PRODUCTIVE AND REPRODUCTIVE PERFORMANCE OF RABBITS FED DIETS SUPPLEMENTED WITH ZINC-METHIONINE

Journal

Abd El-Motaal A.E.M.[1]; T.A. El-Aasar[2] and T.G. Zaki[3]

J. Biol. Chem. Environ. Sci., 2008, Vol. 3(1): 103-122
www.acepsag.org

1- Department of Poultry Nutrition Research, Animal Production Research Institute, Agricultural Research Centre, Dokki, Giza, Egypt.
2- Department of Rabbit, Turkey and Water Fowl Breeding Research, Animal Production Research Institute, Agricultural Research Centre, Dokki, Giza,Egypt
3- Department of Poultry Breeding Research, Animal Production Research Institute, Agricultural Research Centre, Dokki, Giza, Egypt

ABSTRACT

A total number of three hundreds and twenty four Californian(Cal) rabbits was used in the present work to study some productive and reproductive performance of growing and mature rabbits as influenced by supplementing Zinc-Methionine to the diets.

The present study included two experiments. The first experiment was lasted 40 days and carried out during growing period on 230 weaned Cal rabbits aged 30 days. The second experiment was lasted 4 months and carried out on 80 monoparous does and 14 sexual mature bucks of Cal rabbits aged 6 months. All rabbits in two experiments were divided into two equal comparable experimental groups (115 growing rabbits, 7 bucks and 40 does in two sequence parities in each group). The first group was kept untreated (as a control group) and fed the commercial diet, while the other group (treated group) was fed the same diet and supplemented with 400 gm/ Ton Zinc-Methionine (ZM), during the experimental period. The pelleted rations fed to the experimenta lrabbist were covering the nutritional requirements of the growing and mature phase of rabbits..

The results obtained revealed that, daily body weight gain , feed efficiency and feed conversion values of growing Cal rabbits fed diet supplemented with 400 gm/ Ton Zinc-Methionine significantly (P≤0.05) improved. Daily feed intake was insignificantly higher than those of control group. Feeding diet supplemented with 400 gm/ Ton Zinc-Methionine increased significantly (P≤0.05) dressing % and carcass and internal organs weight (absolute and relative) represented by weights and percentages of each of spleen; kidneys; liver; heart and lungs, as well as, blood picture of growing Cal rabbits represented by (red and white blood cells count; hemoglobin concentration and hematocrite percentage) and some blood constitute such plasma total protein and its fractions (albumin; globulin and albumin/ globulin ratio). Some enzymes indicated liver activity of growing Cal rabbits represented by values of each of glutamic-oxaloacetic transaminase (GOT) and glutamic-pyruvic transaminase (GPT) also increased significantly (P≤0.05) due to supplementation of 400 gm/ Ton Zinc-Methionine to the diet.

Supplementing 400 gm/ Ton Zinc-Methionine to the diet of the Cal rabbit bucks improved significantly (P≤0.05) their reproductive capability represented by libido and physical semen quality (semen-ejaculate volume; advanced-sperm motility; live and normal spermatozoa; acrosome status and sperm-cell concentration per ml and per ejaculate); gonads and pituitary gland weight; scrotal circumference and testicular index. Testosterone concentration and mating activity of Cal rabbit bucks ate diet supplemented with 400 gm/ Ton Zinc-Methionine were significantly (P≤0.05) higher than those of fed without Zinc-Methionine (control group).

Cal rabbit does fed diet contained 400 gm/ Ton Zinc-Methionine and mated naturally by using bucks fed the same treated diet recorded kindling rate, litter size and weight at birth; milk yield and pre-weaning mortality rate significantly (P≤0.05) better than those of received untreated diet (control group).

It can be concluded that supplementation 400 gm/ Ton Zinc-Methionine to Cal rabbit diet showed a great role in enhancing the immune system, improved growth performance, blood metabolites and reproductive performance. From the economic point 400 gm/ Ton Zinc-Methionine is recommended for both growing and mature (bucks + does) rabbits.

Key words: rabbits; Zinc-Methionine; blood; carcass; performance, semen, fertility.

INTRODUCTION

Rabbits provide an excellent source of animal protein for human consumption and may play an essential role in solving a part of meat shortage in developing countries including Egypt (Seleem and Rowida, 2005).

Supplementing various materials from different sources to rabbit's diets now is widely used for improving productive and reproductive performance (Boulous et al., 1992 and Seleem et al., 2006 and 2007a& b). Such materials included chemical products, antibiotics, enzymes, hormones, natural herbs ...etc) play an essential role in the rabbit industry. Using some artificial feed additives in animal production become international refused due to their adverse and side effects on both animal and human health (Marzo, 2001). It is interested to replace these feed additives with other substances have no effects on animal and human health (Abaza and El-Said, 2005).

Trace element of rabbit diets has traditionally been supplemented through the use of inorganic salts. However, the intrinsic and extrinsic factors are known to affect the bioavailability of dietary inorganic trace elements. Continuous efforts have been made over the past years to improve their utilization by farm animals. It is well known that trace elements can improve growth performance, reproduction and general health status. There are two forms of zinc as a trace element available in the market for using in animal nutrition as "organic zinc and non-organic zinc ".

Zinc has numerous biological roles including protein metabolism (Forbes, 1984), DNA synthesis (Lieberman et. al., 1963), cell division and multiplication (Rubin, 1972 and Rubin and Koide, 1973), the cell mediated immune response (Fraker, et al., 1977 and Bertuzzi, et al., 1998) and performance (Sadoval, et al., 1999 and Collins and Moran, 1999), carbohydrate metabolism, and basic functions in growth performance (Mohanna, et al., 1999). Zinc is involved in boosting the immune system to disease outbreaks (Luecke, et al., 1978). Kidd, et al. (1996) added that, Zinc is the only metal to be essential for at least one enzyme in all six enzyme classes as follows: Oxidoreductase (4 enzymes), transferase (3 enzymes), hydrolase (3 enzymes), lyase (one enzyme). isomerase (one enzyme) as well as ligase (one enzyme).

