بسم الله الرحمن الرحيم

Sudan University of Science and Technology

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Effect of dietary supplementation of *Coriandrum Sativum* (Kuzbara) Powder on the performance and dressing percentage of broiler chickens

اثراضافة مسحوق الكزبره فى العلف على الأداء الإنتاجي ونسبة التصافى للدجاج اللاحم

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الاستهلال

قَالَ تَعَالَىٰ:

﴿ أَلَمۡ تَرَ أَنَّ ٱللَّهَ أَنزَلَ مِنَ ٱلسَّمَآءِ مَآءٗ فَأَخۡرَجۡنَا بِهِۦ ثَمَرَٰتٖ مُّخۡتَلِفًا أَلۡوَٰنُهَاۚ وَمِنَ ٱلۡجِبَالِ جُدَدُۢ بِيضٞ وَحُمۡرٞ مُّخۡتَلِفٌ أَلۡوَٰنُهَا وَغَرَابِيبُ سُودٞ ٢٧ وَمِنَ ٱلنَّاسِ وَٱلدَّوَآبِّ وَٱلۡأَنۡعَٰمِ مُخۡتَلِفٌ أَلۡوَٰنُهُۥ كَذَٰلِكَۗ إِنَّمَا يَخۡشَى ٱللَّهَ مِنۡ عِبَادِهِ ٱلۡعُلَمَٰٓؤُاْۗ إِنَّ ٱللَّهَ عَزِيزٌ غَفُورٞ ٢٨ ﴾ فاطر(27-28)

قَالَ تَعَالَىٰ: ﴿ وَمَا مِن دَآبَّةٖ فِي ٱلۡأَرۡضِ وَلَا طَٰٓئِرٖ يَطِيرُ بِجَنَاحَيۡهِ إِلَّآ أُمَمٌ أَمۡثَالُكُمۚ مَّا فَرَّطۡنَا فِي ٱلۡكِتَٰبِ مِن شَيۡءٖۚ ثُمَّ إِلَىٰ رَبِّهِمۡ يُحۡشَرُونَ ٣٨ ﴾ الأنعام: ٣٨

صدق الله العظيم

Dedication

I dedicate this:

To my mother and father

To my Husband

To my Brothers and sisters

To my Daughters

To my friends and Colleagues

With love...

Atifa

Acknowledgement

Praise and unlimited thanks to Allah, who gave me the strength and patience to complete this work.

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Abstract

This study was carried out to evaluate the effect of adding different levels of *coriander sativum* in broiler diets on the production performance and dressing percentage. One hundred and twenty 9 day old unsexed broiler chicks (*Hubbard F15*) with average weight 135g were divided into three groups (40chicks/group). Each group was sub-divided into (4) replicates (10 chicks/replicate), in a completely randomized design. Three experimental diets were formulated twice to meet the nutrient requirements of broiler chicks for starter and finisher periods. The control diet (group A) with no *C. sativum* (0%), diets (groups, B and C) contained (0.1 and 0.5%) of *C. sativum* respectively. Complete randomized design was used. The obtained data from this study was analyzed using one way ANOVA followed by least significant difference (LSD) to test the differences between all studied levels. The results showed no significant different of different levels of *C. sativum* ($p>0.05$) on feed intake, weight gain, feed conversion ratio, production efficiency factor, protein efficiency ratio, energy efficiency ratio and dressing percentage. The conclusion from this study was that group C (0.5%) ranked for the highest value in most of the studied performance parameters.

الخُلاصة

أجريت هذه الدراسة لتقييم اثر إضافة مستويات مختلفه من الكزبره الى علائق الدجاج اللاحم على الأداء ونسبه التصافى.استخدم عدد 120 كتكوت عمر 9 يوم غير مجنس من سلاله (الهبردF15) بمتوسط وزن (135جرام) وزعت الطيور عشوائيا الى 3 مجموعات (40 طائر لكل مجموعه)، كل مجموعه قسمت الى 4 مكررات (10 طيور/مكرره) وفقا للنظام العشوائي الكامل، تم تركيب ثلاث علائق للتجربة بحيث تلبي الإحتياجات من العناصر الغذائية لكتاكيت اللحم خلال مرحلتى البادى والناهى حيث إحتوت العليقة (A) التحكم على (0%) كزبره، أما العليقتين(B وC) إحتوت على (0.1% و0.5%) كزبره على التوالى. أخضعت النتائج المتحصل عليها من هذة الدراسة لتحليل التباين في الإتجاة الواحد وأتبعت باختبار اقل فرق معنوي (LSD) لإختبار الفرق بين المجموعات.اظهرت النتائج عدم وجود تأثير معنوى للكزبره (P>0.05)على إستهلاك العلف، الوزن المكتسب ،معدل التحول الغذائى، معامل الكفاءة الإنتاجيه، معدل كفاءة البروتين، معدل كفاءة الطاقة و نسبه التصافى . خلصت الدراسه الى ان معدل اضافة (0.5%)من مسحوق الكزبره الى العليقة فى المجموعة (C) قد احتل أعلى قيم لمعظم قياسات الاداء الإنتاجي.

