturated fatty acids that includes palmitic, stearic and myristic. The oil extracted from black cumin seeds also contain volatile oils which are known as important nutrients and possess enormous health benefits. Also Farhan *et al*., (2021) used in their study hexane extraction method to analyze black cumin seed oil grown in Saudi Arabia. These authors reported that the seed had high content of oil (43.7%) which is rich in linoleic acid.

2.4.2 Effect of cumin seed meal in broilers

It is well known that feed cost constitutes around 65% of total production costs of broilers (MOA, 2005). Therefore, the importance of alternative feed ingredient is becoming a necessity to reduce the feed cost since price of conventional feed ingredients are continuously increasing. Meanwhile, the ban on the use of synthetic growth promoters and antibiotics for poultry has imposed additional strain on producers

to look for natural alternatives that promote growth and health of the birds. Herbal seeds and herbal extracts could be suitable alternatives given their high protein content and their bioactive components. Cumin seeds (CS) and cumin seed meal (CSM) has been recommended (Akhtar *et al*., 2003) as protein supplementation and as a source of natural growth promoter due to their impact on improving immunity and reducing mortality in poultry. Mortality was decreased from 16.67 to 4.17% by supplementation of layer diet with 1.5% black cumin.

Guler *et al.*, (2006), reported that chicks fed with 1% BCS were the highest average daily gain also feed conversion ratio was improved significantly by the supplementation with 1% BCS ($P<0.05$) compared to the control diet. Carcass weight, thigh, breast, wing neck and liver weights were in 1% BCS group the highest. According to these findingsa 1% supplement in black cumin seed diets can be considered as an alternative natural growth promoter for poultry rather than an antibiotic.

The effect of black cumin seeds on the performance and carcass quality of broiler chicks was studied by Durrani *et al*. (2007), who reported that birds supplemented with 4% of black seed in the diet had a significant ($P<0.05$) higher body weight gain, weight of thigh, breast, feed conversion ratio and dressing percentage. Similar results were reported by Halle *et al.* (1999); Osman and Barody, (1999); Al-Homidan *et al*. (2002) who observed that inclusion of CS in broiler rations did improve performance parameters but in varying degrees.

Mahmood (2009) reported that broilers fed with starter mash and broiler finisher mash supplemented with 0.5% and 1.0% *Nigella sativa*, which were fed from 2-4 and 5-6 weeks of age, respectively were significantly ($P<0.05$) higher in average dressing percentages, relative giblet weight (heart, gizzard, liver & spleen) and relative pancreas weight than the non-supplemented diet, they concluded that dietary inclusion of *Nigella sativa* in the rations may be used for economical and efficient production of broilers.

Abu-Dieyeh and Abu Darwish (2008) reported that broilers fed with 1 and 1.5% *Nigella sativa* seeds for a period of 4 weeks was significantly ($P<0.05$) higher body weight gain and improved feed conversion ratio compared to those feed conventional diets.

Osman (2002) found that supplementation of broilers diets with black cumin seed oil significantly enhanced body weight gain (BWG) and feed conversion ratio (FCR), and decreased feed consumption. Similar effects of black cumin seed oil have been observed by Abbas and Ahmad (2010).

Different methods of inserting black seed oil into poultry diets were studied in order to find out the best way of using this natural feed additive to maximize the benefit of using it, However, Ayoola et al., (2020) conducted an experiment to investigate the impact using black seed oil in water in varying levels (1.5 ml/L, 3.0 ml/L and 4.5 ml/L of water) on growth performance and carcass traits of broiler chicken. They reported that a dosage of 4.5ml/L of black seed oil could be used for a significant reduction in bacterial load in chickens and improving growth promoters.

Jamroz and Kamel (2002) reported a stimulating effect of black cumin seeds on digestive tract, resulting in better absorption and performance of broilers. Addition of *Nigella sativa* in feed increased bile flow rate which caused an increased emulsification that activates the pancreatic lipases that aid in digestion and absorption of fat and fat-soluble vitamins (Crossland, 1980).

AL-Beitawi and El-Ghousein (2008) studied the effects of crushed and uncrushed *Nigella sativa* seeds on growth parameters, blood characteristics and carcass quality of broilers. They used different levels of seeds 1.5%, 2.0%, 2.5% and 3.0% respectively. They reported that chicks fed 1.5% showed a significant effect on growth parameters, meanwhile 3.0% crushed and uncrushed *Nigella sativa* seed mainly reduced plasma cholesterol and triglycerides concentration and increased plasma HDL level. Groups fed 2.0% crushed *Nigella sativa* and control had a higher total plasma protein, while 2.0% uncrushed *Nigella sativa* and control rations had a higher plasma albumin and globulin concentration. These authors also reported that neither crushed nor uncrushed seed had any significant effects on broiler carcass characteristics.

Black cumin seed supplementation to broiler diets at the rate of 10 g kg-1 and 1 g kg-1 have a beneficial effects on body weight, feed conversion ratio and carcass weight in result of increasing feed intake Erener*et al.*(2010). Meanwhile there was no significant effect on dressing percentage, edible inner organs, abdominal fat, full gut weight and the total coliform bacteria counts of broilers.

Body weight, weight gain and feed conversion ratio were enhanced by the addition of 1% of *nigella sativa* seed to the diet AL-Hothaify and Al-Sanabani (2016). These results indicate that higher body weight and weight gain compared to the control diet and 0.25% *nigella sativa* seed and better feed conversion ratio than other treatments. The dietary treatment 1% *nigella sativa* seed recorded the higher ($P<0.05$) carcass dressing, breast and thigh percentage compared with the control. However, there were no significant differences in giblets and abdominal fat among all dietary groups. They also clear that the higher level of nigella sativa seed 2% did not have a positive effect on growth characteristics.

Hermes et al., (2009) investigated the effect of different forms and levels of black cumin (*nigella sativa L.*). The research contained 7 treatments, T1 control which was without any addition, T2 and T3 contained Nigella sativa oil at 2 levels of 0.5 and 1.0%, respectively. T4 and T5 *Nigella sativa* seed was added at 2 levels of 1.0 and 2.0%, respectively, while T6 and T7 contained Nigella sativa meal (NSM) at 2 levels of 10 and 20%, respectively. According to their results control group the only group which was affected by the heat stress, as a result there was a poor growth performance , high mortality rate, low carcass characteristics, low nutrients digestibility and low relative efficiency but high relative economic efficiency compared with those fed treated groups (T2-T7). They concluded that using 10% *nigella sativa* meal or 1% *nigella sativa* oil had a positive effect on growth performance. Also Hafez et al., (2011) conducted an experiment under high temperature conditions and tested different forms and levels of *nigella sativa* seed. They reported that we can insert *nigella sativa* oil (0.5%), *nigella sativa* seed (1%) and *nigella sativa* meal (10%) with these concentrations we can avoid adverse effects of high temperature or any stressful conditions. Beside that we can improve physiological performance, body reaction, blood biochemistry and chick livability.

Hermes et al ., (2011) reveled that low levels of NSO (0.5%), NSS (1%) or NSM (10%) can be used in broiler feed to improve the physiological performance, blood biochemical, and livability of chicks to overcome the deleterious effects of high temperature or any stressful condition

On the other hand, Sohail (2012) noticed that 2.5 or 5.0% BSC in the diets of broilers has no deleterious effects with respect to performance, immunity, serum biochemical constituents or haematological indices. Also AlHomidan *et al*. (2002) found that no negative effect when 20 and 100 g/kg *Nigella sativa* seed are used on the diet of broiler chickens.

Abdelmajeed (1999) found that broiler fed 0.5, 0.25, 0.75 Nigella sativa were not affected with respect to live weight total feed intake, body weight gain, feed conversion ratio and dressing percentage. The author observed a significant increase in thigh weight and relative thigh weight at 0.5% level and observed a decrease in bone proportion of select cuts at 0.25% level of *Nigella sativa* seeds.

