# THE EFFECT OF COMPENSATORY GROWTH IN PIG ON THE PROTEOLYTIC POTENTIAL AND MEAT TENDERNESS

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## Background

Tenderness is one of the most important aspects of the eating quality of meat and the post mortem tenderisation process is believed to be caused by proteolytic degradation of structural proteins in the muscle. The sarcoplasmic calpain-calpastatin system have been suggested to participate in this tenderisation process. In living animals the calpain system is believed to be involved in the protein turnover which occur during muscle growth. The concentration and activity of enzymes and enzyme inhibitors are regulated by a wide range of both generic and environmental factors such as feeding and growth rate. It has been known for decades that accelerated growth rates occur in pigs having free access to feed following a period of restricted feeding. The accelerated growth rate is termed "compensatory growth". Fast-growing muscles necessarily have to be remodelled at a faster rate than slow-growing muscles, i.e. fast-growing muscles must have a higher net protein assembly than slow-growing muscles. Therefore, variations in the amount or activity of proteolytic enzymes may occur between fast- and slow-growing muscles. How these variations affect post-mortem proteolysis and thereby the final tenderness of meat is not known.

## Objective

The objectives of the study are to elucidate the effect of compensatory growth on the proteolytic potential of the calpain system in pork and to investigate the effect of compensatory growth on final meat tenderness. This approach is taken in order to evaluate whether compensatory growth can be used to increase the general eating quality of pork.

## Methods

Ten litters of 4 female pigs were allocated to four treatment groups (table 1). From weaning at day 28 to day 90 the pigs were divided into two groups which were fed either restrictively or ad lib fed. The two groups were then divided into two sub-groups which either were fed restrictively or ad lib fed from day 91 to slaughter at day 150. This design is in accordance with a 2 by 2 factorial design. Seven litters have been slaughtered and samples from five litters have been analysed for tenderness and activity of μ-calpain, m-calpain and calpastatin. Samples from the longissimus muscle were frozen 45 minutes after slaughter in liquid nitrogen and afterwards stored at -80°C until analysed for μ-calpain, m-calpain and calpastatin. Calpastatin activity was determined according to Ertbjerg et al. (1999), and μ-calpain and m-calpain were determined according to Geesink & Koohmaraie (1999) with minor modifications. The tenderness of the longissimus muscle was determine after 1 day and 4 days ageing at 4°C using a standard Warner-Bratzler shear force measurement.

| Age (days) | Group 1 | Group 2 | Group 3 | Group 4 |
|---|---|---|---|---|
| 28 - 90 | Ad libitum feeding<br>*44.8 +/- 8.0*<br>*n = 14* | | Restricted feeding<br>*41.0 +/- 3.6*<br>*n = 14* | |
| 91 - 150 | Ad libitum<br>*113.8 +/- 10.7*<br>*n = 7* | Restricted<br>*99.6 +/- 9.1*<br>*n = 7* | Ad libitum<br>*114.8 +/- 7.7*<br>*n = 7* | Restricted<br>*100.0 +/- 9.4*<br>*n = 7* |

**Table 1.** Treatment groups. In italics: animal weight at end of feeding period (kg +/- SD)

## Results and discussion

Compensatory growth was achieved in the treatment group fed restrictively from day 28 to day 90 followed by ad lib feeding until slaughter at day 150 (treatment group 3, table 1). Slaughter weight was significantly lower in group 2 and 4, which were restrictively fed from day 91 to slaughter, compared to pigs fed ad libitum in the same period. No significant difference in slaughter weight was observed between group 1 and 3, and between group 2 and 4.

