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Effect of Feeding of Adding Fenugreek Oil on the Performance and Blood Serum Profile of Broiler Chicks

أثر التغذية باضافة زيت الحلبة على الاداء وخصائص مصل الدم للدجاج اللاحم

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الآية

بسم الله الرحمن الرحيم

قال تعالى:

(وَهُوَ الَّذِي أَنْزَلَ مِنَ السَّمَاءِ مَاءً فَأَخْرَجْنَا بِهِ نَبَاتَ كُلِّ شَيْءٍ فَأَخْرَجْنَا مِنْهُ خَضِراً نُخْرِجُ مِنْهُ حَبّاً مُتَرَاكِباً وَمِنَ النَّخْلِ مِنْ طَلْعِهَا قِنْوَانٌ دَانِيَةٌ وَجَنَّاتٍ مِنْ أَعْنَابٍ وَالزَّيْتُونَ وَالرُّمَّانَ مُشْتَبِهاً وَغَيْرَ مُتَشَابِهٍ انْظُرُوا إِلَى ثَمَرِهِ إِذَا أَثْمَرَ وَيَنْعِهِ إِنَّ فِي ذَلِكُمْ لآيَاتٍ لِقَوْمٍ يُؤْمِنُونَ)

صدق الله العظيم

سورة الأنعام [99]

Dedication

This work is dedicated
To my father, Mother, Brother, sisters and to my friends

With love and respects

Acknowledgments

Firstly and lastly thanks to ALLAH who gave me persistence, and patience to complete this work. No words can adequately express my deep gratitude to my supervisor **Prof.Dr. Mukhtar Ahmed Mukhtar.** For generously providing and for patience, constant support, advices and insight was invaluable to me. He is always available not only for consultation but also to solve any difficulties. Then I wish to express grateful thanks to administration of Sudan University of Science and Technology, College of Agricultural Studies for allowing me to conduct my research and providing any assistance requested.

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Table of Contents

Subject	Page No
الآية	I
Dedication	II
Acknowledgments	III
Table of Contents	IV
List of Tables	VI
List of Figures	VII
Abstract	1
ملخص الدراسة	2
Chapter one **Introduction**	
Introduction	3
Chapter Two **Literature Review**	
2.1 Description and Distribution	4
2.2 Chemical Constituents	4
2.3 Health benefits of fenugreek seeds	7
2.4 The effect of fenugreek seeds on blood sugar profile	7
2.5 The effect of fenugreek seed on lipid profile	8
2.6 Fenugreek as a forage crop	9
2.7: Fenugreek as a functional food	10
2.8 Use of fenugreek seeds in poultry diets	11
2.9 Effect of some treatments	14

Chapter three **Materials and Methods**	
3.1 Duration	15
3.2 The experimental chicks	15
3.3Housing	15
3.4Experimental Diets	16
3.5 Data collection	18
3.6 Blood samples	18
3.7 Carcass Preparation	18
3.8 Panel taste	19
3.9 Exp. Design and statistical data analysis	19
Chapter four **Results**	
Results	**20**
Chapter five **Discussion**	
Discussion	27
Chapter six **Conclusion and Recommendations**	
Conclusion	29
Recommendations	29
References	30
Appendices	47

List of Tables

Table No. **Title** **Page No.**

Table (1) Percent composition of fenureek seeds (dry matter basis)……..6

Table(2): Composition of control diet ingredients……..…. 17

Table (3): Calculated of experimental control diet……....17

Table (4): Chemical composition of control diet…….. 18

Table (5): the average performance of chicks fed fenugreek essential oil……21

Table (6) Effect of feeding broiler chick on diets containing……22

Table (7) Subjective meat attributes……23

Table (8) Effect of adding different levels of FEO on blood serum analysis…....24

Table (9): Economical appraisal for chicks fed on different levels of Fenugreek oil……26

Table (10) Appendix /Panel taste evaluation card ……..……....47

List of Figures

FIG.1:the average performance of chicks fed fenugreek essential oil……..21

FIG.2: Effect of FEO on non-carcass compounds……22

FIG.3: Subjective meat attributes……..23

FIG.4: Effect of different levels of FEO on SGOT, SGPT, Try, and Chol., of blood serum…25

FIG.5: Effect of different levels of FEO on blood serum chemistry**……..**25

Abstract:

The usage of antibiotics as growth promoter was banned, so, the researchers included essential oils in the poultry diets as alternatives to antibiotics, in order to enhance productivity by improvement of digestibility, nutrients absorption. Fenugreek (Trigonella foenum graecum)used as culinary spice, this is experiment was conducted to establish the effects of fenugreek essential oil on the performance and some carcass traits of broiler chicks.

A total of 64 , day– old chicks were randomly divided into three experimental groups, each group was further subdivided into three replicates of seven chicks per each. Chicks were fed on two levels of fenugreek essential oil (FEO)

(0.0, 2.0% and 3.0 %) for a period of six weeks. Diets were iso- nitrogenous and iso- caloric (3100kCal/kg diet), experimental parameters covered growth performance, giblets percentage and serum analysis.

The results showed that group of chicks fed on 2% FEO recorded significantly the highest values for feed intake and body weight gain compared to control group and without any significant affect on feed conversion ratio (FCR). Also result revealed no significant difference for non-carcass components between tested groups.

The results indicated that there were no significant differences among treated groups in internal organs, commercial cuts and their separable tissues and the subjective of meat quality parameters. The results of serum metabolites showed that inclusion of FEO at different levels significantly reduced the total protein, cholesterol and uric acid. However, the treatments did not affect significantly on electrolytes and enzymes (SGOT and SGPI) activities compared to control group.

A according to the results obtained from this study, FEO can be used as a good alternative natural growth promoter in broiler diets.

ملخص الدراسة

بعد ايقاف المضادات الحيوية كمحفزات للنمو و اضاف الباحثين الزيوت الاساسية في علائق الدواجن كبديل للمضادات الحيوية ، وذلك بتحسين الهضم وامتصاص الماء.

استخدمت الحلبة كتوابل للطبخ. تم اجراء التجربة لتوطيد اثر زيت الحلبة علي الاداء الانتاجي وبعض خواص الزبيح للدجاج اللاحم.

تم تقسيم عدد 64 كتكوت عمرها يوم واحد الي ثلاثة معاملات تجريبية ، وتم تقسيم كل معاملة الي لثلاثة مكررات وبكل مكرر سبعة كتاكيت . تم تغذية الكتاكيت علي مستويات مختلفة من زيت الحلبة (0.0 ، 2.0 % ، 4%) . استمرت التجربة لسته اسابيع . كانت العلائق متساوية في نسبة البروتين والطاقة.

شملت القياسات التجريبية الاداء الانتاجي ، قيم الذبح والذبيح، نسبة الاعضاء الداخلية والانزيمات وتحليل الدم والصفات الانطباعية لنوعية اللحم.

اظهرت النتائج علي ان اضافة زيت الحلبة بنسبه 2% تحسين معنوي في قيم العليقة المستهلكه والوزن المكتسب مقارنة بالمجموعة القياسية بينما لم تظهر اي فروقات معنويه علي نسبة التحويل الغذائي ونسبة النفوق .

اشارت النتائج ايضا عدم وجود فروقات معنويه لجميع المعاملات علي الاجزاء الداخلية والصفات الانطباعيه لنوعية اللحم.

اظهرت نتائج التحليل الكيميائي لمصل الدم ان اضافة المستويات المختلفة لزيت الحلبة لها تاثير معنوي في خفض مستوي البروتين الكلي والكلسترول وحامض اليوريك بينما لم تؤثر علي نشاط انزيمي

(SGPT) Serum glutamic pyruvic transaminase

و Serum glutamic oxalocetic transaminase(SGOT)

مقارنة بالمجموعة القياسية.

اسفرت النتائج امكانية اضافة زيت الحلبة كاضافة علفية جيدة في علائق الدجاج اللاحم كمحفز للنمو .

Chapter one

Introduction:

Feed additives are added in animal diets in small quantities to promote the performances of productive animals and maximized the profit. The usage of antibiotics as growth promoters is banned due to their side effects for animal health and their residues in meat for human health (Halfhide, 2003).

Essential oils which are extracted from plant parts have a productive role against bacterial fungal or insect attacks (Brenes,2010), influence the feed and transit times, digestive secretions and enhanced of digestive enzymes activities , have been applied as potential feed additive, (Lee *et al.*,*2004).*

The effects of different essential oils on the performance of broiler chicks were studied by many researchers: Mukhtar,2011)who used the clove oil, Amal *etal.,* (2013) added halfa bar essential oil , (Mukhtar *etal* . 2013) who included spearmint essential oil and Safa *etal*.,(2014),used garlic oil , in broiler chicks , the findings obtained by them were recorded positive results .

Fenugreek leaves and seed and there extracts have beneficial influences on digestion and ability to moodily food texture (Murlidhar and Goswami, 2012).

Fenugreek essential oil, obtained from the seed has some really powerful health benefits, it has tremendous healing properties, antiviral, antioxidant, anti-inflammatory and anti-cancer properties (Al-Habori and Raman, 2002).

There is no previous finding available in literature about fenugreek oil usage in poultry feeding.

The objective of the present study is to investigate the effect of different levels of the fenugreek essential oil as feed additive on the performance and carcass characteristics of broiler chicks.

Chapter Two

Literature Review

2.1 Description and Distribution:

The fenugreek is an erect small annual leguminous herb belonging to the family of fabaceae of the genus Trigonella. The plant grows up to about 2 feet high, similar in habit to Lucerne, with light green color trifoliate leaves and white flowers, it bear long slender, yellow-brown pods containing 10-20 golden-yellow color seeds. The seeds are brownish, about 1/8 inches long, rhomboidal, with a deep furrow dividing them into two unequal lobes.

They are contained, ten to twenty together, in long narrow, sickle, like pods. Raw seeds have maple flavor and bitter taste. However, their taste become more acceptable once they were gently dry-roasted under light heat. It is self pollinating crop (**Petropoulos, 2002**).

