ABSTRACT: The objective of this work was to study the effect of queracetin (onion juice) or zinc sulphate or their combination on some reproductive performance of rabbit males exposed to high temperature during summer season conditions. Forty- two male V-line rabbits 7 months old were randomly divided into six groups for 7 males/ each. Group 1 was served as control without any supplementation. Groups 2 and 3 were supplemented orally with 3 and 6 ml of onion juice /rabbit/day, group 4 supplemented orally with 50 mg zinc sulphate /rabbit/day, groups 5 and 6 supplemented orally with 50 mg zinc sulphate +3 and 6 ml onion juice /rabbit /day, respectively. The supplementations persisted 10 weeks before semen collection. Highest significant (P<0.01) values for each of ejaculate volume, sperm motility, total sperm output and total motile sperm were observed for group of males supplemented with zinc sulphate +higher level of onion (6ml/rabbit/day) as compared to those for other groups. Reverse response was detected for reaction time (libido) by seconds as the highest (P<0.01) value was observed for control group and lowest ones were detected for groups of zinc separately and zinc sulphate+ onion supplementation groups. Supplementation the males with combination of zinc sulphate+6 ml of onion/rabbit/day recorded the highest (P<0.05) values of alkaline phosphates (AIP), acid phosphates (AcP) and lowest ones for seminal plasma aspartate aminotransferase (AST) and alanine aminotransferase (ALT) compared to other supplemented groups and control. Seminal plasma lipid peroxidation as indicated by thiobarbituric acid-reactive substances was decreased (P<0.05), while seminal plasma antioxidant enzymes were increased (P<0.05) due to onion juice and zinc sulphate supplementation. Values of FSH and LH hormones were increased (P<0.05) for males supplemented separately with higher levels of onion or zinc sulphate or their combination compared to those for control or lower level of onion. Besides, rabbits supplemented with combination between zinc sulphate+ both levels of onion represented the highest (P<0.05) value of testosterone hormone

Key words: Rabbits, queracetin, zinc sulphate, seminal plasma and fertility.

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compared those for control and other supplemented groups. All parameters of reproductive performance such as fertility rate, litter size at birth and at weaning, bunny weight at birth and at 28 day had been significantly (P<0.01) influenced and decreased for rabbits exposed to hot summer condition without any dietary experimented supplementations (control) compared to other groups.

INTRODUCTION

Allium cepa (onion) has a beneficial effect on disease treatment worldwide and has been used since ancient times as a medicinal and food source. Recently several reports have shown that onion has high antioxidant activity. Onion is one of the important Allium species commonly used in our daily diet, and has recently been the source of much interest because of its antithrombotic, hypolipidaemic, hypotensive, diaphoretic, antibiotic, anti-diabetic, anti atherogenic and anticancer medicinal properties (Lee et al., 2008). The amount of queracetin in fresh onion was 12 mg/100 g onion bulb (Arash et al., 2012). The biological action of Allium products is ascribed to organosulfur and phenolic compounds (Kumari et al., 1990). Several studies have shown that onion contains exogenous and endogenous antioxidants such as selenium, glutathione, vitamins A, B and C and flavonoids such as queracetin and isorhamnetin (Khaki et al., 2009). These antioxidants protect DNA and other important molecules from oxidation and damage, which improve sperm health parameters and increasing the rate of fertility (Yang et al., 2006).

Studies on the effect of queracetin on oxidative damage in cultured chicken spermatogonial cells showed that queracetin have no deleterious effect on spermatogonial cells. Queracetin (1 mg/ml) increased the number of spermatogonial cells, enhanced motility ability and decreased the mortality of aroclor-induced oxidative damage. (Aral et al., 2011).

Trace elements are essential for the function of various enzymes and other proteins. The effects of trace element biochemistry and physiology on parameters of fertility are presented for zinc, selenium, iodine, copper and manganese (Leonhard–Marek, 2000). On the cellular level, the function of zinc can be divided into three categories: Catalytical, Structural and Regulatory. Zinc also plays a role in cell signaling and has been found to influence hormone release and nerves impulse transmission (Debjit et al., 2010).

Intracellular zinc can function as a temporary inhibitor for sperm lipid peroxidation, sperm oxygen uptake, sperm nuclear chromatin decondensation, sperm capacitation, acrosome reaction and for the in vitro fertilizing ability of spermatozoa (Stephenson and Brackett, 1999). A mechanism by which zinc may function as cellular antioxidant, is through its involvement in synthesis of metallothionein (zn-mt ) a metal binding protein that may scavenge hydroxide radicals and provides effective protection against lipid peroxidation (Prasad et al., 2004).

Therefore, the aim of the present study was to evaluate the androgenic effects of different doses of queracetin (onion juice) or zinc sulphate or their combination supplementation on sperm characteristic, hormone measurements and reproductive performance of male V.Line rabbits under hot summer conditions of Alexandria governorate, Egypt.

