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

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ZHENZHONG XU

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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±1.8kg (mean ± 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 150µg 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 10µm 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±0.20, L=1.18±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 ≥2mm in diameter present on the ovarian surface at the time of the first laparotomy(H=10.70±1.19, L=7.66±0.75, P<0.001); a greater number of follicles being recruited early in the follicular phase (H=3.79±0.19, L=2.80±0.30, P<0.05); and a lower intensity of selection through atresia late in the follicular phase (H=43.7±4.2%, L=53.9±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±3.8h, L=60.9±3.1h, 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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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)