Fenugreek is native to the Indian subcontinent and the Eastern Mediterranean region. It is currently widely cultivated in central Asia, central Europe, northern Africa, North America and parts of Australia. However, India being the leading fenugreek producer in the world (**Fotopoulos, 2002 and Altuntas *et al.*, 2005)**. The plant is suited to cool and temperate growing regions with low to moderate rainfall (**Acharya *et al.*, 2008**). It is known by various names in different countries, i.e. methi (Hindi) in India and also as fenugreek (France), Bockshorklee (German), Hulba (Arabic), Halba (Malaya), Koroha (Japan), and Ku- Tou (China), (**Srinivasan, 2005 and Petropoulos, 2002**).

2.2 Chemical Constituents:

Chemical composition (table 1) and antioxidant activity of husk (seed coat) and endosperm of fenugreek seeds have revealed that endosperm has the highest content of saponin (4.63%) and protein (43.8%) (**Madhava Naidu *et al.*, 2010).** In

contrast, husk (seed coat) contains higher amount of polyphenols (103.8 mg of garlic acid equivalent) and total dietary fiber (77.1%).

Schryver, (2002) reported that fenugreek is a good source of dietary protein (20-30%), the fatty acids from 5-10% which are predominantly linoleic, linolenic, oleic and palmatic acids. It had 45-65% total carbohydrates with 15% galactomannan (a soluble fiber).

The seeds contain many phytochemical compounds such as choline trigonelline, diosgenin, vamogenin, gitogenin, tigogenim and neotigogens . The fenugreek seed is an excellent source of minerals like copper, potassium, calcium, iron, selenium, zinc, manganese and magnesium. It also rich in many vital vitamins that are essential nutrients for optimum health including thiamin, pyridoxine (vit B6),linolic acid, riboflavin, niacin, vitamin A and vitamin C, (**Michael and kumawat, 2003). Rao and Sharma (1987**) found that the seeds of fenugreek contained 4.8% saponins. Fenugreek seeds contained 27%protein, 7-10% oil (**Akgul, 1973**) also, **Abd El-Aal and Rahma, (1986)**reported that fenugreek is considered to be a good source of crude protein, crude fat and total carbohydrates .**Srinivasan (2006**) reported that fenugreek mature seeds (100g)contained protein 30g, fat 7.5g, fiber 50g, sapogenins, diosgenins,yamogenin, gitogenin, neogitogenin, yuccagenin, tigogenin ,sarsasapogenin, smilagenin 2g, trigonelline 380 mg, Ca 160mg, Mg160mg, P 370mg, Fe 14mg, Na 19mg, K 530mg, Cu 33mg, S16mg, CI 165mg, Mn 1.5g, Zn 7.0mg, Cr 0.1mg, Choline 50mg, vitamin C 50mg, B-carotene 90mg, Thiamine 340mg, Riboflavin 290 mg, Nictoinic acid 1.1mg, folic acid 84mg .Fenugreek seed contains approximately 4-10% moisture, 6-8 fat,18-30% protein and 48-55% fibers (**Sauvaire *et al,*. 1976; Sharma,1986b; Vats *et al.*, 2003 and Srinivasan, 2006**) depending on varietal and ecological factors. **Hemavathy and Prabhakar (1989**) reported the lipid composition of fenugreek seeds that total lipids extracted from dry seeds were 7.5% (neutral lipid 84.1%, 5.4% glycolipids and 10.5%phospholipids).

Table1. Percent composition of fenugreek seeds (dry matter basis)

Item	Percent
Moisture	4.1
Dry matter	95.9
Crude protein	25.68
Ether Extract	27.6
Crude Fiber	0.4
N. Free Extract	34.83
Ash	7.3
ME (Mcal/Kg)	2.3896

Lodhi *et al*., (1976)

2.3 Health benefits of fenugreek seeds:

Fenugreek is one of the oldest medicinal plant, dating back to Hippocrates and ancient Egyptian times (**Jensen,1992**). Fenugreek leaves and seeds have been used extensively to prepare extracts and powders for medicinal (**Basch *et.al*. 2003)**. Fenugreek has been used for over two thousand years as a medicinal plant in various parts of the world (**Srinivasan, 2006**) and may regarded as the oldest medicinal plant, use of fenugreek is associated with a wide range of therapeutic applications including its use as a carminative (prevents flatulence) to and use as an aphrodisiac (**Chopra *et al*., 1982**).

Fenugreek seeds are considered as an appetizer and helps indigestion. The seed has antioxidant, antiviral and anti-carcinogenic activities (**Mazur *et al*,. 1998**). The plant is often used for over two thousand years as a medicinal plant in various parts of the world.

2.4 The effect of fenugreek seeds on blood sugar profile:

Pharmacological of fenugreek have been explored to identify a role for the plant in diabetes management (**Sharma *et al*., 1996a; and Puri *et al*., 2002**) and in cardiovascular heath (**Petit *etal*,. 1995b; Sauvaire *et al*.,1996; Hannan *et al*., 2003),** indicating the presence of bioactive compounds in fenugreek which may responsible for its health benefits.

Sharma *et al*,. (1990) evaluated the effect of fenugreek seeds on blood glucose and the serum lipid profile in insulin dependent (type 1) diabetic patients. Defatted fenugreek seed powder (100g) divided into two equal doses was incorporated into iso-caloric diets for 10 days during lunch and dinner. The fenugreek diet significantly reduced fasting blood sugar and improved the glucose tolerance test and LDL cholesterol and triglycerides were also significantly reduced, while the

HDL cholesterol fraction remained unchanged. **Kassaian *et al.,* (2009**) carried study to evaluate the hypolipidemic and hypoglycemic effects of fenugreek seeds in types 2 diabetic patients, diabetic patients were placed on 10 g/day powdered fenugreek seeds mixed with yoghurt or Soaked in hot water for 8 weeks. Findings showed that fasting blood sugar (FBS), Triglyceride (TG) and very low density lipoprotein cholesterol (VLDL.C) decreased significantly (25%, 30% and 30.6% respectively) after taking fenugreek seeds soaked in hot water, whereas there were no significantly changes in lab parameters in cases consumed it mixed with yogurt.

The soluble nature of galactomannan fiber from fenugreek has been linked to numerous human health benefits mainly in the reduction of plasma glucose levels which has an anti-diabetic effect (**Sharma, 1986b, Madar *et al.,* 1988, Madar and Shomer, 1990). Hannan *et al,(*2007)** also have demonstrated that soluble dietary fiber (SDF) protein of fenugreek can significantly improve glucose homeostasis in type 1 and type 2 diabetics delaying reported use of soluble fiber from fenugreek resulted inhibiting glucose absorption in the intestine. **Zargar *et al.,* (1992**) found that patients taken orally 20gm of powdered fenugreek seed showed significantly drop in fasting sugar levels.

Trigonelline, coumarin and nicotinic acid have been isolated from fenugreek seed and shown to be useful in diabetes (**Moorthy *et al.*,2010**). Fenugreek leaves and seeds have been used extensively for preparing extracts and powders in medical performance (**Basch *etal*., 2003; Nithya and Ramachandrmurty, 2007).**

2.5 :Effect of fenugreek seed on lipid profile:

Fenugreek have properties of reducing blood sugar level (**Raghuram *et al.*,1994),**anthelmentic, antibacterial (**Bhatti *et al.,* 1996**), anti-inflamatory, antipyretic (**Ahmadiani *et al.,* 2001**), and antimicrobial (**Alkofahi *et al.* 1996**).

Administration of fenugreek seed powder 25gm orally twice daily for three weeks and six weeks produces significant reduction of serum total cholesterol, triacylglyceride and LDL cholesterol in hyper cholesteremic group (**Abu Saleh *et al.*, 2006).Al-Habori *et al*., (1998**) showed the effect of fenugreek seeds and its extracts on plasma lipid profile on rabbits. Studies have shown that fenugreek seeds reduce serum lipids in rabbits**.**

Sharma (1984, 1986) demonstrated that fenugreek administration increased excretion of bile acid and neutral in feces, thus depleting the cholesterol stores in the body of experimental rats. **Awal *et al.*, (1999**) studied the effect of fenugreek and Karela on lipid profile in hypercholesterolemia diabetic patients and shown that fenugreek significantly reduces the lipid levels .**Basch, *et al*., (2003**) suggested the anti-hyperlipidemic properties of oral fenugreek seed powder.

Xue *et al*,. (2007) concluded that fenugreek extract can lower kidney or body weight ratio, blood glucose, blood lipids and improve hematological properties in experimental diabetes rats. Supplementation of fenugreek seeds were shown to lower serum cholesterol, triacylglycerol and low density lipoprotein in human patients and experimental models of hypercholesterolemia and hypertriglyceridemia (**Kassaian *et al*., 2009**).

2.6 Fenugreek as a forage crop:

Fenugreek can be interesting for cultivation as a forage crop for many reasons: as a legume crops which can profit soil for following crops by fixing nitrogen from the atmosphere (**Acharya *et al.*, 2008**), as a dry land crop (**Kumar *et al*, 2000**) as a leguminous component of annual fodder mixtures in feeding of livestock (**Mir *et al.*, 1998**) and to produce a high quality forage, hay or silage (**Mir *et al.*, 1997**).

Fenugreek has potential as forage crop for ruminant because it contains high quality protein and others benefits of a legume crop rotation (**Acar, 2000**).

2.7: Fenugreek as a functional food:

Fenugreek is best known for presence of the distinctive, pungent aromatic compound in the seed (**Max, 1992**) that impart flavor, color and aroma to foods, making it a highly desirable supplement for use in culinary application. As a spice, it constitutes one of the many ingredients that make up curry powder (**Srinivasan, 2006**).

