

## New Zealand Society of Animal Production online archive

This paper is from the New Zealand Society for Animal Production online archive. NZSAP holds a regular annual conference in June or July each year for the presentation of technical and applied topics in animal production. NZSAP plays an important role as a forum fostering research in all areas of animal production including production systems, nutrition, meat science, animal welfare, wool science, animal breeding and genetics.

An invitation is extended to all those involved in the field of animal production to apply for membership of the New Zealand Society of Animal Production at our website [www.nzsap.org.nz](http://www.nzsap.org.nz)

[View All Proceedings](#)[Next Conference](#)[Join NZSAP](#)

The New Zealand Society of Animal Production in publishing the conference proceedings is engaged in disseminating information, not rendering professional advice or services. The views expressed herein do not necessarily represent the views of the New Zealand Society of Animal Production and the New Zealand Society of Animal Production expressly disclaims any form of liability with respect to anything done or omitted to be done in reliance upon the contents of these proceedings.

This work is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](http://creativecommons.org/licenses/by-nc-nd/4.0/).



You are free to:

**Share**— copy and redistribute the material in any medium or format

Under the following terms:

**Attribution** — You must give [appropriate credit](#), provide a link to the license, and [indicate if changes were made](#). You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.

**NonCommercial** — You may not use the material for [commercial purposes](#).

**NoDerivatives** — If you [remix, transform, or build upon](#) the material, you may not distribute the modified material.

<http://creativecommons.org.nz/licences/licences-explained/>

## The effect of immunological castration on behaviour and growth of young bulls

J.G. JAGO<sup>1,5</sup>, R.R. LASENBY<sup>2</sup>, T.E. TRIGG<sup>3</sup>, P.D. CLAXTON<sup>4</sup>, L.R. MATTHEWS<sup>2,5</sup> AND J.J. BASS<sup>2</sup>

<sup>1</sup> University of Waikato, Biology Department, Hamilton, New Zealand.

### ABSTRACT

This study aimed to raise GnRH antibodies in young bulls (immunocastration) and determine the subsequent effect on behaviour, sexual development, carcass characteristics and meat quality. Thirty Friesian bull calves were assigned to one of three groups balanced by liveweight (control bulls, immunocastrates and steers). At nine months of age (Day 0) immunocastrates were vaccinated against GnRH (Vaxstrate) and boosted one month later (Day 31). Following immunisation there was a rise in GnRH antibody titre and a decrease in testosterone. Control animals gained significantly more weight than immunocastrates and steers in the first 157 days. Overall there was no difference in weight gain between controls and immunocastrates. Mean scrotal diameter of immunocastrates decreased from Day 31 to Day 110 and then rose to reach a diameter similar to those of the control bulls by Day 322. Leg wear scores were lower for treated animals compared to controls until Day 230 of the trial, although these differences were not significant. Immunocastrates had a significantly higher mean ultimate pH than both control bulls and steers. Bulls were significantly leaner than immunocastrates, and both groups were leaner than steers.

**Keywords:** Immunological castration; bull behaviour; meat quality; growth.

### INTRODUCTION

Bulls grow more rapidly with improved feed conversion efficiency and produce leaner and heavier carcasses with better conformation scores and lower fat scores than steers (Field, 1971). However, the sexual and social behaviour of bulls can cause problems during handling. During preslaughter handling these behavioural characteristics contribute to poorer quality meat that is darker in colour and has a higher ultimate pH than steers (Price and Tennessen, 1981; Graafhuis, 1994).

Castration of young male cattle reduces sexual and aggressive behaviour. Testicular function and in particular testosterone is therefore thought to be implicated in bull behaviour. Testosterone is regulated by the gonadotropins, predominantly luteinizing hormone (LH), secreted from the anterior pituitary, which is itself regulated by the secretion of gonadotropin-releasing hormone (GnRH) from the hypothalamus. An alternative to traditional methods of castration is immunocastration. With this method the release of gonadotropins, LH and follicle stimulating hormone (FSH), are prevented by antibodies induced by active immunisation inhibiting GnRH. In the male this results in a reduction in FSH, LH and testosterone secretion, involution of the testes, an arrest of spermatogenesis and a reduction in male secondary sex characteristics (Robertson et al., 1979; Finnerty et al., 1994). The objective of this study was to raise GnRH antibodies in young bulls through immunocastration and determine the effect on subsequent bull behaviour, sexual development, carcass characteristics and meat quality.

