WORLD RABBIT SCIENCE 1994, 2 (3), 79-86.

INFLUENCES OF SEASON AND DIETARY SUPPLEMENTATION WITH SELENIUM AND VITAMIN E OR ZINC ON SOME BLOOD CONSTITUENTS AND SEMEN QUALITY OF NEW ZEALAND WHITE RABBIT MALES.

EL-MASRY K.A.*, NASR A.S., KAMAL T.H.***

* Radiobiology Department, Nuclear Research Center, Atomic Energy Authority (Mail n° 13759) CAIRO - Egypt.
** College of Agriculture, Zagazig University, ZAGAZIG - Egypt.

SUMMARY : In a first experiment, six New Zealand White (NZW) rabbit males (12–15 months old) were subjected to winter (16 ± 3°C and 71 ± 8 % RH) and then to summer (35 ± 3°C and 46 ± 8 % RH) conditions to study the influence of hot summer season on some blood constituents and semen quality of rabbits males. The results showed that hot summer season significantly increased glucose, cholesterol, phospholipid, total lipid concentrations and transaminase enzymes activity in blood, whereas a significant decrease in blood concentrations of total protein, albumin and testosterone were recorded. During hot summer, there were significant rises in whole semen transaminase levels and dead sperm %, cholesterol and total lipids of seminal plasma, while total sperm and live sperm concentrations and sperm motility % were significantly decreased. In addition, hot summer season caused a decline in the mean values of both concentration rate % ($P<0.01$) and litter size at birth ($P<0.05$), as compared with those of winter season.
In a second experiment, performed during the hot season, 3x6 NZW males received a basal diet supplemented or not with 0.7 mg Se + 40 mg Vit. E/kg DM or 35 mg Zn/kg DM. A significant rise in blood testosterone, total sperm concentration and whole semen transaminase activity was recorded with Se + Vit. E supplementation, while a supplementation of Zn to the basal diets caused a significant decline in both blood and seminal plasma cholesterol, total lipids concentrations and transaminase enzymes level. On the contrary, a significant rise in testosterone concentration was detected. Also, semen volume, total live sperm concentrations, sperm mobility %, conception rate % and litter size at birth were significantly increased due to Zn supplementation to the heat stressed rabbit males.

RESUME : Influence de la saison et de la supplémentation de l'aliment en Sélénium et vitamine E ou Zinc sur les constituants sanguins et la qualité du sperme de lapins mâles NZW.
Dans une première expérimentation, six lapins mâles Néo Zélandais Blancs âgés de 12 à 15 mois, ont été soumis aux conditions hivernales (16 ± 3°C et 71 ± 8 % HR) puis estivales (35 ± 3°C et 46 ± 8 % HR) pour étudier l'influence de la saison chaude sur quelques constituants sanguins et sur la qualité du sperme des lapins mâles. Les résultats montrent que durant la saison chaude, dans le sang, les taux de glucose, de cholestérol, de phospholipides, de lipides totaux et l'activité de la transaminase augmentent significativement, tandis qu'une diminution significative des taux de protéines, d'albumine et de testostérone est enregistrée. Pendant la saison chaude, on constate un augmentation à la fois du taux de transaminase du sperme et du pourcentage de spermatozoïdes morts, du cholestérol et des lipides totaux dans le liquide séminal, tandis que le taux de spermatozoïdes total, et vivants, et le pourcentage de motilité des spermatozoïdes diminuent significativement. De plus la saison chaude provoque une baisse des valeurs moyennes du taux de conception % ($P<0.01$) et de la taille de la portée à la naissance ($P<0.05$) comparés aux valeurs hivernales.
Dans une seconde expérimentation, conduite durant la saison chaude, 3 x 6 mâles NZW ont reçu un régime standard supplémenté ou non avec 0.7 mg de Se + 40 mg de Vit. E/kg M.S., ou 35 mg Zn/kg M.S. Une augmentation significative du taux de testostérone sanguine, de la concentration du sperme et de l'activité de la transaminase a été enregistrée avec la supplémentaire Se + Vit. E, tandis que la supplémentaire en Zn du régime de base provoque une diminution à la fois dans le sang et dans le liquide séminal du taux de cholestérol, de lipides totaux et de transaminase. Au contraire, un augmentation significative des taux de testostérone a été détectée. Toutefois, le volume de sperme, la concentration totale et celle des spermatozoïdes vivants, le % de motilité, le taux de conception % et la taille de la portée ont été augmentés par l'apport de Zn aux lapins mâles stressés par la chaleur.

