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URINE SAMPLING TECHNIQUES FOR CAPTIVE WHITE-TAILED DEER

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Abstract: Three urine sampling techniques were employed in nutritional experiments with captive white-tailed deer *(Odocoileus virginianus)*. Urethral catheterization permitted successful urine collection from females. Furosemide induced urination in male fawns 36.4 ± 3.1 min (SE) after injection. Significant ($P<0.05$) variation in the responses of individual fawns to this drug were detected. Xylazine hydrochloride induced urination in adult males 91.8 ± 4.7 min after injection. Significant ($P<0.01$) differences in responses to this drug were detected among individual deer and sample months. The applicability of these urine sampling techniques is discussed.

INTRODUCTION

Physiological characteristics often are used as indices of nutritional status in research with wild cervids. In the past, wildlife biologists have employed hematological and biochemical analyses of blood samples for this purpose.[8,12] Urinalysis as a physiological index of nutritional and disease status has not been widely used for wild species, but is well recognized for humans[5,11] and domestic animals.[1,3,6,10] Urinalysis has been employed by Eriksson and Valtonen[4] for free-ranging reindeer *(Rangifer tarandus)* in Finland. One advantage of urine indices may be that they are less likely to be affected by acute stressors than are blood indices. The obvious disadvantage of urinalysis in wild species is the difficulty of urine collection. However, total 24 h urine collections are not absolutely necessary. "Random" urine samples can be collected at a standardized time and analyzed to determine concentrations of urine components, if expressed as a ratio to urinary creatinine. For further discussion of random samples and the use of creatinine as a ratio compound, refer to Krehl and Hodges,[7] Pollack,[9] Sauberlich *et al.*,[11] Van Niekerk *et al.*,[11] and Vestergaard and Leverett.[13]

The purpose of this paper is to describe three urine sampling techniques that were employed successfully in research with captive white-tailed deer *(Odocoileus virginianus)*.

MATERIALS AND METHODS

Data were obtained in conjunction with several nutritional experiments on captive white-tailed deer as described in detail by Warren.[14] All deer were maintained in 3.65 × 7.30 m covered pens and were fed experimentally formulated, pelleted deer feed. Water was provided *ad libitum*.

Fawn Experiment. Twelve male and 12 female fawns were hand-reared for

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experimental purposes as described by Buckland *et al.*[2] Urine samples were collected on six occasions during an 8-month experiment, beginning when the fawns were 4 months of age. Detailed experimental design and urinalysis results were presented in another publication.[19]

Urine was obtained from males: Each deer was weighed and injected intramuscularly in the hindquarter with furosemide[3] at a dosage of 5 mg/kg. A surgical sponge then was placed over the preputial area and held in place with a triangular rubber pad, measuring approximately 12 cm on each side, and elastic straps. Three elastic straps were used: one around the abdomen and two crisscrossing the pelvis. The straps were joined on the deer's back with velcro fasteners. Upon urination, the sponge became saturated with urine. The deer was recaptured to remove the saturated sponge, which then was wrung out to collect the urine. The urine was acidified with 6 N HCl. Exact volumes of urine or HCl were not critical, because urine components were expressed as a ratio to creatinine. Data were collected on the time elapsed between drug injection and urination.

Female fawns were similarly injected with furosemide. Urine was obtained from the females using Soveriegn polyvinyl chloride urethral catheters[4] after a period which corresponded to the time elapsed between injection and urination by male fawns. Thus, data from females did not truly represent responses to furosemide and, therefore, were not analyzed.

Adult Female Experiment. Twelve, 4.5 year old female deer were employed in another nutritional experiment. Urine was collected once by catheterization. Experimental design details and urinalysis results are presented in another publication.[16]

Adult Male Experiment. Ten, 1.5 year old male deer were employed in another nutritional experiment. Sampling occurred at 4-week intervals for 1 year. The deer were immobilized by intramuscular injection of xylazine hydrochloride[5] using blow-gun syringes.[17] From December through February the dosage employed was 1.71 mg/kg. A dosage of 3.39 mg/kg was employed during other months.

