J. of Animal and Poultry Production, Mansoura Univ., Vol 11 (6):223-228, 2020

Journal of Animal and Poultry Production

Journal homepage: www.japp.mans.edu.eg
Available online at: www. jappmu.journals.ekb.eg

Effect of Dietary Addition of Curcumin and Nano-Curcumin on Carcass Traits, Blood Haematology and Caecal Activity of Growing Rabbits Reared Under Heat Stress Conditions

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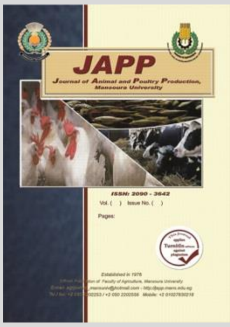

ABSTRACT

The present study investigated the effects of dietary curcumin or nano-curcumin on carcass traits, caecum activity, caecum microbial count and haematological parameters of growing rabbits reared under heat stress conditions. APRI line growing rabbits (n=100, 5-wk of age) were distributed to five equal groups (n=20/group). Rabbits in the 1st group were fed a control diet without any additives, whereas 2nd, 3rd, 4th and 5th groups were fed control diet supplemented with curcumin (25 or 50 mg), and nano-curcumin (2.5 or 5 mg)/kg diet up to 13-wk of age. Carcass traits, meat chemical composition, pH values of gastro-intestinal tract contents, caecum activity, caecum microbial counts, and haematological parameters were determined at 13-wk of age. The mean temperature-humidity index during the experimental period was 29.54. Results showed curcumin or nano-curcumin levels increased (P<0.05) count of red blood cell and platelets, and caecum activity parameters (ammonia nitrogen and volatile fatty acids), while reduced (P<0.05) white blood cells, total microbial and *E. coli* counts in the caecal content. Haematocrit value increased (P<0.05) only by nano-curcumin groups (2.5 or 5 mg/kg diet). Carcass traits, chemical composition of meat and pH values of gastro-intestinal tract contents were not significant among groups. Dietary curcumin or nano-curcumin levels, as natural antioxidants and growth promoters, can alleviate adverse impacts due to heat stress on caecal activity and health status without affecting the carcass traits of growing rabbits. Generally, the dietary addition of curcumin in nano-particles form could contribute to produce healthy and high-quality rabbit's meat for human consumption.

Keywords: Rabbits, phytogenic additives, nanoparticles, haematology, caecal activity

INTRODUCTION

Rabbits have great attention among different farm animal species due to several factors. Rabbits are characterized by production of white meat, and fast reproductive and high economic efficiencies (Basavaraj *et al.*, 2011; El-Ratel, 2017). As a result of high quality, reduced fat content and low cholesterol level in rabbit meat, rabbit production is considered an important source of animal protein for human consumption (Jones, 1990).

Recently, there is wide attention for adding necessary dietary supplements to maximizing production of rabbit meat by improving growth performance of growing rabbits (Hassan *et al.*, 2017; El-Kholy *et al.*, 2019). Rabbits in tropical regions are suffering from some environmental stresses, particularly heat stress, causing adverse effects on rabbit production (Daader *et al.*, 2018). Rabbits greatly hinder the loss of excess heat production because they have unfunctional sweat glands with dense fur. Exposure of rabbits to heat stress, leading to high cost for rabbit farmers, due decreasing to productive and reproductive efficiency (El-Ratel *et al.*, 2019). Also, under heat stress conditions, oxygen-derived free radicals increased, creating oxidative stresses (Daader *et al.*, 2018). In the rabbit industry, heat stress is an important stressor that affects productive performance, and the use of eco-friendly dietary additives to alleviate the negative impacts of heat stress remains a vital issue and increasing the rabbit production (Ayyat *et al.*, 2018; Khalil *et al.*, 2019). Supplementation of natural antioxidants from herbal sources as phytogenic, are accepted as a strategy for improving the utilization of nutrients, productive performance and health status of heat-stressed rabbits (Földešiová *et al.*, 2015; Ojo and Adetoyi, 2017). In animal nutrition, the positive effects of bioactive constituents in plants may affect the appetite and feed consumption, improve the secretion of endogenous enzymes for digestion, and increasing the immunity, and anti-microbial, anti-oxidant, and anti-viral activity (Kafi *et al.*, 2017).

