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EFFECT OF CHROMIUM CHLORIDE OR L-CARNITINE SUPPLEMENTATION EITHER ALONE OR COMBINATION WITH VITAMIN C ON PRODUCTIVE PERFORMANCE OF GOLDEN MONTAZAH CHICKENS DURING THE SUMMER SEASON

M. A. M. Mousa; Abeer R. Khosht and Abeir A. M.Eshera

Anim. Prod. Res. Inst., Agric. Res. Center, Giza, Egypt

Corresponding author: Mohamed Mousa; Email:m_mousa67@yahoo.com

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ABSTRACT: Two experiments were done in this experiment to evaluate the comparison of the use of chromium chloride (Cr) as $CrCl_3$ and L-carnitine, either alone or in combination with vitamin C, during heat stress in the summer on the egg performance and egg quality. In each experiment, one hundred and twenty individual of a 28-week golden Montazah-layer hen, according to a completely randomized design were divided into four groups, each group had three replicates, and each replicate had 10 laying hens. Layers were housed in cages (one bird/cage) and at high ambient temperatures (day and night cyclic temperatures ranged from 28 to 42°C) throughout the 12-week trial period. Layers have been fed by commercial classes throughout the experiment with access to feed and water. In1st experiment, the treatments were Group 1 = control, (0 additives), group 2 = vitamin C, (250 mg/kg feed), group 3 = Cr, (400 mg/kg feed), group 4 = (Cr 400 mg/kg feed + vitamin C 250 mg/kg feed). In 2nd experiment were Group 1 = control, (0 additives), group 2 = vitamin C, (250 mg/kg feed),, group 3 = L-carnitine, (100 mg feed), group 4 = (L-carnitine 100 mg feed + vitamin C 250 mg/kg feed), The results indicated that groups supplementation of 400 mg (Cr) and 100 mg L-carnitine either alone or combination with 250 mg vitamin C /kg diet improving feed conversation, egg number, egg mass and egg production percentage compared with control group or vitamin C alone, while egg weight increased by using L-carnitine with vitamin C compared with other groups. Also results demonstrated feeding supplemental (Cr) and L-carnitine, either alone or in combination with vitamin C had no effect on egg length, egg diameter, egg shell thickness, egg shell weight but its increased albumen height ($p<0.01$). It can be concluded that supplementation of 400 mg (Cr/kg feed) and 100 mg L-carnitine /kg feed either alone or combination with vitamin C 250 mg /kg diet, improved production performance for Golden Montazah hens at 29- 40 weeks of age during the summer season.

Key Words: Chromium chloride, L-Carnitine, Vitamin C, Performance, Egg quality, Laying hens

INTRODUCTION

In summer, high environmental temperatures can be perilous to laying hens, on account of high mortality as well as due to the lessening in the number and quality of the eggs produced Daghir, (1995). Sahin et al. (2018) Note that one of the most important factors that leads to poor productive performance, imbalance of oxidation system and antioxidants, and poor health and immune status in poultry, especially laying birds, is heat stress. Chromium is one of the key elements in the activation of some specific chemicals and the precipitation of proteins and nucleic acids Haq et al. (2016). Belay and Teeter (1996) reported that there are important exploratory considerations in the uses of chromium in animal diets. One of the causes of heat stress is the accumulation of chromium from the tissues and it is excreted through the urine. This may lead to a minimum deficiency of chromium and thus lead to a disorder of protein and carbohydrate digestion, which causes growth retardation, insulin resistance, poor glucose flexibility and hypercholesterolemia (Lien et al. 1996; Vincent, 2000). Chromium has a key role in the metabolism process and that is in strengthening the action of insulin through its presence in an organic mineral molecule called the glucose tolerance factor (GTF) Ibrahim, (2005). The importance of chromium in the processes of digestion and growth and the reduction of fat and protein peroxidation made it one of the most general essential mineral elements in promoting production in poultry Farag et al. (2017). The mechanism of improving the growth process, productive performance and mitigating the effects of heat stress by using chromium is not clear, but the powerful antioxidants present in chromium may contribute to preventing lipid peroxidation caused by heat stress. (Sahin et al. 2017 and Stępniowska et al. (2020).

Arrigoni-Martelli and Caso (2001) reported that L-carnitine is a supplement, found essentially in mitochondria and has possible defensive impacts against mitochondrial harmful specialists. Carrol and Core (2001) found that Prevention of some diseases, strengthening the immune system, resistance to metabolic diseases, and the important role in metabolic processes, all of these are from the beneficial effects of L-carnitine on the productive performance of animals. García-Flores et al. (2021) indicated that one of the good effects of using L-carnitine is that it expands the long-chain polyunsaturated fat complex through the inner mitochondrial film to oxidize and kill the harmful groups of unsaturated fats that cause an expansion in the generation of cell energy. (ATP). L-Carnitine is biosynthesized in certain tissues such as the kidneys and liver Koeth et al. (2019), and in stress situations its ingestion and utilization are exacerbated, and acts by atomic receptors sensitive to explicit supplementation Ringseis et al. (2012). L-Carnitine is widely used in poultry Adabi et al. (2011). Xu et al. (2003); Khan (2011) and Ringseis et al. (2018) They report that L-Carnitine has an advanced non-infectious effect, activates susceptibility to infection, reduces oxidative stress due to its cell-enhancing effect and improves semen quality. In particular, Celik et al. (2004) and Kita et al. (2005) they found that L-carnitine improves egg production and the internal quality of eggs, with better accentuation on albumen. In any case, Corduk and Sarica (2008) and Daskiran et al. (2009) they did not find any positive response in laying hens with the use of 500 mg/kg of L-carnitine. A few studies were conducted to find out the effect of L-carnitine in rations on the productive performance of laying hens Hy-Line Brown (2020).