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CHAPTER ONE

INTRODUCTION

Uses of natural products as substitution to conventional medicine and antibiotics are increased in the last few decades hence the researches are run to find alternative agents to serve as curing materials for several digestive system diseases and feed additives or growth promoters. Aromatic plants and its extracted essential oils from these plants are the most important part of human diet; beside enhancing flavor they become more important due to their effects as antimicrobial and stimulating agent in the animal digestive system (Guler, 2005). Recently the science has started paying attention to the properties of spices (Chaudhry and Tariq, 2006).

Herbs and Aromatic plants have been used traditionally and natural therapy as pharmaceuticals, antiparasitic, anthelminic, analgesic and stimulating effects in the animal digestive system (Egayyar *et al*., 2001 and Lee *et al*., 2004), however, only in recent years aromatic plants and their extracts were introduced to the animal feeding. Some herbs or herbal extracts can beneficially affect feed intake, secretion of digestive tract juices and immune system of animals. *C. sativum* as natural feed additives in poultry nutrition may be of great benefit and value especially for broiler groweres. The beneficial effects of these herbs in animal nutrition may include the stimulation of appetite and feed intake, improvement of endogenous digestive enzyme secretion, activation of immune response and antibacterial, antiviral, antioxidant and antihelminthtic action (singh *et al*., 2002, Cabuk *et al*., 2003, Amel *et al*., 2006, . However, its influence on growth performance of broiler chicks had not been sufficiently documented specially their additive and cumulative properties.

The objective of this study is to evaluate the effect of added *C.sativum* on the performance of broiler chicks and dressing percentage.

CHAPTER TWO
LITERATURE REVIEW

2.1-Feed additives:

Feed additives are used worldwide for many different reasons such as covering needs of essential nutrients and others, increasing growth performance, feed intake and hence optimize feed utilization, enhancing product quality. Substances such as antibiotics and B-agonists might had high risks are banned in animal diets. As such, the feed industry is concerned on valuable alternatives which could be safe for consumers such as probiotics, prebiotics, enzymes and highly available minerals as well as the herbs can be alternatives to metabolic modifiers and antibiotics (Wenk, 2000).

2.1.1-Phytogenic feed additives:

Phytogenic feed additives (phytobiotics/botanicals) are products derived from plant and used in agricultural livestock animals feed to improve their performance. Also are commonly defined as plant-derived compounds added to diets to enhance the productivity of livestock animals through improvement of feed properties, promotion of the animals' production performance, and improving the quality of food gained from those animals (Windisch *et al*., 2008).

2.1.1.1 Classification:

Phytogenics are wide range of substances that have been classified by Windish *et al* (2008), according to botanical origin, processing, and composition to:

-Herbs which are non-woody flowering plants known to have medicinal properties.

- Spices which are herbs with intensive smell or taste, commonly added to human food such as coriander, garlic, anise, cinnamon, oregano, chili, pepper, rosemary and thyme.

-Essential oils which are aromatic oily liquids derived from plant materials such as flowers, leaves, fruits and roots.

- Oleoresins which are extracts derived by non-aqueous solvents from plant material.

Windisch *et al*., (2008) reported that the active content of the substances in these products are different depending on several factors including: the part of the plant used (grains, leaves, roots, bark, flowers or buds), the season of harvesting and geographical origin and the technique of treatment (cold, steam distillation, extraction or maceration with non-aqueous solvent).

