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THE INFLUENCE OF *NIGELLA SATIVA* AND CURCUMIN EXTRACTS AS PHYTOGENIC FEED ADDITIVES ON BROILER PERFORMANCE, BLOOD PARAMETERS, ANTIOXIDANTS STATUS AND INTESTINAL MICROBIOTA

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SUMMARY

The goal of this study was to see how adding Nigella sativa (NE) and curcumin extracts (CE) separately and in combination affected broiler performance, blood biochemical markers, antioxidant status and intestinal microbiota. Four experimental diets formulated: Control, NE (600 ppm), CE (600 ppm), and mix (300 ppm NE + 300 ppm CE). A total 240 chicks at 11 days of age were assigned to the four dietary treatments of 60 chicks each. The results showed that the addition of NE, CE or mix to the broiler diets significantly enhanced ($P<0.05$) body weight gain and feed conversion ratio compared with control group. No significant differences ($P>0.05$) recorded for feed consumption among all treatments in all periods. The inclusion of NE or Mix significantly enhanced the levels of total protein and globulin. The addition of NE, CE, or the Mix did not impact urea, alkaline phosphatase, alanine transaminase, or aspartate aminotransferase levels ($P>0.05$), indicating that there was no deleterious effect on the liver or kidney function. Addition of NE and/or CE significantly ($P<0.05$) increased total antioxidant capacity and catalase while the level of Malondialdehyde decreased compared with the control. Addition of Mix increased ($P<0.05$) the triiodothyronine (T3) levels while not altered on the thyroxine (T4) and T4/T3 levels. The addition of NE or Mix increased the number of lactobacilli, and on the contrary, this addition reduced the total number of faecal bacterial and eliminated *Salmonella sp.* compared to the control. The results also exhibit that, CE was less efficient than NE extract in improving intestinal health, illustrated by the detection of pathogenic *Salmonella sp*. count. From these results, it could be concluded that adding NE extract alone or with the CE at 600 ppm revealed positive effects on the productive performance, economic efficiency, blood biochemical parameters, antioxidants status and intestinal microbiota of growing broilers.

Keywords: *Nigella sativa*, Curcumin, performance, biochemical, microbiota, broiler.

INTRODUCTION

Poultry production is an important sector of agriculture to meet the increasing demand for animal protein. There are many different ways to improve poultry productivity, digestive health and feed efficiency (Singh and Gaikwad 2020; Elsherif *et al.*, 2021 and Samy *et al.*, 2022). Antibiotics used as growth promoters in poultry feed resulted in greater resistance to pathogens, germs, and sedimentation in meat and eggs (Dutta *et al.*, 2019). As a result, In January 2006, antibiotics as a growth booster in poultry feed have been outlawed by the European Union (Bennani *et al.*, 2020). So, the researchers looked for alternative materials. Thus, a number of substances have been used in poultry feed as natural growth enhancers (Elsherif *et al.*, 2021; Khan et al 2021 and Samy *et al.*, 2022). Plant materials called phytogenic and their extracts are used in poultry feed to help the birds grow faster, stay healthy, and digestive enzymes (Pandey *et al.*, 2019 and Ali *et al.*, 2021). Phytogenic as natural feed additives has the greatest beneficial effects such as improving feed utilization and digestive secretions of poultry also may be the presence of variety of active components that act as antimicrobial and antioxidants (Pirgozliev *et al.*, 2019; Alagbe 2021 and Degla *et al.*, 2022).

Seeds of *Nigella sativa* contain variety of active materials, such as thymoquinone, thymol, carvacrol, dithymoquinone, nigellidine and nigellicine-N-oxidethat act as an antioxidant and antibacterial which activate the immune system (Ahmed *et al.*, 2018 and Bektaş *et al.*, 2019). Several studies have found that using *Nigella sativa* instead of antibiotic growth promoters in poultry feeds could be a good option. *Nigella sativa* is good for the growth of chickens and the quality of their meat and eggs (Kumar *et al.*, 2017 and Seidavi *et al.*, 2020). Talebi *et al.* (2021) reported that the addition of *Nigella sativa* (1-2%) to broiler diets improves performance, immune responses, and serum biochemical profiles. So, *Nigella sativa* can be considered as one of the natural growth stimulant in poultry feed to help the birds grow faster (AL-Beitawi *et al.* 2009). Also, Curcumin is added to the broilers feed as a natural feed additive to improve their overall health and immune responses. Curcumin's most important job is to keep the liver healthy, and it acts as an anti-inflammatory, antimicrobial (Xiang *et al.*, 2017; Singh *et al.*, 2017 and Ibrahim *et al.*, 2020). Raheem *et al.* (2021) found that turmeric and *N. sativa* can be used as natural feed additives in poultry feed also they are also considered as immune enhancers. As a result, the goal of this study was to see how adding NE, curcumin, or a combination of the them to broiler diets affected productive performance, blood parameters, antioxidant status, and intestinal microbiota.

