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Effects Dietary of Arginine and *N*-carbamylglutamate on Heamatological and Performance Traits of Female Rabbits

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Abstract

The influences of NCG and Arginine on female rabbits were measured in this study and focused on feed intake, body weight, and daily weight increasing, then the various parameters, especially in the blood tests, have been checked for more clear information on their usage on rabbits production and health. The experiment lasted 9 weeks with 21 female rabbits aged 5-6 months and an average weight 830 ±22 g divided into three groups, each group three rabbits. The control group was fed a basal diet, and second group was fed Arginine (300mg/ orally daily), while the third group was fed NCG (300 mg/ orally daily).

The results of adding Arginine and NCG showed no significant ($P<0.05$) differences in body weight gain (BWG) and feed conversion ratio (FCR) among various dietary treatments recorded from one week to seven. In week eight there was a significant increase in weight gain between Arg and NCG group compared with control, the hematological test showed no significant in WBC, Hb, PCV, Thrm, RBC, group ARG and NCG compared with control. The ALT, AST and ALP enzyme appeared no significantly change($P<0.05$) as well as urea concentration and total protein .

It can be concluded that arginine and *N*-carbamylglutamate have a positive effect on rabbits' performance by improving the productive characteristics of rabbits and not having any harmful effects on the liver and kidneys.

Keywords: Arginine, NCG, rabbits, weight gain, Blood

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Introduction

To increases the efficiency of rabbits ,several mechanisms are used including adding supporting materials (Hussein and Atiyah, (2020). Mahmood ,2023;Kadhim,2024).Amino acids are essential for building the body and their use is necessary, one of these important and main essential amino acids is Arginine in the cycle of urea, nitric oxide (NO), and polyamine this regulates the metabolic system that is essential for growth, reproduction and health state (Tan *et al.*, 2011; Hussein and Atiyah ,2020; Atiyah *et al.*, 2020). Supplementation of Arg can support the action of the intestine of weaned pigs, (Hung *et al.*, 2008) raise immune response in rat models, (Qiaio *et al.*, 2005, Rin *et al.*, 2013) and activate the action of intestinal mucosa in newborn piglets (Zhang et al., 2013). Adding NCG to food increases the level of arginine in blood of pregnant rats (Zeng *et al.*, 2012) and sheep, and muscle (Zhang *et al.*,2016) protein synthesis in sow-reared piglets (Frank *et al.*, 2007) and protective from oxidative stress (Cao *et al.*, 2015; Xiao et al 2016), increased body weight of lamb newborn (Lassala *et al.*, 2010). Certainly, the low concentration of arginine will lead to harmful effects on the health status, including growth in feed is not sufficient to requirements because of high price and sometimes surviving with some abnormal condition like contamination by toxins (Miklif and Atiyah,2016). in 2014 the China National Feed Engineering Research Center classified the (NCG) as a feed additive and the Chinese Ministry of Agriculture, support the product as a promoter of arginine (Morris, 2009), productive trait (Feng *et al.*, 2018), NCG also characterized by a lower degree of degradation compared with Arginine in the rumen (Chacher *et al.*, 2012), which made it possess the ability and an important role in the function of this organ (Sampaio *et al.*, 2009). Many research proven that NCG is safe (Harper et al., 2009; Wu *et al.*, 2015), as well as to lowers its price compared with arginine and does not interact with other amino acids that are also used one of them Lysine, Tryptophan and Histidine (Wu *et al.*, 20014). N-carbamylglutamate (NCG) has been shown to improve intestinal growth and integrity, as well as the availability of dietary nutrients for whole BW gain (Liu *et*

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al., 2012; Wu *et al.*, 2012), increase fetus mass (Zhang et al., 2014), and encourage increase body weight and reproductive performance in sheep, bull, cows, sheep, goats, poultry, rabbits, and fish (Atiyah *et al* .,2020; Zang *et al.*, 2018; Feng *et al.*, 2018; Hu *et al.*, (2019) ; Mikhlif and Atiyah *et al.*, 2019 Wang *et al.*, 2019) respectively. Therefore, this study focused on the role of Arginine and N-carbamylglutamate (NCG) on productive performance and some biochemical tests in female rabbits.

Material and methods

Animals and experimental design

Twenty-one female rabbits were purchased at 5 -6 months of age Bucks (n=21, 830±22 g). After a 10-d adaption were randomly distributed into 3 groups (7 replicates each) with different treatments. The experiment lasted 9 weeks, rabbit in the control group were fed a commercial diet, the second treated group was given a control diet with 300 mg/head 300 µg/head Arginine orally, whereas the third group was given 300 mg/head N-carbamoyl glutamate (NCG) orally. The samples were collected from the rabbits, which were weighed every week and daily feed intake. This measurement was routinely done in the morning before giving the diet, and then the blood samples were directly withdrawn from the heart of all rabbits.