Therefore, the aim of this study was to detect the effect of three levels of commercial organic mineral of Zn-Meth as commercial product on productive and reproductive performance and carcass characteristics of Californian rabbits

MATERIALS AND METHODS

The present study was conducted in a private Industrial Rabbitry, located in El-Shagaah Village, near El-Nobariah City, El-Beherah Province, Egypt, during the period from September, 2007 till January, 2008. The study aimed to evaluate some productive and reproductive aspects of growing and mature rabbits as affected by supplementation of Zinc-Methionine to the diets.

The present work included two Experiments. The first experiment was lasted 40 days and carried out during growing period on 230 weaned Cal rabbits aged 30 days. The second Experiment was lasted 4 months and carried out on 80 monoparous does and 14 sexual mature bucks of Cal rabbits aged 6 months.

The animals in two Experiments were divided into two equal comparable experimental groups (115 growing rabbits, 7 bucks and 40 does in two sequence parities in each group). The first group was kept untreated (as a control group) and fed the commercial basal diet, while the other group was fed the same diet and supplemented with 400 gm/ Ton Zinc-Methionine (ZM), during the experimental period. The pelleted rations fed to the experimental animals were covering the nutritional requirements of the growing and breeding phase of rabbits according to NRC (1977) recommendations. Ingredients calculated and chemical composition of the pelleted rations is shown in Table 1. Animals were individually housed in wired battery cages supplied with feeders and stainless steel nipples for eating and drinking. All batteries were located in a windowed Rabbitry with natural ventilation. Fresh tab water was automatically available all the time in each cage. All the experimental animals were healthy and clinically free from internal and external parasites and were kept under the same managerial and hygienic conditions. The averages of daily feed intake, daily weight gain and feed conversion values of growing Cal rabbits were calculated and recorded weekly.

At the end of the first Experiment (marketing age, 70 days), twenty growing rabbits from each experimental group were randomly taken for slaughter test after being fasted for 12 hours (Abd El-Monem, 1995). After complete bleeding, the carcass, spleen, kidneys, liver, hurt and lungs were weighed. Dressing percentages were the quotient of carcass weight values divided by corresponding pre slaughter (live body) weight values.

Blood samples of growing rabbits were collected during slaughter of 20 rabbits within each experimental group at the end of Experiment 1 (70 days age). Blood samples were collected into dry clean centrifuge tubes. Blood serum was separated by centrifugation at 3000 r.p.m. for 20 minutes and kept in a deep freezer at (-20 ^{0}C) until biochemical analysis. Non-coagulated blood was tested shortly after collection for estimating blood pictures. Red and white blood cells were counted according to Hepler (1966) and Hawkey and Dennett (1989). Hemoglobin concentration and Hematocrite percentage were measured according to Wintrobe (1965) and Tietz (1982).

Total protein level was estimated according to Armstrong and Corri (1960). Albumin level was estimated according to Doumas *et.al.* (1971). Globulin level values were obtained by subtracting the values of albumin from the corresponding values of total protein. Albumin/ globulin ratios were calculated by dividing albumin values on corresponding globulin values. The activities of glutamic-oxaloacetic transaminase (GOT) {aspartate aminotransferase AST} and glutamic-pyruvic transaminase (GPT) {alanine aminotransferase ALT} were estimated according to Reitman and Frankel (1957). Blood samples of rabbit bucks were taken in less than two minutes from the marginal ear vein of six rabbit bucks within each experimental group monthly. Blood serum testosterone hormone concentration of the rabbit bucks was determined (RIA Kits from Immunotech, A Coulter Co., France) according to the manufacturer information.

Libido (sexual desire) was assessed in terms of reaction time in seconds that was estimated just from the time of introducing doe to the buck until the buck start to mount (Daader *et. al.,* 1999a& b and Seleem, 2003). Semen was collected artificially twice a week for up to five weeks by means of an artificial vagina as described by Seleem (1996& 2003). Semen samples ejaculated from each rabbit buck were evaluated individually microscopically and then semen ejaculate volume (ml); advanced sperm motility (%); live spermatozoa (%); morphological normal spermatozoa (%); sperm-cell concentration (N x 10^6/ ml) and total -sperm output (N x 10^6/ejaculate) were estimated according to Salisbury *et. al.* (1978). Acrosome status was determined by using a Giemsa stain procedure as described by Watson (1975).

At the end of experiment, four rabbit bucks from each experimental group were randomly chosen and slaughtered. Live body weight and weights of each of pituitary gland and gonads represented by testes; epididymis and sexual accessory glands were evaluated. Scrotal circumference was measured as the method described by Mickelsen *et. al.* (1982). Testicular index (length x width x depth) was calculated in cubic centimeters as recorded by Daader *et. al.* (2003). Mating activity (frequency of mating within 15 minutes) of each buck was determined using sexually receptive doe.

In the fertility traits, 80 Cal rabbit does in two experimental groups (40 doe in each) and received the same treatments of rabbit bucks were naturally mated in two sequence parities using the experimental groups of rabbit bucks. Natural mating was carried out by transferring each doe to the buck's cage to be mated and return back to its cage after mating. Palpation of all rabbit does was carried out 12 days post mating to determine pregnancy. At kindling, kindling rate and litter size and weight at birth values were recorded. Pre weaning mortality rates and milk yield per doe were estimated also during the suckling period. Milk yield was estimated after deprivation of the pups from suckling their mothers for 24 hours, then the pups were weighed before and after suckling, the increase in pup's weight was used as the doe milk yield.

Data were subjected to analysis of variance according to Snedecor and Cochran (1982) using the General Linear Model Program of SAS (2001). Percentage values were transformed to Arc. Sin values before being statistically analyzed. Duncan's new multiple range tests was used to test the significance of the differences between means (Duncan, 1955). Number of conciered does, kindling rates were analyzed using the Contingency Tables according to Everitt (1977).