2.1.1.2- Mode of action:

Phytogenics feed additives have several actions on improving performace of livestock animals such as increasing feed intake by enhancing the flavor and odor hence palatability improvement especially with the use of essential oils (Kroismayr *et al*., 2006), improvement in gut function by stimulating the effect of phytogenic substances on digestive secretions, such as digestive enzymes, bile, and mucus (Chaudhry and Tariq 2006, Egayyar 2001, Singh 2002, Cabuk 2003, , Frankic 2004 and Rajeshwari and Andallu 2011), anti-oxidative properties of some phytogenic substances which are attributed to the phenolic terpenes in the essential oils. (Aeschbach, 1994 and Jimenez-Alvarez *et al*., 2008) and antimicrobial effects of plant-derived which are mainly attributed to the essential oils of these plants, the plants contain the monoterpenes, carvacrol and thymol, have been demonstrated with high efficacy in vitro

against several pathogens found in the intestinal tract. (Baratta 1998,and Jugl-Chizzola 2005).

2.2-*Coriander sativum*:

Coriandrum sativum (*C. sativum*) belongs to the family Umbelliferae (Rajeshwari and Andallu 2011), It is a herbal plant, commonly named (*kuzbura*), indigenously distributed in Italy, but it is widely cultivated in the Netherlands, central and eastern Europe, Mediterranean countries such as Morocco, Malta, Egypt, also it found in China, India and Bangladesh. (Pathak *et al*., 2011). It tolerates wide range of different climatic conditions and is extensively cultivated in northern Sudan (Khalid *et al*., 2012*)*. It's an erect annual herb with pronounced taproot, and slender branching stems up to 20–70 cm in height. The leaves are lanceolate, green or dark green, glabrous on both surfaces and are variable in shape and lobed. The flowers are borne in small umbels, white or light pink, asymmetrical, with the petals pointing away from the centre (Mandal and Mandal, 2015), while the fruit are round in shape, fruit globular, mericarps usually united by their margins forming a cremocarp about 2-4mm in diameter, uniformly brownish-yellow or brown, glabrous, sometimes crowned by the remains of sepals and styles, primary ridges 10, wavy and slightly inconspicuous secondary ridges 8, straight, it has aromatic odour. It has spicy and characteristic taste (Handa and Kaul 1996).

2.2.1- Chemical compostion:

Naeemasa *et al.*, (2015) reported that the coriander seeds contain 88% dry matter, 153 g/kg crude protein, 336g/kg crude fiber, 200g/kg ether extract and 95g/kg Ash. Moreover, the essential oil content of *C. sativum* fruits was 0.8% (v/w). Moreover, Rajeshwari and Andallu (2011) mentioned that the composition of the volatile oils determine the odour

and flavour character and it contains both steam-volatile and fixed oil. The volatile oil is rich in beneficial phytonutrients, including: carvone, geraniol, limonene, borneol, camphor, elemol, and linalool. In the unripe fruits and the vegetative parts of the plant, aliphatic aldehydes predominate in the steam-volatile oil and are responsible for the peculiar, fetid-like aroma. On ripening, the fruits acquire a more pleasant and sweet odour and the major constituent of the volatile oil is the monoterpene alcohol, linalool. Furthermore, Omnia and Itmad, (2017) reported that about 97% of the present investigated coriander oil was monoterpenes, 87% of which were oxygenated, no sesquiterpenes were detected in the oil. The major constituents identified were linalool (64.61%) α-pinene (5.94%), (+)-2-bornanone (4.73%), α-terpinolene (6.79%), α-pinene (5.94%), and geranyl acetate (2.46%). Also Omnia and Itmad, (2017) reported that the composition of the essential oil from coriander cultivated in Sudan resembled the composition of previously investigated essential oils from coriander world-wise in term of linalool domination.

2.2.2-The medical importance of *C. sativum*:

Elkamali *et al*., (2015) reported that phenolic, flavonoid and terpenoids compounds are found to be responsible for the antioxidant activities of the extracts of all effective plants. Also, Pathak *et al*., (2011) and Rajeshwaari and Andallu, (2011) reported that different parts of the *C. sativum* plant such as leaves, flower seed, and fruit, had antioxidant activity, diuretic, ant-diabetic, sedative, anti-microbial activity, anti-convulsant activity, hypnotic activity and anthelmintic activity and anti-mutagenic. Also, Barros, (2012) reported that the different polyphenols and other phytochemicals in *C. sativum*, related to its high antioxidant activity and can be used for indigestion, rheumatism, and prevention of lipid peroxidation damage. Furthermore, Balasundram *et al*.,(2006) and