### MATERIALS AND METHODS

Thirty Friesian bull calves were assigned to one of three groups of 10 animals balanced by liveweight. One group

(Steers) was surgically castrated at four months of age. At 9 months of age (Day 0) a second group (Immunocastrates) was vaccinated against GnRH (Vaxstrate, Peptech Australia) and given a booster immunisation at Day 31. The third group (Controls) remained intact and served as controls.

The animals were routinely weighed from Day 0 until slaughter. The diameter of the scrotal sack (at the widest point) was measured and blood samples collected from all animals by tail vein venipuncture at 4 weekly intervals throughout the trial. The blood was centrifuged and the plasma stored at -20°C until assayed. Sexual behaviour was assessed by scoring hair and skin wear (0 - no wear, 5 - abraded skin) on the inside of the front legs (as a marker of riding) and wear on the pin bones of the pelvis (as a marker of being ridden).

Prior to slaughter animals were held overnight in their treatment groups in separate pens and their behaviour monitored by video. The incidences of mounting were recorded. Preslaughter liveweight, hot carcass weight (HCW), muscle ultimate pH<sub>24</sub>, fat depth (over the 12th rib), colour (values expressed as Hunter L, a, b) and eye muscle area were measured.

Plasma testosterone concentrations were measured using an in house indirect radioimmunoassay. Intra-assay CV were 11.4%, 8.6% and 7.8% for three samples containing 2.5, 5.5 and 11 ng/ml testosterone, respectively. Inter-assay variation for the same three samples were 14.5%, 8.3% and 7.7% respectively. Assay sensitivity was 0.20 ng/ml. Antibody titres were determined by specific hormone binding at different antibody dilutions at 50% binding of the tracer and expressed as logs calculated by cpm x dilution factor.

Data were analysed by ANOVA (Genstat) with log transformation when not normally distributed. For testosterone concentrations and antibody titres all data were analysed separately for each sampling date. Liveweight gain was ana-

<sup>2</sup> AgResearch, Ruakura Agricultural Centre, Private Bag 3123, Hamilton, New Zealand.

<sup>3</sup> Peptech (Australia), Peptide Technology Limited, P.O. Box 444, N.S.W., Australia.

<sup>4</sup> Websters, Baulkan Hills, N.S.W., Australia.

<sup>5</sup> Animal Behaviour and Welfare Research Centre, Hamilton, New Zealand.

lysed over three periods: Day 0 - 157 (when immunocastrates were gaining weight at a slower rate compared to control bulls), and Day 157 - 413 (when the immunocastrates were gaining more weight relative to controls) and for the entire experimental period (day 0 - 413). Scrotal diameter data were analysed over three periods: Day 0 - 110 when immunocastrates were decreasing; Day 110 - 413 when immunocastrates were increasing; and over the control experimental period (Day 0 - 413). Fat depth and eye muscle area data were adjusted for HCW. Significance levels were set at  $P < 0.05$ .

## RESULTS

Immunisation against GnRH successfully stimulated specific antibodies in immunocastrates. The mean GnRH antibody titre for immunocastrates rose from Day 0, reached a peak at Day 45 and was still significantly higher than control animals at Day 273. Fig 1a shows that the plasma testosterone concentrations of immunocastrates decreased to the levels of steers by Day 45. From Day 110 testosterone levels increased until Day 292 when levels were similar to control bulls. The mean scrotal diameter (Fig 1b) of immunocastrates decreased from Day 31 to 110 then increased to that of control bulls by Day 322.

Leg wear scores for immunocastrates were lower but not significantly different from controls until Day 238. Dur-

ing lairage, immunocastrates displayed significantly more mounting behaviour than either bulls or steers (mean number of mounts over 17.5 hours; immunocastrates, 56; controls, 28; steers, 2;  $SED = 11.4$ ,  $p < 0.05$ )

Liveweight gain data are presented in Table 1. The control animals gained significantly more weight than immunocastrates and steers during the first 157 days. From Day 157 until slaughter immunocastrates had nonsignificantly higher weight gains than controls and gained significantly more weight than steers. There was no difference in weight gain between controls and immunocastrates from Day 0 to slaughter.