Table 1: The ingredients and chemical composition of the pelleted ration fed to rabbits, during the experimental period.

Ingredients	Percentages	
	Growing diet	Breeding diet
Clover hay	30.00	40.50
Wheat bran	26.20	25.00
Yellow corn	-----	14.00
Barley grain	23.00	-----
Soybean meal (44%)	16.00	11.00
Molasses	3.00	3.00
Vinass	-----	3.00
Bone meal	-----	1.75
Limestone	1.00	0.70
Sodium chloride	0.50	0.55
Vitamins & Mineral Premix *	0.30	0.35
DL-Methionine	-----	0.15
Total	**100.00**	**100.00**
lated chemical composition		
**	16.72	18.00
Crude protein (CP) %	2.95	3.00
Ether extract (EE) %	13.07	14.00
Crude fiber (CF) %	2490.00	2720.00
Digestible energy (Kcal/Kg)		

***Vitamins and minerals premix per Kilogram contains:**

Items	Growing diets	Breeding diets	Items	Growing diets	Breeding diets
Vit.A (IU)	10,000	10,000	Biotin (mg)	0.2	0.2
Vit.D3 (IU)	2000	900	Choline (mg)	1200.0	12000
Vit.E (mg)	10000	5000	Niacine (mg)	40.0	50.0
Vit.K (mg)	3.00	2.00	Zn. (mg)	60.0	70.0
Vit.B1 (mg)	1.00	2.00	Cu. (mg)	0.1	0.1
Vit.B2 (mg)	4.00	6.00	Mn. (mg)	62	85
Vit.B6 (mg)	3.00	2.00	Fe. (mg)	40.0	75.0
Vit.B12 (mg)	0.02	0.01	Folic acid (mg)	1.0	5.0
			Pantothenic acid (mg)	15.0	20.0

** Calculated according to **NRC (1994)** for rabbits.

RESULTS AND DISCUSSION

1- Growing rabbit's performance (Experiment 1):

1.1- Growth rate:

Data presented in Table 2 showed that, daily weight gain, feed efficiency and feed conversion values of growing Cal rabbits ate diets supplemented with 400 gm/ Ton Zinc-Methionine improved significantly ($P \leq 0.05$) while daily feed intake was insignificantly higher than those of received untreated diets group. These findings were comparable with those obtained by Abou EL-Wafa *et. al.*(2003) in broiler; Waibel *et. al.* (1974) and Kidd *et. al.*(1994) in turkeys; and Fraker *et. al.* (1977) in mouse.

The improvement in rabbit productive performance may be du to the fact that phytic acid in plant diets inhibits absorption of Zn (O'Dell and Savage, 1960). Re-absorption of both endogenously secreted Zn and dietary Zn are impaired by presence of phytic acid. Furthermore, phytic acid lowers the absorption of Zn through formation of an insoluble complex in the lumen of intestine (Oberleas, *et al.,* 1966). Organic Zinc as Zn-Meth. may be more biologically available than inorganic form such as ZnO. Abou EL-Wafa, *et al.* (2003) reported that supplementing broiler with commercial organic mineral products of zinc-methionine (inorganic) significantly improved body weight, feed conversion and blood plasma of total protein, globulin compared with the control diet during 21-42 days of age or overall period. Dietary Zn-Meth did not affect carcass characteristics (percentages of dressing, liver, heart, gizzard and abdominal fat). Also, they indicated that addition of Zn-Meth to control diet recorded the best economical efficiency compared with the other treatments.

1.2. Carcass and blood parameters:

Tables 3 and 4 revealed that, feeding diet supplemented with 400 gm/ Ton Zinc-Methionine significantly ($P \leq 0.05$) improved dressing percentage, and carcass, and internal organs percentages of each of spleen; kidneys; liver; heart and lungs, as well as, blood picture of growing Californian rabbits represented by (red and white blood cells count; hemoglobin concentration and hematocrite percentage) and some blood constituents such plasma total protein and its fractions (albumin; globulin and albumin/ globulin ratio). Some enzymes indicated liver activity of growing Californian rabbits represented by values of each of glutamic-oxaloacetic transaminase (GOT) and glutamic-pyruvic transaminase (GPT) also increased significantly ($P \leq 0.05$) and were within the normal range by feeding diets supplemented with 400 gm/ Ton Zinc-Methionine than those of that free Zinc-Methionine. These results are in agreement with those obtained by Abou EL-Wafa *et. al.*(2003) in broiler; Waibel *et. al.* (1974) and Kidd *et. al.* (1994) in turkeys; and Fraker *et. al.* (1977) in mouse. The significantly improvement in blood parameters may be due to the improvement in immune responsiveness (McDowell, 1989; William, 1999; Abd-El Hakim *et al.,* 2002 and Daader *et al.,* 2002).

Table 2. Daily feed intake; daily weight gain; feed efficiency and feed conversion of growing Cal rabbits fed diets supplemented with Zinc-Methionin (Means ± SE).

Variables	Zinc-Methionin gm/ Ton	
	0.0 (Control)	400
Daily feed intake (gm)	75.7 ± 4.9	80.1 ± 4.0
Daily weight gain (gm)	21.8 ± 1.1 ^{B}	27.6 ± 1.4 ^{A}
Feed efficiency	0.288 ± 0.04 ^{B}	0.345 ± 0.03 ^{A}
Feed conversion	3.47 ± 0.41 ^{A}	2.9 ± 0.3 ^{B}

A, B Means within the same row are bearing different superscripts, differ significantly (P ≤ 0.05).

Table 3. Dressing percentage and internal organs weight of growing Cal rabbits fed diets supplemented with Zinc-Methionin (Means ± SE).

