IMPACTS OF ENRICHING GROWING RABBIT DIETS WITH CURCUMIN AND *CHLORELLA VULGARIS*MICROALGAE ON GROWTH PERFORMANCE, PHYSIOLOGICAL RESPONSES, CARCASS TRAITS AND ANTIOXIDANT INDICES

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SUMMARY

The aim of the current study was to investigate the effects of curcumin (CUR) and Chlorella vulgaris (CV) on growth, blood constituents and carcass characteristics of growing rabbits. Healthy 36 growing rabbits at 32 d of age were selected for this study and separated randomly into three similar groups (n = 12). The 1st group fed a basal diet (control). The 2nd and the 3ed groups were received 50 mg CUR / kg body weight and 500 mg CV/ kg body weight, respectively. Results showed that feed intake and growth rates increased (P ≤ 0.05) by using 50 mg CUR and 500 mg CV /kg diet, with significantly improvement in feed conversion ratio. There were no changes on albumin, globulin, urea and creatinine concentrations among treatments. However, significant decrease in total cholesterol and triacylglycerol in CUR and CV groups. Moreover, triiodothyronine, thyroxine, reduced glutathione and glutathione peroxidase were higher in CUR and CV groups compared to the control group. Additionally, significant increases were observed for carcass treats, including the weight of hot carcass, carcass yield, organs weights and carcass parts. Also, the highest value (P < 0.05) of economic efficiency, net revenue and relative economic efficiency was recorded in rabbits fed diet supplemented with CUR and CV. The presented results concluded that CUR and CV supplementation improve feed intake, blood biochemistry, growth performance, carcass treats and economic efficiency in rabbits under New Valley conditions in Egypt.

***Keywords*: Curcumin, Chlorella vulgaris, Productive performance, Blood parameters, Rabbits**

INTRODUCTION

Rabbits are considered the most successful agricultural industry, which provides premium animal products with unique qualities, particularly quick growth, and sexual maturity with high fertility, and high carcass meat gain (Gorlov *et al.,* 2020). In the European Union since 2006 using antibiotics to promote growth in farm animals has been banned (Millet and Maertens, 2011). With increasing consumer awareness, the need for natural and safe supplements has arisen to achieve superior livestock production outcomes, hence, growth promoters from herbal plant extracts are widely used nowadays (Zeweil *et al.,* 2016), ensuring the safety and better quality of the products of animals (Abd El-Hack *et al.,* 2022).

Turmeric is a herbal plant (*Curcuma longa*) of the ginger family (Zingiberaceae) of many medical benefits(Pawar *et al.,* 2014).There were three phenolic compounds of turmeric powder curcumin (CUR), demethoxycurcumin and bisdemethoxycurcumin that could be enhancing the antioxidant activity of animals (Balasubramanyam *et al.,* 2003).Al-Sultan and Gameel(2004) showed that CUR can accelerate the fats emulsification by stimulating the bile production so that the fat digestion process will be more optimal. CUR as natural antioxidants, growth promoters, immunomodulatory, antibacterial, antimutagenic and anti-inflammatory properties beside it is have a xanthophyll carotenoid effect against oxygen free radicals as it can break the oxidant chain reaction by its conjugated structure (Partovi *et al*., 2019). Some of the previous studies reported that fed diets supplementation with CUR and curcuminoids in animals can increase growth rates by improving the utilization of nutrient (Al-Sultan and Gameel, 2004). Moreover, Astawa *et al.* (2016) stated that fed diets supplemented with the turmeric extract at 0.04 ml/kg had improved digestibility coefficient of organic matter and crude protein compared to the control group.

Algae are contents of carbohydrates, lipids, proteins, minerals, vitamins and bioactive beside it be a sustainable source of food and energy in the future. Furthermore, animal received diets supplemented with algal products have improved performance and meat goodness in ruminants and non-ruminants (Madeira *et al.,* 2017). The dry *chlorella vulgaris* (CV) contents are protein (50 - 60%), lipids (up to

80%) and carbohydrates (12 - 57%) such as other sources, e.g., yeast, soy four, and milk (Chisti, 2007). Also, chlorella biomass provides basic nutrients, pigments, minerals, vitamins, and pro vitamins (Kotrbáček *et al*., 2015). Chlorella has been proposed as primary ingredients or dietary supplements to enhance the performance and health of animals. In this sense, rabbits fed diets inclusion chlorella showed better growth performance (Sikiru *et al*., 2019), immunity (Lesyk *et al*., 2013) and antioxidants (Abdelnour *et al*., 2019).