**TABLE 1.** Liveweight gain (kg) over three periods for controls, immunocastrates and steers. Values presented are means and standard errors of differences (SED).

| Period (Days) | Liveweight gain (kg) |                    |                  | SED  |
|---------------|----------------------|--------------------|------------------|------|
|               | Controls             | Immunocastrates    | Steers           |      |
| 0 - 157       | 181 <sup>a</sup>     | 144 <sup>b</sup>   | 154 <sup>b</sup> | 6.3  |
| 157 - 433     | 117 <sup>a,b</sup>   | 132 <sup>a</sup>   | 100 <sup>b</sup> | 9.6  |
| 0 - 433       | 298 <sup>a</sup>     | 276 <sup>a,b</sup> | 254 <sup>b</sup> | 11.6 |

<sup>a,b</sup> Values within rows with different superscripts are significantly different ( $P < 0.05$ )

Carcass composition and meat quality data are presented in Table 2. There were no differences between bulls and immunocastrates for HCW, dressing percent and eye muscle area. Bulls were significantly leaner than immunocastrates, and both groups were leaner than steers. There was no difference in lightness (L) values for meat samples from the three groups. Immunocastrates had a significantly higher mean  $pH_u$  (6.01) than both control bulls (5.69) and steers (5.47).

**TABLE 2.** Effect of sex-type (immunocastrates, control bulls and steers) on carcass composition and meat quality. Values presented are means and standard errors of differences (SED).

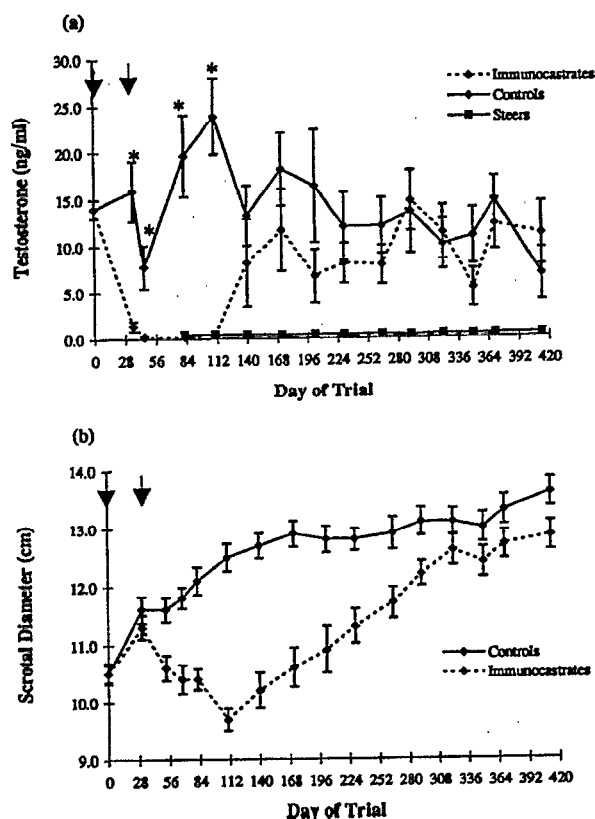
| Factor                      | Controls           | Immunocastrates    | Steers             | SED   |
|-----------------------------|--------------------|--------------------|--------------------|-------|
| <b>Carcass Composition</b>  |                    |                    |                    |       |
| Final                       |                    |                    |                    |       |
| Liveweight (kg)             | 553.9 <sup>a</sup> | 524.8 <sup>b</sup> | 485.6 <sup>c</sup> | 12.55 |
| HCW (kg)                    | 325.1 <sup>a</sup> | 312.1 <sup>a</sup> | 281.8 <sup>b</sup> | 8.81  |
| Dressing Out (%)            | 58.7 <sup>a</sup>  | 59.5 <sup>a</sup>  | 58.0 <sup>a</sup>  | 0.82  |
| Eye Area (cm <sup>2</sup> ) | 77.5 <sup>a</sup>  | 79.2 <sup>a</sup>  | 67.1 <sup>a</sup>  | 5.06  |
| Fat depth (mm)              | 1.2 <sup>a</sup>   | 2.6 <sup>b</sup>   | 6.7 <sup>c</sup>   | 1.07  |
| <b>Meat Quality</b>         |                    |                    |                    |       |
| Colour L                    | 32.15 <sup>a</sup> | 30.84 <sup>a</sup> | 32.54 <sup>a</sup> | 0.87  |
| a                           | 8.58 <sup>a</sup>  | 6.94 <sup>b</sup>  | 10.08 <sup>a</sup> | 0.73  |
| b                           | 4.99 <sup>a</sup>  | 3.93 <sup>b</sup>  | 6.26 <sup>c</sup>  | 0.46  |
| $pH_u$                      | 5.69 <sup>a</sup>  | 6.01 <sup>b</sup>  | 5.47 <sup>c</sup>  | 0.11  |

