

[Bone](#). 2012 Jan;50(1):245-54. doi: 10.1016/j.bone.2011.10.026. Epub 2011 Oct 30.

Does nutrition affect bone porosity and mineral tissue distribution in deer antlers? The relationship between histology, mechanical properties and mineral composition.

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Source

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Abstract

It is well known that porosity has an inverse relationship with the mechanical properties of bones. We examined cortical and trabecular porosity of antlers, and mineral composition, thickness and mechanical properties in the cortical wall. Samples belonged to two deer populations: a captive population of an experimental farm having a high quality diet, and a free-ranging population feeding on plants of lower nutritive quality. As shown for minerals and mechanical properties in previous studies by our group, cortical and trabecular porosity increased from the base distally. Cortical porosity was always caused by the presence of incomplete primary osteons. Porosity increased along the length of the antler much more in deer with lower quality diet. Despite cortical porosity being inversely related to mechanical properties and positively with K, Zn and other minerals indicating physiological effort, it was these minerals and not porosity that statistically better explained variability in mechanical properties. Histochemistry showed that the reason for this is that Zn is located around incomplete osteons and also in complete osteons that were still mineralizing, whereas K is located in non-osteonal bone, which constitutes a greater proportion of bone where osteons are incompletely mineralized. This suggests that, K, Zn and other minerals indicate reduction in mechanical performance even with little porosity. If a similar process occurred in internal bones, K, Zn and other minerals in the bone may be an early indicator of decrease in mechanical properties and future osteoporosis. In conclusion, porosity is related to diet and physiological effort in deer.

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