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A STUDY OF THE EFFECTS OF NUTRITIONALLY-INDUCED BODYWEIGHT
DIFFERENCES ON OVARIAN FUNCTION IN THE EWE

A thesis presented in partial fulfilment
of the requirements for the degree
of Master of Agricultural Science
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1987

Title of thesis: A Study of the Effects of Nutritionally-Induced
Bodyweight Differences on Ovarian Function in the Ewe

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ABSTRACT

The aim of this study was to investigate the mechanisms by which nutritionally-induced bodyweight differences (i.e. the so-called "static bodyweight effect") influence ovulation rate in sheep.

Seventy Romney ewes (5-7 years old) were randomly divided into 2 groups of 35 each and differentially grazed on mixed ryegrass/white clover pastures for 12-16 weeks to generate two treatment groups differing in mean bodyweight by 14.9 ± 1.8 kg (mean \pm s.e.d.) early in the breeding season. Within each bodyweight (BWT) group, ewes were further divided into 3 blocks. Blocks 1 and 2 were used for the main experiment and only ovulation rate data were collected from ewes in block 3.

The oestrous cycles of all ewes were synchronized by treatment for 14 days with progesterone-impregnated intravaginal sponges. Two weeks after sponge withdrawal, ewes in block 3 were subjected to laparoscopy to record their ovulation rate.

After returning to oestrus following sponge withdrawal, ewes in block 1 and 2 were housed indoors and fed a maintenance diet of lucerne chaff until the end of the experiment about 16 days later. On day 12 of the synchronized oestrous cycle, ewes were injected with 150 μ g cloprostenol to induce luteolysis. Laparotomies were performed at 0, 24, 48 (block 1 only), and 76h after the prostaglandin treatment to study the patterns of preovulatory follicular development. The number of corpora lutea present on the ovaries at the time of the first laparotomy were also recorded. Ewes were blood-sampled by jugular venipuncture during the late luteal and follicular phases of the cycle and the plasma concentrations of FSH and LH were measured. After the laparotomy study, ovaries of the ewes were removed, fixed in Bouin's fluid and the left ovaries serially sectioned at 10 μ m thickness. Every 5th section was mounted and observed under a light microscope to study the populations of follicles 0.2mm or greater in diameter.

Ewes in the high BWT group (H) had significantly higher ovulation rates than those in the low BWT group (L) ($H=1.73\pm 0.20$, $L=1.18\pm 0.13$, $P<0.001$). On average, ovulation rate increased by 3.1% for each kilogram increase in bodyweight. Significant relationships between bodyweight and ovulation rate also existed within treatment groups ($P<0.05$). Compared with ewes in the low BWT group, ewes in the high BWT group had more follicles ≥ 2 mm in diameter present on the ovarian surface at the time of the first laparotomy ($H=10.70\pm 1.19$, $L=7.66\pm 0.75$, $P<0.001$); a greater number of follicles being recruited early in the follicular phase ($H=3.79\pm 0.19$, $L=2.80\pm 0.30$, $P<0.05$); and a lower intensity of selection through atresia late in the follicular phase ($H=43.7\pm 4.2\%$, $L=53.9\pm 5.5\%$, $P<0.10$). There were no differences between BWT groups in the total number of follicles 0.2mm or greater in diameter, their size distribution or rate of atresia, but ovaries of ewes in the high BWT group had significantly more healthy follicles greater than 2mm in diameter than those of ewes in the low BWT group. Within treatment, bodyweight was significantly and positively correlated with the numbers of healthy follicles of 0.5-1 and 1-2mm diameter. Plasma FSH levels decreased during the follicular phase, but there was no effect of treatment on mean FSH concentrations during the late luteal and follicular phases. For ewes in block 2, preovulatory LH surges had occurred in most animals by about 72h after prostaglandin injection, with no difference in the time interval from prostaglandin injection to the onset of the LH surge ($H=60.8\pm 3.8$ h, $L=60.9\pm 3.1$ h, $P>0.10$).

It is concluded that variation in ovulation rate due to nutritionally-induced bodyweight differences is associated with changes in the number of follicles being recruited into the actively growing pool shortly after luteolysis and the proportion of the recruited follicles that become atretic at the time of selection late in the follicular phase of the oestrous cycle. However, large differences in bodyweight do not appear to influence the antral follicle populations in the ovary. FSH, which plays many important roles during follicular development, may not be involved in the control of bodyweight-induced variation in ovulation rate.

