

## Chapter one

### Literature review

#### 1.1- *Cymbopogon proximus*:

##### 1.1.1- Description:

The *Cymbopogon proximus* is a herbal plant. Common name is camel's hay and is known locally as (Maharaib). It is a perennial herb, erect, tufted 9 cm long, culms slender, glabrous and 3 – 4 nodes. Leaf simple, alternate, linear 5-7 cm long, 1cm wide, sheathed apex spiny entire, and inflorescence spikelets highly branched 5 cm log (Eltahir and Ereish, 2010).

The plant is widely distributed in Africa (northwest tropical, northeast tropical and east tropical), temperate Asia (western Asia and Arabia) and tropical Asia (Indian and Indo-China). In addition, *Cymbopogon proximus* is found in northern and Central Sudan (Clayton *et al.*, 2005).

##### 1.1.2- Classification of *Cymbopogon proximus*:

Kingdom: Plantae .

Phylum: Magnoliophyta.

Class: Liliopsida.

Order: Poales.

Family: Poaceae.

Genus: *Cymbopogon*.

Species: *Cymbopogon schoenanthus* (L.)Spreng. (Global Biodiversity Information Facility, 2011).

### 1.1.3- Chemical composition:

**Table (1): Proximate analysis of *Cymbopogon proximus*:**

Moisture	Ash	Crude fiber	Crude protein	Crude lipid	Total carbohydrates
11.5	6.5	32.0	11.0	8.5	42.0

(Faten and El-Khateeb, 2013).

**Table (2): Preliminary phytochemical tests of aqueous extract of *Cymbopogon proximus*:**

Terpenes	Tannins	Flavonoids	Saponins	Alkaloids	Carbohydrate or glycoside	Phenolic glycosides
+	+	+	+++	+	++	++

(+++):High concentration; (++):moderate concentration; (+):low concentration

(Faten and El-Khateeb, 2013).

Terpenes are naturally occurring substances produced by a wide variety of plants and animals. A broad range of the biological properties of terpenoids is described, including cancer chemopreventive effects, antimicrobial, antifungal, antiviral, antihyperglycemic, anti-inflammatory, and antiparasitic activities. Terpenes are also presented as skin penetration enhancers and agents involved in the prevention and therapy of several inflammatory diseases. Moreover, a potential mechanism of their action against pathogens and their influence on skin permeability are discussed. The major conclusion is that larger-scale use of terpenoids in modern medicine should be taken into consideration (Paduch *et al.*, 2007).

Tannins are polyphenolic compounds that are broadly categorized into two major groups: (1) hydrolyzable tannins, consisting of a central core of carbohydrate to which phenolic carboxylic acids are bound by ester linkage and (2) condensed tannins, or proanthocyanidins, consisting of oligomers of

two or more flavan-3-ols, such as catechin, epicatechin, or the corresponding gallicocatechin. Tannins have a very high affinity for proteins and form protein-tannin complexes. The ingestion of a plant containing condensed tannins decreases nutrient utilization, protein being affected to a great extent, and decreases feed intake. On the other hand, hydrolyzable tannins are potentially toxic to animals. Consumption of feeds containing high levels of hydrolyzable tannins cause liver and kidney toxicity and lead to death of animals. Oak and yellow wood poisonings are attributed to hydrolyzable tannins (Makkar *et al.*, 2007).

Saponins are steroid or triterpenoid glycosides, common in a large number of plants and plant products that are important in human and animal nutrition. Several biological effects have been ascribed to saponins. Extensive research has been carried out into the membrane permeabilising, immunostimulant, hypocholesterolaemic and anticarcinogenic properties of saponins and they have also been found to significantly affect growth, feed intake and reproduction in animals. These structurally diverse compounds have also been observed to kill protozoans and molluscs, to be antioxidants, to impair the digestion of protein and the uptake of vitamins and minerals in the gut, to cause hypoglycaemia, and to act as antifungal and antiviral agents. These compounds can thus affect animals in a host of different ways both positive and negative (Francis *et al.*, 2002).

Flavonoids are plant pigments that are synthesized from phenylalanine, generally display marvelous colors known from flower petals, mostly emit brilliant fluorescence when they are excited by UV light, and are ubiquitous to green plant cells. The flavonoids are used by botanists for taxonomical classification. They regulate plant growth by inhibition of

the exocytosis of the auxin indolyl acetic acid, as well as by induction of gene expression, and they influence other biological cells in numerous ways. Flavonoids kill many bacterial strains, inhibit important viral enzymes, such as reverse transcriptase and protease, and destroy some pathogenic protozoans. Yet, their toxicity to animal cells is low. Flavonoids are major functional components of many herbal and insect preparations for medical use, which have been used since ancient times. The daily intake of flavonoids with normal food, especially fruit and vegetables is 1–2 g. Modern authorized physicians are increasing their use of pure flavonoids to treat many important common diseases, due to their proven ability to inhibit specific enzymes, to simulate some hormones and neurotransmitters, and to scavenge free radicals (Havsteen, 2002).

Alkaloids many substances which interfere with the inflammatory response have been isolated from plants. Some alkaloids of vegetal origin which in the period of 1907 to 2000 were evaluated regarding a possible anti-inflammatory activity. The alkaloids were classified in sub groups in accordance with their chemical structures and the pharmacological data were obtained from different experimental models. Of the 171 evaluated alkaloids, 137 presented anti-inflammatory activity, and among those, the isoquinoline type was the most studied. The carrageenin-induced paw edema was the most used model for evaluating the anti-inflammatory activity (Filho *et al.*, 2006).

A glycoside consists of two components, an aglycone (non-sugar) part and a sugar part. The aglycone portion may be of several different types of secondary metabolites, including coumarin, flavonoids or hydroxyanthracene. The sugar moiety is linked to the aglycone by a direct

carbon to carbon bond (C-glycoside), or through oxygen to carbon bond (O-glycoside). Cyanide glycosides, release toxic hydrogen cyanide when cells are damaged and act as a defence mechanism. Glucosinolates contain nitrogen and sulfur and are pungent (Veitch *et al.*, 2015).

#### **1.1.4- Medical uses:**

According to phytochemical tests of *Cymbopogon proximus* the presence of saponins, Flavonoids, glycosides and tannins may be a rationale for the use of the plant in medicine preparations.

Flavonoids are known to protect against allergies, diabetes, inflammations, malaria, platelet aggregations and microbial infection (Okwu and Omodiromiro, 2005).

. Phytochemical content of camel grass and chemical composition of its oil indicate an herb with good potentials in medicinal applications and pest control (Amina *et al.*, 2013).

The *Cymbopogon proximus* treated lower levels of serum calcium, serum blood urea nitrogen (BUN) and kidney calcium. The *Cymbopogon proximus* has a significant protective effect against ethylene glycol-induced nephrolithiasis in rats (Warrag *et al.*, 2014).

#### **1.1.5-Traditional uses:**

*Cymbopogon proximus* (Family Poaceae) is a traditional medicinal Sudanese plant commonly known as “Mahareb”, which is used in folk medicine (Eltahir and Ereish, 2010).

It is extensively used as folk medicine to promote diuresis, to alleviate colic pain and as antipyretic plant against fever (Khalid *et al.*, 2012).

In the Egyptian folk medicine, it is famous as an effective diuretic and renal antispasmodic (Eltahir and Abdel Kader, 2008, El-Askary *et al.*, 2003 and Selim, 2011).

A decoction of the entire dried herb has been used for centuries by certain tribes in South Egypt as a diuretic, colic pain killer, aid for removal of small stones from the urinary tract, and antipyretic. The plant has been found to possess antispasmodic, antioxidant (Selim, 2011).

Antibacterial affects (El-Kamali, 2010 and Selim, 2011).

Hypotensive, antiemetic, anticonvulsant properties (Eltahir and Abdel Kader, 2008).

Hypoglycemic properties (Sheweita *et al.*, 2002).

Fungicidal properties (Fawzi *et al.*, 2009 and El-Assiuty *et al.*, 2006).

Ovicidal and larvicidal properties (Bassole *et al.*, 2003).

It was also used to treat constipation, intestinal complaints, carminative, stomachic and as an appetizer (EL-Kamali and EL-Amir, 2010).

