# Effect of adding two types of nutritional flavorings for two powders of (cardamom and cinnamon) and their mixture to the diet on some immune traits and microbial colonies for the digestive tract of broiler chickens (1)

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**ABSTRACT**

This experiment aimed to know the effect of using two types of nutritional flavorings for two powders of (cardamom and cinnamon) and their mixture to the diet on some immune traits and microbial colonies for the digestive tract of broiler chickens that raised to the age of (35 days), where 240 chicks of unsexed broiler chickens (Ross 308), with one day age, were used, the chicks were distributed into four treatments (60 chicks/treatment) and the chicks of each treatment were divided into three replicates (20 chicks/replicate). Chicks were fed on the initiator and final diets, with a crude protein level of (21.76, 18.88%) and metabolized energy (3000.13, 3120.98 Kcal/kg feed), respectively, added to it nutritional flavorings as follows: The first treatment (T1): The control treatment without any addition, the second treatment (T2): adding of 5 g cardamom powder/kg feed, Third treatment (T3): adding of 5 g cinnamon powder/kg feed, Fourth treatment (T4): adding of 2.5 g cardamom + 2.5 g cinnamon/kg feed. The results showed:

The adding treatment (T3) was significantly ($P < 0.05$) excelled compared to the supplementation compared to the T1 treatment with the antibodies level against gumboro virus. A significant increase ($P < 0.05$) was observed in the numbers of lactobacilli bacteria in the duodenum region in favor of the two adding treatments (T3, T4). In contrast, the number of coliform bacteria for the adding treatments decreased significantly ($P < 0.05$) compared to the control treatment. It is concluded from the present study that adding nutritional flavorings (cardamom and cinnamon) and their mixture to the diet of broiler chickens achieved the highest growth for the numbers of lactobacilli bacteria and decreasing the coliform bacteria in the duodenum with an improvement in the antibodies level against gumboro virus.

The research paper from the MSc thesis for the first Author.
**Keywords:** cardamom and cinnamon powder, immune traits, microbial colonies, broiler chickens.



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# تأثير أضافة نوعين من المنكهات الغذائية لمسحوقي(الهيل والقرفة) وخليطهما الى العليقة في بعض الصفات المناعية والمجتمع المايكروبي للقناة الهضمية لفروج اللحم[1]

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**الخلاصة**

استهدفت التجربة معرفة تأثير أستخدام نوعين من المنكهات الغذائية (الهيل والقرفه) وخليطهما الى العليقة في بعض الصفات المناعية والمجتمع المايكروبي للقناة الهضمية لفروج اللحم والمربى لعمر35 يوم ، حيث تم استخدام 240 فرخ من فروج اللحم سلالة Ross 308غير مجنسة بعمر يوم واحد وزعت الافراخ على أربعة معاملات بواقع( 60 فرخ/معاملة) وقسمت افراخ كل معاملة الى ثلاثة مكررات (20فرخ/مكرر) ، غذيت الافراخ على عليقتي البادئ والنهائي بمستوى بروتين خام21.76 و 18.88% ،وطاقة ممثلة 3000.13 و3120.98كيلو سعرة / كغم علف على التوالي مضافاً اليها المنكهات الغذائيه كالأتي :الأولى(T1) معاملة سيطره بدون أية أضافه،الثانية (T2) أضافة 5غم مسحوق الهيل /كغم علف، الثالثه(T3)أضافة 5غم مسحوق القرفه/كغم علف،الرابعة (T4) أضافة 2.5غم هيل+2.5 غم قرفه/كغم علف. وقد اظهرت النتائج :- تفوقت معنوياً ($P<0.05$) معاملة الأضافة T3مقارنة بمعاملة T1 بمستوى الأضداد الموجهة ضد مرض الكمبورو،كما لوحظ حدوث أرتفاع معنوي ($P<0.05$) في أعداد بكتريا العصيات اللبنيه في منطقة الأثني عشري لصالح معاملتا الأضافه T3وT4وبعكس الأتجاه أنخفضت معنوياً ($P<0.05$) أعداد بكتريا القولون لمعاملات الأضافة مقارنة مع معاملة السيطره . يستنتج من الدراسة الحالية ان أضافة المنكهات الغذائيه (الهيل والقرفه) وخليطهما لعليقة فروج اللحم حققت اعلى نمو لاعداد بكتريا العصيات اللبنية وأنخفاض بكتريا القولون في الاثنى عشري مع تحسن من مستوى الاضداد الموجهة ضد مرض الكمبورو