In countries such as India, fenugreek leaves are consumed as leafy vegetable in the diet (**Sharma, 1986b**), while in Ethiopia and Egypt, the plant is used as a supplement in maize and wheat flour for bread-making (**Al-Habori and Raman, 2002).** In Yemen and Persia, fenugreek represents key ingredients in the preparing of daily meals among the general population (**Al-Habori and Raman, 2002)**. As human food in Turkey, bastoorma is made with meat and spices that included fenugreek seed specially. Fenugreek have a great effect in relation to increasing milk supply in lactating women (**Chantry et al., 2004),** also it helps to increase urine and menstruation in women. It helps rickets and anemia. Owing to the existence of mucilage, it helps relieve sore throttle and is useful in the treatment of asthma and difficult breathing, fenugreek is considered as appetizer and helps in digestion (**Mazur et al., 1998**).

Fenugreek seeds have been recognized as a potential source of sapongenins, cartisone and sex hormones (**Brenac and Sauvaire, 1996a,b**).

The fenugreek has many traditional uses in Sudan, it used for digestive system attractions, and many other extra uses. The young leaves and sprouts are good source of protein mineral and vitamin (**Khan *et al.,* 2005;Chhibba *et al.,* 2007**)

and are used as green vegetable in Pakistan and India alone or with potatoes, spinach and meat.

Fenugreek seeds have been extracted for polysaccharide, galactomannan, different saponins such as diosgenin, yamogenin, mucilage, volatile oil and alkaloids such as choline and trigonelline(**Aasim *et al.*, 2010**).

The herb is widely used in cooking as it adds a distinctive flavor to food; it is an appetizer and lends a good aroma to curries. Its extract used to flavor maple syrup in Germany, cheese Switzer land (**Rajagopalan,1998**).

Nabila *et al*., (2012) studied the improvement role of fenugreek leaves, seeds (dried and germinated) and wheat flour supplemented with germinated fenugreek powder at 5 to 10% levels on-iron deficiency anemia in rats. Results of nutritional characteristics revealed that fenugreek flour is a good source of protein, fat, fiber and minerals (Fe, Carcass and Zn). Biscuits supplemented with 10% germinated fenugreek had the highest content polyphones. Supplementation of wheat flour with fenugreek flour at 5% and 10% levels increased the vitamin B2 and carotene contents of biscuits, also produced acceptable and high nutritive values of biscuits.

2.8 Use of fenugreek seeds in poultry diets:

Fenugreek in rabbit diets has traditionally been supplemented through different phases of production. **Seleem *et al*., (2008**) reported that supplementation of 0-3% fenugreek to rabbit diet showed a great role in enhancing the immune system, improved growth performance, blood metabolites and reproductive performance.

Ahmed, (2011) evaluated the effect of graded levels (5, 10 and 15 gm/kg) fenugreek seeds addition to the Japanese quail males ration on semen quality and testis histological traits. Results showed a significant improvement in ejaculation

volume, spermatozoa mortality, viability and semen concentration in comparison with control group. Also, the testis weight, semini ferous tubules diameter, germinal layer thickness and germinal layer area showed significant increase in fenugreek groups.

However, fenugreek used as a supplement to poultry feeding to lowering

plasma total lipids and total cholesterol in Hubbard broiler chicks

(Azoua, 2001) and improve antioxidant status and production performance in laying hens (**ALkatan, 2006**). Fenugreek seeds improve the reproductive and physiological performance of broiler breeder males (**Taha, 2008**) and revealed positive significant results of semen trait in aged broiler breeder males (**Abdul-Rahman *et al.*, 2010**).

Nadir *et al.*, (2012) found that Fenugreek seeds supplementation to broiler chickens diets significantly affected live body weight, feed intake and feed conversion ratio, however, there is no significant difference for the slaughter parameters and mortality. **Sayed and Hesham (2002**) studied the feeding broiler chicks on diets containing various levels (1, 1.5 and 2%) of local natural feed additives (hot pepper and Fenugreek seeds) at different levels of metabolizable energies (3200, 3000 and 2800 Kcal/kg). Chicks fed fenugreek diet had significantly less body weight and higher feed intake and decrease abdominal fat percent.

Rabia (2010) studied the effect of fenugreek, sparsely and sweet basil seeds as natural feed additives on broiler performance. He observed that chicks fed basil diet had significantly heaviest body weight than those fed Fenugreek seeds. However, carcass characteristics had no significant differences.

Alloui *et al.*, (2012) studied the effect of Fenugreek seeds at (3gFenugreek seeds/kg) as natural growth promoter for broiler chicken.

It was that Fenugreek seeds supplementation significantly affected live body weight, feed intake and feed conversion ratio, however, there is no significant difference for the slaughters parameters and mortality. **Farman Ullah *et al.*, (2009)** studied the effect of Fenugreek seed extract on the visceral organs of broiler chicks. It was that aqueous extract of fenugreek has amply good effect on the weight of visceral organs. **Guo *et al.*, (2004**) reported that Chinese herbal medicine containing fenugreek and an antibiotic virginiamycin did not influence the fiber weight in broiler chicks.

Abaza (2007) studied the effect of using some medicinal plants (Fenugreek seeds, chamomile and radish) as feed additives on performance, egg quality, digestibility, blood constituents of laying hens, at the level of 0.5% for each the results showed that supplementation of diet with the medicinal plants increased numerically egg number than those fed control diet, at the same time significantly decreased feed consumption and improved feed conversion.

Metin *et al.*, (2013) fed broiler chicks on diets containing (0, 5, 10, 20 and 40g) fenugreek seed powder per kg commercial broiler diet.

The results revealed decreased in body weight and breast weight in diets supplemented with fenugreek seed powder compared with untreated one, feed intake decreased after 5g Fenugreek seed, while 40g fenugreek treatment decreased feed efficiency. A 20g treatment enhanced blood glucose level and decreased triglyceride level compared to control.

Morsy, (1995) reported significant improvement in body weight gain and dressing percentage with broiler fed diets containing 500g fenugreek. **El-Husseiny *et al.*,**

(2002) lustrated that chicks fed fenugreek diet had significantly less body weight and higher feed in take than those fed the control diet.

2.9 Effect of some treatments:

Shalini and Sudesh (2002) studied the effect of soaking and germination on nutrient and anti- nutrient content of Fenugreek seeds , It was seeds contained higher amount of dietary fiber (46.5%) compared to soak seeds (42.12%) and germination seeds (32.5%).

Soaking reduced the level of total soluble sugars, reducing sugars, non reducing sugars and dietary fiber but improved the protein and mineral availability. Germinated fenugreek seeds had higher total protein (29%) content compared to un-germinated fenugreek seeds. Germination decreases dietary fiber and starch content, thereby, raising the level of sugars. Availability of minerals (Fe, Carcass and Zn) improved after germination. **Laila and Ahmed (1983**) investigated that the major fatty acids of fenugreek seeds reduced after germination.

Carbohydrates of germinating seeds showed an increase of total, reducing, non-reducing sugars and pentosan content and a decrease in polysaccrides and mucilage **(El-Mahdy and El-Sebaiy, 1983).**

Sathyanarayana *et al.*, (2011) reported that sprouts and endosperm from germinated fenugreek seeds was 49.05% and 13.42% where as the seed coat and endosperm of un-germinated fenugreek exhibited 90.94% and 10.13% antioxidant activity respectively. **El-Shimi *et al.*, (1984**) reported a decrease in starch content after soaking and germination. **Hooda and Jood (2003)** reported a decrease in soluble dietary fiber of fenugreek seeds on germination, and also a decrease in anti oxidant activity.

Chapter three

Materials and Methods

3.1 Duration:

The experiment was conducted in the student poultry premises, Collage of Agricultural Studies, Sudan University of Science and Technology, Shambat , during the period from 9/9/2017 to 14/10 /2017.

3.2 The experimental chicks:

A total of sixty four one day commercial unsexed broiler chicks of Ross_308 strain were obtained from commercial poultry farm The chicks were divided into three treatment groups of 21 birds each and randomly assigned to three treatment diets (A, B and C) each treatment group was further subdivided into three replicates .water were provided *adlibitum* .chicks were vaccinated against Gumboro disease at 9 days of age and against Newcastle disease at 22 days of age. Soluble multivitamins compound (pantominovit-pantex Holland B. V 5525.ZG Duizel . Holland), given to chicks before and after three days of each vaccination in order to guard against stress.

3.3Housing:

Chicks were kept in an open wire mesh _side poultry house. The house was constructed on concrete floor. The roof was made of metal sheet; the sides were permanently covered with sacks to reduce hot current air. Stands fan and air coolers ware used to keep temperature in the house cool. The pens ($1m^2$) inside the house were prepared using wire mesh partitioning. The pens were cleaned, washed and disinfected with formalin and phenol solution before the commencement of the experiment. A layer of wood shavings was laid on the pen floor as litter material. Each pen was provided with 2.5 gallon drinker and 5 Kg feeders and drinker's height was adjusted according to the progressive growth of the chicks. Light was

provided 24 hours in a form of natural light during the day and artificial during night.

3.4Experimental Diets:

Fenugreek oil was purchased from the local market. Three experimental (A, B, and C) diets were formulated to meet the nutrient requirements of broiler chicks according to **NRC (1994**). Diet A used as control, diets B and C were the control diet but supplemented with fenugreek oil at (2 and 4 %) respectively. The percent, calculated and chemical composition of the experimental diets were present in tables (2, 3 and 4) . The variation in energy concentration we readjusted with aid of vegetable oil where required.

Table 2: Composition of control diet ingredients on percent bases

	Control	2% FO	4% FO
Dura	64.142	64.142	64.142
Groundnut cake	14.00	14.00	14.00
Sesame cake	15.00	15.00	15.00
Broiler concentrate	5.00	5.00	5.00
Oyster shell	0.487	0.487	0.487
Salt	0.25	0.25	0.25
Declaim phosphate	0.618	0.618	0.618
Lysine	0.344	0.344	0.344
Methionine	0.159	0.159	0.159
Total	100	100	100
FEO	0.0%	2%	4%

Table (3): Calculated compositin of experimental control diet

ME Kcal	3105.212
Crude protein %	22.823
Lysine%	1.497
Methionine %	0.627
Calcium%	1.148
Phosphor %	0.758
Crude fiber %	4.127

Table (4): Chemical composition of control diet

	Moisture %	DM%	Ash %	CP%	EE%	CF%	NFE%	ME/mj
Control	2.25	97.75	2.35	22.45	4.25	3.07	65.48	2.87
2 % FO	1.75	98.25	2.05	22.4	4.9	3.01	65.94	2.94
4% FO	2.25	97.25	2.15	22.45	5.1	3.01	65.04	2.87

3.5 Data collection:

Chicks of each replicate were group weighted at weekly interval and feed consumption was recorded at the time of weighing. Mean body weight gain and feed conversion ratio (FCR) were calculated weekly.

