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# Effects of dietary beta-agonist treatment, Vitamin $D_3$ supplementation and electrical stimulation of carcasses on meat quality of feedlot steers

# Introduction

- The current classification system is utilized for:
  - The description of specific requirements when purchasing carcasses
  - The utilisation of variety in the market with a view to optimum consumer satisfaction
  - utilisation of price differences and to determine selling prices.

- The current system classifies meat by:
  - Age of the animal
  - Fatness
  - Conformation

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- A-age animals are considered to be the most tender and meat from A-age animals is sold for more.

- In reality this is not always the case as many other factors other than age can affect tenderness.

- These factors include both pre- and post-slaughter manipulation:
  - use of beta-agonists
  - Supplementation
  - controlled electrical stimulation of carcasses

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- Most South African feedlots supplement with a beta adrenergic-agonist (hereafter referred to as beta-agonists).

- The beta-agonist zilpaterol is one of the most commonly utilised beta-agonists in commercial beef production.

- Beta-agonists improve rate of gain, feed efficiency and increase carcass meat yield efficiency.

- Both the producer and consumer could benefit as meat becomes less expensive to produce.

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- Beta agonists are known to affect the aging potential of beef muscle negatively by increasing the activity of the enzyme calpastatin.

- This results in the production of tougher meat.

- Both controlled electrical stimulation of carcasses as well as the supplementation of ultra-high levels of vitamin $D_3$, for short periods before slaughter, could enhance the aging potential of beef and alleviate this problem.

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# Materials and Methods

- One hundred and twenty Bonsmara steers.
- Six treatment groups:
  - Control group which received the feedlot diet only.
  - Five remaining groups were all supplemented with zilpaterol hydrochloride (0.15mg/kg live weight for 30 days and withdrawn 4 days prior to slaughter).
  - One of the five groups only received zilpaterol.
  - The remaining four groups received zilpaterol and vitamin $D_3$ at the following levels and durations prior to slaughter:
    - $7 \times 10^6$ IU/animal/day for 3 days (3D7M)
    - $7 \times 10^6$ IU/animal/day for 6 days (6D7M)
    - $7 \times 10^6$ IU/animal/day for 6 days followed by 7 days of no supplementation (6D7M7N)
    - $1 \times 10^6$ IU/animal/day for 9 days prior to slaughter (9D1M)

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- Carcasses were split and the left sides electrically stimulated (ES) for 30s within 30 min of killing and the right sides were not electrically stimulated (NES).

- All samples were collected from the *M. Longissimus lumborum.*

- pH and temperature measurements were taken every hour for 4 hours and a final measurement was taken at 18 hours *post mortem*.

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**The following tests were conducted:**

- Warner Bratzler shear force (WBSF) measurements at 3 and 14 days *post mortem*.
- Myofibril fragment length (MFL) at 3 and 14 days *post mortem*.
- *μ*-calpain, m-calpain and calpastatin activity at 1 hour and 24 hours *post mortem*.
- Sarcomere lengths at 24 hours *post mortem*.

