

PHYSIOLOGIC MANIFESTATIONS OF STRESS FROM CAPTURE AND RESTRAINT OF FREE-RANGING MALE AFRICAN GREEN MONKEYS (*CERCOPITHECUS AETHIOPS*)

Mbaruk A. Suleman B.V.M., Ph.D., Emmanuel Wango B.V.M., Ph.D., Robert M. Sapolsky B.Sc., Ph.D., Hesbon Odongo Dipl. H.N., and Jann Hau M.D., Ph.D.

¹⁰¹From the Institute of Primate Research, P.O. Box 24481, Karen, Nairobi, Kenya (Suleman); the Department of Animal Physiology, University of Nairobi, Box 30197, Nairobi, Kenya (Wango, Odongo); the Department of Biological Sciences, Stanford University, Stanford, California 94305-5020, USA (Sapolsky); and the Division of Comparative Medicine, Uppsala University, BMC, Box 570, S-751 23 Uppsala, Sweden (Hau). Correspondence should be directed to Dr. Suleman

Abstract

Adrenal gland weights, stomach mucosal lesions, and morning serum cortisol and prolactin levels were measured in 15 juvenile and adult male African green monkeys (*Cercopithecus aethiops*) that were shot by a hunter, euthanized after 24 hr of captivity, or euthanized after 45 days of captivity and intermittent blood sampling. Hormone levels were measured in seven additional males that had been in captivity for 7 mo. Mean serum cortisol concentrations were significantly lower in free-ranging wild monkeys at the time they were shot than in the monkeys after 1 day in captivity. Cortisol concentrations were significantly higher in wild-caught monkeys on the day after capture than they were in the same animals after 18 and 26 days of captivity. Cortisol concentrations were also significantly higher in the wild-caught monkeys 18 days after capture than in the laboratory-habituated monkeys in captivity for 7 mo. Mean prolactin concentration was significantly lower in the wild-caught monkeys on day 2 after capture, and the levels increased gradually to 45 days in captivity and was highest in monkeys that had been captive for 7 mo.

Received: April 2, 2001

Keywords: [Prolactin](#), [hormone](#), [cortisol](#), [Cercopithecus aethiops](#), [African green monkey](#), [stress](#)

LITERATURE CITED

- De Feo, P. 1996. Hormonal regulation of protein metabolism. Eur. J. Endocrinol 135:7–8.
[CrossRef](#), [PubMed](#)
- De Feo, P., G. Perriello, E. Torlone, M. M. Ventura, G. Fanelli, and F. Santeusano. 1989. Contribution of cortisol to glucose counter regulation in humans. Am. J. Physiol 257:E35–E42.
[PubMed](#)

Eley, R. M., R. Tarara, C. Worthman, and J. G. Else. 1989. Reproduction in the vervet monkey (*Cercopithecus aethiops*) III. The menstrual cycle. *Am. J. Primatol* 17:1–10. [CrossRef](#)

Else, J. G. 1985. Captive propagation of vervet monkeys (*Cercopithecus aethiops*) in harems. *Lab. Anim. Sci* 35:373–375. [PubMed](#)

European Union Working Party. 1995. Report on Euthanasia of Experimental Animals. European Commission DG XI, Brussels, Belgium. Pp. 11–13.

Johnson, P. T., D. A. Valerio, and G. E. Thompson. 1973. Breeding the African green monkey, *Cercopithecus aethiops*, in a laboratory environment. *Lab. Anim. Sci* 23:355–359. [PubMed](#)

Manser, C. E. 1992. The assessment of stress in laboratory animals. Royal Society for Prevention of Cruelty to Animals, London, U.K. P. 6.

McGuire, M. T., G. L. Brammer, and M. J. Raleigh. 1986. Resting cortisol levels and the emergence of dominant status among male vervet monkeys. *Horm. Behav* 20:106–117. [CrossRef](#), [PubMed](#)

Muchemi, G. 1992. Baboon as a Natural Host of *Schistosoma mansoni*. Ph.D. Thesis, Univ. Liverpool, Liverpool, U.K.