البحث مستل من رسالة ماجستير للباحث الاول
**كلمات مفتاحية**: مسحوق الهيل والقرفة ، صفات مناعية ، مجتمع مايكروبي ، فروج اللحم

## 1. INTRODUCTION

The poultry industry has witnessed a rapid development and widespread interest by researchers as one of the pillars of food products because it provides the consumer with the necessary requirements from animal protein such as eggs and meat, they have used a variety methods to obtain the best product performance and increase the economic yield for birds, Although it characterized by the characteristics of fast growth and high feed conversion efficiency, these advantages increased their nutritional and health needs (Naji, 3). This led researchers to use natural alternatives to achieve good production and reducing the number of problems facing the poultry industry by using herbs and medicinal plants in the diets of birds (Celikbilek et al.,10), because of its benefits and importance in human and animal health and enhancing the body's immunity against pathogens because it has many effective compounds such as phenols, flavonoids, and carotenoids and its contribution to increasing the secretion of digestive enzymes and



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improving the utilization of nutrients (Abo Omar et al., 4) and its role as natural antimicrobial (Jaber, 20). Fuller et al., (16) emphasized that nutritional flavorings and medicinal plants added to diets of broiler chickens will contribute to the elimination of pathogenic bacteria in the intestines or reduce the bulk of them through inhibiting them to increase energy and get as much as possible and benefit from them to improving the physical growth because pathogenic bacteria will use large amounts of energy to sustain their life and perform their functional activities. Therefore, when reducing these microbes in the microbial colonies will lead to increase energy, improving growth and increasing the feed conversion efficiency. Cardamom (Elettaria Cardamomum) is considered one of the important flavorings, it is described as the dry fruit for a perennial herbaceous aromatic plant belonging to the Zingiberaceae family, it contains many effective compounds Which has a good role to play, including Cineole, Limonene, Zingiberene, Terpineol, and many other compounds. Kheiralla et al., (23) indicated that cardamom seed powder or oil extracted from it has a good effect in inhibiting the growth of bacteria, fungi, and toxins produced from them and when added to food, it works to prevent spoiling it and inhibiting bacterial growth during the manufacturing stages, It is a sweet taste spice, it is used as a medical flavoring agent and anti-inflammatory (Verma et al., 39). Essential oils possessing an effective antimicrobial and antimicrobial agent (Smaranika et al., 36). Sema, (34) noted that the cardamom seed powder added to the diet of broiler chickens serves to inhibit the harmful microbial colonies bacteria present in the gastrointestinal tract, including E.coli, Salmonella Typhimurium, S.aureus and other pathogens, due to the phenolic compounds possessed by cardamom that transfers into the bacterial cell through a gap it creates in its cell wall to interact with the protein components within the plasma membrane by bonding with the hydrogen atom within the hydroxyl group causes disturbances in the permeability of the cell membrane for the elements necessary to sustain its vitality and activity, thus its destruction (Kaur and Singh, 22). Omidi, (30) compared between two levels of cardamom oil (50, 100 mg) and two levels of cardamom seed powder (3, 6 g) added to each kilogram of feed provided for broiler chickens which raised to age of (42 days). The results showed a significant increase in the bursa of Fabricius index in favor of oil adding treatment compared to other treatments. Cinnamon (Cinnamomum Cassia) is considered a medicinal herb, which has received great attention as a feed additive for poultry diets because it contains many effective compounds, including Cinnamaldehyde and Eugenol, which have a