Hematological tests, such as liver enzyme function test, white blood cells (WBCs), differential count, red blood cells (RBC), and platelet, which were achieved for the whole blood picture, were done by hematology analyzer tool (BC- 2800Vet, Mindray, China). Conversely, the serum concentrations of alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), Total Protein and Creatinine were tested for liver and kidney enzyme functions by the automated chemistry-immune analyzer (7600-010, Hitachi, Japan).

Statistical analysis

This experiment decides to use a randomized block design. The data observations are analyzed, the one-way analysis of variance (ANOVA.) using Minitab (statistical software/ version 17.0).

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RESULTS

There was no significant difference in body weight during the trial period, but there was a significant increase in body weight gain between the NCG and Arg groups compared to the control (Table 1). The results demonstrate that adding arginine and NCG to normal nutrition has a beneficial impact on rabbit weight gain.

Table 1: Dietary effects of *N*-carbamylglutamate and arginine on the performance of female rabbits (body weight, weight gain, feed intake, and feed conversion ratio)[1]

Parameter	Weeks								
	1	2	3	4	5	6	7	8	9
Body weight (g)									
Control	865±42.2	912±49.5	988±56.4	1070±64.2	1114±61.1	1156±70.9	1187±68.3	1200±68.2	1222±66.4
NCG	829±24.1	874±35.4	906±39.3	947±47.8	973±51.5	1003±70.9	1044±59.5	1100±58.3	1144±47.1
Arg	847±4.74	886±12.5	991±38.9	1025±40.4	1067±43.0	1083±41.4	1139±39.1	1217±40.7	1257±42.4
P-value	0.677	0.757	0.359	0.269	0.195	0.192	0.234	0.322	0.337
Weight gain (g)									
Control	32.8±15.8	46.8±12.8	76.2±27.5	82.6±29.4	43.6±12.9	42.0±10.2	30.4±9.79	13.4±0.927^{b}	22.2±5.65
NCG	17.8±9.54	45.0±21.9	31.8±11.9	40.6±16.5	26.6±11.4	30.0±4.69	40.6±11.4	56.0±13.5^{a}	44.0±14.4
Arg	61.6±12.1	38.6±10.8	105±30.5	33.6±9.84	43.0±10.6	15.6±4.09	56.0±17.9	78.0±9.85^{a}	39.4±6.91
P-value	0.086	0.929	0.149	0.221	0.523	0.056	0.427	0.002	0.289
Feed intake (g)									
Control	324±60.8	343±29.3	427±63.1	431±60.6	386±12.3	352±28.4^{a}	311±20.4	325±15.6	313±24.4
NCG	385±45.5	351±30.6	387±28.9	381±23.7	300±49.9	272±19.2^{b}	299±15.6	331±16.8	305±11.8
Arg	305±39.7	319±17.6	314±22.1	337±15.8	305±21.6	286±11.6^{ab}	287±17.6	344±15.4	321±20.1

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P-value	0.506	0.670	0.199	0.266	0.147	0.043	0.659	0.719	0.839
FCR (g:g)									
Control	0.09±0.04[ab]	0.14±0.04	0.19±0.07	0.21±0.08	0.11±0.03	0.12±0.03	0.11±0.04	0.04±0.003[b]	0.07±0.01
NCG	0.05±0.02[b]	0.13±0.06	0.08±0.04	0.11±0.05	0.15±0.12	0.11±0.02	0.14±0.04	0.17±0.04[a]	0.15±0.05
Arg	0.19±0.03[a]	0.13±0.04	0.32±0.08	0.09±0.03	0.14±0.03	0.05±0.01	0.19±0.06	0.23±0.02[a]	0.12±0.010
P-value	0.023	0.940	0.067	0.333	0.902	0.067	0.478	0.002	0.234

[1] Mean ±SEM, each value is the average of 7 rep with 1 animal each (n=7)

[a-b] Values within columns with different superscripts are significantly different at $P<0.05$

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Feed intake did not differ substantially (P<0.05) across the various dietary regimens throughout 9 weeks (Table 1), demonstrating that arginine and NCG supplementation had no effect. During the trial, however, the feed conversion ratio (FCR) did not distinguish (P<0.05) across the three dietary regimens (Table 1). The addition of arginine and NCG to the basal diet (T1 and T2) did not affect FCR in the current investigation.

Hematological values

The hematological values, Hb, PCV, Thrm, RBC, WBC, Lymph, Mono, Neutro, and Acido, revealed no significant difference (P<0.05) in NCG and Arg compared with control.

