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TURMERIC AS AN EFFECTIVE ALTERNATIVE TO ANTIBIOTICS FOR PROMOTING GROWTH OF JAPANESE QUAIL

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ABSTRACT: Four groups of 360 quail at one day-old distributed at equal body weights and classed to four groups (control and three treatments) the first treatment antibiotic (control diet+ sub-therapeutic dose of avilamycin 8 mg/kg diet), the second and the third Turmeric powder 1% and 3% (control diet +1% and 3% turmeric powder) respectively, and used to test the possibility of using turmeric as natural alternative to antibiotics growth promoters on Japanese quail. The obtained results were summarized as follows: Growth performance was improved through appending quail diets with both 1 and 3% turmeric expressing as heavier LBW38d, BWG10-38, lower FI10-38, better FC10-38 and PI10-38 compared with either the avilamycin treatment or un supplemented group (control) and favoring the 1 % turmeric group which exceeded the 3% turmeric group, however adding turmeric did not affect the carcass, the antibiotic group had the highest dressed meat%. All serum biochemical indices tested at slaughter except HDL and Tri G significantly affected by either treatment or sex effects. The diets supplemented with turmeric showed lower total Cholesterol, LDL, RBS and AST than both avilamycin supplemented and un supplemented groups. Both antioxidant parameters and immune responses significantly affected by treatment effect. Conversely, sex had no effect on these parameters. The increase in turmeric rate of supplementation increased GPx and immune responses (IgG, IgA and IgM) and decreased TBAR. Useful intestinal bacteria (Lactobacillus) in growing quails significantly increased with added turmeric to quail diet and both Salmonella and E. coli (harmful intestinal bacteria) reduced significantly than the control group. The lowest intestinal bacteria counts either useful or harmful were obtained by the avilamycin supplemented group. In conclusion, supplementing quail grower diets with Turmeric1% may be act as an effective antibiotic alternative (avilamycin) for promoting quail growth.

Key words:Antibiotics- Antioxidant Activity- Growth Promoter-Turmeric-Japanese quail.

INTRODUCTION

Recently, most antibiotics used in poultry production for long periods as a growth promoter (AGP) have been forbidden because it is risky due to not only cross-resistance but also to multiple resistances **(**Shazali et al., 2014**)**. Many problems in growth performance and increased in the incidence of disease outbreaks that occurs through using antibiotic growth catalysts (AGPs), particularly sub-clinical necrotic enteritis. This has led to detection of replacements to AGPs. which shows a wide range of pharmacological properties, such as antioxidant, antiproto-zoal, antivenom, antimicrobial, anti-inflammatory ،antiproliferative, antiangiogenic, antitumor and antiaging (Amalraj et al., 2017). Arslan et al., (2017) showed that body weight gains and FCR were improved with turmeric supplementation at a higher dose (1.0 and 1.5%), while occurs reducing in serum total cholesterol and increasing in HDL-cholesterol without effect on triglycerides with addition turmeric levels. Attia et al., (2017) found that turmeric addition at 1 g/kg diet eloquently improved feed conversion ratio (FCR) and European production index compared to mannan oligosacride (MOS) groups and control group, the results in broilers showed that using turmeric as a phytogenic feed additive at 1 kg/t diet as an alternative to mannan oligosacride (MOS) or oxytetracyclin (OTC) without passive effects on the productive and economic traits. Also, adding thyme and turmeric powders to diet by different levels increased chicks body weight compared to control diet at 42 days of age (P>0.05), while total cholesterol, uric acid, LDL,HDL, and triglyceride concentrations were decreased compared to the control groups (Fallah and Mirzaei, 2016).

