EFFECT OF MORINGA, THYME, SUMAC AND THEIR MIXTURE ON BROILER PERFORMANCE, CARCASS QUALITY AND BLOOD PARAMETERS

Amed Mohammed Ameen MOHAMMAD

MASTER THESIS

Department of ANIMAL SCIENCE

Supervisor: Assoc. Prof. Dr. Bünyamin SÖGÜT

2017

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This thesis was unanimously approved by the following jury on 13.06.2017

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PREFACE

To begin with, I thank (Allah) for his blessing who made me able to complete and perform this study with success. I would like to take this opportunity for expressing my sincere gratitude to my dear supervisor, Assoc. Prof. Dr. Bünyamin SÖGÜT for his guidance and patience throughout the project. I would like to acknowledge and thank the presidency of Bingol University, the Deanery of Faculty of Agricultural Sciences and the department of animal science for giving me the chance and providing the available facilities to achieve this proposed project.

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Amed Mohammed Ameen MOHAMMAD

Bingöl 2017

CONTENTS

LIST OF SYMBOLS

SYMBOL	: DESCRIPTION
DM	: dry matter
MLP	: Moringa leaves powder
SFP	: Sumac fruit powder
TLP	: Thyme leaves powder
MST	: mixture of Moringa, Sumac and Thyme
MOLM	: Moringa Oleifera leaf meal
ML	: MOLM low
MM	: MOLM medium
MH	: MOLM high
(+C)	: positive control
T1	: Control (No addition)
T2	: Moringa leaves powder 1%
T3	: Sumac fruit powder 1%
T4	: Thyme leaves powder 1%
T5	: Mixture Moringa, Sumac & Thyme 1%
GC-MS	: Gas chromatography–mass spectrometry
LBW	: Live body weight
BWG	: Body weight gain
FCR	: feed conversion ratio
FI	: feed intake
kg	: kilogram
mg	: milligram
g	: gram
mg/dl	: milligram per deciliter
d	: day
HDL	: high density lipoprotein
LDL	: low density lipoprotein
VLDL	: very low-density lipoprotein

LIST OF FIGURES

LIST OF TABLES

MORİNGA, KEKİK, SUMAK TOZLARI VE KARIŞIMININ ETLİK PİLİÇLERİN BESİ PERFORMANSI, KARKASS KALİTESİ VE KAN PARAMETRELERİ ÜZERİNE ETKİLERİ

ÖZET

Bu çalışma, üç bitki tozun (moringa yaprak tozu, sumak meyve tozu ve kekik yaprak tozu ve bunların karışımları) 1% konsantrasyonu ile besi performansına, karkas özelliklerine ve broilerin bazı kan parametrelerine etkisini araştırmak amacıyla yürütülmüştür. Toplam yüz seksen adet bir günlük erkek broyler civcivleri (Ross 308), 3 tekerürlü beş gruba şansa bağlı olarak dağıtıldı. Civcivler geldikten sonra tartıldılar ve 7 gün süre ile beraber büyütüldüler. Civcivler 8. günde çevre kontrollü yer kafeslerine konuldu ve deneme sonuna kadar aynı yerde beslendi. Peletlenmemiş yem (ad libitum), sırasıyla 7-21, 22-35 ve 36-42 günlerde başlangıç, büyütme ve bitirme olara civcivlere sunuldu. Canlı ağırlık, canlı ağırlık artışı, yem tüketimi ve yem dönüşüm oranı haftalık olarak kaydedildi. Deneme sonunda, karkas oranı ve kan parametrelerini analiz etmek için toplam 30 piliç kesildi. Moringa tohum tohumları (T2), Sumak meyve tozu (T3) ve Moringa, Sumak ve Kekik karışımı (T4) broiler civcivlerdeki canlı ağırlık ve yem dönüşüm oranı üzerinde önemli (P <0,05) ve pozitif etkilere sahip olmuştur. Muamelelerin, T3 grubundaki hayvanların karkas verimi, but ve kanat yüzdeleri hariç, karkas özellikleri üzerinde önemli bir etkisi olmamıştır. Sumak ve kekik yemi katkı maddelerinin abdominal yağ ve bazı iç organ ağırlıkları üzerinde etkisi olmuştur, ancak diğer diğer muameleler etkili olmamıştır. Kontrol grubuna kıyasla Sumac ve Kekik grubunda abdominal yağ anlamlı olarak azaldığı (P <0,05) gözlenmişitr. Ayrıca, denem süresinde kontrol grubuna kıyasla, muamele gruplarında yemden yaralanma oranı daha iyi idi. Moringa ilavesi yem tüketimi üzerine önemli etkisi (P> 0,05) yoktu. Kontrol grubuna ve diğer muamele gruplarına kıyasla Kekik yem tüketimine etkili olmuştur. Ayrıca kontrol grubuna ve diğer muamele gruplarına kıyasla T5 grubundaki kan Albumin haricinde serum biyokimya analizinde gözlenen belirgin (P> 0,05) bir etki gözlenmemiştir. Kan lipidleri açısından T2, T3 ve T5'te Trigliseridler, LDL ve VLDL üzerinde anlamlı etkiler (P <0,05) vardı. Ancak, muameleler arasında ortalama kolestrol ve HDL arasında anlamlı bir farklılık yoktu. Sonuç olarak, araştırmaya göre, ticari broyler rasyonunda antibiyotik yerine büyüme promotörü olarak tek başına Moringa oleifera veya bitki karışımı (Moringa, Sumak ve Kekik)'nın kullanılması önerilmektedir.

Anahtar Kelimeler: Broiler, moringa, sumak, kekik, besi, kan, karkas.

EFFECT OF MORINGA, THYME, SUMAC POWDERS AND THEIR MIXTURE ON PERFORMANCE, CARCASS QUALITY AND BLOOD PARAMETERS IN BROILER CHICKEN

ABSTRACT

This study was conducted to find the effect of inclusion of three herbal powders (moringa leaves powder, sumac fruit powder and thyme leaves powder and their mixture) with 1 % concentration on fattening performance, carcass traits and some blood parameters of broiler. A total of one-hundred-eighty-one day-old-male-broiler-chicks (Ross 308) were divided into five dietary treatments with 3 replicates. On arrival, the birds were weighted and fed together by 7th day of age. Chicks were put in floor pens in a controlled house at 8 d of age, and kept till end of the experiment. Non-pelleted diets (ad libitum) were offered as starter, grower and finisher at 7-21, 22-35 and 36-42 days, respectively. Clean water was provided throughout the period of the experiment. Live body weight, body weight gain, accumulative feed intake and feed conversion ratio were recorded weekly. At the end of experiment, totally 30 birds were slaughtered to analyze carcass cuts percentages and blood parameters. Moringa leaves powder (T2), Sumac fruit powder (T3), and Moringa, Sumac and Thyme mixture (T4) had significant ($P<0.05$) and positive effects on live body weight (LBW) and feed conversion ratio in broiler chicks. The treatments did not have significant effect on carcass traits except carcass yield, thighs and wings percentages of the birds in T3 group. Sumac and thyme feed additives had effects on abdominal fat and some of internal organs weights, but other treatments did not, however abdominal fat was decreased significantly ($P<0.05$) by Sumac and Thyme compared to control group. Also there were positive effects on the most of broilers feed conversion ratio comparing to the control group during the experiment. Also there were no significant ($P>0.05$) effects observed in serum biochemistry analysis, except Albumin of the blood in group T5 as compared to control group and other treatments. In terms of blood lipids, there were significant effects ($P<0.05$) on Triglycerides, LDL and VLDL in T2, T3 and T5. But there were no significant differences in mean cholesterol and HDL among treatments. As a result, according to the research, it is recommended to use mixture of alternative herbal plants (Moringa, Sumac and Thyme) and Moringa oleifera alone for growth promoter in spite of antibiotic in the commercial broiler ration.

Keywords: Broiler, moringa, sumac, thyme, fattening, blood and carcass.

1. INTRODUCTION

Chicken production considers one of the most common animal production species in developed countries due to the cost which is outside the reach of the common man. World Health Organization (WHO) recommended an animal protein intake of 60gm per day is hardly met. It has been reported that, the cost of feed represents up to 60-80% of the total cost of broiler chicks production (Teguia and Beynen 2005), Accounts of feed cost for up to 80% of the total cost of production and is a very important component to finding out the extent of poultry survival and then profitability. Unremitting use of antibiotics in poultry may result in remainder effects in poultry products which may make the bacterial resistance against treatments in the human body. Because of these disadvantage effects to human health, the European Union since 2006 use of antibiotics in poultry was completely banned (Catala et al. 2008). At present prevalent infectious diseases is the major trouble to the whole world which causes the financial failure to the poultry farmers. Also other factors like vaccination failure, infection by immune-oppressive diseases, and using antibiotics with the poor experience can cause deficiency in animal immunity. Various alternatives to these antibiotic growth promoter replacements have been proposed to used such as organic acids and medicinal plants as natural feed additives are now recently used in poultry nutrition to improve the performance of the immune response of birds (Saki et al. 2012).

The medical plants have been the motif of stupendous scientific investigation. Plain and practical application, which is available and not expensive, with characteristics of the whole herbs application in compare to extract or essential oil forms. Due to present a number of pharmacologically effective materials, become to have a field for growth increment of livestock, they are supposed to promote activate digestive enzymes, stimulate immune and feed intake (Lee et al. 2003). Research on the use of mixing of herbal powders might tend to be more effective than of using one herb administration. Therefore there is a needed to innovation more efficient alternatives or blending of

various alternatives to maintaining health and amendment the performance of poultry and other livestock (Fritz et al. 1993). Some authors said significant positive effects on broiler performance (Ertas et al. 2005). Another group of authors proved no effect on gain, feed conversion or feed intake (Cross et al. 2007). Recently, there are a lot of concerns to detecting non-synthetic alternatives for antibiotics amongst the scientists. The affirmative influence of herbal plants on broiler chickens have been reported via many studies. Their antibacterial possibility, growth promoting, hypocholesterolemic effects and availability are the most useful part of herbs, which have towed the scientist's attention themselves (Mansoub 2010). Costumers use alternatives like medicinal plants, probiotics, organic acids, and in spite of higher award of this method, these products have more fans in the costumers (Ipu et al. 2006).

Thyme (Thymus vulgaris) contain the main phenolic components Thymol (5-methyl-1-2-isopropyl phenol) and carvacrol (5-isopropyl-2-methyl phenol) (Masada et al. 1976). Thymus vulgaris species has special functions such as antimicrobial, antioxidant, expectorant, antispasmodic and antiseptic characteristic (Abu-Darwish et al., 2009). Performance promoting influences of extract, essential oil, powder or principal components of thyme have been demonstrated in poultry (Lee et al 2003). Influence of dietary supplemental plant extracts on digestive system development, intestinal microflora of broiler chicks carcass characteristics, performance and some blood parameters, (Tekeli A et al. 2006).

Sumac (Rhus coriaria L. used as a spice and with the long history of use by indigenous people as a medicinal plant, and other applications. The fruits of sumac contain hydrolysable tannins, flavonols, phenolic acids, anthocyans and organic acids such as malice, citric and tartaric acids (Özcan and Haciseferogullari 2004).

Moringa oleifera tree, from the roots to the leaves has beneficial properties. Various parts of Moringa are used as fodder, spices, herbal medicine, food, natural coagulants, fertilizer, nectar for bees and fuel. Moringa contains very high anti-inflammatory and antioxidants compounds (Yang et al. 2006). The leaves, flowers, and pods are used as better sources of vitamins A, B and C, folic acid, ascorbic acid, nicotinic acid, riboflavin, pyridoxine, beta-carotene, iron, calcium, and alpha-tocopherol (Dahot 1988). The pods

are considered as an interesting source of the essential amino acids. A compound, pterygospermin found in the flowers and roots of the Moringa has strong fungicidal and antibiotic effects (Das et al. 1957). The leaves of Moringa Oleifera have increase immunity in broilers. Thus, leaf meal from both Moringa oleifera and Moringa stenopetala might be good feed additives in livestock production, (Du et al. 2007).

2. LITERATURE REVIEWS

2.1. Moringa (Moringa Oleifera) Medical Plant

2.1.1. History and Origin Distribution of Moringa Tree

The origin of Moringa oleifera is from North West India (Ramachandran et al. 1980). It was subsequently introduced to many parts of the world. At present it is vastly distributed in the tropics through the Pacific region (Aregheore 2002), Middle America and the Caribbean (Foidl et al. 1999; Ramachandran et al. 1980), as well as West Africa (Lockett et al. 2000; Freiberger et al. 1998). The most considerable common names in the Pacific are variants of malunggai, Katdes Sajina or kalamunggai and Benaile. Common name in English includes Drumstick tree (description of its pod's shape), Horseradish tree (a description the taste of its roots). And it was profited by the ancient Greeks, Romans, and Egyptians. It is an exemplary multipurpose tree of considerable economic importance because of its leaves and fruits, there are many medicinal and industrial applications and various products to be utilized as food and feed (Ramachandran et al. 1980). It is worth noting that Moringa is one of the most beneficial tropical trees. Moringa has the assurance to save the lives of millions of people on our planet.

2.1.2. Moringa Species

List describe of 13 Moringa species and with their indigenous (Leone et al. 2015), in the following:

1- *Moringa arborea* -Kenya
2- *Moringa borziana* -Somalia
3- Moringa concanensis -India
4- *Moringa drouhardii* -Madagascar
5- *Moringa hildebrandtii* -Madagascar

6- *Moringa longituba* -Ethiopia and Somalia
7- *Moringa oleifera* -India
8- *Moringa ovalifolia* -Namibia and Angola
9- *Moringa peregrina* -Horn of Africa and in the Sinai, Egypt (Dadamouny 2009)
10- *Moringa pygmaea* -Somalia (Dadamouny et al. 2016)
11- *Moringa rivae* -Kenya and Ethiopia
12- *Moringa ruspoliana* -Ethiopia
13- *Moringa stenopetala* -Kenya and Ethiopia (Dadamouny et al. 2016)

2.1.3. Botanical Classification

According to the site of United State Department of Agriculture (USDA 2016), Moringa oleifera is classified as the following:

Kingdom: Plantae – Plants
Subkingdom: Tracheobionta – Vascular plants
Superdivision: Spermatophyta – Seed plants
Division: Magnoliophyta – Flowering plants
Class: Magnoliopsida – Dicotyledons
Subclass: Dilleniidae
Order: Capparales
Family: Moringaceae – Horse-radish tree family
Genus: Moringa Adans. – moringa
Species: *Moringa oleifera Lam.* – horseradishtree

2.1.4. Description of Moringa

Moringa is a perennial tree, with fast growth which can reach a maximum height of 7-12 m and a diameter of 20-40 cm at height of chest (Morton 1991). The physical characteristics of Moringa parts, the alternative twice or thrice pinnate **leaves** grow for the most part at the branch tips. They are greyish-downy, 20-70 cm long when young long petiole with 8-10 pairs of pinnae each holding two pairs of inverse elliptic and one at the peak all 1-2 cm long with glands at the bases of the petioles and pinnae (Morton 1991). The **stem** is naturally straight but on occasion is poorly formed, that can

reach up to 3.0 m. The lengthen branches grow in a confused way and with umbrella shape of the canopy (Morton 1991). The **flowers** which are pleasantly fragrant and 2.5 cm wide are produced profusely in axillary drooping panicles 10 to 25 cm long. They are white or cream color and yellow-dotted at the base. The five reflexed sepals are linear-lanceolate. The five petals are slender spatulate. They surround the five stamens and five staminodes and are reflexed except for the lowest (Morton 1991). The **fruits** are consisting of three lobe pods are 20-60 cm in length, which drop to down from the branches. Each pod contains between 12 and 35 seeds, and they unfold into 3 parts after drying. Each tree capable of producing about 15.000 to 25.000 seeds pre year. The average weight of seed is 0.3 g and the kernel to hull ratio is 75:25 (Makkar and Becker 1997).