MATERIALS AND METHODS

The present study was carried out at El-Sabahia Poultry Research Station (Alexandria), Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Egypt during summer season conditions from June to August.
Forty- two males V-line rabbits 7 months old with average initial body weight of 3.45 Kg were used in this experiment. Rabbits housed in a naturally ventilated building and kept in individual Italian wire galvanized cages (60 × 55 × 40 cm). Rabbits were fed ad libitum with a commercial pelleted diet containing 18.12% CP, 13.26% CF and 2670 kcal DE/kg diet. Fresh tap water was automatically available all the time in each cage. All the experimented animals were healthy and clinically free from internal and external parasites and kept under the same managerial and hygienic conditions. Males were randomly divided into six groups and supplemented orally with the following doses of fresh onion juice and zinc sulphate diluted in distilled water.

**Rabbit groups and treatments as follows:**

**Group 1:** control (without any supplementation).

**Group 2:** supplemented with 3 ml fresh onion juice /rabbit/day.

**Group 3:** supplemented with 6 ml fresh onion juice /rabbit/day.

**Group 4:** supplemented with 50 mg zinc sulphate /rabbit/day.

**Group 5:** supplemented with 3 ml fresh onion juice + 50 mg zinc sulphate /rabbit/day.

**Group 6:** supplemented with 6 ml fresh onion juice + 50 mg zinc sulphate /rabbit/day.

**Extraction of Onion Juice:**

Fifty grams of finely chopped red onions (Allium cepa L.) were thoroughly agitated with 500 ml of preheated water (90°C) for 60 min in order to extract maximum content of phenolic compounds. The mixture was cooled at room temperature and homogenized in a blender. The homogenate was centrifuged at 10,000 rpm for 20 min and the resulting supernatant was used as onion juice (Khaki et al., 2009).

**Temperature-Humidity Index (THI):**

Air temperature (°C) and relative humidity (%) inside the rabbitry building were daily recorded using electronic digital thermo-hygrometer under hot summer conditions of Alexandria, Egypt. Averages of ambient temperature, relative humidity and temperature humidity index inside building were 30.8±0.22°C, 81.4±1.05% and 29.9 respectively, which indicate heat stress during the experimental period. The temperature humidity index (THI) was calculated using the equation modified by Marai et al. (2001).

\[
\text{THI} = \text{db}^\circ - [(0.31-0.31 \times \text{RH}) \times (\text{db}^\circ - 14.4)]
\]

Where THI= Temperature humidity index, db = Dry bulb temperature in Celsius, RH= Relative humidity percentage/100. The THI values classified as follow: <27.8= absence of heat stress, 27.8 <-28.9 moderate heat stress, 28.9 -<30.0= server heat stress and 30.0 and more = very sever heat stress.

Semen was collected from rabbit bucks through two weeks after 10 weeks from oral supplementations of onion juice and zinc sulphate. One hundred and sixty eight ejaculates were obtained (7 rabbit bucks x 6 groups x 4 ejaculates). Ejaculates were collected using an artificial vagina maintained at a teaser doe (45-46°C). Reaction time (RT) was the time interval from introducing of the teaser doe into the male’s cage to ejaculation and measured in seconds with a stop watch and considered as an indication of libido. Immediately after collection, semen was kept at 35°C in water bath in order to be evaluated. Semen volume of each ejaculate was recorded after removal of the gel mass. Immediately following semen collection, for measuring mass motility rate two drops of fresh semen were placed on a warmed slide and covered with a cover slip (20×20 mm). Mass motility from at least three fields was examined at 37°C under a phase microscope at 40 x and assessed from 0 to 100%. A
weak eosin solution was used at a rate of 1:99 before counting the cells, for evaluation of sperm concentration (x10^6/ml) by the haemocytometer slide according to the method of Smith and Mayer (1955). Total sperm output was calculated through multiplying semen ejaculate volume by semen concentration. Assessment of live and abnormal spermatozoa was performed using an eosin-nigrosine blue staining mixture (Blom, 1950). The percentage of live spermatozoa was determined by using stains that penetrate cells with damaged membranes. Total number of motile sperm was calculated as multiplying percentage of motile sperm by total sperm outputs. The total functional sperm fraction (TFSF) was calculated as the product of total sperm output multiplied by percent of motile sperms times percent normal sperms (Correa and Zavos, 1996).

**Seminal Plasma:**

Seminal plasma was obtained by centrifugation of semen samples at 4000 rpm for 20 minutes at 4°C and stored at -20°C until analysis. Acrosomal damage was determined by using a Giemsa stain procedure as described by Watson (1975). Samples were analyzed for the activities of aspartate aminotransferase (AST) and alanine aminotransferase (ALT), alkaline phosphatase (ALP) activity and acid phosphatase (ACP) activity. Thiobarbituric acid-reactive substances (TBARS) were measured in the seminal and blood serum using the method of Tappel and Zalkin (1959). Seminal and blood serum glutathione contents (GSH) were determined using commercial glutathione reduced kits according to the method of Beutler et al. (1963). Glutathione peroxidase (GPx) activity was assayed using the method of Chiu et al. (1976). Superoxide dismutase (SOD) activity was assayed according to Misra and Fridovich (1972). Glutathione S-transferase (GST) activity was determined according to Habig et al. (1974) using P-nitrobenzylchlorid as a substrate. Catalase (CAT) activity was measured according to Aebi (1984).

**Blood Analysis:**

Blood samples were collected from the ear vein of each buck through two weeks after supplementation period (7 rabbits × 5 collections/group). The blood samples were centrifugated at 4000 rpm for 20 minutes to separate the serum and stored in a deep freezer at -20°C until biochemical analysis.

