PRELIMINARY REPORT ON THE QUANTIFICATION OF ULTRAVIOLET-B RADIATION FROM ARTIFICIAL LIGHT SOURCES OVER TIME

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Abstract

The term "metabolic bone disease" encompasses a variety of bone-related diseases, including rickets, osteomalacia, osteopenia, and osteoporosis, all of which are associated with a weakening of bone structure. Metabolic bone disease is considered a serious health problem among certain species of captive reptiles.[1-5,7,8,10,11,13] The occurrence of metabolic bone disease is believed to be due to insufficient concentrations of circulating vitamin D, which is necessary for calcium absorption. If vitamin D deficiency is a chronic problem, the body begins mobilizing calcium stores from bone to satisfy the requirement for circulating plasma calcium concentrations.

Vitamin D can be obtained through the diet or synthesized in vivo upon skin exposure to certain wavelengths of ultraviolet B (UVB) radiaton. For reasons we cannot explain, reptiles and New World primates still exhibit symptoms of vitamin D deficiency even when nutritionally complete feeds are supplemented with vitamin D at levels sufficient for other species.[6,7,12,13]

Giving animals access to direct, unfiltered, unobstructed sunlight with accessible shade and water is the best way to ensure the animal is receiving the UVB exposure necessary to produce vitamin D. Unfortunately, sunlight received through normal glass will contain little, if any, UVB radiation because UVB rays poorly penetrate glass and most acrylics.

Since exposing animals to direct sunlight is not always possible, especially in a zoological setting, it is important to find a way to provide the animal with exposure to UVB radiation in the band width (290-300 nm) documented to synthesize vitamin D.[14] Some light bulbs, which are specifically marketed for herpetologists, are manufactured to produce UVB radiation for captive animals. Two studies were conducted testing UVB bulbs several years ago, but most of those bulbs were test bulbs or are no longer manufactured.[6,9]

Little scientific information exists documenting the UVB output of currently available bulbs and the decline in UVB emission over time. Manufacturers recommend replacing the bulb every six months, but do not support this recommendation with documented scientific proof. The purpose of this study was to quantify the UVB output over a six month period from various artificial light sources. These results determined the intensity of UVB emission from each bulb at specific distances and the longevity of UVB output from each type of bulb.

Three commercially available, incandescent bulbs, T-Rex Acitve UVHeat 160 watt spot (T-Rex Products, Chula Vista, CA), T-Rex Acitve UVHeat 160 watt flood, and ZooMed PowerSun 160

watt flood (San Luis Obispo, CA), and two four foot fluorescent bulbs, Sylvania Blacklight 350 BL (Sylvania, Danvers, MA) and ZooMed Reptisun 5.0, were tested. All bulbs were tested in replicates of three. Using timers, bulbs were illuminated for 12 hours each day. The total UVB output was measured initially and then monthly using a Solartech Solarmeter® 6.2 UV meter (Solartech, Inc., Harrison Township, MI), which quantifies total UVB which ranges from 280 - 320 nm. The incandescent bulbs were measured at distances of three and five feet from the bulb, while fluorescent bulbs, measured at the bulb's centers and six inches from each end, were measured at distances of 12 and 18 inches.These distances were based on the manufacturers' recommendations.

During the first four months of the six month study, there was an expected and noticeable UVB drop from all bulbs as measured with a radiometer. This drop occurred after the first month. Both the flood and spot T-Rex incandescent bulbs emitted a larger irradiance of UVB compared to the ZooMed PowerSun incandescent bulb. The ZooMed Reptisun 5.0 bulb emitted a higher concentration of UVB compared to the Sylvania Blacklight 350 BL bulb, while the centers of each fluorescent bulb emitted more UVB than either of the ends.

It is important to remember that the radiometer used in this study quantified total UVB output and that not all UVB will promote vitamin D synthesis. To overcome this problem, an in vitro ampule model containing 7-dehydrocholesterol (50μg/ml ethanol) was also used to measure UVB emission from the lights. The ampule results were not included in this abstract.

Although some lights had a higher total UVB reading, they may be emitting lower than expected concentrations of UVB in the bandwidth necessary for vitamin D synthesis. Other important considerations include the unknown vitamin D requirements of the animals and the unknown capacity with which they can synthesize vitamin D upon exposure to UVB radiation. Even though a bulb may emit a low concentration of UVB, the radiation may be sufficient for the animal to synthesize their vitamin D needs.

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