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EFFECT OF CLIMATIC CONDITIONS ON SEMEN QUALITY IN RELATION TO PRODUCTION OF RABBITS

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ABSTRACT

A total number of 32 NZW buck rabbits (5 months old and body weight of 2.5 ± 0.02 kg) were used in this study. The experiment continued for 12 months and divided into two periods of cold (November to April) and hot (May to October) climatic conditions. Bucks were individually housed and fed ad libitum diet containing 16.5% crude protein, 13.1% crude fiber, 2.5% fat and 2600 K cal/kg digestible energy. Rectal temperature (RT) and respiration rate (RR) were recorded biweekly in bucks at random through cold (16 bucks) and hot (16 bucks) conditions. Corticosterone (Cor) hormone was determined. Ejaculate volume (ml), sperm concentration ($x10^6$ ml), dead and abnormal spermatozoa (%), sperm motility (%) and hydrogen ion concentration (pH) were determined. Performance of bucks included fertility rate (%), number of services per conception, litter size and weight at birth was estimated.

Rectal temperature (RT) of bucks under hot condition was significantly higher than that of bucks under cold condition. Respiration rate (RR) of bucks during hot conditions significantly increased by about 51% than that of bucks under cold conditions. Hot conditions associated with significantly increase (about 27%) in corticosterone concentration in plasma of bucks. Under hot climatic condition, it was observed that ejaculate volume, sperm concentration and sperm motility % were significantly decreased, however dead sperm% and hydrogen ion (pH) were significantly increased. Climatic condition had no significant effect on sperm abnormalities%, fertility%, number of services per conception, litter size and weight at birth.

INTRODUCTION

Rabbit can play a partial role in bridging the animal protein gap by increasing the demand of meat, especially white meat (FAO, 1987). Many authors reported poor reproductive performance of rabbit (Sakr, 2003 and Abdel-Samee *et al.*, 2005) during the hot climate.

Semen characteristics vary among seasons (Hafez, 1987). Increasing ambient temperature adversely affects semen quality, as well as reducing the ability of leydig and sertoli cells respond to LH (El-Sherry *et al.*, 1980 and Schlolaut, 1985). These disorders caused by high ambient temperature are amplified by the increase in relative humidity (Zeidan *et al.*, 1997 and Marai *et al.*, 2002).

On the other hand, environmental stimulus may enhance or inhibit reproductive performance of rabbits (Theau-Clement, 2000 and Ahmed, Nagwa *et al.*, 2005). High ambient temperature (>30.0 ^oC) reduces the ovulation rate (El-Fouly *et al.*,1977), increases the number of services required for conception (Morsy,2001), impairs the embryonic development and increases mortality rate of the offspring (El-kholy,2003 and Ahmed, Nagwa *et al.*, 2005).

Thus, the objective of this study was to evaluate the semen quality of NZW rabbits in relation to its productivity under cold and hot climatic conditions.

MATERIALS AND METHODS

The present study was carried out in Rabbit Production Unit, Center of Agricultural Production Technology, Fac. of Agric, Cairo University.

A total number of 32 NZW buck rabbits (5 months old and body weight of 2.5 + 0.02 kg) were used in this study. The experiment continued for 12 months and divided into two periods of cold (November to April) and hot (May to October) climatic conditions (Table 1).

Table 1: Indoor ambient temperature (AT) and relative humidity (RH) during cold and hot climatic conditions

Item	Climatic conditions		± MSE
	Cold	Hot	
Minimum AT ^{o}C	11.5^{b}	23.7^{a}	0.11
Maximum AT ^{o}C	19.0^{b}	29.8^{a}	0.28
Minimum RH %	56.5^{a}	44.6^{b}	0.87
Maximum RH %	81.5^{a}	67.7^{b}	0.88

a,b means having different superscripts within the same raw are significantly different (P < 0.05).

Bucks were individually housed in standard dimensions (35×35×60cm) wired metallic cages. Cages were equipped with feeding hoppers made of galvanized steel sheets. Bucks were fed ad libitum a commercial pelleted diet containing 16.5% crude protein, 13.1% crude fiber 2.5% fat, 0.6% minerals mixture and 2600 K cal/kg digestible energy. Fresh water was available all day through nipples drinker system.

