LIVEWEIGHT AND OVARIAN RESPONSE IN EWES TO BOVINE FOLLICULAR FLUID (bFF)

R.C. FRY, M.A. DRIANCOURT and L.P. CAHILL

SUMMARY

In order to study the underlying mechanisms of the liveweight-ovulation rate (O.R.) relationship, the final phase of follicular growth, (Exp.1) and its sensitivity to exogenous follicular fluid (Exp.2) in high (H) and low (L) liveweight ewes were investigated. Firstly, ink-labelling of the large follicles revealed that the higher O.R. of the heavy ewes was mainly due to a lower incidence of atresia during the follicular phase; furthermore H liveweight ewes had significantly more large antral follicles (>4mm diameter) than L liveweight ewes ($P<0.01$). Secondly, when the ovarian response to various doses of bFF was examined in both H and L liveweight ewes after administration of PMSG, the bFF significantly reduced the number of large antral follicles in a similar dose dependent manner for both liveweight groups ($P<0.01$) suggesting no difference in ovarian sensitivity to bFF. However the larger number of follicles >4mm exhibited by the H group following cautery and PMSG treatment at 0 ml bFF ($P<0.05$) suggests a greater ovarian sensitivity to gonadotrophins than in the L group. (Keywords: liveweight, ovulation rate, follicular fluid, follicles).

INTRODUCTION

The observation by Heape (1899) that heavy ewes produced more lambs than light ewes has been found by many authors to be due to a difference in O.R. The physiological mechanism controlling the liveweight - O.R. relationship is still unclear. Gonadotrophin levels (Davis et al. 1981), ovarian sensitivity to gonadotrophins (Allison 1975) together with intraovarian modulators (F.G.I., Cahill et al. 1985) have been suggested to control O.R. The present study to contribute to our understanding of the liveweight-O.R. relationship investigated the final phase of follicular growth (Exp.1) and the ovarian sensitivity to exogenous follicular fluid, (Exp.2) in H and L liveweight ewes.

MATERIALS AND METHODS

Mature Border Leicester X Merino ewes (n = 116) were weighed, condition scored and allocated to feedlot groups at random after stratification according to liveweight. The ration offered during a 10 week period consisted of medium quality pasture hay fed at 1.3 maintenance (M) (H group; n = 58) and 0.25 M (L group; n = 58). Ovulation rate and condition of ewes were determined before feeding treatments were implemented and at the completion of the experiment. Oestrus was synchronised using progestagen impregnated sponges (Repromap-John).

Experiment 1 - Final Follicular Growth

The three largest follicles visible on the surface of each ovary of 16 ewes (H=8; L=8) were measured and ink-labelled at laparotomy (Lap.1) 24h prior to sponge removal (i.e. 12 days after sponge insertion). The three largest follicles of each ovary were again measured at a second laparotomy (Lap.2), 24h after sponge removal, with new, additional follicles ink-labelled if necessary. The number of preovulatory follicles (defined as the largest follicles that do not decrease in size - Driancourt et al. 1985) was assessed at a third laparotomy (Lap.3) when 50% of ewes had exhibited oestrus.

* Animal Research Institute, Department of Agriculture and Rural Affairs, Werribee, 3030, Victoria.

Experiment 2 - Sensitivity to bFF

Twelve days after sponge insertion, 100 ewes (H = 50; L = 50) were randomly allocated to five subgroups (n = 9 - 14), which received subcutaneous injections of bFF at either 0, 0.5, 1.0, 2.0 or 4.0 ml/day,,-twice daily for a period of 48h beginning 12h prior to laparotomy. All surface follicles were classed as <2, 2-4 or >4mm. All follicles >2mm were ablated by electrocautery to reduce the between animal variation in follicle populations. Sponges were removed and 500 IU PMSG were administered, with a further 250 IU given 24h later to override the endogenous gonadotrophin variability. All surface follicles were measured again 48h after cautery.

Statistical analysis

The non-parametric Mann and Whitney test was used in Experiment 1. Experiment 2 was analysed by ANOVA and Student's t-test.