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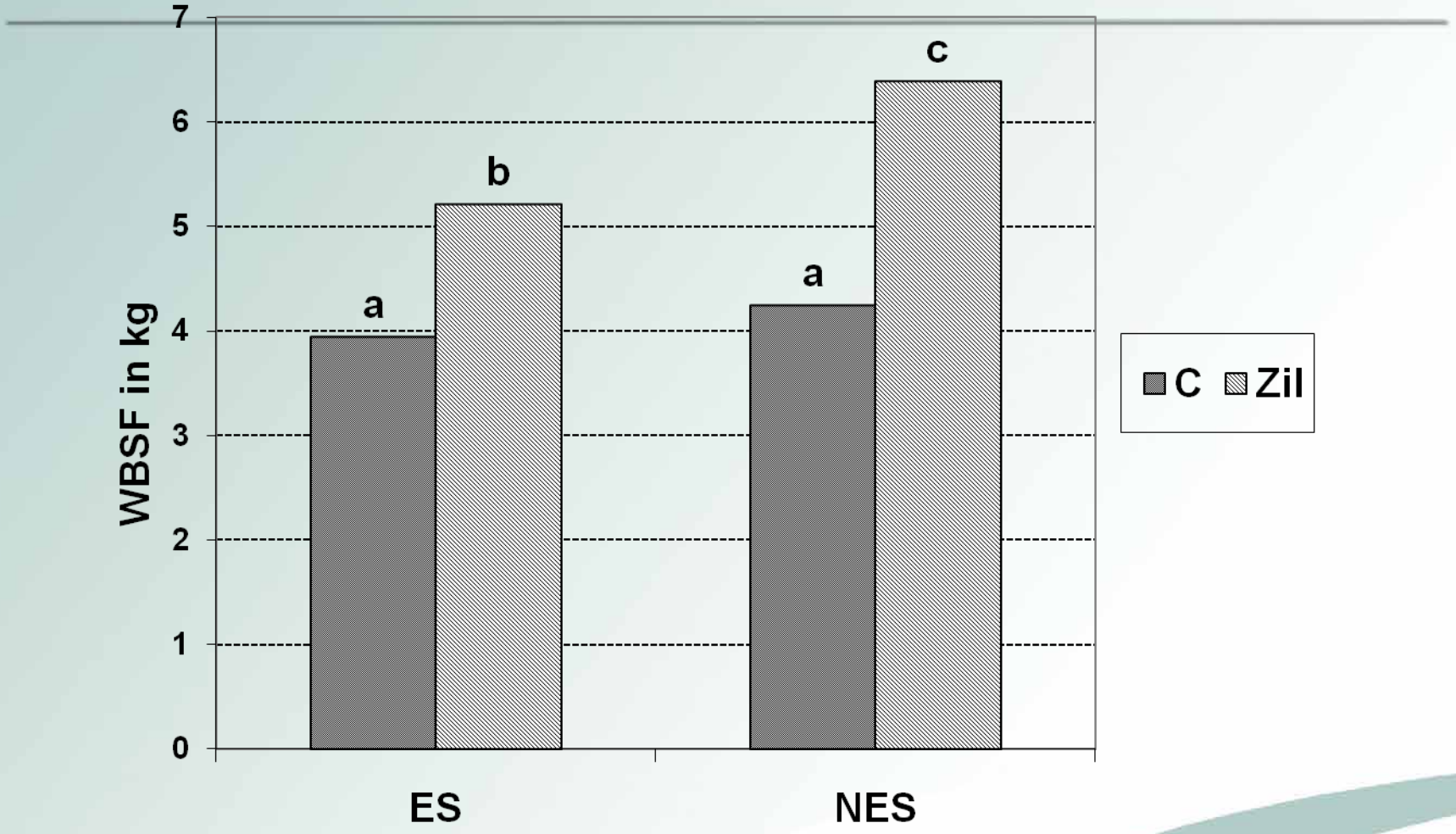


- **Fig. 1.** Interaction between treatment and ES in relation to WBSF (*P* = 0.003). (Bars with different superscripts differ significantly).