Rectal temperature (RT) and respiration rate (RR) were biweekly recorded at random on bucks through cold (16 bucks) and hot (16 bucks) conditions. Rectal temperature was measured by inserting a clinical thermometer 2-3 cm in the rectum for one minute. Respiration rate was determined by counting the frequency of flank movements per minute (Gonzalez *et al.*, 1971).

Corticosterone (Cor) hormone was determined using commercial immuno-assay kits. The cross-reactivity of Cor antibody was 100% with cor, while it was 5.9% with 11-deoxy Cor, 1.4% with progesterone, 0.02% with testosterone, aldosterone and cortisone and 0.01% with other steroids.

Semen was biweekly collected in the morning at 8:00 am using a clean, dried and sterilized standard artificial vagina of rabbits and a teaser doe. Temperature of the artificial vagina was adjusted by warm water to be 41.0 – 43.0 ^{o}C. Ejaculate volume (ml), sperm concentration (x10^{6} ml), dead and abnormal spermatozoa (%), sperm motility (%) and hydrogen ion concentration (pH) were determined.

Performance of bucks included fertility rate (%), number of services per conception, litter size and weight at birth was estimated. Fertile does were using to test productivity of bucks.

Data were statistically analyzed using the General linear model procedure (SAS, 1998). Duncan multiple range was used to test level of significant among the means.

RESULTS AND DISCUSSION

Rectal temperature (RT) of bucks under hot condition was significantly higher than that of bucks under cold condition (Figure 1). However, the change in RT was low (0.4 C^o). Ahmed, Nagwa (2002) reported that the low change in RT during hot season is based on the ability of NZW rabbits to keep their change of body temperature within a narrow range, as all worm blood animals.

Respiration rate (RR) of bucks during hot conditions significantly increased by about 51% than that of bucks under cold conditions (Figure 2). This indicated the enable of rabbits to efficiently dissipate the heat load through panting (Shafie *et al.*, 1970, Ahmed, Nagwa 2000, Morsy 2001 and Ahmed,Nagwa *et al.*, 2006).

Hot conditions associated with significantly increase in corticosterone concentration (Figure 3) in plasma of bucks (about 27%) than those of cold conditions. Christison and Johnson (1972) reported that the increase of plasma glucocorticoid concentrations perhaps elicits physiological adjustments which enable animals to tolerate stressful conditions. The results were in harmony with the findings of Ahmed, Nagwa *et al.* (2006).

Values of ejaculate volume (ml), sperm concentration ($x10^6$ ml) and sperm motility (%) were significantly higher in semen of bucks under cold condition than that of bucks under hot condition (Table 2 and Figure 4). Also, semen of bucks showed significant increase in dead sperm (+6%) and hydrogen ion concentration under hot condition (Table 2 and Figure 4).

Table 2: Ejaculate volume, sperm concentration and pH value of NZW rabbit semen as affected by cold and hot conditions.

Item	Climatic conditions	
	Cold	Hot
Ejaculate volume (ml)	$0.65^a \pm 0.02$	$0.54^b \pm 0.03$
sperm concentration ($x10^6$ ml)	$219.0^a \pm 12.6$	$164.0^b \pm 16.5$
pH	$7.66^b \pm 0.04$	$7.83^a \pm 0.05$

a,b means having different superscripts within the same raw are significantly different (P < 0.05).

Table 3: Reproductive performance of NZW rabbits under cold and hot conditions.

Item	Climatic conditions	
	Cold	Hot
Fertility (%)	$51.4^a \pm 2.9$	$55.8^a \pm 2.9$
* NSC	$2.02^a \pm 0.1$	$1.68^a \pm 0.1$
Litter size at birth	$5.7^a \pm 0.4$	$5.5^a \pm 0.3$
Litter weight at birth (g)	$329.2^a \pm 20.3$	$286.5^a \pm 18.8$

