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SERUM ELECTROPHORETIC PATTERNS IN THE CALIFORNIA GROUND SQUIRREL*

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Abstract: Serum proteins of the California ground squirrel *(Spermophilus beecheyi)* were analyzed by standard electrophoretic methods. Results were presented in terms of total protein, albumin and albumin-globulin (A/G) ratios. Boundaries between globulin fractions were too obscure to warrant analyses of these elements individually.Total protein means differed in squirrels live-trapped at two locations, and live-trapped squirrels had higher total protein levels than squirrels shot. The mean A/G ratios were also significantly different between locations but not between shot and trapped squirrels. Mean total protein and A/G levels in animals with coccidia in the large intestine were the same as from those without coccidia. There was no correlation between adrenal gland weight and total protein or A/G levels.

INTRODUCTION

Serum electrophoresis is commonly used as a clinical test in the diagnosis of disease. While relative variations in the electrophoretic fractions are not specific for any particular disease, they do change appreciably in many disease states and may therefore be used in evaluating the state of an animal's health. In our current studies of the effects of social conflicts on the physiology of reproduction and disease, we seek indicators of health and disease that can be obtained in longitudinal studies of California ground squirrels *(Spermophilus beecheyi)* in their social setting. Because blood samples are readily available from live-trapped squirrels, we are determining base levels of clinical blood chemistry and hematology. This is the first of a series of reports on these levels.

Disease correlates of electrophoretic patterns have been shown for many diseases in humans where the subject has been most intensively studied.[4] Similar information is less abundant for domestic and wild animals. Payne et al.[6] reported progressive variations in the albumin-globulin ratios (A/G) in the white-footed mouse, *Peromyscus leucopus*, in the course of infestations by botflies. Payne et al.[7] found in six species of mammals that the A/G was considerably lower in diseased conditions than in undiseased animals, except in one case of rabies in a fox where the A/G was higher than normal. Franzmann[5] reported no significant difference in serum electrophoretic patterns in captive and free bighorn sheep. Woolf and Kradel[8] presented basal measurements for captive Rocky Mountain bighorns.

METHODS

Ground squirrels were live-trapped at East Garrison and Oil Well Road, Fort Ord, California, and others were also shot at Oil Well Road. The captured animals were anesthetized with carbon dioxide, and blood samples from them and from the shot squirrels were taken

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by heart puncture. Serum from clotted, centrifuged blood was analyzed electrophoretically at the Special Chemistry Laboratory of the U.S. Army Hospital, Fort Ord, California. Total protein was measured by refractive index, and electrophoresis on cellulose acetate was by the Microzone system (Beckman Instruments) with quantitation by Analytrol (Model RB) densitometer. The pooled human serum regularly used at the hospital was used as a control in measuring total protein and in the electrophoresis.

Data from all age and sex classes were grouped in the analyses of variations due to location and sampling methods, since no clear evidence of differences in protein values were found between sexes or ages. Sixteen of the squirrels in the total sample from all treatment classes and locations were young of the year; the other sixteen were one or more years older (adults). No differences were found in any of the mean protein values between the two age groups when samples from all treatment classes and locations were averaged together. (Means were so nearly identical that no tests of significance was required.) Within-treatment tests of differences of means between young and adults was not possible because in all cases one age class or the other was represented by less than three individuals. In no case did the values for the one or two individuals in the one age class differ markedly from the range of values in the other age class. Similarly, there was no apparent difference in protein values between the sexes. In neither the trapped squirrels at East Garrison nor the shot squirrels at Oil Well Road was there a significant difference in protein values between the sexes. In the sample of trapped squirrels at Oil Well Road there were only two females, so no test was made of the differences between sexes.

All squirrels were autopsied after the blood was drawn, with particular concern for gross evidence of disease, adrenal weight as an index of adrenocortical secretion rate, and intestinal parasites. A parasite survey of feces from the lower intestine was made using the magnesium sulphate flotation method.

RESULTS AND DISCUSSION

Only albumin and total globulins were clearly distinguishable in the densitometer traces (Figure 1). In only two instances were the individual globulins sufficiently distinguishable to warrant their differential evaluation. The problem is illustrated in the three traces of Figure 1. In the lower trace of a pooled sample of human serum, the globulin fractions are readily distinguishable. In the middle trace of a squirrel's serum the fractions are also readily distinguishable, but this is exceptional. The upper trace, in which boundaries between fractions are obscure, shows the more usual pattern for squirrels. Here globulins were also partially masked by hemoglobulin and fibrinogen, which occasionally resulted from hemolysis and incomplete clotting.

In Figure 2 analyses of total protein and the albumin-globulin ratio (A/G) are shown in relation to the three "treatment" classes — squirrels trapped at East Garrison and trapped and shot squirrels at Oil Well Road. The means of total protein in all three classes differ significantly, as indicated by lack of overlap of their standard errors. Further research is needed to determine whether the lower protein levels from shot squirrels more nearly reflect *in vivo* conditions than those from trapped squirrels. No ready explanation for the difference between squirrels trapped at the two locations is

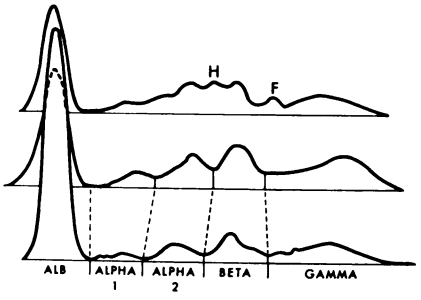

FIGURE 1. Densitometer scans of electrophoretic patterns. The lower trace is from human serum, the upper two traces are from the sera of two squirrels. In the top trace H indicates a hemoglobin peak and F may be a fibrinogen peak.