2.1.5. Uses of Moringa Oleifera Tree

People use the leaves, fresh pods and flowers of Moringa as vegetables while others use it as feed for livestock (Anjorin et al. 2010). The oil obtained from Moringa seeds is used for cooking and was found to contain high levels of unsaturated fatty acids (Lalas and Tsaknis 2002). Moringa is one of the most utilize tree in the world, and as nearly all parts of the Moringa tree are used for food, medication, and industry (Khalafalla et al. 2010). This tree has the prospect to improve nutrition, promote food security, and provides a lot of leafy substance that is useful when using alley cropping systems (Hsu 2006). One of the interest industrial applications is the use of Moringa seeds for the water-cleaning purpose (Kalogo et al. 2001; Broin et al. 2002). Moringa applies enormous potential for serving the world in many ways, such as Human Health improvement, use as a Fodder supplement in Livestock; use as an enhancer in plant growth and for biogas production.

2.1.6. Chemical Composition and Nutrition Content of Moringa

Moringa is an important source of nutrients for rural people in explicit areas of India and West Africa (Lockett et al. 2000). Most reports indicate that Moringa leaves have a high percentage of protein and presence an amino acid composition, which is desirable for human and animal nutrition (Makkar and Becker, 1996; Freiberger et al. 1998). High biomass production of Moringa of more than 100 tons of dry matter (DM)/hectare can

be attained under intensive farming conditions (Foidl et al. 1999). Recently, with a high degree of renewed concern was placed on the nutritional properties of Moringa in many countries where it was not native (Reyes et al. 2006; Oduro et al. 2008). The leaves, flowers, and pods are used as perfect sources of Protein, vitamins, minerals and oil. Moringa nutrition content and Protein (Abrams B et al. 1993) also, studies in countries indicate that the leaves have a high nutritional value such as amino acids vitamins, and minerals (Anwar et al. 2007). as showed in Tables 2.1, 2.2 and 2.3.

Table 2.1. Chemical Composition and Nutrition Content of Moringa in the leaves, flowers, and pods

Nutrition analysis	**Pods (per 100 g)**	**Fresh leaves (per 100 g)**	**Dried leaf (per 100 g)**
Moisture %	86.9	75	7.5
Calories	26	92	205
Protein (g)	2.5	6.7	27.1
Fat (g)	0.1	1.7	2.30
Carbohydrates (g)	3.7	13.4	38.2
Fiber (g)	4.8	0.9	19.2
Minerals (g)	2	2.3	–
Calcium (mg)	30	440	2003
Magnesium (mg)	24	24	368.0
Phosphorous (mg)	110	70	204.0
Potassium (mg)	24	24	1324
Copper (mg)	3.1	1.1	0.6
Iron (mg)	5.3	0.7	28.2
Oxalic Acid (mg)	10	101	0.0
Sulfur(mg)	137	137	870

Table 2.2. Chemical Composition and Nutrition Content of Moringa as protein content (Abrams B et al. 1993)

Amino acid content (per 100 g)	**Pods**	**Fresh leaves**	**Dried leaf powder**
Arginine (mg)	360	406.6	1325
Histidine (mg)	110	149.8	613
Lysine (mg)	150	342.4	1325
Tryptophan (mg)	80	107	425
Phenylalanine (mg)	40	310.3	1388
Methionine (mg)	140	117.7	350
Theroine (mg)	390	117.7	1188
Leucine (mg)	650	492.2	1950
Isoleucine (mg)	440	299.6	825
Valine (mg)	540	374.5	1063

Table 2.3. Chemical Composition and Nutrition Content of Moringa as source of vitamins and Minerals content (Anwar and Bhanger 2003; Prakash 1988)

Vitamin content (per 100 g)	**Fresh leaves**	**Dried leaves**
Carotene (Vit. A) mg	6.78	18.9
Thiamin (B1) mg	0.06	2.64
Ribofavin (B2) mg	0.05	20.5
Niacin (B3) mg	0.8	8.2
Vitamin C mg	220	17.3
Calcium mg	440	2,003
Calories cal	92	205
Carbohydrates g	12.5	38.2
Copper mg	0.07	0.57
Fat g	1.70	2.3
Fiber g	0.90	19.2
Iron mg	0.85	28.2
Magnesium mg	42	368
Phosphorus mg	70	204
Potassium mg	259	1,324
Protein g	6.70	27.1
Zinc mg	0.16	3.29

2.1.7. Biological Properties of Moringa

A prominent number of reports on the nutritional qualities of Moringa nowadays exist in both the scientific and the popular writing. Moringa has been in use for centuries for nutritional as well medicinal purposes. Moringa leaves are entire of essential disease-preventing nutrients. Moringa is a natural food source for antioxidants, and other important compounds that body depends on to stay healthy (Ramachandran et al. 1980; Price 2002; Dhar et al. 1982). Some reported nutritional, prophylactic and therapeutic uses of Moringa oleifera, one of traditional use as antibacterial (Das et al. 1957; Gopalakrishna et al. 1954; Holst S.2000; Kurup and PL Narasimha 1952; Kurup et al. 1954; (ingha Begum et al. 1993). Also leaves of Moringa oleifera containing natural antibacterial for urinary tract bacterial infection (Shaw, and Jana 1982). In other condition like in viral as Antiviral, the leaves of Moringa oleifera, holds a strict structural necessity for inhibition of tumor-promoter- caused Epstein-Barr virus activation (Murakami et al. 1998), efficiency of Thai medicinal plant extracts against herpes simplex virus type 1 infection in vitro and in vivo (Lipipun et al. 2003), a prospective report of dietary intake and acquired immune insufficiency syndrome in HIV-seropositive homosexual men (Abrams et al. 1993), and HIV infection and severe malnutrition (Prazuk et al. 1993). Also, Moringa oleifera leaves used against of many parasites such as Helminths (Fuglie 1999), and Trypanosomes parasite (Mekonnen et al. 1999), also used against another pathogen like Bronchitis, Fever (Fuglie 1999), external sores/ulcers (Caceres and Lopez 1991). Moringa oleifera leaves contain antioxidant compounds (Njoku and Adikwu 1997; Siddhuraju and Becker 2003), Protein (Fuglie 1999), Energy (Lockett et al. 2000), Carotenoids (Delisle Bakari et al. 1997; Nath Sethi et al. 1997; Subadra et al., 1997). Moringa oleifera leaves act as antiseptic (Fuglie 1999), and many other Disorders of Moringa oleifera leaves in Catarrh, Lactation, Scurvy (Fuglie 1999), Carotenoids iron deficiency (Chawla Saxena et al. 1988), Vitamin/Mineral deficiency (Babu 2000; Barminas et al. 1998; Pankaja Prakash 1994).19

2.1.8. Uses of Moringa in Broilers Diets

Moringa leave have been used as feedstuff like some other plant leave for poultry and rabbit as a supplement or as a partial substitute for the cereal grains and forages.

(Melesse et al. 2009) had studied the effects of Moringa stenopetala leaf meal (MSLM) as fed basis in feed intake and weight gain of birds. The experimental which contained (MSML) in the diets to replace of the crude protein, the results showed that the dry matter, daily feed and crude protein feeding of the chicks fed (MSLM) diets were higher ($p<0.05$) than fed the control diet, also the average weight gain of chicks fed (MSLM) supplement diets were higher ($p<0.05$) than fed the control diet. Feed efficiency ratio and protein efficiency ratio were higher for chicks fed MSLM. The results indicated that MSLM is a potential plant for protein add and with included to 6% in the diet could be a source of protein for grower chicks to alternative expensive protein sources.

(Oluglcemil et al. 2010) Had examined the effect of the additive of Moringa cassava leaves meal with intake levels of (0%, 5%, 10%, 15%) on broiler chicks performance and a score of growth and blood chemistry. It was established that the rate of supplement 5% can be applied in the finisher diet without any adverse effect on the growth performance, carcass aspects, and blood parameters.

(Gadzirayi et al. 2012) studied the effects of supplementing Moringa oleifera leaf meal with soybeans as a protein source in poultry production, were the experimental diets with intake levels of (0%, 25%, 50%, 75%, 100%) of Moringa oleifera Leaf when the results were recorded significant differences in feed conversion ratios. (Banjo 2012) determined the impact of additive of Moringa leaves meal in broiler chicks diets with various levels at (0%, 1%, 2%, 3%), the results indicated that there was a difference significant ($P > 0.05$) in weight gain for diet at level 2% and there were no significant differences in feed intake and feed conversion. A study by (Soad 2010) showed the effect of feed Moringa oleifera at levels (0%, 2%, 4%, 6%) significant differences ($P>0.05$) between the tested groups in the final body weight, weight gain, and abdominal fat. And demonstrated results in this experiment it can add Moringa oleifera leaf meal even 6% without any significant effect on broiler performance growth and carcass characteristic.

2.2. Thyme (*Thymus vulgaris*) Medical Plant

2.2.1. History and Origin of Thyme

Thyme is the general name for the many differences of the Thymus species, there are about 350 Thymus species in the mint family, and between them there is a Thymus vulgaris L. which is a native of the western Mediterranean, but it also found arising in North America (Armstrong 2001) and observed growing intense, in rocky areas and on meadow throughout Eurasia, in Egypt (Worwood, 1990; Bown 1998). The spread of thyme across Europe was by the Romans, as they used it to purify their rooms and flavoring cheese and liqueurs. (Grieve and Mrs Maud 1931; Retrieved 2008). Thyme is known as culinary, and common names are common thyme, wild thyme, mountain thyme, garden thyme and creeping thyme. The name of Thymus comes from the Greek word "thymon", which is meaning courage, and extracts of the thyme plant may have been drunk before battle to supply strength. It is cultivated in France, Germany, Hungary and many other countries (Stary and Jirasek 1973).

2.2.2. Thyme Species

There are about 350 species of the thymus, (Jalas and Jaakko 1971); (Easter, Margaret 2008). And there are some of them in the following:

1. *Thymus Adamo vici*
2. *Thymus altaicus*
3. *Thymus caespititius*
4. *Thymus camphoratus*
5. *Thymus capitatus*
6. *Thymus camphoratus*
7. *Thymus carnosus*
8. *Thymus decussatus*
9. *Thymus disjunctus*
10. *Thymus glabrescens*
11. *Thymus herba-barona*

12. *Thymus hirsutus*
13. *Thymus integer*
14. *Thymus lanuginosus,*
15. *Thymus leucospermus*
16. *Thymus mastichina*
17. *Thymus membranaceus*
18. *Thymus mongolicus*
19. *Thymus moroderi*
20. *Thymus pallidus*
21. *Thymus pannonicus*
22. *Thymus praecox*
23. *Thymus proximus*
24. *Thymus pseudolanuginosus,*
25. *Thymus quinquecostatus*
26. *Thymus richardii*
27. *Thymus serpyllum*
28. *Thymus sibthorpii*
29. *Thymus vulgaris* – common thyme
30. *Thymus zygis*

2.2.3. Botanical Classification of Thyme

Botanical Classification of Thyme is according to the site of United State Department of Agriculture (USDA 2016). Thymus vulgaris is classified as the following:

Kingdom: Plantae – Plants
Subkingdom: Tracheobionta – Vascular plants
Superdivision: Spermatophyta – Seed plants
Division: Magnoliophyta – Flowering plants
Class: Magnoliopsida – Dicotyledons
Subclass: Asteridae
Order: Lamiales
Family: Lamiaceae – Mint family

Genus: Thymus L. – thyme

Species: *Thymus vulgaris L.*

2.2.4. Description of the Thyme Plant

Thymus integrates a broad variety of evergreen, aromatic, woody-based perennials and shrubs. Thymus vulgaris L. is a semi-shrub with height about 30- 45 cm, with linear to oval leaves and bearing small, flowers are cylindrical in shape ranging from white to purple between May to October (Bown 1998).

2.2.5. Chemical Composition and Nutrition Content of Thyme

Thyme herb plant (Thymus vulgaris), Fresh leaves and dried leaves, Nutritive value per 100 g. (USDA National Nutrient data base 2016) as in the Table 2.4.

Table 2.4. Chemical Composition and Nutrition Content of Thyme

Content	**Fresh leaf**	**Dried leaf**
Water	65.11 g	7.79 g
Energy	101 kcal	276 kcal
Protein	5.56 g	9.11 g
Total lipid (fat)	1.68 g	7.43 g
Carbohydrate	24.45 g	63.94 g
Fiber, total dietary	14.0 g	37.0 g
Minerals		
Calcium	405 mg	1890 mg
Iron, Fe	17.45 mg	123.60 mg
Magnesium, Mg	160 mg	220 mg
Phosphorus, P	106 mg	201 mg
Potassium, K	609 mg	814 mg
Sodium, Na	9 mg	55 mg
Zinc, Zn	1.81 mg	6.18 mg
Vitamins		
Vitamin C, total ascorbic acid	160.1 mg	50.0 mg
Thiamin	0.048 mg	0.513 mg

Riboflavin	0.471 mg	0.399 mg
Niacin	1.824 mg	4.940 mg
Vitamin B-6	0.348 mg	0.550 mg
Folate, DFE	45 µg	274 µg
Vitamin B-12	0.00 µg	0.00 µg
Vitamin A, RAE	238 µg	190 µg
Vitamin A, IU	4751 IU	3800 IU
Vitamin D (D2 + D3)	0.0 mg	7.48 µg
Vitamin D	0 IU	0 IU
Lipids		
Fatty acids, total saturated	0.467 g	2.730 g
Fatty acids, total monounsaturated	0.081 g	0.470 g
Fatty acids, total polyunsaturated	0.532 g	1.190 g
Fatty acids, total trans	0.000 g	0.000 g
Cholesterol	0 mg	0 mg

2.2.6. Usage of Thyme

Thyme has been used in culinary as to preserve and give an aromatic to flavor cheeses, stews, butter, tomatoes, onions, pickles, fish, and game. It has been known for its strong smell and comparatively pleasing flavor (MAFF 1980). Thyme has been used for the treatment of respiratory and digestive diseases, gargles, mouthwashes and toothpaste due to its antiseptic properties (Stary and Jirasek 1974; Armstrong 2001; Bremness 1991) and also treating warts, whooping cough, neuralgia, rheumatism, acne and fatigue in aromatherapy (Worwood 1990). The essential oil component of thyme, thymol, has a broad range of uses in the manufacturing of perfumes, liqueurs, toilet articles and pharmaceutical products (Rougemont 1989).

