EFFECT OF L-CARNITINE ON GROWTH PERFORMANCE AND SOME BLOOD CONSTITUENTS IN GROWING RABBITS

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ABSTRACT

The experiment was carried out with the aim of studying the influence of L-carnitine on growth performance and some blood parameters of growing New Zealand White (NZW) rabbits. This experiment was carried out at the Intensive Rabbit Production Unit, belonging to Agriculture Studies and Consultation Center, Faculty of Agriculture, Ain Shams University, on 50 weaned male rabbits, four weeks of age and 442.5 gm average live body weight. Rabbits were randomly distributed into two comparable groups of 25 animals each and housed in individual cages provided with continues feeder and automatic waterer facilities during the experimental period, which lasted for 8 weeks. The basal diet (commercial pellets) was fed to the control group (I) without L-carnitine supplementation, while the group (II) was orally administrated with 40 mg L-carnitine / kg body weight / day. Results showed that rabbits in group (II) were significantly ($P \leq 0.005$) heavier in body weight than those of control group. L-carnitine increased ($P \leq 0.05$) number of red blood cells (RBCs), white blood corpuscles (WBCs), hemoglobin concentration (Hb) and hematocrit (PCV %) as compared with control group. Treatment with L-carnitine significantly increased ($P \leq 0.05$) blood plasma vitamin E level as compared with control group. While the effect of L-carntine on plasma vitamin A level was not significant. Plasma cholesterol and glucose were lowered ($P \leq 0.05$) by L-carnitine treatment. L-carnitine increased (P 0.05) blood plasma total protein and globulin level as

compared with control group. The effect of treatment with L-carnitine on plasma, Calcium (Ca), phosphorus (P), Copper (Cu), Zink (Zn), Magnesium (mg) and Iron (Fe) levels were not significant.

Keywords: L-carnitin, rabbits, body weight, cholesterol, glucose, protein, minerals, vitamins and Blood picture.

INTRODUCTION

L-carnitine biosynthesis occurs primarily in the liver and kidney. The synthesis of L-carnitine is catalyzed by the concerted action of five different enzymes, this process requires two essential amino acids (lysine and methionine), iron, vitamin C, vitamin B6 and niacin in the form of nicotinamide (Seim *et al*., 2001). Dietary L-carnitine supplementation promotes the ß oxidation of these fatty acids to generate adenosine triphosphate (ATP) and improved energy use (Neuman *et al*., 2002). Consequently, L-carnitine supplementation to diets reduces long chain fatty acid availability for etherification to triacyl glycerols and storage in the adipose tissue (Xu *et al*., 2003). Mervat *et al*., (2007) reported that L–carnitine supplementation improved daily gain by 23.2 % in growing rabbit than control group. This experiment was carried out to study the effect of oral L-carnitine supplementation on the performance and blood pictures of growing New Zealand White rabbit.

MATERIALS AND METHODS

This experiment was carried out at the Intensive Rabbit Production Unit belonging to Agriculture Studies and Consultation Center, Faculty of Agriculture, Ain shams University.

Animals, Treatment and Management:

A total of 50 growing New Zealand White rabbits, four weeks of age and 442.5 gm average live body weight were randomly distributed just after weaning into two comparable groups of 25 rabbits each. Animals were housed in individual cages (20 x 30 x 20 cm) provided with continues feeders and automatic waterers during the experimental period, which lasted for 8 weeks. Basal diet (commercial pellets) was fed to the control group (I) without L-carnitine supplementation, while animals in group (II) were orally administrated with 40 mg L-carnitine / kg body weight / day. Chemical analysis showed that the basal diet contained 7.93% moisture, 17.6% crude protein, 2.5% ether extract,

11.8% crude fiber, 51.37% nitrogen free extract (NFE) and 8.8% ash. Animals were weighed individually at weekly intervals.