Variables	Zinc-Methionin gm/ Ton	
	0.0 (Control)	400
Pre-slaughter weight	1592.4 ± 39.9 ^{B}	1701.4 ± 41.2 ^{A}
Carcass weight	1093.7 ± 47.5 ^{B}	1211.2 ± 37.2 ^{A}
Dressing percentage	68.68 ± 0.3 ^{B}	71.19 ± 1.2 ^{A}
Spleen weight (gm)	1.29 ± 0.14 ^{B}	1.64 ± 0.17 ^{A}
Spleen weight (%)	0.081±0.02 ^{B}	0.096 ±0.0.3 ^{A}
Kidneys weight (gm)	10.19 ± 1.6 ^{B}	13.21 ± 1.4 ^{A}
Kidneys weight (%)	0.64±0.01 ^{B}	0.78 ±0.02 ^{A}
Liver weight (gm)	46.55 ± 2.9 ^{B}	52.57 ± 3.3 ^{A}
Liver weight (%)	2.92±0.08 ^{B}	3.09 ±0.07 ^{A}
Heart weight (gm)	5.99 ± 0.43 ^{B}	6.17 ± 0.37 ^{A}
Heart weight (%)	0.38±0.03 ^{B}	0.36 ±0.02 ^{A}
Lungs weight (gm)	7.94 ± 0.60 ^{B}	9.81 ± 0.59 ^{A}
Lungs weight (%)	0.50±0.01 ^{B}	0.58±0.02 ^{A}

A, B Means within the same row are bearing different superscripts, differ significantly (P ≤ 0.05).

2- Mature rabbit's performance (Experiment 2)

2.1. Reproductive parameter of bucks

Data presented in Table 5 indicated that, supplementing 400 gm/ Ton Zinc- Methionine to the diets of Californian rabbit bucks significantly ($P \leq 0.05$) improved their reproductive capability represented by libido (sexual desire) and physical semen characteristics (semen-ejaculate volume; advanced-sperm motility; live and normal spermatozoa; acrosome status; sperm-cell concentration and total-sperm output).

Tables 6 and 7 showed that, and relative of each of gonads represented by (testes; epididymis and sexual accessory glands) and pituitary gland weight; scrotal circumference and testicular index, as well as, testosterone concentration and mating activity (number of mating within 15 minutes) of Cal rabbit bucks feed diets supplemented with 400 gm/ Ton Zinc- Methionin were significantly ($P \leq 0.05$) higher, while live body weight was insignificantly higher than those of untreated group.

The improvement in reproductive performance of bucks in treated group may be due to the powerful role of Zinc- Methionin the process of sperm formation, sperm maturation, and the maintenance of sperm quality. Zinc- Methionin is particularly vital in both the development and maturation of sperm in the testes, in the development of the sperm membrane, and in the metabolic processes as an energy source following ejaculation (Balercia, *et al.,* 2005).

2.2. Some doe traits:

Data presented in Tables 8 and 9 showed that, Californian rabbit does ate diets supplemented with 400 gm/ Ton Zinc- Methionin and mated naturally by using bucks treated with the same supplemented diets recorded kindling rate, litter size and weight at birth; milk yield/ doe significantly ($P \leq 0.05$) higher, and pre-weaning mortality rate significantly ($P \leq 0.05$) lower than those of ate diets free Zinc- Methionin (control group).

The increase litter size and weight of newborn rabbits may be related to that; Zinc-Methionin was initially identified as an essential nutrient in newborns. Increased appetite and feed efficiency in rabbits this may leads to increased milk secretion and its yield in treated rabbits. Beside that, the increase in milk production may be due to the increase in litter size at birth and at weaning where there was a positive correlation between the litter size and milk yield (Lebas *et al.*, 1997 and Rommers *et al.*, 2001). Whereas, the increase in litter size seemed to induce stimulation for mammary glands to produce the highest quantity of milk (El-Sayiad, 1994). The increase in blood picture parameters during puerperium may serve in preparing the demands of milk secretion in this stage, since it needs amino acids and other nutrients, which are taken from the doe circulation. Finally, the improve in litter traits proved that Zinc- Methionin treatment is capable to improve the milking ability of the doe which is reflected in her care and ability to suckle her young till weaning.

In conclusion, it could be concluded from the results obtained that, supplementation of 400 gm/ Ton Zinc-Methionin to the diets improved the productive and reproductive capabilities of growing and mature Californian rabbits.

Table 4. Blood picture and some blood serum constitute of growing Cal rabbits fed diets supplemented with Zinc-Methionin (Means ± SE).

Variables	Zinc-Methionin gm/ Ton		Normal range
	0.0 (Control)	400	
Red blood cells (N x 10^6/mm^3)	6.42 ± 0.21^B	6.76 ± 0.24^A	5.3-6.8
White blood cells (N x 10^3/mm^3)	6.94 ± 0.03^B	8.99 ± 0.03^A	5.1-9.7
Hemoglobin (gm/ dL)	12.02 ± 0.1^B	13.45 ± 0.09^A	9.8-14.0
Hematocrite (%)	34.23 ± 0.51^B	39.78 ± 0.36^A	34.0 – 43.0
Total protein (m gm/ 100ml)	6.58 ± 0.07^B	7.46 ± 0.07^A	5.0-7.5
Albumin (m gm/ 100ml)	3.69 ± 0.09^B	4.71 ± 0.08^A	2.7-5.0
Globulin (m gm/ 100ml)	2.89 ± 0.05^B	2.75 ± 0.04^A	1.5-2.7
Albumin/ globulin ratio	1.28 ± 0.06	1.71 ± 0.12	0.8 -1.9
SGOT (AST) (U/ L)	29.81 ± 0.19^B	34.92 ± 0.24^A	20.7-42.9
SGPT (ALT) (U/ L)	18.64 ± 0.99^B	22.10 ± 0.43^A	12.0-25.0

A,B.. Means within the same row are bearing different superscripts, differ significantly ($P \leq 0.05$).