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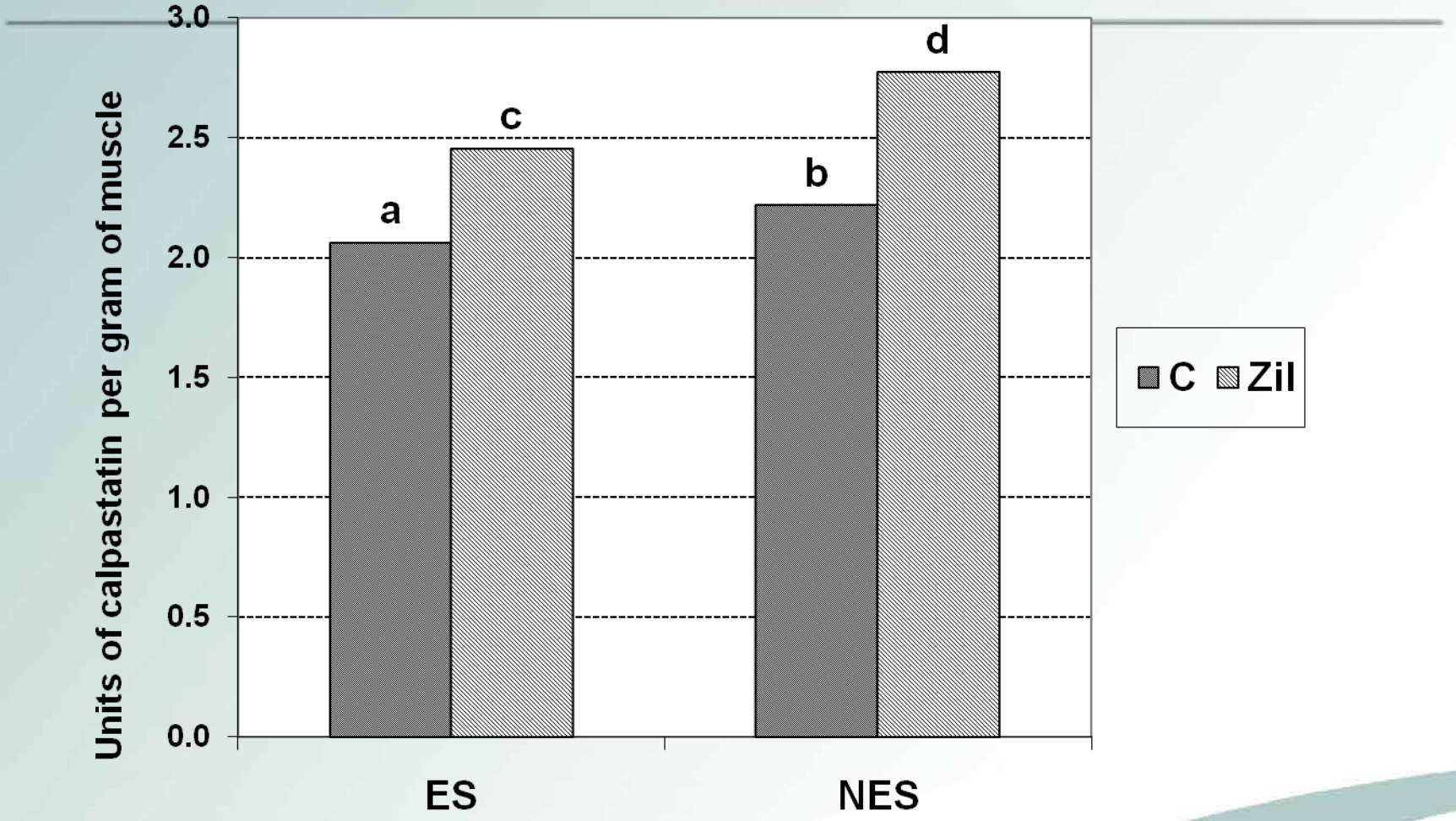


- **Fig. 2.** Interaction between treatment and ES in relation to calpastatin activity (*P* = 0.015). (Bars with different superscripts differ significantly).