MATERIAL AND METHODS

Experimental materials:

Curcumin (CE) in dried turmeric rhizomes was extracted using Soxhlet extraction by Percolation (boiler and reflux) with acetone as solvent to get a curcuminoid-rich extract (Yadav *et al.*, 2017 and Samy *et al.*, 2022).

To obtain extraction of *Nigella sativa* (NE), using the heat reflux extraction procedure with 70 % ethanol under vigorous stirring for two hours. Rotary evaporator used to separate the extract at 40°C (Elsherif *et al.* 2021 and Samy *et al.*, 2022).

Finally, calcium carbonate was used as a carrier material to load the extracts independently, allowing them to be used and mixed with feed ingredients.

Experimental design and diets:

This experiment was carried out at the Poultry Nutrition Research Unit (PNRU), Faculty of Agriculture at Cairo University, Giza, Egypt. Two hundred and forty broiler chicks (Arbor Acres) were grown in three-deck batteries under a heated brooder house at semi-close system. Four groups each group containing 60 birds separated in six replicates. The first ten days all birds fed the same diet according to the strain guide. After that each group fed the experimental diet from 11- 33 days of age as follows, the control group fed the diet according to the strain guides of Arbor Acres to cover all nutrients requirements (Table 1). Treatment 2-to treatment 4 fed the control diets supplemented with 600 ppm of CE, NE or mix of them (300 ppm NE + 300 ppm CE), respectively.

Light was available for the duration of the experiment for a total of 23 hours per day. There was always feed and water available. An anti-avian flu, anti-infectious bronchitis, and anti-infectious bursal illness New Castle virus program was implemented for birds.

Measured parameters:

(I) Productive performance:

At 25 (grower stage) and 33 (finisher stage) days of age, all birds were weighted to calculate weight gain (WG) also the average feed intake (FI) was also recorded. Feed conversion ratios (FCR) for grower, finisher, and overall periods were obtained by dividing FI by WG (Elsherif *et al.*, 2021).

(II) Intestinal microbiota:

Six birds from each treatment were taken and slaughtered then take the fresh cecum content. After that suspension of one gram of the cecum content into the sterile double distilled water, then made serial dilution to reach 10^8 dilution factor. De Man–Rogosa–Sharpe (MRS) agar plates were used to detect the count of *lactobacillus sp.*, whereas MacConkey and Salmonella-Shigella (SS) agar plates were used to count total fecal bacteria and *Salmonella*, respectively at 37ºC (Elsherif *et al.*, 2021).

(III) Biochemical blood parameters:

Collected blood samples during the slaughter of six birds from each treatment at 33 days of age. To get serum, the blood samples were centrifuged at 2200 rpm for 10 min then stored at -20 till use it for analysis. Biochemical blood analysis, total protein, albumin, alanine transaminase (ALT), aspartate aminotransferase (AST), urea and alkaline phosphatase (ALP), conducted using Bio-Diagnostic commercial kits in a high-performance spectrophotometer (FlexorEL200 Biochemical Analyzer).

Table (1): Chemical composition of experimental diets and nutritional content.

Ingredients % \ Period	Grower (11-25 d)	Finisher (26-33 d)
Yellow corn	56.03	63.00
Soybean meal (44% CP)	31.20	25.13
Gluten meal (60% CP)	5.30	5.00
Soybean oil	3.50	3.10
Limestone	1.04	0.93
Mono calcium phosphate	1.60	1.58
Common salt (NaCl)	0.20	0.20
Sodium bicarbonate ($NaHCO_3$)	0.23	0.23
Vitamin & Mineral mix(1)	0.30	0.30
DL-methionine	0.14	0.13
L-lysine HCl	0.32	0.28
Threonine	0.09	0.07
Choline chloride	0.05	0.05
Total	**100**	**100**
Calculated composition (2)		
Crude protein (CP) %	22.15	19.85
ME (Kcal/Kg)	3105	3154
Ether extract%	6.01	5.82
Crude fiber%	3.49	3.21
Lysine %	1.29	1.11
Methionine %	0.51	0.47
Methionine + Cystine %	0.88	0.80
Threonine %	0.88	0.81
Calcium %	0.77	0.71
Nonphytate Phosphorus %	0.47	0.46
Sodium%	0.20	0.196
Chlorine%	0.16	0.16