INTRODUCTION

High environmental heat adversely affects semen quality of rabbits (EL-FOULY *et al.* ; 1987, AMIN *et al.*, 1987 ; BICUDO and PASCHOAL, 1991) by disturbing the normal physiological balance of the animal's body, particularly mineral balance (KAMAL, 1982) and hormonal pattern (MARAI *et al.*, 1990 ; HABEEB *et al.*, 1992). The alterations in both blood and semen in protein, lipid fractions, testosterone level and their reflection on fertility on heat stressed rabbit bucks have not been adequately reported. On the other hand, the role that Se may play on semen quality may be attributed to its effect on epididymal and testis function (UNDERWOOD, 1977). Zn is incorporated in spermatozoa during spermatogenesis for maturation and survival of the germinal epithelium (UNDERWOOD

and SOMERS, 1977) and the imbalance or deficiency of Zn may disrupt the normal sperm chromatin quaternary structure (DVENSON *et al.*, 1993). The relationship between Se and Zn and semen characteristics of heat stressed rabbits are scanty. Therefore, the objectives of the present study were to measure the change in blood constituents level and semen quality of the heat stressed NZW rabbit males. It was also aimed to minimize the constraints of the environmental heat on semen quality by using Se with Vit. E or by using Zn supplements, for heat stressed NZW rabbit males.

MATERIAL AND METHODS

Two experiments were carried out in the National Rabbit Project Farm, Department of Animal Production, Faculty of Agriculture, Zagazig University. In the 1st experiment, the influence of hot summer season on blood constituents and semen quality of rabbit were investigated. Each experiment had six New Zealand White (NZW) rabbit males, 12–15 months old that were maintained under winter and summer season conditions for 3 months (from December to February in winter, and from June to August in summer). The values of the relative humidity (R.H. %) and environmental temperature (°C) averaged 71 ± 8 % and 16 ± 3°C, respectively in winter, and 46 ± 8 % and 35 ± 3°C respectively in summer.

In the second experiment, the effect of supplementation of the heat stressed animals by using either selenium (Se) as selenium sulfate with vitamin E or Zinc (Zn) as zinc sulfate were studied on blood constituents and semen quality using three groups, each of 6 NZW rabbit males, 12–15 months old. They were used for 3 months (June, July and August) when the relative humidity and environmental temperature averaged 42 ± 8 % and 37.5 ± 3°C respectively. Ingredient and chemical composition of the concentrated diet (AOAC, 1970) are presented in Table 1. The first group was offered a pelleted basal diet *ad libitum*. The 2nd group was fed the same basal ration supplements with 0.7 mg Se + 40 mg Vit. E/kg DM (produced by Medical Professions for Veterinary Products and Feeders Additions Company). The 3rd group received the basal ration + 35 mg Zn/kg DM. The supplements were mixed well with wet wheat bran and added to the concentrates for a period of three months. After six weeks, from the beginning of the treatments, heparinized blood samples were collected biweekly from the ear vein and their values of chemical analysis were averaged, while seminal ejaculate was collected from each buck twice weekly by using artificial vagina. Semen volume, percentage of spermatozoa progressive motility, spermatozoa concentration, percentages of live and abnormal spermatozoa, whole semen transaminase and alkaline phosphatase (AKP) activities were determined in each sample immediately after semen collection.

Table 1 : Ingredient and chemical composition of the concentrated rabbit diet during the experimental period.

Ingredient	% of Dry Matter
Berseem hay	38.00
Yellow corn	6.00
Decorticated cotton seed	11.60
Rice bran	21.00
Rice germ	22.38
Wheat flour	0.40
Molasses	0.50
Lime stone	0.08
Mineralized salt[1]	0.03
Vitamins mixture[2]	0.01
Chemical analysis (DM basis)	
Crude protein %	16.70
Crude fiber %	13.23
Ether extract %	2.47
Nitrogen free extract %	57.80
Ash %	8.90
Zn	14 ppm
Se	0.21 ppm
Gross energy[3]	16.83 MJ/kg DM

[1] Mineralized salt : Each kilogram of mineral mixture contains 15 mg Zn, 0.1 mg Co, 15 mg Mn, 50 mg Fe, 20 mg Cu.

[2] Vitamins mixture : each kilogram of vitamins mixture contains 10000 I.U. Vit. A, 900 I.U. Vit. D_3, 2 mg Vit. K, 0.2 mg Biotin, 0.01 mg Vit. B_{12}, 3 mg Folic acid, 4 mg Vit. B_1, 1200 mg cholin, 15 mg Vit. E, 65 mg Niacin, 2 mg Vit. B_6, 35 mg panthotenic acid, 6 mg Vit. B_2.

