

RELATIVE SIZES OF REPTILIAN ADRENALS¹

FRANK A. HARTMAN

Department of Physiology, The Ohio State University, Columbus, Ohio 43210

ABSTRACT

Among the reptiles, members of the families Colubridae and Elapidae have the largest adrenals (0.010 to 0.018 percent of total body weight). The values for the two species of Crotalidae are smaller (*Sistrurus*—0.0061 to 0.0081 and *Crotalus*—0.00139 percent). The adrenals of lizards are smaller than are those of the Colubridae (*Basiliscus*—0.0093 and *Iguana*—0.0074), those of a single specimen of *Heloderma* being lowest (0.0059 percent). The adrenals of the Testudinidae are similar to those of *Heloderma* (0.0057–0.0074 percent). These differences are probably gene controlled.

INTRODUCTION

The adrenals of the class reptilia show considerable variation in structure and in weight relative to body weight. Much more work has been done on the development and histology of reptilian adrenals than on the relative size of the glands.

The size of the adrenal may be indicative of the potential ability of the gland to produce hormones. Since there is little or no storage of adrenocortical hormones, this may be important. However, the largest adrenals, relative to animal size, are not found in the most active birds or animals. The Brown Pelican (Hartman, 1946) and the guinea pig (Bessessen and Carlson, 1923) have relatively large adrenals. Size is a species property. It may also be influenced by exercise, reproduction, and toxins. Very little has been done on the relative weight of the adrenals in reptiles. Values for snakes have been reported by Naccaratti (1922), by Valle and Souza (1942), and by Wright and Jones (1957) for a lizard and a snake. In my collecting of reptiles for adrenal study, I have been able to add to these data.

MATERIALS AND METHODS

All of the material used was collected in the field by me except for the Gila Monster (purchased from a Texas dealer), and the Coral Snake and the Crotalidae (both obtained from a Florida dealer). Those found in the field were dissected within a few hours after collection. Those purchased were kept alive in the laboratory for a few days, except for the Gila Monster, which was kept several months (being fed a hen's egg once a week).

Adrenals were dissected from freshly killed specimens. Because it was the active tissue which was to be measured, all extraneous tissue was removed. Spring balances (10 g to 6 kg capacity) were used to weigh the animal and Roller-Smith balances (10 mg to 1500 mg capacity) were employed for the adrenals. After weighing, the adrenals were fixed for histological study.

RESULTS

The weights of all adrenals measured are given in Table 1 as percent of total body weight of animal. Members of the families Colubridae and Elapidae have the largest adrenals (0.010 to 0.018 percent of animal's total body weight). Although the values for *Ancistrodon* are similar, other members of the Crotalidae are smaller (*Sistrurus*—0.0061 and 0.0081 and *Crotalus*—0.00139 percent.) The smaller size of the last two may be related to less activity on the part of the animals.

The adrenals of lizards are smaller than are those of the Colubridae (*Basiliscus*—0.0093 percent; *Iguana*—0.0074 percent). The smallest value was for that of a

¹Manuscript received November 18, 1969.

single specimen of *Heloderma* (0.0059 percent). The adrenals of the Testudinidae are similar in relative weight to those of *Heloderma* (0.0057 to 0.0074 percent). These differences also may be related to differences in the animals' activity.

TABLE 1
Relative weights of adrenals in reptiles.

Family and species	No. of animals measured	Adrenal weight X 100 ± Standard error Body weight
TESTUDINIDAE	(2)	0.0057; 0.0074
Gopher Tortoise		
<i>Gopherus polyphemus</i>		
Common Map Turtle	(1)	0.0059
<i>Graptemys geographica</i>		
IGUANIDAE	(7)	0.0093 ± 0.0018
Basilisc		
<i>Basiliscus basiliscus</i>		
Common Iguana	(8)	0.0074 ± 0.00024
<i>Iguana iguana</i>		
TEIIDAE	(10)	0.0071 ± 0.0009
<i>Ameiva ameiva</i>		
HELODERMATIDAE		
Gila Monster	(1)	0.0059
<i>Heloderma suspectum</i>		
COLUBRIDAE		
Black snake	(6)	0.0180 ± 0.0026
<i>Coluber constrictor</i>		
Coach whip snake	(3)	0.0128 ± 0.0015
<i>Masticophis flagellum</i>		
Common water snake	(3)	0.0100 ± 0.0012
<i>Natrix sipedon</i>		
<i>Clelia clelia</i>	(2)	0.0147; 0.0203
ELAPIDAE		
Coral snake	(3)	0.0181 ± 0.00015
<i>Micrurus fulvius</i>		
CROTALIDAE		
Copperhead	(1)	0.0133
<i>Ancistrodon contortrix</i>		
Water moccasin	(1)	0.0147
<i>Ancistrodon piscivorus</i>		
Pygmy rattlesnake	(2)	0.0061; 0.0081
<i>Sistrurus miliaris</i>		
Diamond-back rattlesnake		0.00139
<i>Crotalus adamanteus</i>		