Throughout applied to the trachea, thymol and carvacrol have relaxant properties, and thyme extracts have an enhancement in the secretion of bronchial mucus (Duke 1985). The burning of thyme is guessed to expel insects, it is used as antifungal to treat mildew, and it is a component in toothpaste. It is also reported that has the ability to stimulate the increase of white blood corpuscles to resist the infection (Bremness 1991).

2.2.7. Biological Properties of Thyme

New studies have shown that Thymus species have effective antiparasitic, antibacterial, antifungal, antiviral, spasmolytic and antioxidant activities (Stahl-Biskup and Saez 2002). Thyme oil is amid the world's top 10 essential oils and used as to preserve the food (Stahl-Biskup and Saez 2002). It is full in essential oils and antioxidative phenolic components (WHO 1999). Many ethnomedicinal properties are ascribed to decoctions, infusions and essential oils of the upper parts of Thymus species, which are used due to their tonic, digestive, carminative, antioxidant, antispasmodic, antimicrobial, antiviral, antiinflammatory and expectorant activity, for the treatment of colds (Nickavar et al. 2005; Pirbalouti 2009). Thyme is a regarded as folk remedy for anaemia, asthma, bad breath, bronchitis, bruises, callosities, cancer, catarrh, colds, colic, cough, cramps, diabetes, diarrhoea, dysmenorrhea, fever, flatulence, gastritis, gastroenteritis, gingivitis, gout, headache, indigestion, nerves, neuralgia, sciatica, sclerosis, snakebite, sore throat, sprains, tumours, warts, whooping cough and worms (Duke 1985).Carvacrol kills pathogenic microorganism by destroyed their cytoplasms and also prevents an increase in plasma triglyceride and cholesterol (Sengul et al. 2008). The essential oil of Thymus vulgaris has been distinguished as phenolic compounds such as thymol (44.4-58.1%), carvacrol (2.4-4.2%) and γ- terpinene (6.9-18.9%). These compounds have effective antibacterial, which found in the extracted water-soluble fraction of thyme (Sengul et al. 2008). Thymol and Carvacrol have been demonstrated to scope from as low as 3% to as high as 60% of total essential oils (Lawrence and Reynolds 1984). Volatile oil from (Thymus vulgaris) was evaluated for antibacterial and antiviral activity to inhibiting the microbial growth (Rahimi et al. 2008).

2.2.8. Thyme Herb in Broilers Diets

Thyme detected to have antimicrobial, antioxidant and etc. activities and has led to good performance growth for broilers. (Al-Jugifi 2009; Arshad et al. 2012; Mohamed et al. 2012; Tekeli et al. 2011; Herawati and Marjuk 2011) were mentioned that using thyme powder in the diet had a significant positive effect on feed consumption and appetite of broiler chicks. As supplement, essential oils of thyme about 100 and 200 mg/kg reported a significant effect ($p<0.05$) in Feed intake, ($p<0.01$) in feed conversion ratio (Bölükbasi

et al. 2006). As supplement, essential oils of thyme about 100 and 200 mg/kg reported a significant effect ($p<0.05$) in Feed intake, ($p<0.01$) in feed conversion ratio (Bölükbasi et al. 2006). And about 1000 mg/kg reported to had a significant effect ($p<0.05$) in body weight gain (Cross et al. 2007).

2.3. Sumac (Rhus coriaria) medical plant

2.3.1. History and Description of the Sumac

Sumac (Rhus coriaria L.) has a long history of use by native people for medicinal and other applications (Rayne and Mazza 2007; Capcarova et al. 2011). Rhus coriaria is a member of Anacardiaceae family that is used as a spice and alternative medicine. Sumac is found in hot, moderate wheatear, and tropical areas worldwide (Kurucu et al. 1993). Rhus coriaria L. present extensively in the main in the Mediterranean-bordering countries, North Africa, South Europe, Afghanistan and Iran (Nasar-Abbas and Halkman 2004). Rhus coriaria L. (Sicilian Sumac or Tanner's Sumac) usually is grown widely in Asian countries and also in areas of peripheral or on the hoof agricultural capacity. The common name of the Rhus genus is Sumac and includes about 91 of accepted species names in the Anacardiaceae (The plant list 2010). The name "Sumac" comes from "summāq" which means "dark red" in Arabic and Syriac (Quattrocchi 1999). The term of "Sumac" comes from "summāq" from Arabic and Syriac which means "dark red" (Quattrocchi 1999). Sumac has been used as an indigenous source of medication in various dietary cultures all over the world. Sumac is used as a spice and has been used in culinary for millennia. The Greek physician (Pedanius Dioscorides) about 2,000 years ago, wrote in his prodigious "De Materia Medica" ("Of Medical Matters") about the sanitary properties of Sumac, chiefly as a diuretic and anti-flatulent (Norton 2006). Today Rhus coriaria fruits are pressed to extract their essential oils, this practice was acted before by ancient Rome. The oil is then blended with either olive oil or vinegar, according to on the type of condiment sauce which made. Sumac was used for the treatment of symptoms of stroke chronic, as was wrote by Avicenna (Ibn-Sina) in his (well-known book), Canon of Medicine (Zargaran et al. 2013).

2.3.2. Sumac species

At times Rhus has held over 250 species. (Miller et al. 2001; Pell and Susan Katherine 2004). And there are some of Rhus species in the following:

1. *Rhus angustifolia*
2. *Rhus batophylla*
3. *Rhus brenanii*
4. *Rhus chirindensis*
5. *Rhus crenata*
6. *Rhus dentata*
7. *Rhus gerrardii*
8. *Rhus glauca*
9. *Rhus laevigata*
10. *Rhus lancea*
11. *Rhus leptodictya*
12. *Rhus longipes*
13. *Rhus lucida L.*
14. *Rhus pendulina*
15. *Rhus pentheri*
16. *Rhus pyroides*
17. *Rhus sekhukhuniensis*
18. *Rhus tomentosa*

Asia

1. *Rhus chinensis* - Chinese sumac
2. *Rhus delavayi* -Franchet
3. *Rhus verniciflua* (syn. Toxicodendron vernicifluum, lacquer tree)
4. *Rhus succedanea* (syn. Toxicodendron succedaneum)

Australia, Pacific

1. *Rhus taitensis Guill.* (Northeast Australia, Malesia, Micronesia, French Polynesia)
2. *Rhus sandwicensis A.Gray* - neneleau (Hawaii)

Mediterranean Basin

1. *Rhus coriaria* - Tanner's sumac
2. *Rhus pentaphylla* (transferred to the genus Searsia)

Middle East (All of these species have been transferred to the genus Searsia)

1. *Rhus aucheri Boissier*
2. *Rhus thyrsiflora Balf.*

Eastern North America

1. *Rhus aromatica* - fragrant sumac
2. *Rhus copallinum* - winged or shining sumac
3. *Rhus glabra* - smooth sumac
4. *Rhus lanceolata* - prairie sumac
5. *Rhus michauxii* - Michaux's sumac
6. *Rhus typhina* - staghorn sumac

Western North America

1. *Rhus microphylla* - desert sumac, littleleaf sumac
2. *Rhus ovata* - sugar sumac
3. *Rhus rooseae* Manchester - extinct; Middle Eocene
4. *Rhus trilobata* Nutt. - skunkbush sumac
5. *Rhus virens* - evergreen sumac

2.3.3. Botanical Classification of Sumac

According to the (USDA 2016). Rhus coriaria is classified as the following:

Kingdom: Plantae – Plants
Subkingdom: Tracheobionta – Vascular plants
Superdivision: Spermatophyta – Seed plants
Division: Magnoliophyta – Flowering plants
Class: Magnoliopsida – Dicotyledons
Subclass: Rosidae
Order: Sapindales
Family: Anacardiaceae – Sumac family
Genus: Rhus L. – sumac
Species: *Rhus coriaria L.* – Sicilian sumac

2.3.4. Description of Sumac (Rhus coriaria L.)

Rhus coriaria is a shrub or woody vines (3-4) m in height, the leaves compound with (6-8) pairs of small oval leaflets of various sizes, and flowers are white in final inflorescences. The fruits are globes, villus, and reddish drupe when mature, with one seed; they contain tannins, anthocyanin, essential oils, fixed oil and different organic acids. The leaves contain gallic acid, essential oils, (bi) flavonoid, sugar and wax (Ünver and Özcan 2010). Generally, investigations have focused on the tannin and flavonoid contents of Rhus. coriaria leaves, such as length (4.70 mm), weight (0.20)g.

2.3.5. Usage of Sumac

Sumac (Rhus coriaria) has been used in spice mixes and traditionally for hundreds of years (Ali-Shtayeh et al. 2008). Sumac has long been used as a seasoning spice, either in alone form or in mixing with other spices, as a sauce, drink, appetizer, and also as a natural acidulates in food formulas (Abu-Reidah et al. 2014). Rhus coriaria has an importance economic due to its ambling use in preservation of foods, pharmaceutical industries, cosmetic, coloring, veterinary practices and processing technology of animal skins (Bahar and Altug 2009; Kizil and Turk 2010), and also as traditional medicine (Zargari 1997) for the treatment of arteriosclerosis, gastritis and stomach cancer, and because of its presumed analgesic, anorexic, antidiarrheal, antiseptic and antihyperglycaemic properties (Rayne and Mazza 2007; Chakraborty et al. 2009), and for

the saving of antiquities (Kurucu et al. 1993). Sumac was used in folk medicine for the treatment of stroke chronic symptoms, as was described by Avicenna (Ibn-Sina) in his well-known book, Canon of Medicine (Zargaran et al. 2013). Sumac in the Mediterranean region is ordinarily used as a seasonal spice, particularly in meat and fish dishes (Nasar-Abbas et al. 2004). In Turkey whole fruit of Sumac is ground with salt crystals (Mirhadi et al. 2011), while in Iran and Palestine the sumac represents a pure ground fruit without salt crystals of the plant. The ground sumac seeds blended with olive oil, which is used in the food industry in salads and other meals (Kizil and Turk 2010). Nowadays, a lot of literature shows that adding sumac into water or food stuff can have advantageous effects on human and animals (Chakraborty et al. 2009).

2.3.6. Chemical Components and Nutrition Value of Sumac

Chemical components and nutrition value of Sumac is analyzed for Syria sumac fruits (%, dry weight) (Rima Kossah et al. 2009). as in the Table 2.5.

Table 2.5. Chemical components and nutrition value of Sumac fruits

Content	**(Dry weight %)**
Moisture	11.80
Protein	2.47
Fat	7.51
Fiber	22.15
Ash	2.66

And Amino acid profiles of Syrian sumac fruits (Rima Kossah et al. 2009). As compared to the FAO/WHO/UNU reference pattern (mg/g protein). as in the Table 2.6.

Table 2.6. Chemical composition and nutrition protein content of Sumac fruits

Amino acid	**(mg/g protein)**
Essential	
Leucine	1.25

Isoleucine	0.63
Lysine	0.98
Phenylalanine	0.75
Threonine	0.70
Methionine	0.15
Valine	0.71
Tryptophan	0.51
Non-essential	
Arginine	1.09
Histidine	0.68
Cysteine	0.18
Aspartic acid	1.70
Glutamic acid	2.45
Serine	0.93
Glycine	0.60
Alanine	0.96
Tyrosine	0.51
Proline	1.43

2.3.7. Biological Properties of Sumac

Many writing reports show that the addition of Sumac to the feed or water can impart an advantageous effect on both human and animals (Capcarova et al. 2012). Sumac which is one of the medicinal sources belongs to Anacardacease and it contains a considerable amount of tannic acid. In the ancient time, sumac was used as an anti-diarrhea and anti-bleeding agent (Zargari 1997). Some of the recently published information about the biological activities of Sumac fruit in literature is like Antibacterial effective such as using Hydrodistilled extract (Sağdıç and Özcan 2003), ethanol and methanol extracts of Sumac fruit were effective against Gram positive and Gram negative bacteria (Nasar-Abbas and Halkman 2004), ethanol 95% extract Significant antibacterial activities against all tested bacteria species have been shown (Nimri et al. 1999), methanol extract a strong in vitro antioxidant activity indication of the methanolic extract of sumac fruits (Candan and Sökmen 2004), water extract solution extract Bacteriostatic/bactericidal effects by bacteria cycle reduction exerted by sumac extract have established (Gulmez et al. 2006), fermented and ground sumac (Rhus coriaria) could decrease the formation of biofilm, a major virulence cause in staphylococcal infections (Kırmusaoğlu et al. 2012), Ethanol

20% extract a significant inhibitory activity was indicated by sumac extract against Bacillus cereus. Also, it strongly inhibited the growth of Helicobacter pylori. The fruit extract exhibited a good anti-oxidative function, justifying its use as a natural antibacterial protective (Kossah et al. 2013).

Also the biological activities of Sumac fruit is antioxidant activity for example, methanol extract from results it can be observed a desirable antioxidant effective of sumac which in turn could delay the oxidation of palm oil (Ozcan 2003), methanol extract results indicate a strong in vitro antioxidant activity of the methanolic extract of Rhus coriaria fruit based on hydroxyl radical scavenging (Candan 2003). Some studies about Sumac extracts have demonstrated that polyphenols could have positive effects on cardiovascular disease (Hertog et al. 1995) and cancer (Noroozi et al. 1998), and could be considered as bioactive compounds with a high potency health-promoting capacity. Phenolic compounds restrain lipid peroxidation, take away the superoxide anion and hydroxyl radical (Ruby et al. 1995), and improve the activities of detoxifying enzymes such as glutathione-S-transferase (Piper et al. 1998).

Other biological activities of Sumac fruit is anti-diabetic activity, after fractionation of methanol extract with ethyl acetate and hexane-ethyl acetate fraction of sumac fruits indicated considerable biological activity through α-amylase inhibition indicating significant hypoglycemic activity. (Giancarlo et al. 2006), Ethanol 96% of Sumac Extract raised markedly HDL and reduced LDL, raising superoxide dismutase and catalase activities. Also, it inhibited sucrase and maltase activities (Mohammadi et al. 2010), Ethanolic extract Antidiabetic activity in vivo: Alloxan-induced diabetic Wistar rats (Sharma and Arya 2011).