Sethy et al., (2016) showed that significant increasing at (P <0.05) in body weight gain by addition of Curcuma longa powder at 0.5% and 1% caused. On the other study, Rajput et al., (2013) reported that there significant increase in body weight gain and reduced in FCR for broiler chickens with feeding on 0.2 g/kg pure curcumin phytochemicals derived from turmeric. Similarly, Al-Jaleel (2012) reported that body weight gain increased significantly and FCR improved than control group with feed at 0.5g/ kg of turmeric powder. In contrast, Hosseini-Vashan et al., (2012) found that both of body weight, feed intake, feed conversion ratio (FCR), protein and energy efficiency ratio and performance index did not affected by turmeric rhizome powder in broilers diets. While, blood cholesterol and LDL cholesterol was decreased and increased HDL cholesterol when turmeric rhizome powder fed before and after heat stress. Also, happen increasing in blood activity of glutathione peroxidase (GPx) and SOD with decreasing in blood thiobarbituric acid reactive substances (TBARS) index. The results by (Zienali et al., 2009) showed that the antioxidant status for broilers under heat stress reinforced by turmeric powder via improving the activity of glutathione peroxidase and superoxide dismutase with lowering malondialdehyde (MDA) concentration. However, other researches did not uncover any considerable effect on carcass production when addition turmeric at the rate of 1.0 g/kg (Rahmatnejad et al., 2009) or 2.0 g/kg (El-Hakim et al., 2009). Also, Al-Sultan (2003) reported that broilers feeding on diets supplemented by turmeric meal showed no difference in the crude protein

content in breast and thigh muscles. In broiler chickens (Qasem et al., 2016) concluded that dietary turmeric powder had favorable influences on the blood biochemistry measurements, but that antioxidant activity was not affected. Faghani et al., (2014) showed that turmeric extract significantly decreased cholesterol and triglyceride levels in treated groups while HDL levels increased compared with control. Hussein (2013) reported that turmeric powder (7g TP / kg diet) have a positive effect on broiler's performance and lowering effect on blood serum cholesterol, triglycerides, compared with the control group or other dietary treatments. In other studies using broiler chickens, dietary supplementation of turmeric meal reduced ALT (Akbarian et al., 2012) and alkaline phosphatase (ALP) activities in the blood serum (Emadi et al., 2007), which can be indication of better function of liver. There is a positive effect for turmeric on health of the liver whereas contains active components that usefully catalyze bile excretion and bile flow. As noticed by Emadi and Kermanshahi (2007), supplementation of turmeric meal in the diets at the proportion of 2.5-7.5 g/kg lowered the condensations of aspartate aminotransferase (AST), alanine aminotransferase (ALT), lactate dehydrogenase (LDH) and alkaline phosphatase (ALP) in broiler chickensblood. Reductions of these enzymes are important as the aggregation of these enzymes in the liver is attached to toxicity. In more recent study, Malekizadeh et al., (2012) showed that supplementing diets with 10.0-30.0 g/kg turmeric meal reduced the ALT and AST in blood serum of single comb white leghorn (W-36) laying hens. Turmeric has also been proven to have ability to stimulate the expression of genes which are involved in antioxidant and immune system of broiler chickens. Using a quantitative real-time PCR technique, Yarru et al., (2009) showed that 5.0 g/kg turmeric meal supplementation had beneficial effects on the stimulation of genes expression that involved in antioxidant function [cytochrome P450 1A1 and 2H1 (CYP1A1 and CYP2H1)] and genes expression that involved in the immune system [interleukins 6 and 2 (IL-6 and IL-2)] in broiler chickens. These improvements could be attributed to activity of curcumin as immuno stimulant agent (Gautam et al., 2007). Therefore, the purpose of current search was to exam the influence of dietary turmeric powder as natural substitutional to antibiotic growth promoter on intestinal microflora population, blood biochemical, antioxidant statues, immune response and growth performance of growing Japanese quail.

MATERIALS AND METHODS

experimental birds, design and diets

Four groups of 360 quail at one day-old were acquired from market and adapted for 10 days. Quails were randomly distributed at equal body weights into four groups (control and three treatments) the first treatment antibiotic (control diet+ sub-therapeutic dose of avilamycin 8 mg/kg diet), the second and the third Turmeric powder 1% and 3% (control diet +1% and 3% turmeric powder), respectively. Each group was replicated six times, 15 chicks /replicate. Chicks were housed in a five decks, three sections quail cages with stand and dropping pans with automatic watering. The control diet was formulated to meet the nutrient requirements of the quails during the experiment period from 0 to 38 days (NRC, 1994).The antibiotic used in

this study was Avilamycin which is an orthosomycin antibiotic complex manufactured for: Elanco Animal Health, A Division of Eli Lilly and Company, Indianapolis, IN 46285, USA, produced by the fermentation of Streptomyces viridochromo genes. It is primarily active against gram-positive bacteria and is intended for using as a veterinary medicine to control bacterial enteric infections and was earlier authorized as a feed additive for growth promotion in accordance with Council Directive 70/524/EEC.