Not at all like humans, can poultry synthesize vitamin C. In any case, under conditions of high or low heat stress, it was accounted for that vitamin C synthesis is lacking, high production rate and parasite contamination Khan et al. (2012). Nonetheless, it has been accounted for that vitamin C amalgamation is deficient under tension circumstances like high or low ecological temperatures, high important rate, and parasite tainting Smith and Teeter (1987). There are many studies that have been conducted to identify the effect of vitamin C supplementation on the diet to reduce or eliminate the negative effects of severe heat stress on chickens Das et al. (2011); El-Habbak et al. (2011). Seven (2008) reported that one of the effects of vitamin C is to increase feed consumption, improve feed efficiency and egg weight in laying hens under high temperature. Whitehead and Keller (2003) indicated that specific ecological stress can modify vitamin C usage or combine in birds species. Sahin and Onderci (2002) detailed that a diet blend of vitamin C at level 250 mg/kg and Cr at level 400 μg gives the most raised useful results on the exhibition and egg quality attributes of laying birds under a low temperature. Dorr and Balloun (1976) reported that in birds, it had proposed that vitamin C corrosive animates 1, 25-dihydroxy-cholecalciferol and alongside it increments calcium arranging from bones, recommending that vitamin C has a colossal effect in eggshell course of action. The aim of this research is to study the effect of using chromium chloride or L-carnitine either alone or with vitamin C during heat stress in the summer on egg production and egg quality of Golden Montazah hens.

MATERIALS AND METHODS

The experimental work was carried out at El – Fayoum Poultry Farm, Animal Production Research Institute, Agriculture Research Center, Ministry of Agriculture,Egypt.Two experiments were conducted in this experiment to evaluate the comparison of the use of chromium chloride (Cr) as CrCl3 and L-carnitine, either alone or in combination with vitamin C, during heat stress in the summer. In each experiment, one hundred and twenty individual a 28-weeks golden montazh-layer hen, according to a completely randomized design (Steel and Torrie, 1984), were divided into four treatments, each treatment had three replicates, and each replicate had 10 laying hens. In1st experiment, the treatments were Group 1 = control, (0 additives), group 2 = vitamin C, (250 mg/kg feed), group 3 = Cr, (400 mg/kg feed), group 4 = (Cr 400 mg/kg feed + vitamin C 250 mg/kg feed). In 2nd experiment were Group 1 = control, (0 additives), group 2 = vitamin C, (250 mg/kg feed),, group 3 = L-carnitine, (100 mg feed), group 4 = (L-carnitine 100 mg feed + vitamin C 250 mg/kg feed). Layers were housed in cages (bird/cage) and at high ambient temperatures (day and night cyclic temperatures ranged from 28 to 42°C) throughout the 12-week trial period. Birds were fed on diet containing 18 % CP and 2800 Kcal ME. The composition and calculated analysis of diets are shown in Table (1). During the experimental periods, 29-32, 33-36, and 37-40 weeks of age, egg numbers were recorded and weighed daily. Egg production percent were calculated by dividing egg number on number of live female quail. Feed consumption was determined per replicate and feed conversion ratio was calculated as gram feed consumption divided by gram egg mass per hen per day. Fifteen eggs were taken for each random treatment after weekly periods to measure the weight of the egg, its length, diameter, color, high yolk and removal and veneer thickness. Economical efficiency (EEf) was estimated during all period of experiment. EEf was calculated (net revenue divided by total feed costs). While net revenue was calculated as total revenue minus total feed costs.

Statistical Analysis:

Obtained data were statistically analyzed using linear models procedure described in SAS users guide (SAS, 2004). Differences among treatment means were tested using Duncan's multiple range tests (Duncan's, 1955). One – way analysis model was applied for data obtained from the experiment:

$Y_{ij} = \mu + T_i + E_{ij}$

Where: Y_{ij} =Observations

μ =The overall mean

Ti =Effect of i^{th} treatments

E_{ij} =Experimental error

RESULTS AND DISCUSSION

First experiment:

Productive performance:

Effects of feed additives Cr as CrCl3 with or without vit.C on the egg production, feed consumption and feed conversion ratio of golden motazah are shows in Table 2. The results indicated that feed consumption (FC), at first period (29-32 weeks) of age were significantly ($P \leq 0.01$) higher in birds received control with 400 mg Cr /kg feed plus 250 mg vit.C/kg feed (T4) and control (T1). The best significantly feed conversion ratio (FCR) was received by adding vit.C (T2),Cr alone (T3) and Cr + vit.C (T4) 2.93, 2.59 and 2.59 respectively compared to control 3.77. The birds of (T3) and (T4) achieved higher egg production % EP and egg mass EM followed (T2) while (T1) recorded the lowest values. In second period (33-36 weeks) results demonstrated T4 higher FC compared all treatments. Results demonstrated (T4) was significantly higher EP 81.5% followed (T3) 76.2% compared to (T2) 71.4% or (T1) recorded the lowest values 68.9%, although (T4) achieved higher EM while recorded lower egg weight EW with (T1). In third period (37-40 weeks) observed (T4) significantly higher FC and EM compared to different treatments, while T3 and T4 achieved the best FCR 2.73, 2.67 respectively. In all periods (29-40 weeks) results demonstrated EP%, EM (g/day) and FCR of (T3) and (T4) achieved the best followed (T2) while (T1) recorded the lowest values. These results harmony with Sahin et al. (2002) revealed that weight, feed consumption, percent of egg production, and feed effectiveness expanded in heat-focused on layers of Japanese quails received chromium in diet at levels 200, 400, 800, or 1,200 μg/kg of diet as chromium picolinate contrasted and those recived a control diet. These outcomes concurred with those acquired by El-Hommosany (2008) showed that inorganic chromium administration as chromium chloride up to 25 mg/kg of diet improves body weight gain, feed conversion ratio, and supports the immune function by enhancing the humoral immune responses of growing Japanese quail. These results agreed with Ezzat et al. (2018) reported that supplemented 800 μg chromium picolinate (CrPic) /kg diet in Mandarah laying hens during first 90 days of egg production (EP) reared under

Egyptian summer condition observed egg production (EP), egg mass (EM) in hens and some semen characteristics in cocks exposed to heat shock were significantly ($P\leq0.05$) improved. These results harmony with Youssef et al. (2021) reported that supplemented 20 mg of Cr as CrCl3 and 250 mg Vit E in diets of males Japanese quail observed increased ($P\leq0.05$) growth and improved (FCR) and meat protein. Also these outcomes concurred with those acquired by Abdel-Mageed and Hassan (2012) who observed that feeding Japanese quail diets supplemented with CrPic was enhanced EP; EW and EM ratio under hot climate. It is understood that Cr is incorporated into protein mix and there is a relationship of Cr with DNA formats that realized a basic impelling of RNA mix. Vincent (2000) showed that oligopeptide this is a low-weight Cr-limiting protein (chromoduline) that strongly binds four chromium molecules before obtaining the desired modification on the dynamic site of the insulin receptor tyrosine kinase. Along these lines, chromoduline seems to acknowledge a segment in an auto update structure in insulin hailing Sahin et al. (2002). Also, Ezzat et al. (2016) reported that CrPic supplementation; diet significantly ($P\leq0.05$) higher EW, EP rate and EM as compared with control treated group. The results of this study are in line with the results obtained by Sahin and Onderci (2002) that saw that a nutritional mixture of vit. C at a level of 250 mg and chromium at a level of 400 µg/kg gave better results in terms of performance and egg quality characteristics in layers hen. The consequences of the current review are in contradicting Puthpongsiriporn et al. (2001); Eseceli et al. (2010). Puthpongsiriporn et al. (2001) declared no qualification in feed utilization, egg creation and egg mass of layers hen dealt with various groupings of vitamin C (0 to 65 mg/kg diet), however (Eseceli et al. 2010) uncovered no qualification in egg production, egg mass, and feed conversion ratio while laying hens were fed with diets that contained 150 mg/kg chromium from chromium yeast. These outcomes conflict with Torki et al. (2013) was published that there were no significant effects of organic chromium on the percentage of egg production, egg mass, feed conversion ratio and body weight in layers hen raised under heat stress conditions.

Egg quality:

Table (3) shows effect of fed diets supplemented without or with Cr and Vit. C alone or combination. In this study, feeding supplemental Cr and Vit. C alone or combination has been no effect on egg length, egg diameter, egg shell thickness, egg shell weight but the feeding of supplemental vit.C alone or Cr + vit.C diets increased albumen height ($p\leq0.01$) while Cr+ vit. C diets decreased yolk color and yolk weight at 32 weeks of treatment. In period 36 weeks data showed had no effect on egg quality except yolk color. In period 40 weeks data showed had no effect on egg length, egg diameter, egg shell thickness, egg shell weight, yolk height, yolk diameter while Cr diet recorded lower albumen height. These results agreed with Torki et al. (2013) who detailed that addition organic chromium to the diet of layers hen raised under high temperature conditions insignificantly affected Haugh unit, egg index, shell weight and yolk color. our results harmony with Wang et al. (2015) reported that various measures of vit.C at levels 50, 100 mg/kg in the layers hen didn't impact on the shell strength, shell thickness, yolk color, Haugh unit, albumen weigh, yolk weight, shell weight and skin color. There are clashing outcomes on egg quality because of supplemental of chromium in layers hen. Lien et al. (1996) found that no impact on egg quality when the diet of the layers hen upgraded with 800 µg kg-1 of chromium as chromium picolinate. Likewise, Uyanik et al. (2002) reported that diet of layers hen containing chromium at level 20 ppm and recorded not critical effects on Haugh unit, egg specific gravity, egg shape index, and shell thickness. Lien et al. (2004) found that not fundamentally impacts on shell thickness of dietary chromium supplemental upgraded as chromium picolinate, at levels 800 and 1600 µg Cr kg-1 of layers hen diets. On the other hand, these results are inconsistent with Liu et al (1999) who showed that the addition of chromium at a level of 10 mg/k significantly improved the egg quality such as shell thickness, egg specific gravity, and Haugh unit, while layers of Japanese quails benefited from the diets enhanced with chromium (as chromium picolinate) at levels 200, 400, 800 and 1200 µg Cr kg-1 diet under heat stress condition (32.5°C) contrasted and basal diet Sahin et al. (2002). Likewise, Abdallah et al. (2013) called attention to that yolk record and egg yolk % were expanded as diet of chromium dosages expanded, anyway no huge differentiations in the degree of shell weight and egg albumin as well as egg shape and egg albumin were seen between the treatment and control group.