DISCUSSION

The range of values from 0.00139 to 0.0180 is very great. Unfortunately the lower value is based on only one specimen (*Crotalus*). However other low values were obtained (0.0059 for members of the Testudinidae and 0.0059 for *Heloderma*). The high values for the Colubridae are in agreement with the hypothesis that larger adrenals are associated with greater activity.

Values obtained in this study are less than most of those determined for the same species or the same genus by Smith and White (1955), who made their determinations on preserved material. Their values, calculated as percent of body weight, were: *Coluber contortrix*—0.0216; *Natrix sipedon*—0.0193; *Micrurus fulvius*—0.0205; *Ancistrodon contortrix*—0.0178; and *Ancistrodon piscivorus*—0.0215. However, their values for *Sistrurus catenatus* (0.0034) and *Crotalus viridis* (0.00113) were less than mine. It may be that the ratio between adrenals

and body weight in preserved material is not the same as the same ratio in fresh material, since the adrenals are high in lipid content.

The results obtained by Wright and Jones (1957) (*Natrix natrix*, 0.0241, winter and 0.0276, summer) are much higher than mine for *Natrix sipedon* (0.0010). Their values for the lizard *Agama agama* (0.0151) were higher than those for the lizards in this study (0.007; 0.0093).

The hypothesis has been proposed by Smith and White (1955) that the large size of the adrenals in *Heterodon platyrhinos* (0.150 to 0.228 percent) is due to the eating of toads, which are high in catecholoamines and in digitaloid compounds.

It was suggested above that, in some cases, larger adrenals may be related to greater activity on the part of the animal. However, the size of the adrenal does not necessarily indicate accommodation for increased activity. Among birds, the Brown Pelican has the largest adrenal (0.0405 percent) of any bird studied, while the relative size of this gland in the very active hummingbird (0.011–0.020 percent) is not large (Hartman, 1946; Hartman and Brownell, 1961). The guinea pig has adrenals whose relative weight is the largest of any mammal (0.05 to 0.057 percent) (Bessessen and Carlson, 1923), yet this animal is not noted for its great activity.

The range of relative adrenal weight in reptiles is greater than that in birds, with the exception of the Brown Pelican. Some reptile values (*Crotalus*) (Hartman and Brownell, 1961) are lower.

REFERENCES CITED

- Bessessen, A. N., Jr., and H. A. Carlson. 1923. Post-natal growth in weight of the body and of the varied organs in the guinea pig. *Am. J. Anat.* 31: 483–521.
- Hartman, F. A. 1946. Adrenal and thyroid weights in birds. *The Auk*, 63: 42–64.
- Hartman, F. A., and K. A. Brownell. 1961. Adrenal and thyroid weights in birds. *The Auk* 78: 397–422.
- Hebard, W. B., and H. A. Charipper. 1955. A comparative study of the morphology and histochemistry of the reptilian adrenal gland. *Zoologica* 40: 101–123.
- Naccarati, S. 1922. On the relation between the internal secretory glands and the body weight and brain weight. *Anat. Record* 24: 255–260.
- Smith, H. M., and F. N. White. 1955. Adrenal enlargement and its significance in the hognose snakes (*Heterodon*). *Herpetologica* 11: 137–144.
- Valle, J. R., and P. R. Souza. 1942. Observations on the endocrine system of ophidians. *Rev. Brasil. Biol.* 2: 81–88.
-