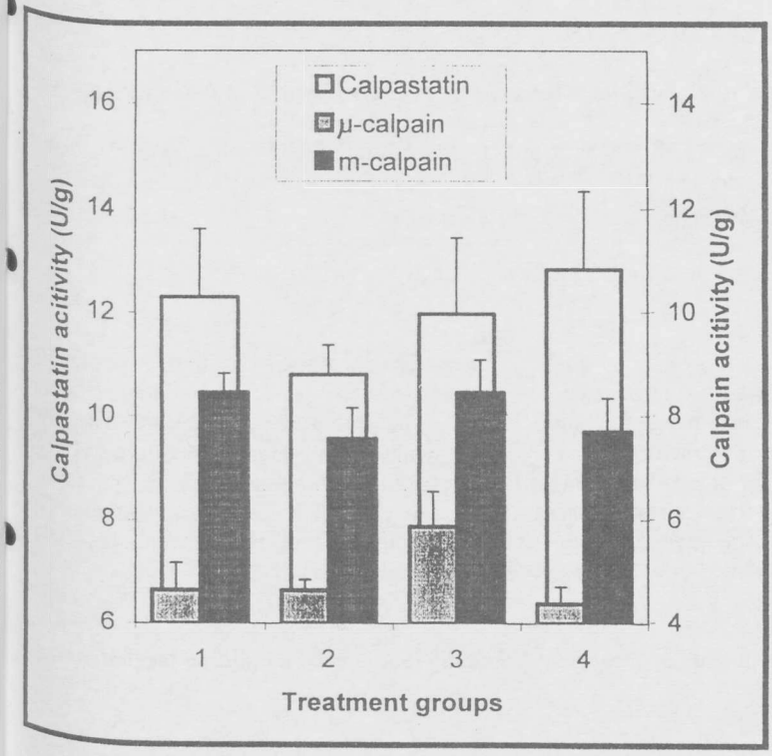


**Figure 1.** Activity of μ-calpain, m-calpain and calpastatin in pig longissimus dorsi at 45 minutes after slaughter. Activities were determined in duplicate on each pig. Bars represent the average of five pigs. Error bars indicate standard error of the mean.

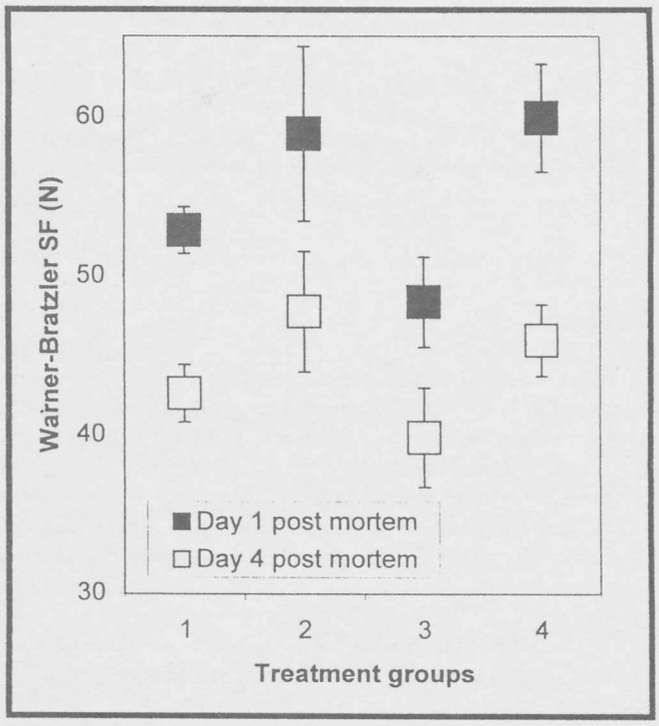


**Figure 2.** Tenderness of pig longissimus dorsi at 1 day and 4 days PM. A standard Warner-Braztler shear force method was used. Points represent the average of five pigs. Error bars indicate standard error of the mean.

The activity of m-calpain was higher ($p = 0.10$) in pigs fed ad-libitum from day 91 to day 150 compared to pigs fed restrictively in the same period (figure 1). The activity of μ-calpain was higher in group 3 than in group 1 ($p = 0.09$) and group 2 ($p = 0.03$) and 4 ($p = 0.005$). No significant differences between treatment groups were found for calpastatin activity.

Tenderness 1 day post mortem (PM) was higher ($p = 0.06$) in pigs fed ad-libitum from day 91 to day 150 compared to pigs fed restrictively in the same period (figure 2, group 1 and 3). At 4 days PM the difference in tenderness between ad libitum fed and restrictively fed pigs was less, but the same trend as day 1 PM could still be observed (treatment group 1 and 3 versus 2 and 4). There was a tendency for treatment group 3 (pigs showing compensatory growth) to produce the most tender meat both at 1 day and 4 days PM. This suggests that the accelerated muscle growth occurring in pigs during compensatory growth are followed by changes in the activities of proteolytic enzymes which, in turn, could have an effect on the tenderness development after slaughter. This interpretation is supported by the observation that treatment group 3 (compensatory growth) showed the highest activity of μ-calpain as compared to the other three groups.

## Conclusion

Compensatory growth had a positive influence on meat tenderness. This result suggests that it might be possible to increase the tenderness of pork using a compensatory growth strategy compared to meat from pigs with a traditional growth strategy. Compensatory growth could therefore be a method to increase the eating quality of pork. Pigs showing compensatory growth had an increased proteolytic potential which might explain the increased tenderness observed.

## References

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