(1) Vitamin - mineral mixture supplied per Kg of diet: Vit A, 12000 IU; Vit E, 10 mg Vit D_3, 2200 IU;; Vit K_3, 2 mg; Vit B_1, 1mg; Vit B_6, Vit B_2, 4mg; 1.5mg; Vit B_{12}, 10μg; Pantothenic acid, 10 mg; Niacin, 20 mg; Folic acid, 1 mg; Biotin, 50 μg; Choline chloride, 500 mg; Iodine, Copper, 10 mg; 1mg; Iron, 30 mg; Selenium, 0.1 mg; Zinc, 50 mg and Manganese, 55 mg.
(2) According to NRC 1994.

Antioxidants status was determined by measured serum, total antioxidant capacity (TAC), catalase (CAT) and malondialdehyde (MDA) levels. Thyroid hormones, T3 and T4, were measured in serum using ELISA kits (My Bio Source Inc, San Diego, CA) and computed the T3/T4 ratio.

(IV) Economic efficiency:

At the end the trial period, the economic efficiency profit of broiler production were calculated using the following formula:

- (Total feed cost + additives cost) Equals total cost per bird.
- (Gained of body weight (kg) X selling price of kg bird) Equals total return per bird (L.E).
- Total return per bird - total cost per bird Equals net return per bird (L.E)
- Net return per bird divided by total cost per bird equals economic efficiency (L.E.).
- Economic efficiency of each treatment calculated for each one with multiplying by 100 (control economic efficiency).

(V) Statistical analysis:

In order to do statistical analysis, SAS (SAS, 2004) used the General Liner Model (one-way analysis of variance). It was applied to differentiate between significant (P<0.05) changes in treatment averages using Duncan's new multiple range test (Duncan, 1955).

RESULTS

Growth performance:

Table 2 shows the impact of dietary interventions on broiler chicken growth performance during the grower (11-25 days), finisher (26-33 days), and total periods (11-33 days). Adding CE, NE or mix to the grower and overall periods resulted in a significant (P<0.05) improvement in weight gain (WG) and feed conversion ratio (FCR) as compared to the control. Chicks fed on NE extract or a mixture of CE and NE had more WG (P<0.05) and feed utilization when compared to those who are fed on CE only or the basal diet. During the finisher period, FCR was improved significantly (P<0.05) with the addition of mix compared to other treatments. At all periods, all the addition had no a significant impact on FI.

Table (2): The impact of dietary interventions on broiler chick's growth performance.

Item	Start weight	Grower period (11-25)			Finisher period (26-33)			Total period (11-33)		
		WG	FI	FCR	WG	FI	FCR	WG	FI	FCR
Control	302	1169^{b}	1833	1.57^{a}	405	699	1.73^{a}	1574^{b}	2533	1.61^{a}
CE	305	1244^{a}	1852	1.49^{b}	415	682	1.64^{ab}	1659^{a}	2534	1.53^{b}
NE	301	1268^{a}	1795	1.42^{c}	404	647	1.60^{ab}	1672^{a}	2442	1.46^{c}
Mix	301	1272^{a}	1820	1.43^{c}	419	642	1.53^{b}	1691^{a}	2462	1.46^{c}
SE of means	±0.67	±0.02	±18.31	±0.02	±8.59	±12.35	±0.03	±15.04	±23.26	±0.02
Significance	NS	*	NS	**	NS	NS	*	**	NS	**

*$^{a-b}$Means assigned with the same letter within the same column are not significantly different at 0.05 probability level, *P<0.05), **P<0.01, NS: Not significant (P>0.05). WG: weight gain, FI: feed intake, FCR: feed conversion ratio, CE: 600 ppm of Curcumin, NE: 600 ppm Nigella sativa extract, mix: (300 ppm NE + 300 ppm CE).*

Blood biochemical parameters:

Table (3) and Figure (1) illustrates the effect of dietary interventions on a variety of blood parameters of broiler chicks at 33 days. The addition of mix (300ppm NE+300 ppm CE) had the best effects on total protein, albumin, and globulin (Figure 1). On the other hand, results revealed that the addition of NE (600 ppm) or mix (300 ppm NE+ 300ppm CE) to broiler diets significantly increased (P<0.05) the levels of total protein and globulin compared with CE and the control groups. No significant differences were observed on urea, ALP, ALT, and AST levels among dietary treatments.

Table (3): Effect of dietary interventions on blood parameters of broiler chicks at 33 days.