Economical Efficiency(EE):

Economical evaluation parameters of the experimental treatments in laying hen diets in terms of feeding cost, net revenue, economical efficiency (EEf) and relative economical efficiency (REEf) of egg production are listed in Table (4). Results showed that adding (Cr) either alone or in combination with vit.C recorded the best economical efficiency (EEf) and relative economical efficiency (REEf) values compared to the control or vit.C alone. This result agreed with those obtained by Sahin et al. (2002) detailed that when Japanese quail was given chromium at levels of 200, 400, 800 and 1200 µg/kg of diet under conditions of heat stress, it gave good results in terms of weight, feed consumption, percentage of egg production and feed conversion efficiency, which was reflected in better economic efficiency compared to control treatment. Also, results agree with Ezzat et al. (2018) reported that supplemented 800 µg chromium picolinate (CrPic) /kg diet in Mandarah laying hens during first 90 days of egg production (EP) reared under Egyptian summer condition had significantly better values of economical efficiency compared to control treatment.

Second experiment:

Egg Production:

Effects of feed additives L-carnitine with or without vit.C on egg production, feed consumption and feed conversion ratio of golden montazah. from 29 to 40 weeks of age are shown in Tables 5. The results indicated that feed consumption (FC), at first period (29-32 weeks) of age were significantly ($P \leq 0.01$) higher in control treatment (T1) 101g followed (T2) 97g while (T3) and (T4) recorded the lowest values 92g, 94 g respectively. The best significant feed conversion ratio (FCR) was obtained by using L-carnitine alone (T3) and L-carnitine combination with vit.C (T4) 2.33, 2.31 respectively, also the birds of (T3) and (T4) achieved higher EP% 75.4 and 77.1 respectively followed (T2) EP% 64.7 while (T1) recorded the lowest values EP% 57.6 while EM (T4)

34.9, (T3) 33.9, (T2) 30.7 and (T1) 26.7 g/hen/day, while not significantly effect of egg weight to all treatments. In second period (33-36 weeks) results demonstrated (T2) lower FC compared to all treatments, the best FCR (T4) 2.26 and (T3) 2.47 followed (T2) 2.55 while (T1) recorded the lowest values 2.82. Results demonstrated (T4) was significantly higher EP % 81.5 and egg mass 39.1 g/hen/day followed (T3) 76.6%, 37 g/hen/day, (T2) 71.4%,35.9 g/hen/day while (T1) recorded the lowest values 68.9%, 33.1 g/hen/day, although (T2) achieved higher egg weight EW followed (T4) while (T1) and (T3) recorded the lowest values. In third period (37-40 weeks) observed (T4) significantly higher FC and EM compared to different treatments, while (T4), (T3) and (T2) achieved the best FCR 2.73, 2.77, 2.88 respectively. In all periods (29-40 weeks) results demonstrated (T4) and (T3) achieved higher EP% 79.6%, 76.9% and the best of FCR 2.43, 2.52 respectively, followed (T2) EP% 69.9%, FCR 2.79 while (T1) recorded the lowest values EP% 66.4, FCR 3.21. These results harmony with Hassan et al. (2011) enhanced various portions of L-carnitine at levels 100 and 200 mg/kg diet with vit.C at level 1 g/kg diet for quite some time and noticed the conceptive execution of Golden Montazah layers hen, and detailed expanded egg production percentage (2.1 and 2.7%). These results harmony with Zelaya et al. (2021) who announced that enhanced L-carnitine at level 24 mg/kg of Hy-Line Brown at 85 weeks old noticed L-carnitine expanded egg weight (EW) 63.35 g versus 65.68 g according to control ($P \leq 0.05$). Yalçin et al. (2005) indicated that consideration of L-carnitine in the feed of layers quail expanded (EW), without changes for its creation. Besides, Suchý et al. (2008) observation L-carnitine further developed (EW) and egg production (EP) of the normal fowl. Be that as it may, concentrates by Yalçin et al. (2006), Corduk et al. (2008) and Rezaei et al. (2008) don't allude observable changes in (EW), when they utilized L-carnitine of layers poultry. These results concurred with Kazemi-Fard et al. 2015) revealed that the diet utilization of L-carnitine at levels 100 and 150 mg/kg of expanded (EP) and egg mass (EM) since this added substance (L-carnitine) improves lipolysis and liver insurance. These outcomes concurred with Hassan et al. (2011) announced that the diet utilization of L-carnitine at levels 100 and 200 mg/kg no matter what vit.C at level 1g/Kg diet results demonstrated that further developing feed conversion in treatment fed of L-carnitine alone or with vit.C contrasted and control treatment additionally, (EM) and (EP%) were altogether expanded by utilizing L-carnitine alone or with vit.C contrasted and control treatment, while (EW) expanded by utilizing L-carnitine with vit.C compared with other treatments..