Curcumin as natural antioxidants and growth promoters are a xanthophyll carotenoid isolated from a spice known as turmeric (Kotake-Nara *et al.*, 2001). This naturally produced carotenoid in curcumin has a primary antioxidant effect against oxygen free radicals as it can break the oxidant chain reaction by its conjugated structure (Sharma *et al.*, 2012). The curcumin has also antibacterial, immunomodulatory, anti-inflammatory, antimutagenic and anticancer properties (Partovi *et al.*, 2019). Low biological stability and poor bioavailability of curcumin due to poor absorption, rapid metabolism and fast systemic elimination (Anand *et al.*, 2007) have been major issues.

Nanotechnology, as a future technology, allow to use nano-particles for improve the bioavailable and the

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DOI: 10.21608/jappmu.2020.106505

soluble properties of curcumin, as a lipophilic compound (Ghalandarlaki *et al*., 2014). *In vivo* bioavailability, tissue distribution, and biological half-life are higher for nano-curcumin than for curcumin (Rahimi *et al*., 2016). The curcumin in nanoparticle form has been used in the form of nano-suspension, nano-emulsion, solid lipid NPs, and hydrogel NPs (Ghalandarlaki *et al*., 2014). Some researchers reported that dietary supplementation with curcumin in animals can improve growth performance by enhancing nutrient utilization (Bozkurt *et al*., 2012; Niu *et al*., 2019). Keeping these points in view, the present study was carried out to compare the effect dietary addition of curcumin (25 and 50 mg/kg) or nano- curcumin (2.5 and 5 mg/kg) diet on carcass traits, caecal activity and haematological parameters of heat-stressed growing rabbits.

MATERIALS AND METHODS

Experimental animals and Management:

This experiment was conducted by Faculty of Agriculture, Poultry Production Department, Damietta University, Egypt. APRI line growing weaned rabbits (n= 100) aged 5-wk and weighing 627.11±2.51 g initial live body weight (LBW) kept at a private rabbit farm, Dakahlia Governorate, were used in this study. Rabbits were distributed to five equal groups (20 rabbits in each) according to LBW. In the 1st group (G1), rabbits were fed on the control diet without any supplementation, while the control diets of the 2nd (G2), 3rd (G3), 4th (G4) and 5th (G5) groups were supplemented with 25 or 50 mg curcumin and 2.5 or 5 mg nano-curcumin (Sigma Company, Egypt) per kg diet, respectively. Rabbits of each group were housed in individual galvanized wire cages (35 × 35 × 60 cm), supplied with feeder and nipple of fresh water, and feeds were offered *ad libitum*. Rabbits in all groups were managed under the same managerial, hygienic and environmental factors. The control diet contained all requirements from essential nutrients of growing rabbits (De Blas & Mateos, 2010). Ingredients and chemical composition of the control diet are shown in Table 1. The curcumin and nano-curcumin were well mixed according to their levels. Feed amounts were weekly formulated and adjusted. During eight weeks (from 15th May to 9th July), as a growing period, ambient temperature, relative humidity and temperature-humidity index (Marai et al., 2001) were 32.77°C, 43.23% and 29.54, respectively.

Carcass traits:

At 13-wk of age, 5 rabbits from each group were chosen, weighed, fasted (12 h), and sacrificed. After scarification, skin with legs was removed and the internal organs were isolated, then the carcass was weighed. Weight of different parts of the carcass and body internal organs was estimated, then percentages of carcass weight and internal organs relative to LBW were calculated. Representative samples from meat were collected from the trunk of each rabbit, and then minced, dried (60ºC for 48 h), and grounded for approximate chemical analysis (AOAC, 2012).

Table 1. Ingredients and composition of basal diet of growing rabbits (as fed).