Item	Urea (g/dl)	ALP (IU/L)	ALT (IU/L)	AST (IU/L)
Control	2.62	145.47	13.13	200
CE	2.39	148.58	13.27	297
NE	2.47	148.34	12.97	195
Mix	2.47	146.75	13.07	197
SE of means	±0.08	±1.01	±0.11	±1.00
Significances	NS	NS	NS	NS

$^{a-c}$Means assigned with the same letter within the same column are not significantly different at 0.05 probability level, NS: not significant. CE: 600 ppm of curcumin, NE: 600 ppm Nigella sativa extract, Mix: (300 ppm NE + 300 ppm CE). Alkaline phosphatase (ALP), alanine aminotransferase (ALT), Aspartate aminotransferase (AST).

Antioxidants status:

Figure 2 showed that adding NE, CE or Mix led to a significant (P<0.05) increase in TAC and CAT while the level of MDA went down compared to the control group.

Thyroid hormones:

The effects of different dietary treatments on thyroid hormones are shown in Figure 3. The addition of a mix of NE and CE significantly (P<0.05) increased T3 levels while T4 and T4/T3 levels were not affected.

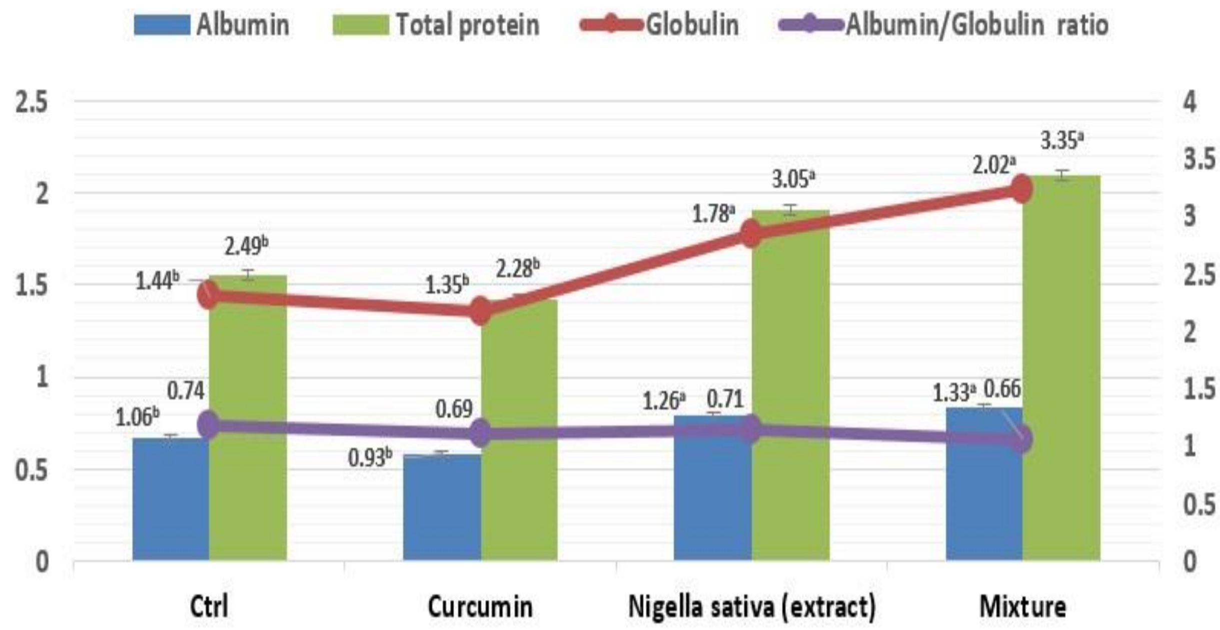

Figure (1): Effect of dietary interventions on blood proteins of broiler chicks at 33 days.