Treatment of drinking water with herbal plants as traditional medicine is worldwide. In particular, the *Cymbopogon proximus* (CP) is widely used in Sudan in a purpose of folk medicine. The addition of *Cymbopogon proximus* (Maharaib) at a rate of 5g CP/1.5 litre water ( $3.3L^{-1}$ ) to ground water removes  $NO_3^-$  in 48 h and at the same time increases total dissolved solids (TDS) and fluoride ( $F^-$ ) levels and consequently increases the risk of dental fluorosis incidence and other fluoride adverse effects (Abdellah *et al.*, 2012).

## **1.2- Poultry:**

### **1.2.1- Biosecurity:**

#### **1.2.1.1- Definition:**

Biosecurity is defined as a set of practices designed to prevent the entry and spread of infectious diseases into and from a poultry farm.

A biosecurity plan should therefore be a part of any poultry production system. The plan consists of a set of practices and measures taken to form physical and conceptual barriers that prevent or control the introduction and spread of infectious agents to a flock by keeping potentially infected animals and objects away from healthy birds (Segal, 2011).

#### **1.2.1.2- The elements of biosecurity:**

Any biosecurity plan regardless of farm size or production type should contain these three essential elements of biosecurity:

1. Segregation and traffic control.
2. Cleaning.
3. Disinfection.
4. Vaccination.

1- Segregation and traffic controls are the strongest and most effective forms of biosecurity able to prevent disease entrance risks. Segregation and traffic control prevents disease agents from entering the farm by keeping potentially infected animals and contaminated objects such as clothing, footwear, vehicles and equipment away from healthy poultry.

2- Cleaning of housing, vehicles and equipment is the next most effective step. Cleaning removes up to 80% of contaminants. When all dirt is

removed, there is little organic material left in which disease agents may be protected and carried. In practice, cleaning means that the surfaces of the walls and equipment must be cleaned to the extent where no dirt, dust or cobwebs are visible to the eye. Proper cleaning requires scrubbing, brushing and high pressure washing with detergents and water. Cleaning should take place prior to the farm entry. This is to be monitored by the farm manager who should ensure that the workers and visitors' hands, feet, clothes and footwear, as well as vehicles, equipment and instruments such as syringes and debeakers are clean.

3- Disinfection is the least reliable element of biosecurity and depends on many factors, in particular on the quality of cleaning and water hardness. To achieve effective disinfection the removal of all dirt during the cleaning process is crucial. Only disinfectants approved by national or international regulatory bodies should be used. The preparation of the disinfectant solution should be done according to the manufacturer recommendations, in the correct concentration and the application at the correct volume to ensure effective contact time and to cover the entire surface of the farm to ensure the destruction of any remaining disease agent. It is important to remember that most disinfectants are highly toxic to workers and poultry, therefore the preparation and application must be done in a safe manner taking all the required precautions (Segal, 2011).

4- Vaccination: is the administration of antigenic material (a vaccine) to stimulate an individual's immune system to develop adaptive immunity to a pathogen. A vaccine is a biological preparation that improves immunity to a particular disease. A vaccine typically contains an agent that resembles a disease-causing microorganism, and is often made from weakened or killed forms of the microbe, its toxins or one of its surface proteins. The agent



stimulates the body's immune system to recognize the agent as foreign, destroy it, and "remember" it, so that the immune system can more easily recognize and destroy any of these microorganisms that it later encounters (WHO, 2016).

## **1.2.2- Performance:**

### **1.2.2.1- Effect of dietary supplementation on broiler performance:**

#### **1.2.2.1.1- Feed intake:**

Addition of extracted from Halfa Bar Oil (HBO) in the broiler diets improved the feed intake. HBO when added as growth promoter in broiler diets has a similar effect as that with antibiotic without any adverse effects (Amal *et al.*, 2013).

Supplementation with 250 uft/kg and 500 uft/kg phytase in broiler diets with reduction of nutritional levels improved feed intake, providing productive performance similar to that presented by birds fed diets with regular levels of nutrients (Lelis *et al.*, 2012).

The use of *Moringa oleifera* un decorticated seeds powder (MOUSP) in the broiler diet increased feed intake during finisher and whole period (Abbas and Ahmed, 2012).

The dietary supplementation of 1.5% and 2% Ginger root powder (*Zingiber officinale*) decreased feed intake (Zomrawi *et al.*, 2013).

Increment of commercial enzyme (xylam 500) to broiler diets containing different levels of full fat safflower seed (FFSS) improved feed intake (Daffa alla *et al.*, 2015).

Supplementation of direct fed microbials (DFM) in broiler diets decreased feed intake of birds during 0-7 days (Salim *et al.*, 2013).

The diets contain 1.5% crushed *Nigella sativa seeds* (Black Cumin) improved feed intake (Albeitawi and Elghousein, 2008).

#### **1.2.2.1.2- Body weight and body weight gain:**

Supplementation of Halfa Bar Oil (HBO) extracted in the diets of broiler increased body weight gain and resulted in economical benefits (Amal *et al.*, 2013).

Addition of 250 uft/kg and 500 uft/kg phytase with reduction of nutritional levels in broiler diets upgraded body weight gain among the periods from 1 to 21 and from 1 to 40 days of age, providing productive performance similar to that presented by birds fed diets with regular levels of nutrients (Lelis *et al.*, 2012).

Broiler chicks can be served 30 to 120 ml of fluted pumpkin leaf extract (FPLE) per litre during the hot period of the year to increase weight gain and profit margin. The birds served 120 ml of FPLE per litre of water for 8 weeks had the best body weight gain, profit, cost benefit ratio and cost of feed per kg live weight gain (Nworgu, 2006).

The supplemental of commercial enzyme (xylam 500) to diets containing different levels of full fat safflower seed (FFSS) increase the body weight gain (Daffa alla *et al.*, 2015).

The dietary supplementation of direct-fed microbials (DFM) increases the body weight gain of birds. Thus, DFM that contained a mixture of

several beneficial microorganisms could be a viable alternative to antibiotics in the broiler diets (Salim *et al.*, 2013, Zhang and Kim, 2014).

Supplemental ascorbic acid in broiler diets increased body weight gain. At a relatively high dosage above 400ppm, it lowered the abdominal fat deposition and improved the colour of chickens 'meat (Ogunwole *et al.*, 2013).

Diets containing 1.5% and 2% Ginger root powder (*Zingiber officinale*) decreased weight gain (Zomrawi *et al.*, 2013).

Broiler diets containing 1.5% crushed *Nigella sativa seeds* (Black Cumin) increase body weight and body weight gain (Albeitawi and Elghousein, 2008).

#### **1.2.2.1.3- Feed conversion ratio:**

Broiler diets containing extract of Halfa Bar Oil (HBO) improved Feed conversion ratio and resulted in economical benefits. Added HBO as growth promoter in broiler diets has a similar effect as that with antibiotic without any adverse effects (Amal *et al.*, 2013).

Supplementation of 250 uft/kg and 500 uft/kg phytase in diets with reduction of nutritional levels improved feed conversion ratio in the periods from 1 to 21 and from 1 to 40 days of age (Lelis *et al.*, 2012).

Addition of commercial enzyme (xylam 500) to diets containing different levels of full fat safflower seed (FFSS) enhanced feed conversion ratio, it is economical to use FFSS with and without enzyme as a source of energy in broiler chicks diets (Daffa alla *et al.*, 2015).

The supplementation of direct-fed microbials (DFM) in broiler diets enhanced feed conversion ratio at an early age (Salim *et al.*, 2013).

During the period of 22-35 days addition of probiotics to broiler diets improved feed conversion ratio (Zhang and Kim, 2014).

Diets containing 1.5% crushed *Nigella sativa seeds* (Black Cumin) improve feed conversion ratio (Albeitawi and Elghousein, 2008).

#### **1.2.2.1.4- Production efficiency factor:**

Broiler diets containing 4% *Prosopis juliflora* seed (PJS) decrease production efficiency factor (PEF) (Mohammadi *et al.*, 2013).

The Supplementation of different levels of lysine in broiler diets (starter and grower) increased production efficiency factor (Nasr *et al.*, 2011).