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TABLE OF CONTENTS

ABSTRACT.....	ii
ACKNOWLEDGEMENTS.....	iv
LIST OF TABLES.....	ix
LIST OF FIGURES.....	x
LIST OF ABBREVIATIONS.....	xi
Chapter I: Introduction.....	1
1 The importance of high reproductive performance in sheep.....	1
2 Determinants of sheep reproductive performance.....	1
2.1 Ovulation rate as a determinant of litter size.....	2
2.2 Embryo survival as a determinant of litter size.....	3
3 Factors influencing ovulation rate in the ewe.....	5
3.1 Season.....	5
3.2 Age.....	5
3.3 Genetics.....	6
3.4 Nutrition.....	7
3.4.1 The static effects of bodyweight.....	8
3.4.2 The dynamic effects of bodyweight.....	9
3.4.3 The effects of protein intake.....	11
4 Physiological basis for the nutritional effects on ovulation rate.....	14
4.1 Effects of nutrition on follicular growth.....	14
4.1.1 Effects of nutrition on follicular population.....	14
4.1.2 Effects of nutrition on preovulatory follicular development.....	18
4.2 Effects of nutrition on hormone action.....	21
4.2.1 Effects of nutrition on circulating levels of gonadotrophins.....	22
4.2.1.1 Luteinizing Hormone.....	22
4.2.1.2 Follicle-Stimulating Hormone.....	24
4.2.1.3 Manipulation of gonadotrophin status and its effects on O.R.....	27

4.2.1.4 Interactions between nutrition, circulating steroid levels and gonadotrophin secretion.....	30
4.2.2 Ovarian sensitivity to gonadotrophins.....	33
5 Purpose and scope of the investigation.....	35
Chapter II: Materials and Methods.....	37
1 Animals and treatments.....	37
2 Laparotomy and prostaglandin treatment.....	38
3 Blood sampling.....	40
4 Histological procedures.....	40
4.1 General.....	40
4.2 Classification of follicles.....	41
5 Hormone assays.....	42
5.1 Follicle-stimulating hormone.....	42
5.2 Luteinizing hormone.....	42
6 Statistical analysis.....	43
6.1 Oestrus data.....	43
6.2 Ovulation rate data.....	43
6.3 Laparotomy data.....	44
6.4 Histological data.....	44
6.5 Hormonal profiles.....	44
6.6 Levels of statistical significance.....	45
Chapter III: Results.....	46
1 Bodyweight changes.....	46
2 Onset of Oestrus.....	46
3 Ovulation rate.....	50
4 Follicle development during the follicular phase.....	52
4.1 Dynamics of preovulatory follicular development.....	52
4.2 Ovulatory activity following prostaglandin injection.....	52
5 Histological studies.....	55
5.1 Total number of follicles.....	55
5.2 Numbers of follicles in different size classes.....	55

5.3 Numbers of follicles in different health status classes.....	55
5.4 Numbers of follicles in different size by status classes.....	57
5.5 Potential ovulations.....	59
6 Hormone profiles.....	60
6.1 Follicle-stimulating hormone.....	60
6.2 Luteinizing hormone.....	60
Chapter IV: Discussion.....	63
References.....	76

LIST OF TABLES

<u>Table</u>	<u>Page</u>
1: Estimates of ovulation rate of prolific sheep breeds	7
2: Assignment of animals and dates of treatment	38
3: Effects of block and treatment on bodyweight and bodyweight changes	48
4: Effects of block, treatment and bodyweight on the ovulation rate during the cycle following sponge withdrawal	51
5: Numeric features of preovulatory follicular development for ewes in the high and low BWT groups	53
6: Effects of block, treatment and bodyweight on the total and mean numbers of follicles in different size or health status classes	56
7: Effects of block, treatment and bodyweight on the numbers of follicles in different size by status classes	58
8: Numbers of potentially ovulatory follicles for block 2 ewes in the high and low BWT groups	59
9: Effects of block and treatment on mean FSH concen- trations prior to and during the follicular phase of the oestrous cycle	61
10: Onset of the preovulatory LH surge for block 2 ewes in the high and low BWT groups	62

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1: Mean bodyweights of ewes at different times after the initiation of the nutritional treatments	47
2: Percentage of ewes showing oestrus at different times following sponge withdrawal	49

LIST OF ABBREVIATIONS

A	Advanced atretic follicles
B	Block (effect)
BXT	Block X Treatment (interaction)
BWT	Bodyweight (or bodyweight effect)
°C	Degree Celcius
c.v.	Coefficient of variation
E	Early atretic follicles
FSH	Follicle-stimulating hormone
g	Gram
GnRH	Gonadotrophin releasing hormone
h	Hour
H	High bodyweight group
He	Healthy follicles
kg	Kilogram
L	Low bodyweight group
La	Late atretic follicles
LH	Luteinizing hormone
ME	Metabolisable energy
MJ	Megajoules
ml	Milliliter
mm	Millimeter
ng	Nanogram
O.R.	Ovulation rate
PMSG	Pregnant mare serum gonadotrophin
s.e.	Standard error
T	Treatment (effect)