*** NSC: number of services/conception**

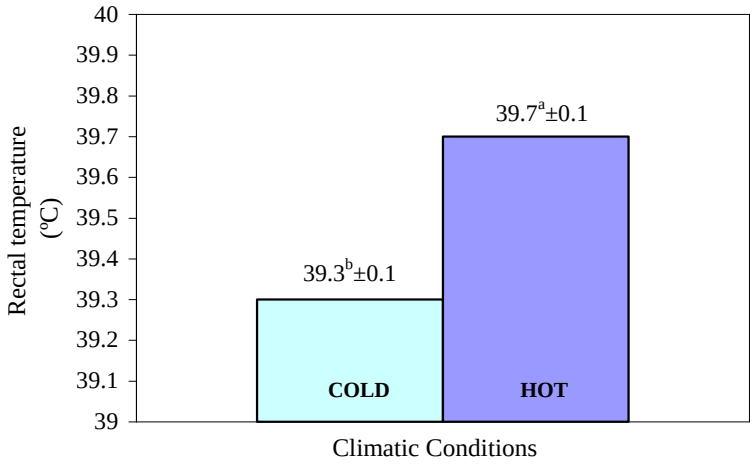

Figure (1) Rectal temperature of NZW buck rabbits under cold and hot climatic conditions.

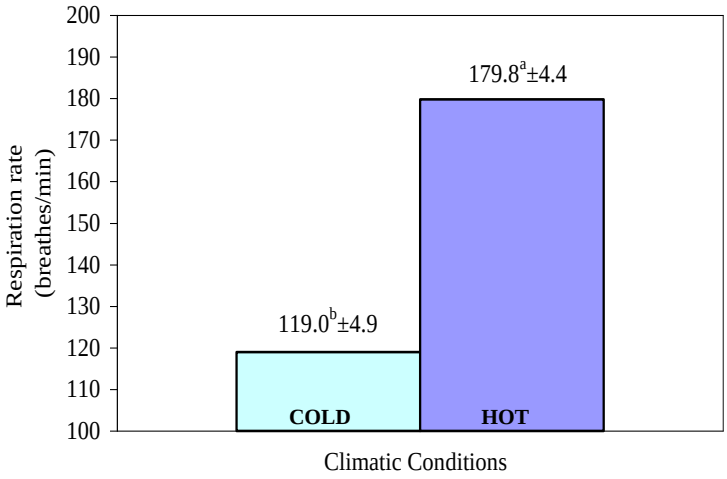

Figure (2) Respiration rate of NZW buck rabbits under cold and hot climatic conditions.

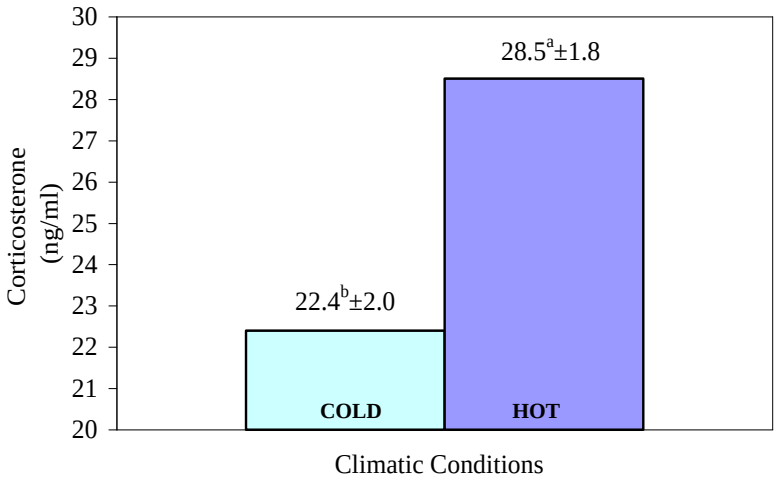

Figure (3) Corticosterone concentration of NZW buck rabbits under cold and hot climatic conditions.

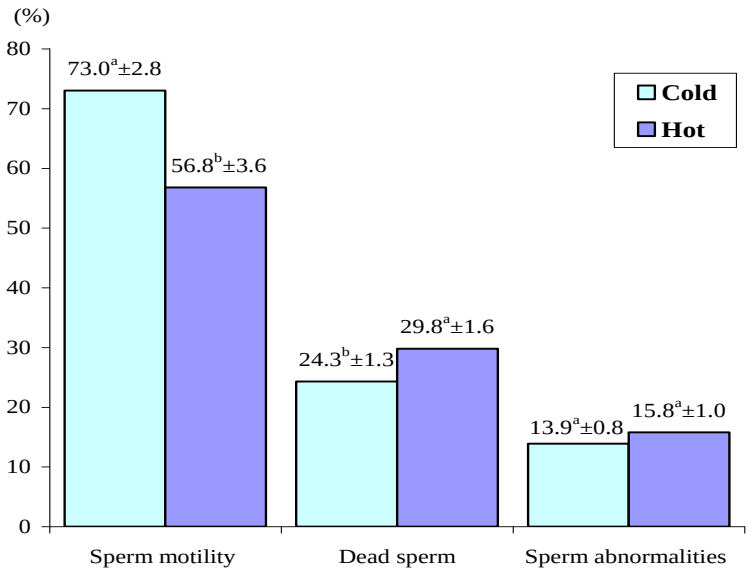

Figure (4) Sperm motility, dead and abnormalities in NZW buck rabbits under cold and hot climatic conditions.

