

Effect of heat stress on 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 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 was reared in air conditioned room with air temperature (18-20 °C). The animals in the second group were treated by adding vitamin C in the drinking water (50 mg/head/day) at 11 a.m. But the animals in the third group were clipped at the beginning of this study. While, the fourth one was treated by placing of glass bottles filled with cold water in the cage and the fifth group was taken as a control.

The rabbits which reared in air conditioned room and those which treated by adding vitamin C in the drinking water, clipping and placing of glass bottles filled with cold water in the cage had low rectal temperature, respiratory rate, water intake and rest period with high feed intake in compared with control group. The gestation period was shorter in control group 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. But, the mortality percentage from birth to weaning was lower in the treated groups than 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 placing of glass bottles filled with cold water in the cage.

Keywords: Air condition, Vit. C, Cooling, Cutting fur, Rabbit

Introduction

Rabbits are hoped to play an important role in solving meat production deficiency particularly in the developing countries. These developing countries are mostly localized in tropical and subtropical regions so, rabbits are suffered from many problems related to hot climate particularly heat stress. Rabbits tend to have a constant internal body temperature so, heat production must be coped the losses to maintain the body temperature constant. They do this by modifying their behavioural (ingestive 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 never great because of fur, the only controlled means of latent heat evacuation is by altering the respiratory rate(**Abd El-Samee, 1987**). The comfort zone for rabbits is 15 to 20^oC so, rabbits can withstand cold weather than warmer one. The metabolic rate increased by about 20% in rabbits when exposed to high air temperature ranged form 30 to 35^oC (**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 had high rectal temperature (**Toson, 1983**). **Abo El-Ezz et al. (1985)** reported that the high ambient temperature had 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 low air one (**Hassanein, 1980 and Abd El-Moty et al., 1991**). But, 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 temperature and ranged from 30–32 days (**Ghaly, 1988**). As well as the litter size , ovulation rate and fertilization rate were not affected by continuous 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. But, the pre-weaning mortality rate was increased in rabbits exposed to high ambient temperature (**Marai et al., 2002**), this may be due to the heat stress led to inhibition of lactogenesis hence , decrease milk supply to the growing 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 Menoufia Governorate, Egypt, during summer season 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 was reared in air conditioned room with an ambient temperature 18-20 °C. The animals in the second group was 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)**, this vitamin C was adding in the drinking water at 11 a.m. The animals of the third group were clipped by clipping machine at the beginning of this study. While, the animals in the fourth group was treated by placing of glass bottles filled with cold water in the cage. These bottles were placed in the cage at 11 a.m. But, the fifth group was taken as a control.

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

Measurements :

- 1- Rectal Temperature using Digital Thermometer.
- 2- Respiratory rate was taken by observing the chest movement per minute.
- 3- Feed and water intakes (ingestive 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.
- 4- Rest period (play behaviour) was measured by recording the rest time which taken by each rabbit during the daylight.
- 5- Gestation period was recorded by counting the days elapsed from time of mating till kindling.
- 6- Litter size (number of kits given by each doe) .
- 7- Kits weight at birth and weaning .
- 8- 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) showed that, there was a significant difference in the rectal temperature and respiratory rate among control group and treated ones, as the rectal temperature and respiratory rate were higher in rabbits in the control group than those in treated groups. These results agreed with that of **Abd El-Hakeam et al. (1991)** who recorded that the exposure of rabbits to high air temperature significantly increased the respiratory rate and rectal one. 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 hyperpnea (**Shafie et al., 1982**) which represents for about 30% of total heat dissipation. Also, table (1) showed that the high ambient temperature had an adverse effect on ingestive behaviour, as, the high air temperature led to decrease the feed intake and increase the water one. But, using of air conditioned room, adding the vitamin C and clipping the fur were considered the best methods to alleviate the heat stress than placing of glass bottles filled with cold water in the cage. These results were coincided with that of **Rakes et al. (1988)**. 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**).

Rest period during daylight was higher in the control group followed by the group (8 ± 0.037 hours) which treated by putting the bottles filled with cold water in the cage (7 ± 0.016 hours) and that treated by clipping (6 ± 0.022 hours) than those treated by vitamin C supplementation (5.5 ± 0.018 hours) and air conditioned room (5 ± 0.019 hours) as shown in table (1) .As, 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) in compared with treated ones (30 days) .

