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# **Improving the Response to Synchronisation Programmes of Dairy Cattle**

A thesis presented in partial fulfilment of the requirement for the  
degree of

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**Science:**

If you don't make mistakes,  
you are doing it wrong.

If you don't correct those mistakes,  
you are doing it really wrong.

If you can't accept that you're mistaken,  
you are not doing it at all.

'Anonymous'

Dedicated to my loving parents

## Abstract

A gonadotrophin, prostaglandin, gonadotrophin + progesterone (GPG+P4) programme with fixed-time artificial insemination (FTAI) is the current recommended synchronisation programme for both heifers and anoestrous cows on New Zealand dairy farms. However, it is an expensive programme and a better understanding of the role of all of its components would be very useful in developing alternative cheaper programmes.

The two components of the programme that are the least understood, in terms of their underlying physiological actions and how they influence the outcome of synchronisation, are the Day 0 gonadotrophin-releasing hormone (GnRH) injection and the progesterone device. Additionally it is well known that energy status has a significant impact on fertility but there is little evidence, particularly under New Zealand conditions, of how energy status affects the response to GPG-based treatments in anoestrous postpartum dairy cows.

The effects of a GPG (Day 0: 100 µg GnRH, Day 7: 500 µg PGF<sub>2α</sub>, Day 9: 100 µg GnRH) programme upon follicular and luteal dynamics, ovulation synchronisation and patterns of oestradiol and progesterone secretion in postpartum anoestrous dairy cows and nulliparous dairy heifers were compared with (i) a GPG programme plus a progesterone insert from Days 0–7 (GPG+P4) and (ii) a GPG+P4 programme from which the first GnRH treatment had been omitted (P+G+P4). Interactions of each treatment with energy balance, as determined by NEFA, IGF-I and insulin concentrations, were also studied in postpartum anoestrus cattle. Finally the conception rate (CR) to fixed time AI of a GPG+P4 programme in which AI was done concurrent with the Day 9 GnRH injection (Cosynch) was compared with a progesterone + prostaglandin programme (P4+PG; Day 0–7: progesterone releasing intravaginal device, morning of Day 6: 500 µg PGF<sub>2α</sub>, afternoon of Day 9: FTAI) in heifers.

The physiological effects of the GPG and the GPG+P4 programmes were similar in anoestrous dairy cows. The inclusion of the Day 0 GnRH still appeared feasible in a GPG programme for treating anoestrous cows as it led to a higher probability of a corpus luteum (CL) on Day 7. In addition, treatment response was significantly affected by the postpartum duration and negative energy balance as evidenced by the significantly higher NEFA concentrations on Days 0, 7 and 9, and a lower insulin concentration on Day 0, in cows that failed to ovulate in response to the synchronisation protocol compared with cows that did ovulate. A clear and significant relationship between NEFA concentrations and ovulation in response to all synchronisation protocols showed that, regardless of the regimen that was used to treat anoestrus, the response was moderated and limited by the degree of negative energy balance.

In heifers, the removal of the progesterone-releasing device from a GPG+P4 programme had no effect on follicular dynamics or on the proportion of heifers which ovulated after either the GnRH injection on Day 0 or Day 9. Additionally, unlike the anoestrous cows, omitting the GnRH injection on Day 0 did not result in significantly delayed ovulation at the end of the programme, inasmuch as treatment with P+G+P4 was associated with earlier ovulation than GPG. Furthermore, synchronising heifers with a significantly less expensive programme (P4+PG) resulted in similar CR to synchronising with GPG+P4 (54.8% *versus* 52.4%, respectively) further confirming that Day 0 GnRH was not essential in heifer synchrony.

In conclusion, the higher conception rate in cows treated with a GPG+P4 programme rather than a GPG programme reported previously does not seem to be modulated by the actions on follicular dynamics and improved synchronised ovulation in dairy cattle with postpartum anoestrous (or in nulliparous heifers); however, the treatment response in anoestrous cows can be significantly affected by negative energy balance. In contrast, in dairy heifers, no benefit of Day 0 GnRH or the progesterone device in a GPG+P4 programme suggests the possibility of more cost effective options (e.g. P4+PG) which can lead to a CR as high as those synchronised using a GPG+P4 programme.

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