Dietary supplementation of CV in rabbits has shown significant benefits. At inclusion levels of 200-500 mg/kg body weight, CV improved growth performance, feed utilization, and antioxidant status in rabbits (Sikiru *et al.*, 2019). Also, a comparative study found that CV at 300 or 500 mg/kg diet improved growth, nutrient utilization, intestinal efficacy and antioxidant status in rabbits (El Basuini *et al.*, 2023). These studies collectively demonstrate that CV supplementation at 300-500 mg/kg is effective in enhancing rabbit performance and antioxidant defenses. On the other hand, CUR supplementation in rabbit diets has shown promising effects on various aspects of rabbit health and performance. At 50-100 mg/kg body weight, CUR demonstrated anticoccidial properties, reducing Eimeria spp. oocyst excretion (Cervantes-Valencia *et al.*, 2015). Dietary inclusion of 100-150 g/t CUR upregulated antioxidant-related genes and improved caecal microbiota, particularly increasing beneficial *Lactobacillus* species (Zhao *et al.*, 2024). Considering that inclusions above this rate would substantially increase diet costs, we selected CV and CUR inclusion levels of 500 mg and 50 mg /kg body weight for this study.

So, this study investigated the influence of CUR or CV microalgae as feed additives on growth performance, physiological responses, carcass traits and antioxidant capacity of New Zealand White (NZW) rabbits during growing period under New Valley conditions in Egypt.

MATERIAL AND METHODS

Materials used:

a) *Chlorella vulgaris* (CV): microalgae were obtained from the algal biotechnology unit, National Research Centre (Egypt).

b) *Curcumin: high purity CUR powder was purchased* from Delta Spice Egy (Egypt).

Animals, experimental design, and housing environment:

Thirty-six unsexed NZW rabbits aged 32 days, within an average body weight (BW) of 633.9 ± 12.5 g were taken in this experiment. Rabbits were randomly distributed into three similar groups (n = 12, 4 replicates in each group with three rabbits in each replicate). The 1st group fed a basal diet (control). The 2nd and the 3rd groups received 50 mg CUR/ kg BW and 500 mg CV/ kg BW, respectively. The average ambient temperature was 18-26°C, the average relative humidity was 11-16% and the daily photoperiod was a 16:8 h light-dark cycle with a semi-continuous lighting program. The basal experimental diet was formulated and pelleted to meet the nutrient requirements of rabbits, according to NRC (1977). The ingredients of the basal experimental diet and the composition of the basal diet are shown in Table (1). The pelleted diets and freshwater were provided *ad libitium*. All rabbits were accommodated to the experimental conditions for seven days before the beginning of the experiment, as adaptation period, and fed on the control diet.

Table 1. Feeding redients and chemical determined composition of the basal diet

Ingredients	(kg/ton)	Chemical composition (%)	Basal diet
Yellow corn	120.0	Crude protein	17.2
Barley	140.0	Crude fiber	13.6
Molasses	30.0	Ether extract	2.8
Alfalfa hay	350.0	Nitrogen free extract	56.8
Wheat bran	150.0	Ash	9.6
Soy bean meal 44%	190.0		
Dicalcium phosphate	6.0		
Limestone	6.0		
Sodium chloride	4.0		
Vitamin and minerals premix	4.0		

Growth performance:

Animals were weighed individually when the trial started and at four week intervals (from 32 to 90 days of age). Feed consumption was determined daily and the feed conversion ratio (FCR) was computed as the ratio of feed consumed (g) to weight gain (g). During the experiment, there was no mortality in growing rabbits. The relative growth rate (RGR) where Wi and Wf denote the rabbit weights at the beginning and completion of the trial, respectively

$$RGR = \frac{(wf - wi)}{\frac{1}{2}(wi + wf)} x100$$

Blood sampling and analyses:

On the 90st day of age, five rabbits per treatment were randomly selected for blood sampling for biochemistry indices assessment. Blood samples were obtained from the marginal ear vein using five ml gauge syringes. Blood samples were left for two hours at room temperature to clot and centrifuged at 2500× for 10 min at 4°C. Sera samples were then

harvested into sterile tubes and refrigerated until use. Serum was analyzed for total protein (TP), albumin (Alb), glucose (Glu), triacylglycerol (TG), total cholesterol (TC), high density lipoprotein cholesterol (HDL-c), low density lipoprotein cholesterol (LDL-c), urea (BU), creatinine (Cr), alanine amino transferase (ALT) and aspartate amino transferase (AST). Direct radioimmunoassay (RIA) technique was performed for determination of thyroid hormones. The concentrations of thyroxine (T_4) and triiodothyronine (T_3) were analyzed according to Barker and Silverto (1982). Cortisol (Cort) concentration was assayed by enzyme linked immunosorbent assay (ELISA) method as described by Munro and Lasley (1988). Thiobarbituric acid reactive substance (TBARS) was guantified by (Łukaszewicz-Hussain *et al*., 2007) method. Nitric oxide (NO) assay was carried out according to (Montgomery and Dymock, 1961). Reduced glutathione (GSH) content was determined according to (Giustarini *et al*., 2017). The activity of glutathione peroxidase (GPx) was determined according to (Chiu *et al*., 1976).

Slaughter traits:

Ultimately, 15 rabbits (five rabbits/group) were taken for slaughter. Rabbits were fasted for 12 hours. Then, the selected rabbits were individually weighed (pre-slaughter weight [PSW]) and were immediately sacrificed within three h. After complete bleeding, skin, distal part of legs, urinary bladder, genitals, and digestive tract were removed. The hot carcass (HC) and internal organs (spleen, heart, liver, kidneys, and lungs) were weighed. Carcass parts (head, shoulders, legs, thorax, and loin) were also immediately weighed. The carcass yield was calculated as follows:

$$\text{Carcass yield} = \frac{HC}{PSW} X100$$

Economic efficiency:

The prices of the ingredients and medicinal plants used in the experiment were estimated according to the market price during the study period for the economic evaluation of the feed.

Selling revenue = body weight gain per rabbit X price of kg for live BW.

Net revenue = selling revenue – feed cost.

Economic feed efficiency (EFE)=

$$(\frac{net\ revenue}{feed\ efficiency})X100$$

Relative economic efficiency (REE), assuming control treatment = 100%

Statistical analysis:

Data were analyzed using SAS software (SAS Institute, 2004). Differences among groups were tested for significance by Duncan test (Duncan, 1955).

The model used was $Yij = \mu + A_j + e_{ij}$

Y_{ij} = Observation traits, μ = Overall mean,

A_j = Experimental treatment e_{ij} = Random error

RESULTS AND DISCUSSION

Growth performance:

Data of NZW rabbits as affected by addition of CUR and CV are presented in Table (2). Rabbits fed diets supplemented with CUR and CV exhibited significantly higher ($P<0.05$) value of final BW, g (FBW), total weight gain, g (TWG), average daily gain, g (ADG), total DM intake, g / h(TDI), daily DM intake, g / h (DDI), as well as better FCR compared with control group. Conversely, there were no changes among treatments regarding initial BW, g (IBW). This study found that fed diets inclusion CUR and CV improves the growth rates due to the improvement could attributed to the bioactive compounds in crude protein and ether extract. Enhancing the digestion nutrients in the gut of birds is one potential mechanism by which promotes growth (Kumar *et al.*, 2017). Also, it's an antibacterial and antioxidants which may enhance digestion of carbohydrates, fat, and protein by raised the secretion of amylase, lipase, and protease enzymes (Utami *et al*., 2020). This finding is in the line of those indicated by Sikiru *et al*. (2019) who reported that adding 200 and 500 mg CV /kg diet in rabbits' diet increased rabbit's FBW and FI. On the other trend, CUR supplementation could enhance the growth performance and feed efficiency of piglet (Moniruzzaman *et al*., 2021).