2.3.8. Uses of Sumac in Broilers Diets

Rayne et al. (2007) Showed that sumac extracts have been detected to have antimicrobial, antioxidant and hypoglycemic activities and has led to better performance growth for broilers. (Ahmadian-attari et al 2007) observed that use of sumac extract can enhance growth and have a good effect on broilers. (Mansoob 2012) showed that using different levels sumac had significant effects on weighing enhancement, an average of weight and

feed conversion of broiler chicks. The enhancement of body weight gain and feed conversion are due to the active materials (cinnamaldehyde and ugenol) present in sumac, inducing higher efficiency in the utilization of nutrition, resulting in improved growth (Lee et al 2003). (Weiner 1994) Reported that some herbal plants or specific combinations of herbs in preparations may act as antioxidants by exerting superoxide scavenging activity or by raising superoxide dismutase activity in various issue sites. The present of Phenolic compounds in sumac restrain lipid peroxidation, scavenge the hydroxyl radical and superoxide anion (Jung 1998; Khalaf et al. 2008) and increase the activities of detoxifying enzymes like glutathione-S-transferase (Mazloom 2011). (Akiba and Matsumoto 1982) the richly level of fibers can increase the excretion of bile cause decreasing the cholesterol level in blood, the major reason of cholesterol and triglyceride reduce in the blood of chicks is substances like carvacrol and thymol which are found in herbs. (Mansoub 2012) established that the serum total cholesterol, triglycerides and LDL concentration were significantly decreased and the serum HDL concentration was significantly increased in treatments which containing sumac powder compared to the control. (Reza Ghasemi et al. 2014) concluded that using sumac extract improve the performance of broilers. Enhancement of health and growth may be due to some biological functions to enhance growth or that maybe due to their role as stimulated, improved digestibility, anti-oxidant antimicrobial and for prevention of gastric toxicity.

3. MATERIAL AND METHOD

3.1. Experimental Place of Research Facilities

The experimental work and all birds feeding studies were carried out at a poultry farm, Animal Science Department, Faculty of Agriculture, the University of Bingol, from May 2, 2016 to June 13, 2016. Bingol is a city found in Bingoel, Turkey. It is situated 38.884720 latitude and 40.493890 longitudes and it is located at elevation 1158 meters above sea level.

3.2. Experimental Design and Plants

3.2.1. Source of Herbal Plants Material

Local feed manufacturers company in Bingol city in Turkey, based broiler starter, grower and finisher, basal diets were formulated according to the ingredient composition. Moringa oleifera leaf powder (MLP) in figure (1) commercially was acquired from online market of Herbal natural international company in the United States, and original of plant from India., Sumac fruit powder (SFP) in figure (2) from our orchard in Dohok-Akre city in Iraq and Thyme leaf powder (TLP) in figure (3) was acquire from Mardin city in Turkey, all herbal plants were purchased as dried grinded and fine powders and they were analyzed in University central laboratory, University of Bingol, by instrument called Gas Chromatography/Mass Spectrometry (GC-MS), to determine active compounds in all of the Moringa, Sumac, and Thyme.

3.2.2. GC-MS Analysis of Herbal Plants

The GC-MS analysis was carried out on a 5975C Agilent in figure (5) provided with a DB-5ms Agilent smelted silica capillary column (30 × 0.25 mm ID; film thickness 0.25 μm), working in electron impact mode at 70 eV. Pure helium (99.999%) was applied as carrier gas at a constant flow of 1 mL/min and an injection volume of 1 μL was used (split ratio is 10:1). Mass transmit line and injector temperature was set at 230 and 250°C, respectively. The oven temperature was scheduled from 70°C°C isothermal for 3 min to 300°C isothermal for 9 min at the range of 10°C/min. Total GC working time was 34 min and the MS detection was completed within 35 min. By GC-MS, the compounds were separated and then they were removed from the column and made come into the detector which had a capability of creating an electronic signal. Then they were treated by the computer for generating chromatogram. Then the compound comes into the electron ionization (mass spectroscopy) detector, where they were bombed with a stream of electrons making them break apart into fragments. These fragments were in reality charged ions with a certain mass. The m/z (mass/charge) ratio received was calibrated from the diagram, called the mass spectrum, and is the fingerprint of the molecule.

3.2.3. Identification of the Compounds

To identify the compounds, the obtained was assigned for comparison of their retention indicators and mass spectra fragmentation forms with those stored in the computer library and also with the issued literature. National Institute of Standards and Technology library sources were also employed for matching the identified compounds from the plant materials (McLafferly FW 1989), (Stein SE 1990). The search report and the results of analyzing of herbal plants in the experiment to determine the active compounds in Moringa (*Moringa oleifera*) leaves powder Table1, Sumac fruit (*Rhus coriaria L.*) powder Table2 and Thyme leaves (*Thymus vulgaris L.*) powder Table3.

3.3. Experimental Design and Birds

A total of one-hundred-eighty-one-day-old-male-broiler-chicks (Ross 308) strain, were purchased from a Banvet commercial hatchery in Elaziğ city/ Turkey. And they were weighed and assigned into five dietary treatments in a complete randomized design. On arrival, they were rising together for one week old and at a 7^{th} day old they were randomly distributed into five dietary treatments and each treatment was divided into three equal replicates to have twelve chicks per replicate. Chicks were put in cages, then after two weeks were kept in floor pens in a controlled house. According to Ross manual 2012, all diets will present to the birds, Moringa, Sumac, and thyme as powders were added to the diet at the 7^{th} day of age. The birds offered non-pelleted diets ad libitum, starter, grower and finisher diets were offered from 7 to 21 days, from 22 to 35 days and from 36-42 days respectively, and clean water is provided all the time throughout the period of the experiment.

3.4. Experimental House

Actually, chicks firstly were housed in battery cages, all treatments were conducted under the same environment including lighting and watering system in a cage house, which it is made by size 90cm × 45cm × 25cm for each replicate. All treatment groups are feeding same diets and rears in battery cages system for the first week after hatch, which each cage contain the automatic electrical heater and light system. After two weeks of the brooding period in the electrical battery cages, they were kept in floor pens in a controlled house in figure (6). The pens as box (1.2 x 1) meter were constructed of iron wall 80cm height. The rest of the wall surrounded of wire netting on all sides. Pens separated from each other by wire netting. They were held in a deep litter housing system on the concrete floor. Wood shavings or sawdust were used as litter at a 5 cm in depth. Before using the house, cages, drinkers, and feeders and all equipment, they were cleaned and disinfected with suitable disinfectants before to the commencement of the experiment. Heating was provided by four electrical heaters, where the initial ambient temperature was set at 33 C˚and was gradually decreased by 2.5 C˚approximately per week to final temperature of 23-22 C˚at the end of experiment according to Arbor Acres Broiler Management Guide 2009 (Table4), with

constant humidity 60-70%, Light Program for improve live performance of Broiler chicks in the experiment according to Arbor Acres Broiler Management Guide 2009 (Table5).Chicks leg-tagged and body weight and feed intake were taken at the beginning of the experiment and subsequently on a weekly. Weight gain, feed conversion ratio and feed efficiency ratios were calculated.

3.5. Data Collection Parameters

Grow performance characteristics include; weekly and final live body weight, weekly and final body weight gain, weekly and accumulative feed intake level, weekly and feed conversion ratio, carcass percentage. All the group of birds was weighed weekly and their feed intake was at the weekly interval on day 0, 7, 14, 21, 28, 35 and 42. At 42 days old of chicks, blood samples for hematological and serum analysis was collected from randomly selected birds. The blood samples were dispensed into tubes for serum analysis. The following blood parameters were determined; total protein, Albumin, triglyceride, total cholesterol, High-density lipoprotein and low-density lipoprotein. Two per birds replicate (Six birds per treatment) of middleweight were randomly selected, starved for 14 hours and then slaughtered by severing the jugular vein and artery. Carcass separated to primal cuts then used to determine the organoleptic properties and proximate compositions of the meat.

3.6. Experimental Design and Rations

Local feed manufacturers company in Turkey, based broiler starter, grower, and finisher basal diets were formulated according to the ingredient composition and feed specification for male broiler chicks grown in the experiment (Carl H. Khan 2004) in (table6). All diets will present to the birds, herbs plants were added to the diet at the 7^{th} day of age. Experimental diets were starter, grower, and finisher, with all of them in non-pelleted form. A starter diet was offered to birds during the period of 7-21 days and included 230g crude protein (CP) and 3.15 Mcal metabolizable energy (ME) kg; a grower diet was offered from 22-35 days and included 212 g CP and 3.20 Mcal ME kg; and a finisher diet was offered from 36-42 days and included 190 g CP and 3.20 Mcal ME kg in (Table7) (Güray Erener et al., 2016). Before to beginning of the

addition of herbs plants the experiment (up to 7 days of age), all chicks were fed on a starter diet containing 230 g CP and 3.15 Mcal ME kg. This study was initiated at 7 days of age. Five dietary treatments namely Control (No addition), Moringa (Moringa oleifera) leaves powder (MLP), Sumac (Rhus coriaria L.) fruit powder (SFP), Thyme (*Thymus vulgaris L.*) leaves powder (TLP), Mixture (Moringa, Sumac & Thyme) leaves powder (MST). The formulation of additive plants in the experiment as the following:

Treatments	Feed additive	%
T1	Control (No addition)	0%
T2	Moringa (*Moringa oleifera*) leaves powder (MLP)	1%
T3	Sumac fruit (*Rhus coriaria L.*) powder (SFP)	1%
T4	Thyme leaves (*Thymus vulgaris L.*) powder (TLP)	1%
T5	Mixture (Moringa, Sumac & Thyme) powder (MST)	1%

3.7. Blood Serum Biochemistry Analysis

Blood samples were obtained from two birds per replicate making a total of six per treatment at forty-two days old of chick, by inserting a new sterile needle into the wing vein of the birds and extracting 2 ml of blood and placing inside sterile test tubes blood samples, and centrifuged at 2,000 rpm for 10 minutes and then the serum was separated, then transferred the blood samples to central laboratory and assayed to measuring, and to determine the blood cholesterol, triglyceride, High-density lipoprotein (HDL), Low-density lipoprotein (LDL) levels, (VLDL) very low density lipoprotein, glucose, total protein, albumin and globulin.

3.8. Evaluation Carcass and Meat Yield

At the end of the experiment at forty-two days old of chick, two birds were randomly selected from each replicate making a total of six per treatment. They were weighed and slaughtered. The birds were starved for 14 hours and then slaughtered by severing the carotid arteries; killer consists of a rotating knife, which severs either the right or left jugular carotid. The birds were bled and then immersed in hot water for 5 minutes to make easy for loosing feathers. The DE feathered carcass was weighed. After dressing, the following weights were taken: carcass weight, gizzard, liver, heart, and shank.

3.9. Statistical Analysis

All data were subjected to statistical analysis as per standard methods outlined by Duncan's multiple range tests Statistical analysis SAS (2005) will be used to analyze the data to account the effects of treatments. The Duncan's multiple range tests will be used to test the significance between means (Duncan, 1955).

3.10. The Performance Traits

3.10.1. Live Body Weight (LBW) and Weight Gain (BWG)

Live body weight was measured by digital balance at one day old and at the end of each week for all birds during the experiment and it was repeated weekly at the same time. Body weight gain(BWG) was calculated by the equation:

Body weight gain (BWG) = B.W at the end of the week - B.W at the beginning of the week. (Naji 2006)

3.10.2. Feed Conversion Ratio (FCR)

During experimental period, growth performance was evaluated. Feed intake is the amount of feed consumed every week and it was calculated for each treatment at weekly at the same time. At the end of the week, the remainder amount of feed was

weighed and subtracted from the known weight of feed at the beginning of the week. The feed intake was divided by the total number of birds.

At the end of experiment Feed conversion ratio (FCR) was calculated; it is the amount of feed consumed per unit of body weight gain as the following equation:

$$\text{Feed conversion ratio (FCR)} = \frac{\text{Feed intake (g) during a period}}{\text{Weight gain (g) during the same period}}$$ (Naji 2006)

3.10.3. Carcass Cuts Percentages

Percentage of breast, legs, wings, and back was calculated by the following equation:

$$\text{Percentage of the cuts} = \frac{\text{Weight of the carcass (g)}}{\text{Weight of the cuts(g)}} \times 100$$ (Hidmi 1994)

Table 3.1. Basic temperature schedule* of the experiment

Age of Birds (days)	Temperature
Day old	33 **°C**
3	31 **°C**
6	30 **°C**
9	28.5**°C**
12	28 **°C**
15	27 **°C**
18	25.5**°C**
21	25 **°C**
24	23.5**°C**
27	23 **°C**
27-42	23-22**°C**

* Basic temperature schedule Recommendations to improve the live performance of chicks in the experiment according to (Arbor Acres Broiler Management Guide 2009).

Table 3.2. Light Program for Broiler chicks flock during experimental period

Age (days)	Intensity (lux) (foot candles)	Day length (Hours)
0-7	30–40 (3–4)	23 light/1 dark
8-3 days before slaughter*	5–10 (0.5–1.0)	18 light/ 6 dark

* For at least the last 3 days prior slaughtering, 23 hours light and 1 hour dark should be provided. Basic recommendations of Light Program for improving the live performance of Broiler chicks in the experiment according to (Arbor Acres Broiler Management Guide 2009).

Table 3.3. Feed Specification for male broiler chicks grown in the experiment

	Age stage		
Feed Specification	**Starter**	**Grower**	**Finisher**
Crude protein (%)	22-25	20-22	18-20
Energy per kg (Kcal)	3010	3150	3200

*Broiler farm production manual, Caribbean Poultry Association, Produced by (Carl H. Khan 2004).

Table 3.4. Composition and ingredients of broiler diets

Ingredient (g kg* as fed)	**Starter**	**Grower**	**Finisher**
Maize, yellow	355.5	330.4	256.8
Soybean meal (480 g CP kg*)	275.3	204.5	171.5
Sunflower meal (350 g CP kg*)	110.0	150.0	111.5
Wheat	99.0	130.0	330.0
Wheat bran	-	38.0	-
Meat-bone meal	64.4	56.0	49.2
Vegetable oil	73.7	85.0	73.6
Limestone	13.6	-	-
Premix1	3.5	3.5	3.1
Sodium chloride	3.0	2.5	2.5
L-lysine	0.4	-	0.1
DL-methionine	1.6	0.1	1.7
Chemical Composition (g kg* as fed)			
ME (Mcal/kg of diet)	3.15	3.20	3.20
Crude protein	230.0	212.0	189.8
Calcium	15.0	9.0	8.0

Available phosphorus	5.0	4.7	3.9
Lysine	12.0	10.0	8.5
Methionine	5.6	4.0	5.2
Methionine + cysteine	9.3	7.6	8.4
Sodium chloride	3.4	2.9	2.9

CP - crude protein; ME - metabolizable energy. * Provides per kilogram of diet: Mn, 80 mg; Zn, 60 mg; Fe, 60 mg; Cu, 5 mg; Co, 0.2 mg; I, 1 mg; Se, 0.15 mg; choline chloride, 200 mg; vitamin A, 12,000 IU; vitamin D3, 2,400 IU; vitamin E, 50 mg; vitamin K3, 4 mg; vitamin B1, 3 mg; vitamin B2, 6 mg; niacin, 25 mg; calcium-D-pantothenate, 10 mg; vitamin B6, 5 mg; vitamin B12, 0.03 mg; D-biotin, 0.05 mg; and folic acid, 1 mg.

