THE PHYSIOLOGY OF SKIN AND WOOL FOLLICLES OF FINEWOOL AND STRONGWOOL MERINOS.

by

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CHAPTER 2. FOLLICLE AND FIBRE CHARACTERISTICS OF STRONGWOOL AND FINEWOOL MERINOS

CHAPTER 3. SKIN BLOOD FLOW OF FINEWOOL AND STRONGWOOL MERINOS

CHAPTER 4. CUTANEOUS MICROVASCULATURE OF FINEWOOL AND STRONGWOOL MERINOS

CHAPTER 5. *IN VITRO* UPTAKE OF RADIOLABELLED NUTRIENTS BY THE SKIN AND FOLLICLES OF FINEWOOL AND STRONGWOOL MERINOS

ABSTRACT

Wool production differences between sheep maintained under similar environmental conditions appear to reside in the functioning of individual follicles. The investigations presented in this thesis utilise the differing wool producing abilities of two strains of Merino, finewool and strongwool Merinos. The relationships between wool production (on both a unit area and individual follicle basis) and skin and follicle characteristics, blood flow and microvasculature of the skin and incorporation of ^{3}H-glucose and ^{35}S-cystine by the skin were examined.

The differences in the structure and function of wool follicles and their association with fibre production were examined in 6 finewool Merinos (Camden Park) and 6 strongwool Merinos (East Bungaree). The strongwool Merinos produced 2.4 times more wool per unit area of skin and 3.5 times the volume of fibre per follicle than the finewool Merinos, when both groups were maintained under similar environmental conditions. The finewool Merinos had a higher follicle density, but a lower average volume of germinative tissue in the follicle bulb and the skin than the strongwool Merinos. The rate of cell production in the follicle bulb was greater in the strongwool Merinos than the finewool Merinos, but the proportion of bulb cells entering the fibre was not significantly different between strains. The number and volume of cells in the bulb and the cell length and volume of the cortical cells, and tended to be greater in the strongwool Merinos than the finewool Merinos, but also were not statistically different between strains due to a high 'between-sheep, within-strain' variation. Wool production per unit area of skin was highly correlated with the total volume of germinative tissue in the skin ($r = 0.91$; $P < 0.01$). This relationship was true for the strongwool and finewool Merinos and also in two groups of sheep from the same genetic base with one group selected using a WOOLPLAN index and the other a randomly-bred flock. It was concluded a) that genotype may determine the volume of potential mitotically-active follicle tissue in the skin, and b) that wool production on both a follicle and unit area of skin basis is not controlled by a single character, but rather is the result of a cumulative effect of a number of characteristics.

The physiology of the skin associated with high levels of wool production was further examined. In particular, blood flow through the skin of the strongwool and finewool Merinos was investigated using a laser Doppler velocimeter. This method was highly correlated with estimates obtained using ^{57}Co-microspheres ($r = 0.92$; $P < 0.01$) although the absolute values estimated by the microsphere technique were significantly greater ($P < 0.001$). Strongwool Merinos had a significantly greater rate of blood flowing through the skin than finewool Merinos ($P < 0.011$) and this was associated both with wool production per unit area of skin ($r = 0.58$; $P < 0.02$) and with follicle density ($r = -0.44$; $P < 0.1$). It was concluded that a) blood flow has an important role in the level of wool produced both within and between strains of Merino, and b) the laser Doppler velocimeter is a useful tool for the study of blood flow in the skin of sheep.

The microvasculature of the skin was examined using an infusion of silicone rubber into the deep circumflex iliac artery within the abdominal flank region of eight Merinos. The area of cascular tissue per unit volume of skin was independent of blood flow, wool growth and follicle density, both within and between strains of Merinos. The limitations of the technique used to examine the microvasculature, and its effect on the results are discussed.

The uptake of ^{3}H-glucose and ^{35}S-cystine by the skin and follicles was examined both *in vitro* and *in vivo* to determine if the follicles of the strongwool Merinos were capable of utilising the large nutrient pool supplied by the high rates of blood flowing through the skin. The skin and follicles of strongwool Merinos incorporate similar amounts of ^{3}H-glucose and ^{35}S-cystine per unit weight of skin than finewool Merinos. It was also found that the amount of radioactivity retained by the skin generally was not dependant on the amount of radioactivity supplied to the skin and follicles.

In summary, this study determined that strongwool Merinos have higher levels of wool production than finewool Merinos due to the presence of a large amount of tissue capable of producing fibre. This characteristic is maintained by a high rate of blood flowing through the skin. Wool production and blood flow through the skin are not influenced by the underlying anatomy of the microvasculature, nor is wool production restricted by the ability of the follicles to utilise nutrients from an extracellular pool for fibre production. Finally, the implications of this study and the usefulness in, and effect on, programs for selection of superior wool-producing genotypes are discussed.