RESULTS

The mean (± s.e.) liveweight, condition score and O.R. was 54 ± 0.77 kg, 2.7 ± 0.07 and 1.52t0.07 respectively at the commencement of the experiment and after the nutrition treatments 57.6 ± 0.83 kg, 2.8 ± 0.06 and 1.78 ± 0.06 for the H ewes and 44.4 ± 0.71 kg, 1.84 ± 0.08 and 1.50 ± 0.07 for the L ewes.

Experiment 1 - Final Follicular Growth

The observed difference in the number of preovulatory follicles (H = 1.86, L = 1.31; Table 1) appeared to be due to a combination of both a lower incidence of atresia in the high liveweight group (37% compared to 48%) and an increased number of follicles recruited (3.0 compared to 2.5). It is interesting to note that there was a large variability between ewes in the number of follicles recruited, and that on a per ewe basis the mean percentage loss at selection, between Lap. 2 and Lap. 3 was 20% (H) and 40% (L; $0.05<P<0.1$).

Table 1 The number of follicles per ewe at laparotomy and the incidence of atresia in ewes of high and low liveweight

Liveweight Group	H	L
Number of follicles		
- labelled (Lap. 1)	6	6
- still growing at Lap. 2	2.6 ± 0.4	2.4 ± 0.3
- additional at Lap. 2	0.4 ± 0.3	0.1 ± 0.1
Total recruited	3.0	2.5
- still growing at Lap. 3 (O.R.)	1.86 ± 0.36	1.31 ± 0.19
Incidence of atresia after Lap. 2	37%	48%

Experiment 2 - Sensitivity to bFF

Prior to cautery the H group ewes had significantly more follicles >4mm than the L group (H=1.52 ± 0.11; L=0.81 ± 0.08, P 0.01). There were no differences in the number of follicles 2-4mm (H=1.51 ± 0.17; L=1.71 ± 0.16) and <2mm (H=19.38 ± 0.90; L=17.47 ± 0.89) between liveweight groups.

Analysis of follicle numbers after cautery, PMSG and bFF treatments revealed no significant differences or interactions between liveweight and dose of bFF in the 2-4mm class. As the dose of bFF increased there was a significant reduction (P<0.01) in the number of follicles >4mm diameter in both groups (Fig.1).

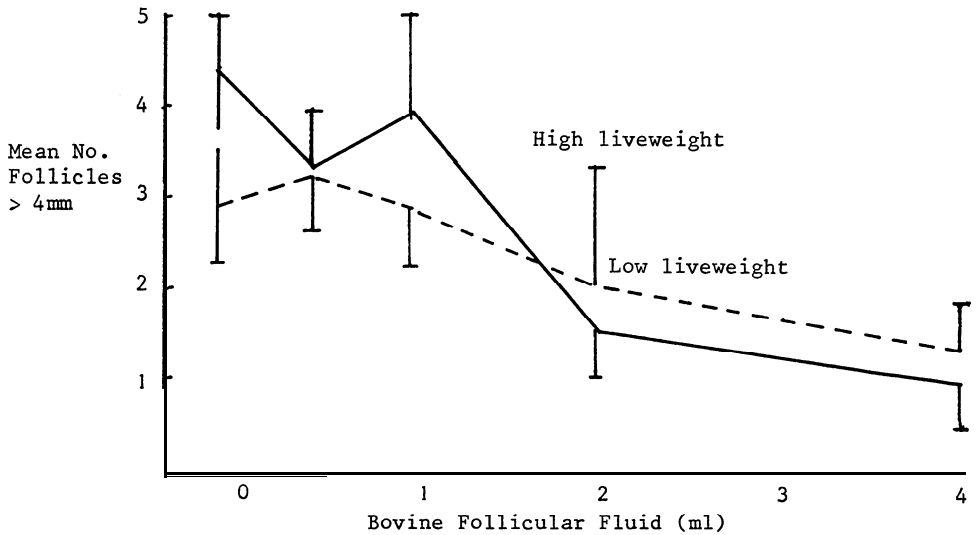

Fig. 1. Effect of nutrition and follicular fluid on the number of follicles >4mm after cautery in the mid-breeding season.