The composition of the basal diet is presented in Table 1. Chicks were exposed to continuous lighting and chicks were fed and watered ad libitum. At 31 day of age, birds were vaccinated against Newcastle virus (Lasota) via spraying.

growth performance and carcass traits measured:

Live body weights of chicks (LBW) were individually weighed and feed consumptions per pen were weekly recorded (FI), the uneaten feed discarded, live body weight gain (BWG) as a difference between final and initial body weights, feed conversion ratio (FCR) , performance index (PI) were calculated based on North (1981) as follows: PI = BW_{kg}/FCR and Growth rate was calculated based on Brody (1945) as follows : GR=(LBW_{10} – LBW_{38})/ 0.5 (LBW_{10} + LBW_{38}). At the end of the experiment (38 of age), six birds from each group were reweighed and slaughtered by cutting the Jugular vein, defeathered and eviscerated. Carcass yield was calculated from eviscerated weight the dressing % was calculated, giblets weight was measured and their % was calculated while blood samples were collected for blood analysis.

blood biochemical, anti-oxidant and immunity:

At slaughter, individual 24 blood samples (4treatment x 6samples/sex) were collected in dry clean centrifuge tubes and serum was separated through centrifugation at 3000 rpm for 15 minutes and assigned for subsequent determination. Quantitative determination was done for the following: total cholesterol (Chol), high density lipoproteins (HDL), low density lipoproteins (LDL), very low density lipoproteins (VLDL) triglycerides (Tri G), Aspartate aminotransferase (AST) and Alanine aminotransferase (ALT). All blood biochemical parameters were calorimetrically determined using commercial diagnosing kits (produced by Spectrum Diagnostics Company, Egypt). The glutathione peroxidase (GPx, EC 1.11.1.9) determined calorimetrically according to Paglia and Valentine (1967) and thiobarbaturic acid- reactive substances' (TBARS) were performed according to Yagi (1998) using commercial diagnosing kits produced by Cayman Chemical Company (USA). The method used for the assay of chicken Immunoglobulins Isotypes IgG, IgM, and IgA in Sandwich ELISA described by Erhard et al., (1992) the absorbance measured on an ELISA plate reader set at 450 nm.

microbial analysis:

After slaughter, intestinal content was immediately collected in sterile glass containers, digesta was evacuated and mixed. At 4°C, the sealed containers were kept in the laboratory till enumeration of microbial population. Samples (1g of the mixed fresh mass) were taken into sterile test tubes, diluted 1:10 in sterile 0.1% peptone solution and homogenized for 3 min in a Stomacher homogenizer. Ten

fold serial dilutions up to 10^{-7} of each sample were prepared in nine ml of 0.1% sterile peptone solution. Viable counts of Salmonella ssp, Escherichia coli (E. coli) and Lactobacilli ssp were performed. One milliliter of the serial dilution was incubated into sterile Petri dishes and sealed with an appropriate medium. Lactobacillus spp. colony count was determined using MRS agar (Biokar Diagnostic, France) after incubation in an anaerobic chamber at 37 °C for 72 h. Salmonella and E. coli colonies were counted on brilliant green agar plate and incubated at 37°C for 24 h). After cultivation in Petri dishes, the total colony count for Lactobacilli, Salmonella and E. coli was then calculated as the number of colonies by reciprocal of the dilution. The microbial counts were determined as colony forming units (cfu) per gram of sample.

statistical analysis:

Using General Linear Models (GLM) procedure of SPSS (2013), studied traits were subjected to a two-way analysis of variance with treatment and sex as main effects as follows:

$Y_{ijk}=\mu+ T_i + S_j+ TSij+e_{ijk}$**.**

Where: Y_{ijk}: Observed value in the i^{th} treatment of the j^{th} sex of the kth individual, μ: Overall mean, T_i: Treatment effect (i: 1 to 4), S_j: Sex effect (j: 1 and 2), TS_{ij}: interaction of T_i and S_j and e_{ijk}: Random error term. When significant F values were obtained main effects means were compared by Duncan's new multiple range tests (Duncan's, 1955). Interaction of T_i and S_j were insignificant effects for all studied traits.