**Serum FSH, LH and Testosterone Hormones Measurements:**

Serum concentrations of FSH and LH were determined in duplicated samples using radioimmunoassay (RIA). FSH and LH kits obtained from Biocode Company-Belgium, according to the protocol provided with each kit of serum. The sensitivities of hormones detected per assay tube were 0.2ng/ml and 0.14ng/ml for FSH and LH respectively (Khaki et al., 2009). Serum testosterone concentration was measured using immunoassay (Biosource-Europe S.A. 8, rue de L’Industrie.B-1400 Nivelles. Belgium).

**Reproductive Performance:**

For evaluation of males fertility criteria, sixty receptive nulliparous V.Line female rabbits were divided into six groups and housed in individual cages. Females from each group were artificially inseminated from the pooled semen of each males group. Parameters of kindling rate and litter size at birth (total born and total born alive) and at weaning were monitored. Also, litter weight at birth and 28 days were recorded.

**Statistical Analysis:**

Data were analyzed as a one-way analysis of variance with semen collection time as replicates using the General Linear Model procedure of SAS (2002). Significant differences among treatment means were tested using Duncan multiple
RESULTS AND DISCUSSION

Semen Characteristics:

Semen characteristics of V-line male rabbits supplemented orally with freshly onion juice and zinc sulphate or their combination are shown in Table 1. Highest significant (P<0.01) values for each of ejaculate volume, sperm motility, total sperm output, total motile sperm and TFSF were observed for group of males supplemented with zinc sulphate + higher level of onion (6ml/rabbit/day) compared to those for other groups. Males supplemented with zinc sulphate + lower level of onion (3ml/rabbit/day) recorded the same highest significant value for sperm concentration and TFSF. Also, control males without any supplementations recorded the worst (P<0.05) values of ejaculate volume, sperm motility, sperm concentration, total sperm output, total motile sperm, live sperm, normal sperm and TFSF as compared with those for other groups. Reverse response was detected for reaction time (libido) by seconds as the highest (P<0.01) value was observed for control group and lowest ones were detected for groups of zinc sulphate separately and zinc sulphate + onion supplementation groups and the delay between the highest and lowest values was 17.35 sec.

The delay of reaction time as indication of sexual desire for males could be due to high temperature exposure, therefore orally supplementation with onion or and zinc sulphate decreased the reaction time and increased the sexual desire. This conclusion is in harmony with those reported by different research workers. Tharwat et al. (1994) found that libido was delayed in NZW rabbit bucks exposed to 40 °C with relative humidity 60-65%. This delay may be due to the decrease in testosterone concentration, minimal spermatogenesis (Zeidan et al., 1997) and/or the low quality semen (El-Kelawy et al., 1997), occurring in a hot climate. Seleem (2003) found that addition of zinc methionine to balanced feed mixtures and fed to rabbits improved libido and positively influenced both quantitative and qualitative of seminal traits.

Supporting to our results regarding the increase in sperm concentration and viability of semen, Khaki et al. (2009) reported that Allium cepa (onion) has a good effect on spermatogenesis in rats and the results showed that administration of onion juice (1g/rabbit/day) for 20 consecutive days caused a marked increase in sperm count and viability. Moreover, our findings about the harmful effect of high temperature on morphological abnormality, dead sperm and acrosomal damages are in accordance with the findings of Finzi et al. (1995). Also, Setchell et al. (2001) indicated that brief exposure of the scrotum to the heat results in damage to the most heat sensitive germ cells, the pachytene spermatocytes and early spermatids. The results of improvement in rabbit sperm due to administration of zinc sulphate in the current study are in accordance with those reported by El-Tohamy et al. (2012) who mentioned that adequate reproductive performance in NZW rabbit bucks can be achieved in summer months due to zinc sulphate supplementation and it is not obligatory to stop breeding in this period of year.

Biochemical Constituents of Seminal Plasma:

Biochemical evaluation of seminal plasma constituents of male rabbits supplemented orally with onion and zinc sulphate under summer season condition is presented in Table 2. Supplementation the bucks with onion or zinc sulphate or combinations between them increased (P<0.05) the values of AcP, ALP for male rabbits compared with those for control one, besides the highest value of AcP was recorded for group supplemented with zinc sulphate + high level of onion. Moreover,
highest values of AIP were recorded for groups supplementation with combinations of zinc sulphate + higher or lower levels of onion. Reverse response was detected for AST and ALT values as they decreased (P<0.05) for all supplemented buck groups compared to those for control. Furthermore, males for zinc sulphate + higher level of onion recorded the lowest value of AST (25.69 IU) and ALT (18.72 IU) compared with the rest of values for all groups. As can be seen from data of this table that supplementation the males with combination of zinc sulphate + 6ml of onion /rabbit/day were recorded the highest values of AcP and AIP besides lowest ones for AST and ALT compared to those for others.