Mortality was recorded daily throughout the experimental period.

3.6 Blood samples:

Blood samples were collected from the birds (one from each replicate) after slaughter in heparinized tubes. The blood samples were centrifuged at 3000 rpm for 15 min. and plasma obtained was stored at -20C° until analysis. Plasma **total protein**(total protein kit (Biuret method)),**albumin, total lipids**, total **cholesterol**(cholesoxidase, peroxidase (CHOD - POD) method), and triglycerides were determined using spectrophotometry., Ca++by colorimetric method.

3.7 Carcass Preparation:

At the end of the experiment, the chicks were fasted overnight except from water, one chick from each replicate was randomly selected, individually weighted and slaughtered. After bleeding the slaughtered chicks were scaled in hot water, feathers plucked manually then washed and drained, after evisceration .The hot

carcass and the individual organs, the liver, heart, gizzard and legs were separately weighted and they expressed as a percentage of live weight.

The carcasses were chilled at 4C° for 24 hours for carcass characteristics and meat yield, and then they were sawed into two halves. The left side then divided into the commercial cuts (breast, thigh and drumstick). Each cut was weighted individually then deboned. The meat was frozen for panel taste.

3.7 Panel taste:

The stored meat samples were cut into small pieces, wrapped individually in aluminum foil and roasted at 190 C° for 70 minutes with average internal temperature of 88C° and served warm. Ten well-trained taste panel were used to score color, flavor, tenderness and juiciness of meat (**Cross et al., 1978**) on scale of 1-8 (Appendix I). The samples were served randomly to each judge and at room temperature. Water was provided for the panelists to rinse their mouth after tasting each sample.

3.8 Exp. Design and statistical data analysis:

Completely randomize design (CRD) was used in the experiment. The data obtained from the growth study was subjected to analysis of variance according to **Steel and Torrie (1980**). The significance between treatments means determined using Duncan's (1955) multiple range test (DMRT)

Chapter four

Results

The effect of feeding two levels of the fenugreek essential oil as growth promoter on the performance of broiler chicks was illustrated in (table 5). the analysis of collected data showed that the supplementation of broiler diet with 2% fenugreek essential oil (FEO) recorded significantly($p<0.05$) the highest values for final body weight, feed consumption and body weight gain compared to control group. However there was no significant ($p<0.05$) difference observed in feed conversation ration between tested groups.

Results obtained showed no significant different between control group and chicks feed on 4%FEO in all measured parameters.

Results obtained for non-carcass components (table, 6) revealed no significant difference in (gizzard, neck, heart, liver, and legs) weights recorded between tested groups.

The effect of treatments on subjective meat attributes is shown in table (7) the average subjective meat qualities score given for color, tenderness, juiciness and flavor are above moderate acceptability.

Table (5) :the average performance of chicks fed fenugreek essential oil

Treatments	Final body weight	Feed intake	Weight gain	FCR
Control	1282.6[b]	2114.8[b]	1162.6[b]	1.8[a]
2%	1618.1[a]	2785.5[a]	1419.1[a]	1.86[a]
4%	1317.4[b]	2189.5[b]	1185.7$_b$	1.85[a]
SE±	95.4	266.4	97.9	0.151

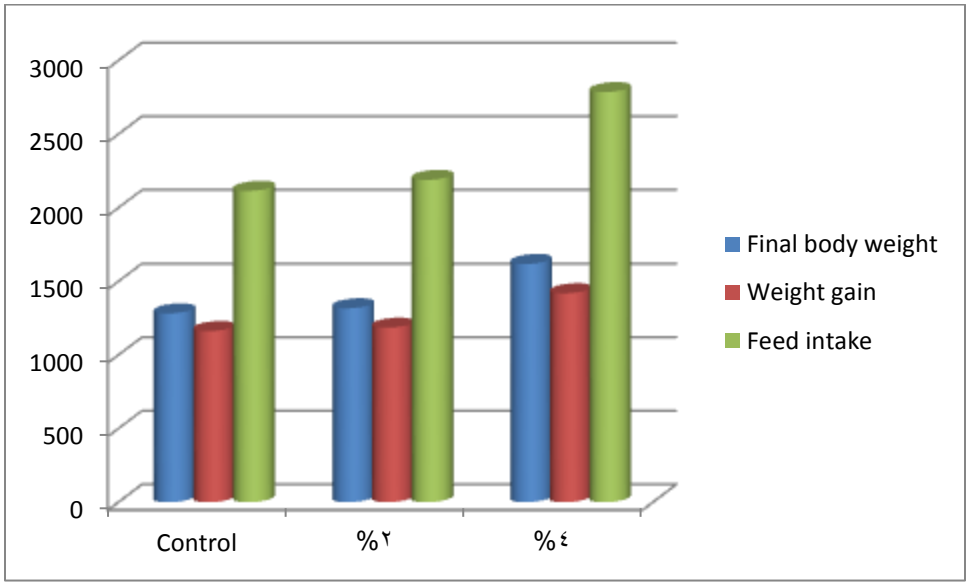


FIG.1:the average performance of chicks fed fenugreek essential oil

Table (6) Effect of feeding broiler chicks on diets containing fenugreek essential oil

Treatment	Neck	Liver	Heart	Head	Legs	SE±
Control	75.00[a]	26.3[a]	5.0[a]	36.66[a]	68.33[b]	20.9[a]
2%	76.6[a]	35.0[a]	6.33[a]	43.33[a]	80.0 [a]	21.6[a]
4%	63.3[a]	31.66[a]	5.0[a]	31.66[a]	55.00[b]	20.9[a]

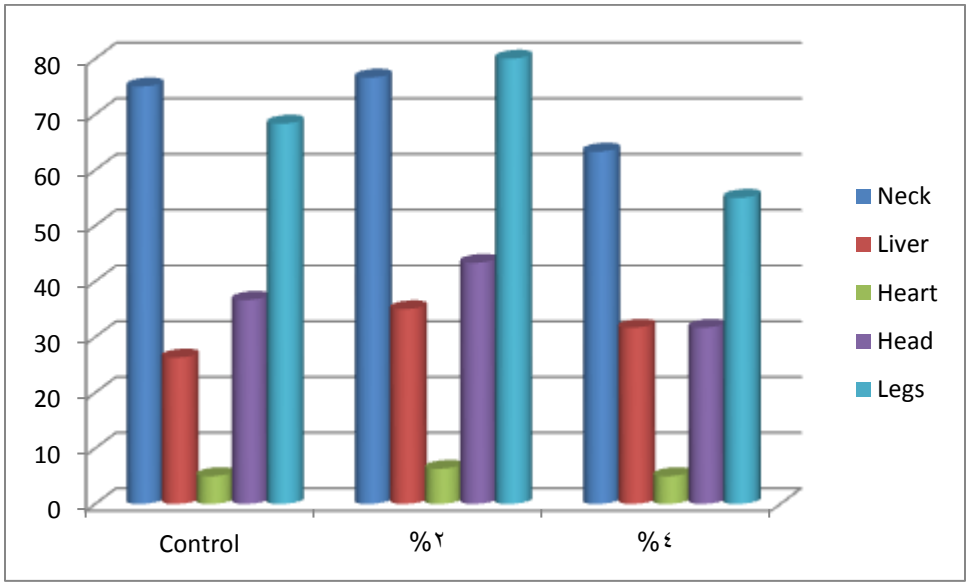


FIG.2: Effect of FEO on non-carcass compounds

Table 7: Subjective meat attributes

Treatments	**Juiciness**	**Color**	**Flavor**	**Tenderness**
0	4.5	6.0	5.0	5.3
2%	5.0	4,5	4.5	5.2
4%	4.5	4.8	4.7	4.6

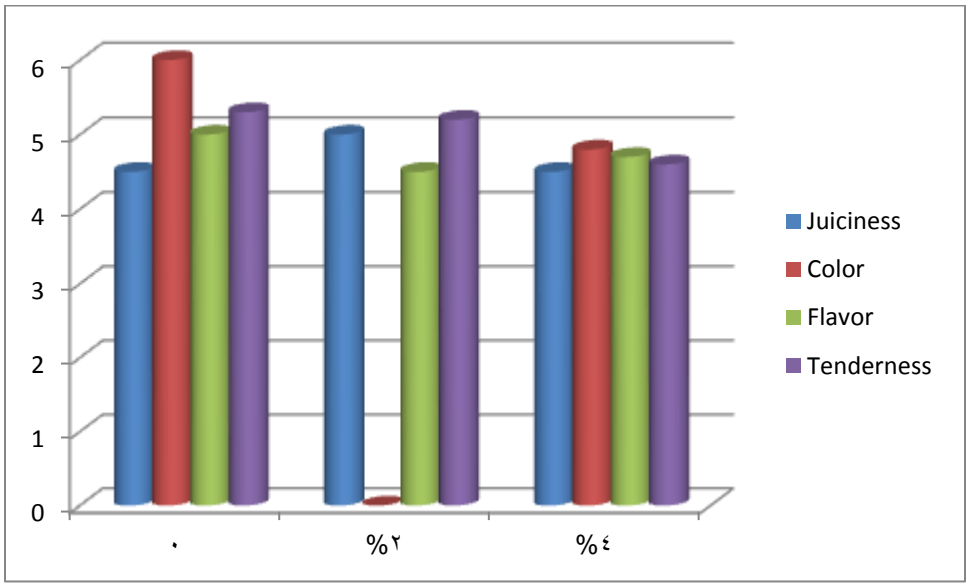


Fig.3:**Subjective meat attributes**

Table 8: Effect of adding different levels of FEO on blood serum analysis

Treatments (gm/kg)	SGOT (µL)	SGPT (µL)	T.P (g/dL)	Alb. (g/dL)	Chol.. (mg/dL)	Uric acid (mg/dL	Ca (mg/dL)	Try. (mg/dL)
Control	83.33	34.66	6.27^{b}	3.53^{a}	54.26^{b}	2.96^{a}	7.5^{a}	177.3^{a}
2%	78.88	51.66	6.62^{a}	3.60^{a}	46.23^{a}	2.50^{b}	7.5^{a}	175.6^{a}
4%	73.20	26.12	6.70^{a}	3.50^{a}	52.66^{b}	2.10^{c}	7.1b	172.0a
SE±	2.10	11.86	0.13	0.144	1.39	0.127	0.131	2.77

Values are mean±SD.