[3] Gross energy was calculated based on the chemical composition of concentrate according to ALDERMAN *et al.* (1975).

Sperm cell concentration (x 10^6/ml) was determined by the direct cell cont using the Neubauer hemocytometer, where semen was diluted with a physiological solution plus eosin stain at a rate of 1:200 before counting the cells. Live spermatozoa concentration (x 10^6/ml) was estimated by counting one hundred sperm cells in each of eosin–nigrosin stained smears from freshly collected semen according to CRESPO GARCIA (1956). The abnormalities percentage of spermatozoa were determined in the same smears prepared for live and dead sperm test. Two hundred spermatozoa were counted in each smear. Motility percentage was estimated by using a microscope provided with a hot stages according to ZEMJONIS (1970). The remaining whole semen was centrifugated at 3000 rpm for 10 minutes, and seminal plasma was prepared and frozen at – 20° C until chemical analysis.

The 6 rabbit males in each group were mated with 24 does during the experimental period and the conception rate % was calculated as follows : Number of fertilized does x 100/total mated does. Litter size at birth was also recorded. All blood and seminal biochemical analysis were assayed in Radiobiology Department, Atomic Energy Authority of Egypt, according to TIETZ (1982). The traits assayed in blood plasma and seminal plasma samples were total protein, albumin, cholesterol and total lipid concentrations. Globulin was calculated by subtracting albumin from total protein. Phospholipid and glucose of blood plasma were estimated. AKP, glutamic pyruvic and glutamic oxaloacetic transaminase (GPT and GOT respectively) of blood serum and whole semen were also determined by using a commercial kits manufactured by Bio Merieux, France. Zn and Se content of the basal diets were determined by atomic absorption spectrophotometry (AOAC, 1970). Blood and semen testosterone concentrations were determined by using Radio–Immuno–Assay technique (Commercial kits) manufactured by Amersham, England. In experiment 1, the differences between the means of winter and hot summer season groups were tested by Student's unpaired "t" test, while in experiment 2, the differences among the mean values of the treatments were tested using analysis of variance and least significant differences according to SNEDECOR and COCHRAN (1982).

RESULTS AND DISCUSSION

Data presented in Table 2 showed that blood glucose level increased ($P<0.05$) during summer compared to winter season. This may be explained by the decline in thyroid activity in animals during hot summer which, in turn decreases the ability to utilize glucose for energy production process (SANO *et al.*, 1983). At that time, the lack of insulin release in heat stressed animals has an effect on decreasing the rate of glucose utilization in tissues (MERTSCHING, 1981) which leads to the rise of blood glucose level. The significant ($P<0.05$) decline in blood plasma protein, which occurred during hot summer season and parallelled with that observed in albumin level, may be attributed to the decline in thyroid activity (SANO *et al.*, 1983) and testosterone level (Table 2), since the decline in these hormones disturbs the protein synthesis (HARPER *et al.*, 1979). The significant ($P>0.01$) rise in cholesterol, phospholipid and total lipid concentrations in blood plasma were evident in hot summer season compared with those obtained under winter season. The elevation in lipid fractions may have been due to increased lipid catabolism (SHEBAITA and KAMAL, 1975), and the less formed glycerol–3 phosphate, allowing the rate of lipolysis to exceed with subsequent accumulation of lipid fractions and their release into the blood (HARPER *et al.*, 1979). Transaminase (SGOT and SGPT) activities were raised during hot summer season as compared with those of winter season due to the rise in both environmental temperature and cortisol level (KUMAR, 1989). Blood testosterone level decreased by 39.5 % in hot summer season. Such a decrease is thought to be related to the physiological activity of Sertoli cells under the control of FSH and LH that had a major effect on the biosynthesis of testosterone (DENNIS, 1973).

The effect of hot summer season on physical characteristics and chemical composition of rabbit semen males are shown in Table 3. The rabbit males in summer season showed significant ($P<0.05$) lower total sperm and live spermatozoa concentration than those maintained under winter season conditions. These results were in agreement with the studies of AMIN *et al.* (1987) and BICUDO and PASCHOAL (1991)

Table 2 : Effect of hot summer season on some blood constituents (X ± S.E) in NZW rabbit males.