#### **1.2.2.1.5- Protein efficiency ratio:**

The addition of different levels of lysine in broiler diets (starter and grower) does not affect protein efficiency ratio (Nasr *et al.*, 2011).

The increment of Silicate Minerals, 3% zeolite in broiler diets enhanced protein efficiency ratio in starter phase, also the Supplementation of 3% kaolin in broiler diet increase protein efficiency ratio in overall period (Safaeikatouli *et al.*, 2012).

The Supplementation of different levels of *Prosopis juliflora* seed (PJS) in broiler diets does not affect protein efficiency ratio (PER) (Mohammadi *et al.*, 2013).

Low-protein diets with constant ME:CP ratio decreased protein efficiency ratio. Whenever dietary protein decreased during grower, finisher, and overall experimental periods protein efficiency ratio was decreased (Kamran *et al.*, 2008).

#### **1.2.2.1.6- Energy efficiency ratio:**

Broiler diets contain different levels of *Prosopis juliflora* seed (PJS) does not affect energy efficiency ratio (EER) (Mohammadi *et al.*, 2013).

Broiler diets content of different levels of lysine in (starter and grower) does not affect energy efficiency ratio (Nasr *et al.*, 2011).

Low-protein diets with constant ME:CP ratio decreased energy efficiency ratio. When dietary protein and energy were decreased during grower, finisher, and overall experimental periods. The energy efficiency ratio was decreased (Kamran *et al.*, 2008).

The Supplementation of Silicate Minerals, 3% zeolite in broiler diet improve energy efficiency ratio in starter phase, also the addition of 3% kaolin in broiler diet increase energy efficiency ratio in overall period (Safaeikatouli *et al.*, 2012).

#### **1.2.2.1.7- Lysine efficiency:**

Supplementation of different levels of lysine in broiler diets (starter and grower) increased lysine efficiency. The diet supplemented with very high level of lysine increased lysine efficiency greater than other levels (Nasr *et al.*, 2011).

### **1.2.2.2- Effect of some environmental factors on performance:**

#### **1.2.2.2.1- Effect of water consumption on broiler performance:**

Water restriction harms broiler performances during their first week of life, but the negative effects are reversed after water is fed ad libitum, allowing the birds to recover performance levels. When birds are submitted to water restriction during the first week of life, they present subsequent compensatory growth, as shown by their better performance during the second and third weeks of the experiment as compared to the birds offered water ad libitum. The addition of 450 ppm of sodium in the drinking water did not cause intoxication in the broilers (Castro *et al.*, 2009).

#### **1.2.2.2.2- Effect of air velocity on broiler performance:**

Broilers exposed to the high air velocity consumed less water and more feed, gained more weight, and had an improved feed gain ratio. The high air velocity had little effect on daily patterns of feed and water consumption. Both feed and water consumption were depressed during the peak of the daily cyclic temperature (May *et al.*, 2000).

#### **1.2.2.2.3- The effect of heat on broiler performance:**

High environmental temperature is negatively affecting feed intake and thus weight gain of broilers. Increasing the energy content of the diet can partially overcome this growth depression. It is common practice now in formulating broiler feeds for hot regions to boost the energy level of these diets by adding fat. This practice not only increases the energy intake but also reduces the specific dynamic effect of the diet, which helps birds to cope better with heat stress (Ghazalah *et al.*, 2008).

Ambient temperature and long-term feed restriction significantly affect broiler performance. Moreover, long-term feed restriction at high ambient temperature increase heat resistance and improve the heat tolerance of growing broilers, when exposed to heat waves in summer season (Abu-Dieyeh, 2006).

The decrease in environmental temperature (cold stress) negatively influenced some indices of performance and blood system in broiler chickens (Blahova *et al.*, 2007).

### **1.2.3- Blood profile:**

The dietary supplementation of 2% Ginger root powder (*Zingiber officinale*) decreased serum glucose, total protein, cholesterol and calcium levels for broiler (Zomrawi *et al.*, 2013).

Addition of Aqueous Extract of Ginger (*Zingiber officinale*) in water decreased glucose and uric acid level. Also serum cholesterol level was lowered (Saeid *et al.*, 2010).

Diets containing 3% crushed and uncrushed *Nigella sativa seeds* (Black Cumin) reduced plasma cholesterol and triglycerides concentration, and increased plasma High-density lipoprotein (HDL) level (Albeitawi and Elghousein, 2008).

Supplement of blood meal in water causes hematological changes in broilers, total erythrocyte count (TEC), packed cell volume (PCV), and hemoglobin (Hb) concentration were decreased (Shahidullah *et al.*, 2008).

The dietary supplementation of black pepper (*Piper nigrum L.*) decreased amounts of triglycerides, total cholesterol, low density lipoprotein

(LDL) and high density lipoprotein (HDL) was increased in chicken blood (Nikola *et al.*, 2014).

Broiler diets containing different Levels of dried whey (DW) affect Serum metabolites, lowest value of creatinine and urea occurred by fed diet containing 2 g DW/kg diet. The diet containing 1.5g and 2g DW/kg decreased total cholesterol in blood. The HDL-cholesterol, LDL and triglyceride were decreased with increasing the level of DW supplementation (Ashour *et al.*, 2015).

The supplementation of 5% *Morinda citrifolia* (Indian mulberry) extract in water lower serum cholesterol in broilers (Sunder and *et al.*, 2011).

The supplementation of 100 mg per kg probiotic *Lactobacillus sporogenes*(*L. sporogenes*) in broiler diets reduced Serum total cholesterol, low-density lipoprotein (LDL) cholesterol, very low-density lipoprotein (VLDL) cholesterol and triglycerides (Panda *et al.*, 2006).

The addition of 10% raw garlic in broiler diet reduced haemoglobin concentration (HBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin concentration (MCHC) and mean corpuscular haemoglobin (MCH). Also the addition of 5% raw garlic to the diet of bird caused reduction in MCH and MCV (Jawad, 2007).

The Supplementation of probiotic in broiler diets increased the number of white blood cells (WBC) and (HCT %). Also supplementation of organic acid will be increase the (WBC) (Al-Saad *et al.*, 2014).



## **Chapter two**

### **Materials and method**

#### **2.1- Experimental site and duration:**

The study was conducted at Sudan University of Science and Technology, College of Animal Production Science and Technology – Khartoum State –East of the Nile–kuku. It was carried out during the period between 3 November to 8 December 2015, in which the ambient temperature ranged between (20 - 37.8°C) to objectives.

#### **2.2- Experimental house:**

The experiment was conducted in an open sided deep litter house constructed from iron sheets roofing, wire netting sides and concrete floor. The long axis of the house extended east – west facing the wind direction for efficient ventilation. The house was partitioned into twelve experimental units (1\*1 m<sup>2</sup>). The experimental house was dry cleaned, burned and washed by water and soap using high pressure pump. Ground cracks were closed by cement and the northern and southern sides of the house were covered by nylon sheets. Then the house was disinfected with Cypermethrin 10% (3 ml/litter) and virocid 0.5% (1:200 litre). The house was left closed until the arrival of the chicks. Fresh wood shaving as litter was spread in the pens at a depth of 5cm before the arrival of the chicks. Each replicate was provided with one feeder and one drinker capacity 8 litre. Both feeder and drinker washed well by water and soap and disinfected by Phonic.

### **2.3- Experimental birds and management:**

A total of one hundred and twenty (120) day old unsexed broiler chicks (Ross) were used in the experiment .The chicks were purchased from Enma Company for Poultry Production. The chicks were brooded for a week and fed pre starter broiler (table 3).

After the week period the chicks were weighted and randomly located into four treatment groups (30) chicks of approximately same weight (150 g/bird) each group was sub-divided in to (3) replicates (10) chicks each.

### **2.4-Prevention and vaccination:**

During the week period the chicks were given antibiotic (Colidad – Colistin [as sulphate] 1g/4litres) and (Tilmovet – Tilmicosin [phosphate] 30ml/100liters) in water for 5 days also given multi vitamins (AD<sub>3</sub>E 1ml/litre) in water for 7 days.