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significant role for their antioxidant activity and for the pathogens and enhancing the body's immunity (Faix et al., 14). Hili et al., (19) show that cinnamon oil acts as a bacteriostatic inhibitor against certain bacterial species such as E.coli, Pseudomonas aeruginosa, Staphylococcus aureus, and Torulopsis utilis, because it possesses a wide range of active compounds, thus makes it a natural antimicrobial against many bacterial species including Escherichia coli (Cabuk et al., 19) while Matan, (26) noted that cinnamon is a good inhibitor against Staphylococcus aureus, Eurotium sp, and Mucor plumbeus, where the presence of phenolic compounds in their components will alter the permeability of microbial cell membranes (Bajpai et al., 7). Lee and Ahn, (24) show the effectiveness of Cinnamaldehyde compound for cinnamon as an antimicrobial that added to the diet of broiler chickens through a significant decrease in the number of coliform bacteria and providing a favorable environment for the growth and reproduction of beneficial bacteria within the gastrointestinal tract and not being exposed to any kind of pathogens (Chang et al., 11). Stefan et al., (37) noted that adding three levels of cinnamon powder with the percentage of (0, 0.1, 0.05, 0.025 %) to the diets of broiler chickens, which contributed to raising the immune response for birds through observing a significant increase in the values of the titer for antibodies against the Newcastle disease virus and Infectious bursal disease compared to the control treatment. It was also observed that the percentage of addition of 0.1% is the best levels that led to a significant increase in the values of the volumetric criterion compared to the rest of the adding treatments. Coinciding with the trend towards the use of flavored medicinal plants and herbs. This study was conducted to know the effect of using two types of nutritional flavorings for two powders of (cardamom and cinnamon) and their mixture to the diet on some immune traits and microbial colonies for the digestive tract of broiler chickens

## 2. MATERIALS AND METHODS

This experiment was conducted in the poultry field belonging to the Department of Animal Production at the College of Agriculture, University of Baghdad (old location for the college of Agriculture), Abu Ghraib for the period from 6/10 to 10/11/2017 to know the effect of using two types of nutritional flavorings for two powders of (cardamom and cinnamon) and their mixture to the diet on some immune traits and microbial colonies for the digestive tract of broiler chickens that raised to the age of (35 days), where 240 chicks of unsexed broiler chickens (Ross 308), with one day age and an average initial weight of (38.6 g / chick), were used, the chicks were distributed



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into four treatments (60 chicks/treatment) and the chicks of each treatment were divided into three replicates (20 chicks/replicate). The treatments were as follows: The first treatment (T1): The control treatment (without any addition), the second treatment (T2): adding of 5 g cardamom powder/kg feed, Third treatment (T3): adding of 5 g cinnamon powder/kg feed, Fourth treatment (T4): adding of 2.5 g cardamom + 2.5 g cinnamon/kg feed. The birds raised a ground floor in hens with an area of (1.8 x 3 m/hen) each of them containing 20 chicks. The temperature was set automatically using gas incubators and airbags. The temperature was then kept gradually until it reached 20-22 C until the marketing age. The chicks were fed freely (ad libitum) and with crushed feed during the duration of the experiment. Initiator diet was used for a period of 1-21 days from the age of chicks, which contained 21.76% crude protein and 3000.13 kcal/kg of metabolized energy, according to the nutrition index for the Ross 308 chick. Thus, the percentage of energy to protein (C / P ratio) amounted to 137.87, followed by the final diet which contained 18.88% crude protein and 3120.98 kcal/kg metabolized energy, Thus, the percentage of energy to protein amounted to 165.30, which continued up to 35 days. Table (1) shows the percentages of feed materials included in the composition of the diets with the calculated chemical composition.

**Table 1:** Percentage of feed materials included in the composition of the diets with the calculated chemical composition.

| **Ingredients of the diet (%)** | **The initiator diet (%)** | **Growth diet (%)** |
|---|---|---|
| Yellow corn | 56.5 | 64 |
| Soybean Meal (1) (48%) | 34 | 26 |
| Concentrated Proteins (2) | 5 | 5 |
| Sunflower oil | 2.5 | 3 |
| Limestone | 1 | 1 |
| Calcium Diaphosphate (3) | 0.5 | 0.5 |
| Salt | 0.3 | 0.3 |
| Mixes of vitamins and minerals (4) | 0.2 | 0.2 |
| Total | 100 | 100 |
| **The calculated chemical composition*** | | |
| Crude protein | 21.76 | 18.88 |
| metabolic Energy (kcal / kg feed) | 3000.13 | 3120.98 |
| C / P ration | 137.87 | 165.30 |
| Lysine (%) | 1.24 | 1.04 |
| Methionine (%) | 0.49 | 0.45 |
| Cysteine (%) | 0.34 | 0.3 |
| Methionine + Cysteine | 0.83 | 0.75 |
| Calcium (%) | 0.77 | 0.75 |
| Phosphorus (%) | 0.48 | 0.43 |



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1) soybeans meal contain 44% protein

2) The concentrated protein (Brocon-5 Special) produced from Al Wafi company contains 40% Crude protein, 5% crude oil, 2.26% raw fiber, 2183.70 kcal, methionine 3.70%, Lysine 3.85%, Calcium 3.53%, phosphormethane 2.65%, methionine + Cysteine 4.12%, vitamins (Vit A 200.000 IU, Vit D3 60.000 IU, Vit E 600.00 mg, VitB1 60.00mg, VitB2 140.00mg, VitB6 80.00mg, VitB12 700.00mg, VitH 2.00mg, Niacin 800.00mg, VitBc (Folic acid) 20.00mg, Vit K3 50.00mg.