Egg quality:

Table 6 shows the effect of L-carnitine or vit.C either alone or in combination on egg quality. In this results, feeding supplementation L-carnitine, or L-carnitine + vit.C had no effect on egg length, egg diameter, egg shell thickness, egg shell weight, yolk weight and yolk color but the addition of L-carnitine, or L-carnitine+ vit.C significantly increased ($p \leq 0.01$) albumen height while not significantly effect on yolk height and yolk diameter at 32 weeks of treatment. In period 36 weeks data showed had no effect on egg length, egg diameter, egg shell thickness, egg shell weight, yolk height, yolk weight, albumen height and yolk diameter while not significantly effect on yolk color. In period 40 weeks data showed had no effect on egg length, egg diameter, egg shell thickness, egg shell weight, yolk diameter and yolk color while no effect on albumen height and yolk weight. Yalçın et al. (2005) revealed that supplementation L-carnitine to laying quails meaningfully affected egg-shell thickness, shell percentage, yolk index, yolk percentage and egg albumin percentage. Like the aftereffects of the current review, egg shell thickness was not impacted by L-carnitine Rabie et al., (1997) supplementation in laying hens. In conflict with the current review, Rabie et al. (1997) detailed that L-carnitine enhanced counts calories expanded ($p<0.01$) egg albumim percentage and diminished ($p\leq0.01$) yolk weight and yolk percentage. These results harmony with Zelaya et al. (2021) who announced that enhanced L-carnitine at level 24 mg/kg of Hy-Line Brown at 85 weeks old noticed L-carnitine didn't change ($P> 0.05$) albumen height, Haugh unit, eggshell strength and yolk color. Nonetheless, L-carnitine expanded ($P <0.05$) eggshell thickness as for control treatment. At week 95, L-carnitine didn't adjust ($P> 0.05$) any sign of egg external and internal quality. The thought of L-carnitine in abstains from food for Hy-Line Brown laying hen's additions (EW) and eggshell thickness at weeks 90 without massive changes in the other egg quality. Hy-Line Brown laying hen's increments egg weight and eggshell thickness at weeks 90 without significant changes in the other egg quality. These results disagreement with Celik et al. (2004); Kita et al. (2005) demonstrated L-carnitine further develops internal egg quality with better accentuation on albumin. In any case, different creators found no positive response in laying hens, while utilizing around 500 mg/kg of L-carnitine in various feeding of Corduk and Sarica (2008) and Daskiran et al. (2009).

Economical Efficiency (EE):

Economical evaluation parameters of the experimental treatments in laying hen diets in terms of feeding cost, net revenue, economical efficiency (EEf) and relative economical efficiency (REEf) of egg production are listed in Table (7).

Results showed that adding L-carnitine either alone or in combination with vit.C recorded the best economical efficiency (EEf) and relative economical efficiency (REEf) values compared to the control or vit.C alone. This result agreed with those obtained by Kazemi-Fard et al. (2015) reported that used L-carnitine at levels 100 and 150 mg/kg of increased (EP %) and (EM) achieved the better relative economic efficiency compared to the control treatment. Also, results agree with Hassan et al. (2011) reported that used L-carnitine at levels 100 and 200 mg/kg diet with or without vit.C at level 1g/ Kg diet had significantly better values of economical efficiency compared to the control treatment.

CONCLUSION

In the present study, fed supplementation by Cr (400 mg / kg feed) or L-carnitine (100 mg / kg feed) either alone or combination with vit.C (250 mg /kg feed) improved productive performance for Golden Montazah laying hen at 29- 40 weeks of age during the summer season.

Table (1): Composition and calculated analysis of the basal diet.

Ingredients	**%**	**Calculated analysis**	**%**
Yellow corn ground	55	ME.K.Cal/Kg	2800
Soybean meal (44%)	31.6	Crude protein %	18.2
Limestone	8.5	Crude fiber %	3.57
Oil(Soya)	3	Crude fat %	5.56
Dicalcium phosphate	1	Calcium %	3.49
Salt (Nacl)	0.3	Avail. P %	0.32
(Vit&Min.)Premix *	0.3	Lysine %	1.06
Choline Chloride	0.1	Meth. %	0.41
Sod. Bicarbonate	0.1		
DL.Methionine	0.1		
Total	100		

*Each 3 kg contains: 15000.000 IU Vit. A, 4000.000 IU Vit. D_3, 50000 mg Vit. E, 4000 mg Vit. K_3, 3000mg Vit. B_1 ,8000mg Vit. B_2, 5000mg Vit. B_6, 16000mg pantothenic acid, 20mg Vit. B_{12},2000mg folicacid,4500mgniacin,200mg biotin,7500mg zinc,5000mg choline,15000mgcopper,150mg cobalt,1000mg iodine,150mg selenium, 100000mgmanganese, 30000mg iron, carrier caco3 add to 3 kg.