Table 2. Growth performance of growing New Zealand White rabbits as affected by addition of curcumin and *Chlorella vulgaris*

Parameter	Experimental rations			±SEM	P-values
	Control	Chlorella	Curcumin		
Total number of rabbits	12	12	12	--	--
Growth performance					
Initial body weight,g	634.6	632.9	634.2	2.09	0.9486
Final body weight, g	1824.6[b]	1865.0[a]	1859.6[a]	6.59	0.0225
Total weight gain, g	1190[b]	1232.1[a]	1225.4[a]	6.43	0.0136
Average daily gain, g	23.8[b]	24.6[a]	24.5[a]	0.13	0.0136
Total DM intake, g / h	4576.3[b]	4585.0[a]	4582.5[a]	1.08	0.0017
Daily DM intake, g / h	91.5[b]	91.7[a]	91.6[a]	0.02	0.0017
FCR	3.85[a]	3.72[b]	3.74[b]	0.02	0.0188
RGR	96.8[b]	98.6[a]	98.3[ab]	0.32	0.0437

[a,b] Means in the same row lacking a common superscript differ significantly ($P<0.05$).FCR, feed conversion ratio: RGR, relative growth rate: DM, dry mater.

Blood biochemistry and antioxidant status:

Blood biochemistry of growing NZW rabbits as affected by addition of CUR and CV are presented in Table (3). Results showed no changes among groups in blood biochemistry expect TC and TG that showed significantly higher (P<0.05) in the control group compared tothe CUR and CV groups. The lower levels of TC and TG could be attributed to CUR and CV and may be due to CUR that enhancing bile production leading to increased fat digestion (Al-Sultan and Gameel, 2004). Moreover, CUR reduced TC due to it carries fat from the liver to the blood vessels and stimulate arterial cholesterol deposition (Obodo *et al.,* 2013). Moreover, the amount of antioxidant such aβ-carotene, phycocyanin, sulfated polysaccharide, and linolenic acid in CV can be decrease the plasma lipid levels (Nagaoka *et al*., 2005). This finding agrees with that obtained by Panda *et al.* (2009) who indicated that turmeric supplementation in rabbit diets reduced TC. Similarly, El-Ratel *et al.* (2020) mentioned that rabbits fed diets supplemented with CUR reduced TC and TG levels in blood. Moreover, Choi *et al.* (2017) noted that decreased serum lipid profiles, TC and LDL-cinbroilers fed diets inclusion CV.

CUR can reduce TC and TG by various theories. First, it hinders proprotein convertase subtilisin/kexin type 9 so enhance LDL-c uptake to the liver to be metabolized (Majeed *et al.,* 2021). Likewise, it promotesremoval of the cholesterol from the macrophages via an increase in the cholesterol efflux regulatory protein(Singh *et al.*, 2021).It also inhibits cholesterol biosynthesis by preventing the activity of 3-hydroxy-3-methylglutaryl-CoA synthase enzyme (Zingg *et al.*, 2013). It restrains fatty acid synthesis by inhibition of sterol regulatory element binding protein-1c (Pan *et al.*, 2022).

Further, the hypocholestermia and hypotriglycerdemia effects of CV is attributed to fatty acids absorption competition due to high content of fiber, glycolipid, phospholipid and carotenoids in CV (Barghchi *et al*., 2023). It enhances cholesterol catabolismthrough the elevation of hepatic cholesterol7α-hydroxylase enzyme activity (Coelho *et al*., 2021). Moreover, CV regulates adenosine monophosphate-activated protein kinase and acetyl-CoA carboxylase enzymes that responsible for lipid metabolism (Chen *et al.*, 2021). CUR and CV have demonstrated significant lipid-lowering effects in animal and human studies (Um *et al.,* 2014 and Sherafati *et al.,* 2022). CUR supplementation in rabbits reduced TC, TG, LDL-c, and oxidized LDL-c levels (Um *et al.,* 2014). Similarly, CV supplementation in humans significantly decreased TC and LDL-c levels, with optimal effects observed at dosages between 0-1500 mg/day (Sherafati *et al.,* 2022). In rats fed a high-fat diet, CV reduced serum and liver lipid concentrations while increasing fecal lipid excretion (Lee *et al.,* 2008). Both compounds exhibited anti-inflammatory properties and modulated gene expression related to lipid metabolism (Um *et al.,* 2014 and Lee *et al.,* 2008). These findings suggest that CUR and CV may have long-term health benefits by improving lipid profiles and reducing cardiovascular risk factors