Bhat *et al*., (2014) reported in animals *C. sativum* could exhibit a wide-range of physiological properties, such as anti-allergenic, anti-atherogenic, anti-inflammatory, anti-microbial, anti-thrombotic, cardioprotective, and vasodilatory effects. There are many factors that influence the chemical composition of plant essential oils and their extracts and other factors that could affect the results of *in vivo* experiments are species and subspecies, geographical location, harvesting time and state of maturity of plants, parts of plant, extraction methods and duration of conservation of plant extracts, Brene and Roura, (2010)

2.2.3- Traditional uses:

C. sativum is used in the preparation of many household medicines to cure bed cold, seasonal fever, nausea, vomiting, stomach disorders and also used as a drug for indigestion, against worms, rheumatism and pain in the joints. Many of healing properties of *C. sativum* can be attributed to its exceptional phytonutrients and hence, it is often referred to as store house for bioactive compounds. (Rajeshwari and Andallu, 2011). Also, (Deepa and Anuradha, 2011) reported that all parts of *C. sativum* herb can be used as flavoring agent and/or as traditional remedies for the treatment of different diseases in the folk medicine systems of different civilizations. Gray and Flatt, (1999) mentioned that *C. sativum* seed extract might used in curing diabetic mellitus as folk medicine as stimulator of insulin secretion from colon B- cell line. Also Debella *et al*., (2007) reported anthelmintic activities when a crude solution and hydro-alcoholic extracts of the *C. sativum* seeds was used.

2.3-Poultry:

2.3.1- Effect of dietary supplementation of *C.Sativum* on broiler performance:

2.3.1.1-Feed intake:

Guler *et al*., (2005) found that dietary supplementation of 0.5%,1% ,2% and 4% coriander seed increased the feed intake except by 0.5% group which it was not differ from control group (0%). Also, Saeid and Al-Nasry, (2010) reported that birds fed diets containing different levels of coriander seed (0.1%, 0.2% and 0.3%) showed lower feed intake than control group (0%). Hamodi *et* al., (2010) and Barad *et al*., (2016) mentioned that addition of 2% of coriander in the broiler diets could improve the feed intake. Same finding by Naeemasa *et al*., (2015) indicated that 1.5% inclusion of coriander powder in broiler diet might improve the feed intake.

2.3.1.2- Body weight and body weight gain:

Guler *et al*., (2005) reported that the dietary supplementation of (0.5%, 1%, 2% and 4%) coriander seed increased weight gain and showed the best responses at 2% level of inclusion. Also, Saeid and Al-Nasry, (2010) reported that birds fed diets contain different levels of coriander seed (0.1%, 0.2% and 0.3%) improved body weight and body weight gain. Furthermore added 2% of coriander in the broiler diets improved overall body weight gain (Barad *et al*., 2016). Inclusion of 952 mg/kg of coriander extract in drinking water improved the weight gain of broiler chickens (Naeemasa *et al*., 2015).

2.3.1.3- Feed conversion ratio:

Guler *et al*., (2005) stated that broiler diet with 2% coriander seed improved feed conversion by 4.3% over the control group. Also, Saeid and El-Nasry, (2010) found improvement in feed conversion ratio of diet contain 3% coriander seed. The supplementing broiler diets with 0.2% mixture of garlic and ginger significantly improved feed conversion ratio, while the high inclusion rates (0.3% and 0.4% resulted in a significant ($P \leq 0.05$) reduction in feed conversion ratio (Mawahib *et al*.,2016).

2.3.1.4-Protein efficiency ratio:

The supplementation of different levels of lysine in broiler diets (starter and grower) did not affect protein efficiency ratio (Nasr *et al*., 2012). The addition of Silicate Minerals, 3% Zeolite in broiler diets increase Protein efficiency ratio in starter phase, also the increment of 3% kaolin in broiler diets increase Protein efficiency ratio in overall period (Safaeikatouli *et al*., 2012). Protein efficiency ratio was not affected by the supplementation of different levels of *prosopis juliflora* seed in broiler diets (Mohammadi *et al*., 2013).

2.3.1.5-Energy efficiency ratio:

Energy efficiency ratio was not affected by addition of different levels of lysine on broiler diets in (starter and grower) (Nasr *et al*., 2012). Broiler diets contain 3% zeolite (Silicate Minerals) improve energy efficiency ratio in starter phase also inclusion of 3% Kaolin in broiler diets improve energy efficiency ratio in overall period Safaeikatouli *et al*., 2012).