Any two mean value(s) bearing different superscript(s) in a column are significantly different ($P \leq 0.05$) according to DMRT.

SGOT = serum glutamic oxaloacetic transminase

SGPT= serum glutamic pyravic transminase

T.P= total protein,

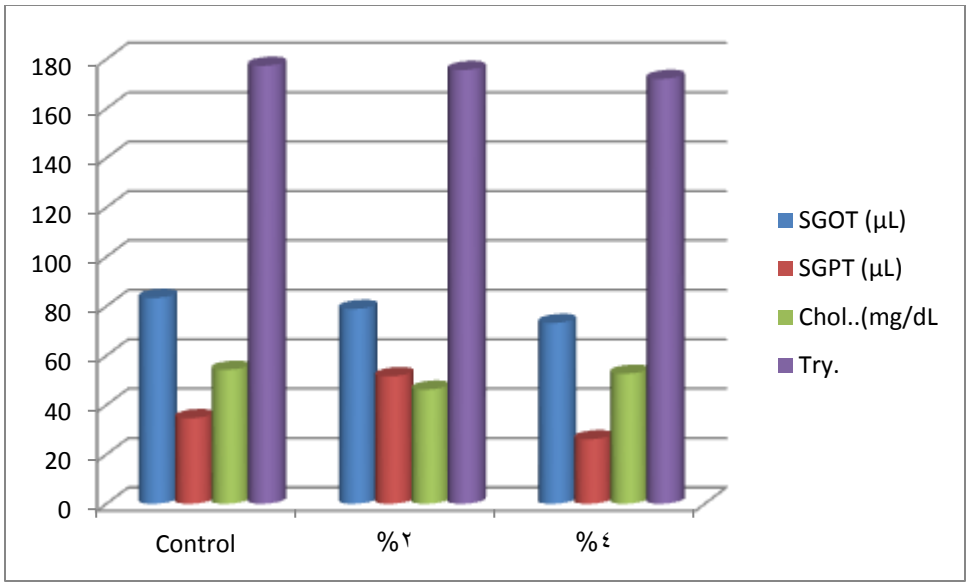
Alb= albumin ,

Chol.= cholesterol ,

Ca= calcium,

Try= triglyceride ,

ES= standard error



Fig, 4:Effect **of different levels of FEO on SGOT ,SGPT, Try , and Chol ,of blood serum**

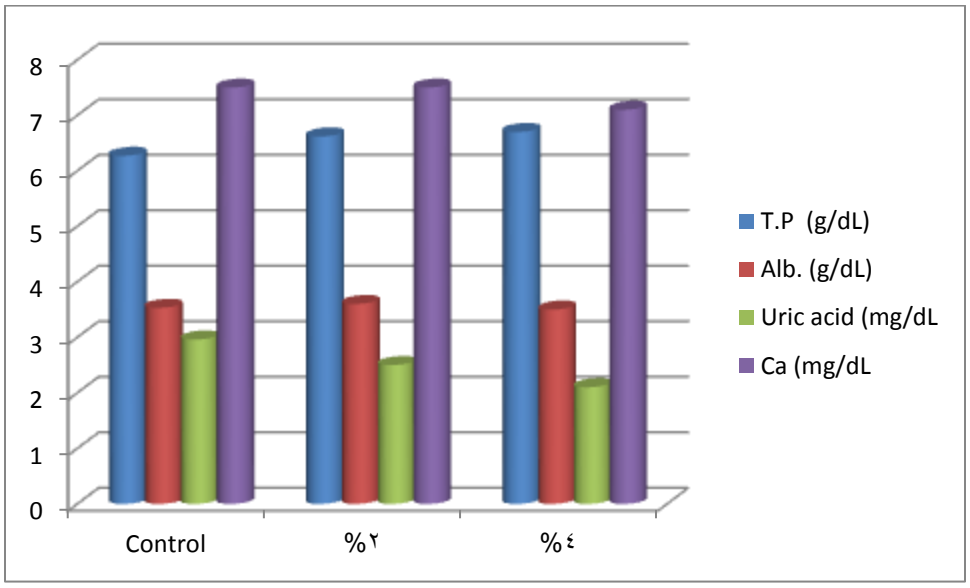


FIG.4: **Effect of different levels of FEO on blood serum chemistry**

The results of enzymes(SGOT and SGPT) activities s (table8) showed that group of chicks fed on 400mg/kg oil showed significant positive ($p<0.05$) however, chicks fed on control diet and diet supplemented with 200mg/kg dietary oil recorded significantly ($P>0.05$) the lowest activity for both enzymes(SGOT and SGPT).

Showed that data cholesterol, sodium, uric acid concentration decreased significantly ($P>0.05$) with the increase of fenugreek oil level. However, Chicks fed on control diet recorded the highest serum total cholesterol, sodium, SGOT, Triglyceride and uric acid concentrations. Chicks in group B recorded the lowest value in cholesterol while those in group C recorded the lowest value for Na, SGOT, SGPT, Triglyceride, Albumin, Calcium and uric acid.

Economical appraisal chicks purchase, illustrated in table (9) ,results showed that chicks fed on diets supplemented with diets with different levels of fenugreek oil profits Profitability ratio (1.03) of group fed on diet supplemented with 200mg/kg was the highest of the tested groups economically.

Table 9: Economical appraisal for chicks fed on different levels of Fenugreek oil

	Control	**200mg/kg**	**400mg/kg**
Diet cost	15.2595	15.456	15.2842
Chick price	7.00	7.00	7.00
Labor	2.00	2.00	2.00
Total cost	24.2595	24.456	24.584
Revenues	56.322	57.753	57.1949
Profit	32.0625	33.297	32.612
Profit ability ratio	1.00	1.03	1.02

Chapter five

Discussion

The result obtained for chicks fed on the two levels of FEO showed that chicks group fed on 2% FEO recorded significantly the highest values for body weight gain and feed intake compared to control group without no effect on FCR ,followed by those fed on 4% FEO. There was no significant deference between control group and chicks fed on 4% FEO in all parameters, this may be due to that the active ingredients in FEO stimulate the appetite, increase the digestibility and absorption of nutrient.

The results were in line which that obtained by **Abaza(2001)Guo *etal* .,(2004), yatoo *etal.*, (2012) and Qureshi (2015**)who found that fenugreek seed inclusion in broiler chicks diets significantly improved the body weight El-**Mallh *et al* .,(2005**), noted that supplementation of turkey chicks diets with 2% of fenugreek seed increased significantly the digestibility and absorption of food. **Alloui *et al.*, (2012**) found that feeding fenugreek seeds at 3g/kg of feed in broiler chicks significantly increased feed intake due to the presence of essential fatty acids and high quality proteins and steroid saponins (appetite stimulating) in the fenugreek seeds which stimulates the appetite and motivation to eat so ,improved in FCR due to the beneficial effect on gut microfilaria .**(Murry *et al.*, 1991).Abo ElNor (1991**) suggested that the fenugreek seeds may have an effect on hypothalamus gland to stimulate hungriness center in the brain and increase the desire for eating, so it may lead to improve body weight and performance and affect on the digestive system (**Hernandez *et.al* 2004, Hind *et.al*2013**).

The presence of viscous polysaccharides (galactomannan) will slow the rate of gastric emptying which determines the rate at which nutrients are exposed to the

digestive enzymes and absorptive surface in the small intestine and hence may increase the rate of nutrient absorption.(**Gallaher et al.,2001**)

Result obtained absorbed that, no significant difference were illustrated between all treatment groups in giblets percentages (gizzard, liver and heart).Data showed numerical increase in liver and heart to chicks fed on diets supplemented with fenugreek essential oil . The result was in line with the findings of **(Farman *et al.*, 2009; Alloui *etal*.,2012** and **Tariq *etal*.,2014).**who found that , the gizzard, liver and heart percentages were not significantly affected by the dietary fenugreek seeds. These results were disagree with those obtained by (**Azoua, 2001**).

Effect of fenugreek oil on some blood constituents of broiler chicks showed that the addition of fenugreek oil to chick's diets increased serum content of total protein and albumin. It is known that the change in albumin levels reflects in the liver function, since the liver is the site of albumin synthesis but globulin is formed by lymphatic tissues (21). Azouz ( ) found that the total protein of serum increased significantly by feeding Hubber broiler chicks on diets supplemented with fenugreek seeds .The increment in total serum proteins may be attributed mainly to that fenugreek seeds may stimulate the thyroid gland directly as T3 and T4 of serum increased significantly and led to increase serum protein content (20).

Raghuram (33) stated that fenugreek seeds or extracts increased the excretion of bile acids and so reduced cholesterol content of serum due to the presence of unsaturated fatty acids in the seed .On the other side Lanksy (25) attributed this effect to steroid saponins which may either compete with cholesterol at binding sites or interfere with cholesterol biosynthesis in the liver.

Chapter six

Conclusion and Recommendations

Conclusion:

The un favorable effective chemical products mainly antibiotics led to search for the effect of using natural products as feed additives .Herbs and plants extracts showed efficiency of feed utilization and growth performance of broiler chicks .Fenugreek essential oil in this regard has many beneficial effects particularly in improve in the performance when included in the broils Chet at 2%without causing any harmful effect an chicks health.