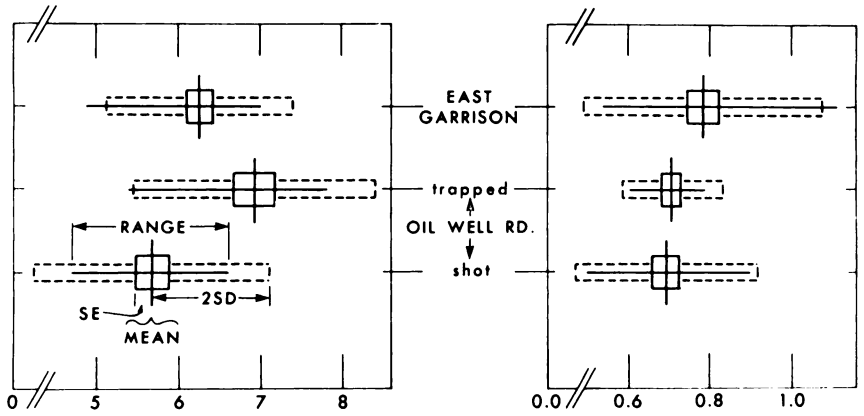

FIGURE 2. Total serum protein and albumin-globulin ratios of samples from 13 squirrels at East Garrison and from seven trapped and 12 shot squirrels at Oil Well Road.

TABLE I. Mean values of serum proteins and A/G's for various domestic and wild animals arranged in order of albumin percentage and A/G*

Species	Total Protein %	Albumin %	A/G	Bibliographic Reference
Domestic rabbit	—	61.8	1.64	7
Human	7.15	60.3	1.52	4
Domestic goat	6.25	60.0	1.50	3
Mountain sheep	6.5	52.8	1.19	5
Dog	6.95	51.5	1.08	3
Domestic sheep	5.81	50.9	1.04	3
White-footed mouse	—	47.4	.90	7
Domestic pig	7.40	45.9	.85	3
Domestic cow	7.26	45.6	.84	3
Cotton rat	—	43.9	.80	7
Calif. ground squirrel				
E. Garrison (13)**	6.26 ± .57	43.6 ± 4.6	.78 ± .15	
Oil Well Road				
Trapped (7)**	6.91 ± .73	41.4 ± 2.1	.71 ± .06	
Shot (12)**	5.68 ± .71	40.6 ± 3.9	.69 ± .11	
Striped skunk	—	38.7	.64	7
Horse	6.72	38.7	.63	3
Gray fox	—	37.4	.60	7

* Values for ground squirrels given ± standard deviation.

** Numbers in parentheses indicate sample size.

apparent. Perhaps the two populations are physiologically distinct because of conditions of disease or stress, although our studies have not yet revealed such diversities.

Mean A/G's differ significantly between East Garrison and Oil Well Road but not between Oil Well Road's shot and trapped samples (Figure 2, right). This is further evidence that an appreciable difference in physiological conditions exists between the squirrel populations at the two localities.

The mean A/G for squirrels (about .74) is in the lower part of the range of A/G's for mammals (Table I). The data reveal no marked trend in total protein, albumin and A/G associated with phylogenetic relationships or domestication.

Mean total protein and A/G values for 15 squirrels positive for coccidia ova did not differ significantly from those of 13 squirrels without ova. Scatter diagrams of total protein and A/G's plotted over adrenal weights showed no correlaton. Payne et al.[6] found that the A/G ratio was strongly correlated with the number of botfly larvae infesting white-footed mice ($r = 0.84$). The A/G decreased progressively with the progress of infestations and recovered after the larvae left the hosts. Bierer[2] found similar effects on the A/G in turkeys artificially infected with fowl cholera. Davidsohn and Henry[4] list many disease correlates of variations in human electrophoretic patterns. Our failure to find similar correlations with coccidial infection and adrenal physiology may be attributable to the relatively chronic and low-grade effects of the coccidia and adrenal secretion rates on the blood protein. In spring and early summer when breeding and the entrance of young squirrels into the population may be expected to induce greater social stress, we might expect to find some influence on the electrophoretic patterns.

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LITERATURE CITED

1. BARNETT, R. N., S. R. GAMBINO, R. G. HOFFMAN, and L. P. SKENDZEL. 1968. Statistical methods in the clinical laboratory. Amer. Soc. Clin. Path. Comm. on Continuing Education. 128 pp.
2. BIERER, B. W. 1969. Blood serum fractions in turkeys exposed to fowl cholera infection. Poultry Sci., 48: 1396-1400.
3. COLES, E. H. 1967. Veterinary Clinical Pathology. W. B. Saunders Co. pp. xii + 455.
4. DAVIDSOHN, I., and J. B. HENRY (Eds.). 1969. Todd-Sanford Clinical Diagnosis by Laboratory Methods, 14th edition. W. B. Saunders Co., pp. xxix + 1308.
5. FRANZMANN, A. W. 1971. Comparative physiologic values in captive and wild bighorn sheep. J. Wildl. Dis., 7: 105-108.
6. PAYNE, J. A., P. B. DUNAWAY, G. D. MARTIN, and J. D. STORY. 1965. Effects of *Cutebra angustifrons* on plasma proteins of *Peromyscus leucopus*. J. Parasit., 51: 1004-1008.
7. PAYNE, J. A., G. D. MARTIN, J. D. STORY, and G. E. COSGROVE. 1967. Electrophoresis as an aid in detecting pathological conditions in wild mammals. Bull. Wildl. Dis. Assoc., 3: 21-22.
8. WOOLF, A., and D. C. KRADEL. 1970. Hematological values of captive Rocky Mountain bighorns. J. Wildl. Dis., 6: 67-68.

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