2.3.1.6- Production efficiency factor:

The addition of 300 ppm Oregano essential oil as phylogenic feed additives on broiler diets impaired production efficiency factor, (Maziar and Moein, 2017). Production efficiency factor increased by supplementation of different levels of lysine in broiler diets (Naser., *et al*., 2012). Broiler diets containing 4% Prosopis juliflora seed (JPS) decrease production efficiency factor (PEF) (Mohammadi *et al*., 2013).

2.3.2-Effect of some environmental factors on broilers performance:

2.3.2.1-Water consumption:

Broiler performance was influenced by water restriction during their first week of life, but when after water is fed adlibitum, negative effects are reversed allowing the birds to recover performance levels. During the first week of life when birds are submitted to water restriction, they

present subsequent compensatory growth, as shown by their better performance during the second and third weeks of the experiment as compared to the birds offered water adlibitum.The addition of 450 ppm of sodium in the drinking water did not cause intoxication in the broilers (Castro *et al.*, 2009).

2.3.2.2- heat stress:

Ambient temperature and long-term feed restriction significantly affect broiler performance. Moreover, long-term feed restriction at high ambient temperature increase heat resistance and improve the heat tolerance of growing broilers, when exposed to heat waves in summer season. (Abu-Dieyeh, 2006). During the heat-stress period applied, chickens decreased eating time to reduce heat generation. Drinking duration showed the opposite trend (Li *et al*., 2015).

CHAPTER THREE

MATERIAL AND METHODS

3.1- Experimental site and duration:

The study was conducted at the Poultry Farm Sudan, University of Science and Technology, College of Animal Production Science and Technology during the period from the 31th March to the 13th May 2017, in which the ambient temperature was ranged between (25.3–44.7˚C) and 20% relative humidity.

3.2-Experimental house:

The experiment was done in an open sided house, constructed from iron sheets roofing, wire netting sides and concrete floor with deep litter. The long axis of the house extended from east to west facing the wind direction for good ventilation. The house was partitioned into twelve experimental units (replicates) (1×1 m^2) of equal area with enough working space allowance. The experimental house was dry cleaned, washed by water using high pressure pump then burned. The northern and southern sides of the house were covered by nylon bags, after that the house was disinfected with formalin (37%, 5ml/ litter). The house was left closed over night and then spread litter from wheat straw of 5 cm depth before arrival of the chicks. Each replicate was provided with one feeder and one drinker (8 litter) capacity. Both feeder and drinker washed well by water and soap and disinfected.

3.3- Experimental birds and management:

A total of one hundred and twenty one day old unsexed broiler chicks (*Hubbard F15*) were purchased from Ommat Company for Poultry Production, the chicks were incubated for a week and fed on (*Na Po*) pre starter broiler (Table 2). After the incubation period the chicks were weighted and randomly allocated into three groups (40 chicks/group) of an average weight (135g/bird) each group was sub-divided into four replicates (10 chicks each).

3.4-Vaccination program:

During the incubation period the chicks were given multi vitamins (AD3E 2ml/litter) in water for 7 days. On the 7^{th} day each chick was vaccinated against Infectious bronchitis and Newcastle disease (IB+ND) by spray. On the 11^{th} day each chick was vaccinated against Gumboro (IBD) by drop in eyes. On 18^{th} day each chick was vaccinated again against Gumboro (IBD) by drop in eyes. On the 21^{th} day each chick was received the second dose of the ND by drop in eyes and 1ml/L of AD3E Vitamins was added in drinking water after each vaccination. On the period from 27^{th} to 30^{th} all birds were provided with preventive dose of Doxycycline (0.3g/litter) for appearing of respiratory symptoms.

3.5-Experimental diets:

The *C.sativum* was purchased from the Omdurman local market, grinded then 30g was sent to the lab for the chemical analysis (table 1). The other ingredients were purchased from the local market too. Coriander powder was mixed to the diets and three experimental diets were formulated twice according to (NRC. 1994) recommendations, for starter and finisher stage (tables 3 and 4). Diet A served as control group with no level of coriander (0%) and the other two diet groups (B and C) contain coriander at level of (0.1% and 0.5%) respectively**.**

Table 1. Proximate analysis of *C sativum*

Item	%
Moisture	5.5
Crude Protein	6.20
Crude Fiber	4.75
Ash	7.5
E.E	2.05

Table (2):- Pre starter chemical composition:

Item	%
Metabolizable Energy (kcal/kg)	3.100.00
Crude protein	23
Crude Fat	6.50
Crude Fiber	0.50
Ash	3
Lysine	1.40
Calcium	1
Sodium	0.16
Thireonine	0.90
Available Phosphorus	0.62
Methionine and cystine	0.99