At day old each chick was vaccinated against infectious bronchitis and Newcastle disease (IB - ND). On the eighth day each chick was vaccinated against Newcastle disease (ND) by injection. On day 11 each chick was vaccinated against Newcastle and infectious bursal disease (ND - IBD) by drop in eyes. On day 17 each chick was vaccinated against infectious bursal disease (IBD) by drop in eyes. A multi vitamin was added in the drinking water before and after vaccination.

### **2.5-Experimental diets:**

The *Cymbopogon proximus* was purchased from the local market and classified by the medical and aromatic plants and traditional medicine

research institute (appendix 1), then dried ground. Proximate analysis of *Cymbopogon proximus* recorded by (Faten and El-Khateeb, 2013).

The other ingredients were purchased from the local market too, the ingredient composition compiled by (Sulieman and Afaf, 1999). Eight experimental diets were formulated four starter diets (table (4)) and four finisher diets (table (7)) to meet the requirements recommended by (Ross308 nutrition specification, 2014). Diet (A) was the control. The other three diets (B, C and D) contain *Cymbopogon proximus* at the ratio of (1, 2 and 3%) respectively.

**Table (3): Pre starter chemical composition:**

Item	%
Crude protein	22.50
Crude fat	5.30
Moisture	9
Crude ash	3
Crude fiber	2.4
Lysine	1.35
Methionine+ Cystine	1
Calcium	0.44
Digestible phosphorous	0.17
Metabolizable energy	3030 kcal/kg

Ingredients: Cereals, Vegetable protein, Salmon oil, Vitamins and minerals, Coccidiostat, Enzymes, Amino acids, Mould inhibitor,  $\beta$  – Glucans, 25 -DH-Hydroxycholecalciferol.

**Table (4): Contents of the experimental starter diets (%):**

Ingredient	A	B	C	D
Sorghum	53.55	54.05	54.85	55.55
Groundnut cake	29.50	30.00	30.00	30.50
Wheat bran	8.70	6.70	4.90	2.70
Concentrate*	5.00	5.00	5.00	5.00
Polyfat	1.50	1.50	1.50	1.50
Methionine	0.10	0.10	0.10	0.10
Lysine	0.30	0.30	0.30	0.30
Antitoxin	0.10	0.10	0.10	0.10
Anticoccidia	0.05	0.05	0.05	0.05
Lime stone	1.00	1.00	1.00	1.00
Salt	0.20	0.20	0.20	0.20
<i>Cymbopogon proximus</i>	0.00	1.00	2.00	3.00
Total	100.00	100.00	100.00	100.00

\* Concentrate (Millerson) composition: Crude protein 35%, Crude fat 2.5%, Crude fiber 3%, Calcium 8.5%, Available phosphorous 5%, Lysine 11%, Methionine 4.5% and Metabolizable energy 2000 kcal/kg.

**Table (5): Calculated chemical analysis of the experimental starter diets:**

Item	Ross308 nutrition specification 2014*	Experimental diets			
		A	B	C	D
Metabolizable energy (kcal/kg)	3000	3016.18	3013.79	3013.79	3016.18
Crude protein	23	23.15	23.21	23.12	23.17
Methionine	0.56	0.58	0.58	0.58	0.58
Lysine	1.44	1.43	1.43	1.43	1.43
Calcium	0.96	1.00	1.00	1.00	1.00
Available phosphorous	0.48	0.64	0.63	0.62	0.61
Crude fiber	-	5.47	5.60	5.70	5.80
Ash	-	4.35	4.37	4.35	4.36

\*www.aviagen.com

**Table (6): Determined analysis of the experimental starter diets (%):**

Item	Experimental diets			
	A	B	C	D
Moisture	6.86	6.66	6.33	6.33
Crud protein	24.04	23.23	23.14	23.19
Crud fiber	5.80	6.00	6.32	6.64
Ash	6.97	6.81	6.40	6.05

**Table (7): Contents of the experimental finisher diets (%):**

Ingredient	A	B	C	D
Sorghum	66.30	67.30	68.50	68.50
Groundnut cake	21.00	21.00	20.80	19.80
Wheat bran	4.00	2.00	0.00	0.00
Concentrate*	5.00	5.00	5.00	5.00
Polyfat	2.50	2.50	2.50	2.50
Methionine	0.05	0.05	0.05	0.05
Lysine	0.20	0.20	0.20	0.20
Antitoxin	0.10	0.10	0.10	0.10
Anticoccidia	0.05	0.05	0.05	0.05
Lime stone	0.60	0.60	0.60	0.60
Salt	0.20	0.20	0.20	0.20
<i>Cymbopogon proximus</i>	0.00	1.00	2.00	3.00
Total	100.00	100.00	100.00	100.00

\* Concentrate (Millerson) composition: Crude protein 35%, Crude fat 2.5%, Crude fiber 3%, Calcium 8.5%, Available phosphorous 5%, Lysine 11%, Methionine 4.5% and Metabolizable energy 2000 kcal/kg.

**Table (8): Calculated chemical analysis of the experimental finisher diets:**

Item	Ross308 nutrition specification 2014*	Experimental diets			
		A	B	C	D
Metabolizable energy (kcal/kg)	3200	3200.21	3202.60	3207.38	3185.87
Crude protein	20	20.35	20.25	20.10	19.77
Methionine	0.48	0.50	0.50	0.50	0.55
Lysine	1.19	1.22	1.22	1.22	1.22
Calcium	0.81	0.82	0.83	0.82	0.81
Available phosphorous	0.41	0.60	0.60	0.58	0.57
Crude fiber	-	4.35	4.44	4.51	4.73
Ash	-	3.59	3.56	3.53	3.50

\*www.aviagen.com

**Table (9): Determined analysis of experimental finisher diets (%):**

Item	Experimental diets			
	A	B	C	D
Moisture	6.75	7.1	6.97	7
Crud protein	20.41	19.99	18.66	17.33
Crud fiber	4.60	4.92	5.24	5.56
Ash	5.30	5.23	5.16	5.10



## **2.6- Data collection:**

### **2.6.1- Feed intake (FI):**

Feed intake for the birds of each replicate was calculated every day from the data of feed given by subtracting the amount of feed remained from the amount of feed given.

### **2.6.2- Body weight (BWT) and body weight gain (BWG):**

Body weight for the birds of each replicate was recorded daily. Weight gain was calculated daily by subtracting the body weight of day before from present body weight.

### **2.6.3- Feed conversion ratio (FCR):**

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

## **2.7- Sampling:**

In the end of experimental period (35day). Six birds from each treatment (two birds from each replicate) were taken after being weighed (weight of the sample similar the average of group weight).

## **2.8- Blood analysis:**

After slaughtering blood samples were taken and analyzed.

### **2.8.1- Blood profile:**

Sysmex kx-21N, SR:b 7637Jaban (appendix 2)

## **2.8.2- Newcastle anti body titer:**

### ***Preparation of 1% (v/v) chicken RBCs***

1. Collect whole blood in an equal volume of Alsever's solution for preservation of erythrocytes.
2. Wash the erythrocytes to remove buffy coat and Alsever's solution by adding 2 ml of blood to a 5ml centrifuge tube and filling the tube with PBS. Gently invert the tube several times to wash the erythrocytes. Centrifuge at  $800 \times g$  for 10 min. Aspirate the PBS and buffy coat from the tube. Refill the tube with fresh PBS, mix by inversion, and repeat the wash and centrifugation cycle t additional times for a total of three washes. Washed erythrocytes can be stored at 4 °C for up to 1 week. The suspension should be discarded if the erythrocytes show evidence of hemolysis (OIE, 2012).

### **haemagglutination inhibition( HI) test:**

1. 0.025 ml of PBS is dispensed into each well of a plastic V-bottomed microtitre plate.
2. 0.025 ml of serum is placed into the first well of the plate.
3. Twofold dilutions of 0.025 ml volumes of the serum are made across the plate.
4. 4 HAU virus/antigen in 0.025 ml is added to each well and the plate is left for a minimum of 30 minutes at room temperature, i.e. about 20°C, or 60 minutes at 4°C.
5. 0.025 ml of 1% (v/v) chicken RBCs is added to each well and, after gentle mixing, the RBCs are allowed to settle for about 40 minutes at room temperature, i.e. about 20°C, or for about 60 minutes at 4°C if

ambient temperatures are high, when control RBCs should be settled to a distinct button.