Items	Winter season (16 ± 3°C and 70 ± 8 % R.H.)	Summer season (35 ± 3°C and 46 ± 8 % R.H.)
Glucose (mg/dl)	110.4 ± 8.4	130.8 ± 9.4 *
Albumin (mg/dl)	3.0 ± 0.17	2.2 ± 0.15
Globulin (mg/dl)	4.1 ± 0.28	4.2 ± 0.35
Total protein (mg/dl)	7.1 ± 0.34	6.4 ± 0.48 *
Cholesterol (mg/dl)	52.8 ± 3.2	71.3 ± 4.4 **
Phospholipids (mg/dl)	121.5 ± 8.3	166.4 ± 8.8 **
Total lipids (mg/dl)	210.7 ± 11.4	279.5 ± 13.3 **
Serum AKP (IU/l)	7.2 ± 0.53	9.4 ± 2.42
SGOT (IU/l)	58.4 ± 4.7	72.1 ± 5.4 *
SGPT (IU/l)	47.8 ± 3.5	62.4 ± 4.4 *
Testosterone (mg/dl)	352 ± 18	213 ± 8 *

* $P<0.05$; ** $P<0.01$

Table 3 : Effect of hot summer season on semen quality and some reproductive traits (X ± S.E) in NZW rabbit males.

Items	Winter season (16 ± 3°C and 70 ± 8 % R.H.)	Summer season (35 ± 3°C and 46 ± 8 % R.H.)
Physical characteristics of semen :		
Semen volume	0.7 ± 0.06	0.8 ± 0.08
Sperm concentration (x 10^6/ml)	210.5 ±14.1	156.11 ±11.8 *
Live sperm concentration (x 10^6/ml)	180.8 ± 13.6	129.9 ± 10.8
Dead sperm (%)	14.6 ± 0.29	17.0 ± 0.17
Sperm motility (%)	56.0 ± 0.83	40.6 ± 0.68
Total abnormalities (%)	14.3 ± 0.51	15.2 ± 0.37
Chemical composition of seminal plasma :		
Albumin (g/dl)	0.6 ± 0.08	0.7 ± 0.08
Globulin (g/dl)	1.9 ± 0.05	1.2 ± 0.06 *
Total proteins (g/dl)	2.5 ± 0.21	2.1 ± 0.11 *
Cholesterol (mg/dl)	52.2 ± 3.86	68.3 ± 5.66 *
Total lipids (mg/dl)	115.8 ± 8.11	136.3 ± 6.66 *
Whole semen AKP (IU/l)	6.2 ± 0.76	8.8 ± 0.72
Whole semen GOT (IU/l)	28.6 ± 1.81	37.3 ± 0.82 *
Whole semen GPT (IU/l)	23.4 ± 1.21	34.1 ± 0.94 *
Testosterone (ng/dl)	100.1 ± 16.3	122.0 ± 13.1
Reproductive traits :		
Conception rate (%)	47.1 ± 6.3	20.2 ± 4.3 *
Litter size at birth	8.3 ± 0.36	6.8 ± 0.42 *

** P<0.01 ; * P<0.05

who found that sperm concentration significantly declined when the temperature was above 30°C. It could be noted that the decline in sperm concentrations (Table 3) is parallelled with the level of testosterone in blood (Table 2) and contrary with those found in seminal plasma (Table 3) for the reasons that the function of testosterone formed within the tubules is to bring about the development of both the germ cells and spermatogenesis process (PAULSEN, 1969 ; DENNIS, 1973). The decline (P<0.05) in sperm motility and the rise (P<0.05) in dead sperm in rabbit males were observed in summer season as compared with those of winter season. Our results associated with those obtained by AMIN *et al.* (1987) and BECUDO and PASCHOAL (1991) who found that high environmental heat adversely affects sperm motility and dead sperm. These alterations could be due to the depression in sperm concentration (Table 3) and changes in seminal biochemical component levels as total protein, Ca, P, fructose, (EL-FOULLY *et al.*, 1987), protein and lipid fractions (Table 3). Also, the change in FSH and LH levels may be contributed in such alterations in semen quality, since injection of the heat stressed male rabbits by LH increased significantly the total number of spermatocytes and promoted their rapid division. FSH treatment , however prevented the decrease in seminiferous tubules diameter and increased the number of type B spermatogonia and prevented the decrease in the total number of spermatocytes caused by exposing rabbits to heat stress (EL-SHERRY *et al.*, 1980). Concerning the chemical composition of semen, it can be showed that hot summer season revealed a significant decline in seminal plasma protein and globulin concentrations. The difference in free amino acid levels of semen and seminal plasma nitrogen (EL-FOULY *et al.*, 1987) had an effect on seminal plasma protein and its fraction in semen of the heat stressed rabbit. Hot summer conditions showed a significant rise in both cholesterol and total lipid of seminal plasma. The reasons of such increase may have been due to the damage and destruction of sperm cell membrane followed by a rise in dead spermatozoa (Table 3) that leads to a high release of cholesterol, phospholipid and fatty acid molecules in the seminal plasma (PHILIPS, 1972). Transaminase (GOT and GPT) enzyme levels of whole semen showed significantly (P<0.05) higher activity during hot summer than during winter season. The latter rises may be as a result of the destruction of spermatozoa due to heat stress because the high level of transaminase enzymes are used as indicator of the degree membrane damage of spermatozoa (PURSEL *et al.*, 1968).