Na Po Pre Starter Feed, Champrix Company,(Netherlands)

Table 3.Feed Composition and calculated analysis of the experimental starter diets

Ingredients	A	B	C
Sorghum	65	65	65
Ground nut cake	27.3	27.3	27.3
Concentrate*	5	5	5
Oil	1.6	1.6	1.6
DCP	1	1	1
Antitoxin	0.1	0.1	0.1
C sativum	0	0.1	0.5
Total	100	100.1	100.5
Calculated analysis			
Metabolizable energy (kcal/kg)	3073.659	3073.659	3073.659
Crude protein	22	22	22
Methionine	0.34	0.34	0.34
Lysine	1.20	1.20	1.20
Calcium	0.68	0.68	068.
Available phosphorous	0.43	0.43	0.43

*concentrate(WAFI)composition: crude protein35%,crude fat 2.7%, crude fiber4.8%, calcium6.8%, available phosphorus 5%, lysine 12%, Methionine 3.71%and (ME) Metabolizable energy 1897.77 kcal/kg.

Table 4. Feed Composition and calculated analysis of the experimental finisher diets

Ingredients	A	B	C
Sorghum	72	72	72
Ground nut cake	19	19	19
Concentrate*	5	5	5
Oil	3.2	3.2	3.2
DCP	0.6	0.6	0.6
Antitoxin	0.2	0.2	0.2
C sativum	0	0.1	0.5
Total	100	100.1	100.5
Calculated analysis			
Metabolizable energy (kcal/kg)	3206.643	3206.643	3206.643
Crude protein	18.82	18.82	18.82
Methionine	0.28	0.28	0.28
Lysine	0.96	0.96	0.96
Calcium	0.55	0.55	0.55
Available phosphorous	0.37	0.37	0.37

*concentrate (WAFI) composition: crude protein 35%, crude fat 2.8%, crude fiber 4.6%, calcium 6.56%, available phosphorus 5.14%, lysine10%, Methionine 3% and (ME) Metabolizable energy 1904.45 kcal/kg

3.6-Perfomance measurements:

3.6.1-Feed intake (FI):

Feed intake for the birds of each replicate was calculated every day by subtracting the amount of residual feed from the amount of provided feed.

3.6.2-Body weight (BW) and body weight gain (BWG):

Body weight for the birds of each replicate was recorded weekly and weight gain was calculated weekly by subtracting the body weight at the beginning of the week from the body weight at the end of the same week.

3.6.3-Feed conversion ratio (FCR):

Feed conversion ratio (FCR) was calculated weekly by dividing the amount of feed consumed by body weight gain (g feed/g gain).

3.7-Mortality:

Mortality was recorded for each group and mortality percentage was calculated.

3.8-Dressing percentage:

At the end of the study period eight birds were randomly selected, individually weighed, slaughtered then carcass weight was recorded and dressing percentage was calculated as the following:

$$\text{Dressing } \% = \frac{\text{carcass weight}}{\text{live body weight}} \times 100$$

3.9-Determination of other feed evaluation parpmeters:

3.9.1-Protein efficiency ratio (PER):

Protein efficiency ratio was calculated weekly according to (Kamran *et al*., 2008) method.

$$\text{PER}=\frac{\text{weight gain}}{\text{protein intake}}$$

3.9.2- Energy efficiency ratio (EER)

Energy efficiency ratio was calculated weekly according to (Kamran *et al*., 2008) method.

$$\text{EER}=\frac{\text{weight gain} \times 100}{\text{Energy intake}}$$

3.9.3-Production efficiency factor (PEF):

At the end of the period of the study the Production efficiency factor was calculated by the method of (Lemme *et al*., 2006).

$$\text{PEF}=\frac{\text{Final weight of bird (kg)} \times \text{livability \%}}{\text{age (days)} \times \text{feed conversion ratio (FCR)}} \times 100$$

3.10-Statistical analysis:

Complete randomized design was used. The obtained data from this study was analyzed using one way ANOVA and least significant difference (LSD) was used to compare between each group using statistical package for social science (SPSS) software program.

