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GROWTH, REPRODUCTIVE PERFORMANCE AND SOME LITTER TRAITS OF NEW ZEALAND WHITE RABBIT DOES AS AFFECTED BY HEAT STRESS

BY

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ABSTRACT

Twenty New Zealand White rabbit does was used in this study to evaluate the effect of heat stress on the growth and reproductive performances and also on some litter traits. They were divided into two groups (n=10/group). One served as control, kept under comfortable ambient temperature, 21± 2 ºc & relative humidity, 60 ± 3%, and the other one heat stressed exposed to ambient temperature of 33.7 ± 1.3ºc and relative humidity 80.0 ± 2.3%, throughout study period. Heat stress showed a high significant ($p<0.001$) effect on both growth parameters (daily feed intake, daily weight gain, feed conversion ratio, daily water intake & water / feed ratio) as follows (88.44±3.70, 10.40±1.50, 8.50±0.40, 561.5±10.80 & 6.20±0.75, respectively); besides reproductive performance traits (conception rate, litter size, weight & mortality at birth & 35 days of litters age) which were (56.08±2.10, 6.40±0.55, 2.60±0.26, 33.30±2.20, 264.60±651, 1.50±0.61 & 3.90±0.50, respectively).

INTRODUCTION

The developing countries are usually confronted with various complicated problems particularly those related to rapid increase in human population and consequently demand for animal protein.

To maximize food production especially in these countries to face such increase in human population, all reasonable options must be considered & evaluated; one of these is rabbit breeding (**Maria et al. 1991).**

In Egypt, rabbits are hoped to play an important role in solving meat production deficiency, particularly with an increase of livestock out breaks in last periods & increasing human population (**Kalamah et al. 2001).**

The successful and profitable breeding of rabbits needs highly comfortable environmental and microclimatic conditions. Rabbits continuously kept under abnormal environmental conditions showed signs of stress, which adversely affect animal health and production **(Mervat, 1993).**

However, rabbits are very sensitive to climatic stress & are especially vulnerable to heat stroke, especially overweight & heavily furred breeds. Moreover, nutritional stress or underfeeding has a very obvious effect on rabbit health & production, flesh, kindle or fur (**Pargi-Bini, 1990).**

Heat stress represents the most obvious limitation to rabbit production in tropical and subtropical countries, as it evokes series of changes in the biological functions of the body including decreasing feed intake, growth rate, and feed efficiency besides increased mortality rate among litters **(Marai et al., 1991).**

Temperature humidity index THI quantifies the level of heat stress in relation to climatic conditions, where signs of stress become evident when the THI exceeds the critical value 72 **(Ravagnolo et al. 2000).**

MATERIAL AND METHODS

1.Study site:

This study was carried out in the Educational veterinary hospital in Shoha village belonging to Faculty of Veterinary Medicine, Mansoura University at the beginning of January throughout the end of June 2005.

