

COMPENSATORY GROWTH OF NORFOLK RABBITS SUBJECTED TO A
MODERATE HEAT STRESS

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Introduction

Compensatory growth is defined as growth that is abnormally rapid after a period of restricted growth. The compensation growth abilities of animals have long been recognized as they relate to nutritional stressors, with more recent recognition of these abilities related to other environmental stressors (Hahn and Sallvik, 1979). A series of studies at the Missouri Climatic Laboratory with ad-lib-fed finishing hogs, cattle and broiler chickens indicated that the ability of growing animals to recover from a period of moderate heat stress is considerable (Hahn et al., 1974, 1975). Body weight gains were less in the rabbits raised at 28.3° as compared to those raised at 8.9° C (Johnson et al., 1957).

This experiment was designed to investigate some physiological responses of ad libitum fed growing rabbits subjected to a moderate heat stress and their recovery ability.

Material and Methods

Twelve Norfolk rabbits, 6 of each sex, aged 35 days, were housed in the Faculty of Veterinary Medicine and Zootechny Climatic Laboratory. Animals were divided into 2 groups of 6 (3 of each sex) and maintained in individual cages with feed (concentrate ration, 17% crude protein) and water available ad libitum. Group 1 (treatment) was kept in the room 1 and group 2 (control) in the room 2 of the Climatic Laboratory.

The experimental procedure was as follows: an adjustment period of 10 days at natural ambient conditions to permit the animals to adjust to the laboratory conditions. Then the test

was designed to provide: 1) A 10 day period with all animals kept at natural ambient conditions (P1); 2) A 10 day period during which the treatment animals were subjected to a moderate heat stress while the control animals remained at natural ambient conditions (P2) and 3) A period of 10 days during which all animals were again kept at natural ambient conditions (P3).

Daily measurements were made of feed intake and rectal temperature for each animal. Body weights were recorded on a daily basis. Ambient temperature and relative humidity (RH) were recorded daily through a hygrothermograph. The "Temperature-Humidity Index, THI" was calculated according to the formula

$$THI = t_s - 0.55 (1 - RH) (t_s - 58) \quad (\text{Kelly and Bond, 1971})$$

Data were analysed by the t test for independent samples (Snedecor and Cochran, 1980).

Results and Discussion

Average ambient temperature, relative humidity and THI during periods 1 and 3 when all animals were under natural ambient conditions were 21.8° C, 86%, 70 and 24.5° C, 82%, 74, respectively. Average values during period 2 for treatment and control rabbits were 32° C, 74%, 84 and 23° C, 84%, 72, respectively (Figure 1).

Data for the 3 periods are presented in table 1. General performance during period 1 was similar for both the treatment and control animals. Average daily feed intake during period 2 was less ($P < .05$) for stressed than for control rabbits (87.08 vs 115.7g) as well as average daily gain (10.18 vs 21.30 g). These results are in general agreement with observations on heat stressed and nonstressed New Zealand white rabbits (Johnson et al., 1957). During period 3 treatment rabbits gained 10% more weight than control rabbits.

During period 2 stressed rabbits required 58% more feed relative to gain in body weight than did controls (8.55 vs 5.42) but during period 3 tended to convert feed more efficiently (3.43 vs 3.76). Studies conducted by Hahn et al. (1975) with hogs and broiler chickens showed that the animals were able to convert feed more efficiently after relief from the heat stress

TABLE 1. Performance of Norfolk rabbits during the 3 experimental periods.

Item	Period 1		Period 2		Period 3	
	Control	Treatment	Control	Treatment	Control	Treatment
Daily feed intake, g	106.56	110.97	115.37 ^a	87.08 ^b	129.52	130.43
Avg daily gain, g	35.19	38.42	21.30 ^a	10.18 ^b	34.44	37.96
Feed conversion (feed/gain)	3.03	2.89	5.42	8.55	3.76	3.43
Final weight, g	1610.83	1610.83	1852.50 ^a	1748.33 ^b	2158.00	2140.00
Rectal temperature, °C	39.60	39.69	39.59 ^a	39.95 ^b	39.52	39.54

^{a, b} Means in the same row bearing different superscripts differ significantly (P < .05)

than unstressed animals.