Figure 3.1. Left: Mature leaves of Moringa tree. Right: Dried Moringa (Moringa oleifera) leaf powder.

Figure 3.2. Left: the Mature fruit of Sumac tree. Right: Dried Sumac (Rhus coriaria L.) fruit powder.

Figure 3.3. Mature Thyme herb. Right: Dried Thyme (Thymus vulgaris L.) leaf powder.

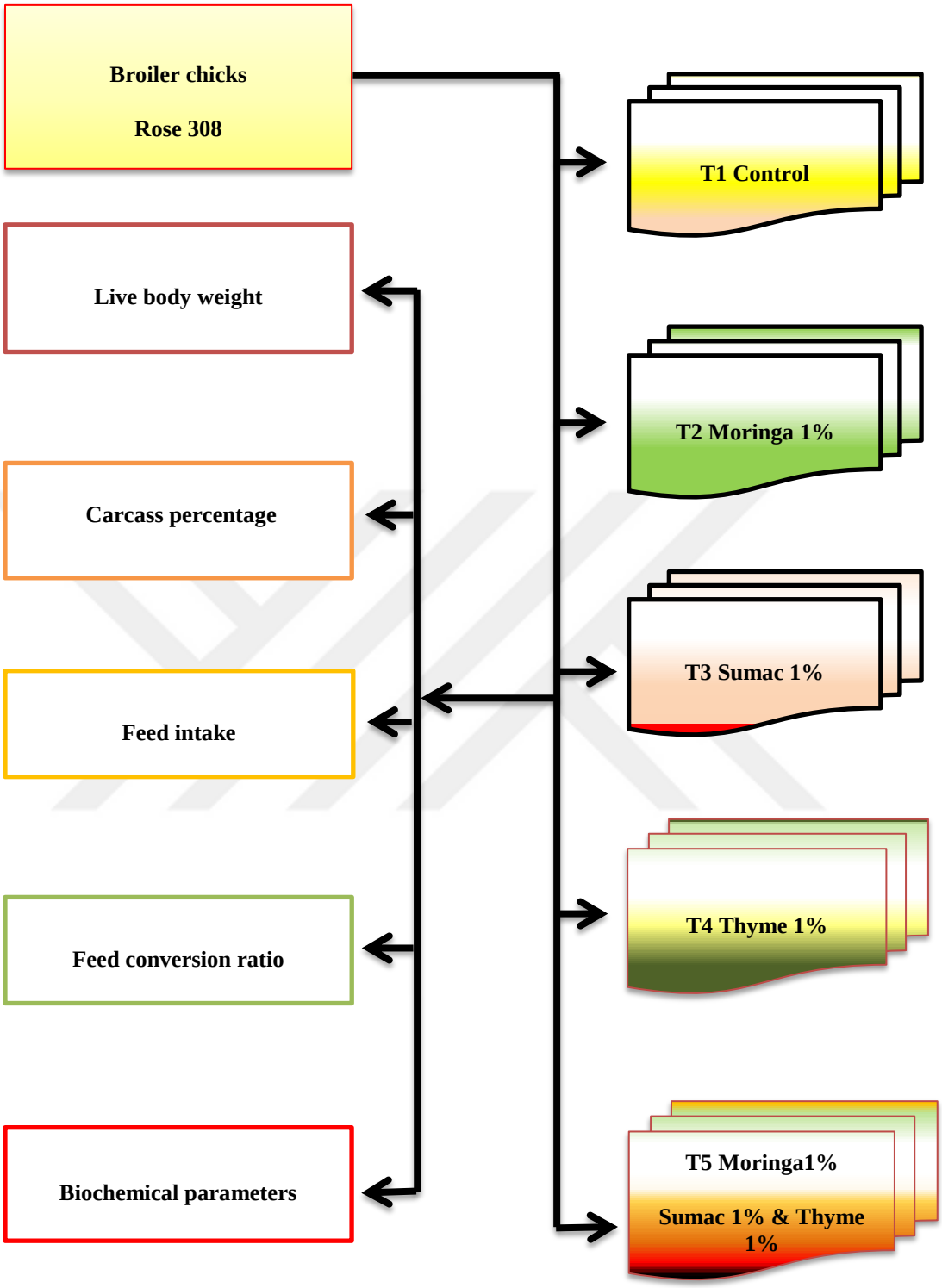

Figure 3.4. The formulation of Parameters and Treatments in the experiment

Figure 3.5. Agilent Technologies 5975c (GC-MS Analysis of herbal plants)

Figure 3.6. left: chicks were housed in cages. Right: chicks were kept in floor pens house

4. RESULTS

4.1 Live Body Weight

In the present study, the effects of herbal feed additives on live body weight of broiler chicks during 7^{th}, 14^{th}, 21^{th}, 28^{th}, 35^{th} and 42^{nd} days of age's period were presented in Table 4.1. Live body weights (LBW) were improved ($p<0.05$) by feeding the diets containing 1% of Moringa leaves powder (T2), 1% of Sumac fruit powder (T3), and 1% of their mixture which consist of Moringa, Sumac and Thyme (T5) in comparing to control (T1) at the end of fatting period. The birds fed the diet containing 1% of Thyme leaves powder (T4) had a lower live body than T1. However, the differences were not significant.

From the results given in experiment, it can be seen that the dietary supplementation of herbal has statistically significant effect on LBW in all fattening periods of broiler chickens. There was a significant ($p<0.05$) difference between treatment groups (T2, T3, T5) and control group at day 14 of age. The differences between control group and (T4) were not significant. The highest and lowest live body weight was observed in group T2 (449.5 g) and T1 (376.6 g), respectively.

There was a significant ($p<0.05$) difference between treatments (T2, T3, T5) and control groups at the 21^{st} day of age. And with decreasing of live body weight in the group (T4) was significant ($p<0.05$) in comparing to control group. The broilers had significantly higher LBW in group T2 (894.4 g) than other groups and the lowest was in group T4 (649 g).

At age of 28 days, birds fed by supplemented with the herb (T2, T3, T5) had higher LBW than control and T4. There was no significant ($P<0.05$) difference between control group and (T3). However, the mean value of LBW for the birds in T4 had lower LBW than T1

(P<0.05). The highest and lowest live body weight was found in group T5 (1392.4 g) and T4 (911.3 g), respectively.

The LBW were higher in all treatment groups (T2, T3, T4, and T5) than T1. The differences were significant (P<0.05) between treatments (T2, T5) and control, however, it was not significant (P>0.05) between treatments (T3, T4) and control. The significant differences between control group at day 35th of age. The highest and lowest results in LBW were noted in the group T5 (1960.3 g) and T1 (1660.5 g), respectively.

In the final period at 42 days of age, in terms of LBW, the results were similar to 35 days of age. Where there was a significant (p<0.05) differences between control group and treatments groups (T2 and T5). And there were no significant differences between control group and treatment group (T3 and T4). The highest and lowest results in live body weight were in the group T2 (2479.7 g) and T1 (1660.5 g), respectively.

Table 4.1. The effect of medical plants powders on live body weight (g) of broilers at different periods

	Live body weight (g) at different time (day)				
Treatments	**0-14**	**0-21**	**0-28**	**0-35**	**0-42**
T1	376.6±10.5^{a}	750.6±27.3^{b}	1168±35.1^{b}	1660.5±59.8^{a}	2275±58.5^{ab}
T2	449.5±10.5^{c}	894.4±27.3^{c}	1371.5±35.1^{c}	1875.2±59.8^{b}	2479.7±53.2^{c}
T3	431.5±10.5^{bc}	841±27.3^{c}	1211.5±35.1^{b}	1811±59.8^{ab}	2387.3±55.2^{bc}
T4	404±10.5^{ab}	649±27.3^{a}	911.3±35.1^{a}	1665.7±59.8^{a}	2194.5±59.8^{a}
T5	447.6±10.5^{c}	887.5±27.3^{c}	1392.4±35.1^{c}	1960.3±59.8^{b}	2436.7±52.3^{c}

T1=Control (No addition), T2=Moringa leaves powder 1%, T3=Sumac fruit powder 1%, T4=Thyme leaves powder 1%, T5= (Mixture Moringa, Sumac and Thyme) 1% and a, b, c = Means between treatments having different letters in the same column are significant ($p<0.05$).

4.2. Carcass Characteristics

Dietary supplementation of 1% of Moringa leaves powder, 1% of Sumac fruit powder, 1% of Thyme leaves powder and 1% of their mixture which consists of Moringa, Sumac, and Thyme. The control group (T1) which hadn't received any herbal feed additives.

As the showed in Table 4.2. the expressions of carcass yield parameter there were no significant effects differences between treatment groups (T2, T5) as compared to control group, except the T3 group which had affected significantly ($P<0.05$) and with the highest value (0.78%) than in comparing to control group. And also there were decreasing of group T4 value significantly ($P<0.05$) differences in comparing to control group.

Birds under the T3 treatment presented the highest thighs percentage (0.31%) significantly ($P<0.05$) difference as compared to the other treatments and control group. there were no significant effects differences between treatment groups (T2, T4, T5) and control group. There were no significant differences in mean heart and liver yield among treatments.

From the results given in experiment, it can be seen that the Breast and Back hadn't recorded any significant influences for all observed treatments in comparing to control group.

In terms of Wings, there were no differences between (T2, T4, T5) as compared to control group significantly. Also, there was a significant ($P<0.05$) difference between treatment group (T3) and control group. The highest and lowest live body weight was observed in group T3 (0.12%) and T1 (0.10%), respectively, and the same case occurred in thighs cuts percentage parameter.

Table 4.2. Carcass characteristics percentage of broiler chickens fed with dietary herbal plants powders addition

Treatment	Carcass yield (%)	Breast (%)	Thighs (%)	Wings (%)	Back (%)
T1	0.77^{b}	0.34^{a}	0.30^{a}	0.10^{a}	0.25^{ab}
T2	0.76^{b}	0.34^{a}	0.29^{a}	0.11^{ab}	0.26^{ab}
T3	0.78^{c}	0.33^{a}	0.31^{b}	0.12^{b}	0.25^{a}
T4	0.67^{a}	0.32^{a}	0.30^{a}	0.11^{ab}	0.26^{ab}
T5	0.73^{b}	0.32^{a}	0.30^{a}	0.11^{ab}	0.27^{b}
SEM	±0.013	±0.008	±0.006	±0.003	±0.007

T1=Control (No addition), T2=Moringa leaves powder 1%, T3=Sumac fruit powder 1%, T4=Thyme leaves powder 1%, T5= (Mixture Moringa, Sumac and Thyme) 1% and a, b, c = Means between treatments having different letters in the same column are significant ($p<0.05$).

4.3. Internal Organ Weight

Internal organs in different treatments were illustrated in Table 4.3. According to the data, there was no significant (P>0.05) difference in terms of the liver weight between all treatments (T2, T3, T4, T5) and control group. However, there was a numerical difference among the tested treatments. The highest liver weight was observed in T2 and the lowest one in T3 and the differences were significant (P<0.05).

The relative weight of gizzard was not affected by Fed additive in treatments groups (T2, T3, T5) in comparing to control group, except T4. The relative gizzard weight of broiler chickens was significantly (P<0.05) decreased by fed additive in T4, in where the gizzard weight was recorded as the lowest.

The results indicated that weight of heart was considerably (p<0.05) higher (26.21g) in group T2 than the groups T1, T3, T4, and it was also higher than group T5 but not significantly. There were significant (p<0.05) differences in the heart between treatment groups (T3, T5) and control group. The lowest heart weight was recorded in control group with 20.25 g.

Abdominal fat weights were varied significantly (p<0.05) depending on herbal feed additive specification in the treatment group; herb decreased the abdominal fat weight in group T4 with the lowest value (27.38 g), and relatively lower in T3 (31.71g) in comparing to the control. The highest weight (41.59 g) was observed in group T1, however, the differences between control and treatment groups (T2, T5) were not significant (P>0.05).

Table 4.3. Effect of the herbal plants powders on internal organs weights traits in broilers

Treatment	Internal Organs (g) Liver	Gizzard	Heart	Abdominal fat
T1	84.68^{ab}	48.78^{b}	20.25^{a}	41.59^{c}
T2	90.89^{b}	53.32^{b}	26.21^{c}	37.97^{bc}
T3	75.75^{a}	50.66^{b}	24.06^{b}	31.71^{ab}
T4	81.74^{ab}	36.64^{a}	21.22^{ab}	27.38^{a}
T5	84.99^{ab}	51.59^{b}	23.75^{bc}	37.37^{bc}
SEM	±3.5	±2.73	±924.4	±2.3

T1=Control (No addition), T2=Moringa leaves powder 1%, T3=Sumac fruit powder 1%, T4=Thyme leaves powder 1%, T5= (Mixture Moringa, Sumac and Thyme) 1% and a, b, c = Means between treatments having different letters in the same column are significant ($p<0.05$).

4.4. Feed Intake

The daily accumulative feed intake (FI) of broiler chicks during 7th, 14th, 21th, 28th, 35th and 42nd days of age's period were presented in Table 4.4.

The birds were fed by supplemented herbal plant at age of 14 days, treatments groups (T2, T4, T5) had no significant differences in comparing to the control group. There was significant ($p<0.05$) difference between control group and T3 only with highest FI (545.02 g). However, FI in group T4 was decreased by feed additive in comparing to control group with the lowest value (385.48) but it was not significant.

According to the results given in experiment at 21 days of age, the dietary supplementation of herbal did not affect ($P>0.05$) the FI in the treatment groups (T2, T3, T5). But it did ($p<0.05$) in T4. The differences between control and T4 with the lowest value (724.75 g) were significant ($P<0.05$).

Same as in 21 days of age results were observed at 28 and 35 days of age's periods, where there was no significant FI between the treatment groups (T2, T3, T5) and control group. However, the differences between T4 and control were significant ($P>0.05$) at 28 and 35 days of age. The lowest FI in the experiment was observed in group T4 with 1309.57 and 1963.65 g at both fattening periods respectively.

Results of this study also indicated that it was not possible to observe a significant difference between the treatment groups (T2, T3, T5) and control one in terms of FI at 42 days of age. On the other hand, the differences between T4 and control were significant ($P<0.05$) as in earlier age. There was no significant FI between the different herbal powders in groups (T2, T3, T5) and control group in broiler chickens. The highest and lowest FI were observed in group T1 (4116.39 g) and T4 (3183.87 g), and the differences were significant ($P<0.05$).