Table (2): Effect of Chromium and vitamin C supplementation on productive performance of Golden Montazah laying hens.

Treat.	T1	T2	T3	T4	SEM
	29-32 Wks				
EP%	57.6^{c}	64.7^{b}	71.7^{a}	75.6^{a}	±1.53
EW	46.4^{bc}	47.7^{a}	47.2^{ab}	45.9^{c}	±0.22
EM	26.7^{c}	30.7^{b}	33.9^{a}	34.9^{a}	±0.72
FC	101^{a}	97^{b}	98^{b}	101^{a}	±0.62
FCR	3.77^{a}	2.93^{b}	2.59^{b}	2.59^{b}	±0.11
	33-36 Wks				
EP%	68.9^{c}	71.4^{c}	76.2^{b}	81.5^{a}	±1.28
EW	48.1^{c}	50.4^{a}	49.3^{b}	48.0^{c}	±0.21
EM	33.1^{c}	35.9^{b}	37.0^{ab}	39.1^{a}	±0.64
FC	103^{b}	99^{bc}	98^{bc}	105^{a}	±0.59
FCR	2.82^{a}	2.55^{b}	2.34^{b}	2.39^{b}	±0.06
	37-40 Wks				
EP%	72.6^{c}	73.7^{bc}	77.8^{ab}	82.7^{a}	±1.40
EW	50.4^{b}	51.9^{a}	51.3^{a}	50.2^{b}	±0.22
EM	36.6^{c}	38.2^{bc}	39.6^{ab}	41.4^{a}	±0.72
FC	121^{b}	119^{b}	122^{b}	125^{a}	±0.73
FCR	3.04^{a}	2.88^{ab}	2.73^{b}	2.67^{b}	±0.06
	29-40 Wks				
EP%	66.4^{d}	69.9^{c}	75.2^{b}	80.0^{a}	±0.85
EW	48.3^{c}	50.0^{a}	49.2^{b}	48.0^{c}	±0.17
EM	32.1^{c}	34.9^{b}	36.9^{a}	38.5^{a}	±0.45
FC	108^{ab}	105^{c}	106^{bc}	110^{a}	±0.75
FCR	3.21^{a}	2.79^{b}	2.56^{c}	2.55^{c}	±0.05

a, b, c Means in the same row with different superscripts are significantly different ($p \leq 0.01$), EP= egg production %, EW= egg weight (g), EM= egg mass (g), FC=feed consumption (g/hen/day), FCR=feed conversion ratio (g feed /g egg), T1= control, T2= vitamin C, T3= Chromium, T4= Chromium + vitamin C

Table (3): Effect of Chromium and vitamin C supplementation on egg quality of Golden Montazah laying hens

Treatment Items	32 weeks of age					36 weeks of age					40 weeks of age				
	T1	T2	T3	T4	SEM	T1	T2	T3	T4	SEM	T1	T2	T3	T4	SEM
Egg weight	46.85^{ab}	48.66^{a}	47.22^{ab}	44.57^{b}	±0.92	49.66	52.35	52.47	51.18	0.85±	50.36	53.81	52.03	51.56	±0.96
Albumin height	0.32^{b}	0.44^{a}	0.39^{ab}	0.45^{a}	±0.03	0.60	0.57	0.65	0.64	0.04±	0.89^{a}	0.88^{a}	0.66^{b}	0.92^{a}	±0.06
Egg length	5.29	5.32	5.20	5.19	±0.05	5.31	5.37	5.47	5.43	0.06±	5.36	5.49	5.40	5.34	±0.06
Egg diameter	4.01	4.06	4.03	3.96	±0.03	4.07	4.13	4.12	4.13	0.02±	4.11	4.15	4.15	4.14	±0.03
Yolk height	1.69^{b}	1.90^{a}	1.76^{b}	1.71^{b}	±0.03	1.77	1.74	1.77	1.73	0.03±	1.71	1.75	1.79	1.71	±0.02
Yolk color	6.93^{ab}	7.13^{a}	7.00^{a}	6.13^{b}	±0.22	5.93^{a}	5.27^{b}	5.27^{b}	5.67^{ab}	0.16±	5.47^{ab}	5.67^{ab}	5.13^{b}	5.87^{a}	±0.19
Yolk weight	14.53^{a}	14.81^{a}	14.51^{a}	13.26^{b}	±0.32	15.45	15.80	16.00	15.69	0.34±	16.43^{b}	18.49^{a}	17.71^{ab}	16.76^{b}	±0.41
Yolk diameter	3.95	3.81	3.97	3.92	±0.07	4.15	4.14	4.21	4.19	0.04±	4.15	4.22	4.23	4.15	±0.04
Shell thickness	0.45	0.43	0.45	0.42	±0.01	0.40	0.41	0.41	0.41	0.01±	0.39	0.41	0.42	0.42	±0.01
Shell weight	5.94	6.00	6.05	5.65	±0.15	5.28	5.48	5.72	5.81	0.15±	5.99	6.31	6.25	5.97	±0.18

a, b, c Means in the same row with different superscripts are significantly different ($p \leq 0.01$).