6. The HI titre is the highest dilution of serum causing complete inhibition of 4 HAU of antigen. The agglutination is assessed by tilting the plates. Only those wells in which the RBCs stream at the same rate as the control wells (positive serum, virus/antigen and PBS controls) should be considered to show inhibition (OIE, 2012).

### **2.9- Carcass characteristics:**

- Hot weight: after slaughtering the birds were weighted.
- weight of the edible organs: after slaughtering liver, spleen, gizzard and heart were weighted
- dressing percentage: was calculated

[birds weight (before slaughtering)/ carcass weight] X100

### **2.10- Advanced performance parameters were determined:**

#### **2.10.1- Production efficiency factor (PEF):**

By (Lemme *et al.*, 2006) method, (appendex3).

#### **2.10.2- Protein efficiency ratio (PER):**

By (Kamran *et al.*, 2008) method, (appendex3).

#### **2.10.3- Energy efficiency ratio (EER):**

By (Kamran *et al.*, 2008) method, (appendex3).

#### **2.10.4- Lysine efficiency:**

By (Nasr *et al.*, 2011) method, (appendex3).

### **2.11- Statistical analysis:**

Complete randomized design (CRD) ANOVA was used to analyse the results obtained from the experiment data. statistical package for social science (SPSS) was used.

## Chapter three

### Results and discussion

#### 3.1- The effect of *Cymbopogon proximus* on broiler performance:

##### 3.1.1-The effect of *Cymbopogon proximus* on feed intake:

The effect of supplemented diets with graded levels of *Cymbopogon proximus* (*Cp*) (0, 1, 2 and 3%) on feed intake was shown in table (10). The addition of *Cp* resulted in reduction of feed intake however this reduction was not significant ( $P>0.05$ ) except in the daily intake week one and the weekly intake of week one and two.

The supplementation of *Cp* in broiler diets reduce feed intake, perhaps the reason for this result *Cp* contain a large amount of tannins, high condensed tannins are often unpalatable to poultry and decrease feed intake. Similar results were recorded by (Makkar *et al.*, 2007) and (Moyle *et al.*, 2012). The result disagreed with study reported by (Mona *et al.*, 2015) who observed that the supplementation of 0.50 % and 0.75% *Cp* in broiler diets improve feed intake. Also disagreed with study made by (Amal *et al.*, 2013) who recorded that inclusion the essential oil extracted from Halfa Bar Oil (HBO) improve feed intake. In this study the percentage of *Cp* is highest when comparing with (Mona *et al.*, 2015) study, therefore the percentage of tannins is high.

**Table (10):The effect of *Cymbopogon proximus* on broilers feed intake(g/bird):**

Parameter Treatment	Daily feed intake				Weekly feed intake				Feed intake during starter period	Feed intake during finisher period	Feed intake during over all period
	Week1	Week2	Week3	Week4	Week1	Week2	Week3	Week4			
0%	42.24±9.50	60.52±7.81 <sup>a</sup>	112.24±19.73	162.86±12.16	301.13±8.16 <sup>a</sup>	430.19±17.56 <sup>a</sup>	801.99±51.58	1140.0±18.24	694.30±82.08	1951.0±55.90	2645.3±114.68
1%	37.59±8.14	54.12±7.51 <sup>b</sup>	112.00±18.38	161.78±10.94	263.18±21.94 <sup>b</sup>	378.87±36.63 <sup>a,b</sup>	784.00±30.46	1132.4±43.75	642.05±55.07	1916.4±74.00	2585.5±126.90
2%	34.69±7.96	50.33±7.73 <sup>b</sup>	110.57±19.98	155.65±12.88	242.86±10.16 <sup>b</sup>	352.33±19.70 <sup>b</sup>	773.99±61.44	1089.6±64.50	595.19±29.59	1863.6±114.4	2458.8±139.27
3%	36.94±6.92	50.92±8.54 <sup>b</sup>	106.61±15.40	153.60±10.37	258.61±3.19 <sup>b</sup>	348.91±36.95 <sup>b</sup>	742.78±55.19	1075.2±35.66	607.52±37.10	1818.0±19.54	2425.5±56.00
Significant	0.163	0.003	0.735	0.156	0.003	0.031	0.439	0.269	0.198	0.215	0.153

Means within the same column followed by different superscripts are significantly (P<0.05) different.

N: 30 bird / treatment.

### **3.1.2-The effect of *Cymbopogon proximus* on weight gain:**

The effect of incremented diets with different levels of *Cp* (0, 1, 2 and 3%) on weight gain was recorded in table (11). The supplementation of *Cp* resulted in reduction of weight gain but this reduction was significant ( $P < 0.05$ ) except in the daily and weekly gain of week one.

The addition of *Cp* in broiler diets decreased weight gain. Maybe weight gain was decreased by the decrease of feed intake due to tannin and other toxic materials. *Cp* include high concentration of saponins, Identical result was observed by (Francis *et al.*, 2002) who recorded that the saponins impact growth in animal and impair the digestion of protein and the uptake of vitamins and minerals in the gut, to cause hypoglycaemia. This result disagreed with study recorded by (Mona *et al.*, 2015) who obtain that broiler diets contain of 0.50% and 0.75% *Cp* mend weight gain. Also disagreed with study reported by (Amal *et al.*, 2013) who observed that inclusion the essential oil extracted from Halfa Bar Oil (HBO) improve weight gain. In (Mona *et al.*, 2015) study the percentage of *Cp* is lowest when comparing with the present study, so the percentage of saponins is low.

**Table (11): The effect of *Cymbopogon proximus* on broilers weight gain(g/bird):**

Parameter treatment	Daily weight gain				Weekly weight gain				Weight gain during starter period	Weight gain during finisher period	Weight gain during over all period
	Week1	Week2	Week3	Week4	Week1	Week2	Week3	Week4			
0%	26.17±10.02	34.71±7.62 <sup>a</sup>	68.27±22.64 <sup>a</sup>	84.01±9.76 <sup>a</sup>	183.22±20.09	262.81±12.50 <sup>a</sup>	490.31±27.05 <sup>a</sup>	578.38±18.67 <sup>a</sup>	446.03±22.94 <sup>a</sup>	1068.70±36.87 <sup>a</sup>	1514.70±44.66 <sup>a</sup>
1%	20.74±9.50	27.27±4.02 <sup>b</sup>	59.97±15.93 <sup>a,b</sup>	78.58±10.25 <sup>a</sup>	145.20±30.43	190.94±11.20 <sup>b</sup>	419.81±07.43 <sup>b</sup>	550.00±12.40 <sup>a</sup>	336.15±19.91 <sup>b</sup>	969.89±19.63 <sup>a</sup>	1306.00±39.53 <sup>b</sup>
2%	21.45±15.10	27.79±4.75 <sup>b</sup>	54.62±13.72 <sup>b</sup>	65.55±8.61 <sup>b</sup>	141.99±21.02	186.98±16.72 <sup>b</sup>	395.69±36.32 <sup>b,c</sup>	458.89±39.17 <sup>b</sup>	328.97±23.65 <sup>b</sup>	854.58±56.15 <sup>b</sup>	1183.60±62.13 <sup>b,c</sup>
3%	20.87±7.12	24.31±6.21 <sup>b</sup>	51.73±07.33 <sup>b</sup>	63.67±7.32 <sup>b</sup>	146.13±05.21	170.18±23.64 <sup>b</sup>	358.65±30.14 <sup>c</sup>	426.03±59.80 <sup>b</sup>	316.30±24.44 <sup>b</sup>	784.68±89.09 <sup>b</sup>	1101.00±111.37 <sup>c</sup>
significant	0.565	0.000	0.015	0.000	0.131	0.001	0.002	0.003	0.000	0.001	0.000

a,b: Means within the same column followed by different superscripts are significantly (P<0.05) different.

N: 30 bird / treatment.



### **3.1.3-The effect of *Cymbopogon proximus* on feed conversion ratio (FCR):**

The effect of supplemented diets with graded levels of *Cp* (0, 1, 2 and 3%) on FCR was evident in table (12). The addition of *Cp* resulted in impairment of FCR moreover this impair is significant except in the daily FCR of week one, two and three and the weekly FCR of week one.