Table 3. Blood biochemistry of growing New Zealand White rabbits as affected by addition of curcumin and *Chlorella vulgaris*

Parameter	Experimental rations			±SEM	P-values
	Control	Chlorella	Curcumin		
Total protein (g/dl)	6.23	6.27	6.63	0.153	0.6014
Albumin (g/dl)	3.77	3.87	3.70	0.058	0.6072
Globulin (g/dl)	2.47	2.40	2.93	0.136	0.2904
A/G Ratio	1.54	1.64	1.28	0.077	0.1718
Alanine amino transferase (U/I)	55.00	44.33	49.33	6.363	0.8517
Aspartate amino transferase (U/I)	43.00	34.33	37.00	3.636	0.7040
Urea (mg/dl)	35.93	35.70	35.30	0.938	0.9743
Creatinine (mg/dl)	1.86	1.82	1.90	0.023	0.4272
Total cholesterol (mg/dl)	115.33[a]	102.33[b]	98.00[b]	2.814	0.0137
Triacylglycerol (mg/dl)	87.00[a]	80.33[ab]	74.00[b]	2.007	0.0111
High density lipoprotein-cholesterol(mg/dl)	50.33	52.00	54.33	0.857	0.2088
Low density lipoprotein-cholesterol(mg/dl)	35.33	35.67	34.33	0.710	0.8027

[a,b] Means in the same row lacking a common superscript differ significantly (P<0.05).

Hormonal profile of data of NZW rabbits as affected by addition CUR and CV are showed in Table (4). The results showed that hormonal profile of T3 and T4 level were higher (P<0.05) in rabbits fed diets contained CUR and CV compared to rabbits fed control diet. In contrary, cortisol level was lower in rabbits fed supplemented with CUR and CV than rabbits fed control diet.

Table 4. Hormonal profile of growing New Zealand White rabbits as affected by addition of curcumin and *Chlorella vulgaris*

Hormone	Experimental rations			±SEM	P-values
	Control	Chlorella	Curcumin		
Cortisol (ng/L)	3.23[a]	2.47[b]	2.43[b]	0.047	0.0377
T3(µg/dL)	0.54[b]	0.79[a]	0.78[a]	0.088	0.0333
T4 (µg/dL)	1.38[b]	1.86[a]	1.82[a]	0.152	0.0296

[a,b] Means in the same row lacking a common superscript differ significantly (P < 0.05).T3, triiodothyronine; T4, thyroxine.

Serum antioxidant status of growing NZW rabbits as affected by CUR and CV addition are given in Table (5). Results showed that GSH and GPx were raised (P<0.05) in rabbits fed diet inclusion with CUR and CV compared to rabbits in control group. On the contrary, the lower level of NO was obtained in group of rabbits that fed supplemented diet with CUR and CV. While, there were no changes among groups in TBARS.

CUR is one of polyphenolic compound that can reduce oxidative damage to cells caused by peroxidation by inhibiting hydrogen peroxide, hydroxyl free radicals and lipid peroxidation. CUR activates nuclear factor erythroid 2-related factor-2, which regulates the enzymes required for maintenance the cellular hemostasis (Zhao *et al.*, 2024). CUR is an unique antioxidant, which contains a variety of functional groups, including the B-diketo group, carbon–carbon double bonds, and phenyl rings containing varying amounts of hydroxyl and methoxy substituents (Menon and Sudheer, 2007). Further, presence of benzene ring in chemical structure of CUR enhances the reactive oxygen species elimination (Baratzadeh *et al.*, 2022)., increased serum antioxidant in rabbits could attributed to fed the CUR and maybe it has large amount of antioxidant (Balasubramanyam *et al*., 2003).