The results of this study revealed of that supplement of in with FEO could be interesting feed additive in improving braid chicks performers.

Recommendations:

According the result of this experiment;

-Fenugreek essential oil could be considered as a potential natural growth promoter.

- based the findings of maybe with while be investigate deferent levels to get if best beneficed effects on performances and immune of broiler checks.

- Future research also should be focus on the use of the natural feed additive and combination FEO with of Eos.

References:

A.O.A.C., (2000). Official Methods of Analysis, 17 Ed,. Association of Official Analytic Chemists International.

Aasim M; Hussain N; Umer EM; Zubair, M; Hussain S.B; Saeed S.H; Rafique T.S .and Sancak C. (2010). In vitro shoot regeneration of fenugreek (Trigonellafoenum-graecumL.) using different cytokinins. Afr. J Biotech 9:(42) 7174- 7179.

Abaza, I.M., (2001). The use of some medicinal plants as feed additive in broiler diets. Ph.D. Thesis, Faculty of Agriculture, Alexandria University, Egypt.

Abaza, I.M., (2007). Effect of using fenugreek, chamomile and radish as feed additives on productive e performance and digestibility coefficients of laying hens. Poult. Sci., 27: 199-218.

Abd El- Aal, M.H.; and Rahma, E.H. (1986). Changes in gross chemical composition with emphasis on lipid and protein fractions during germination of fenugreek seed.. Food Chemistry, 22: 193-207.

Abd El-Aal, E.S.M. and R.S. Attia, (1993). Characterization of blackcumin (Nigella sativa): Chemical composition and lipid. Alexandria Sci.Exchange, 14: 467-482.

Abdul - Rahman, S., Y. and, R. N. Alobaidy. (2012). Effect of Fenugreek seeds and Olive leaves on some physiological characters of laying breeder hens. Mesopotamia Journal of Agriculture. 41(3):111-121.

Abdul - Rahman, S., Y.; Sultan., K. H and Taha., A. T.(2010). The effect of fenugreek seeds on the reproductive performance of aged broiler breeder males. Journal of Tikrit University for Agricultural Sciences. 10 (2) : 156 – 163.

Abdul-Rahman S. Y. (2012). Effect of fenugreek seeds on some physiological characters in broiler breeds males, Mesoptamia J. of Agri. Vol. (40) Suppl. (2) :1-8.

Abou EL-Wafa S; Sayed MAM; Ali SA and Abdallah AG, (2003).Performance and immune response of broiler chicks as affected by methionine and zinc or commercial Fenugreek supplementations. Egypt.Poult. Sci., 23 (III): 523-540.

Abu Saleh M. Moosa,Mamun Ur Rashid,A.Z.S. Asadi, NazmaAra,M. Mojib Uddin and A.Ferdaus (2006). Hypolipidemic effects of fenugreek seed powder. BangladeshJPharmacol2006; 1: 64-67.

Acar, R. (2000). Fenugreek (Trigonella foenum graecumL.) iscultivated. Konya Ticaret Borsası Dergisi, (7):26-31. Konya.

Acharya S.N.; Thomas J.E. and Basu S.K. (2008) Fenugreek, analternative crop for semiarid regions of North America. Crop Science48:841-853.

Ahmadiani, A.; M. Javan,; S. Semnanian; E. Barat and M.Kamalinejad, (2001). Anti-inflammatory and antipyretic effects of Trigonella foenum-graecum leave extracts in the rat. J.Ethnopharmacol., 75: 283-286.

Ahmed T. Taha (2011). Effect of dietary supplementation with different levels of Fenugreek seeds (Trigonella foenum graecum) onsemen quality and histological testis traits of Japanese quail (Coturnixcoturnix japonica). Diyala Agricultural Sciences Journal, 3(1) 1 – 9.

Akgül,A.(1993). Baharat Bilimi ve Teknolojisi. Gıda Bilimi Derneği,yayın no:15.S:71-72.

Al-Habori M. and Raman A. (1998) Antidiabetic and hypocholesterolaemic effects of fenugreek. Phytotherapy Research12:233-242.

Al-Habori M. and Raman A. (2002) Pharmacological properties, in: G.A. Petropoulos (Ed.), Fenugreek - The genus Trigonella, Taylor and Francis, London and New York.pp. 162-182.

Alkatan,M. M. (2006).Effect using some antioxidants on production performance and some physiological characters in laying hens. Ph.D.Thesis. College of Agriculture and Forestry, University of Mosul . Iraq.

Alkofahi, A., R. Batshoun, W. Owais and W. Najib, (1996). Biological activity of some Jordanian medicinal plant extracts. Phytotherapeutics,67: 435-442.

Alloui N.; Ben Aksa S.; Alloui M.N. and Ibrir F.(2012)Utilization of Fenugreek (Trigonella Foenum-Graecum) as Growth Promoter for Broiler Chickens J. Worlds.

Altuntas, E., Engin Ozgoz, O. and Taser, F. (2005). Some physical properties of fenugreek (Trigonella foenum-graecum) seeds. Journal of Food Engineering, 71, 37–43.

Amal, O.A. ; A.M. Mukhtar ; K.A. Mohamed and A.H. Ahlam(2013). Use of Halfa Bar Essential Oil (HBO) as a Natural Growth Promoter in Broiler Nutrition. International Journal of Poultry Science12 (1): 15-18, 2013.

Ammerman GB, (1999). Effect of dietary zinc source and method of oral administration on performance and tissue trace mineral concentration of broiler chicks. J. Anim. Sci., 77 (7): 1788-1799.

Awal MA; Rashid MU; Ahmed KW; Asadi ZS and Islam K. (1999) Effect of karela and fenugreek on lipid profile in hypocholesterolemic diabetic patients. Bangladesh J Physiol Pharmacol. 1999; 15: 6-8.

Azoua HM (2001). Effect of hot pepper and fenugreek seeds supplementation on broiler diets. Ph D Thesis, Faculty of Agriculture, Alexandria University, Egypt.

Balaraman R; Dangwal S and M Mohan M. (2006). Antihypertensive effect of Trigonella foenum –graecum seeds in experimentally induced hypertension in rats. Pharmaceutical Biology 2006; 44: 568-575.

Basch, E., C. Ulbricht, G. Kuo, P. Szapary and M. Smith,(2003).Therapeutic applications of fenugreek. Altern. Med. Rev., 8: 20-27.

Bhatti, M.A., M.T.J. Khan, B. Ahmed, M. Jamshaid and W.W.Ahmad, (1996). Antibacterial activity of Trigonella foenum-graecum seeds. Phytotherapeutic.67: 372-374.

Bin-Hafeez B., Haque R., Parvez S., Pandey S., Sayeed I., RaisuddinS. (2003). Immunomodulatory effects of fenugreek (Trigonella foenum graecumL.) extract in mice. International Immunopharmacology 3:257-265.

Brenac, P. and Y. Sauvaire (1996a). Chemotaxonomic value of sterols and steroidal sapogenins in the genus Trigonella. Biochem. Syst. Ecol.,24: 157-164.

Brenac, P. and Y. Sauvaire (1996b). Accumulation of sterols and steroidal sapogenins in developing fenugreek pods: possible biosynthesis in situ. Phytochemistry, 41: 415-422.

Brenes A. , E. Roura (2010). Essential oils in poultry nutrition: Main effects and modes of action. Volume 158, Issues 1-2, Pages 1–14.

Chantry CJ, Howard CR, Montgomery A, Wight N (2004).Use of glactogogues in initiating or augmenting maternal milk supply. The academy of breast feeding medicine.

Chhibba IM, Nayyar VK, Kanwar JS (2007). Influence of Mode and Source of Applied Iron on Fenugreek (Trigonellacorniculata L.) in a Typic Ustochrept in Punjab, India. Int. J. Agric. Biol. 9: 254-256

Chopra, R. N. L . C. Chopra. , K . L. Honda and, L. D.kapur.(1982). Chopras endogenous drag of India, Academic publisher, Calculate, New Delhi , India. P. 582.

Cross, H.R.R. Moen and Stafield, M.S. (1978) training and testing of judges for sensory evaluation of meat quality food Technology, 32: 48-52.

Devasena,T. and Menon V.P., (2002). Enhancement ofcirculatory antioxidants by fenugreek during 1,2-dimethylhydrazineinducedrat colon carcinogenesis. J. Biochem. Mol. Biol. Biophys., 6:289-292.

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

EL- kaiaty , A.M.; Soliman, A.Z.M.; and Hassan M.S.- H. (2002).The physiological and immunological effects of some natural feed additives in layer .hen diets . Egypt. Poult . Sci. 22: 175-203

El-Husseiny, O.S., Shalash, M. And Azouz, H.M. (2002). Response of broiler performance to diets containing hot pepper and or fenugreek at different metabolizable energy levels. Egypt Poultry Science Journal,22: 387-406.

El-Katcha, M.I.(1990).Effect of linseed oil and characterization of black cumin (Nigella sativa) seeds. 2-Proteinss.Alex.Sci. Exch.,14:483-496.

Ellis,N.(1981).The nutrient composition of Sudanese animal feeds. Bulletin(1). Northern and Central Animal Nutrition Research Laboratry. Kuku Research Centre, Khartoum North, Sudan.

El-Mahdy, A.R. & El-Sebaiy, L.A. (1983). Changes in carbohydrates of germinating fenugreek seeds (Trigonella foenum graecum L.). Journal of the Science of Food and Agriculture, 34, 951–956.

El-Shimi, N.M., Damir, A.A. and Ragab, M. (1984). Changes in some nutrients of fenugreek seeds during germination. Food Chemistry,14,11–19.

Erin , AN; Spirin , M.M ; Tabidze .L. V.and V.E. Kagan. (1984).Formation of - tecopherol complexes with fatty acids. Ahypothetical Mechanism Of Stabilization Of Biomembranes By Vitamin E . Biochem.Biophys. Acta.774:96 – 102

Faman Ullah, K, Durrani FR, Asad S, Rifat Ullah K and Shabana N(2009). Effects of Fenugreek (Trigonella foenum-graecum) seed extracton visceral organs of broiler chicks. ARPN Journal of Agricultural and Biological Science, 4, 1: 58-60.