Hassan (2018) conducted a trial to study the influence of *Nigella sativa* seeds as a natural feed additive, at different levels on growth performance, carcass characteristics and economic efficiency of broiler chicks. They used in this experiment the control diet without any additions and the rest of treatments were supplied with 0.5, 1.0 and 1.5% *Nigella sativa*, respectively. Results showed that the addition of NS at 0.5, 1, and 1.5% levels induced higher final body weight and body weight gain compared to the control group. Carcass weight percentage increased ($P<0.05$) due to feeding *Nigella sativa* at different levels was between 74.7 to 76.5% compared to the control group (66.4%). In addition, Bursa of Fabricius and heart weight percentages were higher than those of the control group at 1 and 1.5% *Nigella sativa* levels.

Jahan and Khairunnesa (2015) inserted black cumin seed meal (BCSM) in broilers diet at 0, 0.5, 1, 1.5% respectively in order to study the effects of BCSM as growth promoter and effects on carcass characteristics and profitability. They reported that there was no significant effect compared to control diet on live weight but there was a significant difference in FCR in early days of the broiler age. There was also no effect on carcass characteristics. A significant difference was noticed on profitability, thus they concluded that 1.5% BCSM can be inserted in broiler diets. On the other hand, Majeed et al., (2010) conduct an experiment to investigate the effect of inclusion of black cumin seed in levels of 0.25, 0.50 and 0.75%. The researcher's dealer that body weight gain during the 1st, 4th and 7th week of the experiment was significantly decreased by each level of dietary black cumin.

Meanwhile, Shewita and Taha (2011) showed that inclusion of *N. Sativa* in the diets of broiler chickens improved body weight and FCR at a lower dose while a higher inclusion rate showed no significant differences in comparison with the control group

Demirci *et al.,* (2019) reported that addition of 0.5-1% black cumin seed oil in the broiler diets improved the performance of broiler chicks and positively affected the fatty acid composition of broiler meat and pointed that BCS oil content ranges from 30-45%. Also Hassan and Mandour (2018) studied the effect of broiler ration supplemented with different levels (0.5, 1 and 1.5%) of whole black cumin seeds on growth performance, carcass characteristics and economics efficiency of broiler chicks. These authors observed a significant improvement in carcass yield of broilers receiving all levels of BCS. They also concluded that addition BCS up to 1% resulted in better growth, improved carcass characteristics and reduced cost production of broilers.

The rapid rise in the prices of traditional plant proteins for poultry diets created a situation that required more research on the search for alternative sources of protein, even as the situation was complicated after the use of grains and oilseeds to produce biofuels (Attia et al., 2008). El-Deek et al., (2009) they conduct a study to evaluate the possibility of using Nigella seed oil meal (NSOM) as a source of protein in broiler diet. They replaced soybean meal (SBM) with NSOM at 0, 10, 20, 30, 40 and 50%. Birds were fed 2 treatment diets based on SBM and NSOM as main sources of protein in the diet. Due to their results replacing SBM protein by NSOM protein up to 50% did not affect growth, feed intake and feed conversion ratio (FCR). Also dressing percentage, abdominal fat, liver, heart, gizzard and pancreas, intestinal length, WBC's, spleen and Bursa were not affected by NSOM protein. They concluded that replacing up to 50 of SBM protein with NSOM protein had no adverse effects on productive performance, meat quality and immune response.

Zeweil (1996) reported that NSOM It can be successfully included as a protein substitute in Japanese quail growth diets by up to 13.5%. Attia et al., (2008) showed that Japanese quail chicks and hens can be fed a diet containing 10% NSOM. However, this level can be increased to 20% when supplemented with the enzyme. They pointed in their research that higher levels of Nigella seed meal resulted in lower growth and feed utilization.

Khadr and Abdel-Fattah (2006) conducted a trial to study the effect of adding black seed (*Nigella sativa*) as a supplement on two levels in broiler diets. The responses tested in this study were growth change, weight gain, food conversion, antibody production, carcass quality, liver and kidney function, lipid stability, economic evaluation and histopathological examination of the liver, proventriculus and intestine. Total 30-day-old broiler chicks were divided into three experimental groups. Birds were fed on basal diet and the rest diets supplemented with 0.0%, 1% and 2% Nigella sativa powder during the experiment period (13-45 days). The results showed that the diet fortified with black seed at a level of 2% resulted in improved performance of broiler chickens, higher antibody titers, improved feed conversion, increased oxidative stability of meat, and modulation of serum cholesterol level that could be reflected in meat and be beneficial for human diets, economically did not adversely affect the overall costs of the diet.

Recent concern about chemical drug resistance has elevated the status of plant feed additives including *Nigella sativa* in the preventive strategy in the poultry industry. Talebi et al.,(2021) a trial was designed to investigate the effectiveness of different levels (0 to 16%) of supplemented N. sativa seeds in broiler diets on performance, immune responses, and hematological and biochemical parameters. The results indicated the following: Supplementation of 1% of N. sativa seeds in the diet had the highest positive effects and 16% of N. sativa seeds had the highest significant effect (P = 0.03) on weight gain, while up to 2% of N. sativa seeds in the diet to reduce feed Conversion Ratio (FCR) while 4% and more FCR increased. Chickens fed with a diet containing 1% *N. sativa* seeds had the highest antibody titers, but those fed with 16% *N. sativa* seeds had the lowest antibody titers at end of the experiment. Dietary inclusion of *N. sativa* seeds increased hemogram parameters and the group fed with 16% *N. sativa* seeds had the highest values on day 21 until the end of the experiment. Chickens fed a diet containing 1% N. sativa seeds had the highest antibody titers, but chickens fed 16% N. sativa seeds had the lowest antibody titers at the end of the experiment.

They concluded that supplementation of N. sativa seed (1-2%) in broiler rations, as a multipurpose natural growth stimulator, improves performance, raises humoral immune responses, affects biochemical profiles in broiler chicken serum, and induces hemogram and hemogram changes. , while there are no side effects, residual, and serious.

Chapter Three

Materials and Methods

3.1 Black Cumin Seed Meal

Black cumin seed meal was secured from a local pressing mill located in Jenine. In this mill cumin seeds are imported from abroad in well ventilated air sacs of 50 kg and are usually stored in rooms away from moisture and light. Later on seeds are ground and then moved to a compressor (extruder) where cumin seeds oil is extracted. The byproduct (cumin seed meal CSM) in the form of pellets as shown in figure 1, then transferred into a special plastic sacs until used as a feed ingredients for local farms. Before our experiment was carried out, samples of cumin seed meal were sent to analytical laboratory (PACIFIC LAB) in Singapore for chemical analysis. Table (1) shows chemical composition of some of the important constituents of the cumin seed meal that was used formulating the experimental rations.

Figure 1

the pelleted form of black cumin seed meal (BCSM) used in the experiment, then it was mashed to insert into the whole diet.

Table 1

Chemical composition of black cumin seed meal (BCSM)

Composition	(%) as dry matter basis
Humidity	7.40
Crude protein	30.70
Crude fiber	4.40
Fat extract	17.80
Ash	5.50
Lysine	1.066
Methionine	0.602
Threonine	1.041

3.2 Birds Management

The experiment was conducted at a privet farm located in the town of Qalqiliya between 22/6/2021 to 2/8/2021. This period of the year is usually the hottest, especially this year when cyclic wave of high temperature was predominate.

