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Summary Only

A BIOPSY STUDY OF GROWTH AND DEVELOPMENT OF MUSCLE

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A MUSCLE BIOPSY TECHNIQUE was described for studying histological and chemical changes in *m. semitendinosus* of steers. The technique was employed in a factorial experiment where the effects of an implanted oestrogenic hormone—hexoestrol—and the biopsy procedure were studied in two-year-old and six-year-old Aberdeen Angus steers.

The diameters of 75 individual muscle fibres were measured from each sample, obtained from the left side of the animal at the commencement of the trial and from the right side at the end of treatment.

Biopsy had no significant effect on the liveweight gain of steers over the treatment period of approximately three months, although there was evidence of an immediate post-operative effect in the six-year-old steers. Increase in liveweight gain owing to implantation of 60 mg hexoestrol in the two-year-old steers was highly significant for the whole treatment period; implantation of 90 mg hexoestrol in the six-year-old steers resulted in a significant increase in liveweight gain only in the second half of the treatment period.

Mean muscle fibre diameter in the two-year-old steers was 50.3 microns in the pre-treatment control samples and 51.7 microns in the pre-treatment samples of steers treated with hexoestrol. These means increased by 46.4 per cent. and 42.3 per cent. respectively during the treatment period, but were of doubtful significance, and the range of fibre diameter also increased greatly.

In the six-year-old steers the mean muscle fibre diameter of pre-treatment samples from the control group was 65.6 microns and in the hexoestrol-treated group 75.2 microns. There was a significant increase in mean muscle fibre diameter during the treatment period of 3.6 per cent. for the control group and 4.6 per cent. for the hexoestrol-treated group. The range of muscle fibre diameter did not increase greatly.

Implantation with hexoestrol significantly increased muscle fibre diameter only in the six-year-old steers.

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DISCUSSION

Q.: What change occurred in the weight of subcutaneous fat from the initial and final biopsy samples?

A.: Subcutaneous fat deposition was decreased in the biopsy area owing to treatment with hexoestrol. This decrease was more apparent in the six-year-old steers than in the younger cattle but the response was more variable. In both age groups there were treatment differences in the weight of fat from the initial samples. These differences may have been due to inefficient trimming of the biopsy samples or, more likely, due to the inability to allocate animals successfully to treatment on a subjective assessment of fatness.

Q.: The effects of muscle biopsy and hexoestrol implantation have been assessed in terms of liveweight gain; a more important consideration is the effect upon carcass weight. With implants of hexoestrol and stilboestrol in lambs in Australia, an increase in liveweight gain was obtained from the treatment but there was no effect upon carcass weight. What were the effects upon carcass weight in these trials?

In the six-year-old cattle there appeared to be a significant difference in the mean muscle fibre diameter of initial samples between the control + biopsy and hexoestrol + biopsy treatments. Can this fact be commented upon?

A.: Employing liveweight gain as a criterion of treatment effects is a valid criticism of these trials, as well as many others. However, throughout all this work the animals have been weighed at a time of sunrise + 3 hours in order to give comparable liveweights. This weighing procedure follows upon the work of Tayler in Great Britain who studied grazing behaviour in relation to liveweight and found that this time of weighing was the least affected by gut-fill. A recent study of grazing behaviour of beef cattle at Ruakura has shown the grazing behaviour pattern to be similar to that reported in Britain and, although the work needs verifying in New Zealand, it seems reasonable to adopt Tayler's suggestions.

With regard to carcass weight, there was a significant increase of some 20 to 25 lb owing to hexoestrol implantation in both age groups of cattle. Biopsy, on the other hand, did not significantly affect carcass weight. Dressing-out percentage was about 1 per cent. less in the hormone-treated cattle so that the treatment differences in terms of liveweight were reduced in terms of carcass weight.

Hexoestrol implants of 15 mg and 30 mg in two-tooth wethers at Ruakura increased liveweight gain slightly but did not affect carcass weight.

No reasonable explanation can be offered for the difference in mean muscle fibre diameter of the initial biopsy samples from the six-year-old steers although it does emphasize the variability that was encountered. In any event, this difference has been catered for by employing analysis of covariance in the examination of treatment effects. It would be preferable in future work of this type to allocate animals to treatment on the basis of results obtained from initial biopsy samples. Unfortunately, this approach is precluded at present by the slow, laborious techniques available for measuring muscle fibres.

Q.: *Did hormone implantation have any effect on the marbling of the meat?*

A.: Chemical analysis of the biopsy samples from the *semitendinosus* muscle revealed a decrease in the deposition of intramuscular fat, or marbling, owing to hexoestrol implantation. Analysis of many other muscles shows a varying effect of hormone implantation upon marbling dependent upon age, the degree of post-natal development of the muscle, and upon the dosage rate of the hormone.

Q.: *Trials with hexoestrol in the Gisborne area have produced a 20 to 25 lb increase in carcass weight. Were there any effects of hormone treatment on carcass composition?*

A.: Yes. Considering first the steers in this present trial: five steers from each of the non-biopsied control and hexoestrol treatments in the two age groups—*i.e.*, a total of 10 steers for each age group—were dissected on an individual muscle basis. In the six-year-old cattle, treatment with hexoestrol produced 3 per cent. extra muscle; certain muscles of the neck, shoulder, shoulder girdle and round were the most affected. There was also 1 per cent. of extra bone but some 3 per cent. less fat in the treated carcasses. These effects were not apparent, to the same degree, in the two-year-old steers.

Secondly, groups of steers which had been implanted with two dosage levels of hexoestrol and subjected to fluctuating winter nutritional conditions were marketed as boneless beef. The hormone-treated steers added an extra 35 lb in carcass weight and there proved to be about an extra 30 lb, or over 3 per cent., edible meat. This term of "edible meat" included muscle, some intermuscular fat and, to a lesser extent, some subcutaneous fat. Fat trimmings were reduced by treatment but bone content was slightly increased. An analysis of the regional effects of the hormone implantation has not yet been made but the wholesale edible meat cuts which showed the most obvious increases included parts of the neck and the buttock.

Q.: *Were any other dimensions of the muscle fibres obtained and what was the variation in the diameter of muscle fibres?*

A.: Only the diameters of the muscle fibres were measured; determination of the length of individual fibres is a very difficult task and was not attempted here. The number of muscle fibres per primary fasciculus or bundle were counted from frozen sections and there appeared to be no significant difference between the two age groups nor was there any effect upon the number over the treatment period. By considering the effects of hexoestrol upon fibre diameter in relation to the number of fibres per bundle, it is possible to estimate the effect upon the texture of the muscle.

An indication of the variation in the diameter of muscle fibres was given in the histograms.