Fotopoulos C. (2002) Marketing, in: G. A. Petropoulos (Ed.),Fenugreek - The genus Trigonella, Taylor and Francis, London and New York. pp. 183-195.

Fraker PJ, Hass SM, Luecke RW, (1977). Effect of zinc deficiency onthe immune response of the young adult mouse. J. Nutr., 107: 1889.

Gallaher, Daniel D., and Barbara O. Schneeman (2001): "Dietary Fiber." In *Present Knowledge in Nutrition.* 8th ed., edited by Barbara A. Bowman and Robert Russell. Washington, D.C.: ILSI Press.

Guler, A.D., Altimus, C.M., Ecker, J.L., and Hattar, S. (2007).Multiple photore-ceptors contribute to non image-forming visual functions predominantly through melanopsin-containing retinalganglion cells. Cold Spring Harb.Symp. Quant. Biol.72, 509–515

Guo FC, Kwakel CRP, Soede J, Williams BA et Verstegen MW(2004). Effect of a Chinese herb medicine formulation, as an alternative for antibiotics, on performance of broilers. British Poultry Science, 45:793-797.

Halfhide, B., (2003). Role of the European Probioti Association. Proceedings: Role of probiotics in animal nutrition and their link to the demands of European consumers, Lelystad, the Netherlands,pp: 3-4.

Hamden K, Jaouadi B, Serge Carreao, Samir Bejar, Abdel Fattah Elfeki. (2010). Inhibitory effect of Fenugreek Galactomannan on digestive enzymes related to Diabetes, Hyperlipidemia, and liver-Kidney dysfunctions. Biotechnology and Bioprocess Engineering 2010; 15: 407-413.

Hannan J.M.A., Ali L., Rokeya B., Khaleque J., Akhter M., FlattP.R., Abdel-Wahab Y.H.A. (2007) Soluble dietary fiber fraction of Trigonella foenum-graecum (fenugreek) seed improves glucosehomeostasis in animal models of type 1 and type 2 diabetes by delaying carbohydrate digestion and absorption, and enhancing insulin action. British Journal of Nutrition 97:514-521.

Hannan J.M.A., Rokeya B., Faruque O., Nahar N., Mosihuzzaman M., Khan A.K.A., Ali L. (2003) Effect of soluble dietary fiber fraction of Trigonella foenum-graecum on glycemic, insulinemic, lipidemic and platelet aggregation status of Type 2 diabetic model rats. Journal of Ethnopharmacology 88:73-77

Hemavathy J., Prabhakar J.V. (1989) Lipid composition of fenugreek(Trigonella foenum-graecum L.) seeds. Food Chemistry 31:1-7.

Hernandez AI, Madrid J, Garcia V, Orengo J et Meglas MD (2004). Influence of two plant extracts on broiler performances, digestibility and digestive organs size. Poultry Science, 83: 169-174.

Hooda, S. and Jood, S. (2003). Effect of soaking and germination onnutrient and antinutrient contents of fenugreek (Trigonella foenumgraecum L.). Journal of Food Biochemistry, 27, 165–176.

Jensen R. (1992). Fenugreek, overlooked but not forgotten. UCLALactation Alumni Newsletter. 1992; 1: 2-3.

Kassaian N, Azadbakht L , Forghani B,Amini M. (2009). Effect of Fenugreek seeds on blood glucose and lipid profiles in type 2 diabetic patients. Int. J Vitamin Nutr. Res 2009;17:737-743.

Kaviarasan S, Vijayalakshmi, K, Anuradha C V. (2004). Polyphenol-Rich extract of fenugreek seeds protect erythrocytes from oxidatived amage. Plant Foods for Human Nutrition 2004; 59:143-147.

Khan MB, Khan MA, Sheikh M (2005). Effect of phosphorus levelson growth and yield of fenugreek. Int. J. Agric. Biol. 7: 504-507

Kidd MT, Qureshi MA, Ferket PR, Thomas LN, (1994). Blood clearance of escherichia coli and evalution of mononuclear-phagocyticsystem as influenced by supplemental dietary zinc methionine in young turkeys. Poult. Sci., 73:1381-1389.

Kumar V., J.S. Yadar, J. Singh B.D. Yadav, (2000). "Irrigation and Phosphorus Requirements of fenugreek (Trigonella foenum-graecum L.)on Light soil", Indian J. Agric Sci., 70 (8), 2000, pp. 515-517.

KUTLU, H.R., (2007). Searching for alternative to antibiotics,, growth stimulants. Cumhuriyet gazetesi (13.02.2007)19.Effect of Seed Powder of a Herbal Legume Fenugreek (Trigonella foenum-graceum L.) on Growth Performance, Body Components, Digestive Parts, and Blood Parameters of Broiler Chicks

Laila, A.E.-S. & Ahmed, R.E.-M. (1983). Lipid changes during germination of fenugreek seeds (Trigonella foenum-graecum). Food Chemistry, 10, 309–319.

Lee KW, Everts H, Kappert HJ, Breynen AC (2004a): Growth performance of broiler chickens fed a carboxymethyl cellulose containing Diet with supplemental carvacrol and/or cinnamaldehyde.International Journal of Poultry Science 3, 619–622.

Lodhi, G.N., D. Singh and I. Ichoponani (1976). Variation in nutrientcontents of feeding stuffs rich in proteins and reassessment of thechemical methods of metabolizable energy estimation for poultry. Journal of Agricultural Science. 86: 293-303.

Madar Z., Abel R., Samish S., Arad J. (1988) Glucose-lowering effect of fenugreek in non-insulin dependent diabetics. European Journal of Clinical Nutrition 42:51-54.

Madar Z., Shomer I. (1990) Polysaccharide composition of a gel fraction derived from fenugreek and its effect on starch digestion and bile acid absoprtion in rats. Journal of Agricultural and Food Chemistry.

Madhava Naidu, M., Shyamala, B.N., Pura Naik, J.,Sulochanamma, G. and Srinivas, P. (2010). Chemical composition and antioxidant activity of husk and endosperm of fenugreek seeds. LWT Food Science and technology, 44, 451–456.

Mariam AEY, Mukhtar AM and Mohamed KA (2013). The effect of feeding broiler chicks on prosopis pods flour supplemented with combinations of microbial xylem and phytase enzymes. Journal of Current Research In Science, Voll.. 1,, No.. 2,, pp::90—95.

Max, B. 1992. This and that - the essential pharmacology of herbs and spices. Trends Pharmacol. Sci. 13, 15-20.

Mazur, W.M.; Duke, J.A.; Wahala, K.; Rasku, S.; and Adlercreutz,H. (1998). Iso flavonoids and lignins in legumes: Nutritional and health aspects in human , J. Nutr Biochemistry, 9: 193 200.

Metin Duru,1 Zeynep Erdoğan,2 Asuman Duru, AltuğKüçükgül,Vesile Düzgüner, D. Alpaslan Kaya and AhmetŞahin5(2013).Effect of Seed Powder of a Herbal Legume Fenugreek(Trigonellafoenum-graceum L.) on Growth Performance, Body Components, Digestive Parts, and Blood Parameters of Broiler Chicks. Pakistan J. Zool., vol. 45(4), pp. 1007-1014,

Michael, D. and Kumawat. D. (2003). Legend and archeology of fenugreek, constitutions and modern applications of fenugreek seeds International-Symp., USA. pp. 41-42.

Mir Z., S.N. Acharia, P.S. Mir, W.G. Taylor, M.S. Zaman, G.J.Mears, L.A. Goonewardene, (1997). "Nutrient composition, in vitrogaz production and digestibility of Fenugreek (Trigonella foenumgraecumL.) and Alfalfa forage", Canadian J. Animal Sci., 77, 1997, pp.119-124.

Mir Z., P.S. Mir, S.N. Acharia, M.S. Zaman, W.G. Taylor, G.J.Mears, L.A. Goonewardene, (1998) "Comparison of Alfalfa and Fenugreek Silages Supplemented with Barley Grain on Performance of Growing Steers", Canadian J. Animal Sci., 78, 1998, pp. 343-349.

Moorthy, R .Prabhu, K.M. and Murthy, P.S. (2010).Ant hyperglycemic compound (G_) from Fenugreek seeds, its purification and effect in diabetes mellitus. Indian J Exp Bot 48: 1111-1118.

Morsy, M.M.A.(1995). The use of fenugreek (Trigonella foenumgraecum), clove (Syzgium Aromaticum) in broiler nutrition as feed additives. M.Sc. Thesis, Fac. Of Agric, Alexandria Univ, Egypt.

Moustafa, kout El-Kloub (2006) . Effect of using commercial and natural growth promoters on the performance of commercial laying hens. Egypt . poult . Sci. 26: 941-965 .

Mukhtar Ahmed Mukhtar (2011). The Effect of Dietary Clove Oil on Broiler Performance .Australian Journal of Basic and Applied Sciences, 5(7): 49-51.

Mukhtar, M. A; K.A. Mohamed; Amal, O.A. and Ahlam, A.H.(2013). Response of Broiler Chicks to different Dietary Levels of Spearmint Oil(SPO) as a Natural Growth Promoter. University of Bakht Alruda Scien.fic Journal Issue No. 6 ,175 183.

Mukhtar, M. A.; K.A. Mohamed; Amal, O.A ; Ahlam, A.H.(2013).Response of Broiler Chicks to Different Dietary Levels of black Cumin Oil as a Natural Growth Promoter University of Bakht Alruda Scientific Journal Issue No. 7 ,185-190.

Mukhtar Ahmed Mukhtar, M. Sena Al-Fadil, and Mohammed H.Tabidi(2013). Responsible of broiler chicks to diets containing gum Arabic as natural prebiotic. Journal of current research in science (ISSN 2322-5009). Vol. 1, No. 4, pp:247-253.