A total of 336 day-old straight – run Ross broiler chicks were purchased from a local hatchery (Palestine Poultry Company, Tulkarm, Palestine). An open –sided broiler house was divided into 48 equal sized floor pens following proper cleaning, disinfection and drying procedure. Pens were separated with 50 cm wood boarders according to treatments and replication. Twenty four chicks were randomly allocated to each of 12 dietary treatments (Appendix A,B and C). The stocking density (8 birds/m^2) allowed for well-being of chicks during harsh summer condition prevailing in the area. Birds in each replicate had one tray feeder and a bottle drinker for the first 5 days of the experiment. Then birds were provided with a cylindrical feeder and a bell- shaped automatic plastic drinker for each replicate. Drinkers were cleaned daily. Feeders and feed for birds in each replicate were weight at the beginning and end of every week. Feed and water were available for chicks around the hour. The chicks were raised on wood shavings 10 cm deep. Moisture in the litter was managed daily and wet spots were removed out with new shavings added whenever necessary. On the first day of arrival to

the farm, chicks were given antibiotic (Enrosel) due to probability of infection with omphalitis for the following 4 days. Chicks were vaccinated against Newcastle disease, Infectious Bronchitis and Gumboro as recommended by local Veterinary Department.

House temperature was 32℃ for the first seven days and was lowered by 2.5℃ weekly therafter. Ambient temperature went far above the recommended temperature several times during the experimental period (41 day) due to the unexpected heat waves. Chicks were exposed to conventional light regimen; birds exposed to 24 hours of light for the first 4days and 23 hours of light and 1 hour of darkness thereafter. At the same day and time of the day of every week, feed consumption was determined and birds were weighted individually. Mortality was monitored daily, however, a few chicks were died during the experimental period.

At the end of the experimental period, 4 chicks were selected at random to be sacrificed to determine meat yield and cut-parts characteristics.

3.3 Experimental Diets and Management

Experimental diets were formulated in accordance with recommended (NRC, 1994) nutrient requirement of broilers. Two types of rations (starter and finisher diets) were formulated. Black cumin seed meal (BCSM) replaced some of the ingredients listed in control diet at levels 1.5, 2.5 and 3.5% for the starter and for the finisher ration. Both rations were in mash form as shown in appendix D. Chicks received the starter ration from day 1 to day 19 and the finisher ration from day 20 to day 41. Feed ingredient were secured from Palestine Poultry Company. All diets were mixed in farm using conventional cement mixer as shown in appendix E. Grains, meals, oil and premixes were weighed prior to mixing using an electronic scale. Tables (2 and 3) show the composition and calculated analysis of the experimental starter and finisher diets.

Table 2

Composition and calculated analysis of the experimental starter diets.

	Experimental starter diets			
Ingredients%	T1	T2	T3	T4
Corn	31.5	31.1	30.95	30.78
Wheat	25	25	25	25
Soybean meal	30	29	28.3	27.6
Sunflower seed meal	5	5	5	5
Cumin seed meal	-	1.5	2.5	3.5
Oil	4.1	4.0	3.9	3.8
DCP	1.65	1.65	1.65	1.65
Limestone	1.35	1.35	1.35	1.35
Premix	0.4	0.4	0.4	0.4
Salt	0.25	0.25	0.25	0.25
Methionine	0.25	0.24	0.23	0.22
Lysine	0.45	0.43	0.41	0.39
Threonine	0.1	0.08	0.07	0.06
Chemical analysis (%)	Percent in air dry basis			
Crude Protein	21.32	21.23	21.07	21.15
Moisture	9.91	9.87	9.87	9.84
Fat	6.30	6.49	6.42	6.50
Ash	4.09	4.12	4.12	4.18
Crude Fiber	3.80	3.79	3.77	3.78
Ca	0.92	0.92	0.91	0.92
P	0.71	0.70	0.69	0.69
DM	90.09	90.13	90.13	90.16
Lysine	0.93	0.92	0.90	0.90
Methionine	0.38	0.38	0.38	0.38
Threonine	0.62	0.62	0.62	0.62

T1 indicates the control treatment, T2, T3 and T4 indicates diets containing 1.5, 2.5, and 3.5 % black cumin seed meal (BCSM) respectively.Premix contents per 4.0 kg : Vitamin (A) 13 MIU. vitamin (D3) 5 MIU. vitamin (E) 80 KIU. vitamin (K3) 3.0 g. Pantothenic acid 15 g. niacin 60.00g. riboflavin 9 g . pyridoxine 4 g . thiamine 3 g. vitamin (B12)0.020 G. folic acid 2 gr biotin 0.25 gr . manganese 100 gr. zinc 100 gr iron 40g.copper 15 g. iodine 1 g. cobalt 0.2g. Selenium 0.35 g. wheat enzyme 100 g phytase 750 kfyt. Lasalocid 100 g. BMD 55 g.

Table 3

Composition and calculated analysis of the experimental finisher diets.

	Experimental starter diets			
Ingredients%	T1	T2	T3	T4
Corn	35.05	34.65	34.45	34.15
Wheat	25	25	25	25
Soybean meal	24.9	23.9	23.2	22.6
Sunflower seed meal	6	6	6	6
Cumin seed meal	-	1.5	2.5	3.5
Oil	5.2	5.1	5.0	4.9
DCP	1.45	1.45	1.45	1.45
Limestone	1.15	1.15	1.15	1.15
Premix	0.4	0.4	0.4	0.4
Salt	0.25	0.25	0.25	0.25
Methionine	0.19	0.18	0.17	0.16
Lysine	0.4	0.38	0.37	0.36
Threonine	0.06	0.05	0.04	0.035
Chemical analysis (%)	Percent in air dry basis			
Crude Protein	19.69	19.33	19.59	19.59
Moisture	9.81	9.63	9.75	9.72
Fat	7.47	7.47	7.64	7.69
Ash	3.84	3.81	3.90	3.92
Crude Fiber	3.68	3.61	3.66	3.66
Ca	0.81	0.79	0.80	0.80
P	0.66	0.64	0.65	0.64
DM	90.19	90.37	90.25	90.28
Lysine	0.82	0.79	0.80	0.79
Methionine	0.37	0.37	0.38	0.38
Threonine	0.56	0.55	0.56	0.56

T1 indicates the control treatment, T2, T3 and T4 indicates diets containing 1.5, 2.5, and 3.5% black cumin seed meal (BCSM) respectively.Premix contents per 4.0 kg : Vitamin (A) 13 MIU. vitamin (D3) 5 MIU. vitamin (E) 80 KIU. vitamin (K3) 3.0 g. Pantothenic acid 15 g. niacin 60.00g. riboflavin 9 g . pyridoxine 4 g . thiamine 3 g. vitamin (B12)0.020 G. folic acid 2 gr biotin 0.25 gr . manganese 100 gr. zinc 100 gr iron 40g.copper 15 g. iodine 1 g. cobalt 0.2g. Selenium 0.35 g. wheat enzyme 100 g phytase 750 kfyt. Lasalocid 100 g. BMD 55 g.

3.4 Performance Parameters

3.4.1 Body Weight and Gain

Body weight was determined for all birds at the beginning of the experiment. Then birds in every dietary treatment were weighted at the last day of every week in the same time of the day.

Body weight gain was calculated by subtracting the live weight at the beginning of the week from the live body weight at the end of the week.

3.4.2 Feed Consumption

Feed consumption for birds in every dietary treatment was calculated at weekly basis. At the end of the week, the feed remained in feeder was weight and then subtracted from the amount of the feed introduced at the beginning of week. Average feed consumed per bird was calculated by dividing of amount consumed by the number of chicks of every dietary treatment.

3.4.3 Feed Conversion Ratio

Feed conversion ratio (FCR) was calculated weekly as the amount of feed consumption per average of body weight gain (average weekly feed consumption (g)/ average weekly gain (g)).