At the end of period 2 a difference in final weight of about 104 g ($P < .05$) existed between treatment (1748.33 g) and control rabbits (1852.50 g). At the end of period 3 the final weights for both the treatment and control animals were similar. During period 2 rectal temperature was higher ($P < .05$) for treatment than for control rabbits (39.95° vs 39.59° C).

Growth curves measured for treatment and control animals during each period are shown in Figure 1. During period 2 the mean ambient temperature (AT) and THI for treatment and control rabbits were quite different. The AT and THI were 11° C and 12 units higher for treatment than for control rabbits, respectively. Growth of treatment rabbits was depressed as a result of heat stress as compared to control rabbits but compensatory growth occurred within the 10 day period (P3) after relief from heat.

Results showed that performance of Norfolk growing rabbits can be affected by a moderate heat stress but a compensatory growth response occurs after relief from heat overcoming the reduced performance during heat stress.

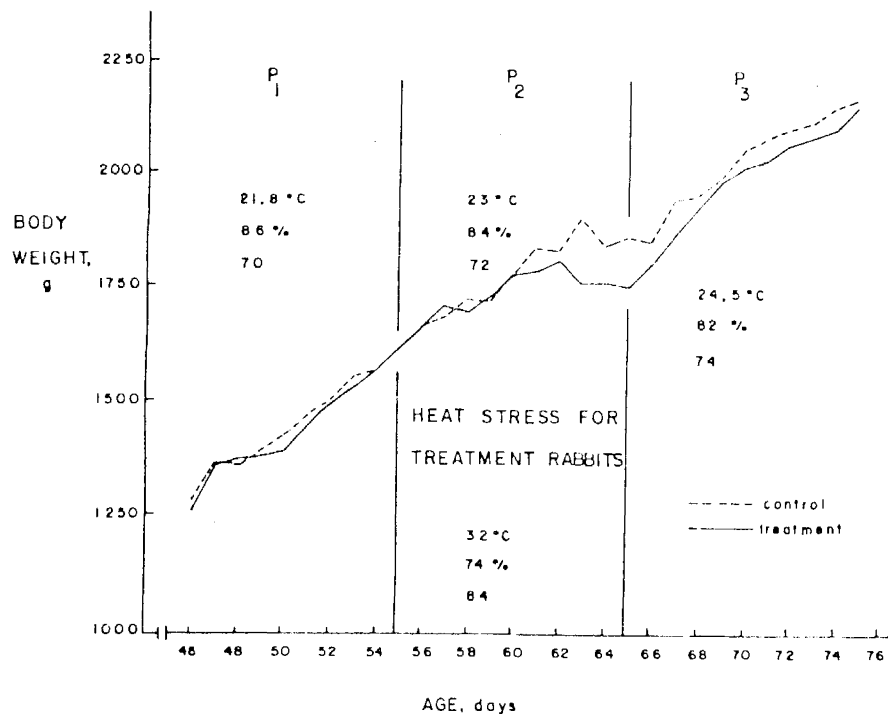


Figure 1. Measured growth curves for heat stressed (treatment) and unstressed (control) rabbits.

Summary

Twelve Norfolk rabbits, 6 of each sex, aged 35 days, were housed in a Climatic Laboratory. Animals were divided into 2 groups of 6 (3 of each sex) and maintained in individual cages with feed and water available ad libitum. Group 1 (treatment) and group 2 (control) were kept separately in 2 similar rooms. After an adjustment period of 10 days at natural ambient conditions the procedure was: 1) A 10 day period with all animals kept at natural ambient conditions; 2) A 10 day period during which the treatment rabbits were subjected to a moderate heat stress while the control animals remained at natural ambient conditions and 3) A period of 10 days during which all animals were again kept at natural ambient conditions. During period 2 average daily feed intake was less ($P < .05$) for stressed than for control rabbits (87.08 vs 115.37 g) as well as average daily gain (10.18 vs 21.30 g) and stressed rabbits required 58 % more feed relative to gain than did controls (8.55 vs 5.42). Growth of treatment rabbits was depressed as a result of heat stress as compared to control rabbits but compensatory growth occurred within the 10 day period after relief from heat. Results showed that performance of Norfolk growing rabbits can be affected by a moderate heat stress but a compensatory growth response occurs after relief from heat overcoming the reduced performance during heat stress.