Table 4.4. Effect of the medicine plants powders on daily accumulative feed intake (g) of broilers

	Accumulative feed intake (g) at different time (day)				
Treatments	**0-14**	**0-21**	**0-28**	**0-35**	**0-42**
T1	439.13^{ab}	978.43^{b}	1762.28^{b}	2915.30^{b}	4116.39^{b}
T2	485.98^{bc}	1041.49^{b}	1820.30^{b}	2873.94^{b}	3883.05^{b}
T3	545.02^{c}	1092.16^{b}	1789.77^{b}	2863.21^{b}	4050.19^{b}
T4	385.48^{a}	724.75^{a}	1309.57^{a}	1934.65^{a}	3183.87^{a}
T5	523.95^{b}	1078.78^{b}	1804.81^{b}	2254.29^{b}	3978.70^{b}
SEM	±28.22	±35.14	±47.8	±69.4	±94.16

T1=Control (No addition), T2=Moringa leaves powder 1%, T3=Sumac fruit powder 1%, T4=Thyme leaves powder 1%, T5= (Mixture Moringa, Sumac and Thyme) 1% and a, b, c = Means between treatments having different letters in the same column are significant ($p<0.05$).

4.5. Feed Conversion Ratio

Weekly feed conversion ratio (FCR) of broilers in different treatments was illustrated in Table 4.5. It was noted that FCR was not affected significantly ($P>0.05$) by the treatment groups (T2, T3, T5) received additives feed comparing to control group at 14 days of age. The highest value of FCR was observed in T3 (1.26). There was a significant ($P<0.05$) difference between treatment T4 and control group, and the lowest FCR was detected in T4 (0.95).

At 21 days of age, the bottom line is that all treatments (T2, T3, T4, T5) did not have a significant effect ($P>0.05$) on FCR in comparing to control group during the period of the experiment.

According to the data, also there were no significant ($P>0.05$) differences in both groups T3 and T4 in comparing to control group in FCR at 28 days of ages. The FCR of the birds fed by herbs supplements in group T2 and T5 had significant ($P<0.05$) differences in comparing to the control group. The better FCR value (1.29) was obtained in group T2 and T5 that because of feed supplement Moringa leaves powder presented in T2 and T5.
FCR for broilers at 35 days of ages was varied significantly ($P<0.05$) depending on herbal fed as supplements, so herb for birds fed on each group (T2, T4, T5) decreased FCR significantly in comparing to control group. T4 had the lowest FCR value (1.38, $P<0.05$) as compared to T1 with the highest value (1.78). There were no significant differences between treatments containing Sumac (T3) and control group in FCR at this period.

In the final stage at 42 days of age, all treatments (T2, T3, T4, T5) had significantly ($p<0.05$) lower FCR value in comparing to control group during the experimental study. The differences between control group and T4 were not significant. The highest and lowest in FCR of broilers was observed in group T1 (1.87) and T4 (1.44), respectively.

Table 4.5. Effect of the medicine plants powders of daily accumulative feed conversion of broilers

	Accumulative feed conversion ratio at different time (day)				
Treatments	**0-14**	**0-21**	**0-28**	**0-35**	**0-42**
T1	1.18^{b}	1.34^{a}	1.52^{b}	1.78^{b}	1.87^{c}
T2	1.08^{ab}	1.16^{a}	1.32^{a}	1.53^{a}	1.63^{b}
T3	1.26^{b}	1.29^{a}	1.47^{b}	1.58^{ab}	1.62^{b}
T4	0.95^{a}	1.12^{a}	1.43^{b}	1.38^{a}	1.44^{a}
T5	1.17^{b}	1.21^{a}	1.29^{a}	1.49^{a}	1.63^{b}
SEM	±0.06	±0.07	±0.03	±0.07	±0.04

T1=Control (No addition), T2=Moringa leaves powder 1%, T3=Sumac fruit powder 1%, T4=Thyme leaves powder 1%, T5=Mixture Moringa, Sumac & Thyme 1%. a, b, c = Means between treatments having different letters in the same column are significant ($p<0.05$).

4.6. Serum Biochemistry Analysis

Analyzing of serums for different treatments of broilers chickens were shown in Table 4.6. According to the indications, there were no significant ($p<0.05$) difference in the glucose level parameter between all treatments (T2, T3, T4, T5) and control group. However, the highest and lowest glucose was obtained in group T4 (188.83 mg/dl) and T5 (163.66 mg/dl), respectively.

Total protein of broilers chickens showed behavior similar to that of glucose, so all treatments (T2, T3, T4, T5) had the worst values ($P>0.05$) in comparing to control group. Birds fed additive in group T3 had recorded the highest value in the terms of total protein (4.07 mg/dl) as compared to control group with the lowest value (3.56 mg/dl).

In terms of albumin, there was no significant effect ($P>0.05$) differences between treatments (T2, T3, T4) as compared to control group. Except the significant ($p<0.05$) difference was observed between treatment group T5 and control group. The highest and lowest value in the terms of albumin was observed in group T5 (2.02 mg/dl) and T4 (1.67 mg/dl).

Finally, the serum biochemistry consisting globulin, all treatments (T2, T3, T4, T5) were not recorded any significant effect ($P>0.05$) differences comparing to control group during the experiment study, as the same case occurred in glucose and total protein. The highest and lowest globulin level in broilers was observed in group T2 (2.32 mg/dl) and T5 (1.43 mg/dl), respectively.

Table 4.6. Effect of the medicine plants powders on blood sugar (Glucose) and (Total protein, Albumin/ Globulin ratio) of broilers

	Parameters			
Treatments	**Glucose** (mg/dl)	**Total protein** (mg/dl)	**Albumin** (mg/dl)	**Globulin** (mg/dl)
T1	177.20±11.37^{a}	3.56±0.24^{a}	1.84±0.13^{a}	2.16±0.25^{a}
T2	173.83±10.38^{a}	3.91±0.22^{a}	1.88±0.12^{ab}	2.32±0.22^{a}
T3	174.33±10.38^{a}	4.07±0.22^{a}	1.67±0.12^{ab}	1.96±0.22^{a}
T4	188.83±10.38^{a}	4.00±0.22^{a}	1.90±0.12^{ab}	1.90±0.22^{a}
T5	163.66±10.38^{a}	3.99±0.22^{a}	2.02±0.12^{b}	1.43±0.22^{a}

T1=Control (No addition), T2=Moringa leaves powder 1%, T3=Sumac fruit powder 1%, T4=Thyme leaves powder 1%, T5=Mixture Moringa, Sumac & Thyme 1%. a, b, c = Means between treatments having different letters in the same column are significant ($p<0.05$).

4.7. Blood lipids

The effects of three natural feed additives in broiler diets on blood lipids parameters are summarized in Table 4.7. Cholesterol blood lipid had no significant (P>0.05) differences by additives diets in all treatments (T2, T3, T4, T5) as compared to control group. The highest in the terms of cholesterol was detected in group T4 (147.92 mg/dl) and lowest in group Moringa content T2 (106.70 mg/dl).

Increasing of triglycerides significantly (P<0.05) detected in (T3, T4, T5) in comparing to control group. And the highest of triglycerides in birds fed on treatment T5 (68.16 mg/dl) and lowest in group T1 (37.20 mg/dl). There was a significant (P<0.05) difference in triglycerides between birds fed on the herbal plant in group T3 and group T5. And significant effect (p<0.05) difference obtained in the terms of triglycerides between birds fed on group T2 and group T5.

From the results given in experiment it had to be seen that the dietary supplementation of herbal has numerical effect on all found treatments of broiler chickens in HDL blood lipid but not significantly, so HDL had no significant (P>0.05) differences by additives diets fed in treatments (T2, T3, T4, T5) and control group same as which was occurred in cholesterol. The highest in the terms of HDL was noticed in Sumac group T3 (51.01 mg/dl) and lowest in group Thyme T4 (40.83 mg/dl).

The increase in the terms of LDL blood lipid observed significantly (P<0.05) in T4 and T5 about (55.66 mg/dl) and (53.86 mg/dl) respectively when compared to control group. That because of feed supplement thyme leaves powder presenting in both of them. There were no significant effects (P>0.05) differences between birds fed on herbal feed additives for treatments groups T3and T4 as compared to control group. The highest value of LDL was noticed in Thyme group T4 (55.66 mg/dl) and lowest in group Moringa T2 (22.33 mg/dl).

What happened to VLDL was the same as that discovered in triglycerides blood lipid exactly in statistically, wherever, there was increasing in the terms of VLDL significantly (P<0.05) in (T3, T4, T5) in comparing to control group. And the highest of VLDL in

birds fed on treatment T5 (13.30 mg/dl) and lowest in group T1 (7.44 mg/dl). Also, there was a significant ($p<0.05$) difference between birds group T3 and group T5. And significant effect ($p<0.05$) difference was observed in VLDL between birds group T2 and group T5.

Table 4.7. Effect of the medicine plants powders on blood lipids traits of broilers

Treatments	Parameters				
	Cholesterol (mg/dl)	**Triglyceride (mg/dl)**	**HDL (mg/dl)**	**LDL (mg/dl)**	**VLDL (mg/dl)**
T1	109.79±22.40^{a}	37.20±4.58^{a}	48.20±3.53^{a}	26.96±7.07^{a}	7.44±0.88^{a}
T2	106.70±20.45^{a}	42.50±4.18^{ab}	47.66±3.23^{a}	22.33±6.45^{a}	10.50±0.80^{ab}
T3	132.38±20.45^{a}	52.50±4.18^{bc}	51.01±3.23^{a}	26.33±6.45^{a}	12.33±0.80^{bc}
T4	147.92±20.45^{a}	59.16±4.18^{cd}	40.83±3.23^{a}	55.66±6.45^{b}	8.50±0.80^{cd}
T5	123.48±20.45^{a}	68.16±4.18^{d}	44.01±3.23^{a}	53.86±6.45^{b}	13.30±0.80^{d}

T1=Control (No addition), T2=Moringa leaves powder 1%, T3=Sumac fruit powder 1%, T4=Thyme leaves powder 1%, T5=Mixture Moringa, Sumac & Thyme 1%. a, b, c = Means between treatments having different letters in the same column are significant ($p<0.05$).

LDL:low-density lipoprotein; HDL: high-density lipoprotein; VLDL: very low-density lipoprotein (mg/dl): milligrams per deciliter.

5. DISCUSSION

5.1. Live Body Wight (LBW)

In the experiment, the effects of herbal feed additives on live body Weight (LBW) of broiler birds during 7^{th}, 14^{th}, 21^{th}, 28^{th}, 35^{th} and 42^{nd} days of ages were presented in Table 8. The control groups (T1) has not received any herbal, fed on 1% of Moringa leaves powder (T2), 1% of Sumac fruit powder (T3), 1% of Thyme leaves powder (T4) and 1% of their mixture which consist of Moringa, Sumac and Thyme (T5). The results indicated that LBW for birds fed on herbal feed additive in treatments T2 and T5 which containing Moringa leaves powder were significantly ($p<0.05$) higher than the control group. And the improving LBW of chick fed with Moringa leaves powder could be attributed to high digestibility of Moringa leaves (Becker 1995) which may enhance absorption of nutrients. Moringa is not only concentrated in nutrients but in the pure form, it seems to inhibit the activity of pathogenic bacteria and molds and enhance the digestibility of other foods, thus assisting chickens to express their natural genetic potential (Gaia, 2005).

These results are in agreement with the finding of Banjo (2012) who observed the inclusion of Moringa oleifera leaf meal (MOLM) with 1%, 2% and 3% levels in broilers significantly ($P<0.05$) improved their weight gain at 1% level which was higher than the control significantly.

Dey and De (2013) mentioned that 0.25 or 0.40 % Moringa oleifera leaf meal (MOLM) in broiler chicks diets gave a significant ($P<0.01$) enhancement in body weight compared to control. The results of this study agree with David et al. (2012) who used seven experimental diets consist of control, negative control, 0.0125% bleomycin (positive control), 0.05% Moringa leaf powder, 0.1% Moringa leaf powder, 0.035% Zigbir (commercial herbal product), 0.05% Moringa fruit powder (MFP) and 0.1% Moringa

fruit powder (MFP), his study exposed that all selected additives dietary supplements significantly ($P<0.05$) enhance the growth performance of birds compared to the negative control. Moreover, the body weight gain of birds was increased with the increasing levels of both Moringa leaf and fruit powders during the finisher and total periods.

Teteh et al. (2013) observed that all chickens weights and daily body weight gain increased significantly ($P<0.05$) compared to the control group when used 1% and 2% Moringa Oleifera leaf meal (MOLM). That might be Moringa is a natural food source for antioxidants, and other important compounds that body depends on to stay healthy (Ramachandran et al. 1980; Price ML 2002; Dhar B et al. 1982).

On the other hand, Nkukwana et al. (2014) applied 500 g zinc bacitracin/kg of feed and positive control (+C) with 668 g salinomycin, MOLM low (ML; 1, 3 and 5g); (MOLM) medium (MM; 3, 9 and 15 g); MOLM high (MH; 5, 15 and 25 g)/ kg of feed, and a negative control. Birds fed MH had the highest BW, while +C had the lowest ($P<0.05$) at 7 and 21 d of age. Along the same line, Karthivashan et al. (2015) showed that birds fed on 0%, 0.5%, 1.0% and 1.5% of MOLM extracts significantly ($P<0.05$) enhanced weight gain compared to control group, while there were no significant differences in weight gain for the dietary treatments with MOLM.

On the contrary, Makanjuola et al. (2014) pointed that adding MOLM at the level of 0.2, 0.4 and 0.6% to the feed, lasted 28 days, had no adverse influence on final weight and BWG in broiler chicken. Also, Paguia et al. (2014) observed that using 0.20%, 0.30%, 0.40% and 0.50% MOLM on broiler diets did not ($P>0.05$) significantly affect the BW and BWG.

The higher weight in the birds fed MLP diets in T2 may be partly due to a good protein quality, perhaps arising from a higher methionine and lysine provide (Booth and Wickens 1980). Vitamin A is necessary for growth. MLP is reported to have a high vitamin A (Booth and Wicken 1988; Grubben and Denton, 2004; Fuglie 2005). The control treatment might have provided insufficient vitamin A, therefore resulting in poor growth since vitamin A to promoting growth. Pond et al., (1995) stated that vitamin An insufficiency in the diets makes the rabbit's exhibit poor growth.

Our collections established that addition of Sumac fruit powder T3 at level 1% for broiler had led to significant ($P<0.05$) differences on the LBW to compare to the control group. Mansoob (2012) showed that using different levels Sumac had significant effects on body weight enhancement and feed conversion of broiler birds ($P<0.05$). The enhancement of body weight gain and feed conversion are because of the active materials (cinnamaldehyde and eugenol) present in sumac, inducing higher efficiency in the utilization of nutrition, resulting in improved growth (Lee et al. 2003). The present of Phenolic compounds in sumac inhibit lipid peroxidation, scavenge the hydroxyl radical and superoxide anion (Jung 1998, Khalaf et al. 2008) and increase the activities of detoxifying enzymes like glutathione-S-transferase (Mazloom 2011).

D-limonene (l-methyl-4-(1-methylethenyl)-cyclohexane) is a monocyclic monoterpene constituent of Sumac that has hypocholesterolemic influences (Kurucu et al. 1993). Ahmadian-attari et al. (2007) observed that use of Sumac Extract can enhance growth and have a good effect on broilers. Rayne et al. (2007) showed that Sumac extracts have been detected to have antimicrobial, antioxidant and hypoglycemic activities and has led to better performance on the growth of broilers.