3.5 Carcass Cuts Preparation and Sampling

At the end of the experiment period, 4 chicks from each replicate. Were selected at random.Selected birds were scarified to determine meat yield and cut – parts characteristics. Selected birds were slaughtered and processed in a small scale facility. Following slaughtering, birds were bleed, scald (60 c for one minute), plucked, eviscerated, dressed and finally dissected following the commercial protocols in the facility. Initial body weight for each bird was recorded, and then weight was recorded prior to every step of processing. Carcass, plucked and dressed weights (Dressing % = Carcass weight/live weight * 100) were then measured. Following dissection, breasts, thighs, drumsticks, wings, abdominal fat, viscera and giblets (gizzard, liver and heart) were all weighted for every slaughtered birds.

3.6 Economic Evaluation

Effects of black cumin seed meal at various inclusion levels on cost of production and profit of broiler chicks was calculated. Variable costs and sales were calculated in NIS.

3.7 Statistical Analysis

Recorded data were analyzed by one way ANOVA (SPSS, statistics 25) using complete randomize design to determine the effect of black cumin seed meal supplementation on performance, meat yield and cut- parts parameters. Duncan's Multiple Range test was used to compare mean values for all parameters.

Chapter Four

Results

4.1 Composition of black cumin seed meal and the experimental diets

In the present study, the composition of the locally produced black cumin seed meal (BCSM) is shown in table 1. Values for crude protein content (30.7%), fat (17.80%), amino acids content and other nutrients were considered accordingly when the experimental diets were formulated.

The composition of the experimental diets is shown in tables 2 and 3. Calculated analysis of crude protein, major amino acids and other nutrients values of the starter and finisher diets for each experimental diet (dietary treatments) were within the recommended range (NRC,1994).

4.2 Broiler Performance

The effects of dietary treatments on body weight, feed consumption and feed conversion ratio (FCR) from day 1 to day 41 of the experiment are presented in table 4and figure 1 in addition to European production efficiency factor (EPEF) which evaluate the growing performance of broiler as suggested by (Van,2003), Marcu*et al* (2013b) and (Aviagen,2015). Higher values of these indicators indicate that the bird's body weight gain is uniform and the flock is in good health (Bhamare*et al.*, 2016). The experimental diets had no effect on body weight, feed intake and FCR of broiler chicks to 41 days of age. Values of FCR for birds fed BCSM were numerically better compared to that for the birds in control treatment (T1).

Table 4

The effect of different dietary levels of black cumin seed meal on the live body weight, feed consumption and conversion ratio of broilers.

	Dietary black cumin seed meal (%)				
	T1	T2	T3	T4	P- value
LBW (kg)	1.66 ± 0.02	1.63 ± 0.04	1.86 ± 0.06	1.58 ± 0.05	0.489
FC (kg)	3.39 ± 0.25	3.29 ± 0.12	3.46 ± 0.11	3.16 ± 0.49	0.518
FCR	2.04 ± 0.05	1.92 ± 0.20	1.89 ± 0.21	1.99 ± 0.11	0.879
$EPEF^{*}$	189.4	212	277	188.9	

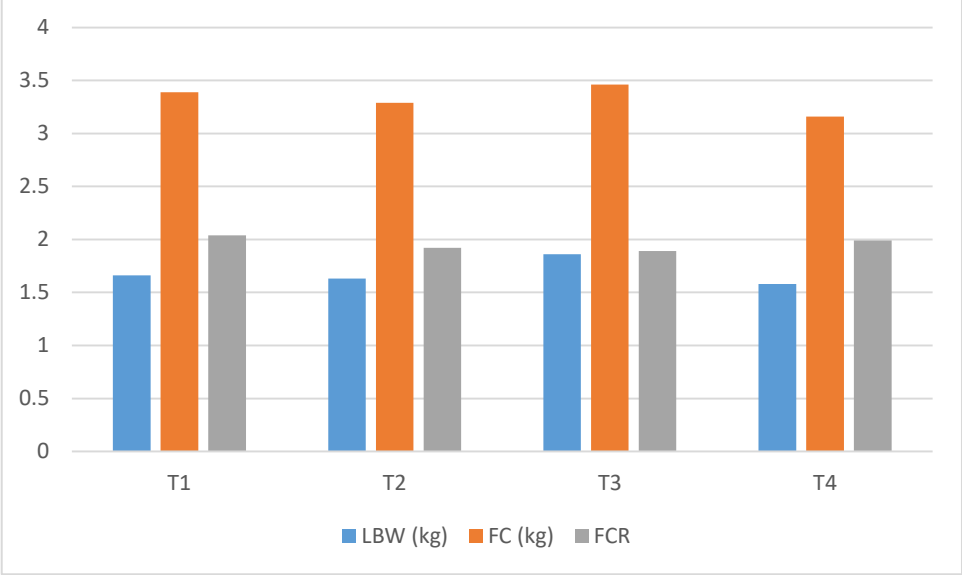
T1 indicates the control treatment, T2, T3 and T4 indicates diets containing 1.5, 2.5, and 3.5 % black cumin seed meal (BCSM) respectively. a,b and ,c Means with in a row with different superscripts are significantly different, SEM = Standard error of mean. LBW= Live body weight, FC = feed consumption, FCR= feed conversion ratio.

*EEF:Europeanefficiency factor

$=(average\ gram\ gained\ per\ day \times survival\ rate\%/feed\ conversion \times 10) \times 100.$

Figure 2

The effect of different dietary levels of black cumin seed meal on the live body weight, feed consumption and conversion ratio of broilers.



The comparisons for weekly body weight of the experimental birds (Table 5 and figure 2). Revealed that there was no significant difference among treatments (P> 0.05) expect for week 4 where control birds recorded higher (P<0.05) mean live body weight compared to those in other treatments (T2,T3 and T4).

Table 5

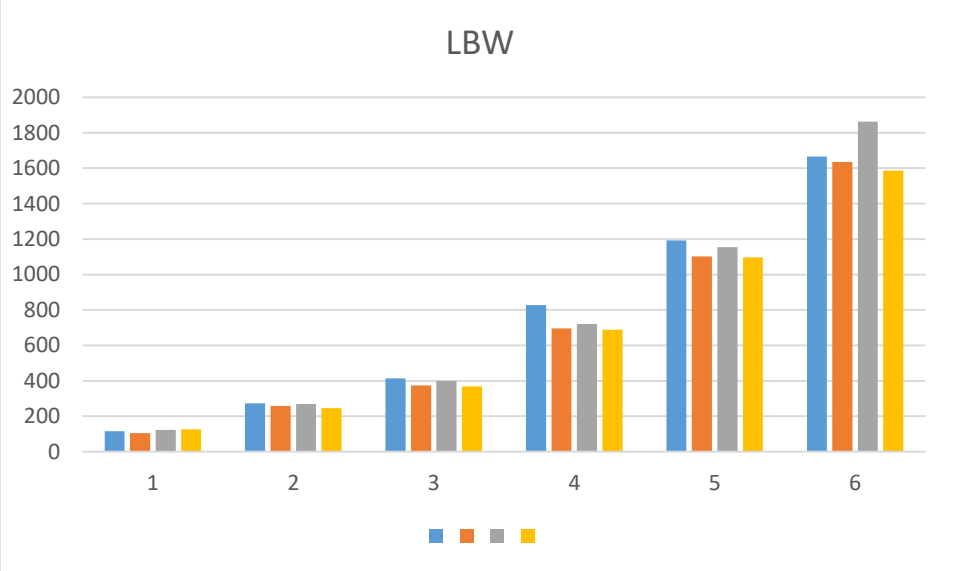
The effect of different dietary levels of black cumin seed meal on the live body weight of broilers (LBW).