The increment of *Cymbopogon proximus* in broiler diets impaired FCR, probably the reason of this result was due to the content of *Cp* of large amount of tannins. Similar result was observed by (Makkar *et al.*, 2007) who recorded that the plant containing condensed tannins decreased nutrient utilization. This result disagreed with study reported by (Mona *et al.*, 2015) who stated that the addition of 0.50 % and 0.75% *Cp* in broiler diets does not affect FCR. Also disagreed with (Amal *et al.*, 2013) who observed that the inclusion of the essential oil extracted from Halfa Bar Oil (HBO) promoted FCR. The variation in result of this study and (Mona *et al.*, 2015) may be due to variation in the percentage of *Cp* in diets.

**Table (12): The effect of *Cymbopogon proximus* on broilers feed conversion ratio(FCR):**

parameter Treatment	Daily FCR				Weekly FCR				FCR during starter period	FCR during finisher period	FCR during over all period
	Week1	Week2	Week3	Week4	Week1	Week2	Week3	Week4			
0%	1.90±0.220	1.78±0.280	1.92±0.370	1.95±0.200 <sup>b</sup>	1.54±0.010	1.64±0.100 <sup>b</sup>	1.66±0.165 <sup>c</sup>	1.97 ±0.070 <sup>b</sup>	1.55±0.120 <sup>b</sup>	1.83±0.117 <sup>b</sup>	1.75±0.110 <sup>c</sup>
1%	2.03±0.360	1.94±0.260	2.12±0.330	2.07±0.200 <sup>b</sup>	1.85±0.310	1.98±0.150 <sup>a</sup>	1.87±0.060 <sup>b</sup>	2.05±0.070 <sup>b</sup>	1.91±0.180 <sup>a</sup>	1.97±0.067 <sup>b</sup>	1.96±0.960 <sup>b,c</sup>
2%	2.01±0.310	1.93±0.310	2.12±0.340	2.39±0.200 <sup>a</sup>	1.73±0.220	1.90±0.280 <sup>a,b</sup>	1.98±0.080 <sup>a,b</sup>	2.37±0.060 <sup>a,b</sup>	1.81±0.180 <sup>a,b</sup>	2.18±0.220 <sup>a</sup>	2.00±0.041 <sup>a,b</sup>
3%	2.06±0.410	2.08±0.360	2.16±0.260	2.35±0.260 <sup>a</sup>	1.77±0.040	2.05±0.090 <sup>a</sup>	2.07±0.060 <sup>a</sup>	2.56±0.460 <sup>a</sup>	1.92±0.030 <sup>a</sup>	2.13±0.096 <sup>a</sup>	2.21±0.187 <sup>a</sup>
Significant	0.799	0.135	0.269	0.000	0.342	0.091	0.007	0.054	0.046	0.003	0.008

a,b: Means within the same column followed by different superscripts are significantly (P<0.05) different.

N: 30 bird / treatment.

### **3.1.4-The effect of *Cymbopogon proximus* in Production Efficiency Factor (PEF):**

The supplemented diets with graded levels of *Cp* (0, 1, 2 and 3%) on PEF was evident in table (13). The increment of *Cp* resulted in significant reduction of PEF.

The supplementation of *Cp* in broiler diets reduced production efficiency factor, maybe the reason for this result the content of *Cymbopogon proximus* of tannins. Similar result was recorded by (Makkar *et al.*, 2007) who observed that the ingestion of a plant containing condensed tannins decreases nutrient utilization. This result disagreed with study made by (Nasr *et al.*, 2011) who reported that the supplementation of different levels of lysine in broiler diets (starter and grower) increased production efficiency factor. Perhaps the reason of this variation in results is a variation in additive.

**Table (13): The effect of *Cymbopogon proximus* in production efficiency factor:**

Treatment	Production efficiency factor
0%	25.10±1.50 <sup>a</sup>
1%	20.10±1.00 <sup>a</sup>
2%	17.20±0.54 <sup>b</sup>
3%	15.40±2.20 <sup>b</sup>
Significant	0.000

a,b: Means within the same column followed by different superscripts are significantly ( $P<0.05$ ) different.  
N: 30 bird / treatment.

### **3.1.5-The effect of *Cymbopogon proximus* in protein efficiency ratio (PER):**

Supplemented of diets with different levels of *Cp* (0, 1, 2 and 3%) on PER was obtained in table (14). The addition of *Cp* resulted in reduction of PER whereas this reduction was significant except in the daily PER of week one, two and three and the weekly PER of week one.

The addition of *Cp* in broiler diets decreased protein efficiency ratio. This might be due to that *Cp* contained tannins and saponins. Similar result was recorded by (Makkar *et al.*, 2007) who stated that tannins have a very high affinity for proteins and form protein-tannin complexes, protein being affected to a great extent and (Francis *et al.*, 2002) observed that saponins impaired the digestion of protein. This result agrees with study recorded by (Kamran *et al.*, 2008) who indicated that low protein diets with constant ME:CP ratio decreased protein efficiency ratio.

**Table (14): The effect of *Cymbopogon proximus* on broilers protein efficiency ratio:**

Parameter Treatment	Daily protein efficiency ratio				Weekly protein efficiency ratio				protein efficiency ratio during starter period	protein efficiency ratio during finisher period
	Week1	Week2	Week3	Week4	Week1	Week2	Week3	Week4		
0%	2.65±0.56	2.53±0.61 <sup>a</sup>	3.00±0.87 <sup>a</sup>	2.58±0.27 <sup>a</sup>	2.81±0.01	2.66±0.17 <sup>a</sup>	3.00±0.30 <sup>a</sup>	2.54±0.10 <sup>a</sup>	2.81±0.23 <sup>a</sup>	2.74±0.17 <sup>a</sup>
1%	2.38±0.88	2.21±0.33 <sup>a,b</sup>	2.74±0.85 <sup>a,b</sup>	2.43±0.25 <sup>a</sup>	2.40±0.44	2.20±0.18 <sup>b</sup>	2.68±0.08 <sup>b</sup>	2.43±0.92 <sup>a,b</sup>	2.29±0.21 <sup>b</sup>	2.53±0.09 <sup>a,b</sup>
2%	2.58±1.49	2.45±0.59 <sup>a,b</sup>	2.55±0.83 <sup>a,b</sup>	2.10±0.18 <sup>b</sup>	2.54±0.34	2.32±0.33 <sup>a,b</sup>	2.56±0.11 <sup>b</sup>	2.10±0.06 <sup>b,c</sup>	2.41±0.24 <sup>b</sup>	2.29±0.02 <sup>b,c</sup>
3%	2.44±0.61	2.10±0.52 <sup>b</sup>	2.48±0.48 <sup>b</sup>	2.00±0.26 <sup>b</sup>	2.46±0.06	2.12±0.10 <sup>b</sup>	2.41±0.07 <sup>b</sup>	1.99±0.33 <sup>c</sup>	2.26±0.05 <sup>b</sup>	2.16±0.23 <sup>c</sup>
Significant	0.894	0.102	0.132	0.000	0.357	0.057	0.011	0.016	0.032	0.006

a,b: Means within the same column followed by different superscripts are significantly (P<0.05) different.  
N: 30 bird / treatment.

### **3.1.6- The effect of *Cymbopogon proximus* in energy efficiency ratio (EER):**

The effect of supplemented diets with graded levels of *Cp* (0, 1, 2 and 3%) on EER was observed in table (15). The increment of *Cp* resulted in reduction of EER however this reduction was significant except in the daily EER of week one, two and three and the weekly EER of week one.

The broiler diets contained different levels of *Cp* reduces energy efficiency ratio. Probably the reason for this result content of *Cp* of Saponins. Similar result was obtained by (Francis *et al.*, 2002) who observed that saponins cause hypoglycaemia. This result agreed with study recorded by (Kamran *et al.*, 2008) who evidence that low protein diets with constant ME:CP ratio decrease energy efficiency ratio.