Items	Control diet
Ingredient	%
Berseem hay	30.05
Barley grain	24.60
Wheat brain	21.50
Soybean meal	17.50
Molasses	3.00
Di-calcium phosphate	1.60
Limestone	0.95
DL-Methionine	0.15
Sodium chloride	0.30
Minerals & vitamins (1)	0.35
Total	100
Analyzed composition (%, on DM basis)	
Organic matter	91.42
Crude protein	17.36
Crude fiber	12.37
Ether extract	2.23
Nitrogen free extract	59.46
Ash	8.58

1) Each 1kg contains on Vitamin A (150, 000 UI),Vitamin E (100 mg), Vitamin B1(10 mg), Vitamin K_3 (21mg), Vitamin B_2 (40mg), Vitamin B_6 (15mg), Vitamin B_{12} (0.1mg), Pantothenic acid (100 mg), Niacin (200 mg), Biotin (0.5mg), Folic acid (10mg), Choline chloride (5000 mg), Manganese (800 mg), Zinc (600mg), Iron (300 mg), Copper (40m g), Iodine (500 mg), Selenium (100 mg), and Cobalt (100 mg).

Caecal activity and pH values of GIT contents:

After sacrificing, samples from the caecal contents were taken and filtrated using an OP-110. Concentration of ammonia nitrogen (NH_3-N) and volatile fatty acids (VFAs) were determined according to Conway (1958) and Eadie *et al.* (1967), respectively. Total microbial and *Escherichia coli* (*E. coli*) counts in the caecal content were approved by American Public Health Association, APHA (1960) and Swennes *et al.* (2012), respectively. Also, values of pH for stomach, small intestine and caecal contents were measured by Radelkis pH-meter (Hungary).

Blood sampling:

The blood samples were harvested from the sacrificed rabbits (n=5/group), and placed in sterile tubes with anticoagulant for haematological parameters, including haemoglobin (Hb, mg/dl) concentration, haematocrit value (Ht, %), count of red blood cells (RBCs, $x10^6/mm^3$), white blood cells (WBCs, $x10^3/mm^3$), and platelets ($x10^3/mm^3$), mean corpuscular volume (MCV, μ3), mean corpuscular haemoglobin (MCH, pg) and mean corpuscular haemoglobin concentration (MCHC, g/dl) in the whole blood samples using Automatic Fully Digital Haematology Analyzer, BC-3000 Plus (Mindary, Bio-Medical Electronics Co., Ltd, Mahwah, NJ, USA).

Statistical analysis:

One-way analysis of variance (ANOVA) was used for statistical analysis of the obtained data as a completely randomized design (software package, SAS, 2002). The following model was use for parameters: $Y_{ij} = \mu + G_i + e_{ij}$ was used, where μ, G_i, e_{ij} represented the overall mean, groups (1-5), and residual error, respectively. Chi-square test was used for statistical analysis of carcass percentages. The significant differences among groups were set at P<0.05 by Duncan's multiple range test of Duncan (1955). The percentage values were transformed by arcsine values before analysis.

RESULTS AND DISCUSSION

Results

Carcass traits:

Effect of dietary inclusion of different levels of curcumin or nano-curcumin on carcass traits including relative weights of different carcass traits are summarized in Table 2. It clearly appears that neither curcumin (G2 and G3) nor nano-curcumin (G4 and G5) added at different levels in rabbit diets had significant effect on all carcass traits. The differences in pre-slaughter weight, and weight percentage of empty body, hot carcass, internal edible organs, inedible organs, trimmings and dressing percentages based on net carcass weight or plus edible organs weights, were not significant.

Table 2. Effect of curcumin or nano-curcumin levels on carcass traits of APRI growing rabbits at 13 weeks of age.

