Effect of fatty acid enriched diets on reproductive parameters in cattle.

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Introduction

Over the past two decades there has been a decline in dairy cow conception rate of the order of 1% per annum. Selection for milk yield without regard for intake capacity has led to cows experiencing negative energy balance (NEB) early postpartum and this deleteriously affects cow reproductive performance. To counteract NEB effects, high energy density diets such as those including fats are frequently fed. Dietary fat has been shown to increase milk yield and alter composition and there is some evidence that independent of its effects on energy balance, it can enhance reproductive performance (Staples et al., 1998), although the mechanism is unclear. It has been suggested that dietary fatty acids may affect ovarian follicle size, corpus luteum (CL) size, progesterone (P_4) production, and/or prostaglandin (PG) synthesis and metabolism, though there is little or no direct evidence for any of these effects. Systemic progesterone concentration on days 5, 6 and 7 post oestrus is positively related to embryo survival (Stronge et al., 2004). Dietary fatty acids may affect systemic P_4 by increasing the size of the pre-ovulatory follicle and thus the subsequent CL or by augmenting systemic concentrations of cholesterol, the primary precursor for P_4 synthesis. The aim of this project was to determine the effect(s) of feeding diets rich in omega 3 (eicosapentaenoic and docosahexaenoic acids) and omega 6 (linoleic acid) fatty acids on follicle and corpus luteum size and on systemic P_4 concentration in cattle.

Materials and Methods

Reproductively normal, oestrus-synchronised crossbred heifers were used in the study to avoid the possible confounding effects of lactation and NEB. Heifers (n=24) with a mean ± s.e. live weight of 441.5 ± 9.64 kg were blocked according to weight and body condition score (BCS) and randomly allocated to one of the three dietary treatments. Diet 1 (Control; n=8) consisted of chopped straw and concentrate in a 3:4 ratio on a DM basis, designed to allow an average daily gain of approximately 0.7 kg; Diet 2 (Whole soyabean (WSB); n=8) was similar to the control diet but with some barley replaced by WSB to give a dietary oil content of 2% of dry matter (DM); Diet 3 (Fishoil (FO); n=8) was also similar to the control diet but with the addition of fishoil at 2% DM. Diets were formulated to be isonitrogenous (14% CP) and heifers were individually fed using Calan Broadbent electronic individual feeders. Ovarian follicle dynamics were recorded from day 7 post-oestrus through to ovulation using trans-rectal ovarian ultrasonography. Corpus luteum diameter was also measured using ultrasonography at day 7 of the oestrous cycle. Blood samples for P_4 were taken on days 5, 6 and 7 and day 15 post-oestrus. Heifers were on the dietary treatments for three weeks before the measurement of the reproductive parameters was started. Data was analysed using repeated measures ANOVA and regression and correlation analyses as appropriate (SAS v.08, 2000).

Results

The effect of dietary treatment on production and reproduction variables is outlined in Table 1. Neither daily DM intake (DMI) nor average daily gain (ADG) was affected by dietary treatment ($P > 0.05$). Diet did not affect oestrous cycle length, dominant follicle growth rate or pre-ovulatory maximum diameter, CL diameter, or systemic P_4 on days 5, 6, 7 or 15 post oestrus ($P > 0.05$).

Table 1. Effect of diet on production and reproduction parameters in heifers (mean ± SE)

	Diet		
	Control	WSB	FO
DMI (kg/day)	7.19± 0.053	7.17 ± 0.070	7.07 ± 0.113
ADG (kg)	0.80 ± 0.167	0.67 ± 0.067	0.90 ± 0.105
Cycle length (days)	22.13 ± 0.950	20.00 ± 0.500	21.50 ± 0.730
Follicles			
DF growth rate (mm/day)	1.31 ± 0.130	1.53 ± 0.570	1.23 ± 0.240
DF diameter (mm)	14.55 ± 1.404	14.18 ± 0.640	14.21 ± 0.403
CL diameter (mm)	23.05 ± 0.990	21.43 ± 1.400	21.88 ± 1.530
P4 (ng/ml)			
Day 5	2.42 ± 0.377	2.07 ± 0.226	2.81 ± 0.305
Day 6	4.00 ± 0.498	3.67 ± 0.538	4.23 ± 0.361
Day 7	5.94 ± 0.748	5.80 ± 0.639	5.26 ± 0.318
Day 15	8.51 ± 0.884	8.05 ± 0.364	7.89 ± 0.572

DF = Dominant Follicle; CL = Corpus Luteum

Conclusion

The fatty acid enriched diets did not affect follicular dynamics, corpus luteum diameter or the concentration of systemic P_4 during the early luteal phase when it is related to embryo survival or the concentration of P_4 on day 15 when it is maximal. These results suggest that any enhancement of reproductive performance as a result of fatty acid inclusion in the diet is not mediated through changes in ovarian follicular dynamics or progesterone production. It is therefore possible that the mechanism by which dietary fatty acids affect cattle fertility is more likely to involve the synthesis and/or metabolism of prostaglandins.

References

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