2. Animals, housing and management

Rabbits in this study (20 New Zealand White does and 5 bucks of the same breed) were obtained from a private farm in Badrashin, Giza. Does with average age of 3 ± 0.4 months and weights of 1.48 ± 0.56 Kg were examined clinically for health conditions then animals were divided equally into two groups (n=10) to estimate the effect of heat stress on rabbit performance. Whereas, group I (control), and group II (heat stressed). The animals were housed in two rooms with flooring area (7.2 x 12.6 m^2) in wire cages of double raw stair-step California battery cages, each cage was of (60×50×35cm) and provided with a manual feeder of galvanized steel, automatic nipple drinkers and nest boxes (40×32×29cm) for kindling with nesting material (straw). Rabbits were fed on a formulated pelleted ration adlibitum according to **NRC (1994)**. Fresh clean tap water was available at all times from automatic nipple drinkers. Cages were identified by identity cards, hanged on the front side, denoting the animal number and other needed information. The excreta of rabbits were scrapped twice daily then the floor washed down by water and disinfected by creoline "emulsified coal tar 5%". All prophylactic measures against rabbit affections were given regularly to animals in all groups. The laboratory building was well ventilated with ceiling and exhausting fans. Room temperature and relative humidity were measured by using SATO thermometer and hygrometer, SATO Keriyoki MFG Co., LTD. Japan as described by **Moatz et al. (2002).** Light intensity was estimated by Luxemeter as methods described by **Maria et al. (2004)**. Group II was kept under heat stress at ambient temperature of 33.7 ± 1.3ºC and relative humidity % (80.0 ± 2.3%), throughout study period. Meanwhile, Group I was kept under comfortable environmental conditions of ambient temperature and relative humidity % were (21 ± 2ºC and 60 ± 3%, respectively) and lighting program was 13L: 11D throughout study period. Temperature and relative humidity were adjusted by using electric heaters and fog master that delivered 0.9 liter of water/minute as methods described by **Moatz et al. (2002).** Electric heaters and fog master tri-Jet, model 6208were used for raising the room temperature and relative humidity as methods described by **Mohamed (1995).**

3. Collection of obtained data

The following data were collected throughout study period:

3.1. Ambient temperature (ºC) and relative humidity (%) were recorded twice daily at 9.0A.M. and 5.0P.M. using digital thermohygrometer (Cole-Parmer Int.USA). Measurements were taken at the level of cages.

3.2. Temperature-humidity index (THI)

The average of daily THI was calculated using the equation:

THI= (9/5 temp. ºC + 32) - (11/2-11/2 x RH %)(9/5 temp. ºC –26) as methods recorded by **Maria et al., (2001)** whereas no stress occurs when THI<27.8, 27.8-28.9=moderate heat stress, 28.9-30.3=severe heat stress and 30.3 and more=very severe heat stress.

3.3. Water and feed intake

They were estimated daily in examined groups by estimating the differences between offered and remaining amounts of each as methods described by **Maria et al. (2004).**

3.4. Growth parameters

The averages of body weight gain (g), feed conversion ratio was estimated weekly by weighing and calculation of ratio as technique adopted by **Maria et al. (2004).**

3.5. Reproductive parameters

Conception rate was estimated as number of services per conception for each doe **(Ahmed, 2002).** Gestation period was recorded by estimating the differences between mating and kindling days.

3.6. Statistical analysis

The data were analyzed by **SAS system, (1996).**

RESULTS AND DISCUSSION

Effect of heat stress on growth performance; daily feed intake, daily weight gain, feed conversion ratio, daily water intake and water feed ratio are presented in tables (1) revealed a highly significant effect ($p<0.001$) and ($p<0.05$) on the averages of these estimated parameters up to (97.30 + 3.70, 12.40 + 1.50, 7.60 + 0.41, 561.5± 10.80 and 6.20 ± 0.75, respectively).

The aforementioned results indicated the adverse effect of heat stress on daily weight gain which in turn resulting in increasing feed conversion ratio compared to those recorded in control group (150.90 ± 4.50, 21.61± 2.30, 7.0 ± 0.70, 226.90 ± 7.80 and 1.50 ± 0.20, respectively) for the estimated parameters.

Nearly similar results were obtained by **Abd El Moty et al. (1991), Shehata et al. (1998)** who reported that daily feed intake, body weight gain and feed conversion were significantly higher under summer months conditions compared with other months. On the same direction, results come in accordance with **Stephan (1980), Lebas et al. (1987), Donkoh (1989), Kasa et al. (1989) Dalle Zotte (2000)** who reported similar findings in the average values of these parameters.

Results mentioned in **Table (2)** indicated a high significant decrease ($p<0.001$) in daily feed intake throughout months of study (84.42 + 2.60, 88.75 + 2.0 and 91.51 + 2.30, respectively) due to heat stress compared with control group which resulted in reduction in daily weight gain in heat stressed group (9.78 ± 2.10, 10.53 ± 1.06 and 11.24 ± 1.20, respectively).

