Measuring faecal glucocorticoid metabolites as a non-invasive tool for monitoring adrenocortical activity in South American camelids

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Abstract

The welfare and productivity of South American camelids may be affected by stressful events. The purpose of this study was to validate a non-invasive method for stress monitoring using faecal samples and to apply it to evaluate a stressful event, such as confinement. For physiological validation, nine alpacas (Vicugna pacos) and six llamas (Lama glama) were subjected to pharmacological stimulation of their adrenal cortex. Serial faecal samples were collected during 48 h before and after stimulation. During confinement, faecal samples from six llamas were collected twice per day during six consecutive days. Faeces belonging to 18 vicuñas (Vicugna vicugna) were collected before and one day after their capture for confinement (Chacu). Faecal cortisol metabolites (FCM) were extracted from each sample and quantified by an 11-oxoaetiocholanolone enzyme immunoassay. Thirty-three and 28 h (median) after ACTH stimulation, FCM concentrations peaked with a ten- and eight-fold increase (median) above baseline in alpacas and llamas, respectively. There were no significant differences in FCM concentrations between sexes. In llamas, FCM concentrations peaked (4.7 times higher than baseline) after five days of confinement in females and after three days (2.7 times) in males. In vicuñas, three times higher FCM levels were observed the day after the start of confinement (in comparison to the starting values). Based on our findings, this non-invasive method is well suited to measure adrenocortical activity in alpacas, llamas and vicuñas. Thus, this method could help to improve management, handling and welfare in wild and domesticated South American camelids.

Keywords: animal welfare, faeces, glucocorticoids, New World camelids, plasma, stress

Introduction

South American camelids (SAC) include the domesticated alpacas (Vicugna pacos) and llamas (Lama glama) along with the wild species, vicuña (Vicugna vicugna) and guanaco (Lama guanicoe). There is a growing population of alpacas and llamas in the USA, Europe and Australia, but more than 95% of them are located in the Andean region of Perú and Bolivia where they provide fibre, meat, pelts and faeces, the latter being used as fuel and fertiliser. Worldwide, alpacas and llamas are used for breeding, fibre production, trekking, and as companion animals. Moreover, llamas are utilised as pack animals in some isolated regions (Fernández-Baca 1993).

Reproductive disorders in SAC (especially in females) are one of the main problems that make their reproductive management complicated for breeders and veterinarians (Vaughan & Tibary 2006). Stressful situations during common management activities, such as transportation, handling, and restraint for medication or venipuncture are considered to contribute to this problem. For example, stress from transportation has been associated with foetal losses in alpacas (Knight et al 1995) and embryo mortality seems to be the main cause of low reproductive efficiency in alpacas (Fernández-Baca 1993). Moreover, it is hypothesised that stressors such as long walks, antiparasitic shower-dip and shearing may result in a fulminant systemic infection, known as ‘Alpaca fever’ (Hewson & Cebra 2001).

Stress triggers a physiological response that involves a cascade of events ending with the release of glucocorticoids (cortisol, corticosterone) by the adrenal cortex (Möstl & Palme 2002; Palme 2012). Initial attempts to evaluate stress in SAC began with studies measuring cortisol in plasma samples. Anderson et al (1999a) found a significant increase in serum cortisol concentration in alpacas following transportation, while behavioural characteristics and heart rate were not found to be useful indicators of stress. In a later study, concentration of salivary cortisol did not rise after transportation while serum cortisol did, suggesting that cortisol in saliva is not a sensitive indicator of transport stress (Anderson et al 1999b). High concentrations of serum cortisol were found in alpacas after birth and weaning (stressors) and decreased to baseline values with time (Bravo et al 2001).