RESULTS AND DISCUSSION

Supplementing quail diets with both 1 and 3% Turmeric amended growth performance expressing as heavier LBW_{38d} , BWG_{10-38} , lower FI_{10-38} , better FC_{10-38} and PI_{10-38} compared with either the avilamycin supplemented or un supplemented groups and favoring the 1 % Turmeric group which exceeded the 3% Turmeric group in these traits but had slower $GR_{10-38.}$ Females better performance than males due to significant sex effects was shown for all growth traits studied, except for FI_{10-38} and $GR_{10-38.}$ Females significantly surpassed their males in LBW_{38d}, $BWG_{10-38,}$ better FC_{10-38} and higher PI_{10-38} Table (2). The present results indicate that 1% turmeric /kg diet is adequate as an alternative growth promoter that could replace avilamycin and have a better impact on productive performance. The potential effect of turmeric on growth performance of quails are in line with those reported elsewhere (Attia et al., 2017 and Al-Sultan 2003). The above-mentioned authors showed that growth performance of broiler chickens was bettered with turmeric addition at the rate (2%) 20 g/kg without detrimental influences on mortality. These prospective influences for turmeric could be related to its curcuminoids (3 to 5 %, as found in turmeric powder), bisdemethoxy curcumin and demethoxy curcumin, the main active components in turmeric (Roughley et al., 1973). These compounds show an enormous spectrum of biological activities including antibacterial, antioxidant, antiviral, antiprotozoal, antifungal, anti-inflammatory and anticoccidial properties, digestion- and absorption-enhancing effects, and protection effects against coccidiosis and toxins (Eevuri and Putturu 2013). Turmeric also improves liver and bile functions through increased bile secretions, protects the stomach from ulcers and reduces liver toxins. These

improvements can enhance digestion, metabolic processes and nutrient utilization for growth through stimulation of protein synthesis by the chicken enzymatic system (Al-Sultan 2003). Turmeric has been observed to enhance the intestinal lipases, amylase, trypsin and chymotrypsin secretions (Rajput et al., 2012). Therefore, the improvement in the growth performance due to turmeric supplementation to broilers' diets can be partly attributed to improving the ecology and function of the digestive tract of chickens. The current results agreed with(Suvanated et al., 2003) who reported that broiler chicks fed dietary turmeric powder had a higher body weight gain, energy efficiency ratio, yield of production and lower FCR than the basal diet ($P < 0.05$).Treatment effect resulted in significant differences among different groups where the avilamycin supplemented group had the highest dressed meat weight and the control had lower estimate than other groups. However, treatment effect did not influence other carcass studied traits. Females had heavier weights of both edible parts and giblets and higher giblets% than males due to the significant sex effect Table (3). The present results of dressed meat % disagreed with those of Durrani et al., (2006) who showed beneficial effects of dietary turmeric meal supplementation (5.0 g/kg) to reduce fat content, increase carcass quality and dressing percentage while the However, results of the rest parameters agreed with some studies did not find any significant effect of turmeric supplementation at the rate of 1.0 g/kg (Rahmatnejad et al. 2009) or 2.0 g/kg (El-Hakim et al. 2009) on carcass production. Also, Ürüşan and Bölükbaşı (2017) reported that adding turmeric did not affect the carcass yield. There were no differences in the weight of the heart. Neither treatment nor sex effects significantly affected all carcass chemical composition of growing quails as shown in Table (4).The present results agreed with those of Al-Sultan (2003) reported no difference found in the crude protein content in breast and thigh muscles following turmeric meal supplementation in the broiler diets It may be due to the fact that turmeric is an aromatic plant and is not involved in metabolic pathways by the way it changes the chemical composition of the body.All serum biochemical indices that tested at slaughter except HDL and Tri G significantly affected by either treatment or sex effects Table (5). The diets supplemented with Turmeric showed lower total Chol, LDL, RBS and AST than both avilamycin supplemented and un supplemented groups. It can be seen that the increase in Turmeric level of inclusion increased total Chol, LDL and VLDL and resulted in decreases in RBS, Tri G, AST and ALT which limited the possibilities of raising the rate of inclusion of Turmeric more than 1% to avoid undesirable effects on serum indices. Females had higher total Chol, LDL and lower RBS and liver activities (AST and ALT) than males Table (5). The current results partially agreed with those of Arslan et al., (2017) who reported that turmeric supplementation reduced serum total cholesterol and HDL-cholesterol was increased, while LDL-cholesterol and triglycerides remained unaffected due to turmeric supplementation and completely agreed with those of Fallah and Mirzaei (2016) who observed that broilers receiving turmeric and thyme powders had lower uric acid, total cholesterol, HDL, LDL and triglyceride concentrations compared