**Table (15): The effect of *Cymbopogon proximus* on broilers energy efficiency ratio:**

Parameter Treatment	Daily energy efficiency ratio				Weekly energy efficiency ratio				energy efficiency ratio during starter period	energy efficiency ratio during finisher period
	Week1	Week2	Week3	Week4	Week1	Week2	Week3	Week4		
0%	4.85±1.04	4.64±1.12 <sup>a</sup>	4.55±1.29 <sup>a</sup>	3.85±0.41 <sup>a</sup>	5.51±0.02	4.87±0.31 <sup>a</sup>	4.52±0.44 <sup>a</sup>	3.79±0.14 <sup>a</sup>	5.15±0.41 <sup>a</sup>	4.09±0.25 <sup>a</sup>
1%	4.36±1.61	4.06±0.61 <sup>a,b</sup>	4.09±1.26 <sup>a,b</sup>	3.62±0.37 <sup>a</sup>	4.39±0.81	4.03±0.33 <sup>b</sup>	4.00±0.12 <sup>b</sup>	3.63±0.14 <sup>a,b</sup>	4.19±0.39 <sup>b</sup>	3.78±0.13 <sup>a,b</sup>
2%	4.73±2.73	4.50±1.07 <sup>a,b</sup>	3.81±1.23 <sup>a,b</sup>	3.14±0.27 <sup>b</sup>	4.65±0.63	4.25±0.60 <sup>a,b</sup>	3.82±0.16 <sup>b</sup>	3.14±0.09 <sup>b,c</sup>	4.41±0.45 <sup>b</sup>	3.42±0.035 <sup>b,c</sup>
3%	4.47±1.12	3.86±0.95 <sup>b</sup>	3.70±0.72 <sup>b</sup>	3.11±0.40 <sup>b</sup>	4.50±0.11	3.88±0.18 <sup>b</sup>	3.60±0.11 <sup>b</sup>	2.97±0.49 <sup>c</sup>	4.15±0.08 <sup>b</sup>	3.22±0.34 <sup>c</sup>
significant	0.894	0.102	0.132	0.000	0.357	0.057	0.010	0.016	0.032	0.006

a,b: Means within the same column followed by different superscripts are significantly ( $P < 0.05$ ) different.

N: 30 bird / treatment.



### **3.1.7-The effect of *Cymbopogon proximus* in lysine efficiency:**

The effect of increment diets with different levels of *Cp* (0, 1, 2 and 3%) on lysine efficiency is shown in table (16). The addition of *Cp* result was increase of lysine efficiency moreover this increase was significant except in the daily lysine efficiency of week one, two and three and the weekly lysine efficiency of week one.

The supplementation of *Cp* in broiler diets increased lysine efficiency this result agrees with that reported by (Nasr *et al.*, 2011) who showed that the supplementation of different levels of lysine in broiler diets (starter and grower) increase lysine efficiency. Result agrees with (Nasr *et al.*, 2011), perhaps the reason for increasing of lysine efficiency in *Cp* treatments may be that *Cp* contained high content of lysine.

**Table (16): The effect of *Cymbopogon proximus* on broilers lysine efficiency:**

Parameter Treatment	Daily lysine efficiency				Weekly lysine efficiency				lysine efficiency during starter period	lysine efficiency during finisher period
	Week1	Week2	Week3	Week4	Week1	Week2	Week3	Week4		
0%	24.43±4.96	26.17±7.68	21.94±7.69	23.86±2.55 <sup>b</sup>	22.13±0.10	23.44±1.56 <sup>b</sup>	20.25±2.00 <sup>c</sup>	24.1±0.94 <sup>b</sup>	22.22±1.77 <sup>b</sup>	22.30±1.43 <sup>c</sup>
1%	28.76±8.50	28.77±5.10	24.10±6.54	25.37±2.52 <sup>b</sup>	26.49±4.50	28.38±2.25 <sup>a</sup>	22.78±0.69 <sup>b</sup>	25.12±0.97 <sup>b</sup>	27.36±2.62 <sup>a</sup>	24.10±0.84 <sup>b,c</sup>
2%	29.00±12.32	26.54±5.65	26.10±7.61	29.19±2.50 <sup>a</sup>	24.78±3.28	27.19±4.14 <sup>a,b</sup>	23.89±1.00 <sup>a,b</sup>	29.00±0.81 <sup>a,b</sup>	25.98±2.64 <sup>a,b</sup>	26.61±0.27 <sup>a,b</sup>
3%	27.00±6.80	31.28±8.10	25.35±4.26	29.79±4.10 <sup>a</sup>	25.32±0.61	29.41±1.38 <sup>a</sup>	25.29±0.76 <sup>a</sup>	31.32±5.69 <sup>a</sup>	27.49±0.55 <sup>a</sup>	28.51±3.18 <sup>a</sup>
significant	0.538	0.151	0.272	0.000	0.341	0.091	0.007	0.054	0.046	0.013

a,b: Means within the same column followed by different superscripts are significantly (P<0.05) different.  
N: 30 bird / treatment.

### **3.2-The effect of *Cymbopogon proximus* on blood profile and Newcastle antibody titer:**

The effect of diets that contained graded levels of *Cp* (0, 1, 2 and 3%) on blood profile and Newcastle antibody titer is recorded in table (17). The supplementation of *Cp* did not affect the blood profile except platelet cell (PLT) which showed observed significant reduction. Furthermore there are no significant affect in Newcastle antibody titer.

Reduction in platelet maybe an indicator to a defect in liver. Comparable result was obtained by (Poordad, 2007) who observed that thrombocytopenia is a common finding in advanced liver disease. Also (Witters *et al.*, 2008) indicated that the liver is closely intertwined with the function and number of blood platelets, Thrombocytopenia is a marked feature of chronic liver disease and cirrhosis, this agree with result shown in table (18).

**Table (17) :The effect of *Cymbopogon proximus* on blood profile and Newcastle antibody titer:**

parameter	WBC *10 <sup>3</sup> /ml	RBC *10 <sup>6</sup> /ml	HGB(g/dl)	HCT%	MCV(fl)	MCH(pg)	MCHC(g/dl)	PLT*10 <sup>3</sup> /ml
Treatment								
0%	228.90±14.30	2.27±0.22	9.77±1.10	30.82±03.00	135.50±3.89	42.92±1.80	31.70±0.55	50.00±18.20 <sup>a</sup>
1%	228.80±05.58	2.34±0.21	9.82±0.88	31.40±02.80	134.40±3.33	41.91±1.00	31.20±0.50	29.70±13.30 <sup>b</sup>
2%	231.70±08.10	2.26±0.22	9.50±0.63	30.15±02.44	133.20±3.00	42.00±1.40	31.50±0.57	19.70±9.80 <sup>b</sup>
3%	236.40±18.80	2.52±0.71	10.80±3.60	34.60±10.30	136.80±1.90	42.60±1.70	31.10±0.83	24.60±11.70 <sup>b</sup>
significant	0.744	0.757	0.745	0.656	0.366	0.701	0.493	0.029

**Continue**

parameter	LYM%	MXD%	NEUT%	LYM_A*10 <sup>3</sup> /ml	MXD_A*10 <sup>3</sup> /ml	NEUT_A*10 <sup>3</sup> /ml	RDWSD (fl)	RDWCV%	ND-HI titer(log <sub>2</sub> )
Treatment									
0%	84.00±5.00	9.00±3.30	6.90±2.40	192.00±9.90	20.90±8.40	16.10±6.25	43.00±3.50	14.45±2.28	4.20±0.84
1%	84.60±3.20	7.80±3.20	7.60±2.00	193.40±4.90	17.85±7.50	15.87±6.80	38.88±4.10	14.33±1.40	3.00±1.22
2%	86.50±3.30	7.40±2.60	6.00±1.50	200.20±6.30	17.30±6.20	14.12±3.82	36.85±6.30	14.27±2.89	3.67±0.52
3%	82.40±10.40	8.40±4.80	9.20±5.60	193.20±12.97	20.58±13.82	22.58±16.15	37.98±1.40	13.30±2.20	3.33±0.82
significant	0.805	0.916	0.556	0.561	0.916	0.572	0.240	0.828	0.188

a,b: Means within the same column followed by different superscripts are significantly (P<0.05) different.

N: 6 bird / treatment.

