

Press information

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Antlers may be the best model to study bone mineralization

A new study carried out in deer shows that antlers –the bones with the fastest growth rate that regenerate each year– show the fastest mineralization among medium and large size mammals. This characteristic may allow to test in deer pharmaceutical products to promote mineralization and to study their efficiency with much greater sensitivity than in other animal models. Researcher from University of Hildesheim are involved.

For many years, scientist have been studying deer antlers because they are extraordinary structures: they are the only external bones in vertebrates that are regenerated every year, they constitute 20% of the weight of the skeleton of the animal. And they show in their composition, mechanical properties and even histology, information about mineral deficiencies in the diet, exposure to certain environmental contaminants and changes in the habitat produced by extraordinary weather.

In a **study to be published in 2013** in the leading scientific journal **BONE**, a multidisciplinary team of **Spanish and German scientist** from the **University of Cadiz** (Drs. Santiago Gomez (leading author) and Salvador Luna), the **Spanish national game institute (IREC)** (Drs. Tomas Landete-Castillejos, Andres Garcia, and Laureano Gallego) and the **University of Hildesheim** (Drs. Horst and Uwe Kierdorf) studied the process of bone growth in antlers of red deer by means of marking the forming bone tissue at different times (a process called labelling) by repeatedly injecting stags with oxytetracycline, an antibiotic that becomes incorporated in bone at sites of mineralization and can be visualized in sections because of its fluorescence.

These labels within the bone (see figure) allow calculating the amount of bone created between two known dates, i.e. the speed of mineralization of the bone. The field work for the study was done from 2009 to 2011 in the experimental deer farm of the University of Castilla-La Mancha in Albacete. This farm is considered the best in the whole of Europe.

The results show for the first time that antlers, which elongate between 1 to 2 centimetres per day during peak growth, have a very high mineralization rate of 2.2 $\mu\text{m}/\text{d}$, three times that of humans (0.7 $\mu\text{m}/\text{d}$) and twice that of dogs (1.1 $\mu\text{m}/\text{d}$). The study also provided two other interesting findings. First that the osteons (the microscopic bone tubes that form mature compact bone) are filled between days 70 to 100 after a new antler starts growing (in the studied red deer, this corresponds to May). This means that, as the authors point out, the porosity of the bone tissue is

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determined in this period. That is why this period of 30 days is the most sensitive stage to increase antler mass (a goal of deer managers) by improving nutrition. Furthermore this period is critical for studies assessing the effects of minerals in the diet or of toxic substances on bone mineralization. Because of their rapid mineralization, antlers are particularly sensitive models of bone mineralization that are very well suited for pharmaceutical studies aimed at elucidating the factors influencing the mineralization process and thereby bone quality.

The second finding, reinforcing the potential applications in humans, is that certain antler areas that are not well mineralized (transition zone between antler cortex and spongy core) show a histological appearance also seen in osteomalacia, a disease that is characterized by a defective bone mineralization.

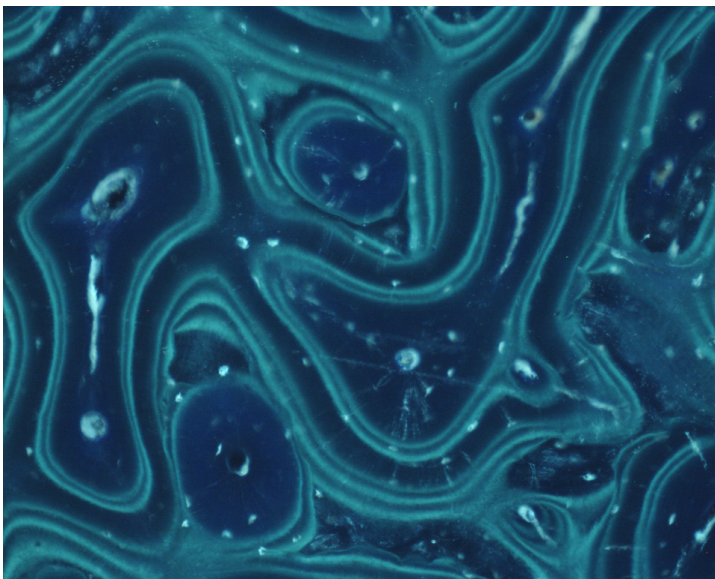
The study is framed within a long time research line of the cooperating scientists on **antler and bone histology** as well as **antler mechanical performance and composition**, and their applications to game management. The newly established collaboration between the Spanish and German researchers with their different scientific backgrounds may be particularly fruitful as studies on antlers appear to have implications beyond mere zoology or game management.

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Information on the accompanying photo:



Microscopic image of a cross section through the compact outer bone layer of a red deer antler showing multiple fluorescent labels.