Item	Control (G1)	Curcumin levels		Nano-curcumin levels		SEM	P-value
		20 mg/kg diet (G2)	25 mg/kg diet (G3)	2.5 mg/kg diet (G4)	5 mg/kg diet (G5)		
Pre-slaughter weight (g)	1970.00	2015.00	2021.00	2016.00	2020.00	-	-
Empty body weight (g)	1780.40	1829.60	1836.80	1833.80	1837.00	0.4761	0.4182
Hot carcass weight(g)	1085.00	1109.20	1114.00	1113.30	1113.20	25.445	0.2989
Dressing (%)*	55.08	55.04	55.12	55.27	55.11	0.7440	0.4563
Dressing (%) **	60.94	60.62	60.64	60.71	60.60	0.8801	0.9784
Weight of edible organs (%):							
Head and ears	8.15	8.25	8.06	8.10	8.16	0.1033	0.8811
Liver	2.78	2.70	2.82	2.85	2.80	0.1245	0.9146
Kidney	0.58	0.59	0.60	0.62	0.59	0.053	0.9964
Heart	0.28	0.26	0.28	0.29	0.30	0.0151	0.1285
Spleen	0.05	0.05	0.05	0.05	0.05	0.0013	0.9893
Total	11.84	11.85	11.81	11.91	11.90	0.0870	0.8527
Weight of in-edible organs (%):							
Lung	0.78	0.77	0.82	0.84	0.78	0.0332	0.4813
Empty GIT	6.35	6.28	6.30	6.15	6.34	0.1748	0.6190
Testicles	0.31	0.33	0.31	0.31	0.32	0.0031	0.5113
Total	7.44	7.38	7.43	7.30	7.44	0.1143	0.3315
Trimmings (%):							
Skin	10.25	10.30	10.50	10.45	10.55	0.0546	0.8812
Four legs	2.85	2.98	2.93	2.88	2.95	0.1019	0.1257
GIT contents	9.62	9.40	9.21	9.04	9.06	0.0432	0.1342
Blood	2.92	3.05	3.00	3.15	2.99	0.0958	0.6804
Total	25.64	25.73	25.64	25.52	25.55	0.0281	0.2213

GIT: Gastro-intestinal tract.
*** Hot carcass weight/ Pre-slaughter weight x 100**
**** Hot carcass weight/carcass weight and edible organ weight x 100.**

Chemical compositions of meat:

Chemical composition of meat for growing rabbits treated with different curcumin or nano-curcumin levels at the end of the growing period (13-wk of age) are presented in Table 3. All levels of curcumin (G2 and G3) or nano-curcumin (G4 and G5) supplementation had no significant effect on chemical composition the heat-stressed growing rabbit's meat including crude protein, ether extract, ash and moisture.

Table 3. Effect of curcumin or nano-curcumin on meat composition of APRI growing rabbits at 13 weeks of age.

Item	Control (G1)	Curcumin levels		Nano-curcumin levels		SEM	P-value
		20 mg/kg diet (G2)	25 mg/kg diet (G3)	2.5 mg/kg diet (G4)	5 mg/kg diet (G5)		
Moisture	74.36	74.39	74.41	74.42	74.34	0.0400	0.5435
Crude protein	20.37	20.30	20.31	20.33	20.40	0.0500	0.5630
Ether extract	3.22	3.28	3.31	3.30	3.27	0.0380	0.4201
Ash	2.05	2.03	1.97	1.95	1.99	0.0401	0.3656

pH values of GIT contents:

Effect of dietary curcumin or nano-curcumin supplementation on pH of stomach, intestine and caecum contents of growing rabbits at 13 weeks of age are presented in Table 4. Adding different levels of CUR and nano-CUR in rabbit diets had insignificant ($P \geq 0.05$) effect on pH values. Values of pH in contents of stomach, intestine and caecum are within the normal range of growing rabbits.

Table 4. Effect of curcumin or nano-curcumin levels on pH values of gastro-intestinal tract contents of APRI growing rabbits at 13 weeks of age.

Item	Control (G1)	Curcumin levels		Nano-curcumin levels		SEM	P-value
		20 mg/kg diet (G2)	25 mg/kg diet (G3)	2.5 mg/kg diet (G4)	5 mg/kg diet (G5)		
Stomach pH	3.51	3.56	3.58	3.57	3.537	0.0320	0.5039
Intestine pH	7.25	7.34	7.36	7.42	7.35	0.1120	0.6080
Caecum pH	6.25	6.30	6.22	6.20	6.27	0.0790	0.5648

Caecal activity:

Caecal activity parameters, including concentration of NH_3-N and VFAs, and microbial counts (total and *E. coli*) for rabbits treated with curcumin or nano-curcumin at the end of growing period are presented in Table 5.

Concentration of NH_3-N and VFAs significantly ($P<0.05$) increased in curcumin (G2 and G3) and nano-curcumin (G4 and G5) groups as compared to the control (G1), being the highest for curcumin at level of 2.5 mg/kg diet. The observed reduction of total count of bacteria significantly (P<0.05) in G2, G3, G4 and G5 as compared to G1 was in parallel with decreasing in harmful bacteria count, particularly *E. coli,* which may enhance the condition of microbial fermentation in the caecum in term of increasing NH_3-N and VFAs concentrations in all curcumin and nano-curcumin treatments.

