EFFECT OF ACTH ON REPRODUCTIVE ORGANS OF IMMATURE FEMALE NORTHERN GRASSHOPPER MICE (*ONYCHOMYS LEUCOGASTER*)

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Impaired reproductive function among adults and delayed sexual maturation in juveniles are associated with high population densities in a variety of small rodent species (Christian, 1968, 1971). Increased activity of the pituitary adrenocortical axis is postulated as a mechanism regulating population growth (Christian, Lloyd & Davis, 1965). Evidence linking increases in ACTH and plasma corticoids with gonadal dysfunction under laboratory conditions has been obtained for *Mus musculus* (Christian, 1964), *Peromyscus leucopus* (Pasley & Christian, 1972), *Microtus pennsylvanicus* (Pasley & Christian, 1971) and *Rattus norvegicus* (Desjardins & Ewing, 1971). The present study was initiated to examine the effects of ACTH on the reproductive organs of female northern grasshopper mice (*Onychomys leucogaster*), a predatory species characterized by low population densities under natural conditions (Egoscue, 1960). Results extend previous work on muroids and indicate that exogenous ACTH may promote gonadal dysfunction in prepubertal females. Females used in these experiments were first or second generation offspring of animals trapped in northwestern Oklahoma and paired non-selectively in the laboratory. Experimental females were weaned at 30 days of age and housed singly in polypropylene cages under a lighting regimen of 15 hr light/24 hr. Food and water were always available in excess.

Beginning at either 60 or 100 days of age, females received subcutaneously either ACTH in gelatin vehicle (Adrenome: Armour-Baldwin Laboratories; 4 units, 0.1 ml) or 0.1 ml of 0.8% saline only through 80 or 108 days of age, respectively. Injections were given daily, usually between 13.00 and 15.00 hours. Animals were killed and weighed 24 hr after the last injection, the gastrointestinal tract was removed, and the remainder of the animal was placed in 10% neutral buffered formalin. All organs were weighed wet following fixation. Treatment means were compared using Student's *t* test, and probability levels of 0.025 or less are reported as statistically significant. Daily injections of ACTH for 21 days resulted in statistically significant changes in weights of adrenal glands, thymus glands, ovaries and uteri (Table 1). Compared to those of controls, adrenal glands were 88% heavier in 80-day-old females, while thymus glands were 81% lighter. The weights of the ovaries

Table 1. Body and organ weights of grasshopper mice receiving ACTH or saline

Age of animals (days)	Treatment	No. of mice	Body wt (g)	Organ wt (mg)				
				Adrenals	Thymus	Spleen	Kidneys	Ovaries
60 to 80	Saline	9	34.7 ± 1.2	31.8 ± 1.6	46.4 ± 4.1	68.1 ± 5.9	413.5 ± 19.6	29.8 ± 2.5
	ACTH	10	32.6 ± 1.4	60.0 ± 6.0	8.7 ± 1.6	52.6 ± 7.0	441.1 ± 21.1	22.2 ± 5.4
100 to 108	Saline	13	34.6 ± 1.0	33.1 ± 2.0	20.8 ± 3.2	55.3 ± 6.5	439.3 ± 10.4	25.9 ± 3.0
	ACTH	15	28.8 ± 1.4	33.2 ± 2.1	14.5 ± 3.1	49.1 ± 3.9	417.8 ± 10.5	23.8 ± 1.7

Values are expressed as means ± S.E.

and uteri were reduced by 25% and 32% respectively. Body, spleen and kidney weights were not affected significantly by chronic ACTH treatment.

Briefer exposure to exogenously administered ACTH in slightly older females also resulted in a significant 30% reduction in uterine weight (Table 1). Unexpectedly, total body weights of animals receiving ACTH, although comparable initially, were significantly less at death in this experiment, while absolute weights of the adrenals, spleen, kidneys, ovaries and thymus glands were unaffected by ACTH treatment. In both experiments, histological examination of serial sections of ovaries failed to reveal obvious differences in the numbers of maturing or atretic follicles.

The influence of ACTH on reproductive organs of female northern grasshopper mice, as indicated by organ weights, parallels that seen in other small rodents. Assuming that female *O. leucogaster* reach puberty after about 120 days of age (Pinter, 1970), our results indicate that exogenously administered ACTH modified reproductive organ function in maturing animals. Although effects of the hormone in reducing ovarian weight were limited to animals receiving ACTH for 21 days, lowered uterine weights obtained following either 9 or 21 days of ACTH injection are probably a result of reduced secretion of oestrogens (Astwood, 1938; Hisaw, 1959). Equal or similar doses of ACTH and durations of treatment have also led to reduced uterine and/or ovarian weights in immature *Microtus pennsylvanicus* (Pasley & Christian, 1971), *Mus musculus* (Christian, 1964; Christian *et al.*, 1965) and *Peromyscus leucopus* (Pasley & Christian, 1972). Failure of ACTH to inhibit ovarian follicular development in *O. leucogaster*, however, is in apparent contrast to effects of the hormone on the above species. The dose level of hormone incorporated in the present study is presumed to be within the physiological range of other small rodent species, and the proportionate increase in adrenal weights in response to 4 units ACTH/day are also consistent with other findings (Christian, 1964; Pasley & Christian, 1972).

If increased function of the pituitary-adrenal gland axis occurs in response to high levels of social stimuli in this species as in other small rodents (Christian, 1971), behavioural-endocrine mechanisms may potentially function in population regulation through inhibition of sexual maturation. Since the northern grasshopper mouse is carnivorous and occurs characteristically at low population densities, its ecological niche differs from that of other species which are primarily granivorous and occur naturally at relatively high population densities. The effects of ACTH on the reproductive organs of maturing females of the latter species have already been reported (Christian, 1964; Pasley & Christian, 1971, 1972). Thus gonadal dysfunction in response to exogenously administered ACTH, at least under laboratory conditions, appears to characterize several species of rodents occupying quite different ecological niches. This latter concept is supported further by the generality of apparent increases in adrenocortical function and reduced natality as correlates of high population densities in mammals (Christian *et al.*, 1965; Tanner, 1966).

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