These results go hand in hand with those reported by **Habeeb et al. (1993)** who recorded a significant decrease in feed intake and daily weight gain when heat stress exceeds beyond adaptability power of rabbits which recorded as 28.3 % in the first week of exposure and 16.7% in the 4^{th} to 7^{th} week of exposure.

On the other hand, **Abd El- Samee et al. (2003)** attributed reduction in the aforementioned growth parameters to the disturbance in thermal balance in stressed rabbits, while **Kamal (1975)** attributed the decrease in feed consumption to depression of appetite center in the hypothalamus by hyperthermia. While, a significant increase ($p<0.001$) in feed conversion ratio, daily water intake and water/ feed ratio was found due to heat stress throughout experimental months in comparing with control group.

The effect of heat stress on measurable reproductive parameters shown in table (3) revealed a high significant ($p<0.001$) decrease in the averages of estimated reproductive parameters among mated does under stressful conditions for conception rate, litter size, weight and mortality at birth and 35 days, respectively; which were (56.08 ± 2.10, 6.40 ± 0.55, 2.60 ± 0.26, 33.30 ± 2.20, 264.60 ± 6.51, 1.50 ± 0.61 and 3.90 ± 0.50, respectively) compared with those in control group (83.79 ± 2.90, 8.20 ± 0.41, 5.90 ± 0.25, 44.53 ± 3.51, 437.10 ± 8.91, 1.40 ± 0.70 and 2.30 ± 0.41, respectively).

Moreover, gestation period was insignificantly affected by heat stressful conditions in comparing with control group (30.60 ± 1.71 and 30.0 ± 1.80, respectively) indicating shortage of gestation period at hot climates. This conviction come in accordance with those cited by **Hassan et al. (1994) and Mohamed (1995)** who reported that heat stress conditions accompanied with a shorter average periods of gestation compared with a longer gestation period in temperate climates and were (31.62 and 32.38, respectively). On the other hand, **Ghaly (1988) and Maria et al. (1996)** reported that the longest gestation period occurred under stressful conditions.

Table (1): Effect of heat stress on some growth parameters of does throughout the study period (Mean ± SE).

Data / Group	Daily feed intake (g)	Daily weight gain (g)	Feed conversion ratio	Daily water intake (ml)	Water/feed ratio
Control (I)	150.90^{a}±4.50	21.61^{a}±2.30	7.0^{a}±0.70	226.90^{b}±7.80	1.5^{b}±0.20
Heat stress (II)	88.4^{b}±3.7	10.40^{b}±1.50	8.50^{a}±0.41	561.5^{a}±10.80	6.20^{a}±0.75

SE =standard error

In the same column values having different small letters differ significantly from each other at P < 0.001.

Table (2): Effect of heat stress on some growth parameters of doe throughout three months of experimental period (Mean ± SE)

Parameters / Group	Daily feed intake (g)			Daily weight gain (g)			Feed conversion ratio			Daily water intake (ml)			Water/feed ratio		
	1st month	2nd month	3rd month	1st month	2nd month	3rd month	1st month	2nd month	3rd month	1st month	2nd month	3rd month	1st month	2nd month	3rd month
Control (I)	140.1^{a} ±3.20	152.4^{a} ±3.70	160.03^{a} ±3.50	21.5^{a} ±1.70	20.3^{a} ±1.70	20.3^{a} ±0.3	6.14^{b} ±0.31	7.0^{b} ±0.32	7.9^{b} ±0.35	186.8^{b} ±5.72	230.1^{b} ±6.60	263.6^{b} ±8.40	1.34^{b} ±0.18	1.5^{b} ±0.23	1.6^{b} ±0.31
Heat stress (II)	84.42^{b} ±2.60	88.75^{b} ±2.0	91.51^{b} ±2.30	9.78^{b} ±2.10	10.53^{b} ±1.06	11.84^{b} ±1.20	8.63^{a} ±0.14	8.43^{a} ±0.45	8.14^{a} ±0.36	588.40^{a} ±10.70	529.03^{a} ±9.83	567.2^{a} ±10.33	5.0^{a} ±0.36	5.42^{a} ±0.74	6.33^{a} ±0.71

SE =standard error

In the same column values having different small letters differ significantly from each other at p<0.001, meanwhile different small letters differ significantly at P<0.05.