*According to Seleem (2003)

**According to Beshandy (2000).

Table 5. Libido and physical semen characteristics of Cal rabbit bucks fed diets supplemented with Zinc-Methionin (Means ± SE).

Variables	Zinc-Methionin gm/ Ton	
	0.0 (Control)	400
Sexual desire –libido- (sec.)	28.9 ± 3.1 ^{A}	16.9 ± 2.8 ^{B}
Semen-ejaculate volume (ml)	0.54 ± 0.03 ^{B}	0.81 ± 0.02 ^{A}
Advanced-sperm motility (%)	69.4 ± 2.6 ^{B}	81.7 ± 3.2 ^{A}
Alive spermatozoa (%)	81.6 ± 3.2 ^{B}	89.4 ± 1.6^{A}
Morphological normal spermatozoa (%)	83.4 ± 2.2 ^{B}	89.9 ± 3.7 ^{A}
Acrosomal damages (%)	12.6 ± 1.0 ^{A}	9.7 ± 0.9 ^{B}
Sperm-cell concentration (N x 10^6 / ml)	490.2 ± 28.7 ^{B}	714.6 ± 34.6 ^{A}
Total-sperm output (N x 10^6 / ejaculate)	264.7 ± 19.6 ^{B}	578.8 ± 27.7 ^{A}

A, B.. Means within the same row are bearing different superscripts, differ significantly ($P \leq 0.05$)

Table 6. Body, gonads and pituitary gland weights, scrotal circumference and testicular index of Cal rabbit bucks fed diets supplemented with Zinc-Methionin (Means ± SE).

Variables	Zinc-Methionin gm/ Ton	
	0.0 (Control)	400
Live body weight (gm)	3101.9± 64.6	3222.5± 54.7
Testes weight (gm)	5.54 ± 0.19 ^{B}	6.66 ± 0.29 ^{A}
Testes weight (%)	0.179 ± 0.01 ^{B}	0.207 ± 0.06 ^{A}
Epididymis weight (gm)	0.89 ± 0.01 ^{B}	0.99 ± 0.00 ^{A}
Epididymis weight (%)	0.029 ± 0.01 ^{B}	0.031 ± 0.00 ^{A}
Sexual-accessory glands weight (gm)	2.79 ± 0.28 ^{B}	3.69 ± 0.11 ^{A}
Sexual-accessory glands weight (%)	0.090 ± 0.00 ^{B}	0.115 ± 0.04^{A}
Pituitary gland weight (gm)	0.29 ± 0.01 ^{B}	0.34 ± 0.02 ^{A}
Pituitary gland weight (%)	0.009 ± 0.00 ^{B}	0.011 ± 0.00 ^{A}
Scrotal circumference (cm)	7.19 ± 0.09 ^{B}	7.84 ± 0.12 ^{A}
Scrotal circumference (%)	0.232 ± 0.01 ^{B}	0.243 ± 0.016 ^{A}
Testicular index (cm^3)	5.92 ± 0.07 ^{B}	6.68 ± 0.06 ^{A}
Testicular index (%)	0.191 ± 0.04 ^{B}	0.207 ± 0.05 ^{A}

A,B.. Means within the same row are bearing different superscripts, differ significantly ($P \leq 0.05$)

Table 7. Testosterone concentration and mating activity of Cal rabbit bucks fed diets supplemented with Zinc-Methionin (Means ± SE).

Variables	Zinc-Methionin gm/ Ton	
	0.0 (Control)	400
Testosterone concentration (ng/ ml)	4.46 ± 0.29 B	5.98 ± 0.33 A
Mating activity (frequency of mating/ 15 minutes)	3.64 ± 0.49 B	4.99 ± 0.46 A

A, B... Means within the same row are bearing different superscripts, differ significantly ($P \leq 0.05$).

Table 8. Some doe traits of Cal rabbit do naturally mated and fed diets supplemented with Zinc-Methionin (Means ± SE).

Variables	Zinc-Methionin gm/ Ton	
	0.0 (Control)	400
Number of mating	40 X 2	40 X 2
Number of conceived does	51^{B}	64^{A}
Kindling rate (%)	63.75^{B}	80.0^{A}
Litter size at birth	5.86 ± 0.46^{B}	7.72 ± 0.38^{A}
Litter weight at birth (gm)	249.3 ± 31.4^{B}	342.9 ± 19.5^{A}

A, B.. Means within the same row are bearing different superscripts, differ significantly ($P \leq 0.05$)

Table 9. Milk yield and pre-weaning mortality rate of Cal rabbit does naturally mated and fed diets supplemented with Zinc-Methionin (Means ± SE).

Variables	Periods		Zinc-Methionin gm/ Ton	
	From	To	0.0 (Control)	400
Milk yield (gm/ doe)	Birth	7 days	604.33 ± 21.72^{B}	786.24 ± 27.91^{A}
	Birth	14 days	2010.36 ± 28.62^{B}	2204.75 ± 26.96^{A}
	Birth	21 days	2815.32 ± 31.42^{B}	3014.29 ± 29.65^{A}
	Birth	28 days	3128.34 ± 43.46^{B}	3335.39 ± 39.94^{A}
Pre-weaning mortality rate	Birth	7 days	2.65 ± 0.27^{A}	1.68 ± 0.19^{B}
	Birth	21 days	6.11 ± 0.18^{A}	4.17 ± 0.24^{B}
	Birth	28 days	7.12 ± 0.24^{A}	5.92 ± 0.31^{B}

A, B.. Means within the same row are bearing different superscripts, differ significantly ($P \leq 0.05$).

REFERENCES

Abaza, I.M. and H. El-Said (2005). Effect of using yucca schidigera as feed additive on performance of growing rabbits. *Proceeding 4th International Conference Rabbit Production Hot Climates*, 24-27 Febr., Sharm El-Sheik, Egypt, 259-266.)