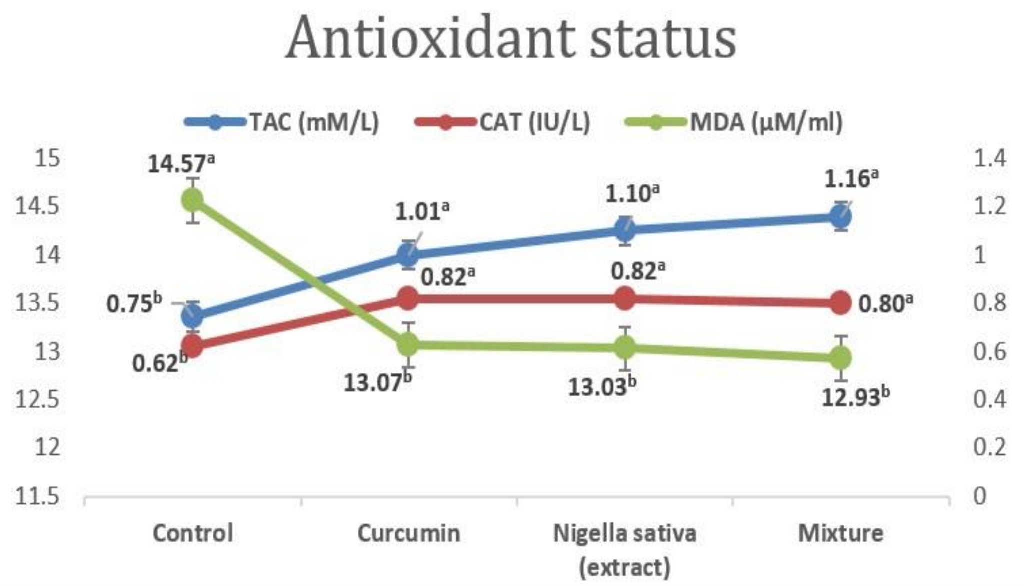

Figure (2): Effects of dietary interventions on broiler chicks antioxidant status (Total antioxidant capacity (TAC), Catalase (CAT), Malondialdehyde (MDA)) at 33 days of age.

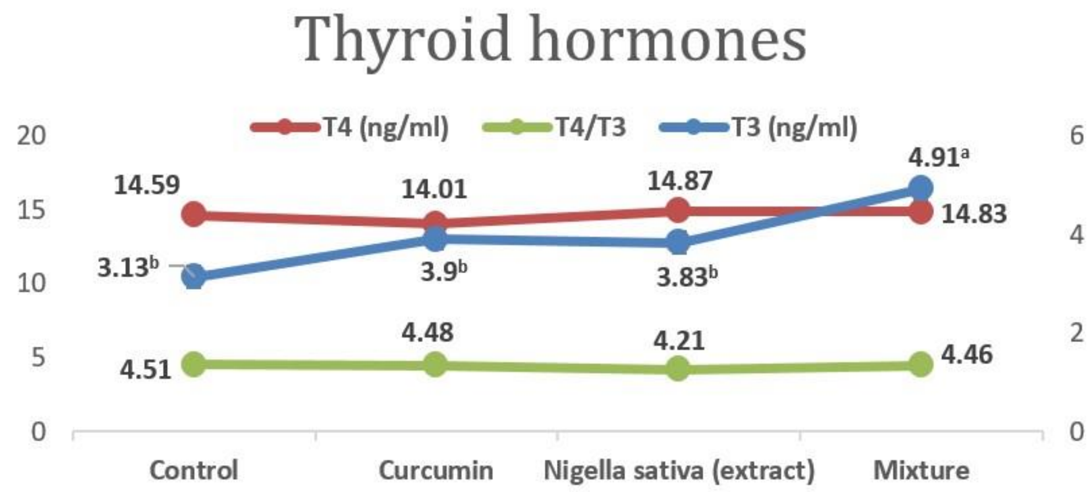

Figure (3): Effect of different treatments on thyroid hormones (T3: Triiodothyronine, T4: Tetra iodothyronine).

Bacterial population in the intestinal contents:

Results in Table (4) and Figure (4) represent colony-forming unit (CFU) of the main bacterial genera in 1g of cecum boilers chicken after 4 weeks of feeding on a basal diet mixed with CE, NE or mix. Compared to the control group all the extracts administrated trials showed enhancement in chicken intestinal health by increasing the total *Lactobacilli* count and decreasing the total fecal coliforms count. The most effective administration was NE extract followed by the mix which resulted in the elimination of *Salmonella sp*. existence compared with the control. *Lactobacillus* count was enhanced ($3x10^7$ and $4x10^7$ *vs.* $3x10^6$ of the control) with a decrease in total fecal bacteria existence ($8x10^6$ and $5x10^7$ *vs.* $5x10^8$ of the control) for NE and the Mix, respectively. The CE group was the less potent trial in enhancing intestinal health and microflora composition which was illustrated by the presence of *Salmonella* sp. but still less than the control group.

Table (4): Total main bacteria count in response to different phytogenic extracts

Item	Total fecal coliforms	*Lactobacilli*	*Salmonella* sp.
Control	$5x10^8$	$3x10^6$	$7x10^2$
CE	$2x10^8$	$2.5x10^6$	$5x10^2$
NE	$8x10^6$	$3x10^7$	0
Mix	$5x10^7$	$4x10^7$	0

CE: 600 ppm of Curcumin, NE: 600 ppm Nigella sativa extract, mix: (300 ppm NE + 300 ppm CE).