DISCUSSION

This study demonstrates that the ovarian response to changes in ewe liveweight is unlikely to be mediated through a change in ovarian sensitivity to follicular fluid and that a change in ovarian sensitivity to gonadotrophins is more likely.

The change in O.R. associated with the liveweight and body condition score differences for ewes on the two levels of feed intake is consistent with the review of Morley et al. (1978) who reported a 2-2.5% increase in O.R. for each additional kg in liveweight. Inspection of the ovaries prior to cautery in experiment 2 revealed a significant increase in the mean number of large (>4mm diameter) follicles on the ovary surface of the H group (P<0.01), which agrees with previous results (Allison 1984). Four important points arose from this study.

Firstly, ink-labelling of large follicles (Exp.1) during the follicular phase revealed that the difference in O.R. between liveweight groups was due to a decreased number of follicles recruited in the L group and a higher incidence of atresia which was defined by a regression in follicle size at the time of

selection. A similar conclusion was attained by Haresign (1981) when examining the action of "flushing" on O.R. It would appear that the higher number of follicles >4mm in the heavy ewes is not the only cause of the high O.R. but it is also mediated by a difference in atresia.

Secondly, experiment 2 demonstrated a dose dependent relationship between bFF and number of large surface follicles for both liveweight groups following stimulation of folliculogenesis by PMSG and cautery (Fig.1). A similar decrease in the regrowth of ovarian follicles despite the presence of high levels of exogenous gonadotrophins has been reported and suggests that follicular fluid contains an inhibitor of follicular growth (F.G.I.; Cahill et al. 1985).

Thirdly, there was no difference in ovarian sensitivity to bFF, as shown by the slopes of the dose response curves in Fig.1 between liveweight groups. Hence an alteration in ovarian sensitivity to follicular fluid is unlikely to be the mechanism controlling the liveweight - O.R. response. However a difference in ovarian content of F.G.I. is still to be ascertained.

Fourthly, in those ewes receiving the same amount of exogenous gonadotrophin but no bFF, the H liveweight ewes had significantly more follicles >4mm than L liveweight ewes ($P<0.05$) indicating that their ovaries may be more sensitive to gonadotrophins. This supports previous claims (Guerra et al. 1971, Allison 1975) and could be the major factor responsible for the liveweight effect since gonadotrophin levels have been found not to be altered (Findlay and Cumming 1976, Knight et al. 1981) or only marginally altered (Davis et al. 1981) by feeding.

REFERENCES

ALLISON, A.J. (1975). N.Z. J. Ag.Res. 18 : 101.

CAHILL, L.P., DRIANCOURT, M.A., CHAMLEY, W.A. and FINDLAY, J.K. (1985). J. Reprod. Fert. (In press).

DAVIS, I.F., BRIEN, F.D., FINDLAY, J.K. and CUMMING, I.A. (1981). Anim. Reprod. Sci. 4 : 19.

DRIANCOURT, M.A., CAHILL, L.P. and BINDON, B.M. (1985). J.Reprod.Fert. 73 : 93.

FINDLAY, J.K. and CUMMING, I.A. (1976). Biol. Reprod. 15 : 335.

GUERRA, J.C., THWAITES, C.J. and EDEY, T.N. (1971). J.Agric.Sci., 76 : 177.

HARESIGN, W. (1981). Anim. Prod. 32 : 197.

HEAPE, W. (1899). J. Royal Agric. Soc. 38 : 217.

KNIGHT, T.W., PAYNE, E. and PETERSON, A.J. (1981). Proc.Aust.Soc.Reprod.Biol. 13 : 19.

MORLEY, F.H.W., WHITE, D.H.,, KENNEY, P.A. and DAVIS, I.F. (1978). Agric. Systems. 3: 27.