to the control groups. Turmeric powder affects blood lipid metabolisms. This study revealed higher blood HDL cholesterol for quails fed turmeric powder compared with control or antibiotic. The same findings were reported by Emadi et al., (2007) and Hosseini-Vashan et al., (2012). Curcumin reduces plasma LDL and VLDL significantly and liver cholesterol content along with an increase of plasma α-tocopherol level in rat, suggesting in vivo interaction between curcumin and α-tocopherol that may decrease cholesterol levels (Kamal-Eldin et al., 2000). Lowering cholesterol effects may be mediated by the stimulation of hepatic cholesterol-7- hydroxylase activity because the digestibility of TG was not affected by curcominoid supplementation (Asia et al., 1999). Therefore, minimum curcumin will have effect on the activity of this enzyme.Both antioxidant parameters and immune responses significantly affected by treatment effect. Conversely, sex had no effect on these parameters Table (6). The increase in turmeric rate of supplementation increased GPx and immune responses (IgG, IgA and IgM) and decreased TBAR. Hosseini-Vashan et al.,(2012) reported that increase in the activity of antioxidant enzymes such as SOD and GPx was revealed in chicks fed turmeric powder (TP) as compared to the control under heat stress and decreased TBARS which completely agreed with the current results. SOD "metalloprotein enzyme" is the first enzyme contributed in the antioxidant defense system. GPx "seleno enzyme" catalyses the reaction of hydro peroxides with reduced glutathione to form glutathione disulphide (GSSG). Therefore, elevated concentration of these enzymes may improve the steady state of antioxidant system of broilers. The TBARS index or the concentration of serum MDA is another index for evaluating antioxidant systems. Suvanated et al., (2003) reported that the supplementation of turmeric that corresponded to 90 ppm curcuminoid had a trend to decrease MDA. These findings show that TP diets reduce the oxidative reactions in the body of broiler chicks and the rate of MDA production and TBARS index. It could improve the meat quality via the reduction of free radical and peroxide radical. Generally, the use of feed components and supplements with an-tioxidants or immuno stimulatory properties mitigates oxidative stress, which is manifested through suitable changes in the activity of these enzymes; thus, such activity is regularly evaluated to discern positive effects of different feed supplements (Ognik and Krauze, 2016). Turmeric has also been proven to have ability to stimulate the expression of genes which are involved in antioxidant and immune system of broiler chickens (Yarru et al., 2009).Useful intestinal bacteria (Lactobacillus) in growing quails significantly increased by Turmeric supplementation to quail diet and both E coli and Salmonella (harmful intestinal bacteria) desirably decreased than the control group. The lowest intestinal bacteria counts either useful or harmful were obtained by the avilamycin supplemented group. On the other hand, sex did not affect intestinal bacteria in growing quails Table (7). The simultaneous decrease in Turmeric and curcumin for poultry Escherichia colipopulations in parallel with increased Lactobacillus spp. counts (Faghani et al., 2014) agreed with the current results which also in line with Al-Mashhadani, 2015 and Ürüşan and Bölükbaşı (2017) who reported that dietary

supplementation of broiler diets with turmeric powder caused a significant ($P<0.05$) increase in Lactobacillus and decrease of E. coli count compared with the control group.

CONCLUSION

Supplementing quail grower diets with turmeric1% or 3% may be act as an effective antibiotic alternative (avilamycin) for promoting quail growth performance since improving growth performance, showing desirably lower lipid profile (total Chol, LDL, Tri G), lowering RBS , AST and ALT and increasing useful intestinal bacteria (Lactobacillus) and decreasing harmful intestinal bacteria (E coli and Salmonella).

Table (1): Feed ingredients and chemical composition of basal experimental diet.

Feed Ingredient	**Basal diet %**
Yellow corn	56.00
Soybean meal (44 CP %)	32.00
Concentrate meal[1](50% CP)	10.30
Calcium carbonate	0.60
Sodium chloride	0.30
Vegetable oil	0.50
Vitamin and mineral premix[2]	0.30
Calculated analysis:	
Metabolizable energy (Kcal/Kg	2907
Crude protein (CP)	24.00
Crude fiber (CF)	3.60
Calcium (Ca)	0.81
Available phosphorus (Av P)	0.46
Lysine	1.62
Methionine	0.51
Methionine+Cystine	0.88

[1]- Concentrate meal%: CP 50, CF 1.3, Ca 4.72, Av P 3.1, lysine 6, methionine 2, Meth+Cyst 2.5 and ME 2650 kcal/kg.

