PHYSIOLOGY AND GROWTH OF ANTLERS IN DEER 221

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At the present time 'velvet' or growing antler is a valuable product derived from farmed red deer (Cervus elaphus L) in New Zealand. As part of our research programme on deer, we are attempting to define some of the factors which control and regulate the antler growth cycle, in order to devise treatments which will stimulate antler growth and increase 'velvet' production.

Antlers are bony outgrowths from the skull found in most members of the deer family (Cervidae). Except for reindeer and caribou, they are carried only by males. Antlers are normally replaced annually - the new growth arises from the skin of the pedicle, the pedicles being bony projections of the frontal bone of the skull. In the young red stag the pedicles develop over the first winter-spring with pedicle development and antler growth being an apparently continuous process. The growing antlers are covered by skin (velvet) and are very well supplied with blood vessels. The histological differentiation of the antler is complex with mesenchymal tissue in the growing tip, progressing through the differentiation of cartilage which matures and mineralises. As the antlers approach their full size, further internal maturation takes place and a dense compact bone with primary and secondary Haversian systems is formed. The final maturation of the antler tissue is accompanied by loss of blood supply to the velvet. Consequently the velvet dries up and is cleaned off by rubbing. The antlers are thus in the hard state for the rut (mating season). In the red deer stag the hard antler drops off in the spring as a result of resorption of bone just below the coronet; the skin around the pedicle then grows over initiating new antler growth.

The seasonal pattern of antler growth is apparently under photoperiodic control and is very closely related to the events of the sexual cycle, which is also under photoperiodic control. In this respect, the casting of the hard antler in the spring is associated with a low concentration of testicular testosterone, whereas velvet shedding is associated with a high concentration of testosterone. It is likely that the cycle is under the integrated control of sex steroids and other hormone(s), presumably of pituitary origin. Much of the understanding of the antler cycle has come from research on the effects of castration and hormone therapy. Castration of male calves before puberty prevents pedicle growth and subsequent antler development while testosterone therapy stimulates pedicle development. If a stag is castrated while his antlers are in velvet, the antlers will remain in this state. In contrast a stag castrated while bearing hard antlers will cast these and new antlers grown immediately; the new antlers will remain in the velvet.

The process of antler growth and its control will be reviewed and examined with the emphasis being on the red deer. A hypothesis concerning the control of antler growth will be presented and current and planned lines of research designed to investigate factors which influence antler growth outlined. The possible effects of nutrition on pedicle development and antler growth will be considered along with an examination of the relative demands for nutrients for the growth of the antler and repletion of body tissues during the spring.