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# The effect of body condition at calving and supplementation with *Saccharomyces cerevisiae* on energy status and some reproductive parameters in early lactation dairy cows

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ABSTRACT

Improving the energy status of dairy cows during the early post-partum (PP) period by adding a safe dietary supplement such as live yeast culture (YS) may have a positive effect on reproductive function. The objective was to examine potential benefits of YS supplementation on PP energy status and fertility indices of dairy cows managed to have low or high body condition score (BCS, 1–5 scale) at calving. Forty (10 primiparous and 30 multiparous) Holstein/Friesian dairy cows were blocked by yield, parity, BCS, and predicted calving date. Within each block, cows were randomly allocated to a $2 \times 2$ factorial arrangement of treatments which were: BCS at calving (low $\leq$3.5 or high $\geq$3.75; $n = 20$) and YS supplementation (2.5 g/cow/day for pre-calving and 10 g/cow/day for post-calving $\times 10^8$ CFU of *Saccharomyces cerevisiae*/g) (supplemented or control; $n = 20$). Daily milk yield was recorded and weekly milk composition, BCS and BW were assessed from calving to week 10 PP. Forage (100% grass silage pre-calving; 50% grass silage, 50% maize silage post-calving; *ad libitum*) intake was recorded individually. Concentrate (2 kg of pre-calver nuts $\pm$ YS for pre-calving and 8 kg of lactating nuts $\pm$ YS for post-calving) feeding was controlled individually. Estimated energy balance PP was calculated on a weekly basis individually as the difference between the net energy (NE) intake and the sum of NE for maintenance and milk production. Insulin and IGF-I concentrations were determined on days 14 and 7 pre-calving and 1, 5, 15, 25 and 35 post-calving. Daily ovarian ultrasonography was performed from day 10 PP to monitor the size and development of the first dominant follicle (>10 mm in diameter with absence of other large growing follicles), first ovulatory follicle and days to first ovulation PP. Pre-ovulatory peak of serum oestradiol concentration was determined during the 2 days before ovulation day. Cows with high BCS (over-conditioned) at calving ingested less NE, produced more milk NE output, and consequently had a significantly ($P < 0.05$) exacerbated negative energy balance in comparison with low BCS cows (moderately conditioned) during early lactation. Higher ($P < 0.05$) insulin concentrations and a tendency for higher ($P = 0.06$) pre-ovulatory peak oestradiol concentrations in low BCS group were detected in the early PP period. Supplementing the diet with YS had no effect ($P > 0.10$) on NE intake, NE milk output or energy balance. On the other hand it increased ($P < 0.01$) insulin concentration and tended to increase ($P = 0.07$) pre-ovulatory peak oestradiol concentrations and the size of first ovulatory follicle ($P = 0.09$) early PP. Feeding YS had no effect on energy status of lactating dairy cows with high or low BCS at calving, whilst it improved serum insulin concentration, pre-ovulatory peak of oestradiol and the size of first ovulatory follicle in the early PP period. These observed effects of YS supplementation require to be substantiated with further research.



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## 1. Introduction

High genetic merit dairy cows in early lactation do not consume sufficient feed to meet their energy requirements for maintenance and milk secretion. To cope with this shortfall in nutrient balance, fat and protein stored in body reserves are mobilized and used for required physiological functions. Consequently, most dairy cows enter into a period of negative energy balance (NEB) during the early post-partum (PP) period. Body condition score (BCS) at calving has been shown to have a marked effect on energy balance in early lactation (Garnsworthy and Topps, 1982; Wathes et al., 2007a). Furthermore, NEB during early lactation has a well documented deleterious effect on dairy cow reproductive performance (Beam and Butler, 1999; Butler, 2003; Wathes et al., 2007b). Thus, altering BCS at calving provides an opportunity to assess the effect of dietary supplements on NEB of differing severities within the same experiment.

