AN INSULIN-LIKE GROWTH FACTOR-1 (IGF-1) BASED VACCINE IMPROVES GROWTH RATE IN STEERS

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The need for low-cost strategies to improve growth rate and feed conversion efficiency (FCE) in extensively grazed cattle has seen the development of hormonal treatments which have three essential features: 1) they must be easily applied to the animal; 2) the treatment effect should be prolonged; and 3) the treatment must be acceptable to both domestic and international markets, leaving minimal or acceptable residue in the meat product. These requirements have led to the investigation of vaccination with hormones, and hormone-receptor compounds to improve growth and FCE.

In using this strategy, the immune system is stimulated to produce antibodies which will bind hormones or hormone receptors in the tissues. As a prolonged antibody response can be produced by giving two (or more) doses of a vaccine formulation containing only microgram amounts of the intended substance, the vaccination strategy is close to compliance with the three features listed above.

The hormone Insulin-Like Growth Factor-1 (IGF-1) is a potent stimulator of muscle growth, and is essential for normal growth and development (Pell and Bates 1988). The growth rate of laboratory animals can be improved by administering antibodies raised in sheep which were immunised with IGF-1 (Stewart \textit{et al}. 1993). In addition, these anti-IGF-1 antibodies increase the circulating pool of IGF-1 (Hill \textit{et al}. 1997), and their affinity for IGF-1 is close to the affinity of the receptor for the hormone (2 x 10\textsuperscript{8} L/mol, Stewart \textit{et al}. 1993). These appear to be important characteristics of growth-enhancing antibodies. Furthermore, antibodies raised in cattle have a similar affinity for IGF-1 to the growth-enhancing antibodies raised in sheep (Smith \textit{et al}. 1996). The aim of the present experiment was to determine whether vaccination with IGF-1 would improve growth-rate in cattle under extensive grazing conditions.

Steers (n = 7, mean liveweight 239 kg) were randomly allocated to a test or control group and grazed at pasture. Steers in the test group were given IGF-1 vaccine (150 mg IGF-1 conjugated to a carrier protein). The controls received saline. Each animal received a total of three vaccinations at four-weekly intervals. Steers were weighed weekly and a small blood sample was taken fortnightly for antibody analysis by indirect Enzyme-Linked Immunosorbent Assay (ELISA) using a standard protocol.

Six of the seven test animals responded to vaccination, producing antibodies against IGF-1 from week 6. Antibody titres were moderate (maximum titre 1200), with a mean titre of 310 during the period when antibody response was detected, weeks 6 to 12. Between weeks 0 and 6, there was no difference in the growth rates of the treated and control groups, however between weeks 6 and 12, the test group showed a higher weight gain than the controls (P = 0.05, one way analysis of variance), the test animals being approximately 4% or 11 kg heavier than the controls by week 12. The effective dose of antibodies is difficult to control. Only modest titres were evoked in the present study, however when the weight gain of the treated group was regressed against the sum of antibody titres (four samples per animal) the relationship was significant (P = 0.017, r\textsuperscript{2} = 0.72). This study has shown that it is possible to generate an immune response in cattle against IGF-1 and that during the period when antibodies were detected the growth rate of the treated cattle was greater than that of the controls. As we have previously shown that cattle antibodies raised against IGF-1 have properties which suggest that they will improve its growth-promoting actions, the present results indicate further investigation is warranted. This work was funded by the Central Queensland University (University Research Grants Scheme).