Mugambi, K. G., M. T. Butynski, M. A. Suleman, and W. Ottichilo. 1997. The vanishing de Brazza's monkey (*Cercopithecus neglectus* Schlegel) in Kenya. *Int. J. Primatol* 18:995–1004. [CrossRef](#)

Rehbinder, C. and L-E. Edqvist. 1981. Influence of stress on some blood constituents in reindeer (*Rangifer tarandus* L). *Acta Vet. Scand* 22:480–492. [PubMed](#)

Sapolsky, R. M. 1982. The endocrine stress-response and social status in the wild baboon. *Horm. Behav* 16:279–292. [CrossRef](#), [PubMed](#)

Sufi, S. B., A. Donaldson, and S. L. Jeffcoate. 1998. Method Manual for Matched Assay Reagents for the Radioimmunoassay of Hormones in Reproductive Physiology. WHO Special Programme of Research, Development and Training in Human Reproduction. WHO Collaborating Centre for Immunassay, London, U.K. Pp. 16–24.

Suleman, M. A., R. Tarara, and P. D. Sayer. 1995. Spontaneous acute gastric mucosal erosions and ulcerations in vervet monkeys (*Cercopithecus aethiops*). Part I. *J. Zoo Wildl. Med* 26:67–71.

Suleman, M. A., E. Wango, I. O. Farah, and J. Hau. 2000. Adrenal cortex and stomach lesions associated with wild male African green monkeys (*Cercopithecus aethiops*) in the post-capture period. *J. Med. Primatol* 29:338–342. [CrossRef](#), [PubMed](#)

Szabo, S. 1985. Understanding biologic stress for study design and interpretation of results. *Dig. Dis. Sci* 30:(Suppl.). 28S–31S. [CrossRef](#), [PubMed](#)

Tarara, E., R. P. Tarara, and M. A. Suleman. 1995. Stress-induced gastric ulcers in vervet monkeys (*Cercopithecus aethiops*): the influence of life history factors. Part II. *J. Zoo Wildl. Med* 26:72–75.

Uno, H., R. Tarara, J. G. Else, M. A. Suleman, and R. M. Sapolsky. 1989. Hippocampal damage associated with prolonged and fatal stress in a primate. *Neuroscience* 9:1705–1711. [PubMed](#)

Wall, H. S., C. Worthman, and J. G. Else. 1985. Effects of ketamine anaesthesia, stress and repeated bleeding on the haematology of vervet monkeys. *Lab. Anim* 19:138–144. [CrossRef](#), [PubMed](#)

Wiklund, E., G. Malmfors, K. Lundstrom, and C. Rehbinder. 1996. Pre-slaughter handling of reindeer bulls (*Rangifer tarandus tarandus* L.): effects on technical and sensory meat quality, blood metabolites and muscular and abomasal lesions. *Rangifer* 16:109–117. [CrossRef](#)

Cited by

Angélica María Sánchez-Sarmiento, Ticiana Zwarg, Renata Carolina Fernandes-Santos, Thaís Guimarães-Luiz, Alexander Genoy-Puerto, Eliana Reiko Matushima. (2015) Hematological parameters and the variations resulting from stress of *Alouatta caraya* during a wildlife rescue program in Brazil. *American Journal of Primatology* **77**:10.1002/ajp.v77.3, 246-253.

Online publication date: 1-Mar-2015.

[CrossRef](#)

Amanda R. Hau, Faisal A. Guhad, Margaret E. Cooper, Idle O. Farah, Ouajdi Souilem, Jann Hau. 2014. Animal Experimentation in Africa: Legislation and Guidelines. *Laboratory Animals*, 205-217.

[CrossRef](#)

Alba Zulema Rodas-Martínez, Domingo Canales, Dulce María Brousset, William F. Swanson, Marta C. Romano. (2013) Assessment of adrenocortical and gonadal hormones in male spider monkeys (*Ateles geoffroyi*) following capture, restraint and anesthesia. *Zoo Biology* **32**, 641-647.

Online publication date: 1-Nov-2013.

[CrossRef](#)

J.T. Amory, W.M. Du Plessis, A. Beierschmitt, J. Beeler-Marfisi, R.M. Palmour, T. Beths. (2013) Abdominal ultrasonography of the normal St. Kitts vervet monkey (*Chlorocebus sabaeus*). *Journal of Medical Primatology* **42**:10.1111/jmp.2013.42.issue-1, 28-38.

Online publication date: 1-Feb-2013.

[CrossRef](#)

John F. Cockrem. (2013) Individual variation in glucocorticoid stress responses in animals. *General and Comparative Endocrinology* **181**, 45-58.

Online publication date: 1-Jan-2013.