(3) phosphorus 18%, Calcium 24%

(4) Premix contains vitamin and elements (VitA 1.250.000IU/kg, Vit D3 310.000IU/kg, Vit E acetate 5.000mg/kg, Vit K3 200mg/kg, VitB1 250 mg/kg, VitB2 500mg/kg, D.Pantothenic Acid 200mg/kg, VitB6 500mg/kg, VitB12 2mg/kg, Vit PP 3.500mg/kg, Folic Acid 150mg/kg, Vit H(Biotin) 2.5mg/k, Choline Chloride 40.000mg/kg.

* The calculated Chemical composition for the ingredients of the diet according to (NRC, 29).

The birds were starved for 4 hours prior to the slaughter. six birds then took from each treatment randomly. The birds were slaughtered and submerged in the water at 54 °C for two minutes and the feathers were removed. The removal of the internal intestines was conducted in a precise anatomical manner from the beginning of the esophagus to the end of the Rectum according to the method (Fletcher, 15). The infectious bursal disease was extracted after cutting the connective tissue around the bursal and then weighed by a sensitive balance for four decimal and the relative weight for the infectious bursal disease and the bursal index were calculated according to the method (Lucio and Hitchner, 25) and according to the following equations:

$$\text{The relative weight for the bursa of Fabricius} = \frac{\text{the weight of the bursa of Fabricius (g)}}{\text{the weight of live body (g)}} \times 100$$

$$\text{The bursa of Fabricius index} = \frac{\text{the weight for the bursal in the experimental treatment (g)}}{\text{the weight for the bursal in the control treatment (g)}} \times 100$$

The titer of antibodies directed against the Newcastle and Gumboro virus was performed at the end of the breeding period, where this test is used to determine the Titer for serum antibodies directed against Newcastle disease and fever caused Gumboro disease. This criterion was calculated using The enzyme-linked immunosorbent assay (ELISA), according to (Mond, 27), thus giving a very accurate result for the level of the bird's immune response. The test was conducted at the laboratories of Scientific Group Company, Baghdad. The number of lactobacilli bacteria on MRS Agar media and coliform bacteria on MacCoky Agar media were estimated in the contents of the duodenum using Pour-Plate Method and incubation in an anaerobic container at 37 °C for 2 days for lactobacilli bacteria only according to the method described



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in (AOAC, 6). The statistical program (SAS33) was used and by applying the completely randomized design (CRD) in data analysis, The differences between the treatments were tested using Duncan's Multiple Range Test (Duncan, 13) to comparing the significant differences between the averages for the studied traits.

## 3. RESULTS AND DISCUSSION

Figure (1) shows the effect of using two types of nutritional flavorings (cardamom and cinnamon) and their mixture for the diet of broiler chickens on the relative weight of bursa of Fabricius. where it was not observed significant differences for all the treatments (T2, T3, T4) compared to the control treatment (T1), although there was an improvement in favor of the adding treatments, where the adding treatment T4 achieved the highest treatment amounted to (0.10 %), compared to the control treatment (T1) which amounted to (0.05%).

Figure (2) shows the effect of using two types of nutritional flavorings (cardamom and cinnamon) and their mixture for the diet of broiler chickens on the bursa of Fabricius index. where it was not observed significant differences for all the treatments (T2, T3, T4) compared to the control treatment (T1), although there was an improvement in favor of the adding treatments, where the adding treatment T4 achieved the highest treatment amounted to (1.86 %), Similarly, the adding treatment (T3) which amounted to (1.69%) and then the T2 treatment which amounted to (1.66%) compared to the control treatment (T1) which amounted to (0.99%).