Originally, urine collection was not considered possible in this experiment. Catheterization of male deer is extremely difficult because of the sigmoid flexure in the penis. However, observations during the first several sampling periods indicated that immobilized males invariably urinated. Thurmon *et al.*[17] indicated that xylazine hydrochloride increases urine filtration and urine flow in cattle. Therefore, during the last six sample periods of the experiment, urine was collected: The tip of a urethral catheter was cut off to maximize urine flow. After immobilization, the proximal (back) end of the catheter was inserted into the preputial sheath and secured with tape. The cut tip was inserted in a plastic Erlenmeyer flask, which had a sleeve attached around the opening to prevent spillage. Upon micturition, urine flowed through the catheter and into the flask. Data were collected on the time elapsed between xylazine hydrochloride injection and urination for the last six sample periods. Additional details on the design of this experiment and urinalysis results are presented in another publication.[18]

Statistical analyses were conducted by analysis of variance according to the

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design of each experiment to determine nutritional and sample period effects on the time elapsed between drug injection and urination. Thereafter, the analyses were repeated as a randomized block design to test for significant differences between individual deer.

RESULTS AND DISCUSSION

Fawn Experiment. Urine collection in this experiment was 100% successful. Only those data on time elapsed between injection and urination by male fawns in the first four sample periods were analyzed. Mean elapsed time from furosemide injection to initial micturition was 36.4 ± 3.1 min (SE), with a range of 11 to 113 min. These responses were not affected significantly by the nutritional treatments employed. Significant ($P<0.05$) variation in the time elapsed between injection and urination existed among individual male fawns. However, no significant differences in these responses were detected among the four sample periods, which occurred from October to December.

Adult Female Experiment. Urine samples were obtained from 7 of 12 adult females (58%). The lower success achieved in obtaining urine samples in this experiment compared to the previous one likely is due to the fact that furosemide was not employed. Catheterization was successful in 11 of 12 adult females (92%); however, four of them had empty bladders. Despite numerous attempts, catheterization of one female was unsuccessful. A duct of a vestibular gland or the suburethral diverticulum may have prevented passage of the catheter into the bladder.

Adult Male Experiment. Three deer died during the course of this 1 year experiment. Necropsy results from these deer indicated xylazine hydrochloride may have been a factor in the deaths of two of them. Only those deer surviving the entire experiment were considered in the analysis. Urine was collected from 7 deer at six sample periods, except on one occasion when a deer recovered from the xylazine hydrochloride before urinating. Mean elapsed time from xylazine hydrochloride injection to initial micturition was 91.8 ± 4.7 min with a range of 39 to 164 min. These responses were not affected significantly by the nutritional treatments employed. However, significant ($P<0.01$) variation in these responses existed among individual adult males. Differences ($P<0.01$) also were detected among the six sample periods (Table 1). These differences are difficult to explain. The time elapsed between injection and urination did not increase until 4 weeks after the xylazine hydrochloride dosage was decreased.

TABLE 1. Mean (±SE) time elapsed between xylazine hydrochloride injection and urination by adult male white-tailed deer.

Sample Period (Month)	n	Urination Response (Min)[a]
8 (October)	7	82.6 ± 10.2
9 (November)	7	83.7 ± 14.8
10 (December)	7	79.0 ± 8.7[b]
11 (January)	7	101.0 ± 9.6
12 (January)	6	103.3 ± 17.0
13 (February)	7	102.6 ± 6.9

[a]Significant ($P<0.01$) variation among sample periods.
[b]Injection dose was decreased from 3.39 mg/kg to 1.71 mg/kg for sample periods 10-13.

Thus, these differences likely are not related to the changed dosage. However, the possibility of a dose-response relationship needs to be investigated. Seasonal changes in body metabolism must also be considered as possible contributing factors.

CONCLUSIONS

Urine sampling techniques described herein were successful under captive conditions. Their applicability and success in field situations remains yet to be determined. It is conceivable that deer immobilized in the field could be injected with furosemide to facilitate collection of urine samples. However, the time required to induce urination would be an obvious limitation. Also, in these situations, the possibility of immobilizing and diuretic drug interactions must be considered.

The techniques described are applicable in studies where relative comparisons are to be made. Use of diuretic drugs cannot be employed to determine absolute, base-line concentrations of urinary components, as the effects of furosemide or xylazine hydochloride on urinary components are unknown.