The litter size (number of kits) was found to be lower in the control group (5 kits) than those treated by vitamin C supplementation, clipping and placing of glass bottles filled with cold water in the cage (6 each) and in air conditioned room was (7 kits) as shown in table (1). These results may be attributed to the decrease in fertility and 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. 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 young.

Lastly, the mortality percentage for kits from birth to weaning was higher in control group (3%) than those treated by placing of glass bottles filled with cold water in the cage (2.5%), clipping (1.9%), vitamin C supplementation (2%) and air conditioned room (1.8%) as shown in table (1). This result was substantiated with that of **Marai et al. (2002)**, these results 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 concluded 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 them or on it.

Table (1) : Effect of air conditioned room, vitamin C supplementation, clipping and placing of glass bottles filled with cold water in the cage during summer season on rabbits' behaviour and performance (Mean \pm SE).

Treatments	Air conditioned group	Vit. C supplemented group	Clipped group	Glass bottle containing group	Control group
Rectal temperature	39.1 \pm 0.081 ^a	39.4 \pm 0.028 ^a	39.3 \pm 0.050 ^a	39.6 \pm 0.033 ^a	40.1 \pm 0.012 ^b
Respiratory rate/minute	136 \pm 0.023 ^c	140 \pm 0.041 ^a	140 \pm 0.011 ^a	150 \pm 0.021 ^b	181 \pm 0.032 ^d
Feed intake (g/day)	159 \pm 0.016 ^a	154 \pm 0.026 ^b	155 \pm 0.034 ^c	130 \pm 0.031 ^d	122 \pm 0.044 ^e
Water consumption (ml/day)	270 \pm 0.051 ^a	285 \pm 0.027 ^b	280 \pm 0.055 ^c	300 \pm 0.038 ^d	385 \pm 0.013 ^e
Rest period During daylight (hours)	5 \pm 0.019 ^a	5.5 \pm 0.018 ^b	6 \pm 0.022 ^c	7 \pm 0.016 ^d	8 \pm 0.037 ^e
Gestation Period (days)	30 \pm 0.011 ^a	30 \pm 0.009 ^a	30 \pm 0.018 ^a	30 \pm 0.036 ^a	29 \pm 0.024 ^b
Litter size (Number of kits)	7 \pm 0.011 ^a	6 \pm 0.018 ^b	6 \pm 0.052 ^c	6 \pm 0.061 ^d	5 \pm 0.023 ^e
Wt. of kit at birth (g)	65 \pm 0.027 ^a	60 \pm 0.014 ^b	62 \pm 0.040 ^c	58 \pm 0.004 ^d	55 \pm 0.019 ^e
Wt. of kit at weaning. (g)	520 \pm 0.016 ^a	501 \pm 0.013 ^b	500 \pm 0.029 ^c	480 \pm 0.034 ^d	418 \pm 0.014 ^e
Mortality %	1.8 \pm 0.018 ^a	2 \pm 0.021 ^a	1.9 \pm 0.009 ^a	2.5 \pm 0.043 ^b	3 \pm 0.037 ^c

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

References

Abd El-Hakeam, A. A. ; Abd El-Moty, A. k. and Abd El-Rahman, A. M.

(1991): Physiological responses of rabbits to high air temperature.

I- Thermoregulation and blood constituents. Egyptian J. of Rabbit Science, 1 (2) : 136–145.

Abd El-Moty, A. K. ; Abd El-Hakeam, A. A. and Abd El-Rahman, A. M.

(1991): Physiological responses of rabbits to high air temperature .

II- Productive and Reproductive efficiency. Egyptian J. of Rabbit Science, 1 (2) : 146 – 158.

Abd El-Samee, A. M. (1987): The role of cortisol in improving productivity of heat stressed farm animals with different techniques, Ph. D. Thesis, Fac. Agric., Zagazig Univ., Egypt.

Abo El – Ezz, Z. ; Salem, M. H. ; Abd El – Fattah , G. A. and Yassen, A. M.

(1985) : Effect of exposure to direct solar radiation on body weight, Thermo regulation and reproductive efficiency in the male rabbit. Indian J. Agric. Sci., 57 (4) : 324 – 330 .

Ayyat, M. S. ; Marai, I. F. and El – Sayiad, G. H. (1995): Genetic and

nongenetic factors affecting milk production and pre weaning litter traits of New Zealand White does, under Egyptian conditions. J. World Rabbit Sci., 3 : 119– 124.