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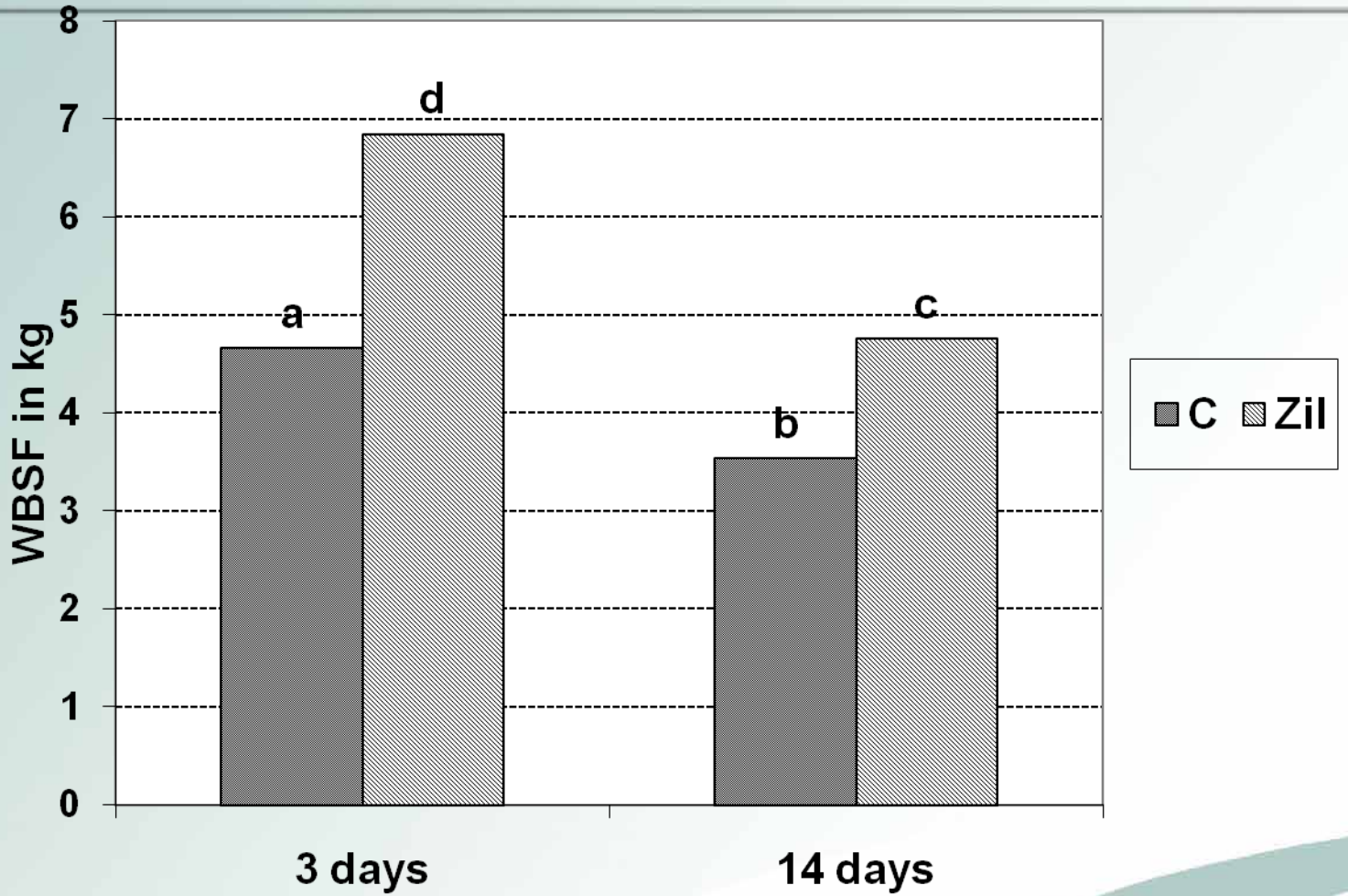


- **Fig. 3.** Interaction between treatment and *post mortem* aging in relation to WBSF ($P < 0.001$). (Bars with different superscripts differ significantly).