[CrossRef](#)

Shervin Liddie, Robin J. Goody, Rodrigo Valles, Matthew S. Lawrence. (2010) Clinical chemistry and hematology values in a Caribbean population of African green monkeys. *Journal of Medical Primatology* **39**:10.1111/jmp.2010.39.issue-6, 389-398.

Online publication date: 1-Dec-2010.

[CrossRef](#)

Lisa Yon, Brian Faulkner, Sumolya Kanchanapangka, Narongsak Chaiyabutr, Sompast Meepan, Bill Lasley. (2010) A safer method for studying hormone metabolism in an Asian elephant (*Elephas maximus*): accelerator mass spectrometry. *Zoo Biology* **29**:10.1002/zoo.v29.6, 760-766.

Online publication date: 1-Nov-2010.

[CrossRef](#)

A. MÃ¡rquez-Arias, A.M. SantillÃ¡n-Doherty, R.V. Arenas-Rosas, M.P. Gasca-MatÃ¡as, J. MuÃ±oz-Delgado. (2010) Environmental enrichment for captive stump-tail macaques (*Macaca arctoides*). *Journal of Medical Primatology* **39**:10.1111/jmp.2009.39.issue-1, 32-40.

Online publication date: 1-Feb-2010.

[CrossRef](#)

Nigel J. Adams, Kevin A. Parker, John F. Cockrem, Dianne H. Brunton, E. Jane Candy. (2010) Corticosterone responses and post-release survival in translocated North Island Saddlebacks (*Philesturnus rufusater*) in New Zealand. *Emu* **110**, 296.

Online publication date: 1-Jan-2010.

[CrossRef](#)

Giovanna Massei, Roger J. Quay, Joanne Gurney, Dave P. Cowan. (2010) Can translocations be used to mitigate human–wildlife conflicts?. *Wildlife Research* **37**, 428.

Online publication date: 1-Jan-2010.

[CrossRef](#)

R.M. Ngure, S.M. Karanja, N.K. Mungatana, C.N. Wamae, J.M. Ngotho, C.W. Gichuki. (2008) Biochemical changes in cerebrospinal fluid of *Chlorocebus aethiops* naturally infected with zoonotic *Meningonema peruzzii*. *Journal of Medical Primatology* **37**:10.1111/jmp.2008.37.issue-4, 210-214.

Online publication date: 1-Aug-2008.

[CrossRef](#)

ERIN KENNERLY, ANNE BALLMANN, STANTON MARTIN, RUSS WOLFINGER, SIMON GREGORY, MICHAEL STOSKOPF, GREG GIBSON. (2008) A gene expression signature of confinement in peripheral blood of red wolves (*Canis rufus*). *Molecular Ecology* **17**:10.1111/mec.2008.17.issue-11, 2782-2791.

Online publication date: 1-Jun-2008.

[CrossRef](#)

A. L. Fernström, W. Sutian, F. Royo, A. L. Fernström, W. Sutian, F. Royo, K. Westlund, T. Nilsson, H.-E. Carlsson, Y. Paramastri, J. Pamungkas, D. Sajuthi, S. J. Schapiro, J. Hau. (2008) Stress in cynomolgus monkeys (*Macaca fascicularis*) subjected to long-distance transport and simulated transport housing conditions. *Stress* **11**, 467-476.

Online publication date: 1-Jan-2008.

[CrossRef](#)

Danielle A. Springer, Kate C. Baker. (2007) Effect of ketamine anesthesia on daily food intake in *Macaca mulatta* and *Cercopithecus aethiops*. *American Journal of Primatology* **69**:10.1002/ajp.v69:10, 1080-1092.

Online publication date: 1-Oct-2007.

[CrossRef](#)

Paula F. Kahn, Craig Guyer, Mary T. Mendonça. (2007) Handling, Blood Sampling, and Temporary Captivity Do Not Affect Plasma Corticosterone or Movement Patterns of Gopher Tortoises (*Gopherus Polyphemus*). *Copeia* **2007**:3, 614-621.

Online publication date: 14-Jan-2009.

[Abstract & References](#) : [Full Text](#) : [PDF](#) (203 KB)

J.M. Kagira, M. Ngotho, J.K. Thuita, N.W. Maina, J. Hau. (2007) Hematological changes in vervet monkeys (*Chlorocebus aethiops*) during eight months' adaptation to captivity. *American Journal of Primatology* **69**:10.1002/ajp.v69:9, 1053-1063.

Online publication date: 1-Sep-2007.