Photoperiodic Changes in the Testes of the Gerbil, Meriones unguiculatus

Wpływ fazy świetlnej na rozwój jąder u *Meriones unguiculatus*

Abbie B. MOOS, David F. TREAGUST & G. Edgar FOLK, Jr.

Moos A. B., Treagust D. F. & Folk G. E., Jr., 1979: Photoperiodic changes in the testes of the gerbil, *Meriones unguiculatus*. Acta theriol., 24, 31 [With 1 Fig.].

The photoperiodic changes of testicular development in the Mongolian gerbil *Meriones unguiculatus unguiculatus* (Milne-Edwards, 1867) were studied. Two groups of the animals were used; one group experienced constant light (L:L) while the second group experienced constant darkness (D:D). Weekly through-the-skin measurements of the right testis, were made. After ten weeks, laparotomies were performed to enable a correction factor measurement to be applied to the through-the-skin measurements. It was found that there was a fluctuating difference in testicular volume measurements, expressed as the ratio of testicular volume per gram of body weight; the testicular volume of the gerbils in constant light showed a significantly different increase ($p<.005$) over the gerbils in constant darkness. These results are in accord with expectations from comparative rodent data.

[Dept. Physiol. & Biophysics, Coll. Medicine, Univ. Iowa, Iowa City, Iowa 52242, USA].

INTRODUCTION

The Mongolian gerbil, common name »jird«, is a native of eastern Mongolia, northeast China and western Manchuria. Almost nothing is known about the normal ecology of this species except that it is a burrowing animal which lives in arid regions.

The Mongolian gerbil is reported to be both day and night active (Walker, 1964), and it maintains body temperature within narrow limits (Robinson, 1959), though whether this animal is a hibernator is still subject of debate (Theissen & Yahr, 1977). It is likely, however, that during adverse winter conditions gerbils spend much of their time in lightless underground burrows. It might also be expected that under these conditions the gonads regress (Reiter, 1974). This suggestion is supported by the observation that most litters are born between April and September following a gestation period of 25—29 days (Walker, 1964). The purpose of this investigation was to examine the photoperiodic response of testicular development in the Mongolian gerbil in attempts to determine the role light might play in this animal's reproductive life.

MATERIALS AND METHODS

Twenty male gerbils, 6 weeks of age, ranging in body weight from 40—50 g (mean weight 48.5 g) were randomly divided into two experimental groups each consisting of 10 animals, housed 5 per cage. One group experienced constant darkness (D:D, 21.5±.5°C), the other group experienced constant daylight conditions (L:L, light intensity 60±5 footcandles, 21.5±.5°C). Other environmental conditions were held constant for both groups. The animals were fed Purina rat chow and water *ad libidum*. Every week during the 10-week experimental period, the animals were weight and the length and width of the right testis was measured through the skin

using a pair of calipers and a rule measured in 1/64 inch. Testicular volume in mm^3 was calculated from these values, using the formula for an oblate spheroid, $v=4/3\pi ab^2$, where a is the major radius and b is the minor radius. Following the 10th week, laparotomies were performed and the actual volume of the right testis was calculated using measurements obtained with the same caliper and rule. These measurements permitted determination of a correction factor for the weekly through-the--skin measurements. The weekly through-the-skin volume measurements were 18% greater than actual measurements acquired following laporatomy. This difference was only reflected in the length measurements due to the variable position of the epididymis; the width measurements were nearly identical in all cases.

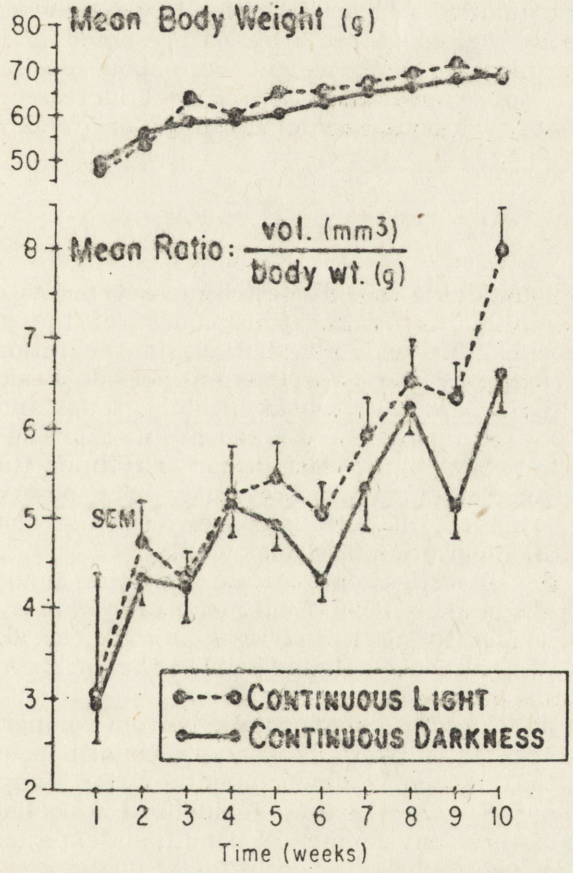

Fig. 1. Mean body weight and mean ratio of testicular volume ± standard error of the mean for gerbils maintained in constant light (N=10) and constant darkness (N=10). The testes in constant light were larger ($p<0.005$).