Table 5. Effect of curcumin or nano-curcumin supplementation on caecal activity of APRI growing rabbits at 13 weeks of age.

Item	Control (G1)	Curcumin levels		Nano-curcumin levels		SEM	P-value
		20mg/kg diet (G2)	25mg/kg diet (G3)	2.5mg /kg diet (G4)	5 mg /kg diet (G5)		
Caecum activity							
NH_3-N (mg/100 g)	13.38^c	19.02^b	19.19^{ab}	19.27^a	19.14^{ab}	0.0610	0.0001
VFAs (mEq/100 g)	6.52^b	11.38^a	11.35^a	11.53^a	11.32^a	0.0885	0.0001
Microbial counts							
Total bacteria log^{-1}cfu/ml	5.81^a	5.20^b	5.29^b	5.26^b	5.37^b	0.0565	0.0003
E. coli log^{-1}cfu/ml	7.21^a	6.08^b	6.35^b	6.37^b	6.44^b	0.1515	0.0039

NH_3-N: ammonia nitrogen, VFAs: volatile fatty acids and *E. coli: Escherichia coli*.
Means in the same row with different letters differ significantly (P<0.05).

Blood haematological parameters:

The influences of curcumin or nano-curcumin supplementation on some haematological parameters of rabbits are shown in Table 6. Count of RBCs significantly (P<0.05) increased, while WBCs and platelets significantly (P<0.05) decreased by curcumin (G2 and G3) or nano-curcumin (G4 and G5) levels compared with the control diet (G1). Hematocrit value significantly (P<0.05) increased only by nano-curcumin groups (2.5 and 5 mg per kg diet). However, Hb concentration and erythrocytic indices (MCV, MCH and MCHC) were not affected by curcumin or nano-curcumin groups. In comparing treatment groups, curcumin in nano-particles form showed a more positive effect on most haematological parameters than curcumin in natural form. Effect of nano-curcumin in G4 had superiority in comparing with G2 and G3 or with G5.

Table 6. Effect of curcumin or nano-curcumin on haematological parameters of APRI growing rabbits at 13 weeks of age.

Item	Control (G1)	Curcumin levels		Nano-curcumin levels		SEM	P-value
		20 mg/kg diet (G2)	25 mg/kg diet (G3)	2.5 mg/kg diet (G4)	5 mg/kg diet (G5)		
RBCs (×10^6/mm^3)	5.87^c	5.99^b	6.25^b	6.64^a	6.54^a	0.051	0.0001
WBCs (×10^3/mm^3)	7.93^a	7.76^b	7.56^c	7.16^d	7.27^d	0.046	0.0001
Platelets (×10^3/mm^3)	262.40^a	226.80^b	221.60^b	187.20^d	199.80^c	2.699	0.0001
Haemoglobin (mg/dl)	12.61	13.28	13.20	14.12	13.60	0.662	0.6015
Hematocrit (%)	40.29^c	45.20b^c	43.80^{bc}	50.80^a	49.16^b	1.772	0.0033
Erythrocytic indices							
MCV (μ3)	62.47	62.20	62.80	63.00	62.60	1.159	0.9904
MCH (pg)	20.67	20.40	20.80	20.60	20.20	1.635	0.9991
MCHC (g/dl)	34.60	34.40	34.24	34.35	33.44	2.158	0.9962

RBCs: red blood cells, WBCs: white blood cells, MCV: mean corpuscular volume, MCH: mean corpuscular haemoglobin and MCHC: mean corpuscular haemoglobin concentration.
Means in the same row with different letters differ significantly (P<0.05).