Table (4): Effect of dietary supplementation on economical efficiency (EEf).

Varia bles	Feed intake(Kg/ hen)	Price feed (Kg)	Total feed intake cost(LE/Kg)	Price egg (LE/Kg)	EP(Kg/ hen)	Total sell price(LE)	Net revenue (LE/Kg)	EEf	REEf %
T1	9.072	5.4	48.9888	25	2.696	67.4	18.4112	0.375825	100
T2	8.82	5.43	47.8926	25	2.932	73.3	25.4074	0.530508	141.1583
T3	8.904	5.62	50.04048	25	3.100	77.5	27.45952	0.548746	146.0112
T5	9.24	5.65	52.206	25	3.234	80.85	28.644	0.548673	145.9916

T1= control, T2= Vitamin C, T3= Chromium, T4= Chromium+ vitamin C feed price= according to the price different ingredients available in the market (2020), sell price= according to the local market price (2020) EP= egg production EEf=Economical efficiency= (net revenue per unit/total feed cost). REEf=Relative economical efficiency, assuming that the control diets=100%.

Table (5): Effect of *L-Carnitine and* vitamin C supplementation on productive performance of Golden Montazah laying hens.

Treat.	T1	T2	T3	T4	SEM
			29-32 Wks		
EP%	57.6^{c}	64.7^{b}	75.4^{a}	77.1^{a}	±1.51
EW	46.4	47.7	48.2	50.8	±1.76
EM	26.7^{c}	30.7^{b}	35.0^{a}	36.2^{a}	± 0.70
FC	101^{a}	97^{b}	92^{c}	94^{c}	±0.63
FCR	3.77^{a}	2.93^{b}	2.33^{c}	2.31^{c}	± 0.10
			33-36 Wks		
EP%	68.9^{b}	71.4^{b}	76.6^{a}	81.5^{a}	±1.36
EW	48.1^{c}	50.4^{a}	48.4^{c}	49.4^{b}	±0.26
EM	33.1^{c}	35.9^{b}	36.7^{b}	40.0^{a}	±0.67
FC	103^{a}	99^{c}	102^{a}	101^{ab}	±0.59
FCR	2.82^{a}	2.55^{b}	2.47^{bc}	2.26^{c}	±0.06
			37-40 Wks		
EP%	72.6^{c}	73.7^{bc}	78.6^{ab}	80.1^{a}	±1.44
EW	50.4^{b}	51.9^{a}	51.3^{ab}	52.1^{a}	±0.34
EM	36.6^{c}	38.2^{bc}	39.7^{ab}	41.1^{a}	±0.73
FC	121^{bc}	119^{c}	124^{b}	126^{a}	±0.71
FCR	3.04^{a}	2.88^{ab}	2.77^{b}	2.77^{b}	±0.06
			29-40 Wks		
EP%	66.4^{c}	69.9^{b}	76.9^{a}	79.6^{a}	±0.86
EW	48.3^{b}	50.0^{ab}	49.3^{ab}	50.8^{a}	±0.61
EM	32.1^{d}	34.9^{c}	37.1^{b}	39.1^{a}	±0.44
FC	108^{a}	105^{b}	106^{ab}	107^{ab}	±0.83
FCR	3.21^{a}	2.79^{b}	2.52^{c}	2.43^{c}	±0.05

a, b, c Means in the same row with different superscripts are significantly different ($p \leq 0.01$)
EP= egg production %, EW= egg weight (g), EM= egg mass (g), FC=feed consumption (g/hen/day), FCR=feed conversion ratio (g feed /g egg), T1= control, T2= vitamin C, T3= L-carnitine, T4= L-carnitine+vitamin C

Table (6): Effect of *L-Carnitine and* vitamin C supplementation on egg quality of Golden Montazah laying hens

Treatmen Items	32 weeks of age					36 weeks of age					40 weeks of age				
	T1	**T2**	**T3**	**T4**	**SEM**	**T1**	**T2**	**T3**	**T4**	**SEM**	**T1**	**T2**	**T3**	**T4**	**EM**
Egg weight	46.85	48.66	47.58	48.38	±0.91	49.66	52.35	51.69	52.66	0.89±	50.36^{b}	53.81^{a}	51.24^{ab}	53.27^{a}	±0.77
Albumin height	0.32^{b}	0.44^{ab}	0.45^{a}	0.56^{a}	±0.03	0.60	0.57	0.59	0.57	0.04±	0.91^{a}	0.88^{ab}	0.68^{b}	0.67^{b}	±0.06
Egg length	5.29	5.32	5.27	5.25	±0.05	5.31	5.37	5.46	5.46	0.06±	5.36	5.49	5.43	5.51	±0.05
Egg diameter	4.01	4.06	4.02	4.09	±0.04	4.07	4.13	4.09	4.13	0.02±	4.11	4.15	4.11	4.15	±0.03
Yolk height	1.69^{c}	1.90^{a}	1.75^{bc}	1.82^{ab}	±0.03	1.77	1.73	1.67	1.71	0.04±	1.71	1.75	1.80	1.80	±0.03
Yolk color	6.93	7.13	7.60	7.20	±0.23	5.93^{a}	5.27^{b}	5.60^{ab}	5.60^{ab}	0.16±	5.47	5.60	5.07	5.67	±0.18
Yolk weight	14.53	14.81	14.57	14.58	±0.31	15.45	15.76	16.53	15.99	0.34±	16.46^{b}	18.47^{a}	17.08^{ab}	16.86^{b}	±0.39
Yolk diameter	3.95^{ab}	3.81^{ab}	3.96^{a}	3.75^{b}	±0.06	4.15	4.14	4.17	4.21	0.03±	4.15	4.21	4.22	4.23	±0.04
Shell thickness	0.45	0.43	0.45	0.44	±0.01	0.40	0.41	0.42	0.42	0.01±	0.39	0.41	0.38	0.37	±0.01
Shell weight	5.94	6.00	5.87	5.95	±0.15	5.28	5.48	5.51	5.61	0.14±	5.99	6.31	6.12	6.00	±0.14