Abd El-Monem, U.M. (1995). Heat stress effects and their amelioration on some traits of rabbits under Egyptian summer conditions in Egypt. M. Sci. Thesis, Faculty of Agriculture, Zagazig University, Zagazig, Egypt.

Abd-El Hakim, A.S.; A.A. Sedki and A.M. Ismail (2002). Black seed forms and its effect on rabbits performance and blood constituents. *3rd Science Conference On Rabbit Production in Hot Climate,* 8-11 October. Hurghada, Egypt.: 579-588.

Abou EL-Wafa, S.; Sayed, M.A.M.; Ali, S.A. and Abdallah, A.G. (2003). *Performance and immune response of broiler chicks as affected by methionine and zinc or commercial zinc-methionine supplementations. Egypt. Poult. Sci., 23 (III): 523-540.*

Armstrong, W.D. and C.W. Corri (1960). *Physiological Chemistry.* Laboratory Diction, 3rd Edition, P. 75 Punges publishing Co., Minneapolis, USA.

Balercia, G.; F. Regoli; T. Armeni; A. Koverech; F. Mantero; and M. Boscaro (2005). Placebo-controlled double-blind randomized trial on the use of L-carnitine, L-acetylcarnitine, or combined L-carnitine and L-acetylcarnitine in men with idiopathic asthenozoospermia. *Fertility Steril.*, 84 (3):662-671.

Bashandy, A. M.(2000). *Gide for the care and use of laboratory animals in medical research*, Egypt.

Bertuzzi, S.; Manfreda, G. and Franchini, A. (1998). *Influence of dietary inorganic zinc and vitamin E on broiler immune response. Selezione-Veterinaria, 8-9: 627-636.*

Boulos, N.Z.; Shalash, M.A. EL-Skeikh; H.M. Abdella and N.A. Hattaba (1992). Effect of the biogenic enhancer Ascogenr on laying hen performance. *Egyptian Poultry Science,* 12 :679-695.

Collins, N. E. and Moran, E. T. Jr. (1999). *Influence of supplemental manganese and zinc on live performance and carcasses quality of broilers. J. of Applied Poultry Research, 8 (2): 222-227.*

Daader, A. H.; H. A. Gabr; A. M. F. Khadr and T. S. T. Seleem (2003). Some nutritional and physiological aspects of heat-stressed rabbits as affected by Diuretics and/ or Gn-RH. *Egyptian Journal Nutrition and Feeds*, 6, (Special Issue): 245-252.

Daader, A. H.; M. M. Nasr-Alla; I. A. Azazi; S. M. Attia and T. S. T. Seleem (2002). Amelioration of heat stressed Bouscat rabbits by feeding diurnally or nocturnally diets containing *Nigella Sativa L.* or *Fenugreek. 3rd Science Conference on Rabbit Production in Hot Climates*, 8-10 October, Hurghada, Egypt, 287-300.

Daader, A.H.; H.A. Gabr and T.S.T. Seelem. (1999a). Reproductive performance of Californian rabbits as affected by season of the year and oxytocin or adrenaline. *1st International Conference on Indigenous Versus Acclimatized Rabbits*, 7-9 Sept., El-Arish, North-Sinai, Egypt, 299-311.

Daader, A.H.; H.A. Gabr and T.S.T. Seleem (1999b). Productive and reproductive performance of New-Zealand White and Californian rabbit bucks as affected by supplementing vitamin "A" to the diet, during summer and winter seasons. *7th Science Conference on Animal Nutrition*, 19-21 Octob., El-Arish, North-Sinai, Egypt, 551-564.

Doumas, B.; Watson; W. and Biggs H. (1971). Albumin standars measurement of serum with bromocresol green. *Clinical Chemistry Acta*, 31:37.

Duncan, D.B. (1955). Multiple Range and Multiple (F-test). *Biometrics*, 11: 1-42.

El-Sayiad, G. A. (1994). A study on milk production of New Zealand White and Californian rabbits under Egyptian conditions. *Egyptian Journal of Rabbit Science,* 4:47-59.

Everitt, B.S. (1977). *The Analysis of Contingency Tables. Monographs of Applied Probability and Statistics.* pp, 38-66 London, Chopman Hall.

Forbes, R. M. (1984). *Use of laboratory animals to define physiological functions and bioavailability of zinc. Fed. Prd. C., 43: 3835.*

Fraker, P. J.; Hass, S. M. and Luecke, R. W. (1977). *Effect of zinc deficiency on the immune response of the young adult mouse. J. Nutr., 107: 1889.*

Hawkey, C. M. and Dennett T. B. (1989). A Color Atlas of Comparative Veterinary Hematology Wolf Publishing Limited, London, England.

Hepler, O. E. (1966). *Manual of Clinical Laboratory Methods*. Thomas Spring Field, Illinois.

Kidd, M. I.; Ferket, P. R. and Qureshi, M. A. (1996). *Zinc metabolism with special reference to its role in immunity. World's Poult. Sci., J. 52: 309-324.*

Kidd, M.T.; Qureshi, M. A.; Ferket, P. R. and Thomas, L. N. (1994). *Blood clearance of escherichia coli and evalution of mononuclear-phagocytic system as influenced by supplemental dietary zinc methionine in young turkeys. Poult. Sci., 73:1381-1389.*

Lebas, F.; P. Coudert; H. De. Rochambeau; and R. G. Thébault (1997). The Rabbit Husbandry, Health and Production. *Food and Agriculture Organization of the United Nations*, FAO, Rome, Italy.

Lieberman, I.; Abrams, R.; Hunt, N. and Ove, P. (1963). *Levels of enzyme activity and deoxyribonucleic acid synthesis in mammalian cells cuttured from the animal. J. Biol. Chem. 238: 3955.*

Luecke R. W.; Simonel, C. E. and Ferker, D. J. (1978). *The effect of restricted dietary intake on the antibody mediated response of the zinc deficient A/J mouse.J.Nutr.8:881.*

Marzo, I. (2001). New strategies in rabbit feed: Additives and alternatives to antibiotic use. *26th Symp. ASESCU,* Aveiro, (Portugal), 51-68.