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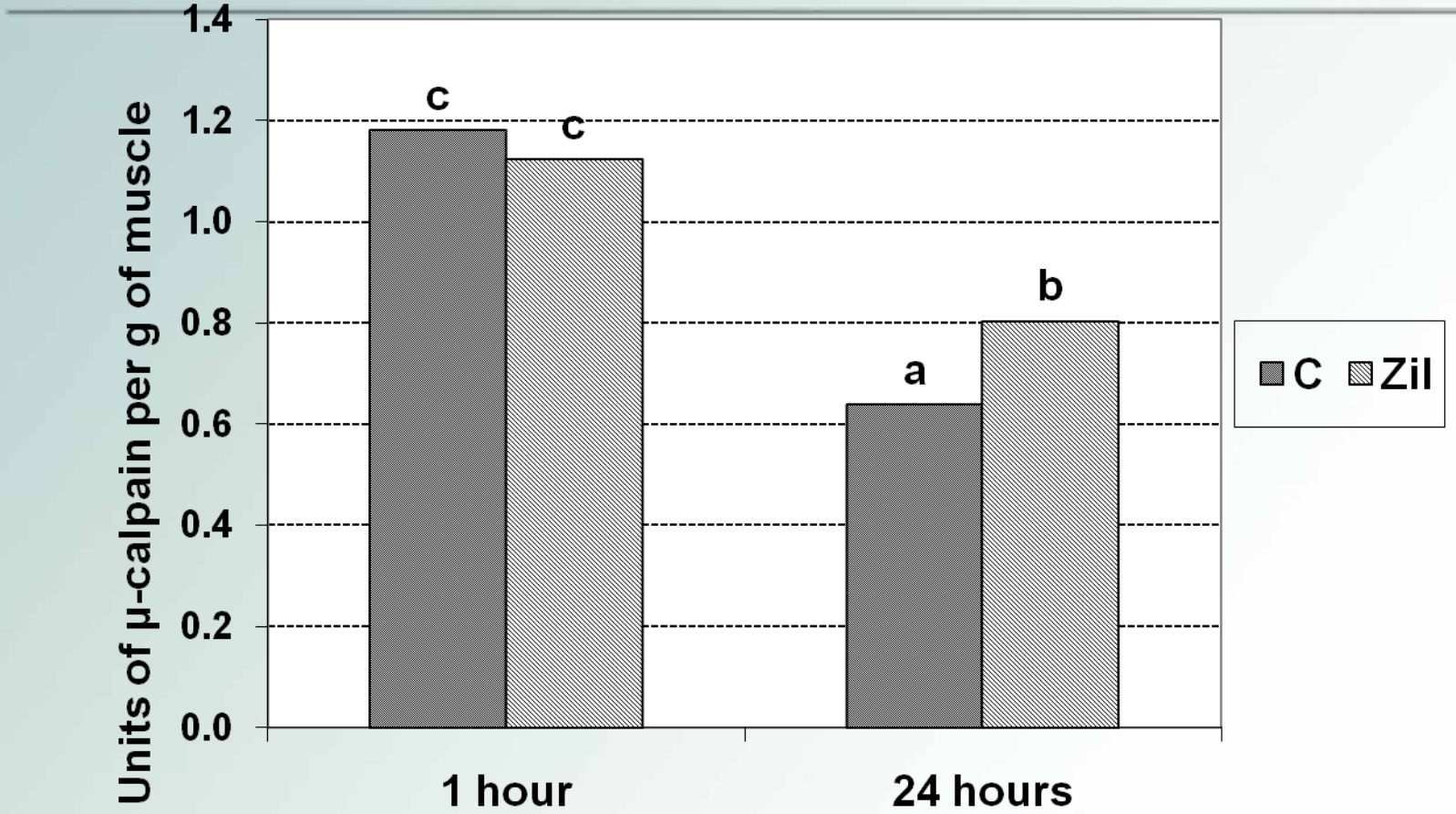


- **Fig. 4.** Interaction between treatment and time of measurement in relation to µ-calpain activity ($P < 0.002$). (Bars with different superscripts differ significantly).