CV is one of such antioxidants; it is a unicellular microalga and a rich source of polyphenols and carotenoids which has been reported for its capacity of reducing oxidative stress by up-regulation of antioxidant genes (Sikiru *et al.,* 2019). The antioxidant influence of CV is related to its higher content of vitamin C and E, lutein, carotenoids, tocopherol, lycopene, and omega-3-fatty acids (Moradi *et al.*, 2021). In addition existence of hydroxyl groups in CV, resulting in a decreased lipid peroxidation process (Barghchi *et al.*, 2023).CV inhabits formation of free radicals as well as decreased malondialdehyde due to of its carotenoids components; these carotenoids reduced free radicals using their double bonds to neutralize free radicals and capable of moderating the antioxidant geneexpression (Zuluga *et al.* 2017).

Our results agree with those obtained by Abdelnour *et al.* (2019) who reported that adding 1.0 g of CV to the diet of rabbits could improve their antioxidant activity. Similarly other previous study executed by El-Basuini *et al.* (2023) who mentioned that rabbits fed 300 or 500 mg CV /kg diet. Another study confirmed that broiler chicks fed ration supplemented with CUR could enhance their growth, feed utilization, antioxidant activity and immunity (Attia *et al.,* 2017).

Table 5. Serum antioxidant status of growing New Zealand White rabbits as affected by addition of curcumin and Chlorella vulgaris

Antioxidant Parameters	Experimental rations			±SEM	P-values
	Control	Chlorella	Curcumin		
GSH (mg/dl)	0.66[b]	1.09[a]	0.95[a]	0.068	0.0141
GPx (mg/dl)	0.27[b]	0.84[a]	0.94[a]	0.108	0.0051
TBARS (nM/ml)	0.25	0.23	0.21	0.010	0.2123
NO (nM/ml)	1.38[a]	0.63[b]	0.70[b]	0.134	0.0239

[a,b] Means in the same row lacking a common superscript differ significantly (P<0 .05). GSH, glutathione; GPx, glutathione peroxidase; TBARS, Thiobarbituric acid reactive substance; NO, Nitric oxide

Carcass traits:

Carcass traits of NZW rabbits as affected by addition of CUR and CV are summarized in Table (6).It was noted that rabbits that received CUR and CV significantly higher (P<0.05)in PSW,HC, carcass yield, head and legs weights compared to control group. While, the differences of heart, kidneys, lungs, spleen, shoulders, thorax and lion are not significant. The present results showed that rabbits supplemented with CUR and CV had higher carcass yield. This finding agree with Basavaraj *et al.* (2011) who reported that rabbits treated with CUR improved the carcass yield, edible and non-edible parts weight. Similarly, CUR inclusion in broiler diets significantly increases the FBW and improves the carcass traits(Oke, 2018).Contrary; rabbit fed CV had no effect on carcass traits (Abdelnour *et al.*,2019).Also, broiler fed diets inclusion CUR had no effect on the carcass traits(Abd El-Hack *et al.,* 2021).This study suggested that both CV and CUR can be effective dietary supplements for enhancing meat quality, animal growth and overall health in various livestock species.

Table 6. Carcass traits of growing New Zealand White rabbits as affected by addition of curcumin and *Chlorella vulgaris*

Parameter	Experimental rations			±SEM	P-values
	Control	Chlorella	Curcumin		
Preslaughter weight (g)	1821.7[b]	1866.7[a]	1855.0[a]	6.809	0.0012
Hot carcass weight (g)	924.7[b]	1007.3[a]	956.3[ab]	13.33	0.0211
Carcass yield (%)	50.8[b]	54.0[a]	51.5[ab]	0.615	0.0925
Organs weight (g)					
Liver	57.0[b]	70.1[a]	61.5 [b]	2.112	0.0185
Heart	3.4	3.7	3.8	0.153	0.2547
Kidneys	10.8	11.1	10.7	0.091	0.5811
Lungs	11.0	11.1	10.9	0.301	0.7248
Spleen	1.7	1.8	1.6	0.066	0.4832
Carcass parts (g)					
Head	85.0[b]	97.0[a]	99.2[a]	2.266	0.0046
Shoulders	168.7	180.7	177.1	2.515	0.1723
Legs	318.9	338.7	332.3	3.748	0.0989
Thorax	148.3	153.3	147.4	2.418	0.6651
Loin	200.3	237.6	203.7	7.633	0.0963

[a,b] Means in the same row lacking a common superscript differ significantly (P<0.05)

Economic efficiency:

Economic efficiency (EE) results of rabbits treated with CUR and CV were summarized in table (7). The highest value (P<0.05) of EE, net revenue and REE was recorded in rabbits treated with CUR and CV. The present data confirmed that rabbits fed CUR and CV achieved EE this may be related to the enhanced FCR and increase BWG. These results are in line with previous studies which concluded that herbal extracts improved the EE (Abd–ElGhany *et al.*, 2023). Also, Samy *et al*. (2023) found higher EE, net revenue and REE in broiler fed diets supplemented with CUR.