Discussion

Uncontrolled conditions of heat stress can evoke multiple changes in animal biology and physiology (Ducray *et al.*, 2016). In rabbit industry, heat stress is one of the important stressors affecting the productive performance, and usage of eco-friendly additives in the diet is essential for elimination of the harmful effects of heat stress on rabbit production (Ayyat *et al.*, 2018). Therefore, the present study was conducted to evaluate the beneficial roles of curcumin and nano-curcumin, as natural feed additives on carcass traits, caecal activity and haematological parameters of growing rabbits reared under heat stress conditions. Regarding the insignificant effect of dietary curcumin or nano-curcumin groups on carcass traits of rabbits in the present study, turmeric supplementation in rabbits did affect percentages of carcass, edible and in-edible organ weights of rabbits (Alagawany *et al.*, 2016), dressing percentage (Peiretti *et al.*, 2010) under normal conditions. Similarly, Basavaraj *et al.* (2011) found that were no beneficial impacts of dietary inclusion of turmeric powder (0, 0.15 and 0.30%) on meat characteristics of growing rabbits under heat stress. Contrary, turmeric supplementation (*Curcuma Longa*) decreased kidney, skin and legs weights as well as dressing percentage of growing rabbits (Alagawany *et al.*, 2016). While increasing the dietary turmeric (6 g/kg) increased relative heart weight and carcass weight as compared to the control group of rabbits (Alagawany *et al.*, 2016).

The obtained results indicated that curcumin or nano-curcumin significantly increased caecal activity of rabbit, in terms of increasing production of NH_3-N and VFAs, leading to improvement of the microbial capacity within the GIT of rabbits. The degree of pH value in different GIT segments could be an establisher of the microbial loading which affects the nutritional digestion and absorption rates (Uddin *et al*., 2014; Celia *et al*., 2016). In the present study, a dietary addition with curcumin or nano-curcumin had no influence on pH scale for stomach, intestine, wand caecum contents of growing rabbits. The obvious unchanged caecal pH may be due to increasing production of VFAs and NH_3-N together. In general, these values are among the traditional normal physiological range in accordance with the age (Celia *et al*., 2016).

The observed increase in NH_3-N and VFAs concentrations in all groups in this study was in parallel with decreasing total count of bacteria causing by significant decrease in some harmful bacteria, particularly *E. coli*. In this way, Rahmani *et al.* (2018) found that supplementation of curcumin or nano-curcumin in diet decreased caecal *E. coli* population compared to those fed control diet of broiler. Also, dietary phytogenic additives improved caecal activity and microbial counts of growing rabbits (Khalil *et al.,* 2019).

Phytogenic materials contain some bioactive compounds like curcuminoids, curcumin, demethoxycurcumin and bisdemethoxycurcumin (Alagawany *et al.,* 2016), which have positive effects, such as the gut microflora regulation and the immune-response stimulation (Huang and Lee, 2018). The anti-microbial activity of curcumin on total microbial count of the caecal contents associated with reducing *E. coli* count may be attributed to the presence of bioactive compounds, inhibiting the microbial growth and interrupting some metabolic processes (Sin-Yeang *et al*., 2012). Accordingly, curcumin could be a promising natural anti-microbial agent, beside the anti-oxidant activity (Rahmani *et al.,* 2018). Beside the beneficial effects of curcumin or nano-curcumin administration on caecum activity and microbial count of rabbits, most haematological parameters were also improved, indicating impacts on health status of growing rabbits in term of higher viability rate of rabbits in treatment groups than in control (unshowed data). The assessment of these parameters could be useful in determining rabbit health status (El-Ratel *et al*., 2017). Blood hematological parameters are physiologically, pathologically, and nutritionally indicators in rabbits and can be potential to exhibit the impact of dietary additives (Alagawany *et al*., 2016). Under heat stress, Basavaraj *et al.* (2011) found that no beneficial impact of dietary inclusion of turmeric on haemoglobin and erythrocytic indices of rabbits. Also, Abdelnour *et al.* (2018) showed that dietary phytogenic supplementation did not affect the haemoglobin content and MCV in growing rabbits. Generally, the phytochemical contents in curcumin (polyphenolic, alkaloids, and flavonoids) has positive impacts on haematological measurements, which could be attached to the cellular plasma membranes to savaging the oxidative stress by protection of the body cells from the produced free radicals, and/or activating the antioxidant enzymes (Alagawany *et al.,* 2016; Tungmunnithum *et al.,* 2018). The contradicting results of curcumin and nano-curcumin on farm animals obtained in our study may be attributed to characteristics of curcumin in nano-form, bioactive components amount, the various doses of herbal plant, duration of experimental period, number of experimental animals and animal age (Alagawany *et al*., 2016). Although curcumin powder has beneficial effects as a medicinal herb, it has low biological stability and poor bioavailability due to poor absorption, and rapid metabolism and fast elimination from the body (Anand *et al*., 2007). The curcumin in nano-particles form enhancing the *in vivo* bioavailability properties (Shi *et al*., 2010) and improving solubility of lipophilic compounds in curcumin powder (Ghalandarlaki *et al*., 2014). Also, biological half-life is higher for nano-curcumin than for curcumin (Rahimi *et al.,* 2016).