### **3.3-The effect of *Cymbopogon proximus* on carcass characteristics:**

The effect of increment diets with different levels of *Cp* (0, 1, 2 and 3%) on final body weight, hot carcass weight, dressing out percentage and edible organs percentage was recorded in table (18). The supplementation of *Cp* result did not affect dressing percentage and edible organs percentage except liver weight significant ( $P < 0.05$ ) increase .One the other hand significant reduction in life weight and hot weight were recorded.

The addition of *CP* in broiler diets did not affect dressing percentage and spleen, gizzard and heart this result agrees with (Amal *et al.*, 2013) who observed that the supplementation of graded levels of essential oil extracted from Halfa Bar Oil (HBO) did not affected dressing percentage and edible organs. Probably the reason of the increased liver weight is due to *Cp* tannins. Identical result was observed by (Makkar *et al.*, 2007) who recorded that hydrolyzable tannins are potentially toxic to animals. Consumption of feeds containing high levels of hydrolyzable tannins caused liver and kidney toxicity, also (Witters *et al.*, 2008) obtained that the liver closely intertwined with the function and number of blood platelets. This agreed with the result shown in table (17) where the platelet account decrease in treatment (1, 2 and 3%) *Cp*.

The supplementations of *Cp* in broiler diets impaired final weight. Perhaps the justification for this result the reduction in feed intake as a result of large amount of tannins that led to impair the bird's weight. Similar result was recorded by (Makkar *et al.*, 2007). The result disagreed with study obtained by (Mona *et al.*, 2015) who recorded that the broilers diets containing of 0.50 % and 0.75% *Cp* to improve weight. Also disagreed with

study made by (Amal *et al.*, 2013) who observed that addition of the essential oil extracted from Halfa Bar Oil (HBO) improved weight. The difference in results of this study and (Mona *et al.*, 2015) study may be due to difference in percentage of *Cp* in diets. Maybe, as the final weight was affected by supplementation of *Cp* the hot carcass weight was affected.

**Table (18): The effect of *Cymbopogon proximus* on carcass characteristics:**

parameter	body weight	carcass weight	Dressing out%	Liver%	Spleen%	Gizzard%	Heart%
treatment							
0%	1400.00±70.60 <sup>a</sup>	920.00±60.20 <sup>a</sup>	65.70±1.50	0.0032±0.00022 <sup>b</sup>	0.00015±0.000031	0.0039±0.00041	0.0011±0.00017
1%	1327.50±61.70 <sup>a</sup>	887.50±47.80 <sup>a</sup>	66.80±1.50	0.0037±0.00030 <sup>a</sup>	0.00017±0.000032	0.0039±0.00069	0.0009±0.00013
2%	1246.70±51.70 <sup>b</sup>	813.70±46.00 <sup>b</sup>	65.30±2.30	0.0039±0.00027 <sup>a</sup>	0.00015±0.000039	0.0040±0.00049	0.0010±0.00008
3%	1166.70±70.70 <sup>c</sup>	766.70±43.50 <sup>b</sup>	65.70±1.10	0.0040±0.00035 <sup>a</sup>	0.00015±0.000053	0.0040±0.00058	0.0010±0.00012
Significant	0.000	0.000	0.481	0.001	0.703	0.971	0.432

a,b: Means within the same column followed by different superscripts are significantly ( $P<0.05$ ) different.  
N: 6 bird / treatment.

## **Chapter four**

### **Conclusion**

The addition of *Cymbopogon proximus* in graded levels to broiler diets resulted are:

1. Reduced broiler performance.
2. Decreased production efficiency factor, protein and energy efficiency ratio and platelet.
3. Increased lysine efficiency and liver weight.

### **Recommendations**

1. It is recommended that the action of *Cymbopogon proximus* in blood clotting time showed be explored.
2. Further investigations is recommended to study the effect of *Cymbopogon proximus* on liver functions.
3. It is recommended to analyze *Cymbopogon proximus* and determined lysine contain.



## Chapter five

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## **Appendixes**

### **Appendix1**

#### **Certificate of *Cymbopogon proximus* classification**



Date 1-9-2015

To whom it may concern


This to certify that the plant materials were taxonomically authenticated by Yahya Sulieman Mohamed at the herbarium of Medicinal and Aromatic Plants & Traditional Medicine Research Institute (MAPTMRI), National center for Research, Khartoum, Sudan, and voucher herbarium samples were deposited there for further future reference.

Botanica name .Cymbopogon schoenanthus .L

Family : Poaceae

Name : Alaa Abdalla Ibrahim

Sudan University Of Science & Technology

  
Dr. Reem Hassan Ahmed  
Head department of Taxonomy &  
Plants Research & Tradition Medicine &

  
Prof. Awatif Ahmed Mohamed  
Director of Medicinal and Aromatic Photochemistry  
Institute (MAPRTMI)

## Appendix2

### 1- Calibration:

The most efficient way to calibrate the open sample mode of the cell-DYN 1700 system is to use calibrator and the auto-Cal method. When a control is used as a calibrator, a different lot or brand of control must be used for Daily Quality Control (DQC) the procedure as the following

Return each control at 2-8°c for 1 min then shake the DOQ and allow to rest and warm for 50 min.

### 2- Procedure, principle and reagents:

The apparatus can suck 2ml of careen reagent, computerized the data and the result were given in the screen. The screen reagents consist of diluents, lytic agent, detergent and enzymatic cleaner.

#### 2.1-Diluents:

Cell-DYN Diluents are formulated to meet following the requirements: WBC, RBC, PCV and Hb.

-Rinse the sample probe and maintain the cell volume of RBC during the count.

-Sizing portion of the measurement cycle.

And it consists of: Sodium sulfate anhydrous < 1%, Sodium chloride < 0.5%, Anti-microbial agent< 0.5%, Buffer < 0.1% and Stabilizer < 0.1%.

#### 2.2- Lytic agent:

It is formulated to meet the following requirements:

- Rapidly lyses the RBC and minimize the result out cell stroma.
- Alters the WBC membrane to allow the cytoplasm to slowly diffuse and allow the membrane to shrink around the nucleus and any granules that may present.
- Converts the Hb to a modified the hemoglobin cyanide complex that is measurable at 540 nm.

It consists of: Quaternary ammonium salt 50% (< 4.50%) and Potassium cyanide <0.08%.

### 2.3-Detergent:

Detergent is formulated to meet the following requirement:

- Provide an optically clear solution that is used to obtain the zero preference during the Hb measurement cycle.
- Provides proper meniscus formation in both metering tubes and maintain it during each run cycle and rinse both chambers, both metering tubes, and the HGB flow cell with minimal bubble formation.

And it consists of: Sodium sulfate anhydrous < 1.50%, Sodium chloride < 0.60%, Anti-microbial agent < 0.10% and Poly oxyethylene ether < 0.25%.

### 2.4-Enzymatic cleaner:

Enzymatic cleaner is formulated to effectively remove protein build up with the instrument.

### 3-Thrombocytes count:

Dissolve sodium citrate 3.8 g, formaldehyde (40%) 0.2ml and brilliant crystal blue 0.1 g in distilled water 100.0 ml. 1.0 ml from the diluting fluid was taken by the RBC pipette; 0.5 ml of blood was added; mixed and shaken; expel a third of the fluid, fill both sides in haemocytometer. Place the haemocytometer in Petri dish containing filter paper keep it without touch. Count in erythrocytes counting area. The number of erythrocytes x 1.0 = No. of erythrocytes/ $\mu$ l = thrombocyte cells x  $10^3$   $\mu$ ml/l. (Schalm *et al.*, 1981)

## Appendix3

### Equations

#### **Production efficiency factor (PEF):**

= (Bird final weight/ kg x livability %) / (age per days x Feed conversion ratio (F.C.R) x100) (Lemme *et al.*, 2006).

#### **Protein efficiency ratio (PER):**

= weight gain / protein intake (Kamran *et al.*, 2008).

#### **Energy efficiency ratio (EER):**

= (weight gain x 100) / energy intake (Kamran *et al.*, 2008).

#### **Lysine efficiency:**

= Lysine intake (mg) / weight gain (Nasr *et al.*, 2011).