Murlidhar, M. and T.K. Goswami, (2012). A review on the functional properties, nutritional content, medicinal utilization and potential application of fenugreek. J. Food Proc. Tech., 3: 1-10.

Murray RK, Granner DK, Mayes PA et Rodwell VW (1991). TheText Book of Harpers Biochemistry. 22 Edn. Applecton and large. Norwalk, Connecticut/Loss Altos, California.

Nabila Y. Mahmoud, Rabab H. Salem and Amal A. (2012).Mater Nutritional and Biological Assessment of Wheat Biscuits Supplemented by Fenugreek Plant to Improve Diet of Anemic Rats Academic Journal of Nutrition 1 (1): 01-09, 2012

Nadir Alloui, S. Ben Aksa, M.N Alloui(2012).Utilization of Fenugreek (Trigonella Foenum-Graecum) as Growth Promoter for Broiler Chickens. J. World's Poult. Res. 2(2): 25-27, 2012.

National Research Council. (1994). Nutrient Requirements of Poultry.9th rev. ed. National Academy Press, Washington, DC.

Nazar AE, EL-Tinay AH. Functional properties of fenugreek (Trigonella foenum-graecum) protein concentrate. Fd. Chem. 2007; 103:582-589.

Nithya, K.S. and B. Ramach and ramurty,.(2007) .Screening of some selected spices with medicinal value for Cu (II)-ninhydrin positive compounds. Int. J. Biol. Chem., 1:62-68. Cross Ref | Direct Link |

Pandian RS, Anuradha CV, Vishwanathan P. (2002). Gastroprotective effect of fenugreek seeds (Trigonella foenum– graecum) on experimental gastric ulcer in rats. Journal of Ethno pharmacology 2002;81:393-397.

Petit P.R., Sauvaire Y.D., Hillairebuys D.M., Leconte O.M., BaissacY.G., Ponsin G.R.,Ribes G.R. (1995b) Steroid saponins from fenugreek seeds - extraction, purification and pharmacological investigation on feeding behavior and plasma cholesterol. Steroids60:674-680.

Petropoulos G.A. (2002) Fenugreek - The genus Trigonella, Taylor andFrancis, London and New York. pp. 255.

Puri D., Prabhu K.M., Murthy P.S. (2002) Mechanism of action of a Hypoglycemic principle isolated from fenugreek seeds. Indian Journal of Physiology and Pharmacology 46:457-462.

Rabia J.A., 2010 - Effect of Using Fenugreek, Parsley and Sweet Basil Seeds as Feed Additives on the Performance of Broiler Chickens. University of Basra, Iraq, International Journal of Poultry Science, Vol.9 (3): 278-282.

Radwan, Nadia, L. (2003). Effect of using some medicinal plants on performance and immunity of broiler chicks. Ph. D . Thesis, Fac. Of Agric .,Cairo Univ., Egypt.

Raghuram T.C., Sharma R.D., Sivakumar, B. and Sahay B.K.(1994) Effect of fenugreek seeds and intravenous glucose disposition in non-insulin dependent diabetic patients. Phytotherapy Research 8: 83-86.

Rajagopalan, M.S. (1998). "Fenugreek, what this herb can offer?", Naturally, 1, 1998, pp. 1-4.

Rao Udayasekhara, P.; and Sharma, R.D. (1987). An evaluation of mprotein quality of fenugreek (Trigonella Foenum graecum L.) and their supplementary effects. Food Chemistry, 24: 1-9.

Rayes N, Sechofer D, Neuhaus P. (2009). Prebiotics, probiotics,synbiotics in surgery--are they only trendy, truly effective or even dangerous? Langenbecks Arch Surg 2009; 394(3): 547-55.

Safa MA El Tazi1, Zolikha M. A, K.A Mohamed2, Mukhtar Ahmed Mukhtar(2014). Response of Broiler Chicks to Diets Supplemented with Garlic Essential Oil as Natural Growth Promoter. International Journal of Science and Research (IJSR) Volume 3 Issue 52319-7064.

Sathyanarayana Shakuntala ; Jarpala Pura Naik,; ThangarajJeyarani ;Madineni Madhava Naidu1 and PullabhatlaSrinivas(2011).Characterisation of germinated fenugreek (Trigonella foenumgraecumL.) seed fractions International Journal of Food Science and Technology 2011, 46, 2337–2343 2337.

Sauvaire Y., Baccou J.C., Besancon P. (1976). Nutritional value ofproteins of a leguminous seed - fenugreek (Trigonella foenum-graecumL.). Nutrition Reports International 14:527-537.

Sauvaire Y., Baissac Y., Leconte O., Petit P., Ribes G. (1996) Steroid saponins from fenugreek and some of their biological properties. Advances in Experimental Medicine and Biology 405:37-46.

Sayed M.S., and Hesham,M.A., (2002). Response of broilerperformance to diets containing hot pepper, and /or fenugreek at different metabolizable energy levels. Cairo University, Giza, Egypt, Egyptian Poult.Sci, Vol. 22(11):387-406.

Schryver, T., (2002). Fenugreek. Total Health, 24: 42-44.6. Basch, E.,C. Ulbricht, G. Kuo, P. Szapary and M. Smith, 2003. Therapeutic applications of fenugreek. Alt. Med. Rev., 8: 20-27.

Seleem T.S.T. ; M.A. Elsawy, W.A.A. Ali and H.E. Radwan (2008).Rabbit productivity and reproductivity as affected by Fenugreek in diets. The first Egyptian Conference on Rabbits Sciences Nutrition & Feeds.

Shalini Hooda and Sudesh Jood, (2002). Effect of soaking and germination on nutrient and anti-nutrient contents of fenugreek. Available at: http://www.pfigueiredo.org/ Bro37.pdf.

Shalini, H. & Sudesh, J. (2003). Effect of soaking and germination on nutrient and antinutrient contents of fenugreek (Trigonella foenum graecum L.). Journal of Food Biochemistry, 27, 165–176.

Sharma R.D. (1984). Hypocholesterolemic activity of fenugreek (Trigonella foenumgraecum) - an experimental study in rats. NutritionReports International 30:221-

Sharma R.D. (1986b) Effect of fenugreek seeds and leaves on blood glucose and serum insulin responses in human subjects. Nutrition Research 6:1353-1364.

Sharma R.D., Raghuram T.C., Rao N.S. (1990) Effect of fenugreek seeds on blood glucose and serum-lipids in type-1 diabetes. European Journal of Clinical Nutrition 44:301-306.

Srinivasan K. (2005). "Plant foods in the management of diabete smellitus: spices as beneficial antidiabetic food adjuncts". International Journal of Food Sciences and Nutrition 2005; 56: 399-414.

Srinivasan, K. (2006). Fenugreek (Trigonella foenum-graecum): Areview of health beneficial physiological effects. Food-Reviews-International, 22, 203–224.

Steel,G. D. R. and H. J. Torrie (1980).Principles and procedures of statistical Biometrical approach.p.633. 2nd.University of Wisconsin.

Steiner T (2009). Phytogenics in Animal Nutrition. Natural Concepts to Optimize Gut Health and Fenugreek for Broiler Chickens

Taha., A. T.(2008). The Role of Vitamins A, C and Fenugreek Seeds in Lowering Oxidative Stress Effect on Physiological and Reproductive Performance of Males Broiler Breeder. PhD. Thesis, College ofAgriculture and forestry, University of Mosul.

Tariq Mamoun, Mukhtar Ahmed Mukhtar and Mohamed H Tabidi , (2014). Effect of fenugreek seed powder on the performance ,carcass characteristics and some blood serum attributes .Adv. Res. Agri. Vet. Sci. Vol. 1, No. 1: 6-11.

Tuncer, H.İ., (2007). To banned usage of hormones, antibiotics, anticoccidials and drugs in compound animal feed. Journal of Lalahan Anim. Res. Inst., 47:29-37.

Vats V., Yadav S.P., Grover J.K. (2003) Effect of Trigonella foenum graecum

on glycogen content of tissues and the key enzymes of carbohydrate metabolism.Journal of Ethnopharmacology 85:237-242.

Waibel PE, Vaughan GD, Behrends BR, (1974). Effect of zincmethionine complex on growth and reproduction in turkeys. Poult. Sci.,53: 1988 (Abstr.).

Xue, W.L., LI, X.S., Zhang, J., Liu, Y.H., Wang, Z.L. and Zhang, R.J.,(2007). Effect of Trigonella foenumgraecum (fenugreek) extracts on blood glucose, blood lipid and hemorheological properties in streptozotocin induced diabetic rats. Asia Pac. J. Clin. Nutr.,16(Suppl.1):422-426.

Zargar AH, Nehru A, Laway BA, Dar FA (1992). Effect of consumption of Powdered fenugreek seeds on blood sugar and HbAIc levels in patients with Type II diabetes mellitus. Intl. J. Diab. Dev. Count. 12: 49-5

Appendice

Card used for judgment of subjective

Meat quality attributes

Sensory Evaluation Card

Evaluate this sample for color, flavor, juiciness and tenderness. For each sample, use the appropriate scale to show your attribute by checking at the point that desk describes your feeling about the sample. If you have any question please ask. Thanks for your cooperation.

NameDate_____.

Tenderness	**Flavor**	**Color**	**Juiciness**
6-Extremely tender	6-Extremely intense	6-Extremely desirable	6-Extremely Juicy
5-Very tender	5-Very intense	5-Very desirable	5-Very Juicy
4-Moderately tender	4-Moderately intense	4-Moderatel desirable	4-Moderately Juicy
3-Slightly tender	3-Slightly intense	3-Slightly desirable	3-Slightly Juicy
2-Slightly tough	2-Slightly bland	2-Slightly desirable	2-Slightly Juicy
1- Moderately tough	1- Moderately bland	1- Moderately undesirable	1- Moderately dry

Serial	**Sample Code**	**Tenderness**	**Flavor**	**Color**	**Juiciness**	**Comment**


WEIGHT
UNIT PRICE
1290


WEIGHT
UNIT PRICE


1445