McDowell, L.R. (1989). *Vitamins in Animal Nutrition.* Academic Press, Inc., San Diego.

Mickelsen, W. D.; L. G. Paisley and J. J. Dahmen (1982). The relationship of libido and serving capacity test score in rams on conception and lambing percentage in the ewe. *Theriogenology,* 18: 79.

Mohanna, C.; Carre, B. and Nys, Y. (1999). *Influence of dietary viscosity on growth performance and zinc and manganese biovailability in broilers . Animal Feed Science and Technology ,77(3-4):255-266.*

NRC (1977). *Nutrient Requirements of Rabbits.* National Academy of Science, Washington, DC. USA.

O'Dell, B.L. and Savage, J.E. (1960). *Effect of phytic acid on zinc availability. Proc. Soc. Exper. Biol. Med. 103:304-306.*

Oberleas, D.; Muhrer, M. E. and O'Dell, B. L. (1966). *Dietary metal-complexing agents and zinc availability in the rat. J. Nutr. 90:56-62.*

Reitman, S. and M. Frankel (1957). An colorimetric method for determination of serum oxaloactic and glutamic pyruvic transaminase. *Animal Clinical Pathology Journal*, 16: 28-56.

Rommers, J. M.; Meijerhof; R. Noordhuizen; J. P. T. M and Kemp B. (2001). Effect of different feeding levels during rearing and age at first insemination on body development, body composition and puberty characteristics of rabbit does. *World Rabbit Science*, 9:101-108.

Rubin, H. (1972). *Inhibition of DNA synthesis in animal cells by ethylene diamine tetracetate and its reversal by zinc. Proc. Natl. Acad. Sci., USA. 69:712.*

Rubin, H. and Koide, T. (1973). *Inhibition of DNA synthesis in chick embryo cultures by deprivation of either serum of zinc. J. Cell Biol. 56: 777.*

Sadoval, M.; Henry, P. R.; Littell, R. C.; Miles, R. D.; Butcher, G. D. and Ammerman, G. B. (1999). *Effect of dietary zinc source and method of oral administration on performance and tissue trace mineral concentration of broiler chicks. J.Anim. Sci., 77 (7): 1788-1799.*

Salisbury, G. W.; N. L. Van Demark; and J. R. Lodge (1978). *Physiology of Reproduction and Artificial Insemination of Cattle.* W.H. Freeman and Company, San Francisco, *USA.*

SAS (2001). *Statistical Analysis System.* User's Guide Version 8.2, Cary NC. USA.

Seleem, T.S.T and Rowida M. Riad (2005). Enzymatic activity and fertilizing ability of rabbit semen supplemented with *Nigella sativa* extraction. *The 4th International Conference on Rabbit Production in Hot Climate*, Sharm El-Sheikh, Egypt:183-189.

Seleem, T.S.T. (1996). Studies on some reproductive characteristics in rabbits. M. Sci., Thesis, Faculty of Agricuture, Zagazig Universty, Zagazig, Egypt.

Seleem, T.S.T. (2003). Studies on productive and physiological characteristics of rabbits under different managerial conditions. Ph.D. Thesis, Faculty of Agriculture, Zagazig University, Zagazig, Egypt.

Seleem, T.S.T.; A. E. M. Abd El-Motaa; I.M.M. Assaf; A.M.A. Torkia and Leila B. Bahgat (2007b). Some productive and reproductive performance of rabbits as affected by supplementing *Nigella Sativa* to the diet. *The 5th Inter. Con. on Rabbit Prod. in Hot Clim., Hurghada, Egypt, 273 - 286.*

Seleem, T.S.T.; A. E. M. Abd El-Motaal and K. H. El-Kholy (2006). Effect of L-carnitine preparation in drinking water on some productive and reproductive performance of NZW rabbits. *The 1st Conference. on Clean Environment and Safety Food*, December, Ain Shams University, Egypt.

Seleem, T.S.T; H. Ibrahim; A.M. Ali ; A.M. Abd-Elmotaal and A. E.B. Zeidan (2007a). Rabbit performance as affected by *Origanum Majorana* in diets. *The 5th Inter. Con. on Rabbit Prod. in Hot Clim., Hurghada, Egypt, 495 - 508*

Snedecor, G.W. and W.G. Cochran (1982). *Statistical Methods.* 2nd Ed. Iowa University, Press Ames, Iowa.

Tietz, N.W. (1982). *Fundamental of Clinical Chemistry.* Edition by Norbert Saurders Company. Philadelphia.

Waibel, P. E.; Vaughan, G. D. and Behrends, B. R. (1974). *Effect of zinc methionine complex on growth and reproduction in turkeys. Poult. Sci., 53:1988(Abstr.).* Weichselbaum, P.E. (1946). *Am.J.Path. 16,40.*

Watson, P. F. (1975). Use of Giemsa stain to detect changes in acrosomes of frozen ram spermatozoa. Veter. Research, 97: 12-15.

William, H.C. (1999). Organic minerals for pigs. Biotechnology in the feed industry, *Proceeding of the 15th Annual Symposium*, pp: 51, Nottingham University, Press. Nottingham,Leics.UK.

Wintrobe, M.M. (1965). *Clinical Haematology.* Lea and Febiger, Philadelphia.

Zeweil, H.S. (1996). Evaluation of substituting Nigella sativa oil meal for soybean meal on the performance of growing and laying Japanese quails. *Egyptian Poultry Science*, Vol. 16 (11): 451-477.

