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Effect Of Garlic On The Immunity And Reproductive Perfermance In Broilere Chickens

A GRADUATION RESEARCH PROJECT SUBMITTED COUNCIL OF THE SHAQLAWA TECHNICAL COLLEGE AT ERBIL POLYTECHNIC UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF BAKALOROS IN VETERINARY TECHNIQUES

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قُلِ الْحَقُّ مِن رَّبِّكُمْ فَمَن شَاءَ فَلْيُؤْمِن وَمَن شَاءَ فَلْيَكْفُرْ

إِنَّا أَعْتَدْنَا لِلظَّالِمِينَ نَارًا أَحَاطَ بِهِمْ سُرَادِقُهَا

سورة الكهف

Decision of the Supervisor

Research entitled (**Effect Of Garlic On The Immunity And Reproductive Perfermance In Broilere Chickens**) under my Supervision in Shaqlawa Technical College Veterinary Department Submitted for the Purpose of obtaining a bachelors in (Veterinary).

Signature

Dr. Nawal Kamal Shokry Barzani

Date: / /2024

Certification

I certify that this study was prepared by students (**Luqmman Hama Said , Ismail Mala Mahmood**), under my supervision at the Shaqlawa Technical College Veterinary Department, in partial Fulfillment of the requirements for the degree of Bachelor in Veterinary.

Signature

Dr. Nawal Kamal Shokry Barzani

Dedication

To … Mohammed Ibn Abdullah … The last Messenger of Allah (Peace Be Upon Him)

To … My Love Land Kurdistan

To … My Dear Parents …For Their effects and Kindness

To … All My Friends

To … my supervisor Nawal Barzani for your help me for preparation of this seminar

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Abstract

Poultry consumption is increasing due to the increasing human population and the cost of protein. Scientists are exploring alternative growth promoters to maintain healthy poultry guts and balance with microflora. Antibiotic resistance is a growing concern, and there is a need to investigate alternative growth enhancers that improve animal performance and prevent infectious diseases. Probiotics and medicinal plants are used in poultry diets to enhance immune response. Garlic powder can replace antibiotic growth promoters, maintaining broiler productivity, abdominal fat, and meat cholesterol. Garlic supplementation decreases broiler chicken mortality, improves digestion, weight gain, meat quality, and immune system stimulation. Feed consumption data shows significant differences between groups in the 15-30 and 1-42 days of age, with the best FCR recorded in group 2.

Aim

Purpose of use Effect of garlic on poultry production in terms of meat and eggs. Effect on immunity, growth and weight.

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Chapter One

Introduction

Since most governments have banned antibiotics as growth promoters for 10 years, research has focused on finding safer alternatives. Researchers are studying herbal plants with therapeutic characteristics. This safe and natural source of active chemicals has intrigued academics for decades, yielding promising results.
(Jayaprakasha et al. 2006).

Their actions caused the range of pathogenic microorganisms in the digestive tract to shrink, which in turn caused the poultry's immunity to rise, growth to accelerate, and overall health to improve. (Kumar et al., 2010) Every day, there are more and more medicinal herbs that could be used as herbal feed supplements for hens. (Suriya et al., 2012) . Garlic holds a unique position in medicine due to its wide range of applications and accessibility to poultry breeders. (Fadlalla Et al., 2010). It benefits chickens by acting as an antibiotic, having an antioxidant impact, lowering mortality, and increasing stomach secretion. (Sivam, 2001). These characteristics are the outcome of the activities of the bioactive substances included in . (Amagase Et Al., 2001; Suriya, 2012) . the most important of which are organic sulphurous compounds aliin, allicin, ajoene and allylpropyl disulphide and diallyl trisulphide, sallilcisteine and others(Freeman and Kodera, 1995) .

On a basic level garlic contains oligosaccharides — prebiotics that stimulate the growth of beneficial bacteria in the large intestine, thus stimulating immunity. Small amounts of crushed raw garlic fed to baby chicks twice a week not only help their immune systems develop but also get them used to the flavor so they will be more likely to accept it later in life. (Gail Damerow 2016) .The bacterial strains commonly used for garlic fermentation are Lactobacillus plantarum, Bacillus subtilis, Weissella koreensis, and Leukonostoc mesenteroides. Garlic fermented with either W. koreensis or L. mesenteroides equally produced higher sulfur-related metabolites, such as 3-vinyl-[4H]-1,2,-dithiin, allylmethyl trisulfide, diallyl disulfide, diallyl trisulfide, but lower alliin compared with fresh garlic . (Yan et al., 2012). Additionally, studies have shown that supplementing broiler meals with garlic reduced triglycerides, cholesterol, and low-density lipoprotein (LDL) concentration. (Dehkordi et al., 2010).