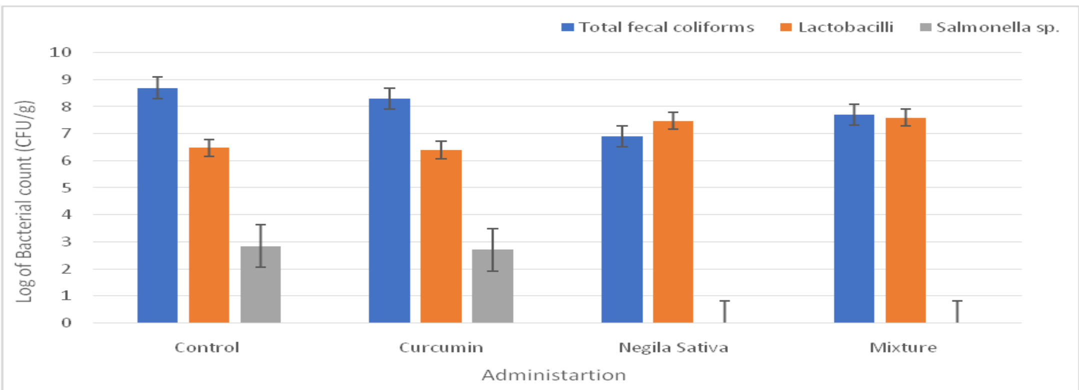

Figure (4): log of CFU of main bacterial population count in chicken cecum.

Economic efficiency:

Table 5 displays the estimated economic efficiency (EE) and relative economic efficiency (REE) values for the experimental diets that were used in the study. The results showed that supplementing broiler chick diets with CE, NE, or both enhanced REE when compared to the control group. When compared to the control group, the chicks given the mixture of extracts had the best REE, followed by the chicks fed NE. The inclusion of CE, NE, or their combination enhanced REE by 68, 125, and 133%, respectively. These findings indicated that with the goal to maximize profitability from broiler production, adding CE, NE, or their combination would lower the relative cost per unit of body weight and be more cost-effective.

Table (5): Economic efficiency and relative economic efficiency of broiler chicks at 33 days.

Item	Control	CE	NE	Mix
Body weight gain (g)	1574	1659	1672	1691
Feed intake/chick (g)	2533	2534	2442	2462
Feed cost/chick (LE)	44.33	44.35	42.74	43.10
Additives cost/chick (LE)*	0.00	0.40	0.50	0.45
Fixed cost/chick**	10.00	10.00	10.00	10.00
Total cost/chick (LE)	54.33	54.75	53.24	53.55
Sale price/chick (LE)***	58.24	61.38	61.86	62.57
Net profit (LE)	3.91	6.63	8.62	9.02
Economic efficiency (EE)****	0.072	0.121	0.162	0.168
Relative EE (%)	100	168	225	233

Feed cost was calculated according to the price of different ingredients available in the market at experimental time, *Include materials and solvent price, **Include chick price, management and vaccine and medicated cost,
*** Body weight gain X 37.00 LE/kg, ****EE=Net profit/Total cost /bird.

DISCUSSION

Growth performance:

The current investigation found that supplementing broiler chickens with NE and/or CE increased their performance. Whereas, adding NE extract alone or mix had a greater effect than those fed the control diet which may be related to better utilization of feed than those fed on the control diet. Broiler chickens' performance has been shown to be improved by phytogenic (Demirci *et al.*, 2019; Elsherif *et al.*, 2021 and Samy *et al.*, 2022) confirming the current results. The enhanced in WG and FCR of the birds fed *Nigella Sativa* added diets is consistent with prior researches (Ghasemi *et al.*, 2014; Jahan *et al.*, 2015 and Rahman and Kim 2016). Adding 1% or 2% of black cumin seeds to broiler diets increased WG and FCR in the broilers (Rahman and Kim, 2016). In addition, Demirci *et al.* (2019) found that adding 0.5-1% *Nigella Sativa* seeds oil to broiler diets improved BW, WG, and FCR compared to the control group. Also, the group that was provided a diet enriched with 1% oil was more effective, whereas the feed consumption wasn’t affected. Oke *et al.* (2021) investigated the effects of in ovo injecting NE extract at 2, 4, 6, and 8 mg/egg on the broiler performance. At 8 weeks old, the best overall weight and FCR were recorded for post-hatch birds treated by in ovo injection with NE extract at 6 mg. Samy *et al.* (2022) found that addition of CE at 200 and 400 ppm to the growing rabbits diet improved significantly ($P<0.05$) WG and FCR compared with control group. The performance improvement may be attributed to the bioactive compounds in NE and CE. Enhancing nutrients in the gut of birds is one possible mechanism by which black cumin promotes growth (Kumar *et al.*, 2017). Some herbal extracts stimulate the digestive enzyme secretion, appetite, and immune response. In addition, they can act as antibacterial and antioxidants which may affect the properties of the digestive system. The use of CE in broiler diets can improve the digestion of carbohydrates, fat, and protein by increasing the secretion of amylase, lipase, and protease enzymes (Utami *et al.*, 2020).