Blood samples were withdrawn once weekly from the ear vein of each animal in a heparinized syringe and put in a vacutainer tube under cooling until reach to the laboratory. Red blood corpuscles (RBC's) and white blood corpuscles (WBC's) were counted by using heamocytometer, hematocrit ratio (PCV %) and hemoglobin concentration (Hb) were also measured in immediately after blood collection according to Tietz (1983). The plasma was carefully separated after centrifugation and stored at -20^{o}C for biochemical analysis. Blood plasma total protein was determined according to Henary *et al*., (1974), albumin according to Doumas *et al*., (1971), cholesterol according to Stein (1986) and glucose estimated as described by Bahram and Trinder,(1972). Plasma cacium (Ca) phosphorus (P), Copper (Cu), Zink (Zn), Magnesium (Mg), Potassium (K) and Iron (Fe) were determined using Inductive Coupled Plasma (ICP) technique. Perkin Elmer Optima 2000 DV as described in AOAC (2000). Determination of plasma vitamins A and E was carried out using High Performance Liquid Chromatography (HPLC) according to Leth and Jacobsen, (1993) and Leth and Sondergaro (1983), respectively.

Statistical Analysis:

Data of the present investigation were analyzed according to SAS (1996), version 6.12 as repeat measurements.

RESULTS AND DISCUSSION

1- Growth performance

Rabbits supplemented with L-carnitine were heavier ($P \leq 0.01$) than the control (Fig.1). The final body weights averaged 1624±25.3 and 1928±25.3 gm for control and treated groups, respectively. Similar results were recorded by Rincker *et al* (2003) who showed that piglets supplemented with L-carnitine had higher body weight ($P \leq 0.005$) than piglets fed the control diets. Also Mervat *et al* (2007) reported that L –carnitine supplementation improved daily gain by 23.2 % in growing rabbit than control group. This improvement of growth performance may be due to the effect of L- carnitine on hepatocytes, which enhances ß-oxidation by increasing the activity of

carnitine palmitoyl transferase I and stimulating the reutilization of amino acids from waste protein for protein synthesis (Owen *et al*., 2001), In addition Birkenfeld *et al*., (2006) reported that L-carnitine increased plasma concentration of insulin-like growth factor (IGF-I), which stimulates proliferation and differentiation of skeletal muscle cells and regulates muscle growth and development (Waylan *et al*., 2005).

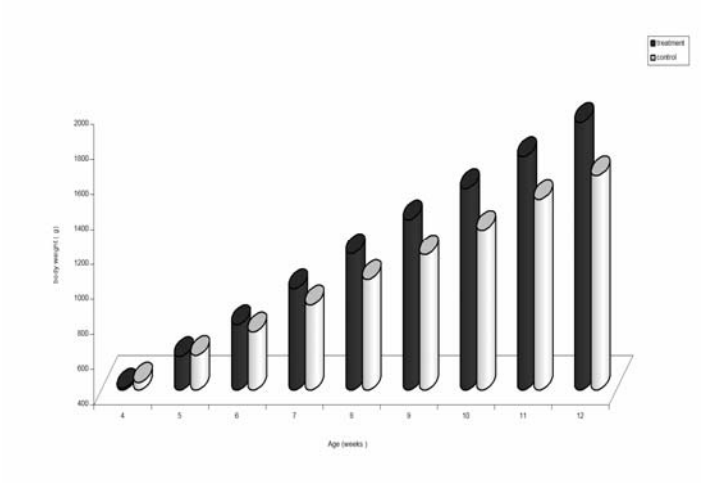

Figure (1): Average weekly live body weight of growing NZW rabbits

2-Hematological parameters

Hematological parameters of growing male New Zealand White rabbits are presented in table (1). Rabbit received L-carnitine showed higher ($P \leq 0.05$) values of RBCs, Hb and PCV% as compared with control group. These results are in agreement with Yukika *et al*., (2005) who reported that oral L-Carnitine treatment may alleviate renal anaemia by stimulating erythropoietin secretion and preserving RBC membrane integrity. Several lines of research have confirmed the latter mechanism as manifested by an improvement in RBC membrane stability. Arduini, *et al.,* 1990 reported that L-carnitine is required for formation of hemoglobin and has a dual role in the formation of erythrocytes so increases packed cell volume (PCV). Also, Lorenzo *et al*., (2008) found that carnitine increased, hemoglobin and hematocrit as compared with patients not treated with L- carnitine. Treatment with L- carnitine increased white blood cells (WBC's) as

compared with control group (Table1). The increase of WBC's my be due to increase Lymphocyts. Similar results reported by Franceschi *et al*., (1990) they found that Lymphocyte proliferation was markedly increased in rats treated with L-carnitine or acetyl-L- carnitine.