Chapter Two

2.1 Garlic

The scientific name of Garlic is *Allium sativum "A.sativum"*. Garlic is a member of the Liliaceae family and is a common ingredient for flavor and spice and it is one of the most commonly used herbs in modern folkloric medicine. Garlic is widely distributed and used in all parts of the world as a spice and herbal medicine for the prevention and treatment of disease, ranging from infection to heart disease (Javandel *et al*., 2008).Garlic's bulb, composed of few or many cloves, is the main economic organ. The fresh leaves, pseudostems and bulbils are also consumed. It has a higher nutritive value than the other bulb crops (Stavẽlỉkovả, 2008). Garlic (Allium sativum) is well known as a spice and herbal medicine for the prevention and treatment of variety of diseases (Onibi *et al.,* 2009).

2.2 Morphology of Garlic

The leaves are 12–15 cm tall and have a green tint (but some species can reach a height of 60 cm). The fruit of the garlic plant is pale or barely yellowish and has a strong aroma. Depending on the cultivar, the tall leaves may grow from a softer pseudo-stem made of overlapping leaf sheaths or from tiny, hard stems above the bulb. Up to 20 edible bulblets(Iciek M., et al ,2009). known as cloves are contained in the membrane-skinned bulbs. The bulb, an underground section, is made up of clove clusters. It has lengthy leaves with alternately arranged blade groups .(Shinde A., et al ,2021)

2.3Different Types Of Garlic:

The stem. The pseudo-stem, which is quite short, creates a tray at the base from which adventitious roots sprout. The leaves are connected by their sheaths to form a string.(Saddique H., et al ,2015)

The root. Its adventitious root system is thick and sparsely branched, and it surrounds the central stele with an endoderm, a multicellular cortex, and an epidermis. (So .T.K.A., et al ,2021)

The leaves. The species' leaves range in number from 9 to 12 and are linear and alternate with a tubular sheath . (Mann L.K., et al ,1952).

The bulb. With rounded, elliptical, or circular shapes, as well as transverse broad and transverse narrow elliptical shapes, it can be white, brown, light brown, violet, light violet, or dark violet (Nasir A., et al ,2020).

2.4 Classification of Allium Sativum

Table 1. Classification of Allium sativum

Kingdom	Plantae
Subkingdom	Tracheobionte
Superdivision	Spermatophyta
Division	Magnoliophyta
Class	Equisetopsida
Subclass	Magnoliidae
Superorder	Lilianae
Order	Asparagales
Family	Amaryllidaceae
Genus	Allium

(So ,T.K.A. , et al ,2021).

2.5 Chemical Compostion

Garlic contains more than 200 chemical compounds with multiple properties. It is 65% water, 28% carbohydrates, 2.3% organosulfur compounds, 2% proteins, 1.2% free amino-acids, and 1.5% fiber (Lucía Melguizo-Rodríguez, et al ,2022)

Component	Importance
Carbohydrates (33.06 g)	Important for energy, immunity, disease prevention, and blood clotting
Protein (6.36 g)	Development of body tissues
Fiber (2.1 g)	Shortens the stagnant time in the gut
Sugar (1 g)	for energy, immunity, disease prevention, and blood clotting
Fats (0.5 g)	Formation of cell membranes
Vitamin B5 (0.6 g)	Formation of coenzymes of amino acid metabolism
Vitamin B3 (0.7 g)	Formation of coenzyme NAD
Vitamin B2 (0.1 g)	Formation of coenzyme FAD
Vitamin B1 (0.2 mg	Carbohydrate metabolism and synthesis of acetylcholine
Vitamin B6 (1.2 mg)	Formation of coenzymes in different reactions
Vitamin C (31.2 mg)	Protein synthesis
Vitamin B9 (3 µg)	Synthesis of DNA
Phosphorus (153 mg)	Formation of lipids, proteins, sugars, and nucleic acid
Calcium (181 mg)	Formation of bone and coagulation process
Magnesium (25 mg)	Cofactor for kinase and decarboxylase
Sodium (17 mg)	Formation of membrane
Selenium (14.2 µg)	Cofactor for glutathione coagulase
Zinc (1.16 mg)	Cofactor for some enzymes
Sulfur (16%)	Antimicrobial

(Wafaa A. Abd El-Ghany ; 2024).