CONCLUSION

Results of the current study suggest that dietary addition of curcumin or nano-curcumin, as a natural antioxidant, could be a better strategy to improve caecal activity and health status without adverse effects on carcass traits of growing rabbits under heat stress conditions. Effect of nano-curcumin at a level of 2.5 mg /kg diet had superiority in comparing with curcumin or with the high dose of nano-curcumin used in our study.

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تأثير اضافة الكركمين والنانوكركمين على صفات الذبيحة، نشاط الأعور وخصائص الدم الهيماتولوجية للأرانب النامية المرباه تحت ظروف الاجهاد الحرارى

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تهدف هذه الدراسة الى تقييم تأثير اضافة الكركمين او النانوكركمين على صفات الذبيحة، نشاط والعد الميكروبى فى الاعور وخصائص الدم الهيماتولوجية للارانب النامية تحت ظروف الاجهاد الحرارى. استخدم فى هذه التجربة 100 من الارانب الابرى النامية ذات عمر 5 اسابيع، قسمت الى خمس مجموعات متساوية (20 فى كل مجموعة). غذيت الارانب فى المجموعة الاولى على عليقة كنترول بدون اى اضافات، بينما غذيت الارانب فى المجموعة الثانية، الثالثة، الرابعة والخامسةعلى العليقة الكنترول مضاف اليها الكركمين (20 او 50 ملجرام) او النانوكركمين (2.5 او 5 ملجرام) لكل كجم عليقة، حتى عمر 13 اسبوع. بلغ متوسط دليل درجة الحرارة والرطوبة خلال الفترة التجريبية 29.54. تم تقدير صفات الذبيحة ، التركيب الكيميائي للحم ، وقيم الأس الهيدروجيني لمحتويات الجهاز الهضمي المعوي، نشاط الأعور والعد الميكروبي للأعور وخصائص الدم الهيماتولوجية عند عمر 13 أسبوع. بلغ متوسط درجة الحرارة والرطوبة خلال الفترة التجريبية 29.54. وقد اظهرت النتائج ان اضافة الكركمين او النانوكركمين بتركيزات مختلفة ادى الى زيادة معنوية (P<0.05) فى عدد كرات الدم الحمراء، الصفائح الدموية و نشاط الاعور (تركيز نتروجين الامونيا و الاحماض الدهنية الطيارة)، مع انخفاض معنوى (P<0.05) فى عدد كرات الدم البيضاء و محتوى الاعور من الميكروبات الكلية وبكتريا *E. Coli* الضارة مقارنة بالكنترول. أدت المعاملة بالنانوكركمين عند مستوى 2.5 و 5 ملجرام/كجم عليقة، الى زيادة معنوية (P<0.05) فى قيمة الهيماتوكريت. ولم يلاحظ وجود اى تأثرات معنوية للتركيزات المختلفة من الكركمين او النانوكركمين على صفات الذبيحة، التركيب الكيماوى للحم وقيمة الأس الهيدروجيني لمحتويات الجهاز الهضمي المعوي.نستخلص من هذه الدراسة : يمكن استخدام الكركمين سواء فى الصورة الطبيعية او على هيئة نانو (كمضاد اكسدة طبيعى و محفز للنمو) فى التخفيف من الآثار الضارة الناجمة عن الإجهاد الحراري على نشاط الاعور والحالة الصحية دون حدوث اى تأثرات سلبية على صفات الذبيحة للارانب النامية . بشكل عام، يمكن أن يساهم إضافة الكركمين في شكل جزيئات النانو الى العليقة في إنتاج لحم أرانب صحي وعالي الجودة للاستهلاك البشري.