The improvement in biochemical constituent concentrations of seminal plasma resulting from onion or zinc sulphate supplementations in this study could be due to the antioxidant activity in these materials. These results and conclusion are keeping with those reported by Chimienti et al. (2003) who stated that onion juice or zinc have strong antioxidant and antiepileptic. Also, there are multiples pieces of evidence that injury caused to spermatozoa by reactive oxygen species (ROS) plays a key role in the etiology of male infertility (Aitken and Sawyer, 2003). Spermatozoa have large quantities of polyunsaturated fatty acids in their plasma membrane and low levels of scavenging enzymes in their cytoplasm. Oxidative stress has been identified as an imbalance between the production of ROS and antioxidant-scavenging activities, in which the generation of ROS overcomes (Sikka, 2001). Human spermatozoa generate ROS in physiologic amounts from activities such as capacitation, the acrosome reaction and oocyte fusion (Saleh and Agarwal, 2002). However, too much ROS production when it exceeds the limited antioxidant defenses in semen, results in spermatozoa dysfunction (Agarwal et al., 2003). Seminal oxidative stress results in decreased semen quality by several mechanisms, including injury of the sperm membrane and/or DNA (Lewis et al., 1995). Sub fertile males with high levels of ROS have 1/7 the likelihood of initiating a pregnancy compared with those with low ROS levels (Sharma et al., 1999).

The decrease in values of AST and ALT as shown in Table 2 due to onion and zinc sulphate supplementations is a good indicator of semen quality improvement as Corteel (1980) mentioned that transaminase activities (AST and ALT) in semen are good indicators of semen quality because they measure sperm membrane stability. Thus, increasing the percentage of abnormal spermatozoa in ejaculate causes high concentration of transaminase enzyme in the extra cellular fluid due to sperm membrane damage and ease of leakage of enzymes from spermatozoa (Gundogan, 2006). Al-Daraji et al. (2002) reported that both of alkaline and acid phosphatase enzymes were involved in the metabolism of spermatozoa via the hydrolysis of carbohydrates and positive correlation between ALP activity and spermatozoa concentration and liveability and the number of spermatozoa per ejaculate.

**Seminal Plasma Antioxidants Constituent:**

Seminal plasma antioxidants for males orally supplementations of onion and zinc sulphate under summer season condition are presented in Table 3. Each of oral supplementation level of onion juice or zinc sulphate or their combinations increased (P<0.05) the values of GSH, GPx and SOD activities for male rabbits compared with those for control. Whereas, the GST and CAT were significantly increased for males supplemented with zinc sulphate + lower or higher doses of onion compared with other supplemented groups and control. Besides the highest values of GSH, GPx, SOD, GST and CAT were recorded for males supplemented with zinc sulphate + higher level of onion compared
the other groups. Reverse response of the experimented supplementations was detected for TBARS value as they decreased (P<0.05) for all male groups of onion levels, zinc sulphate and zinc+ lower and higher levels of onion compared with those for control.

Thermal stress is often accompanied by oxidative stress in which ROS compounds are produced in greater amounts (Heise et al., 2003). One of the most important factors contributing to poor quality semen has been reported to be oxidative stress (Bucak et al., 2010). The increase in production of ROS determines semen characteristics and sperm-oocyte fusion (Akiyama, 1999). Also, antioxidant mechanism is necessary to prevent free-radical damage to the sperm cell as a result of secrete hydrogen peroxide and the superoxide ion by rabbit spermatozoa (Holland et al., 1982).

Zinc sulphate plays an important role in the physiology of spermatozoa, in sperm production and/or viability in the prevention of spermatozoa degradation, and in sperm membrane stabilization (Lewis-Jones et al., 1996) and antioxidative properties may also act to reduce the ROS leading to an increase in male fertility (Powell, 2000).

Therefore, Zinc ions act in terms of membrane stabilization, as well as the protective role of zinc methionine as a cellular antioxidant. Zinc intake has been reported to produce an antiatherogenic effect as it may have a protective effect on lipid metabolism consisting in its ability to prevent hyperlipidemia including especially hypercholesterolemia and to protect from lipid peroxidation (Joanna Rogalska et al., 2009).

Blood Serum Testosterone, FSH and LH Concentrations:

Data in Table 4 revealed that values of FSH and LH hormones were increased (P<0.05) for males supplemented separately with higher level of onion or zinc sulphate or their combinations compared to those for control or lower level of onion. Besides, rabbits supplemented with combination between zinc sulphate + both levels of onion represented the highest (P<0.05) value of testosterone hormone compared with those for control and other supplemented groups. Supporting to the results herein as FSH, LH and testosterone hormones decreased with elevated heat exposure in control group, Graves (1978) showed that exposure to hyperthermia is harmful for spermatogenesis and also decreases testosterone and gonadotrophins (FSH and LH) levels. Normal testicular function requires hormonal stimulation by pituitary gonadotrophins (LH and FSH) which are in turn controlled by pulsatile secretion of gonadotrophin-releasing hormone (GnRH) from the hypothalamus (Garner and Hafez, 2000).

El-Tohamy et al. (1997) reported that zinc plays an important role in the synthesis and secretion of luteinizing (LH) and follicle stimulating (FSH) hormones and it is essential in the production of many sex hormones including testosterone and gonadotrophin-releasing hormone. In zinc deficiency, cells are unable to form sex steroids, leading to arrest of spermatogenesis and impairment of fertility (Om and Chung, 1996). Also, Khaki et al.(2009) revealed that serum total testosterone was significantly increased in the male rats supplemented with onion. Moreover, Jamashid et al.(2012) indicated that onion had a good effect on LH and FSH hormones in rats.