Garlic is estimated to contain different bioactive compounds, including organosulfur compounds diallyl thiosulfonate (allicin), diallyl sulfides, diallyl disulfide, diallyl trisulfide, and S-allyl-cysteine sulfoxide (alliin), saponins, phenols (β-resorcylic acid, pyrogallol, gallic acid, rutin, protocatechuic acid, and quercetin), amino acids, polysaccharides (fructose, glucose, and galactose), essential oils, vitamins (ascorbic acid, ribofavin, niacin, thiamine, and folic acid), minerals (germanium, selenium, phosphates, calcium, and iron), and enzymes. The chemical structure of garlic is illustrated .The allin and alliinase enzymes collaborate to produce allicin , which is released from its precursor form when garlic bulbs are crushed or destroyed in digestion. Allicin, or daily thiosolphinic acid, is an active inhibitory principle of garlic (Wafaa A. Abd El-Ghany ; 2024).

A diverse array of polyphenols has been identified in different garlic varieties, including gallic acid, chlorogenic acid, caffeic acid, epicatechin, luteolin, quercetin, hyperoside, ferulic acid, allyl isothiocyanate, and others . These polyphenols contribute to the potential health benefits of garlic and its multifaceted applications in culinary and medicinal practices. However, alliin takes the spotlight as the primary sulfur component in garlic. This essential compound arises when garlic undergoes mechanical manipulation, leading to the release of alliinase from vacuoles. The alliinase enzyme is crucial in transforming alliin into allicin and other thiosulfinates (Alejandra Meza-Rios. et al ,2024).

2.6 Medical Uses

Studies have shown that eating garlic lowers total cholesterol (TC) and low-density lipoprotein (LDL), and that these effects are more noticeable when taken for a longer period of time and at a lower dosage, particularly in people with cardiovascular disorders. (Li S., Guo W., Lau W., et al 2022) . You can use raw garlic and garlic extract (in powder or oil form) as functional and therapeutic foods. A large body of research suggests that garlic has anti-tumor, antioxidant, and preventative functions in enhancing the immune system. Garlic also shields the body from free radical damage. (Cheng H., Huang G., Huang H.2020) . Garlic consumption appears to significantly affect antihypertensive effects based on data from preclinical studies and clinical trials. (Hussein H.J., Hameed I.H., Hadi M.Y., 2017) . In immunocompromised mice, garlic has been shown to reduce inflammation and the quantity of the gastrointestinal illnesscausing cryptosporidiosis (Farid A., Yousry M., Safwat G. 2022) . Under biotic and abiotic stress circumstances, garlic extract has been demonstrated to enhance crop quality and soil conditions (Hayat S., Ahmad A., Ahmad H., et al. 2022). Garlic oil offers superior efficacy against aerobic bacteria incomparison to neem, clove, and tulsi oils (Isani A., Masih U., Joshi K. 2022) .

2.7 Role of Garlic in Poulty

Because of its antimicrobial properties, garlic is a highly studied medicinal plant used as a growth promoter in broiler chickens (Lewis M.R. et al 2003). Therefore, the trials assessed garlic as an alternative growth promoter in poultry and revealed itsexcellent effects on growth, digestibility and carcass characteristics (Bampidis VA, Christodoulou V. et al. 2005).Hoever, precise mechanisms for improving the growth performance of poultry fed garlic remain unclear while some researchers have linked this improvement to the increased feed intake of garlic supplemented diets .Garlic is usually used as seasonings to intensify the taste and, thus, the palatability of the feed may be increased, thereby increasing the voluntary consumption of feed. Brzoska et al. [that garlic extract (2.25 mL/kg of feed) stimulated chicken's appetite, resulting in considerably higher feed consumption and thereby higher body weight gains who speculated that garlic, would possibly be responsible for the increase in weight gain of birds when included in their rations. Kirubakaran et al. postulated that garlic can increase the rate of salivary flow and gastric juice secretion in the broiler diet, contributing to improved digestibility and higher body weight. Contrarily adverse affects on growth efficiency in broilers have also been observed with 1 g of garlic powder/kg feed and 15 g of garlic bulb/kg feed supplementation . The addition of alliums may minimize the palatability of the diet due to their pungency and, as a result, the consumption of feed and the body weight of the animals may decrease (P. Singh , G. Kumar, et al ,2020).