[2]-Premix provided per kg of diet: vitamin A, 12000 IU; vitamin D3, 2400 IU; vitamin E, 30 mg; vitamin K_3, 4 mg; vitamin B_1, 3 mg; vitamin B_2, 7 mg; vitamin B_6, 5 mg; vitamin B_{12}, 15 µg; niacin, 25 mg, Fe, 80 mg; folic acid, 1 mg; pantothenic acid, 10 mg; biotin, 45 mg; choline, 125,000 mg; Cu, 5 mg; Mn, 80 mg; Zn, 60 mg; Se, 150 µg.

Table (2): Effects of treatment and sex on growth traits of Japanese quail (Main effects).

Item	LBW_{10d} (g)	LBW_{38d} (g)	BWG_{10-38} (g)	FI_{10-38} (g)	FC_{10-38} (g/g)	GR_{10-38} (g/g)	PI_{10-38} (%)
Treatment effect:							
Control	40.68	201.09^{b}	160.42^{b}	584.21^{a}	3.66^{a}	1.32^{b}	5.56^{c}
Avilamycin	41.40	219.59^{a}	178.20^{a}	583.37^{a}	3.28^{b}	1.37^{a}	6.73^{b}
Turmeric1%	42.11	222.81^{a}	180.71^{a}	518.82^{c}	2.92^{c}	1.36^{a}	7.83^{a}
Turmeric3%	41.76	222.44^{a}	180.69^{a}	531.35^{b}	2.96^{c}	1.37^{a}	7.62^{a}
SE	0.80	2.39	2.22	2.94	0.07	0.01	0.17
Probability (P)	P≤0.66	P≤0.001	P≤0.001	P≤0.001	P≤0.001	P≤0.03	P≤0.001
Sex effect:							
Females (F)	42.31^{a}	220.40^{a}	178.09^{a}	553.95	3.14^{b}	1.36	7.19^{a}
Males (M)	40.67^{b}	212.57^{b}	171.91^{b}	554.92	3.27^{a}	1.36	6.68^{b}
SE	0.56	1.67	1.55	2.05	0.05	0.01	0.12
Probability (P)	P≤0.04	P≤0.001	P≤0.01	P≤0.74	P≤0.05	P≤0.80	P≤0.002

SE: Standard error, BWG: Body weight gain= LBW_{38d} - LBW_{10d}, FI: Feed intake, PI: Performance index= (LBW_{kg}/FCR) X 100, FC: Feed conversion= FI_{10-38} / BWG_{10-38}, GR: Growth rate ($LBW_{10} - LBW_{38}$)/ 0.5 ($LBW_{10} + LBW_{38}$). $^{a-c}$: Means within the same column with different superscript.

Table (3): Carcass traits of growing quails at slaughter as affected by treatment and sex (Main effects).

Item	Edible parts(g)	Dressing %	Dressed meat(g)	Meat %	Giblets(g)	Giblets %
Treatment effect:						
Control	155.89	75.45	79.65^{b}	38.54	12.74	6.20
Avilamycin	176.88	76.70	94.82^{a}	40.99	14.18	6.11
Turmeric1%	168.56	74.50	81.68^{b}	36.15	14.83	6.46
Turmeric3%	169.05	79.64	81.37^{b}	38.38	13.18	6.22
SE	5.74	1.57	3.75	1.41	0.83	0.34
Probability (P)	P≤0.12	P≤0.15	P≤0.04	P≤0.16	P≤0.31	P≤0.84
Sex effect:						
Females (F)	175.51^{a}	75.67	87.80	37.81	15.53^{a}	6.66^{a}
Males (M)	153.67^{b}	77.47	80.96	39.21	11.93^{b}	5.83^{b}
SE	4.06	1.11	2.65	1.00	0.59	0.24
Probability (P)	P≤0.01	P≤0.27	P≤0.09	P≤0.34	P≤0.01	P≤0.03

$^{a...c:}$ Means within the same column with different superscript ; NS: Not significant. SE: Standard error ; Edible parts(g) = Giblets weight(g) + Carcass weight(g)
Dressing % = (Edible parts(g) / LBW_{38}(g)) X 100 ; Dressed meat(g)= boneless meat(g)
Meat% =(Dressed meat(g) / LBW_{38}(g)) X 100.

