THYROXINE DEFICIENCY INDUCES FOLLICLE SHUTDOWN

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Thyroidectomy of fetal sheep results in failure of initiated follicles to mature and produce a fibre (Hopkins and Thorburn 1972) while in adult sheep, removal of thyroid hormones reduces wool growth by about 60%, largely as a consequence of a decrease in the rate of fibre length growth, with little effect on fibre diameter (Wallace 1979). However there are reports of an involvement of thyroxine (T_4) in stimulating fibre production in previously inactive follicles (eg. Ebling and Johnson 1964), so it is possible that a deficiency of T_4 results in follicle shutdown. This possibility was examined in mature sheep, as there is considerable current interest into the role of so-called follicle shutdown in staple strength.

Seventeen Corriedale sheep, 3 years of age and weighing 39.2 ± 1.00 kg at the start of the experiment were allocated to 3 groups; Group 1= thyroidectomised (n = 7), Group 2 = control (n = 5) and Group 3 = hyperthyroid (0.5 mg/day T_4 subcutaneously). The sheep were placed in individual pens and offered 1 kg/day sheep pellets for a 10 week period post-surgery. Plasma samples were taken weekly 4 hours post-feeding and the T_4 levels measured by radioimmunassay. Skin biopsy samples (1 .0 cm) were taken from the midside of the animals at the end of the 10 week period. The biopsies were sectioned transverse to the plane of the follicles midway between the sebaceous glands and the bulbs, and stained by the SACPIC method. A minimum of 300 follicles were scored as active or inactive (the latter are characterised by irregular fibre shape or no fibre present, nuclei aligned on the periphery of the outer root sheath, and irregular staining of the inner root sheath). Wool growth was measured on tatooed patches, fibre length growth rate by the ^{35}S-cysteine technique and fibre diameter by FFDA.

The mean (± sem) plasma T_4 levels in Groups 1, 2, and 3 were 0, 48 ± 5.2 and 122 ± 12.2 ng/mL respectively. Wool growth was decreased by 60% by thyroidectomy while fibre volume output was decreased only 40%, a discrepancy accounted for by a large increase (P = 0.004) in the proportion of inactive follicles in the hypothyroid sheep (Table 1). Nearly 25% of the follicles in the hypothyroid sheep were inactive. Fibre volume was depressed largely as a consequence of a decrease in fibre length with only a small (ns) change in fibre diameter. Hyperthyroidism increased patch wool growth but had no significant effect on fibre volume output or follicle activity.

Table 1. Mean (± se) effects of hypo- and hyperthyroidism on wool growth and follicle activity

Treatment group	Wool (mg/cm^2.day)	Fibre length (μm/day)	Fibre diameter (μm)	Fibre volume (μm^3/day)	Inactive follicles (%)
1 (hypo-T_4)	0.28 (0.042)^a	277 (14.7)^a	21.9 (0.72)^a	4416 (446.5)^a	22.9 (6.32)^a
2 (control)	0.66 (0.050)^b	412 (13.2)^b	23.9 (0.68)^{ab}	7705 (376.3)^b	1.2 (0.91)^b
3 (hyper-T_4)	0.91 (0.027)c	436 (14.9)^b	25.3 (1.01)^b	9228 (1002.3)^b	0.1 (0.12)^b

Follicles with different superscripts differ at P < 0.05.

This is the first study to show that the wool follicles of mature sheep can be induced into inactivity by the removal of thyroxine and that the decrease in wool growth coincident with thyroidectomy is a consequence of a decrease in fibre number as well as fibre length growth. The fact that fibre diameter is not greatly altered by thyroidectomy and yet some follicles are induced to shut-down suggests that follicle shutdown is not simply a consequence of fibre diameter being reduced to an unsustainable level. It is considered unlikely that thyroxine plays a role in detemining follicle inactivity in grazing sheep because even very low levels of T_4 allow normal wool growth rates. Nevertheless hypothyroidism may present a useful model for determining the role of follicle inactivity in staple strength without the compounding impact of changes in fibre diameter.

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