	Dietary black cumin seed meal (%)				
Week	T1	T2	T3	T4	p-value
1	115.73 ± 3.40^{ab}	104.33 ± 8.31^{b}	123.60 ± 4.55^{ab}	127.10 ± 5.57^{a}	0.091
2	272.68 ± 3.75	258.30 ± 9.73	268.70 ± 12.65	245.16 ± 28.21	0.648
3	414.20 ± 9.23	373.33 ± 34.00	399.53 ± 12.76	369.20 ± 26.50	0.493
4	827.50 ± 49.51^{a}	695.36 ± 24.94^{b}	720.53 ± 17.34^{b}	688.46 ± 20.45^{b}	0.042
5	1192.53 ± 36.13	1102.36 ± 61.78	1153.73 ± 17.19	1097.20 ± 38.87	0.376
6	1666.00 ± 22.40	1635.36 ± 80.59	1863.60 ± 29.20	1586.96 ± 48.72	0.692

T1 indicates the control treatment, T2, T3 and T4 indicates diets containing 1.5, 2.5, and 3.5 % black cumin seed meal (BCSM) respectively. a,b and ,c Means with in a row with different superscripts are significantly different, SEM = Standard error of mean. LBW= Live body weight.

Figure 3

The effect of different dietary levels of black cumin seed meal on the live body weight of broilers (LBW).



The effect of the experiment diets on weekly feed consumption (FC) are presented in table 6 and figure 3. The comparisons for weekly feed consumption indicated that there was no significant difference among treatment from week 1 to week 5, whereas as feed

consumption was significantly lower (P<0.05) for birds in T4, compared to those in control group (T1), T2 and T3.

Table 6

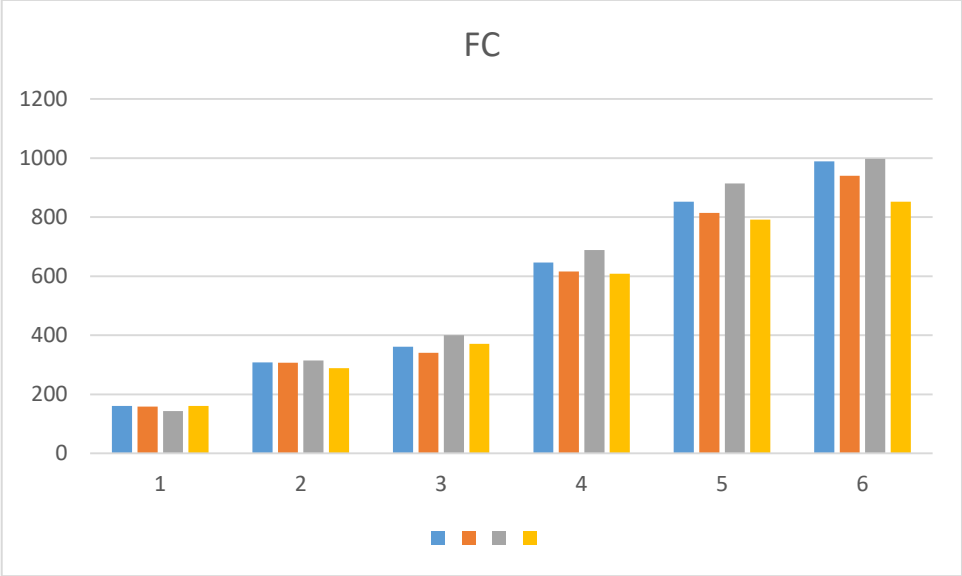
The effect of different dietary levels of black cumin seed meal on the feed consumption of broilers (g/bird/week).

	Dietary black cumin seed meal (%)				
Week	T1	T2	T3	T4	P- value
1	161.06 ± 5.21	157.83 ± 6.95	143.33 ± 4.24	160.30 ± 20.90	0.680
2	308.40 ± 24.60	307.26 ± 1.80	314.96 ± 2.70	288.10 ± 49.25	0.910
3	360.66 ± 21.30	340.16 ± 5.91	388.63 ± 6.80	370.40 ± 28.90	0.373
4	646.20 ± 38.78	616.13 ± 14.99	668.16 ± 90.54	607.80 ± 22.45	0.827
5	852.53 ± 3.73	814.46 ± 16.49	914.00 ± 32.18	791.26 ± 49.86	0.094
6	988.33 ± 25.22^{a}	939.76 ± 1.40^{ab}	997.33 ± 31.17^{a}	852.46 ± 17.35^{b}	0.006

T1 indicates the control treatment, T2, T3 and T4 indicates diets containing 1.5, 2.5, and 3.5 % black cumin seed meal (BCSM) respectively.a,b and ,c Means with in a row with different superscripts are significantly different, SEM = Standard error of mean, FC = feed consumption.

Figure 4

The effect of different dietary levels of black cumin seed meal on the feed consumption of broilers (g/bird/week).



The comparisons for weekly feed conversion ratio (FCR) (Table 7 and figure 3), revealed that there was no significant difference among treatments (P>0.05), expect for week 5 during which birds in T2 had the lowest (P<0.053) FCR compared to other treatments. In week 6, birds in T3 and T4 had numerically lower (1.84 and 1.88, respectively) FCR compared to those in control (2.29) and T1 (2.28) treatments

Table 7

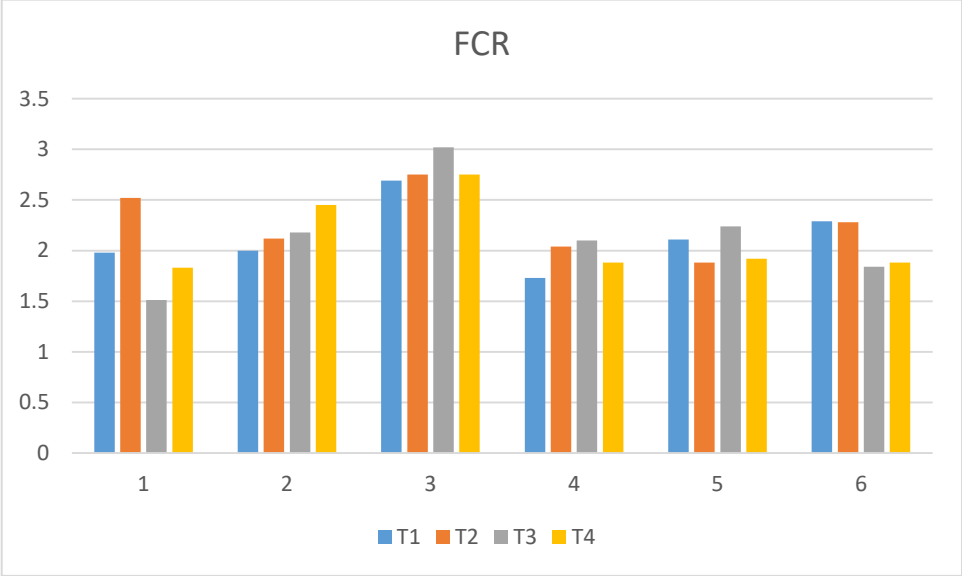
The effect of different dietary levels of black cumin seed meal on the feed conversion ratios (FCR) (g feed/ g gain) of broilers.

	Dietary black cumin seed meal (%)				
Week	T1	T2	T3	T4	P- value
1	1.98 ± 0.09^{ab}	2.52 ± 0.31^{a}	1.51 ± 0.02^{b}	1.83 ± 0.02^{ab}	0.038
2	2.00 ± 0.10	2.12 ± 0.26	2.18 ± 0.11	2.45 ± 0.24	0.473
3	2.69 ± 0.17	2.75 ± 0.46	3.02 ± 0.08	2.75 ± 0.33	0.867
4	1.73 ± 0.31	2.04 ± 0.21	2.10 ± 0.21	1.88 ± 0.07	0.649
5	2.11 ± 0.15^{ab}	1.88 ± 0.06^{b}	2.24 ± 0.02^{a}	1.92 ± 0.02^{b}	0.053
6	2.29 ± 0.04	2.28 ± 0.17	1.84 ± 0.53	1.88 ± 0.18	0.581

T1 indicates the control treatment, T2, T3 and T4 indicates diets containing 1.5, 2.5, and 3.5 % black cumin seed meal (BCSM) respectively.a,b and ,c Means with in a row with different superscripts are significantly different, SEM = Standard error of mean. FCR= feed conversion ratio.