Conception rate was lower (P<0.05) in summer than in winter season due to the decline in live sperm concentration with a significant alteration in the levels of seminal plasma composition (Table 3). On the other side, photoperiod is likely to be one of several environmental factors that had an effects on semen characteristics (SOAD *et al.*, 1993), conception rate and litter size at birth, where the increase in day length

during Egyptian summer conditions caused a decrease in concentration and motility of sperms of NZW rabbit males (ABD-ELHAKEAM *et al.*, 1992) and had a major role in a depression in conception rate and litter size at birth (GHALY, 1988 ; MARAI *et al.*, 1993 ; TAWFEEK *et al.*, 1993). Also, some natural physiological and nutritional factors due to does (YAMANI *et al.*, 1990) may be involved in such decline in conception rate and litter size at birth.

Data presented in Table 4 showed some blood metabolites under the influence of Se + Vit. E or Zn supplements of heat stressed rabbit males. The concentrations of cholesterol and total lipid of blood plasma were significantly lower in rabbits fed the Zn diet than those of untreated rabbits. Effectively Zn had an active role in the acceleration of some enzyme activities i.e. lecithin cholesterol acyltransferase, lipoprotein and hepatic lipase which plays a major role in metabolism of lipid fractions (MONTGOMERY *et al.*, 1990). At the same time, the adhering of Zn to the insulin molecule increases the duration of insulin action that influence on the levels of blood protein and lipid fractions (DAVIES, 1972). Rabbits receiving diets containing Zn showed a significant low activity of transaminase enzymes (SGPT and SGOT) due to that Zn ion acts as a buffer for the regulation of enzyme activities of animals (HARPER *et al.*, 1977). A significant rise in blood testosterone levels by about 22.9 % and 37.5 % as a function of Se + Vit. E or Zn supplemented diets, respectively were recorded. The variations in testosterone levels may be explained through the metabolism of cholesterol since, the biosynthesis of testosterone involves cholesterol as an obligatory intermediate, beside FSH level which mainly affected by Zn ions (HARPER *et al.*, 1977) also had an action on testosterone biosynthesis (MONTGOMERY, 1990).

Table 5 showed the physical characteristics and chemical composition of rabbit semen as affected by the Se + Vit. E or Zn treatments. Supplementation with Zn showed higher significant mean of semen volume than that found in non-supplemented animals due to the activity of accessory sexual glands and testis (UNDERWOOD and SOMERS, 1977), which appeared as a significant rise in sperm concentrations (Table 5). Se + Vit. E induced a significant rise in sperm concentration compared to the control group. Other workers found that semen volume and sperm concentration increased by 2500 mg vitamin E with 50 mg Se / kg DM in rams (GOKEN *et al.*, 1990). The animals fed the Zn supplemented diets showed an increase in total and live sperm concentrations by 79.1 % and 91.9 % respectively, compared to non-supplemented animals. The latter increase may be attributed to that the availability of sufficient Zn for incorporation of high amounts into sperm during the final stage of maturation is essential for DNA synthesis and its stability (DEVENSON, 1993), cell division, maintenance of spermatogenesis and survival of the germinal epithelium (DAVIES, 1972) which parallelled with the increase of testosterone level in both blood and seminal plasma (Table 4 and 5).

The significant rise in sperm motility was observed by adding Zn to the basal diet of heat stressed rabbit males. The high level of testosterone

Table 4 : Effect of dietary supplementation with Se and Vitamin E or Zn on some blood constituents (X ± S.E) in heat stressed NZW rabbit males.