The drastic effect of hot conditions (high ambient temperature) on semen quality of rabbits in the present study was in consistent with the result of EL-Bashary *et al.* (2005). Also, Lin and Ramirez (1991) reported that low quality of semen in hot season was due to the decrease in GnRH release which disturbs spermatogenesis processes.

Sperm abnormalities (Fig. 4) increased by about 15% due to hot conditions. Increasing of dead sperm during the period of high ambient temperature (AT) may be related to spermatozoa characteristics are susceptible to oxidative stress which increased during high AT inducing damage of normal sperm (Aitken and Fisher, 1994).

Climatic conditions, had no significant effect on fertility%, number of services per conception, litter size and weight at birth (Table 3). Ahmed Nagwa (2000) reported insignificantly higher conception rate of NZW rabbits was observed during high ambient temperature. On the other hand, El-Fouly *et al.* (1984) found that ovulation rate and fertilization processes were not influenced by exposure of rabbits to high ambient temperature.

Although the semen quality of NZW rabbits was lower during hot climatic conditions than that during cold, the productive performance of bucks did not drastically affect. While, both litter size and weight at birth were slightly affected by high ambient temperature.

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تأثير الظروف المناخية على جودة السائل المنوى وعلاقته بالإنتاج فى الأرانب

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استخدم فى هذه الدراسة عدد ٣٢ ذكر ارنب نيوزلندى عمر ٥ شهور يبلغ وزنها حوالى ٢,٥كجم في بداية التجربة. استمرت التجربة ١٢ شهراً تم تقسيمها الى فترة باردة من (نوفمبر الى ابريل) وفترة حارة من (مايو الى اكتوبر). تم تسكين الذكور فرديا وتغذت على عليقة مصبعات تجارية تحتوى على ١٦,٥%بروتين خام، ١٣,١% الياف خام، ٢,٥% دهن، ٢٦٠٠ كيلو كالورى طاقة مهضومة.

تم قياس درجة حرارة المستقيم ومعدل التنفس كل أسبوعين عشوائياً على عدد ١٦ ذكر خلال الظروف الحارة، ١٦ ذكر خلال الظروف الباردة كما تم تقدير تركيز هرمون الكورتيكوستيرون فى البلازما. تم تقدير حجم القذفة (مل)، تركيز الحيوانات المنوية (× ١٠ ٦ / مل) والنسبه المئوية (%) للميت والشاذ. كما تم تقدير كل من الحركة (%) وتركيز ايون الهيدروجين. تم تقييم الذكور من حيث الخصوبة وعدد مرات التلقيح اللازمة للإخصاب وتأثيره على عدد ووزن الخلفات عند الميلاد.

أوضحت النتائج إرتفاع درجة حرارة المستقيم معنويا فى الذكور تحت الظروف الحارة كما ارتفع معدل التنفس معنوياً بنسبه تصل الى ٥١ % عنها فى الذكور التى كانت تحت الظروف الباردة. ارتفاع درجة الحرارة والظروف المصاحبة من رطوبة ادت الى ارتفاع تركيز هرمون الكورتيكوستيرون بحوالى ٢٧%. أدت الظروف المناخية الحارة إلي خفض كل من حجم القذفة وتركيز وحركة الحيوانات المنوية معنوياً ، بينما أدت الى ارتفاع معنوى فى كل من النسبه المئوية للحيوانات المنوية الميتة ودرجة تركيز أيون الهيدروجين. لم تؤثرالظروف المناخية معنوياً على النسبه المئوية للشاذ من الحيوانات المنوية أو المظهر الإنتاجى للأرانب من خلال تسجيل نسبه الخصوبة وعدد التلقيحات اللازمة للإخصاب وعدد ووزن الخلفه عند الميلاد.