RESULTS

The mean weekly corrected testicular volume measurements expressed as the ratio: testicular volume/gram body weight for each group are summarized in Fig. 1. The ratio of testicular volume to body weight increased in both groups over the 10-week experimental period. However,

the rate was not constant and weekly fluctuations in both groups were observed. At the start of the experiment (Week 1) the ratio values were D : D 2.92 and L : 3.04. After 10 weeks of experimental conditions the mean values were D : D 6.61, an increase of 126% over the initial value, and L : L 8.00, an increase of 163% over the initial value. A *t*-test for matched-pairs (W i n e r, 1971, p. 44—48) was calculated from the data contained in Fig. 1. The result ($t = 3.50$, $p < 0.005$) implied that the mean weekly differences for the two groups of gerbils were significantly different. Histological preparations were made of four of the testes (2 L : L, 2 D : D). A trained pathologist could not determine a difference due to photoperiod, either qualitatively or quantitatively by cell count.

Mean weekly body weight values are also presented in Fig. 1 which show that increases in mean body weight were about the same for both groups of animals. Both groups showed a weight increase over the 10-week period, but weekly fluctuations of up to 5 g or 7% of body weight were observed.

DISCUSSION

The technique of obtaining weekly testes measurements on the same animals allowed examination of the time course of the photoperiodic response. This revealed the wide fluctuations in the ratio values that were observed throughout the experimental period. Peaks in values occurred in the 5th, 8th, and 10th weeks in both groups and low values were observed in both groups in the 6th and 9th weeks. The fluctuations in ratio values seem to reflect, at least in part, rhythmic fluctuations in body weight. This phenomenom has previously been observed in hamsters (F o l k & F a r r a n d, 1957). It is conceivable that testes may undergo normal rhythmic variation in size as well.

The results of this investigation indicate that the Mongolian gerbil shows a photoperiodic response. The final mean ratio values of testicular volume per body weight for dark and light animals, *i.e.* 6.61 and 8.00 respectively, indicate that those animals kept in the dark condition show inhibition of testicular development.

This result is in accord with our expectations from comparative rodent data (R e i t e r, 1974). It is likely that under conditions of decreased light, *i.e.* winter, that testicular development of the Mongolian gerbil would be inhibited. We would further be inclined to believe that this is the response to natural environmental conditions experienced by the gerbils, and might explain why apparently fewer young are born between September and April, the time of the northern winter.

Acknowledgements: Professor Frederick W. Stamler kindly provided histologic slides of the testes and made a quantitative analysis of them. Mary A. Folk provided the illustration and editorial assistance. John Cody wrote the computer programs to analyze the data.

REFERENCES

Folk G. E., Jr. & Farrand R. L., 1957: Factors influencing the nutritional status of the hamster. Proc. Animal Care Panel, 7, 4: 245—252. Reiter R. J., 1974: Circannual reproductive rhythms in mammals related to photoperiod and pineal function: A review. Chronobiologica, 1: 365. Robinson P. F., 1959: Metabolism of the gerbil, *Meriones unguiculatus*. Science, *130*: 502—503. Thiessen D. D. & Yahr P., 1977: The gerbil in behavioral investigations: Mechanisms of territoriality and olfactory communication. Univ. of Texas Press: 1—224. Austin. Walker E. P., 1964: Mammals of the World. The Johns Hopkins Press, *2*: 757—758. Baltimore, Maryland. Winer B. J., 1971: Statistical Principles in Experimental Design. McGraw-Hill Book Company, 2nd Ed.: 1—907. New York.

Accepted, March 10, 1979.

PAŃSTWOWE WYDAWNICTWO NAUKOWE ✲ WARSZAWA 1979

Nakład 856+90. Obj. ark. wyd. 11,0. Maszynopis otrzymano 25.IV. 1979 r. Podpisano do druku 1.X.1979 r. Druk ukończono w październiku 1979 r. Papier. druk. sat. kl. III 80 g. Format B5

Białostockie Zakłady Graficzne. Zam. 970/79. Cena zł 40.—