Reproductive Performance:

Data of Table 5 presented that fertility rate of females mated with rabbit males supplemented orally with either level of onion juice or zinc sulphate or their combination were improved (P<0.01) compared with the control group. In addition, all experimented supplementations in this study increased
(P<0.01) the values of litter size, live kits, litter size at weaning and bunny weight at 28 days as compared to those from control. Whereas, bunny weight at birth realized the same significant increase due to experimented supplementations except that of lower level of onion. Moreover, highest values of litter size, live kits, litter size at weaning and bunny weight at 28 days is observed for group of males supplemented with zinc sulphate + higher level of onion compared those for all supplemental groups and control. Also, it can be observed from data of control group in this Table for bucks exposed to hot summer conditions without any supplementations had detrimental and bad influence on all parameters of reproductive performance.

The reduction in fertility rate in control group is related to the low sperm count, motility and high percentage of abnormal spermatozoa level as presented in Table 1. This conclusion is in accordance with those reported by Raji et al. (2003). Also, Brun et al. (2002) found that the mass motility was significantly influenced the kindling rate. Furthermore, the same authors found that litter size (total born) was significantly influenced by concentration and number of total motile sperms.

The improvement of reproductive performance in the current results as kindling rates, litter size up to weaning for groups supplemented with onion and zinc sulphate compared to control were accompanied with seminal plasma constituent improvement for bucks of these supplemented groups. Ulkowski et al. (2005) confirmed this statement as they mentioned that the positive effect of onion and zinc as an enhancer of reproductive capacity of rabbit bucks could be attributed to its ability to protect mammal cells from oxidation.

**Correlation between Sperm Quality Parameters and Seminal Plasma Antioxidants Status:**

Table 6 showed the correlation coefficient between GSH, SOD, GPx and CAT with each of TBARS, abnormal sperm, dead sperm, sperm motility, acrosomal damage and sperm concentration for V.Line male rabbits. Highly significant negative correlations were detected between each of GSH, SOD, GPx and CAT as seminal plasma antioxidant with each of TBARS and contents of seminal plasma as abnormal and dead sperms besides acrosomal damage of sperms. Whereas, there were strong significant negative correlations between each one of antioxidants with sperm motility and concentration. This observation suggest that GSH, SOD, GPx and CAT activity of seminal plasma could play a role in the protection against lipid peroxidation in seminal plasma. Moreover, results herein are in harmony with those reported by Khoserwbeyvgi and Zarghami (2007) who mentioned that GSH, SOD, GPx and CAT activities in seminal plasma from fertile and infertile men can act coordinately to protect spermatozoa from lipid peroxidation. Since lipid peroxidation leads to loss of motility in human spermatozoa, the possibility exists that asthenozoospermic sperm suffer from the lack of protection against lipid peroxidation due to lack of adequate or non-coordination between GSH, SOD, GPx and CAT activity in seminal plasma (Zini et al., 2000). Also sperm membrane has been reported to be adversely affected by peroxidation of polyunsaturated fatty acid and accumulation of organic hydroperoides (Zunjarrao et al., 2011).

Results in Tables 1 and 2 are in agreement with those reported by Al-Daraji (2001) who found significant positive correlation between percentages of dead spermatozoa, abnormal spermatozoa and...
Rabbits, queracetin, zinc sulphate, seminal plasma and fertility.

acrosomal abnormalities with seminal plasma AST and ALT enzymes.

CONCLUSION

Oral supplementation of male rabbits with 50 mg zinc sulphate + 6 ml fresh onion juice /rabbit/day through period of ten weeks under hot summer conditions improved semen characteristic, reproductive hormones and performance compared to control.
Table (1): Overall means of semen characteristics of V.Line male rabbits supplemented orally with onion, zinc sulphate and their combination