Weiner (1994) Reported that some herbal plants or specific combinations of herbs in preparations may act as antioxidants by exerting superoxide scavenging activity or by raising superoxide dismutase activity in various tissue sites. Mansoob (2011) Establish that antimicrobial substances existing in sumac can decrease the harmful bacteria in the gastrointestinal tract and increase the levels of absorbed amino acids, sumac contains polyphenol components which may be causing the hypocholesterolemic action. Polyphenols have been shown to let down the reverse cholesterol transport, decrease the intestinal cholesterol absorption and increase bile acid excretion (Mansoob 2012; Singh et al. 2007).

Although it was awaited that supplementing the plant extracts (Demir et al., 2003; Lee et al. 2003) or additive herbs (Bampidis et al. 2005; Cross et al. 2002; Cross et al. 2007) could induce the growth performance of broilers. Plant extracts, essential oil and the main components of the essential oil afforded contradicting results (Alcicek et al. 2003; Acamovic and Broker 2005; Griggs and Jacob, 2005; Bampidis et al. 2005).

In the present study, thyme (T4) did not have significant effect (P>0.05) on in live body comparing to control, these results are in agree with (Demir et al. 2003; Cross et al. 2002, 2007; Hernandez et al. 2004; Botsoglou et al. 2004; Bampidis et al. 2005). Also (Najafi et al. 2010) reported that the low dosage of (5g/Kg) of thyme had a significant effect on broiler chick body weight and their feed conversion ratio, while the high dosage of (10g/Kg) did not. The improvement of performance observed in broilers fed the mixture of dried thyme leaves powder with other herbs could be due to the enhancement of nutrient digestibility established in this study with the development of digestive organs (Lilja 1983). Reduce in crypt depth in the ileum of birds given dietary natural growth promoters, and conserved the energy by the decrease turnover rate of the epithelial cells may be utilized for lean tissue mass synthesis (Lilja 1983).

5.2. Carcass Characteristics

Dietary supplementation of feed additive is shown in Table 9. Cutting carcass percentage had similar trend with Soda (2010) who showed that the effect of feed Moringa oleifera at levels of 0%, 2%, 4%, 6% had no significant (P>0.05) differences on cutting carcass of the treatment groups tested

Nuhu (2010) noticed that offering rabbits a diet containing Moringa leaf meal significantly (P<0.05) increased dry matter and protein digestibility, crude protein of meat and daily weight gain, and it decreases ether extract of meat compared to a control diet, but diets which were containing Moringa leaf meal had no significant effect (P>0.05) on carcass characteristics.

On the other hand, Oluglcemil et al. (2010) had examined the effect of additive of Moringa cassava leaves meal with intake levels of 0%, 5%, 10% and 15% on broiler chicks performance and score of growth and blood chemistry. It was established that 5% of supplement can be applied in the finisher diet without any adverse effect on the growth performance, carcass aspects, and blood parameters.

It was stated that the birds fed by Moringa oleifera at levels of 0%, 2%, 4%, 6% had significant differences (P>0.05) effect on tested groups in terms of carcass weight and

breast (Soad, 2010). Ologhobo et al. (2014) who concluded that feeding birds with MOLM at levels of 0.2, 0.4 and 0.6% had no negative influence on the carcass quality but improved the breast of birds.

In the present study, finding of no significant effect of thyme on the treatments groups in terms of carcass percentages, and with decreasing of Carcass yield agree with the findings of El-Deek et al. (2002), Moorthy et al. (2009), Najafi and Torki (2010), Rahimi et al. (2011) who did not reported significant effects on carcass cuts percentages when they added thyme in feed or drinking water of broiler birds.

5.3. Internal Organ Weight

Internal organ weights in different treatments were illustrated in Table 10, our study agrees with the findings of Nkukwana et al. (2015) who noted that they did not found significant ($P>0.05$) differences effect on visceral organs, except the heart, which we found higher weight about 26.21 g/bird in 1% Moringa leaf powder group.

Soad (2010) stated that the feed Moringa oleifera had significant differences ($P<0.05$) effect on the tested groups in terms of abdominal fat. And David et al. (2012) found that 0.1% of Moringa fruit powder had raised the gizzard fat content, while 0.1% of Moringa leaf powder reduced the gizzard fat.

In the study of sumac powder, finding decrement in abdominal fat agrees in results of F. Kheiri et al., (2015) and Hosseini Mansoub, (2012) who established that applying of sumac reduced the accumulation of fat in the abdominal areas of broiler chickens.

Langhout (2000) showed that the herbal plants could stimulate the digestion system in birds, improve the function of the liver and raise the pancreatic digestive enzymes, and the improvement of the metabolism, carbohydrates, and proteins in the most organs would increase the growth rate of these organs.

The result about Thyme of this study showed that no significant difference between treatment and control groups in terms of the percentage of liver, heart, and gizzard agree

with the findings of Hanan E Al-Mashhadani, (2014), Najafi and Torki (2010) and Sadeghi et al. (2011).

Thyme has inhibitory results on abdominal fat in broiler chicks (Al-Kassie, 2009). The researcher reported that adding 200 ppm thyme oil to the diets of birds during the experiment period (42 days) caused a significant decreasing in the abdominal fat percentage compared with the control diet.

Abdulkarimi et al. (2011) showed that adding 0.6% thyme extract to drinking water decreased the abdominal fat of broiler chickens significantly ($P<0.05$). This reducing in the abdominal fat traits caused by thyme may have been attributable to the saponins in thyme (Abdulkarimi et al. 2011), which have an inhibitory influence on lipogenesis (Qureshi et al. 1983).

5.4. Feed Intake

The effect of feeding graded level of the dietary supplementation of Moringa leaves powder and as a discussion about feed intake the study agrees with the findings of Gadzirayi et.al. (2012) who showed that no significant($P>0.05$) differences were observed in the amount of feed intake by broilers feed (25, 50, 72 and 100%) Moringa oleifera leaves.

Banjo, (2012) reported no significant ($P>0.05$) differences in feed intake in broilers fed levels of Moringa at (0%, 1%, 2%, 3%). Also agrees with the findings of Soad, (2010), who state that there were no significant differences ($P>0.05$) in feed intake between the groups feed (0%, 2%, 4%, 6%) Moringa oleifera leaves.

This note was supported by the findings of Ravindran et al. (1983) were feed intake and feed/gain raised as cassava leaf meal or dehydrated alfalfa meal leaf meals incorporated level was raised.

On the other hand, Madubuike and Ekenyem (2006) reported enhanced feed intake for broilers fed diets with 5% and 10% levels of Moringa, but intake was depressed at 15% not consistent with the present study. This conforms to the observations established by

Ash et al. (1992) that including of leaf meals in broiler diets about 5% to 10% results in depressed performance. Feed intake increased as Moringa oleifera leaf meal MOLM containing increased probably due to increased bulk and lower metabolism ability concentration.

Sumac fruit powder T3 had the highest feed consumption and feed conversion among the control treatment, and showed as a rich of tannin Kosar et al. (2006). Gönül et al. (2010); Özcan & Haciseferogullari (2004), and Potter & Fuller (1968) reported the lower availability of arginine, methionine, and choline in broiler chickens with the dietary supplementation of high tannic acid 1%. Tannins reduce the protein digestibility in their action on the brush border membrane of the small intestine, where the activity of enzymatic is mainly located (Marzo et al. 1990). The organization of an insoluble tannin-protein complex has been described in the gastrointestinal tract by dietary supplementation of tannic acid (Tamir and Alumot 1970). Studies have also shown that tannic acid and degradation products are absorbed from the small intestine and made toxic effects (Kardivel et al. 1969; Karin et al. 1978; Marzo et al. 2002 and Vohra et al. 1966).

The results are in agreement with the findings of Al-Jugifi, (2009); Arshad et al. (2012); Mohamed et al. (2012); Tekeli et al. (2011); Herawati and Marjuk (2011) who mentioned that using thyme powder in the diet had a significant positive effect on feed consumption and appetite of broiler chicks.

As a supplement, essential oils of thyme about 100 and 200 mg/kg reported a significant effect ($p<0.05$) in Feed intake, ($p<0.01$) in feed conversion ratio, but no significant in body weight gain (Bölükbasi et al. 2006). On the other hand, the results are in disagreement with the findings of Abdulkarimi et al. (2011); Ademola et al. (2009); Al-Mashhadani et al. (2011); Al-Homidan (2005); Demir et al. (2008); El-Deek et al. (2002); Foroughi et al. (2011); Kehinde et al. (2011); Mansoub and Myandoab (2011); Moorthy et al. (2009); Rahimi et al. (2011); Najafi and Torki (2010); and Toghyani et al. (2010) when they were concluded that dietary supplementation of birds diets with thyme did not affect the feed consumption compared to the control group.

And about 1000 mg/kg of essential oils of thyme reported no significant effect of feed intake, and no significant effect in feed conversion ratio, but a significant effect ($p<0.05$) in body weight gain (Cross et al. 2007). With addition about 120 mg/kg of essential oils of thyme, there was no significant effect of feed intake, no significant effect in feed conversion ratio and no significant effect in body weight gain (Tekeli et al. 2006).

Also with an addition of 1000, 3000 and 5000 mg/kg of essential oils of thyme there was no significant effect of feed intake, no significant effect in feed conversion ratio and no significant effect in body weight gain (Cross et al. 2003).

5.5. Feed Conversion Ratio

In the terms of FCR of birds fed by Moringa leaves powder supplement in group T2 and as mixture with other herbs plants in T5 at 28, 35 and 42 days of ages decreased significantly ($P<0.05$) in comparing to the control group, so the results agree with the findings of Onunkwo and George (2015) when they showed the significant decrease in the feed conversion ratio of feeding dietary supplementation of Moringa oleifrea leaf meal. Broilers that were fed without Moringa oleifrea leaf meal had higher FCR, this suggests that birds fed Moringa oleifrea leaf meal dietary supplementation had better utilization of the nutrients.

Results of this study disagree with the findings of Gadzirayi et.al. (2012) who showed that no significant ($P>0.05$) differences effect were observed in the amount of feed conversion ratio by broilers fed by Moringa Oleifera leaf meal. Moreover, low Feed conversion ratio was observed in birds fed diets containing 5%, 10% and 15% (Iheukwumere et al. 2008) consistent with present findings, feed conversion among the Moringa leaf fed groups was comparable on 10%.

The result of sumac of this study agrees with the findings of Mansob (2011) who demonstrated that using different levels Sumac had significant ($P<0.05$) effects on weight improvement and feed conversion ratio of broilers, and this because of the active materials (cinnamaldehyde and eugenol) found in Sumac, causing high efficiency in the utilization of feed, resulting the growth. Results of this study

disagree with the findings of Yazdankish et.al. (2010) who observed feed conversion ratio was not affected by Sumac powder during starting period. Also there was disagreement with the findings of Golzadeh et al. (2012) who concluded that feed diet of sumac fruit powder, especially at high doses, worsens the performance of chickens, however, birds had no significant (P>0.05) differences effect in feed conversion ratio among the treatments.

In the terms of FCR of the birds fed by thyme leaves powder supplement in group T4 at 14, 35 and 42 days of ages had decreeing significantly (P<0.05) differences in comparing to the control group, so the results agree with the findings of Al-Jugifi 2009; Al-Mashhadani et al. (2011); Foroughi et al. (2011) who observed that using diet additive of thyme in broilers had a significant effect on the feed conversion ratio compared to the control. Aromatic oil from thyme (Thymus vulgaris) was evaluated for antibacterial, antifungal and antiviral activity as inhibitors of microbial growth (Dorman and Deans, 2000). Harmful bacteria in the intestine has a negative effect on bile salts secretion (Freigher and Dashkevicz 1988) so reducing microbial growth may be because of higher synthesis or secretion of bile salts by the liver. This phenomenon perhaps leads to increase the availability of fatty acids and hence, performance improvement. The study disagrees with the findings of Anvar,A. et al. (2012) who concluded that feed diet of thyme to the control diet at level 0.3% and 0.6% were not significant effects on the feed conversion ratio over the entire trial.

5.6. Serum Biochemistry Analysis

According to the indications the analyzing of serums for treatment fed by Moringa leaves powder of broilers chickens, there were no significant (P>0.05) difference between treatments T2 and T5 as mixture with other herbs plants in comparing to control group, Like finding of Nuhu (2010) who noticed that offering rabbits a diet containing Moringa leaf meal had no significant effect (P>0.05) on blood composition (total protein, albumin, globulin, cholesterol, white blood cells, neutrophils, lymphocytes, eosinophil, red blood cells, hemoglobin, and packed cell volume).

The author attributed the enhancement of rabbit growth to the higher quantity of vitamin A in Moringa leaf meal, as showed by Grubben and Denton. (2004). And increase in protein digestibility with the adding of Moringa leaf meal, Fahey et al. (2005) mentioned that Moringa contains highly digestible protein.

The study agrees with the findings of Tijani et al. (2016) who showed the effect of different Moringa oleifera leaf meal (MOLM) containing levels on the serum biochemical, the Albumin content was significantly ($p<0.05$) between birds fed control diet and 15% MOLM. The observations are not similar to the findings of Tazi and Tibin (2014), in there was significant effect ($p<0.05$) in the value of total protein while there was no significant effect ($P>0.05$) difference in the value of Albumin. And about the study of Sumac, the results agree with the findings of Mansoob (2011) who observed the effect of Sumac was not significant difference between the treatments for glucose comparing to control.

This study disagrees with the findings of Kheiri et al. (2015) who observed Sumac were added 1.0% and 1.5% in ration of broiler birds, total protein and total globulin in the blood had a significant increased ($p<0.01$) glucose as compared with 0.5% Sumac and control significantly were reduced ($p<0.01$). The observations are similar to the findings of Toghyani et al. (2010) and Toghyani et al. (2011) who observed that addition Thyme powder at levels of 5 and 10 g/kg diet did not have any effects on the total protein, albumin, Albumin / Globulin ratio. Similar results were observed by Tekeli et al., (2006) who didn't find any effect on the glucose"e concentration with addition thyme essential oil 120mg/kg diet compared to the control. The study disagreement with the findings of Zhu et al. (2014) who observed that addition thyme essential oil markedly increased serum total proteins and globulins and significantly reduce the Albumin to globulin ratio.

5.7. Blood Lipids

The effect of feeding dietary supplementation of Moringa leaves powder, there were no significant ($P>0.05$) difference between treatments T2 and T5 as mixture with other herbs plants in comparing to control group, the study agrees with the findings of Nuhu (2010)

noticed that offering rabbits a diet containing Moringa leaf meal had no significant effect (P>0.05) on cholesterol. In other studies, animals fed diets high in cholesterol or saturated fat had increased blood cholesterol and carcass cholesterol levels (Blanch and Grashorn, 1995).

