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An investigation of vitamin D metabolism in kiwi (*Apteryx mantelli*), tuatara (*Sphenodon punctatus*) and New Zealand sea lion (*Phocarctos hookeri*) and the relationship of vitamin D metabolism with their life history characteristics.

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Abstract

Vitamin D, a fat-soluble vitamin, has a wide range of functions in vertebrates. The aim of the study was to determine if the evolutionary history of different animal species affects their predominant route of vitamin D metabolism. The species chosen in this study were Brown kiwi (*Apteryx mantelli*) for their nocturnalism, tuatara (*Sphenodon punctatus*) for their diurnal sun basking nature and New Zealand sea lion (*Phocarctos hookeri*), as a marine mammal species.

A survey of plasma or serum concentrations of 25-hydroxyvitamin D_2 ($25(OH)D_2$) and 25-hydroxyvitamin D_3 ($25(OH)D_3$) in kiwi, tuatara and New Zealand sea lion and analysed the ability of skin to produce vitamin D_3 in response to UV exposure from post mortem samples of these three species. Assessment of morepork (*Ninox novaseelandiae*) skin was also carried out as an additional example of a nocturnal species.

Wild kiwi had lower plasma $25(OH)D_3$ concentrations than captive kiwi and this variation was most likely of dietary origin. The low concentrations of plasma $25(OH)D_3$ in wild kiwi in their natural habitat, suggest that these minimal levels are sufficient to fulfill their vitamin D requirements in the body or they utilise calcium independent of vitamin D. Captive diets for kiwi may be over-supplemented with vitamin D. In contrast to this finding, the skin of both kiwi and morepork was able to produce small but measureable amounts of vitamin D_3 in response to UV exposure. This result was unexpected, considering their nocturnal nature and the overall pattern of vitamin D metabolism in the kiwi is still unclear.

Vitamin D metabolism in tuatara suggests that both dietary and dermal pathways are important. The survey of plasma $25(OH)D_3$ concentrations in captive tuatara showed variation between the five zoological institutions, which was correlated to the variation in the dietary vitamin D provided between captive institutions.

However, analysis of tuatara skin showed that tuatara had a strong ability to synthesise vitamin D dermally, indicating that it is an important route of vitamin D metabolism in tuatara.

New Zealand sea lion showed overall higher serum $25(OH)D_3$ concentrations than kiwi and tuatara, which might be attributed to the high UV-B radiation exposure they receive in their natural habitat. New Zealand sea lion skin also had comparatively higher vitamin D concentrations both prior to and in response to UV exposure, which shows that dermal route of vitamin D is an important route of metabolism in these marine mammals.

Table of contents

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List of tables

List of figures