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A Bovine Reproductive Physiology Model to Predict Interactions Between Nutritional Status and Reproductive Management

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This model has been developed within a multi-disciplinary project bringing together physiologists, veterinarians, modellers, and breeding industry experts with the aim to develop a realistic representation of bovine reproductive physiology able to accommodate the effects of known nutritional factors on reproduction. Three related modules have been developed: The first represents the axis of reproductive biology structures namely the hypothalamus, pituitary gland, ovary (follicle, oocyte and corpus luteum), and uterus together with the associated dynamic patterns of the major hormonal signals (GnRH, FSH, LH, oestrogen, progesterone, prostaglandins, and interferon tau). This model successfully recreates hormonal profiles through the different reproductive stages (postpartum anoestrus, oestrus cycling, and pregnancy). An example of an LH profile simulated by the model through 2 successive oestrus cycles is presented in Figure 1, relative to an observed profile. This module also simulates follicle waves with selection and ovulation (or not) of the dominant follicle. It also models the cross talk between the corpus luteum and uterus with respect to length of the luteal phase and embryonic loss (early or late) or maintenance of pregnancy. In the second module, oestrus expression behaviour is simulated. This is based on the hormonal profiles from the first module (mainly oestrogen) and incorporating other factors such as number of herd mates in oestrus. The third module represents reproductive management. In this module a wide range of reproductive management strategies can be represented in terms of their temporal structure both within day as time windows of oestrus observation and across lactation or calendar time as time windows of different reproductive actions. This module is designed to allow the impact of different reproductive management strategies on herd reproductive performance to be tested. At present, the reproductive physiology model has been shown to provide a realistic representation of hormonal profiles, follicle and corpus luteum dynamics, and hence normal reproductive performance measures. The next phase of this work (which will be carried out in a European Union funded project) will use the model to develop improved reproductive management tools that are urgently needed by the cattle industry.

Figure 1. Model generated and observed LH profiles (scaled to lie between 0 and 1) through 2 successive ovarian cycles.