<table>
<thead>
<tr>
<th>Items</th>
<th>Control</th>
<th>Onion</th>
<th>Zinc 50 mg/rabbit/day</th>
<th>Zinc +</th>
<th>Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
<td>H</td>
<td></td>
<td>L. Onion</td>
<td>H. Onion</td>
</tr>
<tr>
<td>Reaction time (sce)</td>
<td>34.19±0.44</td>
<td>25.05±0.35</td>
<td>25.13b±0.51</td>
<td>17.15a±0.56</td>
<td>16.98a±0.51</td>
</tr>
<tr>
<td>Ejaculate volume (ml)</td>
<td>0.53±0.021</td>
<td>0.63±0.015</td>
<td>0.67±0.016</td>
<td>0.75b±0.030</td>
<td>0.76b±0.028</td>
</tr>
<tr>
<td>Sperm motility (%)</td>
<td>62.14±0.65</td>
<td>67.86±0.61</td>
<td>72.67±0.63</td>
<td>75.23a±0.69</td>
<td>77.42a±0.43</td>
</tr>
<tr>
<td>Sperm concentration (x10^6/ml)</td>
<td>214.33±4.2</td>
<td>325.41±4.0</td>
<td>382.46±4.3</td>
<td>435.61b±5.9</td>
<td>468.55±6.0</td>
</tr>
<tr>
<td>Total sperm output (x10^6)</td>
<td>114.23±8.3</td>
<td>211.47±8.8</td>
<td>262.11±7.2</td>
<td>329.45±9.1</td>
<td>365.16±7.3</td>
</tr>
<tr>
<td>Total motile sperm (x10^6)</td>
<td>72.36±7.3</td>
<td>143.62±8.6</td>
<td>191.43±6.9</td>
<td>252.63±8.8</td>
<td>285.14±7.8</td>
</tr>
<tr>
<td>Live sperm (%)</td>
<td>75.92±0.64</td>
<td>79.61±0.69</td>
<td>82.45ab±0.55</td>
<td>83.72a±0.61</td>
<td>83.91±0.59</td>
</tr>
<tr>
<td>Normal sperm (%)</td>
<td>80.68±0.53</td>
<td>83.36±0.48</td>
<td>84.14b±0.22</td>
<td>86.56±0.53</td>
<td>87.12±0.66</td>
</tr>
<tr>
<td>Dead sperm (%)</td>
<td>21.58±0.27</td>
<td>19.36±0.30</td>
<td>16.57±0.25</td>
<td>15.21±0.33</td>
<td>13.04±0.40</td>
</tr>
<tr>
<td>Abnormal (%)</td>
<td>16.51±0.26</td>
<td>14.38±0.29</td>
<td>13.27±0.24</td>
<td>12.37±0.40</td>
<td>11.53±0.41</td>
</tr>
<tr>
<td>Acrosomal damage (%)</td>
<td>13.19±0.33</td>
<td>12.54±0.39</td>
<td>11.24b±0.32</td>
<td>11.46b±0.37</td>
<td>10.65±0.41</td>
</tr>
<tr>
<td>TFSF (x10^6)</td>
<td>94.9±3.7</td>
<td>214.7±4.2</td>
<td>229.6±5.4</td>
<td>253.5±5.5</td>
<td>356.9±9.4</td>
</tr>
</tbody>
</table>

*Means within the same row bearing different superscripts, differ significantly * P<0.05; ** P<0.01;
TFSF= Total functional sperm fraction; L= Lower dose (3ml/rabbit/day); H= Higher dose (6ml/rabbit/day).
Table (2): Overall means of seminal plasma biochemical (AcP, AIP, AST and ALT) for V.Line male rabbits supplemented orally with onion, zinc sulphate and their combination

<table>
<thead>
<tr>
<th>Items</th>
<th>Control</th>
<th>Onion</th>
<th>Zinc</th>
<th>Zinc +</th>
<th>Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>50 mg/rabbit/day</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>H</td>
<td>L. Onion</td>
</tr>
<tr>
<td>AcP (U/L)</td>
<td>33.11±0.21</td>
<td>33.73±0.32</td>
<td>34.19±0.18</td>
<td>34.83±0.25</td>
<td>35.76±0.22</td>
</tr>
<tr>
<td>AIP (U/L)</td>
<td>51.78±0.42</td>
<td>53.24±0.39</td>
<td>56.63±0.51</td>
<td>60.67±0.36</td>
<td>66.57±0.44</td>
</tr>
<tr>
<td>AST (IU)</td>
<td>30.77±0.39</td>
<td>29.17±0.41</td>
<td>27.85±0.42</td>
<td>27.72±0.34</td>
<td>26.89±0.46</td>
</tr>
<tr>
<td>ALT (IU)</td>
<td>24.58±0.28</td>
<td>23.83±0.32</td>
<td>21.63±0.27</td>
<td>20.47±0.60</td>
<td>19.43±0.19</td>
</tr>
</tbody>
</table>

*Means within the same row bearing different superscripts, differ significantly *P<0.05;
AcP=Acid phosphatase; AIP=Alkaline phosphatase; ALT=Alanine aminotransferase; AST=Aspartate aminotransferase;
L= Lower dose (3ml/rabbit/day); H= Higher dose (6ml/rabbit/day).

Table (3): Overall means of seminal plasma antioxidants (TBARS, GSH, GPx, SOD, GST and CAT) for V.Line male rabbits supplemented orally with onion, zinc sulphate and their combination

<table>
<thead>
<tr>
<th>Items</th>
<th>Control</th>
<th>Onion</th>
<th>Zinc</th>
<th>Zinc +</th>
<th>Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>50 mg/rabbit/day</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>H</td>
<td>L. Onion</td>
</tr>
<tr>
<td>TBARS (nmol/ml)</td>
<td>1.74±0.051</td>
<td>1.25±0.047</td>
<td>1.05±0.036</td>
<td>1.023±0.051</td>
<td>1.031±0.049</td>
</tr>
<tr>
<td>GSH (g/dl)</td>
<td>13.13±0.19</td>
<td>14.56±0.24</td>
<td>16.87±0.31</td>
<td>18.73±0.18</td>
<td>18.71±0.22</td>
</tr>
<tr>
<td>GPx (mg/l)</td>
<td>4.37±0.037</td>
<td>4.80±0.063</td>
<td>4.77±0.051</td>
<td>5.00±0.044</td>
<td>5.08±0.036</td>
</tr>
<tr>
<td>SOD (IU)</td>
<td>7.24±0.025</td>
<td>7.49±0.036</td>
<td>7.50±0.047</td>
<td>7.52±0.025</td>
<td>7.51±0.019</td>
</tr>
<tr>
<td>GST (μmol/hr)</td>
<td>1.26±0.062</td>
<td>1.30±0.044</td>
<td>1.30±0.052</td>
<td>1.33±0.063</td>
<td>1.42±0.057</td>
</tr>
<tr>
<td>CAT (μ/ml)</td>
<td>14.30±0.12</td>
<td>14.96±0.14</td>
<td>16.40±0.12</td>
<td>16.90±0.13</td>
<td>17.93±0.11</td>
</tr>
</tbody>
</table>

*Means within the same row bearing different superscripts, differ significantly *P<0.05;
TBARS = Thiobarbituric acid–relative substances; GSH=Glutathione content; GPx=Glutathione peroxidase; SOD=Superoxide dismutase; GST=Glutathione S-transferase; CAT=Catalase; L= Lower dose (3ml/rabbit/day); H= Higher dose 6ml/rabbit/day.