<sup>a,b,c</sup> Values within rows with different superscripts are significantly different ( $P < 0.05$ )

## DISCUSSION

The dramatic increase in GnRH antibody titre following immunisation indicated that a specific immune response had been developed. This was associated with decreased plasma testosterone concentrations and smaller scrotal diameter. The

**FIGURE 1.** (a) Mean (s.e.m) testosterone concentration over time for control bulls, immunocastrates and steers. \* indicates significant differences between the control bulls and both immunocastrates and steers ( $P < 0.05$ ) (b) Mean (s.e.m) scrotal diameter for control bulls and immunocastrates. Arrows indicate primary and booster immunisations on day 0 and day 31 respectively.



titres remained high even when testosterone and scrotal diameter were recovering, which is consistent with that reported by Finnerty et al., (1994). This may be explained by a loss of immunoneutralising capacity attributed to an increase in GnRH production because of a lack of negative feedback from testosterone. The increased GnRH may saturate the circulating antibodies which would result in increased plasma testosterone concentrations and increasing scrotal diameter.

Liveweight gain decreased following immunisation and this is consistent with results of Enright et al., (unpublished data) and may be associated with a general adverse response to the antigen and adjuvant. Subsequently immunised bulls increased their weight gain relative to entire bulls such that there was no difference in weight gain over the trial period.

The immunocastrates showed a tendency (non significant) for lower leg wear scores than control bulls at a time when they had reduced testosterone concentrations and smaller scrotal diameters than control animals. The higher incidence of mounting by immunocastrates while in lairage could be attributable to increasing levels of testosterone stimulating sexual behaviour. The higher pH<sub>u</sub> of immunocastrates is likely to have been caused by the higher levels of mounting observed during lairage.

Immunocastration allows male cattle to achieve growth rates similar to entire bulls while avoiding some of the undesirable behaviour of bulls. However it appears that the effect is temporary when immunised at 9 months of age therefore multiple booster immunisations may be required

for effective long-term control of behaviour on farm and during preslaughter handling.

## ACKNOWLEDGMENTS

We thank Websters, Youngs Animal Health and Peptide Technology (Australia) for donation of the anti-GnRH vaccine (Vaxstrate) and assay of GnRH antibody titres, Mr Arie Graahuis for assistance with the meat quality analysis and Neil Cox for the statistical analysis. We are grateful to Ken McLean and Ken Jones for animal management. During this work J. Jago was a recipient of a University of Waikato post-graduate scholarship.

## REFERENCES

- Field, R.A. 1971. Effects of castration on meat quality. *Journal of Animal Science.*, **32**: 849-858.
- Finnerty, M., Enright, W.J., Morrison, C.A. and Roche, J.F. 1994. Immunisation of bull calves with a gonadotropin-releasing hormone-human serum albumin conjugate: effect of conjugate dose, type of adjuvant and booster interval on immune, endocrine, testicular and growth responses. *Journal of Reproduction and Fertility.*, **101**: 333-343.
- Graahuis, A. 1994. Incidence of high pH beef and lamb II: Results of an ultimate pH survey of beef and sheep plants in New Zealand. *Proceedings of the 28th Meat Industry Research Conference.*, p133-141.
- Price, M.A., and Tennessen, T. 1981. Preslaughter management and dark-cutting in the carcasses of young bulls. *Canadian Journal of Animal Science.*, **61**: 205-208.
- Robertson, I.S., Wilson, J.C. and Fraser, H.M. 1979. Immunological castration in male cattle. *Veterinary Record.*, **105**: 556-557.