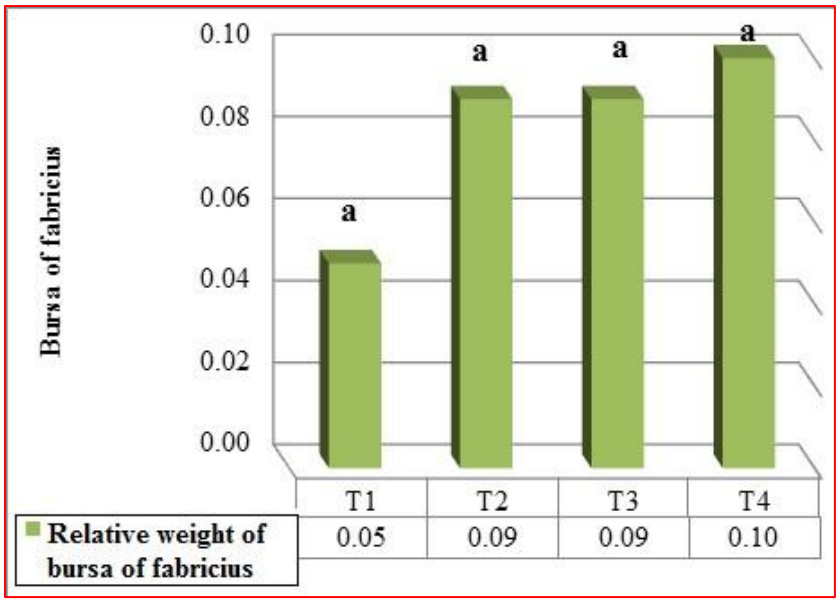


**Figure 1:** Effect of using two types of nutritional flavorings (cardamom and cinnamon) and their mixture to the diet of broiler chickens in the relative weight of bursa of Fabricius.



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Different letters within a single color mean significant differences between the averages of the treatments.

The first treatment (T1): The control treatment (without any addition), the second treatment (T2): adding of 5 g cardamom powder/kg feed, Third treatment (T3): adding of 5 g cinnamon powder/kg feed, Fourth treatment (T4): adding of 2.5 g cardamom + 2.5 g cinnamon/kg feed.

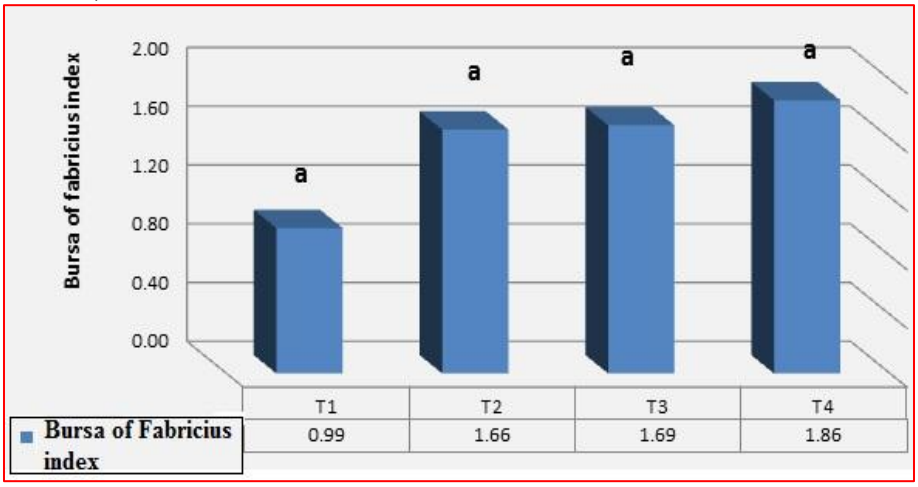


**Figure 1:** Effect of using two types of nutritional flavorings (cardamom and cinnamon) and their mixture to the diet of broiler chickens in the relative weight of bursa of Fabricius.

Different letters within a single color mean significant differences between the averages of the treatments.

The first treatment (T1): The control treatment (without any addition), the second treatment (T2): adding of 5 g cardamom powder/kg feed, Third treatment (T3): adding of 5 g cinnamon powder/kg feed, Fourth treatment (T4): adding of 2.5 g cardamom + 2.5 g cinnamon/kg feed.

Figure (3) shows the effect of using two types of nutritional flavorings (cardamom and cinnamon) and their mixture for the diet of broiler chickens on the titer of antibodies directed against the Newcastle virus. where It was found that there was an improvement for antibodies directed against Newcastle virus for all adding treatments (T2, T3, T4) compared to the control treatment (T1), but this improvement did not rise to the significant level, which recorded values amounted to (1433.67, 1817, 905.33), respectively compared to the control treatment (T1) which amounted to (0). The T3 treatment gave the highest titer values for antibodies against Newcastle disease.