	Hot summer conditions (37 ± 3°C and 42 ± 8 % R.H.)		
Items	***Control diet***	***0.7 mg Se + 40 mg Vit. E (per kg DM)***	***35 mg Zn (per kg DM)***
Glucose (mg/dl)	134.2 ± 8.8^{a}	127.8 ± 7.8^{a}	123.2 ± 6.4^{a}
Albumin (g/dl)	2.4 ± 0.19^{a}	2.6 ± 0.24^{a}	2.6 ± 0.22^{a}
Globulin (g/dl)	3.9 ± 0.28^{a}	3.9 ± 0.27^{a}	4.0 ± 0.37^{a}
Total protein (g/dl)	6.3 ± 0.38^{a}	6.5 ± 0.58^{a}	6.6 ± 0.48^{a}
Cholesterol (mg/dl)	78.1 ± 4.9^{a}	68.6 ± 6.8^{ab}	58.4 ± 5.3^{b}
Phospholipids (mg/dl)	158.7 ± 9.4^{a}	141.8 ± 11.8^{a}	133.5 ± 8.9^{a}
Total lipids (mg/dl)	268.7 ± 12.3^{a}	246.8 ± 10.3^{ab}	230.5 ± 13.2^{b}
Serum AKP (IU/l)	9.1 ± 1.55^{a}	8.5 ± 0.86^{a}	7.9 ± 0.88^{a}
SGOT (IU/l)	63.2 ± 5.81^{a}	59.3 ± 5.32^{ab}	55.3 ± 3.31^{b}
SGPT (IU/l)	63.2 ± 5.30^{a}	71.2 ± 5.77^{ab}	51.8 ± 4.62^{b}
Testosterone (ng/dl)	23.1 ± 6.50^{a}	28.4 ± 7.85^{ab}	32.0 ± 9.36^{b}

Means bearing different superscripts within the same classification differed significantly ($P<0.05$)

which accompanied with an increase in sperm concentration and the action on Zn on both testicular tubules and seminal enzymes (UNDERWOOD, 1977) may be responsible in such increase in motility. Supplementation with Zn showed a significant decline of both cholesterol and total lipid of seminal plasma. Also, transaminase enzyme activities in whole semen declined significantly in response to Se + Vit. E or Zn supplements. The declines in the previous parameter may be due to the presence of Se ions (UNDERWOOD *et al.*, 1977), or Zn (DAVIES, 1972) may had a protective action to reduce the damage of cell membrane of sperms and sperm dead (Table 5) which leads to the decline of the release of lipid fractions and transaminase enzymes in seminal plasma (PURSEL *et al.*, 1968). When the treatments with Se + Vit. E and Zn were terminated under hot summer conditions, seminal plasma testosterone raised significantly by 22.9 an 38.5 % respectively, compared with non-supplemented animals. The increase in testosterone level of seminal plasma parallelled with its level in blood plasma (Tables 4 and 5). In another study, testosterone concentration in seminal buffalo bull averaged 141 ng/dl and correlated with mass activity of semen (TULI *et al.*, 1991). The conception rate increased on average 57.7 % due to the addition of Zn to the basal diet of the heat stressed rabbit males for the reason that Zn improved most physical and chemical characteristics of semen (Table 5) which almost related to the rise in the conception rate and pay had an enhancement in the number of the fertilized ova that appeared as an increase in the litter size at birth (Table 5).

Table 5 : Effect of a dietary supplementation with Se and Vitamin E or Zn on semen quality and some reproductive traits (X ± S.E) in heat stressed NZW rabbit males.

	Hot summer conditions (37 ± 3°C and 42 ± 8 % R.H.)		
Items	***Control diet***	***0.7 mg Se + 40 mg Vit. E (per kg DM)***	***35 mg Zn (per kg DM)***
Physical characteristics of semen :			
Semen volume (ml)	0.9 ± 0.07[a]	1.0 ± 0.15[a]	1.3 ± 0.05[b]
Sperm concentration (x 10^6/ml)	148.0 ± 12.1[a]	234.0 ± 18.7[a]	265 ± 24.9[b]
Live sperm concentration (x 10^6/ml)	131.1 ± 11.8[a]	191.5 ± 17.7[b]	251.6 ± 23.3[b]
Dead sperm (%)	18.5 ± 0.68[a]	15.9 ± 0.35[a]	9.7 ± 0.11[b]
Sperm motility (%)	41.0 ± 0.79[a]	41.5 ± 0.86[a]	61.6 ± 0.64[b]
Total abnormalities (%)	16.1 ± 0.65[a]	13.8 ± 0.31[a]	17.6 ± 0.20[a]
Chemical composition of seminal plasma :			
Albumin (g/dl)	0.6 ± 0.05[a]	0.6 ± 0.06[a]	0.7 ± 0.08[a]
Globulin (g/dl)	1.2 ± 0.06[a]	1.3 ± 0.04[b]	1.5 ± 0.06[b]
Total proteins (g/dl)	1.8 ± 0.08[a]	2.1 ± 0.08[b]	2.2 ± 0.07[b]
Cholesterol (mg/dl)	78.1 ± 5.66[a]	81.1 ± 6.66[a]	58.0 ± 3.88[b]
Total lipids (mg/dl)	128.6 ± 7.35[a]	133.0 ± 9.53[ba]	120.9 ± 7.35[b]
Whole semen AKP (IU/l)	9.2 ± 0.91[a]	6.8 ± 0.66[a]	7.6 ± 0.06[a]
Whole semen GOT (IU/l)	33.1 ± 2.15[a]	23.5 ± 1.62[b]	20.5 ± 1.35[b]
Whole semen GPT (IU/l)	30.0 ± 2.33[a]	21.7 ± 1.05[b]	20.2 ± 0.93[b]
Testosterone (ng/dl)	130.2 ± 8.52[a]	175.0 ± 9.33[b]	191.2 ± 7.90[b]
Reproductive traits :			
Conception rate (%)	22.3 ± 3.1[a]	25.3 ± 2.3[a]	35.4 ± 4.4[b]
Litter size at birth	6.8 ± 0.4[a]	7.2 ± 0.36[a]	8.1 ± 0.48[b]