Feed intake and efficiency of digestion are important determinants of energy status in early lactation and thus it is appropriate to investigate the effect of supplements that may improve energy balance and reproductive performance. One of these dietary supplements is the live yeast culture (YS) of the strain *Saccharomyces cerevisiae*$^{1026}$ which has been widely used to alter rumen fermentation and enhance ruminal digestive function. Most of the work with this supplement has been performed on fistulated dry cows or steers or even *in vitro*. On the other hand, results of the limited research conducted with dietary yeast supplement in dairy cows during the transition period have been inconsistent. Various studies have reported beneficial effects of YS supplementation on DMI, ration digestibility, and milk yield and composition (Wohlt et al., 1998; Robinson and Garrett, 1999; Dann et al., 2000). In contrast, others have found no significant benefits of YS supplementation (Robinson, 1997; Soder and Holden, 1999). Bruno et al. (2009a) reported no effect of YS on reproduction of multiparous cows under heat stress. However, no studies have investigated the effect of YS supplementation on reproductive performance in cows not under heat stress in component fed herds. Furthermore, no studies have determined if the effect of YS supplementation on dairy cow reproductive performance differs between cows with high BCS at calving (expected to have severe NEB) and cows with moderate BCS at calving (expected to have moderate NEB).

Therefore, the objectives of this experiment were, to investigate the effect of supplementing YS (*S. cerevisiae*$^{1026}$) to the diet of Holstein/Friesian dairy cows beginning at approximately 14 days pre-calving until day 70 of lactation on net energy (NE) intake, milk NE output, energy balance (EB) and some reproductive indices in dairy cows that have high or low BCS at calving.

## 2. Materials and methods

### 2.1. Animals and experimental design

All procedures involving animals were approved by the Animal Research Ethics Committee (University College Dublin) and conducted under experimental license from the Irish Department of Health and Children in accordance with the Cruelty to Animals Act 1876, and the European Communities (Amendment of Cruelty to Animals Act, 1876) Regulations, 1994, for the use of live animals in experiments. Forty (10 primiparous and 30 multiparous) Holstein/Friesian dairy cows were housed in free stall facilities equipped with a computerized individual feed intake recording system (Insentec B.V. Repelweg 10, 8316 PV Marknesse, Holland) and with *ad libitum* access to fresh water 21 days before their expected calving date until 70 days in milk (DIM). Cows were blocked by previous lactation 305-d milk yield, parity, BCS, and predicted calving date. Within each block, cows were randomly allocated to a $2 \times 2$ factorial arrangement of treatments approximately 60 days before parturition.

### 2.2. Treatments and feeding management

Treatments were imposed from day 14 pre-calving until day 70 of lactation. The main effects in this factorial experiment were: (1) BCS (1–5 scale) at calving (L for Low BCS, BCS $\leq$3.5 or H for High BCS, BCS $\geq$3.75; $n = 20$) and (2) feed supplementation with YS (Y for supplemented or C for control; $n = 20$).

All groups had *ad libitum* access to grass silage for the entire 60-day dry period and each group was supplemented with 2 kg/cow/day of a pre-calver concentrate containing thermo-stable (TS) live yeast cultures (2.5 g/cow/day $\times 10^8$ colony forming unit (CFU) of *S. cerevisiae*/g), or 2 kg/cow/day of a control pre-calver concentrate for the last 14 days pre-calving. After calving, cows had *ad libitum* access to a mixture of 50% grass silage and 50% maize silage. Lactating cow concentrate was fed in the milking parlour twice daily beginning with 4 kg/cow/day at calving and increasing stepwise by 0.5 kg/cow/day until a full allocation of 8 kg of concentrate per day was reached. Concentrates for Y group were supplemented with YS (10 g/cow/day $\times 10^8$ CFU of *S. cerevisiae*/g). The live yeast cultures used Yea-Sacc$^{1026}$ TS (Alltech, Inc., Nashville, KY, USA) which was composed of live yeast cells from the strain *S. cerevisiae*$^{1026}$ grown in batch cultures on a media of corn, molasses, malt and trace minerals. The result is a concentrated mixture of live yeast cells and cell metabolites produced during growth. The product is carefully dried to maintain viability (Alltech, Inc.). Ingredient and chemical composition of the feeds used are presented in Tables 1 and 2.

**Table 1**
Average chemical composition of grass and maize silage used.

| Item | Unit | Maize silage | Grass silage |
|---|---|---|---|
| DM | g/kg DM | 273 | 202 |
| CP | g/kg DM | 105 | 140 |
| pH | – | 39 | 40 |
| Ash | g/kg DM | 47 | 56 |
| NDF | g/kg DM | 454 | 483 |
| Starch | g/kg DM | 250 | – |
| DMD | g/kg DM | – | 745 |
| ME | MJ/kg DM | 11.1 | 10.7 |
| $NH_3$-N | % of total N | – | 7.6 |