Some blood biochemical:

The addition of NE or mix to the broiler diets significantly enhanced the levels of total protein and globulin compared with the control group. Our findings are consistent with those of Kumar *et al.* (2017), who found that broiler hens fed black cumin had more total protein in their serum blood than those fed a control diet. The immune-modulating actions of black cumin may be responsible for the increase in total protein. Also, the same results are shown by Khan *et al.* (2012) found that broiler fed diets treated with various amounts of NE resulted in an increase in blood total protein. Singh and Kumar (2018) reported that the inclusion of 1.5% of NE in the broiler diet significantly (P<0.05) increased serum total protein. Talebi *et al.* (2021) observed that chickens fed diets with various doses of *Nigella Sativa* seeds had significantly (P<0.05) greater albumin and total protein levels than the control group. Regarding antioxidants status addition of NE or CE extracts significantly increased TAC and CAT while MDA was significantly decreased compared with the control group. Similar results were reported by El-Gindy *et al.* (2020) who found a significant increase in TAC and a decrease in MDA antioxidants enzymes in rabbits fed diet supplemented with 600 mg/kg of NE. Also, increased TAC, SOD, CAT, and GSH antioxidants were recorded by adding CE at 200 and 400 ppm compared to the control group in growing rabbits (Samy *et al.*, 2022). The improvement in antioxidants enzymes of broiler chickens fed NE or CE may be related to the more antioxidants components in NE and CE. Therefore, NE and CE are good sources of natural antioxidants. *Nigella Sativa* extract has been shown to increase the activity of several enzymes involved in oxidative stress modulation in broiler chickens, including SOD, catalase, and glutathione-S-transferase (Rahman and Kim 2016).

Bacterial population in the intestinal contents:

Recently, synthetic antibiotics resistant traits aroused among different pathogenic microbes had caused inevitable challenges on how to decrease or eliminated the usage of these antibiotics for pharmacological and feed additives application. Commonly, synthetic antibiotics are used in boilers chicken diets to improve the general health condition of young birds. However, drawbacks aroused about synthetic antibiotics resistivity had necessitated the discovery of new natural alternatives to take the lead for usage in different daily applications (Azeem *et al.*, 2014). Curcumin and NE are widely known plants for their antimicrobial activity against different pathogenic bacteria (Azeem *et al.*, 2014). Haq *et al.* (2020) reported the advantage of NE administration to *E. coli* challenging boilers chicken diet in decreasing total *E. coli* count in their faces samples. Rahmani *et al.* (2018) showed that adding 200 mg/kg of CE to the broiler diets decreased the number of *E. coli* and raised the number of *lactobacilli* compared to the control diet. Singh *et al.* (2021) and Alagbe (2021) suggested that phytogenic extracts such as phenols, flavonoids and alkaloids are able to decrease the activities of pathogenic microbes by competitive exclusion and stimulate the reproduction of beneficial bacteria such as *Lactobacillus*. Therefore, phytogenic extracts have provided enough evidence to be alternatives of synthetic antibiotics in poultry feeds.

Economic efficiency:

These results revealed that supplementing broiler diets with CE, NE, or their combination reduces the relative cost per unit of body weight, hence increasing the cost-effectiveness of reaching maximum broiler output. An improvement in feed conversion ratio and an increase in body weight gain in broiler chicks fed diets supplemented with CE, NE, or both may be related to the increase in economic efficiency. These results corroborate earlier studies' conclusions that herbal extracts enhanced the economic evaluation (Abaza *et al.*, 2008; Issa and Abo Omar, 2012; and Abd –El Ghany *et al.*, 2023). According to Puvaca *et al.* (2016) broiler chicken diets supplemented with herbal powder had the lowest feed cost per kilogram of body weight gain. Additionally, they reported that adding herbal powder to the diet lowers broiler production expenses and raises the economic efficiency index. Hassan (2018) also noted that the drop in feed prices resulted in a reduction in broiler production expenses. Compared to the control group, broiler chicks fed diets enriched with *Nigella sativa* were more cost-effective. The percentages of relative economic efficiency, net revenue, and total revenue all demonstrated significant increases. These findings suggested that the herbal extract-containing diets were more cost-effective than the control diet.