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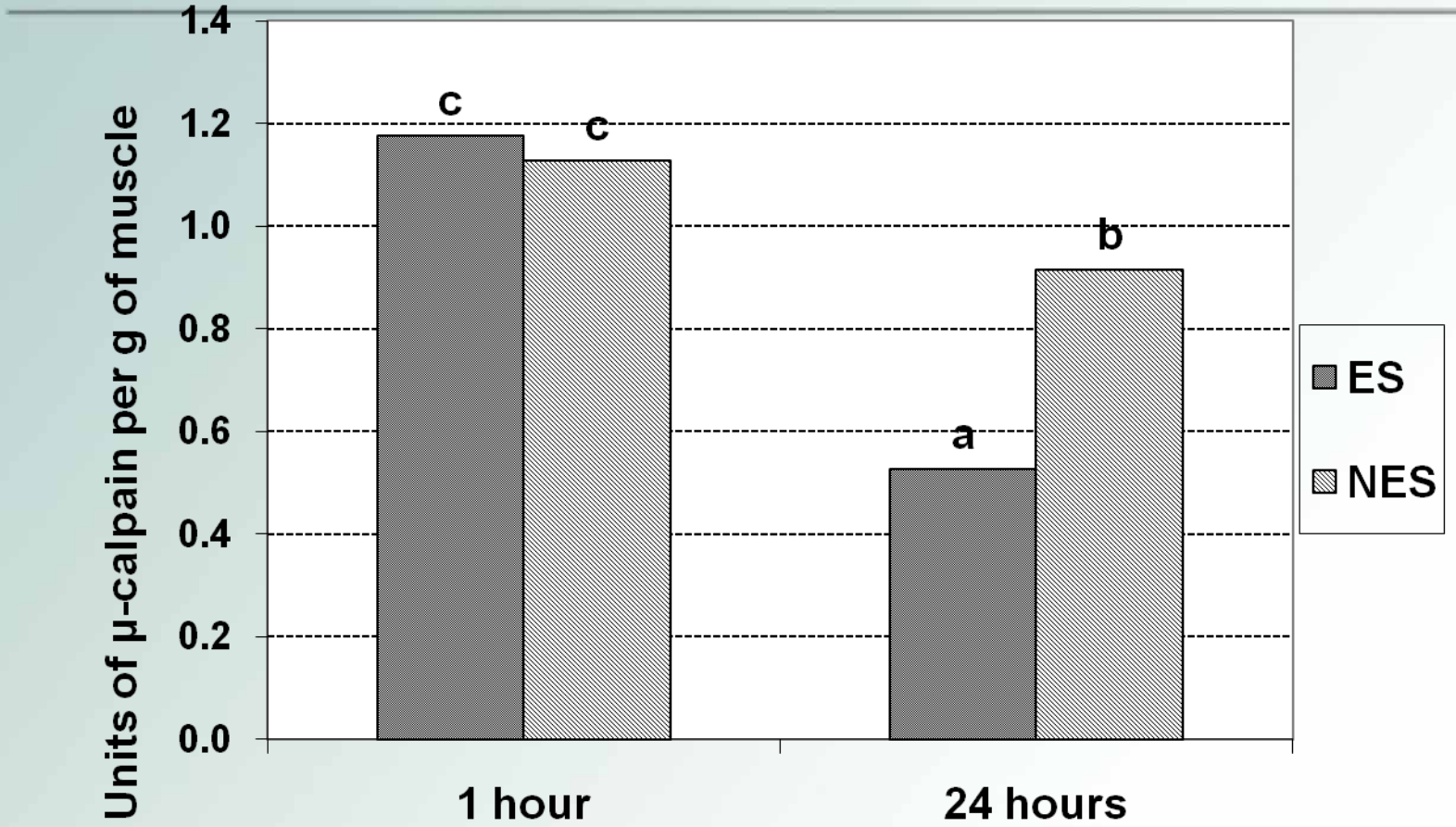


- **Fig. 6.** Interaction between stimulation and time of measurement in relation to µ-calpain activity ($P < 0.001$). (Bars with different superscripts differ significantly).

