EFFECT OF HEAT STRESS ON FEMALE NEW ZEALAND WHITE RABBITS' BEHAVIOUR AND PERFORMANCE

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SUMMARY

This work was carried out for 10 weeks in a private rabbitry in Menoufia Governorate, Egypt; during summer season (2003) to study the effect of heat stress on rabbits' behaviour and performance using 30 New Zealand White female rabbits with an average age 9 months. These animals were divided randomly into five groups (6 each) and reared in rooms under natural conditions with an ambient temperature ranged from 33 to 35 °C except the first group and subjected to some specific managemental treatments. The first group (group I) was reared in an air-conditioned room with air temperature (18- 20 °C). The animals in the second group (group II) were treated by adding vitamin C in the drinking water (50 mg / head / day) at 11 a.m. The animals in the third group (group III) were clipped at the beginning of this study while, the fourth one (group IV) was treated by placing glass bottles filled with cold water in the cage and the fifth group (group V) was taken as a control.

The rabbits which were reared in the group I and those in the groups II, III and IV showed low rectal temperature, low respiratory rate, low water intake and rest period with high feed intake compared with the group V. The gestation period was shorter in the group V than others. The litter size (number of kits) was more in the treated groups as well as the kits weight at birth and weaning was higher in the treated groups than control one. The newly born mortality percentage from birth to weaning was lower in the treated groups than the control one.

From this work, it could be concluded that the productivity of rabbits during summer season can be improved by applying the modern husbandry; using air conditioned farm , adding vitamin C in the drinking water, clipping the fur and/or placing of glass bottles filled with cold water in the cage.

INTRODUCTION

Rabbits are supposed to play an important role in solving meat production insufficiency particularly in the developing countries. These developing countries are mostly localized in tropical and subtropical regions so, rabbits are faced with many problems related to hot climate particularly heat stress. Rabbits required to have a constant internal body temperature so, heat production must cope the losses to maintain the body temperature constant. They do this by modifying their behavioral (ingest and play) and physiological status (respiratory rate and peripheral temperature specially ear one).

Most of the sweat glands in rabbits are not functional and perspiration (evacuation of water via the skin) is scanty because of the fur, the only controlled means of latent heat evacuation is by altering the respiratory rate (Abd ElSamee, 1987). As the comfort zone for rabbits is 15 to 20 ^{o}C , rabbits can withstand cold weather rather than warm one. The metabolic rate was increased by about 20% in rabbits when exposed to high air temperature ranging form 30 to 35 ^{o}C (Gonzalez et al., 1971) while, the feed intake was decreased (Rakes et al., 1988 and Habeeb et al., 1993). The rectal temperature is considered as a good measure of core one and has been used by many investigators as an indicator for the response of animals to air temperature fluctuations (Dukes, 1984). The heat stressed rabbits always have high rectal temperature (Toson, 1983). Abo ElEzz et al. (1985) reported that the high ambient temperature has an adverse effect on the reproductive performance of rabbits and on the productive efficiency (Ghaly, 1988 and Fernandez et al., 1994). The lowest body weight was recorded in rabbits kept under high ambient temperature as compared to those cold air (Hassanein, 1980 and Abd ElMoty et al., 1991). But, some other studies showed that the difference in daily gain weight between summer and winter was not significant (Daader et al., 1999) . The gestation period was not affected by different environmental temperatures and ranged from 3032 days (Ghaly, 1988). Also, the litter size, ovulation rate and fertilization rate were not affected by continuos exposure of female rabbits to high ambient temperature (Hanada et al., 1983). In contrast, Bassuny (1999) and Radwan (1998) reported that the litter size values were significantly lower during summer than winter season. The preweaning mortality rate was high in rabbits exposed to

high ambient temperature (Marai et al., 2002), this may be due to that the heat stress led to inhibition of lactogenesis and so decrease milk supply to suckling rabbits (Abd El–Moty et al., 1991).

The aim of the present work was to study the effect of heat stress on rabbits ' behaviour and performance.

MATERIALS AND METHODS

The present work was carried out for 10 weeks in a private rabbitry in Minufiya Governorate, Egypt, during summer season (2003) using 30 New Zealand White female rabbits with an average age 9 months. These animals were divided randomly into five groups (6 each) and reared in rooms under natural conditions with an ambient temperature ranged from 33 to 35 ^{o}C except the first group and were subjected to some specific managemental treatments. The first group (group I) was reared in air conditioned room with an ambient temperature 18-20 ^{o}C. The animals in the second group (group II) were treated by adding vitamin C (100% concentration from Frankwright Company, England) in the drinking water (50 mg / head / day) according to Ismail et al. (1992), the vitamin C was added to the drinking water at 11 a.m.(Commence of elevation in air temperature). The animals of the third group (group III) were clipped by a clipping machine at the beginning of this study. While, the animals in the fourth group (group IV) were treated by placing of glass bottles filled with cold water as a cooling agent in the cage. These bottles were placed in the cage at 11 a.m. The fifth group (group V) was taken as a control.