Biochemical parameters: The total serum protein in all groups were a non-significant difference (P<0.05) from that of NCG and ARG, while it remained comparable to that of control. (Table 2)

Table 2: Effects of dietary *N*-carbamylglutamate and arginine on haematological values of rabbits

	Treatment			
	Control	NCG	Arg	P value
Hb	13.3±0.09	13.5±0.47	13.2±0.79	0.904
PCV	0.05±0.009	0.17±0.07	0.14±0.06	0.300
Thrm	93±8.75	292±104	241±139	0.383
RBC	5.50±0.128	5.96±0.16	5.38±0.42	0.338
WBC	4.39±0.32	6.75±0.61	6.01±0.86	0.059
Lymph	33.6±1.21	28.8±1.46	30.8±1.15	0.062
Mono	3.2±0.37	3.2±0.58	4.6±0.67	0.167
Neutro	62.4±1.63	63.4±2.54	61.2±0.853	0.688
Acido	3.2±0.37	2.4±0.51	3.0±0.45	0.445
Urea	47.4 ±2.73	38.4±3.44	50.2±4.75	0.34
Protein	8.0±0.5	7.9±0.1	8.3±0.5	0.711

[1]Mean±SEM, n=7

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The Aspartate Aminotransferase (AST), ALP and Alanine aminotransferase (ALAT) activities in ARG and NCG groups were not significant (P<0.05) change comparable to control.

Table 3: Effects of dietary *N*-carbamylglutamate and arginine on liver enzymes of rabbits (Mean ±SEM, n=7)

	Treatment			
	Control	NCG	Arg	P value
ALT	66.8±8.3	57.8±7.8	83.2±5.0	0.077
AST	8.6±2.6	9.2±1.01	15.8±5.1	0.261
ASP	16.6±2.9	10.3±2.3	13.1±2.6	0.275

[1]Mean±SEM, n=7

Discussion

There are no previous studies on the effect of adding NCG on the productive traits of rabbits, but there are on the effect of arginine, so that study is the first in this field.

In the present study, no significant difference in DMI was noted among treatments, in the first 7 weeks indicating that NCG did not affect in rabbits. This is similar to (Chacher *et al.*, 2012) who found in their work in cows that these traits did not change after adding the NCG to the diet. In week eight there is a significant increase between Arg and NCG groups compared with control this confirms that continuing to add this material will gradually improve these qualities.

It may improve growth hormone (GH) and insulin-like growth factor I (IGF-I), (Palencia, et al., 2018; Sampaio *et al.*, 2009) showed the addition of NCG increases arginine concentrations in maternal plasma, thus improving fetal growth, by promoting higher birth weight.

This indicates that giving NCG has positive effects on raising production efficiency, there are other studies conducted on farm animals by (Zhang *et al.*, 2014) on pigs and (Chacher *et al.*, (2014)) on cows also noted it by (Wu *et al.*, 2015) in mice (Liu *et al.*, 2012; Frank *et al.*, 2007) confirm that synthetic arginine and concentrations were increased after addition of NCG.

Several studies comparing the addition of arginine alone or with NCG found that there are clear positive indications for the

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presence of a material such as NCG that would raise the concentrations of the utilization of arginine in supporting the productive characteristics of farm animals. This conforms to (Wu *et al.*, 2012; Zhang *et al.*, 2015) as both are paramount importance in this and several researchers also agreed with them in confirming this importance in the field of reproduction (Liu *et al.*, 2012, Zang *et al.*, 2018; Sun, *et al.*, 2018; Atiyah *et al.*, 2020). The most important and who encouraged the using of this material specialized in encouraging use in those areas' recommendations by poultry researchers (Jahanian, 2009, Fouad *et al.*, (2013), Ebrahimi *et al.*, 2014, Jahanian and Khalifeh- Gholi., 2018).

The previous study (Cheng WeiXuan *et al.*, 2015) observed that supplementing Nile tilapia with 0.2% NCG had a significant impact on weight. Supplementing with NCG is beneficial to pig body weight animals (Frank *et al.*, 2007). Another study on muscles verified this, and the impact was seen by (Zhang et al., 2013) discovered that adding NCG to the weaning diet increased pig body weight growth. (Wang *et al.*, 2019) found that feeding 0.12 or 0.16 % NCG mirror carp an Arg-deficient diet increased development, feed utilization, intestinal antioxidant capacity, and immunological response. Supplementing rabbits with NCG enhanced their growth, according to this study. (Mahdi, *et al.*, 2021) improve the productive traits of Awassi lambs, this gives encouraging reasons for the mix of NCG with other materials to support the production of productive animals.

During the study, we noticed that there is no increase in the liver enzyme, a good indication that adding the NCG effect on the liver, this gives it good properties as a safe supplement material to animals, which is compatible with

(Liao *et al.*, 2017; Cao *et al.*, 2016; Miklif and Atiyah,2016) who they found that NCG non-toxic with no genotoxicity, and then suggested that dietary supplementation with 1% NCG, and ARG was effective in enhancing the antioxidant status, and supplementation of 1% ARG and 0.1% NCG can partially protect the liver and plasma from oxidative stress. Dietary supplementation with L-arginine exerts a protective role in pigs fed mold-contaminated foods and protect the liver and muscles respectively. The urea had maintained its natural levels in the blood and this gives the stabilization of this materials, the arginine and NCG, It has been confirmed

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that NCG is a non-toxic substance with no genotoxicity, (Wu *et al.*, 2015).

Conclusion

Supplementation of arginine and NCG to rabbits can increase growth production, in addition, that is safe and has no harmful effect on the body compared to its many benefits in the field of production and this encourages using it as feed additives.

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