2 .8 Hematology

Hematology The supplementation of garlic in poultry has a beneficial effect on the hematological profiles of poultry birds. Hematological analysis reported by (Kung-chi C. et al 2006) .found that white blood cell and red blood cell levels, hemoglobin, hematocrit and mean corpuscular hemoglobin values in rats were substantially improved by the consumption of garlic oil. In comparison, it has been stated that garlic in broilers does not affect the number of leukocytes (Singh et al. 2020) .

Antibacterial affect

Garlic can be used to treat Colibacillosis, Salmonellosis and Cholera in poultry. Garlic exerts a differential inhibition between beneficial intestinal microflora and potentially harmful enterobacteria (Rees L.P. et al.1993). .For the same garlic dose inhibition zone 7 observed in E. coli was more than 10 times than that seen in Lactobacillus casei (Skyrme D.A.1997)

Antiviral effects

Mostly the commercially available antibiotics are not affective against viruses. That is the reason these cannot be used to control the viral diseases of poultry. Very less research is done on antiviral properties of garlic compared to antibacterial. Allicin and allicin-derived substances are active against viruses and no activity has been indicated with alliin or S-allyl cysteine. It has been proved that garlic shows in vitro activity against influenza A and B viruses, rhinovirus, HIV, herpes simplex virus 1 and 2, cytomegalovirus, viral pneumonia and rotavirus (Fenwick G.R. et al.1985).

Anti-protozoal

Affects Use of garlic in poultry feed exhibits antiprotozoal effects in poultry but the exact mechanism of action remains to be explored. Several studies have shown that it is effective against a host of protozoa including Opalina ranarum, Entamoeba histolytica,Balantidium entozoon, O. dimidicita, Trypanosomes, Leishmania, and Leptomonas . (Reuter, 1996)

Antifungal effects

Alike other antimicrobial properties antifungal activity of garlic has also been proven to be thanksgiving. The first ever report of antifungal activity of garlic in epidermophyte cultures . Studies suggest that garlic can prevent the growth of Aspergillus, Torulopsis, Trichophyton, Cryptococcus, Candida and Trichosporon.(Zaib Ur Rehman., et al ,2015).

2.9 Immune Organ

A tiny collection of tissues and organs, including the spleen, bursa, tonsil, and thymus, represented the avian lymphoid tissue. An The lymphatic tissues' most noticeable feature is that They have a lot of lymphocytes packed within them. This is due to their role in the generation of lymphocytes, immunological reactions, or both of the processes taking place at concurrently . Moreover, lymphoid tissue can be divided into “peripheral” and “central” tissues. The core lymphoid tissue, which includes bone, is where lymphocytes develop most frequently. Thymus, bursa, and marrow in birds. The auxiliary or It appears that secondary lymphoid tissues rely on the Principal lymphoid tissue for their genesis and growth And perform. They comprise lymphoid tissue in birds The spleen and across the digestive system, encompassing the cecum Tonsils The immune system of birds serves as a priceless example For research in fundamental immunology (Khalil Mohsin, Islam Z.I., Khalil Mansur, Islam R., 2002).

The immune organs of birds can be categorized into peripheral immune organs (such as the spleen and caecum tonsil) and central immune organs (such as the thymus, bursa and bone marrow) based on their structures and functions. The central immune organs originate during the embryonic stage and continue to develop from organ primordia to fully functional organs with age. The central immune organs can cultivate mature functional lymphocytes without antigen stimulation and then export these lymphocytes to the peripheral immune system to participate in immune reactions. The development of the peripheral and central immune organs gradually decreases and ceases with sexual maturity (Gordon J., Manley N.R., 2011) .