CONCLUSIONS

These results could be concluded that supplementation of 600 ppm *Nigella Sativa* extract (NE), 600 ppm Curcumin (CE) or the mixture of 300 ppm NE with 300 ppm of CE in growing broiler diets improves productive performance, blood biochemical parameters, and intestinal microflora. The birds fed a diet containing a mixture of NE and CE had the best growth performance, FCR, gut health and economic efficiency.

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تأثير مستخلص حبة البركة والكركمين كإضافات غذائية نباتية على أداء دجاج التسمين، مقاييس الدم، حالة مضادات الأكسدة وميكروفلورا الأمعاء

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هدفت هذه الدراسة إلى دراسة تأثير إضافة مستخلص حبة البركة ومستخلص الكركم (الكركمين) والخليط بينهم إلى علائق دجاج اللحم على الأداء الإنتاجي والمقاييس البيوكيميائية للدم وحالة مضادات الأكسدة وهرمونات الغدة الدرقية والميكروفلورا المعوية. تم استخلاص المستخلصات الخاصة بحبة البركة والكركم في قسم الانتاج الحيواني بالمركز القومي للبحوث. وتم تكوين أربع علائق: العليقة الأولي تغطي جميع الاحتياجات الغذائية بدون أي إضافات (عليقة الكنترول)، العليقة الثانية هي عبارة عن عليقة الكنترول مضاف لها 600 جزء في المليون من مستخلص حبة البركة، العليقة الثالثة هي عبارة عن عليقة الكنترول مضاف لها 600 جزء في المليون من مستخلص الكركم (الكركمين)، العليقة الرابعة هي عليقة الكنترول مضاف لها 300 جزء في المليون من مستخلص حبة البركة + 300 جزء في المليون الكركم (خليط). تم استخدام 240 كتكوتًا عمر 11 يومًا بأوزان متقاربة وزعت الي أربع مجموعات بواقع 60 كتكوت لكل معاملة (6مكررات X 10 كتاكيت في كل مكررة). تم قياس الأداء الإنتاجي والمقاييس البيوكيميائية للدم وحالة مضادات الأكسدة وهرمونات الغدة الدرقية والميكروفلورا المعوية.

أظهرت النتائج أن إضافة أي من المستخلصين منفردين أو الخليط ما بينهم إلى علائق دجاج اللحم أدى إلى تحسن معنوي في الزيادة في وزن الجسم ومعامل التحويل الغذائي مقارنة بمجموعة الكنترول. لم تسجل أي فروق معنوية ($P>0.05$) في استهلاك العلف بين جميع المعاملات في جميع الفترات. أدت اضافة مستخلص حبة البركة أو الخليط من مستخلص حبة البركة والكركمين إلى تحسين مستويات البروتين الكلي والألبيومين والجلوبيولين بشكل كبير. بينما لم تؤثر أي معاملة من المعاملات المختلفة على مستويات اليوريا أو ناقلة أمين الألانين أو ناقلة أمين الاسبارتات أو الفوسفاتاز القلوي مما يشير إلى عدم وجود أي تأثيرات ضارة على كلاً من وظائف الكبد والكلى. أدت إضافة مستخلص حبة البركة أوالكرمين أوالخليط مابينهم إلى تحسن ملحوظ في القدرة الكلية المضادة للأكسدة وكذلك في مستوي انزيم الكاتالاز بينما انخفض مستوى الإجهاد التأكسدي كدليل على إنخفاض الإجهاد التأكسدي مقارنةً بمجموعة الكنترول. أيضاً أدت إضافة الخليط من مستخلص حبة البركة والكركمين إلى زيادة معنوية في مستويات ثلاثي يود الثيرونين (T3)بينما لم تؤثر على مستويات الثيروكسين. كما أدت إضافة مستخلص حبة البركة أوالخليط بين مستخلص حبة البركة والكركمين إلى زيادة عدد البكتريا النافعة (بكتيريا حامض اللاكتيك)، وتقليل العدد الكلى للبكتيريا الضارة والقضاء على السالمونيلا وبالتالي تحسين صحة الأمعاء مقارنة بالمضاف لها الكركمين والكنترول. من هذه النتائج،

يمكن استنتاج أن إضافة 600 جزء في المليون من مستخلص حبة البركة أو الخليط من مستخلص حبة البركة والكركمين إلي علائق دجاج اللحم أظهر تأثيراً إيجابياً على الأداء الإنتاجي، والمقاييس البيوكيميائية للدم، وحالة مضادات الأكسدة وميكروفلورا الأمعاء والكفاءة الإقتصادية.