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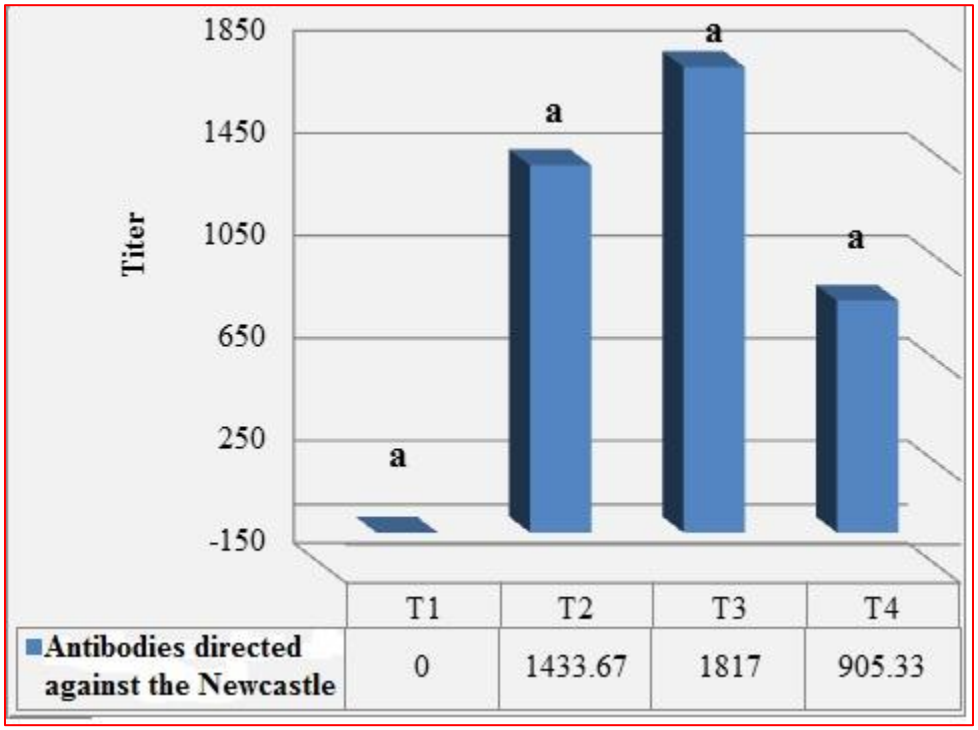


**Figure 3:** Effect of using two types of nutritional flavorings (cardamom and cinnamon) and their mixture to the diet of broiler chickens in the titer of antibodies directed against the Newcastle virus.

Different letters within a single color mean significant differences between the averages of the treatments.

The first treatment (T1): The control treatment (without any addition), the second treatment (T2): adding of 5 g cardamom powder/kg feed, Third treatment (T3): adding of 5 g cinnamon powder/kg feed, Fourth treatment (T4): adding of 2.5 g cardamom + 2.5 g cinnamon/kg feed.

Figure (4) shows the effect of using two types of nutritional flavorings (cardamom and cinnamon) and their mixture for the diet of broiler chickens on the titer of antibodies directed against the Gumboro virus. where It was found that the T3 treatment has excelled by recording a value amounted to (3037.67) compared to the control treatment (T1) which amounted to (280), which did not differ significantly from the two treatments (T2, T4) which amounted to (1522.67, 1475.67), respectively. The two treatments did not differ with the control treatment (T1), although there was an improvement in the values of that trait.