Spleen

The largest secondary lymphoid organ in mammals, birds, and reptiles is the spleen. It carries out vital functions in the body, such as blood filtration by the elimination of senescent red blood cells and the destruction of blood-borne antigens by initiating a particular immune response (Cesta, 2006) . The lack of lymph nodes and lymphatic veins in birds increases the functions of the spleen in the fight against invasive infections, such as bacteria and viruses (Kita, 2014) . The red and white pulps are the two main functioning parts of the spleen. Massive numbers of blood cells are found in the sinusoids and Billroth cords, which make up the red pulp. The white pulp is mostly composed of lymphocytes, which are grouped at three molecularly different places, in addition to the subdivisions of the splenic artery structure. The periarteriolar lymphoid sheath (PALS), which envelops the central arterioles (CAs), makes up the avian white pulp. the lymphoid follicles at various locations along the ramification of CAs and the peri-ellipsoidal lymphoid sheath (PELS) surrounding the penicillar capsules (PCs). from the arteries that parent them (Oláh, Nagy, & Vervelde, 2014).

Bursa of Fabricius

The bursa of Fabricius is an Immunological organ that plays a primordial role in the Poultry immunity (5. Hassan S.A. Al-Tememy, Jinan S. Hussien, Bushra S. Rasool). The bursa of Fabricius, is a central lymphoid organ, chestnut in shape, present dorsally to The cloaca (Taylor R.L., McCorkle F.M. A. ; 2009) . It is a site of B lymphocyte repertoire differentiation and maturation, located in the dorsal terminal part of the cloacae of the birds that plays a primordial role in the poultry immunity (Heidari S., Toghyani M. 2018). The luminal (interior) surface of the bursa is plicated with primary and secondary plicae or folds. These plicae have hundreds of bursal follicles containing follicle-associated epithelial cells, lymphocytes, macrophages, and plasma cells. The bursa is surrounded by a thick, smooth muscle layer like other hollow organs. It is an immunological organ that plays a primordial role in the poultry immunity (T. Khenenou, M. Melizi, H. Benzaoui. 2012 . Bursa of Fabricius provides the microenvironment for the development, maturation and differentiation of B lymphocytes and antibody diversification, aiding in humoral immune response in avian species (Arakawa H., Hauschild J., Buerstedde J.M. 2002).

Thymus

In both birds and reptiles, the thymus has a row of big nodes running the length of the neck. the thymus in birds is thought to as a primary or key lymphoid in terms of immunity organ's existence is necessary for the growth of peripheral lymphoid organs and their related adaptive immune responses play a crucial element that distinguishes higher vertebrates from other animals among the phyla of animals. (Hanaa , K . A., 2016). The first organ to form and grow immediately after birth in response to postnatal antigen stimulation and the need for a large number of mature T cells is the thymus gland, which is listed as one of the primary lymphoid organs.(Suster, S. and Rosai, J. 1992). The thymus was the center of attention because of its significant influence on the immune response. It is thought to be the starting point for the development of T cell immunological function. It also produces, develops, and matures B and T lymphocytes, respectively. (Hui S., Kemei P., Shenghe L.I., Yan W., Lan W. et al. 2012.) And the presence of thymus is important for the development Of peripheral lymphoid tissues and responsible for cell mediated immunity and immune observation (Haseeb, A., M.G. Shah, J.A., 2014).

2.10 Overview Of The Avian Immune Systems

The potential pathogen and other risks facing mechanisms are slight different from those come across by mammals. It is therefore essential that mechanisms be available to combat invading bacterial, viral and parasitic pathogens and to destroy neoplastic or other altered cells. It is also essential in birds, as in mammals, that the resulting immune response be regulated to ensure that it is adequate in quantity and quality To acquaint you with these defense mechanisms, let's examine the immune system of chickens. The thymus and bursa of Fabricius are the chicken's principal lymphoid organs, and both are necessary for the emergence of adaptive immunity.

Despite its normal thymus, the bird's weak bursal lymphoid tissue had no antibodies to distinct antigens. Almost all delayed hypersensitivity reactions to tuberculin or VACV were prevented.

Significant variations exist in this environment, particularly with regard to the diversity of the lymphoid tissue. For example, the Fabricius bursa is found in hens but absent in mammals. Immunoglobulin Y (IgY) is the predominant blood antibody class found in chickens, whereas IgG is found in mammals. The immune system of hens is devoid of IgE antibodies. Furthermore, in hens, the transference of maternal antibodies happens through the absorption of egg yolks and, in mammals, by transplacental transit. The existence of both the innate and acquired immune responses is one feature that both chickens and mammals share. These animal species have immunological chemicals and cells.