Means bearing different superscripts within the same classification differed significantly (P<0.05).

It can be concluded that hot summer season impairs most blood and seminal biochemical components included testosterone hormone that leads to produce poor quality semen from rabbit males. However, supplementation of the diets of the heat stressed NZW rabbit males with 0.7 mg Se + Vit. E/kg DM are slightly efficient to obtain a good semen, while 35 mg Zn is favourable additive which offers a promise to improve the heat induced decline of rabbit semen quality, percentage of conception rate and litter size at birth.

Received : January 14, 1994.
Accepted : March 11, 1994.

BIBLIOGRAPHY

ABD-ELHAKEAM A.A., ABD-ELMOTY A.K.I., EL-BAGDADY A.H., HASSANIEN H.H., 1992. Some physical characteristics of rabit semen as affected by breed, lighting systems and ejaculation sequences. *Egyptian J. Rabbit Sci., 2, 37-47.*

ALDERMAN G., HARVARD A., TODD J.R., EDWARD R.A., MORGAN A.E., 1975. Energy allowance and feeding systems for ruminants. *HMSO (Ministry of Agriculture, Fisheries and Food, technical bulletin n° 33. London*

AMIN S.O., EL-FOULY M.A., EL-SHOBHY H.E., EL-SHERBINY A.M., 1987. Effect of season, breed and sequence of ejaculation on some physical characteristics of rabbit semen. In : *Proc. 1st Conf. Agric. Develop. Res., 1, 54-67.*

A.O.A.C., 1970. Official Methods of Analysis. *11th Ed. Association of Official Analytical Chemists, Washington D.C.*

BICUDO S.D., PASCHOAL J.P.S., 1991. Some rabbit semen traits in spring and early summer. In : *Ann. IX Congresso Brasileiro de Repruducao Animal, Belo Horizonte, Brasil, 2, 457-459.*

CRESPO GARCIA J., 1991. Determination of living and dead spermatozoa in semen. *Rev. Partonato Biol. Anim., 2, 23-51.*

DAVIES I.J.I., 1972. The clinical significance of the essential biological metals. *Heinemann.*

DENNIS L., 1973. Androgen dependency of spermatogenesis and the physiological significance of steroid metabolism in vitro by the seminiferou tubules. *In : The endocrine function of the human testis. James H.T., Serio M., Martini L.I. (ed.) Academic Press, 493-523.*

DVENSON D.P., ENERICK R.J., JOST L.K., KAYONGOMAL H., STEWART S.R., 1993. Zinc/Silicon interactions influencing sperm chromatin integrity and testicular cell development in the rat as measured by flow cytometry. J. Anim. Sci., **71**, 955-962.

