

MEASURING ACUTE STRESS IN *CTENOMYS SOCIABILIS*

H196 Proposal
(Empirical projects)

I. Objective

This study will validate fecal glucocorticoid metabolite (FGM) concentrations as measures of acute stress response in colonial tuco-tucos (*Ctenomys sociabilis*). Although acute stress response has been measured for multiple mammals using blood plasma samples, the ability to detect such response in fecal samples remains largely unexplored. Because fecal samples provide a non-invasive method of obtaining material from captive and free-living animals, validation of FGMs as measures of response to acute stress will provide an important tool for studying physiological responses to environmental challenges.

II. Hypothesis

Acute stress causes increased levels of glucocorticoid hormones that can be detected in feces.

III. Predictions

Individual colonial tuco-tucos exposed to acute stressors (e.g., physical restraint) will exhibit elevated fecal glucocorticoid metabolites relative to control animals that do not experience acute stressors.

IV. Background

Acute stress is a critical physiological event that has pervasive effects on an animal's ability to function and, potentially, its survival and fitness. To date, plasma sampling is the most widely utilized method for measuring changing glucocorticoid levels in response to acute stress. Though the sensitivity, precision and ability to capture rapid changes in hormone levels make this an attractive method, the invasive nature of drawing blood samples is counterproductive, as it can induce acute stress in animals. Moreover, plasma monitoring is impossible for endangered or elusive species that cannot easily be captured. FGM monitoring offers a potentially important, non-invasive alternative method of measuring acute stress.

This study seeks to establish new methods for the measurement of acute stress in *C. sociabilis*, a social, subterranean rodent endemic to South America. Stress hormones have been examined as a possible indicator of benefits of sociality in this species. Enzyme immunoassays (EIAs) have already been validated in this species as a method for measuring baseline FGM levels and induced glucocorticoid response by injection with ACTH, however, they have not been validated for measurements of acute stress in *C. sociabilis*, nor in most other animals (Woodruff *et al.* 2010). By first establishing a baseline corticosterone level, acute incidents of stress could be determined using statistical methods that would identify significant deviations from baseline. To show that fecal sampling is reliable, it is necessary to show that the hormone levels it reports are consistently related to hormone levels measured by an established technique like plasma sampling.

III. Methods

Captive colonial tuco-tucos housed on the Berkeley campus will be stressed in two different, ecologically significant ways. First, they will be released into an open arena for one hour, a stressful experience for a fossorial rodent that does not spend extensive time above ground. Second, they will be enclosed in plastic tubes for one hour. Control animals will be handled in the same manner as experimental animals but will not be subject to the open arena or restraint in a tube. For all animals, fecal samples will be collected every 6 hours for 36 hours. Sample collection will begin 12 hours before exposure to a stressor to provide a baseline measure for each animal. Hormones will be extracted from fecal samples, after which EIAs will be used to measure GC concentrations for experimental and control animals. Although both experimental and control animals will likely exhibit increased GC concentrations (due to un-preventable human interaction), I predict that GC concentrations for experimental animals will deviate more from baseline (pre-stressor) levels. I also predict that concentrations of FGMs will roughly parallel plasma concentrations over the course of data collection. Together, these results would show that, if fecal samples are collected and processed in a chronological manner, the acute stress curve (concentration corticosterone vs. time) could be quantified using FGM analysis.

IV. Broader Impacts

Baseline GC levels are often used as a metric of ecological health, fitness and stability for threatened populations. GC response to acute stress would also be a usable quantification of these ecological parameters, given that the sensitivity of an animal's acute stress response may reflect its ability to adapt to environmental change.

References:

Woodruff, J. *et al.* 2010. Contrasting Fecal Corticosterone Metabolite Levels in Captive and Free-Living Colonial Tuco-Tucos. *J. Exp. Zool.* 313:498-507.