2.11 Innate Immune Systems

Innate (natural) immunity differs from acquired immunity with respect to the detection systems (receptors and structures detected on pathogens), the cells engaged, and the nature of the mechanisms. Innate immunity is an ancient system, with similar structures in plants, invertebrates, and vertebrates are involved in the development of defense against pathogens. Toll-like receptor (TLR) structures are present in all organisms, and some mechanisms (i.e. complement activation) were also discovered in invertebrates and vertebrates. During infection, innate reactions develop before acquired immune reactions do. Natural immunity involves such reactions as the production of different cytokines, chemokines, and interleukins; the innate, cytokines-dependent nonspecific immunity of leukocytes; HLA-independent pathogen-killing cells, and phagocytosis. Such cytokines as interferons, the TNF family, and interleukines 12 and 18 participate in antiviral, antibacterial, antiprotozoan and anticancer natural immunity. NK cells, cytokines of the TNF family, and the complement system activated by lectins are engaged in the non-specific killing of infected or tumor cells. As over-activation of the innate system can be dangerous, the system must be submitted the strict control. The exact mechanism of this control system is not yet known, but there are several indications of its presence. (Marta .S.,2005).

2.12 Adaptive Immune

Activation of adaptive immune responses is carried out by white blood cells, specifically lymphocytes. Two major classes of immune responses, namely antibody responses and cell-mediated immune responses, are executed by different types of lymphocytes, known as B cells and T cells, respectively. In response to antibody responses, B cells release immunoglobulins, which are proteins. This means that these antibodies circulate throughout blood and penetrate the other bodily fluids, where they bind specifically to this foreign antigen which stimulated their production. Binding of antibody inactivates viruses and microbial toxins (such as tetanus toxin or diphtheria toxin) by blocking their ability to bind to receptors on host cells. Antibody binding also marks invading pathogens for destruction, mainly by making it easier for phagocytic cells of the innate immune system to ingest them. cell-mediated immune responses, the second class of adaptive immune response, activated T cells react directly against a foreign antigen that is presented to them on the surface of a host cell. The T cell, for example, might kill a virus-infected host cell that has viral antigens on its surface, thereby eliminating the infected cell before the virus has had a chance to replicate . In other cases, the T cell produces signal molecules that activate macrophages to destroy the invading microbes that they have phagocytosed. (Alberts. B., Johnson. A., Lewis. J., et al. 2002)

Chapter Three

Results of Productive Performance

3.1 Results of Heterophil/ Lymphocyte ratio

Table-1 shows that there were significant differences ($P \leq 0.05$) in H count between the groups. The mean counts were (23, 21, and 25 for the groups respectively). It may be noticed that there is an increase in H count in G5 over the other two groups. Groups 2 recorded the lowest ($P \leq 0.05$) counts.

With respect to L count, there were significant differences ($P \leq 0.05$) between means (68, 71 and 65 for the groups respectively), in contrast to H count in which L count recorded the highest counts in groups 2 in comparison to the other groups, while group 5 recorded the lowest count in comparisons to the other two groups.

Regarding H/L ratio, the differences ($P \leq 0.05$) were evident between the groups. It may be noticed that groups 2 (0.30) recorded the lowest ratio and groups 1 and 5 (0.34 and 0.39 respectively) the highest ratio. (Barzani, N.,K.,Sh.,2010).

Table 1: Effect of garlic powder in feed and Enrofloxacin in water on lymphocyte, Heterophil and Heterophil/ Lymphocyte ratio the broiler chickens[1].

Ratio Groups[2]	% H	% L	H/L
G1 Control	23 ± 0.26 b[3]	68 ±0.37 b	0.34±0.00 b
G2 1% Garlic powder	21 ± 0.58 c	71 ±0.58 a	0.30±0.01 c
G3 Enrofloxacin[4]	25 ± 0.61 a	65 ±0.61 c	0.39±0.01 a
Statistical significance	*	*	*

(Barzani, N.,K.,Sh.,2010).

3.2 Results of Immune Organs Weight/Body Weight

Table-2 represents the means of Spleen weight/body weight (SW/BW) and Bursa weight/body weight (BW/BW) of the experimental groups.

The means of SW/BW showed significant differences (P≤ 0.05) between the groups. The mean ratio of G1 and G2 (0.14 and 0.14 gm respectively) were the highest in comparison to G5 (0.11 gm) recorded the lowest SW/BW ratio.