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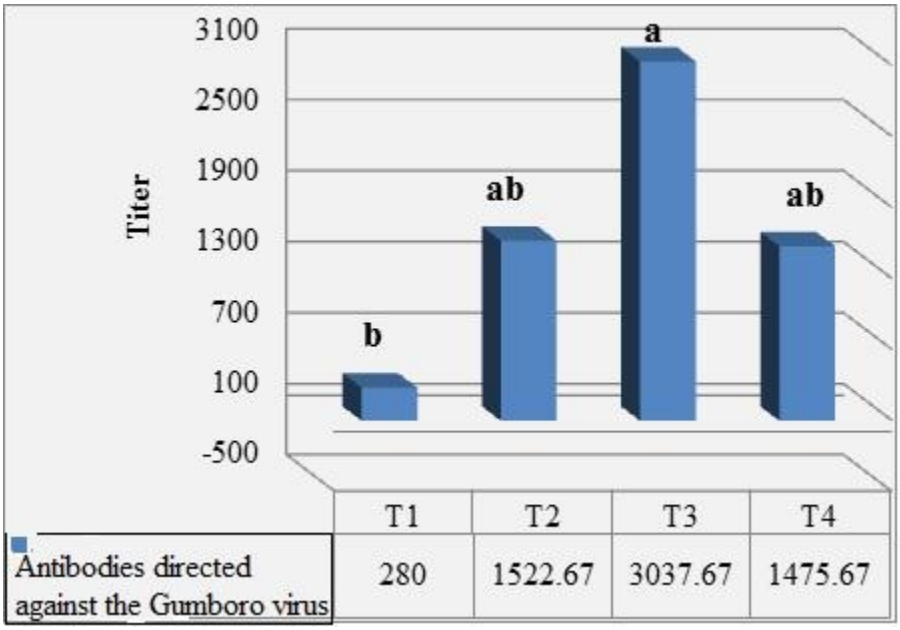


**Figure 4:** Effect of using two types of nutritional flavorings (cardamom and cinnamon) and their mixture to the diet of broiler chickens in the titer of antibodies directed against the Gumboro virus.

Different letters within a single color mean significant differences between the averages of the treatments.

The first treatment (T1): The control treatment (without any addition), the second treatment (T2): adding of 5 g cardamom powder/kg feed, Third treatment (T3): adding of 5 g cinnamon powder/kg feed, Fourth treatment (T4): adding of 2.5 g cardamom + 2.5 g cinnamon/kg feed.

The reason for the high relative weight of bursa of Fabricius is due to the groups of birds fed on cardamom and cinnamon diets because of the presence of the active compounds in it in high concentrations such as Cinnamaldehyde and Cineole, which indicates that these substances have worked to provide immunity to birds and raising the immune response by observing the improvement in the weight values of the bursa compared to birds that did not feed on these materials as well as their inhibitory role for fungi, bacteria, and parasites causing physical infections (11,18). Al-Obeidi, (1) indicated that the evolution of the immune system in the body of the bird can be identified by knowing the weight and index of Fabricius where they are considered one of the important measurements for the immunity in the body and the high index values and relative weight of bursa of Fabricius are considered a good indicator for the bird's body with its high immunity. The lowering of relative weight for the bursa of Fabricius less than 0.7 indicates that the bursa is ineffective to do its work because being inactivity and atrophy (Bumstead, 8). These results agree with (Stefan et al., 37) who observed increase the levels of immune response to birds fed at different levels of cinnamon (0.1, 0.05,



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0.025%), and agree with (Raja et al., 31) who observed there are no mortalities when adding different levels of cardamom powder (0.15, 0.3, 0.45%). This shows that cardamom powder worked to raise the immunity of birds and providing immunity to them against diseases and pathogens. Some studies (5, 35, 38) have already shown that medicinal plants such as ginger, marjoram, cinnamon, and anise play a key role in increasing the immune response and enhancing cellular immunity in the body because they have a high effect and microbial inhibitory. They work to increase the number of white blood cells, which are considered the cells devouring the microorganisms and works to increase the level of immune globulins in the blood plasma. Najda et al., (28) emphasized that the presence of active substances such as Thymol and Carvacrol in medicinal plants have a clear effect on the immune response of the body where they contribute to raise immunity by increasing the relative weight of the bursa of Fabricius, which has a role in the formation of humoral immunity, as well as the roles of phenolic substances as antioxidants where antioxidants work on maintaining the metabolic reactions in the body and continuing the bio-functions leading to the preservation of the physical balance for the body, Ultimately, birds enjoy health and safety from disease (Ruiz and Iglesias, 32). Figure (5) shows the effect of using two types of nutritional flavorings (cardamom and cinnamon) and their mixture for the diet of broiler chickens on the logarithmic numbers of lactobacilli and coliform bacteria in the duodenum for broiler chickens, where the numbers of lactobacilli were significantly ($P < 0.05$) excelled for the adding treatment (T4) which recorded a value amounted to (8.18 log $cfu.g^{-1}$) compared to the control treatment (T1) which amounted to (7.00 log $cfu.g^{-1}$) from the duodenal contents, followed by the excelling the T3 treatment which amounted to (7.93) from the duodenal contents compared to the control treatment (T1). Data of the same figure also show a significant decrease ($P < 0.05$) in the logarithmic numbers of Coliforms bacteria in the duodenum of broiler chicks for the T4 treatment which amounted to (3.96 log $cfu.g^{-1}$) compared to the control treatment (T1) which amounted to (5.27 log $cfu.g^{-1}$). which followed by the significant decrease ($P < 0.05$) the adding treatments (T3, T2) which amounted to (4.58, 4.82 log $cfu.g^{-1}$) compared to the control treatment (T1). The high average of lactobacilli in the duodenum is due to the role of the active compounds Thymol, Linalool, 1.8-Cineole, Cinnamaldehyde, pinene-α, Eugenol, limonene in the used nutritional flavorings in the study in the maintenance of microbial equilibrium through the Selective Enrichment process for beneficial bacteria such as lactobacilli and Bifidobacterium, which have good features for