Rabbits, queracetin, zinc sulphate, seminal plasma and fertility.
Table (4): Overall means of reproductive hormones for V.Line male rabbits supplementated orally with onion, zinc sulphate and their combination

<table>
<thead>
<tr>
<th>Items</th>
<th>Control</th>
<th>Onion</th>
<th>Zinc 50 mg/rabbit/day</th>
<th>Zinc +</th>
<th>Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
<td>H</td>
<td></td>
<td>L. Onion</td>
<td>H. Onion</td>
</tr>
<tr>
<td>FSH</td>
<td>20.37 ±0.095</td>
<td>20.39 ±0.086</td>
<td>21.61 ±0.078</td>
<td>21.65 ±0.091</td>
<td>21.72 ±0.088</td>
</tr>
<tr>
<td>LH</td>
<td>18.78 ±0.076</td>
<td>18.79 ±0.056</td>
<td>19.97 ±0.073</td>
<td>19.96 ±0.059</td>
<td>20.02 ±0.078</td>
</tr>
<tr>
<td>Test.</td>
<td>4.24 ±0.046</td>
<td>4.45 ±0.055</td>
<td>4.77 ±0.062</td>
<td>5.05 ±0.049</td>
<td>5.30 ±0.062</td>
</tr>
</tbody>
</table>

* Means within the same row bearing different superscripts, differ significantly *P<0.05;
L= Lower dose (3ml/rabbit/day); H= Higher dose (6ml/rabbit/day).

Table (5): Overall means of reproductive performance for V.Line male rabbits supplementated orally with onion, zinc sulphate and their combination

<table>
<thead>
<tr>
<th>Items</th>
<th>Onion</th>
<th>Zinc 50 mg/rabbit/day</th>
<th>Zinc +</th>
<th>Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
<td>H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fertility (%)</td>
<td>56.68 ±1.33</td>
<td>71.89 ±1.18</td>
<td>79.70 ±1.24</td>
<td>82.94 ±1.31</td>
</tr>
<tr>
<td>Litter size at birth (n)</td>
<td>5.57 ±1.02</td>
<td>7.30 ±1.14</td>
<td>8.90 ±0.89</td>
<td>8.85 ±1.19</td>
</tr>
<tr>
<td>Live litter at birth (n)</td>
<td>4.35 ±0.76</td>
<td>6.71 ±0.92</td>
<td>8.28 ±1.03</td>
<td>8.42 ±0.79</td>
</tr>
<tr>
<td>Litter size (n) at weaning</td>
<td>3.58 ±0.85</td>
<td>6.28 ±0.96</td>
<td>7.28 ±0.74</td>
<td>7.85 ±0.81</td>
</tr>
<tr>
<td>Bunny weight (g) at birth</td>
<td>44.57 ±1.39</td>
<td>46.14 ±1.51</td>
<td>56.44 ±1.25</td>
<td>56.57 ±1.46</td>
</tr>
<tr>
<td>Bunny weight (g) at 28 d</td>
<td>422.00 ±21.1</td>
<td>559.00 ±27.15</td>
<td>606.60 ±28.18</td>
<td>639.43 ±29.1</td>
</tr>
</tbody>
</table>

* Means within the same row bearing different superscripts, differ significantly **P<0.01;
L= Lower dose (3ml/rabbit/day); H= Higher dose (6ml/rabbit/day)
Table (6): Correlation coefficient between GSH, SOD, GPx and CAT with TBARS, abnormal sperm, dead sperm, sperm motility, acrosomal damage and sperm concentration for V.Line male rabbits.

<table>
<thead>
<tr>
<th>Items</th>
<th>TBARS</th>
<th>Abnormal sperm</th>
<th>Dead sperm</th>
<th>Sperm motility</th>
<th>Acrosomal damage</th>
<th>Sperm concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSH</td>
<td>-0.855</td>
<td>-0.917</td>
<td>-0.929</td>
<td>0.907</td>
<td>-0.644</td>
<td>0.941</td>
</tr>
<tr>
<td>SOD</td>
<td>-0.790</td>
<td>-0.599</td>
<td>-0.652</td>
<td>0.665</td>
<td>-0.574</td>
<td>0.747</td>
</tr>
<tr>
<td>GPx</td>
<td>-0.795</td>
<td>-0.782</td>
<td>-0.816</td>
<td>0.851</td>
<td>-0.585</td>
<td>0.878</td>
</tr>
<tr>
<td>CAT</td>
<td>-0.702</td>
<td>-0.805</td>
<td>-0.775</td>
<td>0.800</td>
<td>-0.629</td>
<td>0.803</td>
</tr>
</tbody>
</table>

TBARS = Thiobarbituric acid–relative substances; GSH= Glutathione content; GPx= Glutathione peroxidase; SOD= Superoxide dismutase; CAT= Catalase.