In respect to BW/BW the significant differences (P≤ 0.05) were evident between the groups. The highest ratio was recorded in groups 1 and 5 (0.19 and 0.19 gm respectively), then G4 (0.13 gm) which was the lowest among the groups. (Barzani, N.,K.,Sh.,2010).

Table 2: Effect of garlic powder in feed and Enrofloxacin in water on immune organs weight/ body weight (gm/gm) in the broiler chickens[1].

Organs Groups[2]	Spleen Weight /Body Weight	Bursa Weight /Body Weight
G1 Control	0.14±0.01 a[3]	0.19±0.02 ab
G2 1% Garlic powder	0.14±0.01 a	0.13±0.01 c
G3 Enrofloxacin[4]	0.11±0.01 b	0.19±0.01 ab
Statistical significance	*	*

(Barzani, N.,K.,Sh.,2010).

3.3 Result of Live Body Weight

Table-3 shows that live body weight was significantly different among all experimental groups at different age periods.At 15 days of age, the heaviest body weight ($P \leq 0.05$) was 334 gm in G2, while the lightest body weight was 305 gm recorded in G1. Means weights at 30 days of age the heaviest body weight ($P \leq 0.05$) was 1373 gm in G2, while the lowest means values of G3 and G1 were 1301 and 1346 gm respectively and no significant differences ($P \geq 0.05$) among themselves. The mean of G4 was 1373 gm different significantly ($P \leq 0.05$) from groups 1 and 3. At 42 days of age the heaviest body weight ($P \leq 0.05$) was recorded in G2 which was 2607 gm, while those of G3 and G1were 2452 and 2540 gm respectively were the lightest and no significant differences ($P \geq 0.05$) among themselves.(Barzani, N.,K.,Sh.,2010)

Table 3: Effect of garlic powder in feed and Enrofloxacin in water on body weight (gm) in the broiler chickens[1].

Days Groups[2]	15 days	30 days	42 days
G1 Control	305±7.63 c[3]	1346±30.37 b	2540±49.68 b
G2 1%Garlic powder	334±12.73 ab	1373±39.97 ab	2607±53.83 ab
G3 Enrofloxacin[4]	313±7.79 bc	1301±25.79 b	2452±36.17 b
Statistical significance	*	*	*

(Barzani, N.,K.,Sh.,2010).

3.4 Results of Feed Conversion Ratio (FCR)

The Feed Conversion Ratio (FCR) of the experimental groups is shown in Table-5. It may be seen that there were significant differences ($P \leq 0.05$) between the groups in the periods 15-30 and 1-42 days of age. The means of the period 1-42 days were 1.77, 1.72 and 1.84 for groups 1, 2 and 3 respectively. The best FCR was recorded in G2, then groups 1. The worst FCR was in G5. (Barzani, N.,K.,Sh.,2010)

Table 4: Effect of garlic powder in feed and Enrofloxacin in water on Feed Conversion Ratio (FCR) in the broiler chickens[1].

Days Groups[2]	1-15 days	15-30 days	30-42 days	1-42 days
G1 Control	1.87±0.06 a	1.30±0.04 ab[3]	2.31±0.13 a	1.77±0.03 ab
G2 1% Garlic powder	1.82±0.07 a	1.31±0.05 ab	2.15±0.10 a	1.72±0.04 bc
G3 Enerofloxacin[4]	1.86±0.06 a	1.36±0.04 a	2.33±0.10 a	1.84±0.03 a
Statistical significance	N.S[5].	*	N.S.	*

(Barzani, N.,K.,Sh.,2010).

Chapter four

Conclusions and Recommendations

4.1 Conclusions

1. Garlic powder at rate 1% in feed showed anti stress effects measured by reduction of Hetrophil/Lymphocyte.
2. Garlic powder at the rate 1% in feed improve the immune response represented by improving immune organ weight/ body weight.
3. Garlic powder at rate 1% in feed improved the productive performance of the birds.

4.2 Recommendations:

1. Garlic powder can be used at the rate of 10 Kg /ton in broiler feed which have better economic benefit than using antibiotic therapy.
2. More researches is need to find out:
   a. The effects of garlic powder on the infection of other bacteria in broiler chickens.
   b. Similar studies are needed for layers.

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