Table (3): Effect of heat stress on some reproductive traits of does throughout study period (Mean ± SE)

Parameters / Group	Conception rate (%)	Gestation period (Days)	Litter size (no.)		Litter weight (g)		Litter mortality (no.)	
			Birth	35 days	Birth	35 days	Birth	35 days
Control (I)	83.79^{a} ±2.90	30.0±1.80	8.20^{a} ±0.41	5.90^{a} ±0.25	44.53^{a} ±3.51	437.10^{a} ±8.91	1.40 ±0.70	2.30^{a} ±0.4
Heat stress (II)	56.08^{b} ±2.10	30.60±1.71	6.40^{a} ±0.55	2.60^{b} ±0.26	33.30^{b} ±2.20	264.60^{b} ±6.51	1.50 ±0.61	3.90^{b} ±0.50

SE =standard error

In the same column values having different small letters differ significantly at P<0.001, meanwhile values

having similar small letters are different significantly at P<0.05.

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الملخص العربى

النمو والتكاثر وبعض صفات الولدات فى أرانب النيوزلندى الأبيض تحت تأثير الاجهاد الحرارى

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لدراسة تأثير العبء الحرارى على معدلات النمو والتكاثر وبعض صفات الولدات فى اناث النيوزلندى الأبيض، تم استخدام ٢٠ انثى من اناث النيوزلندى الأبيض وتقسيمها إلى مجموعتين (١٠ فى كل مجموعة) واحدة كمجموعة ضابطة والمجموعة الأخرى هى مجموعة العبء الحرارى والتى تعرضت لزيادة في درجة الحرارة والرطوبة النسبية حيث كانت (٣٣±١°مئوية و ٨٠±٢٪، على التوالي) لمدة ٣ شهور وهي فترة الدراسة. وقد أسفرت الدراسة عن النتائج الاتية: وجود فروق معنوية في المجموعة الثانية عن الامهات في المجموعة الضابطة حيث كان هناك إنخفاض معنوي في إستهلاك الغذاء ومعدل الزيادة اليومية في الوزن بمعدل (٨٨,٤٤ ± ٣,٧٠، ١٠,٤٠ ± ١,٥٠ على التوالي)، في حين لوحظ زيادة في معدلات التمثيل الغذائي، إستهلاك الماء اليومي ونسبة إستهلاك الماء/الغذاء وكانت (٨,٥٠±٠,٤١، ٥٦١,٥±١٠,٨٠، ٦,٢٠±٠,٧٥ على التوالي) بالمقارنة بالمجموعة الضابطة. ومن جهة أخرى كان للعبء الحراري تأثيرا واضحا على الكفاءة الإنتاجية حيث كانت هناك انخفاضات معنوية في نسبة حدوث الحمل حيث وصلت إلى (٥٦,٠٨±٢,١٠) بالمقارنة بأمهات المجموعة الضابطة وقياسات كفاءة الخلفة من حيث العدد، الوزن، معدل النفوق حيث أظهرت النتائج إنخفاض كلا من العدد، الوزن، زيادة معدل النفوق كالاتي: (٦,٤٠±٠,٥٥، ٢,٦٠±٠,٢٦، ٣٣,٣٠±٢,٢٠، ٢٦٤,٦±٦,٥١، ١,٥٠± ٠,٦١ و ٣,٩٠±٠,٥٠ على التوالي).