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Rabbits, quercetin, zinc sulphate, seminal plasma and fertility.

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Rabbits, quercetin, zinc sulphate, seminal plasma and fertility.

The effects of quercetin (chive) and zinc sulphate on seminal plasma and fertility in rabbits under summer heat.

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The present study was conducted to investigate the effects of quercetin (chive) and zinc sulphate on the semen quality and fertility in rabbits under summer heat conditions.

Materials and methods

Twenty-four rabbits were divided into two groups, each containing six rabbits. The first group was fed a diet containing 0.5% quercetin, while the second group was fed a diet containing 0.5% quercetin and 0.5% zinc sulphate. The rabbits were housed in individual pens and had free access to water and feed.

Results

The results showed that quercetin had a significant effect on the semen quality and fertility of rabbits under summer heat conditions. The rabbits fed the diet containing quercetin had a higher sperm concentration, motility, and viability compared to the control group.

Conclusion

Quercetin and zinc sulphate have a positive effect on the semen quality and fertility of rabbits under summer heat conditions. Further studies are needed to investigate the mechanism of action of these compounds on semen quality and fertility.

المص明白

تأثير استخدام الكيوراستين (عصير البصل) وكبزيتات الزنك على الأداء التناسلى لذكور الأرانب تحت ظروف الصيف الحاره

محمد السيد السبيعى و على محمد الحنون

معهد بحوث الانتاج الحيواني ، مركز البحوث الزراعية ، وزاره الزراعه ، مصر

تهدف تلك الدراسة إلى دراسة تأثير استخدام الكيوراستين (عصير البصل) وكبزيتات الزنك على الأداء التناسلى لذكور الأرانب تحت ظروف الصيف الحاره. تم إعداد 20 نسمه من أرانب من بوروندي مخيمات لكل منها 6 ذكور. المجموعة الأولى كانت بدون أي معاملات واعتبرت مرجعية (كمترول). المجاميع الثانية وثالثة تم معاملتها بالتجريبي بالكبيريات الزنك بمعدل 20 ملم/الأرنب/اليوم. بينما المجاميع الخامسة والسادسة تم معاملتها أيضا بالتجريبي بالقلم بـ 40 ملم كبريات الزنك بالإضافة إلى 3 و 6 ملي من عصير البصل/الأرنب/اليوم على التوالي. المعاملات استمرت لمدة 10 أسابيع متتالية قبل البدء في تجميع السائل المنوي وتعتبر أهم النتائج ما يلي:

1- حدثت زيادة معنوية (P<0.01) في كل من حجم القيمة، التركيب الدئملي للحيوانات المنوية، عند الحيوانات المنوية المحمولة بالقلم، عند الحيوانات المنوية الحية والطبيعة لمجموعة الذكور التي تم معاملتها بمخلوط من الزنك والجرعه العالية من عصير البصل 2 مللي/الأرنب/اليوم بالمقارنة بالمجمع الأخرى. حدثت استجابه عكسية لوقت الرغبة الجنسية من وقت رد الفعل الثاني وبناءً على قيم معنوية (P<0.01) مشاهدة لجميع الكبريات وقليل قيمة للجميع المعاملة بالزنك فقط أو بالزنك مضافة اليه عصير البصل.

2- معاملة الذكور بمخلوط من الزنك مضافة اليه 2 ملي من عصير البصل/الأرنب/اليوم أدى إلى حدوث زيادة في عصير البصل بالعديد من الحساسيات معنوية لكلا AIP والفاعلي ACP وهذين الأمين أنتاترفراز إنترلاسك (AST) والفاعل Aminotransferase (ALT) من كم مختل من التركيز اللبنسي الحاضر المجاميع الأخرى وجمجم الكبريات. كنستة البيبودات في البلانزsalene المعونية تعتبر مؤشر لانخفاض الشوارد الحر، بينما زادت الازديوديات المضادة للذكور نتيجة للمعاله بالكبيريات الزنك ومتغيرات الكبريات. حدثت زيادة معنوية (P<0.05) في كلا من مستوى هرمون التستستيرون وهرمون النتليسون وهرمون نقص الحويضات ذكور الذي تم معاملتها بالجرعه العالية من عصير البصل أو من الزنك أو مخلوط من كلا البار مقارنة مع مجموعة الكبريات التي تم معاملتها بمخلوط من الزنك وعصر البصل. بناءً على ذلك أن المجموعة التي تم معاملتها بمخلوط من الزنك وعصير البصل، تحصلت على أعلى قيم معنوية (P<0.05) في جميع البارات الدئملي من عصير البصل. في حين أن المجموعة التي تم معاملتها بالمكملات من عصير البصل والكبيريات الزنك على الأداء التناسلى مثل معدل الخصوبة، حجم الخلق، عدد الميلان، عدد الخلايا المنوية، وزن الخلق عند الميلان وزن الزيادة عند الميلان (P<0.01) بشكل كبير. وحدوث الأصوات الأذى المعرضة لظروف الصيف الحاره ولم يتم معاملتها بأي من معاملات التجربة (الكمترول) بالمقارنة بالمجمعا الأخرى.