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LITERATURE CITED

1. ALBIN, R.C. and D.C. CLANTON. 1966. Factors contributing to the variation in urinary creatinine and creatinine-nitrogen ratios in beef cattle. J. Anim. Sci. 25: 107-112.
2. BUCKLAND, D.E., W.E. ABLER, R.L. KIRKPATRICK and J.B. WHELAN. 1975. Improved husbandry system for rearing fawns in captivity. J. Wildl. Manage. 39: 211-214.
3. CHETAL, U., U.R. MEHRA, K. NATH and S.K. RANJHAN. 1975. On the variation of urinary creatinine in buffalo calves and the effect of dietary protein intake on urinary creatinine, creatinine-nitrogen ratio and creatinine coefficient. J. Agric. Sci. (Camb.) 84: 1-5.
4. ERIKSSON, L. and M. VALTONEN. 1974. Seasonal changes in renal urea concentration in the reindeer *(Rangifer tarandus* L.). Ann. Zool. Fennici 11: 200-203.
5. FREE, A.H. and H.M. FREE. 1972. Urinalysis, critical discipline of clinical science. Crit. Rev. Clin. Lab. Sci. 3: 481-531.
6. GUADA, J.A., J.J. ROBINSON and C. FRASER. 1976. The effect of a reduction in food intake during late pregnancy on nitrogen metabolism in ewes. J. Agric. Sci. (Camb.) 86: 111-116.
7. KREHL, W.A. and R.H. HODGES. 1965. The interpretation of nutrition survey data. Am. J. Clin. Nutr. 17: 191-199.
8. LeRESCHE, R.E., U.S. SEAL, P.D. KARNS and A.W. FRANZMANN. 1974. A review of blood chemistry of moose and other Cervidae with emphasis on nutritional assessment. Naturaliste Can. 101: 263-290.

9. POLLACK, H. 1970. Creatinine excretion as index for estimating urinary excretion of micronutrients or their metabolic end products. Am. J. Clin. Nutr. 23: 865-867.

10. ROBINSON, J.J., D. SCOTT and C. FRASER. 1973. Observations on the effect of protein intake and stage of gestation on the proportion of urinary nitrogen excreted as urea in sheep. J. Agric. Sci. (Camb.) 80: 363-368.

11. SAUBERLICH, H.E., R.P. DOWDY and J.H. SKALA. 1973. Laboratory tests for the assessment of nutritional status. Crit. Rev. Clin. Lab. Sci. 4: 215-340.

12. SEAL, U.S. 1978. Assessment of habitat condition by measurement of biochemical and endocrine indicators of the nutritional, reproductive, and disease status of free-ranging animal populations. Proc. Symp. on Classification, Inventory, and Analysis of Fish and Wildlife Habitat, Off. Biol. Serv., U.S. Fish and Wildlife Serv., Washington, D.C. pp. 305-324.

13. THURMON, J.C., D.R. NELSON, S.M. HARTSFIELD and C.A. RUMORE. 1978. Effects of xylazine hydrochloride on urine in cattle. Australian Vet. J. 54: 178-180.

14. VAN NIEKERK, B.D.H., A. BENSADOUN, O.L. PALADINES and J.T. REID. 1963. A study of some of the conditions affecting the rate of excretion and stability of creatinine in sheep urine. J. Nutr. 79: 373-380.

15. VESTERGAARD, P. and R. LEVERETT. 1958. Constancy of urinary creatinine excretion. J. Lab. Clin. Med. 51: 211-218.

16. WARREN, R.J. 1979. Physiological indices for the assessment of nutritional status in white-tailed deer. Ph.D. Thesis. Virginia Polytech. Inst. and State Univ., Blacksburg. 250 pp.

17. ——, N.L. SCHAUER, J.T. JONES, P.F. SCANLON and R.L. KIRKPATRICK. 1979. A modified blow-gun syringe for remote injection of captive wildlife. J. Wildl. Dis. 15: 537-541.

18. ——, R.L. KIRKPATRICK, A. OELSCHLAEGER, P.F. SCANLON, and F.C. GWAZDAUSKAS. 1981. Dietary and seasonal influences on nutritional indices of adult male white-tailed deer. J. Wildl. Manage. 45: (In Press).

19. ——, ——, ——, ——, K.E. WEBB, JR. and J.B. WHELAN. 1982. Energy, protein, and seasonal influences on white-tailed deer fawn nutritional indices. J. Wildl. Manage. 46: (In Press).

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