Aspects Of Wool Follicle Morphology and Cell Proliferation in Romney Sheep Selected For High Fleece Production

A thesis presented in partial fulfilment of the requirements for the degree of Doctor of Philosophy in Veterinary Science at Massey University

Sabina Antonia Holle

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This work is dedicated to my parents, and especially to my father, who always encouraged and supported me in my efforts, and who unfortunately did not live to see me completing my work and degree.

TABLE OF CONTENTS

DISCUSSION

ABSTRACT

The mechanisms involved in the expression of genotypic differences in wool production have been investigated. Understanding the control of wool growth involves the understanding of the function of the follicle. The specific objectives were to clarify some of these mechanisms within the wool follicle in this thesis using histological techniques on two lines of New Zealand Romney sheep differing in their level of annual wool production.

A method was established to identify replicating cells in the follicle bulb, by administering the thymidine analogue bromodeoxyuridine (BrdU) to the skin, by either local infusion or intracutaneous injection. Immunocytochemical detection of incorporated BrdU allowed visualization of BrdU labelled, proliferating cells. Various follicle dimensional measurements made using image analysis were tested for their ability to discriminate between morphological variations related to functional changes in the follicle bulb.

The characteristics of the wool fibres of both lines, such as length and diameter, were determined at three stages of the year and subsequently related to results obtained on follicle characteristics. Fibre volume output was increased in sheep with a higher level of wool production, with the diameter being the component contributing most to this increase.

Metabolic measurements (glycogen, SDH) of follicles using histochemical techniques were undertaken to determine, whether they reflect differences in follicle activity at a time during the year, when line differences in wool production were expected to be greatest. Glycogen storage was not associated with energy requirements of the follicle bulb cells. SDH activity was low, suggesting that the follicle utilises glucose mainly by anaerobic glycolysis.

Investigations of individual follicles emphasised follicle dimensions and the proliferating bulb cell population at three stages of the year. Measurements were based upon the use of intracutaneously administered BrdU to assess the replicating cell population in wool follicles. Immunocytochemical detection techniques in association with image analysis enabled quantification of changes in bulb cell replication and follicle dimensions. Both genotypes exhibited a seasonal pattern of follicle changes, with higher values occurring during summer. The higher producing line of sheep showed their advantage by developing larger follicles, larger dermal papillae and larger germinative tissue areas, and therefore larger numbers of proliferating

bulb cells.

Close relationships between follicle diameters and fibre diameters of fibre sections measured within the hair canal and at the surface existed.

The width and area of the fibre cortex and the IRS at a level above the top of the dermal papilla was determined. Proportional changes were observed. This indicates the existence of a redistribution mechanism of cells to cortex or IRS, which is partly influenced by genotype. In sheep genetically inferior in wool production, relatively more bulb cells migrate into the IRS during times of increased bulb cells production (summer) than do cells of sheep on higher production levels.

Theories on the possible influence of the dermal papilla on cell migration in the bulb and on the expression of different follicle components are discussed.

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List of Abbreviations

AOV	- analysis of variance (one-way)
BM	- basement membrane
BrdU	- 5-bromo-2'-deoxyuridine
CLT	- control treatment group
FD	- fibre diameter
FL	- fibre length
FWT	- fleeceweight selected group of sheep
GFW	- greasy fleece weight
GTA	- germinative tissue area
IRS	- inner root sheath
LSMEAN	- least square mean
NS	- not significant
ORS	- outer root sheath
SDH	- succinate dehydrogenase
SEM	- standard error of the mean

Significance levels for statistical tests

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<tr><td>0.1%</td><td>p<0.001</td><td colspan="2">***</td></tr>
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