تأثير إضافة مثيونين الزنك في العليقة على معدلات ألاداء الإنتاجى و التناسلى فى الارانب

علاء الدين محمد عبد المتعال[1] ـ طارق عبد الغفار الأعصر[2]ـــ طارق جابر زكى[3]
[1]- قسم بحوث تغذية الدواجن، معهد بحوث الإنتاج الحيواني، مركز البحوث الزراعية، الدقي، جيزة، مصر.
[2]- قسم بحوث تربية الأرانب و الرومي و الطيور المائية، معهد بحوث الإنتاج الحيواني، مركز البحوث الزراعية، الدقى، جيزة، مصر.
[3]- قسم بحوث تربية الدواجن، معهد بحوث الإنتاج الحيواني، مركز البحوث الزراعية، الدقي، جيزة، مصر.

أستخدم فى هذه الدراسة 324 أرنب كاليفورنيا لتقييم تأثير إضافة مثيونين الزنك في العليقة على بعض معدلات الأداء الإنتاجية و التناسلية للأرانب.

اشتملت الدراسة على تجربتين أساسيتين. التجربة الأولى استغرقت 40 يوماً، و أجريت على 230 أرنب كاليفورنيا نامى مفطوم حديثاً على عمر 30 يوماً. و التجربة الثانية استغرقت أربعة أشهر و أجريت على 14 ذكر ناضج جنسياً، و 80 أم بكارة على عمر 6 أشهر من أرانب الكاليفورنيا.

قسمت كل الأرانب في التجربتين إلى مجموعتين تجربتين متساويتين لتضم كل مجموعة (115 أرنب نامى، 7 ذكر ناضج جنسياً، 40 أم في بطنين متتاليين). حفظت المجموعة الأولى بدون معاملة (مجموعة ضابطة) و غذيت على عليقة تجارية، بينما أضيف لعليقة المجموعة الثانية 400 جرام/ طن مثيونين الزنك خلال فترة التجربة. كانت العلائق المقدمة للأرانب تغطى الاحتياجات الغذائية لمرحلتي النمو و النضج الجنسي تبعاً لمقررات NRC (1994) الموصى بها.

أوضحت النتائج المتحصل عليها من هذه الدراسة أن قيم كل من الزيادة اليومية في وزن الجسم و كفاءة الغذاء لأرانب الكاليفورنيا النامية كانت أعلى معنوياً (عند مستوى 5%)، و كانت قيم معدل تحويل الغذاء إلى وزن حي أقل معنوياً (عند مستوى 5%)، بينما كانت كمية الغذاء المأكول اليومية أعلى بقدر غير معنوي بسبب إضافة 400 جرام/ طن مثيونين الزنك في العليقة مقارنة بالعليقة الغير مضاف إليها مثيونين الزنك. أدت تغذية أرانب الكاليفورنيا لعليقة مضاف إليها 400 جرام/ طن مثيونين الزنك إلى زيادة معنوية (عند مستوى 5%) فى نسبة التصافي و الأعضاء الداخلية النسبية متمثلة فى وزن و نسبة كل من (الطحال، الكليتين، الكبد، القلب، الرئتين)، و أيضاً قيم صورة الدم متمثلة فى كل من (عدد كريات الدم الحمراء و البيضاء، و تركيز الهيموجلوبين، و نسبة الهيماتوكريت)، بالإضافة إلى بعض مكونات الدم الأخرى مثل تركيز كل من بروتين بلازما الدم الكلى و مفرداته (الألبيومين، الجلوبيولين، نسبة الألبيومين إلى الجلوبيولين). سجلت مستويات إنزيمين الـ SGOT & SGPT الدالين على نشاط الكبد زيادة معنوية (عند مستوى 5%) كنتيجة لإضافة 400 جرام/ طن مثيونين الزنك فى عليقة أرانب الكاليفورنيا مقارنة بغيرها و التي تغذت على عليقة خالية من المثيونين زنك (المجموعة الضابطة).

أدى إضافة 400 جرام/ طن مثيونين الزنك فى عليقة ذكور الأرانب الكاليفورنيا الناضجة جنسياً إلى تحسين معنوي (عند مستوى 5%) فى رغبتها الجنسية و الخصائص الطبيعية للسائل المنوى متمثلة فى قيم كل من (حجم قذفة السائل المنوى و نسب كل من الحركة التقدمية للحيوانات المنوية، الحيوانات المنوية الحية و السليمة مورفولوجياً، حالة الأكروسوم و كذلك تركيز الحيوانات المنوية فى المل و فى القذفة)، بالإضافة إلى أوزان الغدة النخامية و الأعضاء الجنسية، و محيط كيس الصفن و الدليل الخصوى. سجلت ذكور أرانب الكاليفورنيا و المغذاه على عليقة محتوية على 400 جرام/ طن مثيونين الزنك قيم لكل من تركيز الهرمون الذكرى التستيسترون و النشاط التزاوجى (عدد مرات التلقيح فى 15 دقيقة) أعلى معنوياً (عند مستوى 5%) عن تلك التى تغذت على عليقة خالية من مثيبونين الزنك.

إناث أرانب الكاليفورنيا المقدم إليها عليقة محتوية على 400 جرام/ طن مثيونين الزنك و الملقحة طبيعياً من ذكور مغذاه على نفس العليقة سجلت قيم لكل من معدل ولادات، و عدد و وزن خلفات عند الميلاد، و محصول لبن لكل أم، و كذلك معدلات نفوق للخلفات قبل الفطام أفضل معنوياً (عند مستوى 5%) مقارنة بتلك التى سجلتها الأرانب التى تغذت على عليقة لا تحتوى على مثيونين الزنك (المجموعة الضابطة).

و مما سبق فإن الدراسة أوضحت فى مجملها أن إضافة 400 جرام/ طن مثيونين الزنك إلى علائق أرانب الكاليفورنيا النامية والناضجة جنسياً أعطى نتائج أفضل معنوياً (عند مستوى 5%) فى معدلات الأداء الإنتاجية والتناسلية مقارنة بالعليقة الخالية من المثيونين زنك.