Several researchers like Oayzdogˇan et al. (1996); Bachorik et al. (1991) have shown that low HDL and high LDL are values causing atherosclerosis. When previous research of HDL and LDL was examined, it was concluded that the blood and products of animals had high HDL and low LDL values (Ozdogan and Aksit 2003; Chen and Chiou 2005).

On the other hand, several researchers have mentioned low HDL and high LDL (Bachorik et al. 1991; Grundy 1991; Park et al. 2005). Not Similar results have been obtained by Dey and De (2013) who found that 0.25 or 0.40 % Moringa Oliefera leaf MOL in broiler diets was significant (P<0.01) reduced in total cholesterol, triglyceride, LDL-cholesterol but increase in HDL-cholesterol level in MOL treatment birds, actually there is same change in parameters but not significantly for example recording lowest of cholesterol and LDL in T2 comparing to control and other treatments. Nuhu (2010) noticed that offering rabbits a diet containing Moringa leaf meal had no significant effect (P>0.05) on blood composition.

Results about effect of sumac on biochemical blood values were in the same finding with Golzadeh et al. (2012), who observed that there was no significant difference between treatments for plasma HDL concentrations, but in adverse to the results of Hosseini Mansoub (2012) who showed that the concentration of serum HDL was significantly increased in treatments with sumac dietary comparing to the control and the serum total cholesterol, triglycerides, and LDL concentration were significantly reduced.

And also the sumac extract raised markedly HDL and reduced LDL, raising superoxide dismutase and catalase activities. Polyphenols have been shown to let down the reverse cholesterol transport, decrease the intestinal cholesterol absorption and increase bile acid excretion (Mansoob 2012, Singh et al. 2007). Also, it inhibited sucrase and maltase activities (Mohammadi et al. 2010). As well as F. Kheiri et al. (2015) concluded that

supplement of sumac powder (0.02%) can decrease cholesterol, triglyceride, and LDL in plasma of female broiler chicks.

The study of thyme effect on serum biochemical parameters, there was increasing of Triglycerides in T4 about 59.16 mg/dl, however the experimental study agrees with finding of Bolukbası et al. (2006), who reported that dietary thyme oil increased the plasma level of triglycerides, but on the other hand Najafi and Torki (2010) found no significant differences in triglyceride concentration of the broiler fed on thyme essential oil 200mg/kg.

Also, there was no significant effect of thyme on plasma HDL concentrations, the results agree with the findings of Najafi and took (2010); Toghyani et al. (2010), who showed the effect of thyme did not have the change in HDL concentration. In this study, there was increasing of plasma level LDL in T4 (55.66 mg/dl) and T5 (53.86 mg/dl).

Cholesterol was recorded to be the same in treatments Fed staff with thyme without any change significantly effect. Thyme improved hemoglobin concentration and hematocrit percentage, but not significantly (Rahimi et al. 2011). Toghyani et al. (2010) reported that adding thyme powder 5 and 10 g/kg diet did not have any effects on the total cholesterol in broilers blood serum when compared control groups. Similar results were observed by Tekeli et al. (2006) who did not find any effect on the total cholesterol concentration when added thyme essential oil 120mg/kg diet compared to the control. This study agrees with the findings of Bolukbası et al. (2006) who reported that dietary thyme oil increases plasma level of LDL-cholesterol in broilers.

On the other hand, Al–Niumi (1999) used the different medicinal plant in the male broiler diet and with thyme powder with 1% which showed significantly decreasing in the cholesterol and total lipid of blood compared to the control group.

The results which were obtained did not agree with those reported by Ali et al. (2007) who found that addition thyme to hen's feed diets significantly decreased total cholesterol, plasma HDL, and triglycerides.

The reduction of cholesterol and triglycerides noticed with thyme in animal studies was due to the lowering effect of thymol or carvacrol on 3-hydroxy-3-methyl-glutaryl-coenzyme A (HMG-Co A) reductase the rate-limiting enzyme of cholesterol synthesis (Case et al. 1995).

6. CONCLUSIONS AND RECOMMENDATIONS

Results showed that there was a significant difference ($p<0.05$) among the experimental groups. Medical plants powders diet for broilers, Moringa leaves powder (MLP), Sumac fruit powder (SFP), and Moringa, Sumac and Thyme (MST) had significant ($p<0.05$) effects on most broilers performance and they were recorded positive effect of dietary supplementation in live body weight, weight gain and feed conversion ratio in broiler chicks, and with the highest body weight in (MLP) and (MST). But herbal plants powders dietary treatments in this study had no significant ($p<0.05$) differences for birds fed on Thyme leaves powder (TLP) relative to the control group during all total periods (0-42) day of age. There were no significant effects of treatments on Carcass cuts percentages, except the birds fed on the (SFP) which had a significant effect on Carcass cuts percentages, however, the Carcass yield, shank, and Wing percentages were higher ($P<0.05$) for broilers fed at (SFP). Feed supplementations with Sumac and Thyme of herbs have an effect on abdominal fat and some of viscera organs, abdominal fat was decreased significantly ($p< 0.05$) by using additive of Sumac compared to control group. Thyme leaves powder had affected significantly ($p<0.05$) differences compared to the control group and to all other treatments, but other treatments had no effected significantly ($p<0.05$) compared to the control group. Also there were positive effects on the most of the broilers accumulative feed conversion comparing to the control group during the experiment and the best significant accumulative feed conversion was obtained by using fed on Moringa additive, but there were no significant effects ($P<0.05$) on accumulative feed intake for all treatments except the feed supplementation with Thyme only when comparing to control group and other treatments. Generally, there was no significant effect on Serum Biochemistry Analysis parameters of the broiler chicks by herbal plants additives, only fed on the mixture MST had changing in Albumin compared to control group and other treatments. And about broilers blood lipids there were effects on the most comparing to the control group such as increasing of Triglycerides, LDL and

VLDL significantly (P<0.05) in (SFP), (TLP) and (MST) compared to control group, but there's no significant effects (P<0.05) on cholesterol and HDL

And the Recommendations as the following:

1- According to the research, it is recommended to use mixture of alternative herbal plants (Moringa, Sumac and Thyme) and *Moringa oleifera* alone for growth promoter in spite of antibiotic in the commercial broiler ration.

2- Limited and high cost of commercial stored has been partially responsible for the decline in indigenous and broiler production.

3- The average body weight was higher in mixture (Moringa, Sumac and Thyme) and also in *Moringa oleifera* treated groups, suggestive of beneficial effect of *Moringa oleifera* on body weight. No mortality was observed in Moringa oleifera and mixture containing moringa throughout experiment period. Therefore, Moringa oleifera was recommended as a feed additive for broilers.

4- There is the need to exploit feed resources that are available not expensive, and not in direct competition with humans and other industrial users. Moringa tree can be planted for forage production under intensive farming systems and the yield can reduced the cost of poultry feed production as compared to purchased commercial feed.

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APPENDIX

Table 1. Active compounds and component analysis of Moringa (*Moringa oleifera*) leaf powder

Peak	Constituents	Ref	CAS	RT	Area%
1	p-Cymene	317	000099-87-6	17.263	19.03
2	gamma-Terpinene	210	000099-85-4	18.144	56.70
3	pelargonaldehyde	65032	000124-19-6	19.969	7.55
4	Carvacrol	127	000089-83-8	26.904	13.30

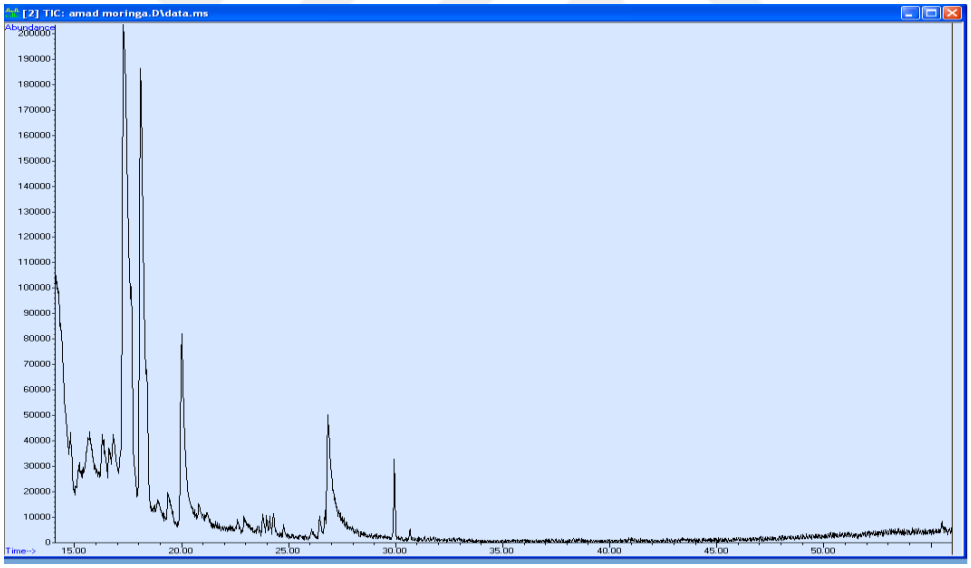

Figure 1. Analysis of active compound in the tubers of Moringa (*Moringa oleifera*) leaf powder by GC-MS

Table 2. Active compounds and component analysis of Sumac (*Rhus coriaria L.*) fruit powder

Peak	Constituents	Ref	CAS	RT	Area%
1	Myrcene	337	000123-35-3	15.237	2.17
2	alpha-terpinene	418	000099-85-4	16.628	2.16
3	p-Cymene	317	000099-87-6	17.348	42.74
4	gamma-Terpinene	210	000099-83-2	18.132	47.76
5	11.51 NONANAL	44	000124-19-6	20.44	1.71
6	beta-Caryophyllene	110	000087-44-5	29.937	3.47

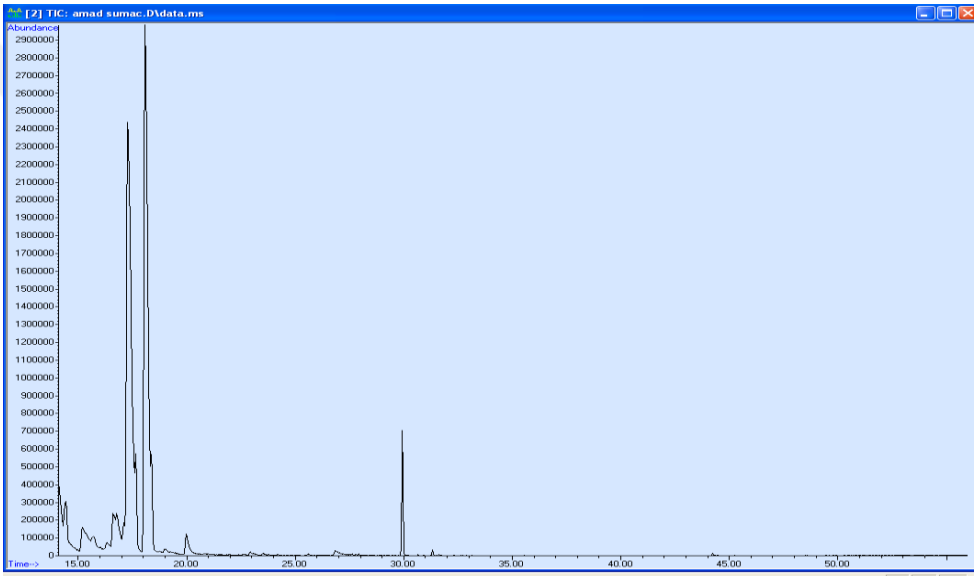

Figure 2. Analysis of active compound in the tubers of Sumac (*Rhus coriaria L.*) fruit powder by GC-MS

Table 3. Active compounds and component analysis of Thyme (*Thymus vulgaris L.*) leaf powder

Peak	Constituents	Ref	CAS	RT	Area%
1	Myrcene	337	000123-35-3	15.231	2.65
2	alpha-terpinene	418	000099-86-5	16.622	2.15
3	8.59 CYMENE<ORTHO->	1575	000527-84-4	17.354	23.10
4	gamma-Terpinene	210	000099-85-4	18.161	17.09
5	9.78 TERPINENE<GAMMA->	1025	000099-85-4	18.899	9.78
6	Terpinolene	221	000586-62-9	19.105	0.80
7	Linalol	271	000078-70-6	19.357	0.30
8	3,7-DIMETHYL-1,6-OCTADIEN-3-OL	9154	999009-15-5	19.534	0.97
9	3-CYCLOHEXEN-1-OL	101732	000562-74-3	23.042	1.31
10	gamma-Terpinene	210	000099-85-4	23.608	0.29
11	Carvacrol	127	000499-75-2	26.343	2.20
12	PHENOL,2-METHYL-5-(1-METHYLETHYL)	278164	000499-75-2	26.950	42.27
13	beta-Caryophyllene	110	000087-44-5	30.028	5.58
14	Valencene	156	004630-07-3	30.709	0.76
15	28.68 VIRIDIFLORENE	6	021747-46-6	32.306	0.24

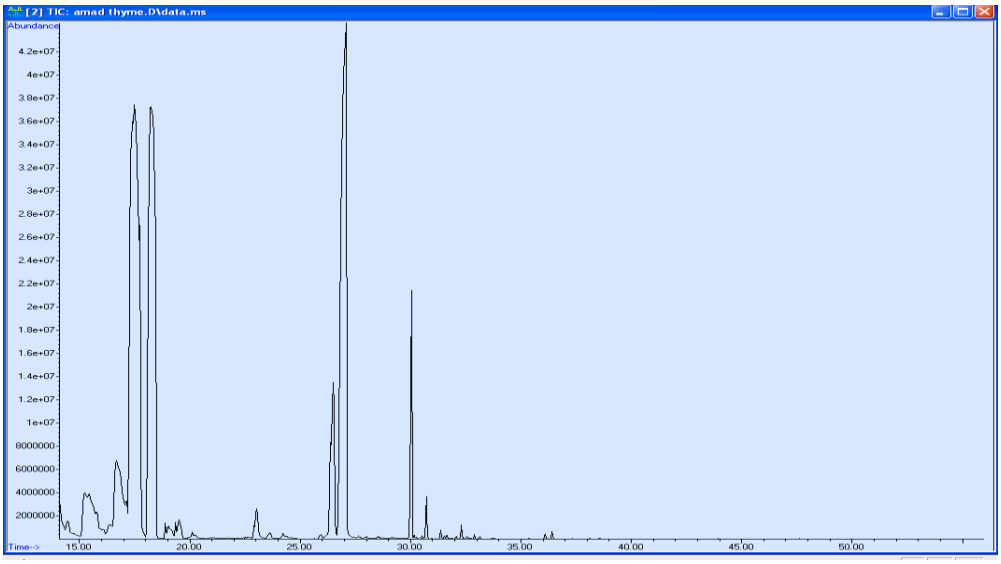

Figure 3. Analysis of active compound in the tubers of Thyme (*Thymus vulgaris L.*) leaf powder by GC-MS

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English	Excellent	Very good	Very good
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