Rabbits were housed individually in commercial hutches (60 x 55 x 40 cm) provided with feeders, automatic drinkers and a nest box (40 x 30 x 30 cm) and fed a commercial pelleted diet of 17% crude protein and 2900 ME/ Kg (Cairo Company). The diet was offered twice daily at 9 a.m. and 5 p.m. with adlibitum amount and provided with drinking water. All the does were mated by a well examined New Zealand White bucks of proven fertility.

Measurements:

Rectal Temperature using a Clinical Mercuric Thermometer.

Respiratory rate was taken by observing the chest movement per minute.

Feed and water intakes (maintenance behaviour) were determined by weighing the remained amounts of feed and measuring the amount of water then subtracting them from the offered before putting the new ones.
Rest period was measured by recording the rest time taken by each rabbit during the daylight.
The gestation period was recorded by counting the days elapsed from time of mating till kindling.
Litter size (number of kits given by each doe) .
Individual kits weight at birth and weaning.
Mortality rate for kits from birth till weaning.
N.B.: The weaning was done at 4 weeks from birth in all groups.

Statistical analysis:

Data were collected, arranged, summarized and analyzed using the general linear model procedures of the SAS, Institute INC(1985) .

RESULTS AND DISCUSSION

Data in table (1) shows that, there was a significant difference in the rectal temperature and respiratory rate between the control group and the treated ones, as the rectal temperature and respiratory rate were higher in rabbits in the control group than those in treated groups. These results nearly the same with that of Abd ElHakeam et al. (1991) who recorded that the exposure of rabbits to high air temperature significantly increased the respiratory rate and rectal temperature. This may be attributed to the heat production was increased by heat stress as a result of increasing the metabolic rate resulting in hyperthermic animal which try to alleviate this hyperthermia via hyperpenea (Shafie et al., 1982) which represents about 30% of total heat dissipation.

Also, table (2) shows that the high ambient temperature has an adverse effect on feed and water intakes, as, the high air temperature led to decrease the eaten feed intake and increase the water intake. This result may be attributed to the exposure of rabbits to high air temperature led to inhibition of hypothalamic appetite center and hence , reduced the feed intake (Dukes, 1984) but , the high consumption of water during heat stress helps the animals to increase the heat loss through vapourization of water during respiration (Chiericato et al., 1992). Using of air-conditioned room, adding the vitamin C and clipping the fur were considered

the better methods to alleviate the heat stress than placing of glass bottles filled with cold water in the cage. These results coincided with that of Rakes et al. (1988).

Rest period during daylight was higher for rabbits in the group V (8 ± 0.037 hours) followed by the group IV (7 ± 0.016 hours) and for those in the group III (6±0.022 hours) than for those in the group II (5.5±0.018 hours) and group I (5±0.019 hours) (Table 2) . This may be due to that when the air temperature increased, the animals, stretch out and erect their ears to loose as much heat as possible by radiation and convection (Lebas et al., 1986). Also, placing the glass bottles filled with cold water in the cage encourage the animals to lie on them or beside them resulting in an increase in the rest period.

The gestation period seemed to be affected by heat stress as the gestation period was decreased (29 days) in rabbits exposed to high ambient temperature (control group) compared with treated ones (30 days) (table 2). The litter size (number of kits) was found to be lower in the group V (5 kits) than those in the groups II, III and IV (6 kits each) and group I (7 kits) as shown in table (3). These results may be attributed to the decrease in conception rate under high environmental temperature as a complex set of events are expressed in a significant reduction in total young born and in an increase in percentage of young born dead (Matassino et al., 1970). Kits weight at birth and weaning was found to be affected significantly by heat stress, as it was smaller in control group than the other treated groups (Table 3). Logically, hyperthermic pregnant dams had low feed intake, depressed thyroid activity and hence, metabolic rate resulting in decrease in the litter weight at birth; in addition such dams had low milk yield resulting in less feed for the growing kits.

Lastly, the mortality percentage for kits from birth to weaning was higher in control group (30%) than those treated by placing of glass bottles filled with cold water in the cage (25%), clipping (19%), vitamin C supplementation (20%) and air conditioned room (18%) as shown in table (3) . This result was substantiate with that of Marai et al. (2002), and may be explained by the direct effect of heat stress on the sensitive offspring, in addition to the reduction in the milk yield from heat stressed dams (Ayyat et al., 1995).

From this work, we conclude that the performance of rabbits during summer season can be improved by applying some managerial techniques for alleviation of the heat stress as using of air conditioned farms, providing the rabbits with vitamin C in the drinking water, shearing the fur and/or placing a glass bottles filled with cold water in the cage to lie beside or on them.

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Table (1) : Effect of different treatments on rectal temperature and respiratory rate of New Zealand White rabbits (Mean ± SE).

Treatments / Variables	Air conditioned group	Vit. C supplemented group	Clipped group	Glass bottle containing group	Control group
Rectal temperature	39.1 ± 0.081a	39.4 ± 0.028a	39.3 ± 0.050a	39.6 ± 0.033 a	40.1 ± 0.012b
Respiratory rate / minute	136 ± 0.023c	140 ± 0.041a	140 ± 0.011a	150 ± 0.021 b	181 ± 0.032d

Table (2) : Effect of different treatments on maintenance behaviour and gestation period of New Zealand White rabbits (Mean ± SE).