Figure 5

The effect of different dietary levels of black cumin seed meal on the feed conversion ratios (FCR) (g feed/ g gain) of broilers.



4.3 Carcass Characteristics

Live body weight, plucked weight, cold carcass weight and dressing percentage (carcass yield %) are shown in table 8 and figure 5, except the dressing percentage there was no significant difference in the live weight, plucked weight and cold carcass weight among all dietary treatments. It can be seen that birds in T4 (3.5% BCSM) had the highest (71.73 %) dressed percentage compared to those in T1 (69.96 %), T2 (68.13%) and T3 (69.96 %).

Table 8

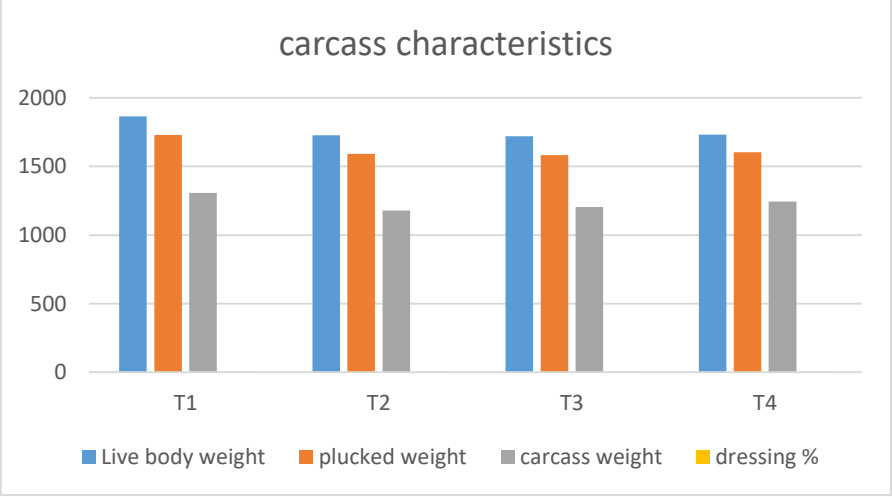
Carcass characteristics of broiler chickens fed different levels of black cumin seed meal (BCSM).

	T1	T2	T3	T4	P - value
Live bodyWeight (g)	1865.41±60.21	1727.66±60.47	1719.50±25.46	1732.33±56.42	0.235
Pluckedweight (g)	1729.66±57.67	1591.66±55.93	1583.16±23.39	1603.00±53.20	0.202
Carcassweight (g)	1306.66±44.22	1178.33±45.42	1204.00±14.75	1244.33±39.20	0.170
Dressing %	69.96 ± 0.18^{b}	68.13 ± 0.34^{a}	69.96 ± 0.60^{b}	71.73 ± 0.08^{c}	0.001

T1 indicates the control treatment, T2, T3 and T4 indicates diets containing 1.5, 2.5, and 3.5 % black cumin seed meal (BCSM) respectively. a,b and ,c Means with in a row with different superscripts are significantly different, SEM = Standard error of mean.

Figure 6

Carcass characteristics of broiler chickens fed different levels of black cumin seed meal (BCSM).



Effect of different levels of dietary black cumin seed meal on cut parts, giblets and offals of broilers are shown in table 9 and figures 6,7 and 8 . In this study there were no significant effect of dietary treatments on broilers cut part, giblets andoffals weight at 41 day of age.

Table 9

The effect of black cumin seed meal (BCSM) on broiler carcass cut parts, giblets and offals.

	T1	T2	T3	T4	P- value
WholeBreast weight (g)	327.50±16.80	292.00±13.48	298.50±4.33	312.58±14.29	0.299
Breastweight (g)	253.33±17.97	229.16±11.27	232.00±3.50	245.75±12.33	0.504
Wing weight (g)	69.16±2.66	62.83±2.24	66.50±1.00	66.83±1.96	0.262
Wholelegweigh t (g)	190.33±7.77	170.33±7.03	177.00±1.80	179.16±6.89	0.242
Drumstickweig ht (g)	88.08±1.17	81.66±2.12	83.33±1.45	86.66±2.42	0.135
Thighweight (g)	102.25±8.84	88.75±5.14	93.66±1.87	92.83±4.41	0.438
Back and neck weight (g)	285.00±8.12	271.00±15.46	281.66±3.08	280.50±12.50	0.820
Shank and Head (g)	110.16±4.08	106.50±3.90	105.00±4.25	109.83±1.96	0.708
Gibletsweight (g)	110.83±4.33	106.33±2.84	104.33±5.48	106.83±5.98	0.811
Viceraweight (g)	289.25±31.45	295.50±10.72	262.83±9.40	241.83±14.21	0.232
Blood Weight (g)	47.41±9.69	52.00±2.64	61.91±4.36	52.16±10.14	0.595
Fat pad weight (g)	24.33±0.88	23.75±0.38	23.33±0.44	25.00±0.76	0.359

T1 indicates the control treatment, T2, T3 and T4 indicates diets containing 1.5, 2.5, and 3.5 % black cumin seed meal (BCSM) respectively. a,b and ,c Means with in a row with different superscripts are signifycantly different, SEM = Standard error of mean.

Figure 7

The effect of black cumin seed meal (BCSM) on broiler carcass cut parts.

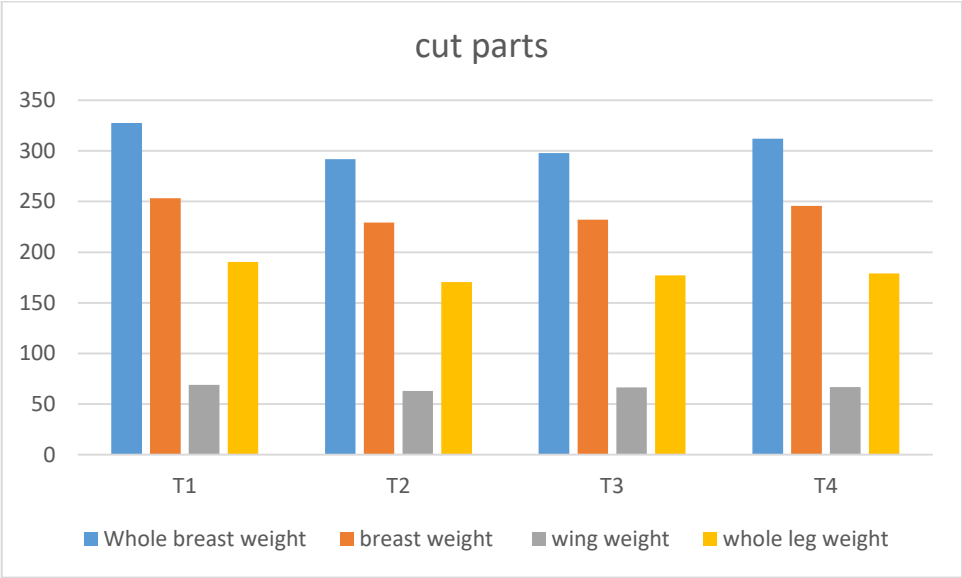


Figure 8

The effect of black cumin seed meal (BCSM) on broiler carcass cut parts.