Table (4): Carcass chemical composition of growing quails affected by treatment and sex (Main effects).

Item	Moisture%	CP%	Oil%	Ash%	NFE%
Treatment effect:					
Control	66.60	20.60	9.41	2.00	1.38
Avilamycin	66.93	20.34	9.42	1.99	1.32
Turmeric1%	66.30	20.69	9.62	2.07	1.32
Turmeric3%	66.39	20.47	9.89	1.87	1.38
SE	0.21	0.14	0.15	0.06	0.04
Probability (P)	P≤0.18	P≤0.35	P≤0.09	P≤0.19	P≤0.59
Sex effect:					
F	66.56	20.54	9.52	2.00	1.38
M	66.54	20.52	9.65	1.96	1.32
SE	0.15	0.10	0.11	0.05	0.03
Probability (P)	P≤0.92	P≤0.91	P≤0.38	P≤0.58	P≤0.18

SE: Standard error NS: Not significant.

Table (5): Serum biochemical indices at slaughter as affected by treatment and sex (Main effects).

Item	Total Chol mg/dl	HDL mg/dl	LDL mg/dl	VLDL mg/dl	RBS mg/dl	Tri G mg/dl	AST U/L	ALT U/L
Treatment effect:								
Control	189.64[a]	104.13	67.51[a]	18.01[b]	235.68[a]	124.79	99.12[a]	17.33[b]
Avilamycin	188.32[a]	99.96	64.15[a]	24.22[a]	233.53[a]	120.99	98.90[a]	21.83[a]
Turmeric1%	151.90[b]	102.55	32.55[b]	16.80[b]	198.49[b]	112.86	90.72[b]	17.77[ab]
Turmeric3%	159.76[b]	104.29	36.95[b]	18.53[b]	191.15[b]	92.55	83.57[c]	10.43[c]
SE	4.54	3.25	2.15	1.31	2.50	9.24	1.51	1.43
Probability (P)	P≤0.001	P≤0.77	P≤0.001	P≤0.005	P≤0.001	P≤0.10	P≤0.001	P≤0.003
Sex effect:								
Females (F)	178.53[a]	104.63	53.28[a]	20.62	211.97[b]	110.42	90.03[b]	14.92[b]
Males (M)	166.29[b]	100.83	47.30[b]	18.16	217.45[a]	115.18	96.13[a]	18.72[a]
SE	3.21	2.30	1.52	0.93	1.77	6.54	1.07	1.01
Probability (P)	P≤0.02	P≤0.26	P≤0.01	P≤0.08	P≤0.04	P≤0.61	P≤0.001	P≤0.02

Chol: Cholesterol, HDL: High density lipoprotein , LDL:Low density lipoprotein, VLDL: Very low density lipoprotein, RBS :Random blood sugar ,Tri G: Triglycerides, AST: Aspartate aminotransferase , ALT: Alanine aminotransferase. [a...c:] Means within the same column with different superscript . NS: Not significant, SE: Standard error.

Table (6): Antioxidant parameters and immune response as affected by different dietary treatments and sex (Main effects).

Item	Antioxidant parameters		Immune response		
Treatment effect:					
	GPx (nmol/min/ml)	**TBAR (nmol /ml)**	**IgG (mg/dl)**	**IgA (mg/dl)**	**IgM (mg/dl)**
Control	6.43[c]	1.86[a]	936.15[c]	175.53[c]	93.62[c]
Avilamycin	6.75[c]	1.76[a]	848.80[d]	159.15[d]	84.88[d]
Turmeric1%	8.28[b]	1.55[b]	1049.93[b]	196.86[b]	104.99[b]
Turmeric3%	9.43[a]	1.08[c]	1124.03[a]	210.76[a]	112.40[a]
SE	0.17	0.06	17.97	3.37	1.80
Probability (P)	P≤0.001	P≤0.001	P≤0.001	P≤0.001	P≤0.001
Sex effect:					
Females (F)	7.67	1.55	997.23	186.98	99.72
Males (M)	7.78	1.58	982.23	184.17	98.22
SE	0.12	0.04	12.71	2.38	1.27
Probability (P)	P≤0.53	P≤0.64	P≤0.42	P≤0.42	P≤0.42

GPX: Glutathione peroxidase ; TBAR: thiobarbaturic acid IgG, IgA ,IgM Immunoglobulins G,A,M ; SE: Standard error

[a...d:] Means within the same column with different superscript .NS: Not significant.