Table 7. Economic efficiency of diets supplemented with curcumin and *Chlorella vulgaris* of New Zealand White rabbits

Parameter	Experimental rations		
	Control	Chlorella	Curcumin
Total number of rabbits	12	12	12
Average feed intake/rabbit (kg)	4.576	4.585	4.583
Costing of one kg feed, (LE)	16.5	16.75	16.70
Feed cost (L.E/50 days)	75.50	76.80	76.55
Average body weight gain (kg)	1.190	1.232	1.225
Price /kg live body (LE)	125	125	125
Selling revenue (L.E)	148.75	154.00	153.12
Net revenue (L.E)	73.25	77.20	76.59
EEF (%)	97.01	100.52	100.07
REE (%)	100.00	103.62	103.15

EEF, Economic feed efficiency; REE, Relative economic efficiency

CONCLUSION

In the present study we observed that rabbits fed diets inclusion curcumin and *Chlorella vulgaris* could have beneficial effects on growth performance, reduced harm effect of cholesterol and triglyceride levels beside may be promote antioxidant indices as well as improved economic evaluation during growing period of rabbits.

ETHICS STATEMENTS

The rabbits involved in this study underwent evaluation and approval by the Research Ethics Committee of New Valley University, Egypt. The Ethical Committee protocol number is provided: (NVREC0236-2024-19).

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تأثير إثراء علائق الأرانب النامية بالكركومين وطحالب *Chlorella vulgaris* على أداء النمو والاستجابات الفسيولوجية وصفات الذبيحة وحالة مضادات الأكسدة

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أُجريت هذه الدراسة لتحديد تأثير إستخدام الكركومين وطحالب *Chlorellavulgaris* على أداء النمو ومؤشرات الدم وخصائص الذبيحة في الأرانب النامية. تم إستخدام ٣٦ أرنبًا في عمر ٣٢ يومًا في هذه الدراسة وتم تقسيمهم عشوائيًا إلى ثلاث مجموعات (ن = ١٢). تم تغذية المجموعة الأولى على نظام غذائي أساسي (مجموعة كنترول). تم إعطاء المجموعتين الثانية والثالثة ٥٠ مجم من الكركومين / كجم من وزن الجسم و٥٠٠ مجم من طحالب / *Chlorella vulgaris* كجم من وزن الجسم على التوالي. أظهرت النتائج أن تناول العلف ومعدلات النمو زادت ($P \leq 0.05$) باستخدام ٥٠ جم من الكركومين و٥٠٠ مجم من الطحالب/ كجم من النظام الغذائي، مع تحسن كبير في معدل تحويل العلف. لم تحدث أي تغييرات في تركيز الألبومين والجلوبيولين واليوريا والكرياتينين بين المعاملات. ومع ذلك، كان هناك إنخفاض كبير في الكوليسترول الكلي والدهون الثلاثية في المجموعات المعاملة. علاوة على ذلك، كانت T3 وT4 وGSH وGPx أعلى في مجموعات المعاملة مقارنة بالمجموعة الكنترول. بالإضافة إلى ذلك، لوحظت زيادة كبيرة في أداء الذبيحة، بما في ذلك وزن الذبيحة، ووزن الأعضاء، وأجزاء الذبيحة. كما تم تسجيل أعلى قيمة ($P <0.05$) للكفاءة الاقتصادية وصافي الإيرادات في الأرانب التي تغذت على نظام غذائي مكمل بـ الكركومين والطحالب. وخلصت النتائج المقدمة إلى أن مكملات الكركومين و*Chlorella vulgaris* تعمل على تحسين تناول العلف ومؤشرات الدم وأداء النمو والذبيحة والكفاءة الإقتصادية في الأرانب تحت ظروف الوادي الجديد.