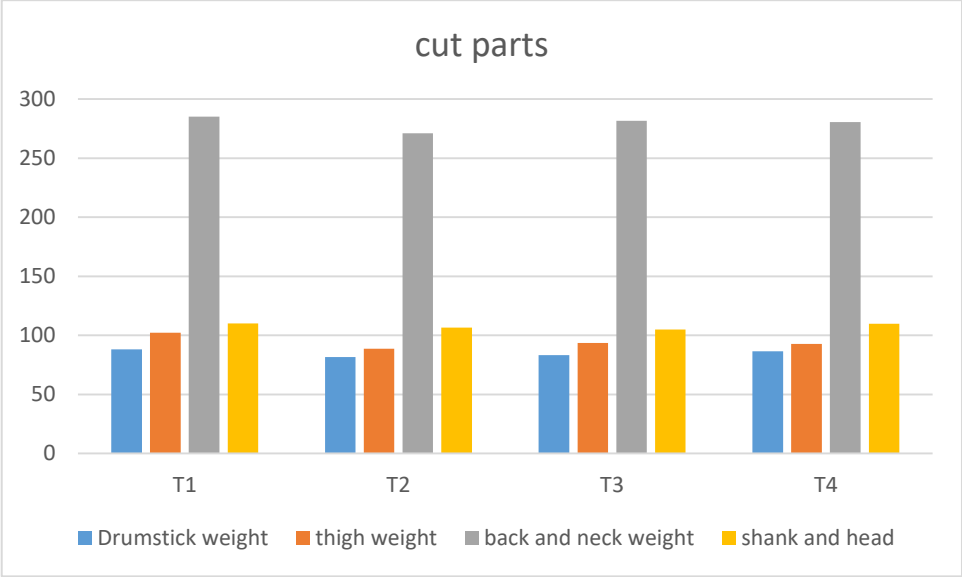
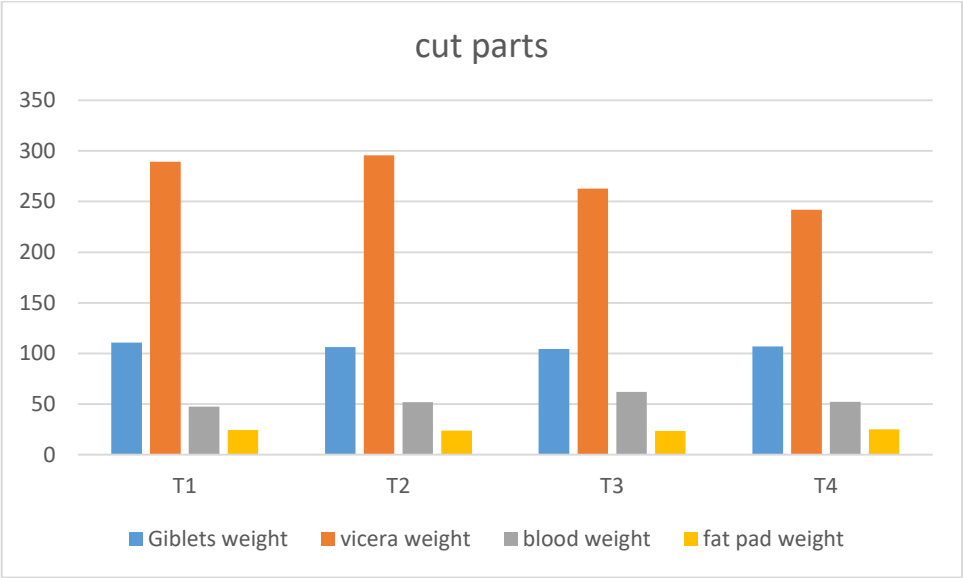


Figure 9

The effect of black cumin seed meal (BCSM) on broiler carcass cut parts, giblets and offals.



4.4 Feasibility Study

At the end of the experiment the birds was sold on the market price, the price was relatively low due to the summer season. The profit was very low due to high price of day-one chicks and very low price of sale. The numbers are shown in table 10 and figure 9. The price of chicks was 3.5 NIS for each and the price of sale was 5.5 NIS for 1 kg. Other expenses was 100 NIS for electricity, 100 NIS for water and 200 NIS for wood shivers. From the table we can see numerical difference in feed intake which is lower in treatment with BCSM and also lower in feed cost.

Table 10

Effects of black cumin seed meal at inclusion levels of 0, 1.5, 2.5 and 3.5% on cost of production and profit of broiler chicks.

Treatment	Total feed intake (Kg)	Total feed cost (NIS)	Total meat production live weight (Kg)	Price of sale (NIS)
T1	247.97	481.00	131.22	721.71
T2	218.58	419.60	126.71	696.90
T3	235.14	449.10	138.30	760.65
T4	234.65	443.40	129.62	712.91

T1 indicates the control treatment, T2, T3 and T4 indicates diets containing 1.5, 2.5, and 3.5 % black cumin seed meal (BCSM) respectively.

Figure 10

Effects of black cumin seed meal at inclusion levels of 0, 1.5, 2.5 and 3.5% on cost of production and profit of broiler chicks.

Chapter Five

Discussion

5.1 Composition of BCSM and experimental diets

There is a significant body of research relating to the use of black cumin seed oil in poultry rations, however, a few studies have been conducted on the effect of black cumin seed meal (BCSM) on broiler performance. In the present study, black cumin seed meal (BCSM) was used in broiler rations. BCSM was analyzed prior to formulation of broiler starter and finisher rations. Results of BCSM analysis were 30.70, 17.80, 5.50, 1.066, 1.041 and 0.602% crude protein, fat, ash, lysine, threonine and methionine respectively.

Unfortunately, few studies have been conducted to observe the effects of BCSM on performance of broiler chickens. None of these studies stated the composition of BCSM when incorporated in poultry rations. However, AL-Jassir (1992) reported that black cumin seeds grown in Saudi Arabia, contain 20.38% protein, 38.20% fat 4.64% moisture, 4.37% ash, 7.94%crude fiber and 31.94% total carbohydrates. Given that some of the oil in the black cumin seeds used in the present study, was extracted, findings of the analysis (Table 1) is consistent with those reported (AL-jassir,1994 and Demirei*et al*.,2019).

5.2 Broiler Performance

The current study was conducted to study the effect of incorporating BCSM at 1.5%, 2.5% and 3.5% in broilers diets. Previous study showed that using whole black cumin seeds, or black cumin seed oil (Guler*et al*., 2006 and Demirei*et al.,* 2019) may have positive effect on performance of broiler performance parameters.

5.2.1 Live Body Weight

The final live body weight (LBW) was not affected by the various levels of BCSM (Table 4). Birds in T3 (2.5%) had numerically higher (1863g) live body weight compared to those in T1 (1666g), T2 (1635g) and T4 (1586). These findings were in agreement with those reported by AL-Homidan*et al., (*2002) who observed improvement in live body weight of broilers receiving diets that contain 20 and 100g

BCS per kg ration. In contrary, Gular *et al.*, (2006) reported no significant effects of supplemental black cumin seeds in broiler growth. Recent research (Hassan and Mandour, 2018) recommended supplemental black cumin seeds at 1% is appropriate to improve growth of broilers. In the current study, using up to 3.5% black cumin seed meal (BCSM) did not have any negative effects on growth of broiler chickens. Other studies showed that addition of black cumin seeds into the diet significantly decreased BW of the chickens (Akhtar et al., 2003, Majeed et al., 2010). Other studies (AL-Beitawi and EL-Ghousein,2008; Abu-Deiyeh and Abu-Darwish,2008) found that live body weight of broilers was better attained when a level of 1.5% black cumin seeds is used in broiler rations. These authors attributed the improvement in broiler performance to the antioxidant properties of the black cumin seed.

5.2.2 Feed consumption

Significant difference were not seen in feed consumption among treatments at 1-41 days of the current experiment. These results are consistent with the results of Lee *et al*., (2003). In agreement with our results, Mehmet *et al.,* (2008) reported that7.5 ml/kg of black cumin seed reduced feed consumption of broiler. In current experiment feed intake of birds ($P<0.06$) in T4 (3.5% BCSM) decreased in week 4 through week 6 compared to that of birds in other treatments. Authors reported that diets containing 4% black cumin were found to consume less feed compared to the control diet and the FCR was better (Durrani et al., 2007).

