P36(a). Optical properties evaluation of bovine hooves for phototherapeutic dosimetry optimization in laminitis treatment

FP Sellera[1], RG Gargano[1], CP Sabino[2], AM Deana[3], MS Ribeiro[2], RD Ollhoff[4], FC Pogliani[1]
[1] University of São Paulo, Brazil; [2] Center for Lasers and Applications, IPEN-CNEN/SP, Brazil; [3] Nove de Julho University – Biophotonics Program, Brazil; [4] Pontíficia Universidade Católica do Paraná, Brazil
fabiocp@usp.br

Introduction

Visible and near-infrared radiations have been widely employed in medical sciences over the last few decades. Even though most of the recently developed techniques are yet restricted to basic science in laboratories, biophotonics already became a powerful alternative tool in health sciences from diagnosis to therapeutics and phototherapy arise in this context as a potential approach.
Among the researched phototherapies, the low level laser therapy (LLLT) has been helping tissue repair through their biomodulation effects (Woodruff et al, 2004), and its application in inflammatory processes has been investigated mainly by causing reduction in the number of inflammatory cells (Whelan et al, 2001). Laminitis is an aseptic, inflammatory and degenerative disease (Greenough, 2007), therefore, LLLT may be an useful tool for the treatment of laminitis and should be investigated as therapeutical method. However, depending on light parameters results could be unsatisfactory and/or null. The optical barriers characteristics located prior to the target tissue must be well known to apply an ideal dosimetry.
The aim of this study was to evaluate whether the radiation emitted by laser penetrates the bovine claw horn enabling future research on the treatment of laminitis with LLLT.

Materials and Methods

Five Holsteins cows were randomly chosen at slaughterhouse and pigmented and unpigmented claws were collected. Four samples from different anatomical regions extracted according to corium characteristics (i.e. periople and coronary band, lamenar and sole zones). Each sample was cut in 15mm wide squares and had the external surface sanded to remove environmental residues.
Spectroscopic measurements were carried out by a spectrophotometer coupled to a single integrating sphere. The spectra for transmittance and reflectance wavelengths were measured ranging from 350 nm to 1400 nm. The optical absorption, scattering and total attenuation coefficients were determined using an one-dimensional, two-flux Kubelka-Munk model.

Results

The attenuation coefficients were calculated originating the graph in Figure 1. We considered that an attenuation coefficient below 5 cm^{-1} indicates a high transmission of waves. This occurred between 600 to 1350 nm and is also known as an optical window, indicating the wavelengths that can be employed for phototherapeutic procedures.

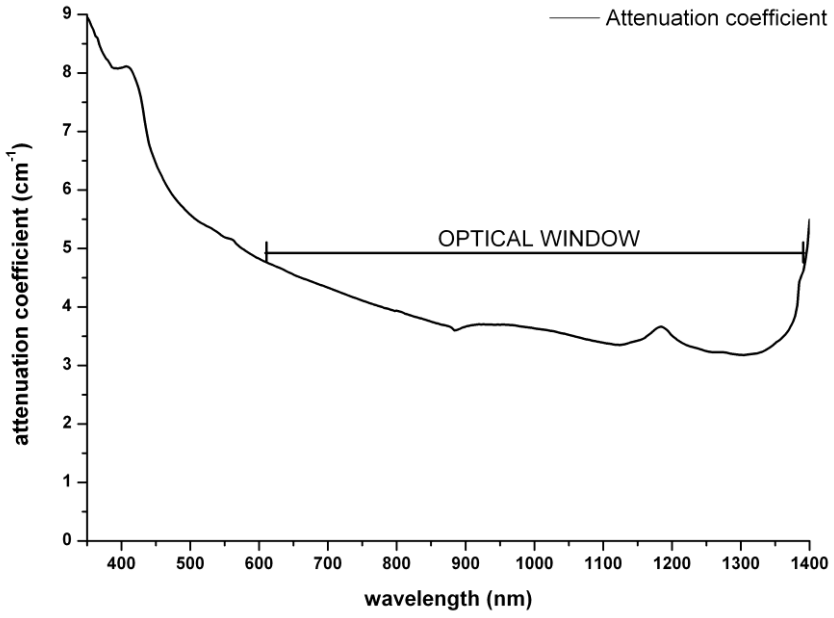

Figure 1 Optical window of bovine hooves.

Discussion

In the present study we evaluated the optical properties of pigmented and unpigmented Holstein cattle hooves to establish recommended irradiation parameters for phototherapies in cattle laminitis.

The radiation emitted by low level lasers with spectral interval ranging from 600 to 1350nm was denominated as optical window in all regions of cattle pigmented and unpigmented hooves. Once bovine hooves presented variable thickness, the most privileged light transmission anatomical site was the perioplic region. The results show that the radiation emitted by lasers pervade the hooves, making light in wavelengths between 600 to 1350 nm suitable to be tested in the treatment of laminitis or other claw injuries located in the tissue surrounded by the horn capsule, encouraging future studies.

References

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