EL-FOULY M.A., AMIN S.O., EL-SOBHY H.E., EL-SHERBINY A.M., 1987. Effect of breed and season on some chemical characteristics of rabbit semen. In : *Proc. 1st Conf. Agric. Develop. Res., 1, 68-77.*

EL-SHERRY M.I., EL-NAGGAR M.A., NASSAR S.M., 1980. Experimental study of summer stress in rabbits. 6 - Quantitative and qualitative effect of hormonal injection of spermatogenic cell on cycle of stressed rabbits. *Assiut Vet. Med. J., 7, 80-101.*

GHALY K.M.A., 1988. Effect of environmental condition on the reproductive performance of rabbits. *M. Sc. Thesis, Faculty of Agriculture, Minia University, Egypt.*

HABEEB A.A., MARAI I.F., KAMAL T.H., 1992. Heat stress. *In : Farm Animals and the Environment. Philips C., Piggns D. (ed.), C.A.B. International, Willingford, University Press, Cambridge, U.K., 27-47.*

HARPER H.A., RODWELL V.W., MAYES P.A., 1979. Review of physiological chemistry. *17th ed., Librairie du Liban.*

KAMAL T.H., 1982. Heat-induced mineral imbalances in Animals. In : *The use of isotopes ot detect moderate mineral imbalances in farm animals. International Atomic Energy Agency, TECDOC-167-367, Vienna, 49-61.*

KUMAR R., 1989. Hormonal and biochemical profile of blood during different developmental and reproductive stage in buffaloes. *M.V.Sc. dissertation submitted to the PAU, Ludhania, India.*

MARAI I.F., ABDEL-SAMEE A.M., EL-GAFAARY M.N., 1990. Criteria of response and adaptation to high temperature for reproductive and growth traits in rabbits. In : *2nd Conf. on Rabbit Production and Genetics in the Mediterranean Area, September, University of Zagazig, Egypt, 1-16.*

MERTSCHING H.J., 1981. The effects of high environmental temperature on plasma levels of insulin, growth hormone, prolactin and glucose in fed and fasted monlactating dairy cattle. *M.S. Thesis, University of Missouri, Columbia.*

MONTGOMERY R., CONWAY T., SPECTOR A., 1990. Biochemistry . *5th Ed., Mosby C.V. Co, Toronto.*

PAULSEN A., 1969. The testes. In : *Textbook of endocrinology, Williams R.H., Saunders W.B. Co., 4th ed., 405-457.*

PHILLIP, M.C., 1972. The physical state of phospholipids and cholesterol in monolayers, bilayers and membranes. *Prag. Surface Membr., 5, 139-142.*

PURSEL V.G., JOHNSON L.A., GERRITS R.J., 1968. Glutamic oxaloacetic transaminase and LDH

enzymes activities in cold-shocked and frozen boar semen. *J. Anim. Sci., 27, 1729-1788.*

SANO H., TAKAHASHI K., AMBO K., TSUDA T., 1983. Turnover and oxydation rates of blood glucose and heat production in sheep exposed to heat. *J. of Dairy Sci., **66**, 856-861.*

SHEBAITA M.K., KAMAL T.H., 1975. Lean body mass and body fat change in lactating animals under Sahara climate. *World Rev. of Anim. Prod., 11, 50-55.*

SNEDECOR G.W., COCHRAN W.C., 1983. Statistical Methods. *Iowa State Press, Ames, Iowa, USA.*

SOAD S.A., IBRAHIM H., RASHWAN A.A., TAWFEEK M.I., 1993. Semen characteristics and some physiological body reactions of buck rabbits. *Egyptian American Conf. on Physiology of Anim. Prod., November, El-Fayoum, Egypt, 26-34.*

TAWFEEK M.I., RASHWAN A.A., IBRAHIM H., SOAD S.A., 1993. Performance of rabbit production as affected by lighting and warming systems. *Egyptian American Conf. on Physiology of Anim. Prod., November, El-Fayoum, Egypt, 228-240.*

TIETZ N.W., 1982. Fundamentals of clinical chemistry. *Tietz and Saunders Co (ed.), West Washington Square, Philadelphia, USA.*

TULI R.K., LOHAN I.S., GOYAL R.L., SINGAL S.P., 1991. Testosterone and progesterone hormones in buffalo bull seminal plasma and thei correlations with seminal characteristics. *Indian J. Dairy Sci., 44, 587-589.*

UNDERWOOD E.J., 1977. Trace elements in human and animal nutrition. *3th Ed., New York, USA.*

UNDERWOOD E.J., SOMERS M., 1977. Zinc. In : *Trace elements in human and animal nutrition. 4th Ed., Academic Press, New York, San Francisco, London, 196-242.*

YAMANI K.A., DAADER A.H., ASKER A.A., 1990. Non-genetic factors affecting rabbit production in Egypt. In : *2nd Conf. on Rabbit Prod. and Genetics in Mediterranean Area, September, University of Zagazig, Egypt, 1-16.*

ZEMJANIS R., 1970. Diagnostic and therapeutic techniques in animal reproduction. *2nd Ed., Balliere Tindall and Cox Ltd, London (ed.).*