Resumen

CRESCIMIENTO DE COMPENSACIÓN DE CONEJOS NORFOLK SUBMETIDOS A UN STRES TÉRMICO MODERADO

Fueron utilizados 12 conejos de la raza Norfolk, 6 de cada sexo, con la edad de 35 días, y mantenidos en cámara climática. Los animales fueron divididos en 2 grupos de 6 (3 de cada sexo) y mantenidos en jaulas individuales, con ración y agua ad libitum. El grupo 1 (tratamiento) y el grupo 2 (control) fueron mantenidos separadamente en 2 cuartos similares. Después de un período de ajuste de 10 días en condiciones de ambiente natural, fue echo el siguiente procedimiento: Período 1: 10 días con

todos los conejos en condiciones de ambiente natural; Período 2: 10 días en que los conejos del grupo 1 sufriran stres térmico moderado, mientras que los del grupo 2 se quedaron en las condiciones de ambiente natural y Período 3: 10 días en que todos los animales volvieron a las condiciones de ambiente natural. Durante el período 2 los conejos que sufriron stres térmico presentaron una disminución ($P < .05$) del consumo diario medio de la ración (87.08 vs 115.37 g) y una reducción ($P < .05$) de la ganancia media de peso (10.18 vs 21.30 g) cuando comparados con los conejos del grupo control. El grupo que sufrió stres tuvo una conversión de 8.55 que correspondió a una disminución de 58% en relacion al control (5.42). El crecimiento de los conejos que sufriron stres fue deprimido cuando comparado con los conejos del grupo control, pero, un crecimiento de compensación ocurrió en los 10 días despues del stres. Los resultados mostraron que el desempeño de conejos Norfolk puede ser afectado por el stres térmico, pero, una respuesta de crecimiento de compensación ocurre despues del stres, mejorando suficientemente el desempeño reducido que se verificó durante el período de stres térmico.

Bibliography

- Hahn, G.L., Meador, N.F., Thompson, G.B. and Shanklin, M.D. 1974. Compensatory growth of beef cattle in hot weather and its role in management decisions. Livestock Environment: Proc. Int'l Lvstk. Environ. Symp. 288-295. SP-01-74. Amer. Soc. Agr. Eng., St. Joseph, Michigan.
- Hahn, G.L., Meador, N.F., Stevens, D.G. Shanklin, M.D. and Johnson, H.D. 1975. Compensatory growth in livestock subjected to heat stress. Paper Nº 75-4008, Amer. Soc. Agr. Eng., St. Joseph, Michigan.
- Hahn, G.L. and Sallvik, K.G. 1979. Livestock compensatory performance influences on shelter criteria: a discussion of concepts. Paper Nº 79-4016, Amer. Soc. Agr. Eng., St. Joseph, Michigan.

Johnson, H.D., Ragsdale, A.C. and Cheng, C.S. 1957. Environmental physiology and shelter engineering with special reference to domestic animals. XLV. Comparison of the effects of environmental temperatures on rabbits and cattle. Part 1 - Influence of constant environmental temperatures (50° and 80° F) on the growth responses and physiological reactions of rabbits and cattle. Univ. Mo. Agric. Exp. Stn. Res. Bull., N° 646.

Kelly, C.F. and Bond, T.E. 1971. Bioclimatic factors and their measurement. National Academy of Sciences - A guide to environmental research on animals. Washington, D.C.:7-92.

Snedecor, G.W. and Cochran, W.G. 1980. Statistical methods. 7th Ed. The Iowa State Univ. Press, Ames.