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its high adhesiveness and settlement in the digestive system. It also consumes cholesterol, its high production for acid, inhibitory factors for the growth of pathogenic bacteria and its ability to stimulate the immune system and possess enzymes that increase the effectiveness of digestion and absorption of nutrients necessary for the body (Gusils et al., 17) on the expense of harmful and pathogenic bacteria in the process of competitive elimination of coliform bacteria, where a rapid decrease in the pH value for the gastrointestinal tract occurs through its final products for the fermentation process conducted by it which represented by the production of lactic acid, which contributes to the creation of an acidic environment and inappropriate conditions will contribute to reducing the numbers of coliform bacteria, which forms E. coli bacteria, where their presence is considered one of the important bacterial indicators to infer the intestinal pathogens (Al-Mendelawi, 2), As well as the work of phenolic compounds in the destruction and tearing for the cell wall of harmful bacteria and changing the permeability of its cytoplasmic membrane, so clotting its protein, inhibiting its activity and slowing its bioprocesses (12, 21). The interaction with the protein-membrane for the pathogenic bacteria causes a distortion in the structure of the cell functions, leading to its destruction and death (Bajpai et al., 7).

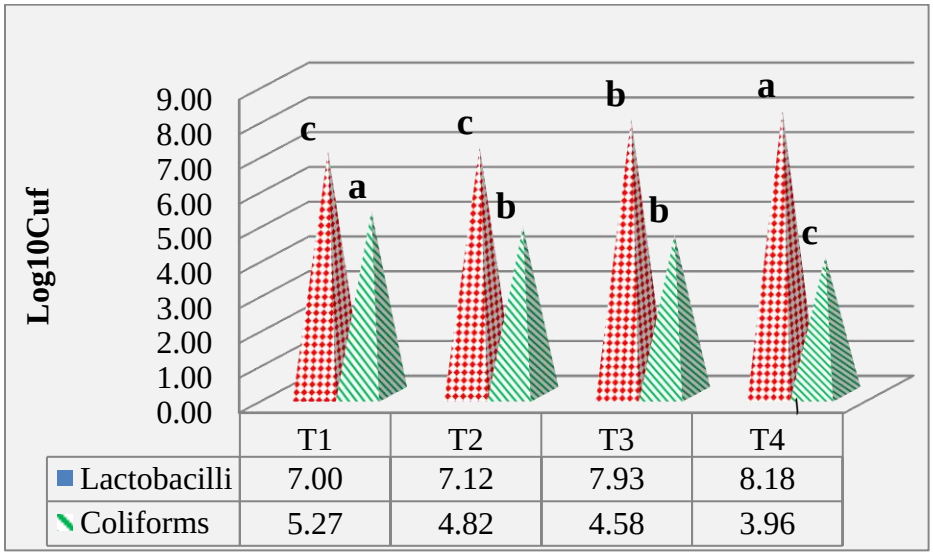


**Figure 5:** Effect of using two types of nutritional flavorings (cardamom and cinnamon) and their mixture to the diet of broiler chickens in the logarithmic numbers of lactobacilli and coliform bacteria.

Different letters within a single color mean significant differences between the averages of the treatments.



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The first treatment (T1): The control treatment (without any addition), the second treatment (T2): adding of 5 g cardamom powder/kg feed, Third treatment (T3): adding of 5 g cinnamon powder/kg feed, Fourth treatment (T4): adding of 2.5 g cardamom + 2.5 g cinnamon/kg feed.

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