Bassuny, S. A. (1999) : Performance of doe rabbits and their weanlings as affected by heat stress and their alleviation by nutritional means under Egyptian J. Rabbit Sci., 9:61–72

Chiericato, G. M. ; Bailoni, L. and Rizzi, C. (1992) : the effect of environmental temperature on the performance of growing rabbits. J. Appl. Rabbit Res., 15 : 723 – 73.

Daader , A. H. ; Gabr, H. A. and Seleem , T. S. (1999) :

Productive and reproductive performance of New Zealand White and Californian rabbit Bucks as affected by supplementing vitamin A to the diet during summer and winter seasons. Proceeding of 7th Conference on Animal Nutrition (Ruminants, Poultry and Fishes), El – Arish, North – Sinai, Egypt, 551 – 564 .

Dukes H. H. (1984) : The physiology of the Domestic animals . 10th Ed., Comstock, Cornell Univ. press, Ithaca, N. Y., USA.

Fernandez, C. I. ; Blas, E. and concha, C. (1994) : Growth and some carcass traits of adult rabbits under high ambient temperature. J. World Rabbit Sci., 2 : 147 - 151.

Ghaly, K. A. A. (1988) : Effect of environmental conditions on the reproductive performance of rabbits. M. Sci. Thesis, Fac. Agric., Minia Univ., Egypt.

Gonzalez, R. R. ; Kluger, M. J. and Hardy, J. D. (1971) : Partitional Calorimetry of New Zealand White rabbit at air temperature 5-35 ° C. J. Appli. Physiol., 31 : 729 – 736.

Habeeb, A. A. ; Aboul – Naga, A. I. and Yousef, H. M. (1993) : Influence of exposure to high temperature on daily gain, Feed efficiency and blood components of growing male Californian rabbits . Egyptian J. of Rabbits Science, 3 (1) : 73 – 80 .

Hanada, A. ; Togashi, N. ; Shorgan, B. Yaguchi, T. ; Shugano, T. and Shioya, Y. (1983) : Decrease in developing embryos and fetuses in rabbits exposed to a hot environmental for one or three days after mating. Bulletin of National Institute of Animal Industry, Japan , No. 41: 9 – 16 .

Hassanein, A. M. (1980) : Reproductivity of rabbits under different heat conditions. M. Sci. Thesis, Fac. Agric., Cairo Univ., Egypt.

Ismail, A. M. ; Shalash, S. M. ; Kotby, E. A. and Cheeke, P. R. (1992) : Effects of Vitamin A, C and E on the reproductive performance of heat stressed female rabbits in Egypt. J. of Applied Rabbit Research., 15 : 1291 – 1300 .

Lebas, F. ; Coudert, P. ; Rouvier, R. and De Rochambeau, H. (1986) : The rabbit , Husbandry, Health and Production. FAO, Animal Production and Health Series No. 21.

- Marai, I. F. M. ; Habeeb, A. A. and Gad, A. E. (2002) :** Rabbits' productive, reproductive and physiological performance traits as affected by heat stress : A review livestock Production Science, 78 : 71 – 90
- Matassino, D.; Bordi, A. and Nardone, A. (1970) :** Some vital statistics of the native improved breed of rabbit. Animal Prod., 9 : 21 .
- Radwan, H. E. M. (1998) :** Comparative study for New Zealand White rabbits and their cross under different production systems. Ph. D. Thesis, Fac. Agric., Zagazig Univ. Egypt.
- Rakes, J. M. ; Heird, C. E. ; Harris, G. C. ; Wittorff , E. K. and Johnson, Z. B. (1988) :** Effects of heat stress, nutrition and gonadotrophins on reproduction of New Zealand rabbit proceeding of 11th International Congress on Animal Reproduction and Artificial Insemination. University College, Dublin, Ireland, Vol. 3, Breef Communication .
- SAS (1985) :** SAS user's guide : Statistics version 5 Edition. SAS Ins . INC. Cary, NC.
- Shafie M. M. ; Kamar, G. A. ; Borady, A. M. and Hassanein, A. M. (1982) :** Thermoregulation in rabbit under different environmental conditions . Proceeding of 6th International conference on Animal and Poultry Production, Zagazig, Egypt, pp. 21– 23.
- Toson, M. A. (1983) :** Genetic differences of heat tolerance and their effect on some productive traits in rabbits. M. Sci., Thesis, Fac. Agric., Moshtohor, Zagazig Univ., Egypt .