CHAPTER FOUR

RESULTS AND DISCUSSION

4-The effect of *C.sativum* on broiler performance:

4.1-The effect of *C.sativum* on feed intake of broiler chicken:

The effect of added different levels of coriander (0%, 0.1% and 0.5%) on feed intake (Table 5) shows no significant differences (P>0.05), between the experimental groups except in the 4th week, Spite of that group C (0.5%) showed the highest feed intake values. These results were different from those of Guler *et al*., (2005); Saeid and Al-Nasry, (2010) and Barad *et al*., (2016).This might be due to different inclusion rate of coriander seed powder, coriander type and management conditions particularly the housing system.

Table 5. Effect of *C. sativum* on broiler feed intake

Period	Feed intake (g/bird/week)			Significant
	A (0%)	B (0.1%)	C (0.5%)	
Week1	114.43±24.78	109.75±19.53	128.00±16.95	NS
Week2	355.86±29.76	331.94±71.75	406.36±51.44	NS
Week3	482.40±39.71	505.85±82.76	557.41±121.23	NS
Week4	548.10 ± 67.97^{b}	624.88 ± 78.25^{ab}	720.88 ± 83.43^{a}	*
Week5	696.49±99.58	752.63±94.73	782.56±239.31	NS
Starter	470.28±53.00	441.69±90.74	534.36±52.39	NS
Finisher	1726.98±166.33	1883.35±249.56	2060.85±429.27	NS
Overall	2197.26±151.11	2325.03±334.31	2595.21±476.43	NS

N:40 bird/treatment

*=significant different at P<0.05

NS=No significant differences

Different superscript letters within the same row means significant difference at (P<0.05)

4.2- The effect of *C.sativum* on weight gain of broiler chicken:

The effect of supplemented different levels of coriander (0%, 0.1% and 0.5%) on broilers chicken weight gain (Table 6) showed no significant differences (P>0.05), But group C (0.5%) showed the highest weight gain values. These findings were agreed with those of Guler *et al*., (2005). Deferent results were recorded by Hamodi *et al*., (2010), Al-Mashhadani.,(2011), Soha.,(2013) and Saleh, (2014), this could be due to the differences in inclusion rate and type of coriander .

Table 6. Effect of *C.sativum* on broiler weight gain

Period	Weight gain (g/bird/week)			Significant
	A (0%)	B (0.1%)	C (0.5%)	
Week1	106.58±33.36	85.00±43.01	114.75±39.31	NS
Week2	268.44±52.29	247.38±34.76	305.57±34.94	NS
Week3	307.20±33.26	320.97±58.67	333.04±65.60	NS
Week4	326.11±127.33	374.63±43.80	411.72±21.84	NS
Week5	355.97±56.25	347.00±46.43	406.20±42.04	NS
Starter	375.02±72.41	332.38±66.32	420.32±55.43	NS
Finisher	989.28±95.99	1022.88±108.43	1150.96±90.35	NS
Overall	1364.30±154.80	1355.25±160.25	1571.28±137.27	NS

N=40 Bird/treatment
NS=No significant differences

4.3- The effect of *C.sativum* on feed conversion ratio of broiler chicken:

From table (7) it is clear that, the feed conversion ratio was not affected (P>0.05) by the added levels of *c. sativum* in broilers diet. This result agreed with those of Saleh *et al*., (2014), Naeemasa *et al.*, (2015) and Barad *et al*., (2016). However, this result disagreed with Guler *et al*., (2005), Hamodi *et al*., (2010) and Farah and Al-Jaff (2011), this disagreement can be attributed to the differences in inclusion levels of *C.sativum* and type.

Table 7. Effect of *C.sativum* on broiler feed conversion ratio

Period	feed conversion ratio			Significant
	A (0%)	B (0.1%)	C (0.5%)	
Week1	1.14±0.34	1.55±0.72	1.19±0.30	NS
Week2	1.35±0.17	1.34±0.20	1.33±0.06	NS
Week3	1.58±0.17	1.61±0.30	1.67±0.05	NS
Week4	1.56±0.22	1.82±0.22	1.78±0.20	NS
Week5	2.71±1.98	2.01±0.12	1.89±0.52	NS
Starter	1.79±0.19	1.99±0.35	2.21±0.33	NS
Finisher	1.76±0.29	1.84±0.09	1.78±0.27	NS
Overall	1.63±0.22	1.72±0.05	1.64±0.18	NS

N=40 Bird/treatment
NS=No significant differences

4.4- The effect of *C.sativum* on protein efficiency ratio of broiler chicken:

Few researches were done on effect of added different levels of *C. sativum* on protein efficiency ratio, energy efficiency ratio and production efficiency factor. The protein efficiency ratio was not affected (P>0.05) by adding different levels of *C. sativum* in broilers diets (Table 8). These results were similar to those found by Mohamadi *et al*., (2013). But, they were differ from those of Kamaran *et al*., (2008).