Table (7): Useful and harmful intestinal bacteria in growing quails as affected by different dietary treatments and sex (Main effects).

Item	Lactobacillus (log 10 cfug)	E coli (log 10 cfug)	Salmonella (log 10 cfug)
Treatment effect:			
Control	6.52[a]	8.40[a]	8.22[a]
Avilamycin	4.72[b]	5.19[c]	5.03[c]
Turmeric1%	6.92[a]	7.22[b]	6.95[b]
Turmeric3%	7.03[a]	6.85[b]	6.43[b]
SE	0.24	0.21	0.23
Probability (P)	P≤0.001	P≤0.001	P≤0.001
Sex effect:			
Females (F)	6.28	6.76	6.82
Males (M)	6.31	7.07	6.49
SE	0.17	0.15	0.16
Probability (P)	P≤0.89	P≤0.16	P≤0.16

E coli: Escherichia coli SE: Standard error

cfug: logarithm of colony forming unit per gram of digesta

[a...d:] Means within the same column with different superscript.

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الملخص العربى

الكركم كبديل فعال للمضادات الحيويه المحفزه للنمو في السمان الياباني النامي

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استخدم في الدراسه الحاليه اربع مجموعات من 180 كتكوت سمان عمر يوم واحد موزعة بأوزان جسم متساويةفي عمر 10 ايام إلى أربع مجموعات الاولي مجموعة مقارنه (مع عدم وجود إضافات) الثانيه مجموعة المضادات الحيوية (مجموعة مقارنه + جرعة دون علاجية من افيلاميسين 8 ملغم / كغم من العليقه) الثالثه مجموعة الكركم 1 ٪ (مجموعة مقارنه + مسحوق الكركم 1 ٪) الرابعه مجموعة الكركم 3 ٪ (مجموعة مقارنه + مسحوق الكركم3 ٪). استخدمت لاختبار إمكانية استخدام الكركم كمحفز نمو طبيعي بديل للمضادات الحيوية على السمان الياباني. النتائج التي تم الحصول عليها ملخصة على النحو التالي:

اضافه الكركم الي علائق السمان الياباني النامي بنسبه 1 و 3٪ يحسن النمو معطياتثقل وزن نهائي واعلي وزن مكتسب نهائي واقل مأكول من العلف وافضل معدل تحويل غذائي واعلي مؤشر اداء مقارنة مع عليقه المضاد الحيوي وعليق الكنترول الخاليه من الاضافات وكانت الافضليه لمجموعة الكركم 1%. ولم يكن لاضافه الكركم لعليقه السمان بأي من مستوياته اي تأثير علي صفات الذبيحه في حين اظهرت مجموعة المضاد الحيوي اعلي نسبه مئويه للحم المشفي. بينما جميع المؤشرات البيوكيميائية في الدم اعطت نتائج معنويه لصالح اضافه الكركم للعليقه فقد اظهرت المجموعات المعامله بمسحوق الكركم اقل كوليستيرول كلي واقل LDL ، RBS و AST مقارنه بمجموعه المضاد الحيوي او الكنترول. تأثرت مقاييس مضادات الاكسده فى الدم ومقاييس المناعه بشكل كبير بالمعامله فقد اظهرت مجموعات الكركم اعلي قيم ل GPX والاستجابات المناعية (IgG، IgA و IGM) وانخفاض TBAR مقارنه بالمضاد الحيوي والكنترول. البكتيريا المعوية المفيدة (Lactobacillus) في طيور السمان النامية زادت بشكل كبير عن طريق اضافه الكركم لعيقه السمان بمستوياته وكلا من E coli و Salmonella (البكتيريا المعوية الضارة) انخفضت بشكل ملحوظ عن مجموعة التحكم. أقل بكتيريا معوية مفيدة أو ضارة تم الحصول عليها من قبل مجموعة أفيلاميسين.

في الختام ، قد نخلص الي ان نسبه 1% أو 3% كركم تصلح للاضافه لعلائق السمان كبديل محفز للنمو عن المضاد الحيوي افيلاميسن.