Treatments / Variables	Air condition-ed group	Vit. C supplemented group	Clipped group	Glass bottle containing group	Control group
Feed intake (g/ day)	159 ± 0.016 a	154 ± 0.026 b	155 ± 0.034 c	130 ± 0.031 d	122 ± 0.044 e
Water consumption (mL / day)	270 ± 0.051a	285 ± 0.027 b	280 ± 0.055 c	300 ± 0.038d	385 ± 0.013 e
Rest period During daylight (hours)	5 ± 0.019a	5.5 ± 0.018b	6 ± 0.022c	7 ± 0.016d	8 ± 0.037e
Gestation Period (days)	30 ± 0.011a	30 ± 0.009a	30 ± 0.018a	30 ± 0.036 a	29 ± 0.024b

- Means which subscript with different small letters (a, b, c ...) within the same row differ significantly at ($P < 0.05$) .

Table (3) : Effect of different treatments on some reproductive traits of New Zealand White rabbits (Mean ± SE).

Treatments / Variables	Air conditioned group	Vit.C supplemen -ted group	Clipped group	Glass bottle containing group	Control group
Litter size (Number of kits)	7 ± 0.011 a	6 ± 0.018 b	6 ± 0.052c	6 ± 0.061 d	5 ± 0.023 e
Wt. of individual kit at birth (g)	65 ± 0.027 a	60 ± 0.014 b	62 ± 0.040c	58 ± 0.004 d	55 ± 0.019 e
Wt. Of individual kit at weaning. (g)	520 ± 0.016 a	501 ± 0.013 b	500 ± 0.029c	480 ± 0.034 d	418 ± 0.014 e
Mortality %	18 ± 0.018 a	20± 0.021a	19 ± 0.009a	25 ± 0.043 b	30 ± 0.037 c

* Means which subscript with different small letters (a, b, c ...) within the same row differ significantly at ($P < 0.05$) .

الملخص العربى

تأثير الإجهاد الحرارى على سلوكيات و أداء إناث الأرانب النيوزلاندى

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أجريت هذه الدراسة على مزرعة خاصة للأرانب بمحافظة المنوفية ــ مصر لمدة عشرة أسابيع خلال موسم الصيف2003 و فيها تم اختيار 30 من أمهات الأرانب النيوزيلاندى البيضاء و متوسط أعمارهم تسعة شهور . قسمت هذه الأرانب إلى خمس مجموعات و تم رعاية هذه الحيوانات فى حجرات تحت الظروف الطبيعية ذات درجة حرارة جو تتراوح من 33 إلى 35 درجة مئوية فيما عدا المجموعة الأولى و تعرضت أيضا لبعض المعاملات الخاصة كما يلى :

المجموعـــة الأولـــى تم رعايتها فى حجرة مكيفة الهواء وذات درجة حرارة جو 18 ــ 20 درجة مئوية و المجموعة الثانية تم إضافة فيتامين ج إلى مياه الشرب من الساعة الحادية عشر صباحا بمعدل 50 ملليجرام لكل حيوان يوميا . أما حيوانات المجموعة الثالثة فتم قص فروتها عند بداية التجربة . والمجموعة الرابعة تم وضع زجاجات مياه مملوءة بالماء البارد فـــى الـــبطارية لكى يستخدمها الحيوان كمصدر للتخلص من ارتفاع حرارة الجو عن طريق الملامســـة .أمـــا المجموعـــة الخامســـة فتم رعايتها تحت الظروف الطبيعية بحيث تستخدم كمجموعة ضابطة.

و أظهـــرت النـــتائج أن رعاية الأرانب فى حجرة مكيفة الهواء أو إضافة فيتامين ج إلـــى مـــياه الشـــرب أو قـــص الفـــروة وكذلك وضع زجاجات مياه مملوءة بالماء البارد فى البطارية أدى إلى انخفاض فى درجة حرارة الجسم و معدل التنفس بالإضافة إلى معدل الأكل و فـــترة الـــراحة بيـــنما زاد معدل استهلاك الماء . فترة الحمل كانت قصيرة فى المجموعة الضابطة عن المجموعات المعاملة.

زاد عدد الأرانب المولودة فى البطن الواحدة باستخدام هذه المعاملات و كذلك زادت أوزانهم عند الولادة وأيضا عند الفطام بينما قلت نسبة النفوق ابتداء من الولادة و حتى الفطام باستخدام هذه المعاملات.

ومـــن هذه الدراسة نستنتج أن استخدام المزارع المكيفة الهواء أو إضافة فيتامين ج إلـــى مـــياه الشـــرب أو قـــص الفروة و كذلك وضع زجاجات مياه مملوءة بالماء البارد فى البطاريات للأرانب خلال موسم الصيف تستخدم كطرق رعائية للتخلص من الإجهاد الحرارى و تؤدى أيضا إلى تحسن فى أدائها.

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