On the other hand, the results of the current study were in disagreement with those of Erener *et al.,* (2010) who reported that feed consumption increased as BCS amount increased in the broiler diets. Researchers (Guler *et al*., (2006); AL-Beitawi and EL-Ghousein, 2008) attributed the decreasing effect of BCS on feed consumption of broilers to the repellent odor presents in the BCS. Moreover, these authors state the BCS contain other anti-nutritional factors that may result in lower broiler performance.

5.2.3 Feed Conversion Ratio

In the current study, there was a numerical difference in feed conversion ratio (FRC) among experimental diets. Feed conversion ratios were 1.8, 1.88, 2.28 and 2.29 for birds in T3, T4, T2 and T1 respectively. These results were in agreement with those of Abdelmajeed (1999) who reported that 0.25, 0.5 and 0.75% BCS had no significant

effects in broiler performance. However, the rate of FCR was increased in some studies that added black cumin (Osman & El-Barody, 1999; Al-homidan et al., 2002; Abbas & Ahmed, 2010).

5.3 Carcass Characteristics

In the present study, there were no significant differences in live body weight, plucked weight and carcass weight (Table 8) of birds among all treatments. However, T2 (1.5) had significantly ($P<0.05$) better dressing percentage (68.13%) compared to that of birds in treatment T(control), T3(2.5) and T4 (3.5). These results are in agreement with those reported by Jahan *et al* (2015). These authors observed no significant differences in live weight and carcass yield of birds receiving diets containing 0.5, 1 or 1.5% BCSM. Effects of BCSM in carcass yield in T2(1.5%) were consistent with the results reported by Hassan and Mandour (2018) who observed significant improvement in carcass yield of broilers receiving all levels (0.5, 1 and 1.5%) of black cumin seeds. However, these authors recommended that addition of cumin seed up to 1% resulted in better growth and carcass yield. On the other hand, Jahan *et al*. (2015) concluded that 1.5%BCSM seems to be an optimal level of incorporation of the meal in broiler ration. Our results indicates no additional improvements in carcass yield would be attained by BCSM beyond 1.5% in broiler ration. Erener et al., (2010) and Toghyani (2010) recorded non-significant effect ($P>0.05$) for dressing weight or edible organ weight percentages.

In the current study, results of cut of parts characteristics (Table 9) revealed no significant effects of BCSM among all experimental treatments. In consistent with our results, Guler et al., (2006) and Durrani (2007) observed that inclusion of BCSM in broiler ration did not have any impact on cut of parts characteristics. On the other hand, our results were in disagreement with those reported by Jahan *et al* (2018) who observed significant positive effects of BCSM at 1.5% on breast meat, drumstick, skin and decreasing effect on abdominal fat pad.

5.4 Mortality

In the present study, mortality was recorded for experimental birds from day 1 to day 41. It is worth to noting that birds in T2 (1.5%), T3 (2.5%) and T4 (3.5%) have

numerically lower mortality percentage (97.61%) compared to birds in control treatment T1 (control). Our results are in agreement with those reported by Jahan *et al*.(2015) who observed lower mortalities among birds receiving rations contains increasing levels of BCSM. Earlier studies (Toghyani *et al.* (2010) explained the lower mortalities among birds receiving black cumin seeds to the active components of these seeds while have antioxidant, antibacterial and anti-inflammatory.

5.5 Cost Evaluation

Day old chicks used in our experiment were bought for 3.5 NIS per bird. At market age, birds were sold for 5.5 NIS/ Kg live body weight. In our study, the cost of experimental ration that were supplemented with BCSM was relatively lower than the cost of the control rations. In agreement with results of Ihsan (2003), inclusion of BCSM resulted in lower feed cost. Hassan (2018) reported in his research that the decrease in feed cost lead to lower production cost of broilers. Broiler chicks fed diets supplemented with 0.5% and 1% NS were more economical than the control group. They showed a high increase in total revenue, net revenue and relative economic efficiency percentages.

Conclusions and Recommendations

In conclusion, black cumin seed meal did not have an adverse effects on broiler performance parameters at any levels (1.5, 2.5 and 3.5 %) of inclusion in broiler rations.

More attention should be given to secure the locally produced black cumin seed meal in order to make it used in poultry ration as safe and economically reasonable.

More work is required to better define the optimal levels of inclusion of black cumin seed meal in broiler rations as well as other poultry rations. In addition, more work is required to raise the awareness of feed mills as well as farmers on potential benefits of black cumin seeds as an agro- industrial by- products as an alternative feed ingredients to the conventional yet costly ingredients.

List of Abbreviations

BCS	Black cumin seed
BCSM	Black cumin seed meal
BWG	Body weight gain
Ca	Calcium
CS	Cumin seed
DCP	Di-calcium phosphate
DM	Dry matter
EPEF	European production efficiency factor
FAO	Food and Agriculture Organization
FC	Feed consumption
FCR	Feed conversion ratio
G	Gram
HDL	High density lipoprotein
LBW	Live body weight
NSOM	Nigella seed oil meal
NRC	National Research Council
P	Phosphorus
SBM	Soybean meal
T1	Treatment one (control)
T2	Treatment two (1.5% of BCSM)
T3	Treatment three (2.5% of BCSM)
T4	Treatment four (3.5% of BCSM)
WBC's	Wight blood cells
WHO	World Health Organization

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Appendices

Appendix A: birds were supplemented with tray feeders and bottles drinkers.

Appendix B: this pictures shows how pens were separated with 50 cm wood boarders according to treatments and replication.

Appendix C: Twenty four chicks were randomly allocated to each of 12 dietary treatments. As shown in this picture.

Appendix D: Both rations were in mash form as shown in this picture

Appendix E: All diets were mixed in farm using conventional cement mixer as shown in this picture.

جـامعـــة النجاح الوطنية

كليـــة الدراســـات العليـــا

دراسة في أداء وتقييم تغذية الدجاج اللاحم علمستويات مختلفة من بذور القزحة

إعداد

نادية عبد الفتاح خليل غنام

إشراف

د. معن سمارة

قدمت هذه الأطروحة استكمالاً لمتطلبات الحصول على درجة الماجستير في الإنتاج الحيواني في كلية الدراسات العليا في جامعة النجاح الوطنية في نابلس– فلسطين.

2022

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إشراف

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الملخص

أجريت هذه الدراسة لمعرفة أثر إضافة كسبة حبوب القزحة على أداء وخواص ذبيحة دجاج اللحم.

تم تكسير كسبة حبوب القزحة إلى أجزاء صغيرة إضافتها بنسبة (0 , 1.5 ,2.5 , 3.5 %) إلى عليقة دجاج اللحم لتكوين أربعة معاملات غذائية، بالإستعانة ب 336 صوص عمريوم من صنف (روس 308) وتم استخدامها حتى عمر 41 يوم. تم قياس كمية العلف المستهلك والزيادة في الوزن اسبوعيا ومن خلالها حساب كفاءة التحويل الغذاء. عند الوصول إلى عمر 41 يوم تم أخذ 12 عينة من كل معاملة بطريقة عشوائية وذلك لمعرفة ودراسة خواص اللحم. تبين من نتائج هذه الدراسة أن إضافة مسحوق كسبة القزحة إلى عليقة دجاج اللحم لايؤثر على الزيادة الوزنية أومعدل استهلاك العلف أو كفاءة التحويل الغذائية وقطع اللحم والأعضاء الداخلية. يمكننا القول أن إضافة مسحوق كسبة القزحة لم يؤثر سلبا على أداء الطيور ولذلك يمكن إضافته بنسبة 3.5% إلى عليقة الدجاج اللاحم.