Table (7): Effect of dietary supplementation on economical efficiency (EEf).

Varia bles	Feed intake(Kg/ hen)	Price feed (Kg)	Total feed intake cost(LE/Kg)	Price egg (LE/Kg)	EP (Kg/h en)	Total sell price(LE)	Net revenue (LE/Kg)	EEf	REEf %
T1	9.072	5.4	48.9888	25	2.696	67.4	18.4112	0.375825	100
T2	8.82	5.43	47.8926	25	2.932	73.3	25.4074	0.530508	141.1583
T3	8.904	5.46	48.61584	25	3.116	77.9	29.28416	0.602358	160.2764
T4	8.988	5.49	49.34412	25	3.284	82.1	32.75588	0.663825	176.6317

T1= control T2= Vitamin C T3= L-carnitine T4= L-carnitine +vitamin C feed price= according to the price different ingredients available in the market (2020), sell price= according to the local market price (2020) EP = egg production EEf=Economical efficiency= (net revenue per

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الملخص العربى

تاثير اضافة كلوريد الكروميوم أو ال- كارنتين بمفردهما او مزيج مع فيتامين ج على الاداء الانتاجى فى دجاج المنتزة الذهبى البياض خلال فصل الصيف

محمد عبد العظيم محمد موسى، عبير ربيع خشت، عبير احمد محمد عشرة

معهد بحوث الانتاج الحيوانى – مركز البحوث الزراعية – جيزة - مصر

أجريت تجربتان في هذه التجربة لتقييم مقارنة استخدام كلوريد الكروميوم (Cr) وال- الكارنتين إما بمفردهما أو مع فيتامين ج أثناء الإجهاد الحراري على أداء انتاج البيض وجودة البيض. في كل تجربة ، تم تقسيم مائة وعشرين دجاجة من المنتزه الذهبي عمر 28 أسبوعًا إلى أربع مجموعات ، وبكل مجموعة ثلاث مكررات ، وبكل مكرر 10 دجاجات بياضة. تم وضع الطيور في أقفاص (طائر واحد / قفص) طوال 12 أسبوع. في التجربة الأولى ، كانت المجموعات عبارة عن مجموعة1 كنترول (بدون اضافة) ، مجموعة 2 (250ملجم فيتامين ج/كلجم علف) ، مجموعة 3 (400 ملجم كروميوم/كلجم علف) ، مجموعة 4 (250 ملجم فيتامين ج + 400 ملجم كروميوم لكل كلجم علف). في التجربة الثانية كانت المجموعة 1 كنترول (بدون اضافة) ، المجموعة 2 (250ملجم فيتامين ج/كلجم علف) ، المجموعة 3 (100 ملجم إل-كارنيتين / كلجم علف) ، المجموعة 4 (250 ملجم فيتامين ج + 100 ملجم إل-كارنيتين لكل كلجم علف). أشارت النتائج إلى أن المجموعات 400 مجم كروميوم و 100 مجم ال-كارنتين إما بمفردهما أو مع 250 مجم فيتامين ج / كجم يحسن معامل التحويل الغذائى وكتلة البيض والنسبة المئوية لانتاج البيض مقارنة بمجموعة الكنترول أو فيتامين ج وحده ، بينما زاد وزن البيض باستخدام ال- كارنتين مع فيتامين ج مقارنة بالمجموعات الأخرى. أظهرت النتائج أيضًا أن المجموعات 400 مجم كروميوم و 100 مجم ال- كارنتين إما بمفردهما أو مع 250 مجم فيتامين ج / كجم ، لم يكن لها تأثير على طول البيضة ، قطر البيضة ، سمك قشرة البيضة ، وزن قشرة البيضة بينما كانت هناك زيادة فى ارتفاع الالبيومين. يمكن أن تؤدى اضافة 400 مجم كروميوم و 100 مجم ال- كارنتين إما بمفردهما أو مع 250 مجم فيتامين ج / كجم إلى تحسين الاداء الانتاجى فى دجاج المنتزة الذهبى البياض خلال موسم الصيف