3- Blood biochemical parameters:

It was observed that blood plasma total protein and globulin levels in rabbits supplemented with L-carnitine were increased (P≤ 0.05) by 3.64 and 24 %, respectively as compared with the control group (Table 1). The increased globulin level in the treated rabbits may be due to the L-carnitine enhancement of the immune system (Thangasamy *et al* 2008). While blood plasma albumin was lowered insignificantly by 7.3 % in L-carnitine supplemented rabbit as compared with control group.

Plasma cholesterol was decreased (P≤ 0.05) in male rabbit received L-carnitine as compared with control (Table, 1). Similar results were reported by Diaz *and* Lopez (2000) who showed that the reduction of total cholesterol in animals fed a cholesterol-rich diet plus L-carnitine was associated with a marked decrease in the ratio of cholesteryl ester to free cholesterol and a dramatic increase in their phospholipids. However, Plasma glucose concentration was lower (P≤ 0.05) in rabbit received L-carnitine as compared with control rabbits. These results were similar to those reported by Bertol *et al* ., (2005) who found that pigs fed 150 ppm of supplemental L-carnitine had lower baseline blood glucose (P ≤ 0.05). The low level of plasma glucose may be regarded to the increased overall glucose elimination from plasma and glucose oxidation due to L-carnintine **(**Andrea et al ., 1999).

Plasma fat soluble vitamins in male New Zealand White rabbits are presented in table (2). Rabbit received L-carnitine showed higher (P≤0.05) blood plasma vitamin E level, while vitamin A increased insignificantly. Clark, *et al*. (2007) found that dietary L-carnitine significantly increased liver alpha-tocopherol and tended to increase plasma alpha-tocopherol (P≤ 0.09) compared with control group. However, Wei Zou *et al.*,(2005) found that dietary L-carnitine significantly enhances the lymphatic absorption of fat , alpha-tocopherol and a fat-soluble vitamin, in rats.

Table (1): Mean ± SE of some hematological and plasma parameters of growing male rabbit as affected by L-carnitine administration.

Item	Control	L-carnitine	Changes%	MSE	Probability
Samples number	200	200			
Blood Parameters					
RBCsX10^6	4.714±0.09	5.75±0.09	21.97	1.69	≤0.05
WBCsX10^3	8.20±0.05	8.70±0.05	6.09	0.495	≤0.05
Hb(gm/dl)	11.01±0.15	13.67±0.15	15.74	4.50	≤0.05
PCV%	38.37±1.40	43.75±1.40	14.02	3.92	≤0.05
Plasma parameters					
Total Protein (gm/dl)	7.14±0.05	7.40±0.5	3.64	0.54	≤0.05
Albumin (gm/dl)	4.64±0.10	4.30±0.10	7.32	1.84	ns
Globulin (gm/dl)	2.50±0.04	3.10±0.04	24.0	0.32	≤0.05
Glucose (mg/dl)	105.98±0.84	95.30±0.84	10.77	141.1	≤0.05
Cholesterol (mg/dl)	110.30±4.64	85.48±4.64	22.50	4305.92	≤0.05

4- Blood plasma minerals:

Least square means of Cu, P, Zn, Mn , Fe and Ca concentration in blood plasma are presented in table (2). No significant differences were found between treated and control groups for all studied minerals. Blood plasma Fe, Ca was increased in the treated group. The increase of calcium concentration my be due to that L-carnitine help the body to absorb calcium from the gut. (Keizo , 2006). Also, the increased of Iron concentration my be due to a linear correlation existed between total L-carnitine and iron concentration (Bohles *et al* .,2005) . The plasma P, Mn and Zn concentration were decreased in blood plasma of the treated rabbit. The lower concentration of pervious minerals in blood plasma may be due to that certain minerals have to interact, either positively or negatively with the absorption of other minerals. For example, copper and zinc interfere with the absorption of others and excessive amounts of calcium can influence phosphorus and selenium absorption (Bell, 2003). In conclusion L-carnitine supplementation improves rabbit growth and increase RBC's , PCV% and blood plasma fat soluble vitamins in growing New Zealand White male rabbits

Table (2): Mean ± SE of fat soluble vitamins and minerals in blood plasma of growing male rabbit as affected by L-carnitine administration.

Item	Control	L-carnitine	change%	MSE	Probability
Samples number	200	200			
Vitamin (E) (mg/l)	1.1±0.04	1.4±0.04	22.27	0.304	≤0.05
Vitamin (A) (mg/l)	0.47±0.05	0.5±0.05	6.38	0.540	ns
Calcium (Ca) (mg/dl)	9.4±0.1	10.2±0.1	8.50	3.380	ns
Phosphorus (P) (mg/dl)	5.4±0.04	5.1±0.04	5.55	0.288	ns
Copper (Cu) (mg/dl)	0.12±0.001	0.13±0.001	5.83	0.0001	ns
Zinc (Zn) (mg/dl)	0.15±0.001	0.14±0.001	6.66	0.0002	ns
Magnesium (Mg) (mg/dl)	6.3±0.56	6.0±0.56	4.76	61.600	ns
Sodium (Na) (mg/dl)	125.0±1.13	132.0±1.13	5.60	257.190	ns
Potassium (K) (mg/dl)	7.1±0.6	6.8±0.6	4.22	59.840	ns
Iron (Fe) (mg/dl)	0.053±0.0007	0.6±0.0007	7.54	0.0001	ns

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تأثير الـ L- carnitine على اداء النمو و بعض مكونات الدم فى الأرانب النامية

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الهدف من البحث دراسة تأثير الـ L- carnitine على اداء النمو ومكونات الدم للارانب النيوزيلاندى الابيض النامية

اجرى هذا البحث فى وحدة الانتاج المكثف للارانب بمركز الدراسات و الاستشارات الزراعية بكلية الزراعة جامعة عين شمس على 50 ذكر ارنب نيوزيلاندى مفطوم على عمر 4 اسابيع بمتوسط وزن حى 442.5 وزعت عشوائيا الى مجموعتين كل مجموعة بها 25 ذكر ارنب وتم وضع الارنب فى اقفاص فردية مذودة بمغذيات وماء اتوماتيكى اثناء فترة التجربة لمدة 8 اسابيع اخرى. مجموعة غذيت على عليقة تجارية بدون اعطاء L- carnitine ومجموعة غذيت علي عليقة تجارية + (40 مليجرامL- carnitine/ كجم وزن حى)

اوضحت النتائج ان الارانب فى المجموعة الثانية زادت زيادة معنوية ($P<0.005$) فى وزن الجسم عن المجموعة التى لم تجرع L- carnitine كذلك المعاملة بـ L- carnitine زود عدد كرات الدم الحمراء والبيضاء والهيموجلوبين والهيماتوكريت بالمقارنة بالمجموعة المقارنة.

المعاملة بـ L- carnitine زودت فيتامين (هـ) فى بلازما الدم زيادة معنوية اذا قورنت بالمجموعة المقارنة بينما تاثير L- carnitine على فيتامين (أ) غير معنوى. المعاملة قللت مستوى الكوليسترول وزودت البروتين الكلى والجلوبيولين فى بلازما الدم بالمقارنة بالمجموعة المقارنة وتاثير المعاملة غير معنوى على كل من الجلوكوزوعناصر الكالسيوم- الفوسفور- النحاس – الزنك- الماغنسيوم و الحديد.