Table 8. The effect of different levels of *C.sativum* on protein efficiency ratio (PER)

	protein efficiency ratio			Significant
Period	A (0%)	B (0.1%)	C (0.5%)	
Week1	4.21±1.30	3.34±1.35	3.99±1.14	NS
Week2	3.34±0.44	3.39±0.57	3.36±0.14	NS
Week3	3.4±0.40	3.42±0.71	3.19±0.08	NS
Week4	3.47±0.46	2.97±0.40	3.02±0.39	NS
Week5	2.58±1.13	2.66±0.16	3.05±1.13	NS
Starter	3.54±0.43	3.36±0.13	3.50±0.19	NS
Finisher	3.08±0.48	2.90±0.14	3.05±0.53	NS

N=40 Bird/treatment
NS=No significant differences

4.5- The effect of *C.sativum* on energy efficiency ratio of broiler chicken:

The effect of adding different levels of coriander (0%, 0.1% and 0.5%) on energy efficiency ratio (Table 9) showed no significant effect (P>0.05) between studied groups. However, these findings were disagreed with those of Kamaran *et al*., (2008).

Table 9. The effect of different levels of *C.sativum* on energy efficiency ratio (EER)

	energy efficiency ratio			
EER	A (0%)	B (0.1%)	C (0.5%)	Significant
Week1	30.63±9.42	24.32±9.84	29.05±8.30	NS
Week2	24.37±3.20	24.68±4.10	24.45±1.01	NS
Week3	19.98±2.32	19.99±4.20	18.68±0.46	NS
Week4	20.30±2.72	17.38±2.35	17.66±2.25	NS
Week5	15.10±6.64	15.53±0.96	17.85±±6.57	NS
Starter	25.78±3.11	24.46±0.96	25.48±1.40	NS
Finisher	18.01±2.82	16.96±0.81	17.85±3.12	NS

N=40 Bird/treatment

NS=No significant differences

4.6- The effect of *C.sativum* on production efficiency factor of broiler chicken:

Table (10) showed the effect of adding different levels of *C. sativum* on production efficiency factor. The results revealed that there was no significant effect (P>0.05) among the groups. However, group C (0.5%) ranked the highest value in PEF. Results agreed with those of Pistova *et al*., (2017) who recorded that the addition of garlic, walnut and wormwood as feed additive had no affect on PEF. On the other hand, these findings were disagreed with Maziar and Moein, (2017) who found that the addition of 300 ppm OEO (Oregano essential oil) as phylogenic feed additives on broiler diets significantly affect PEF.

Table10. Effect of different levels of *C.sativum* in Production efficiency factor (PEF)

Parameter	Production efficiency factor			Significant
	A (0%)	B (0.1%)	C (0.5%)	
PEF	21.06±3.62	20.70±1.92	22.20±2.05	NS

N=40 Bird/treatment
NS=No significant differences

4.7- The effect of coriander seed on dressing percentage of broiler chicken:

From table (11) the dressing percentage was not significantly affected (P>0.05) by the level of *C. sativum* on broilers diets. These results were similar to those of Ouyang *et al*., (2015) who added humic substance, garlic, walnut and wormwood, Mustafa, (2016) who added MEO(Anise, Clove and Caraway) and Pistova *et al*., (2017) who added Alfa alfa as feed additive. While, the results were disagreed with those of Soha, (2013). This could be due to the differences in the inclusion rate of *C. sativum*.

Table 11. Effect of *C.sativum* on broiler dressing percentage

Parameters	dressing %			Significant
	A (0%)	B (0.1%)	C (0.5%)	
Body weight	1640.60±133.16	1747.50±351.24	1863.80±216.99	NS
Carcass weight	1162.50±82.84	1242.4±247.51	1330.60±171.44	NS
Dressing percentage	70.91±1.13	71.12±0.44	71.32±0.94	NS

N=40 Bird/treatment.
NS= No significant differences

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

It can be conclude from this study:

- Different levels of *C.sativum* powder improved performance parameters of broiler chickens.
- Group C (0.5%) of *C. sativum* seed powder was the highest in most performance parameters.

The study recommends:

- More studies are needed on broilers chicken performance by the addition of different levels of *C. sativum* to determine the best levels under different environmental conditions and seasons.

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