SOME ATTRIBUTES OF ANTLERS

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Antlers are cranial organs of bone which are grown and cast each year by males of the deer family. Young males are not born with antlers, but these grow first as permanent pedicles then as deciduous antlers during the first 15 month of life. Antlers evolved as male secondary sexual characters for fighting and display during the breeding season; it is at this time that antlers are most effective weapons. Antlers are the only mammalian organs to fully regenerate and the fact that this regeneration takes place each year makes antlers truly unique. Antler growth takes place from the tip, a growing antler can be thought of as a column of tissues with progressive differentiation distally from fibroblasts to cartilage cells to true bone. Antlers have fascinated people since early times. Aristotle understood the links between reproductive and antler cycles and to the Ancient Chinese the antler was the animal epitomy of pure 'yang'. Today the antler is a valuable component of the Oriental Medical Pharmacopoeia and is widely used to increase stamina, cold resistance and as a overall tonic for children. Velvet antler represents a NZ$50M export industry largely to Korea. Research in China, Russia, Korea and now in New Zealand has indeed shown that there are indeed repeatable therapeutic and potentially therapeutic properties of velvet. Specifically antler preparations have growth promoting and cyto-toxic activity in cell culture, in addition to beneficial tonic effects to the whole body.

Research on the endocrine mechanism of antler growth has centred on two areas, namely steroids (testosterone) and growth factors. As mentioned above the antler cycle is strongly linked to the reproductive cycle and broadly speaking the antler is clean, hard and dead during the breeding season when testosterone is high and soft growing during the spring growing season when testosterone is low. However the first antler grown by a stag is strictly generated, not regenerated. Although it has been known for some time that testosterone was involved in this initial antler generation, whether this was the sole province of testosterone was in dispute. In a series of studies we have shown in castrate male, freemartin and intact females that a regime of testosterone treatment, until the pedicle has reached a length of 5 cm, followed by withdrawal, was sufficient, alone, to cause an antler to develop. We have also demonstrated the presence of androgen binding sites in early pedicle tissue. This data refutes earlier work which suggested that additional testicular substances or wound formation were required for the growth of the first antler.

Although insulin like growth factor 1 has been strongly linked with antler growth, we have carried out studies on antler cells in culture which convincingly show that both IGF 1 and 2 are mitogenic for antler cells, probably acting via the Type 1 IGF receptor. While IGF 1 mRNA has not been found in the antler at this time, Type 1 IGF receptor gene transcripts have been observed which suggest a likely endocrine mechanism of IGF action.

Overall the antler is a model for many types of bone growth studies and may also provide a useful study tool for nerve and blood vessel growth.