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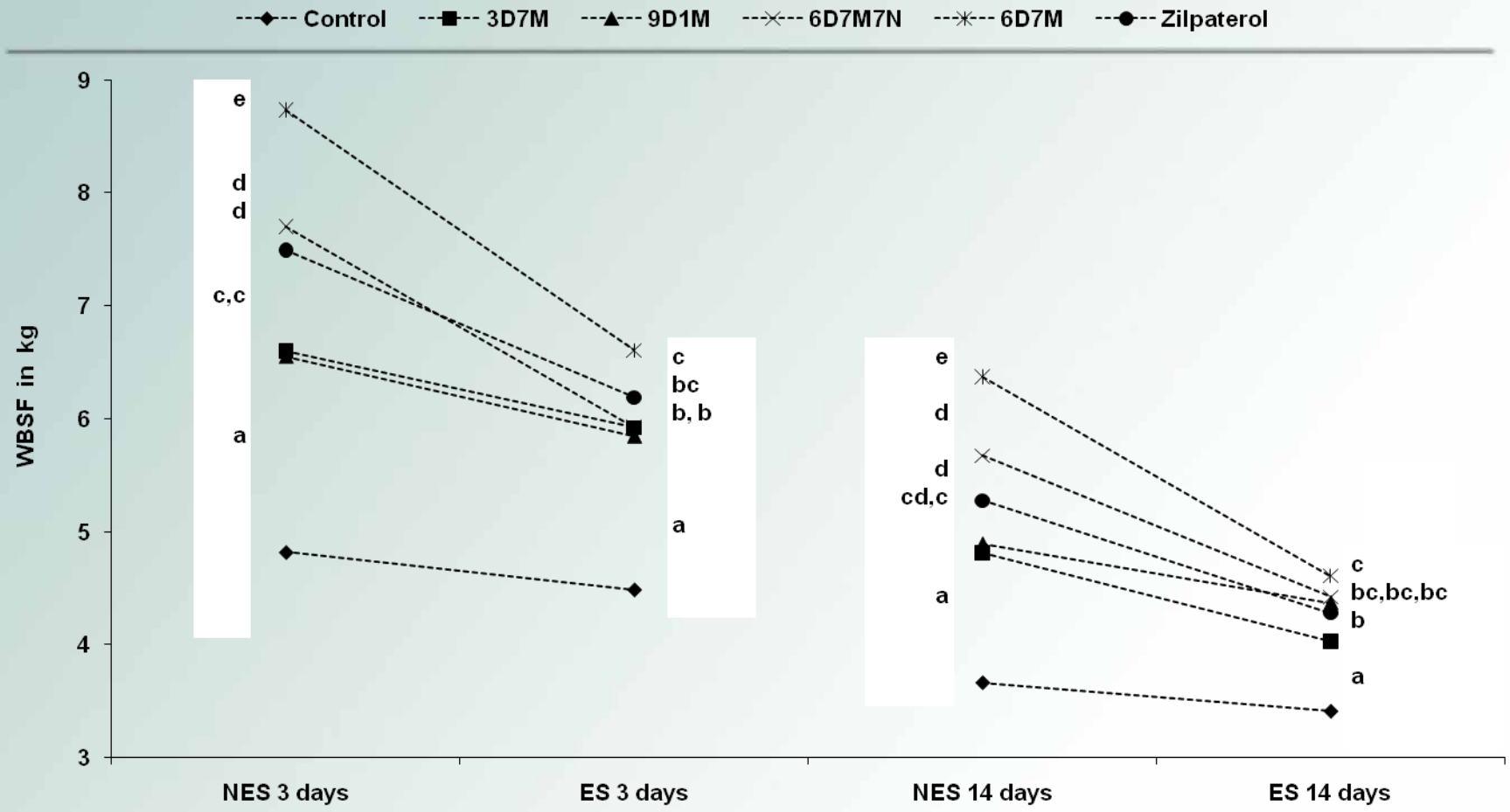


**Fig. 1a.** Interaction between treatment (Control, 3D7M, 9D1M, 6D7M7N, 6D7M, Zilpaterol), electrical stimulation (NES and ES) and *post mortem* aging (3 and 14 days) for Warner Bratzler shear force.

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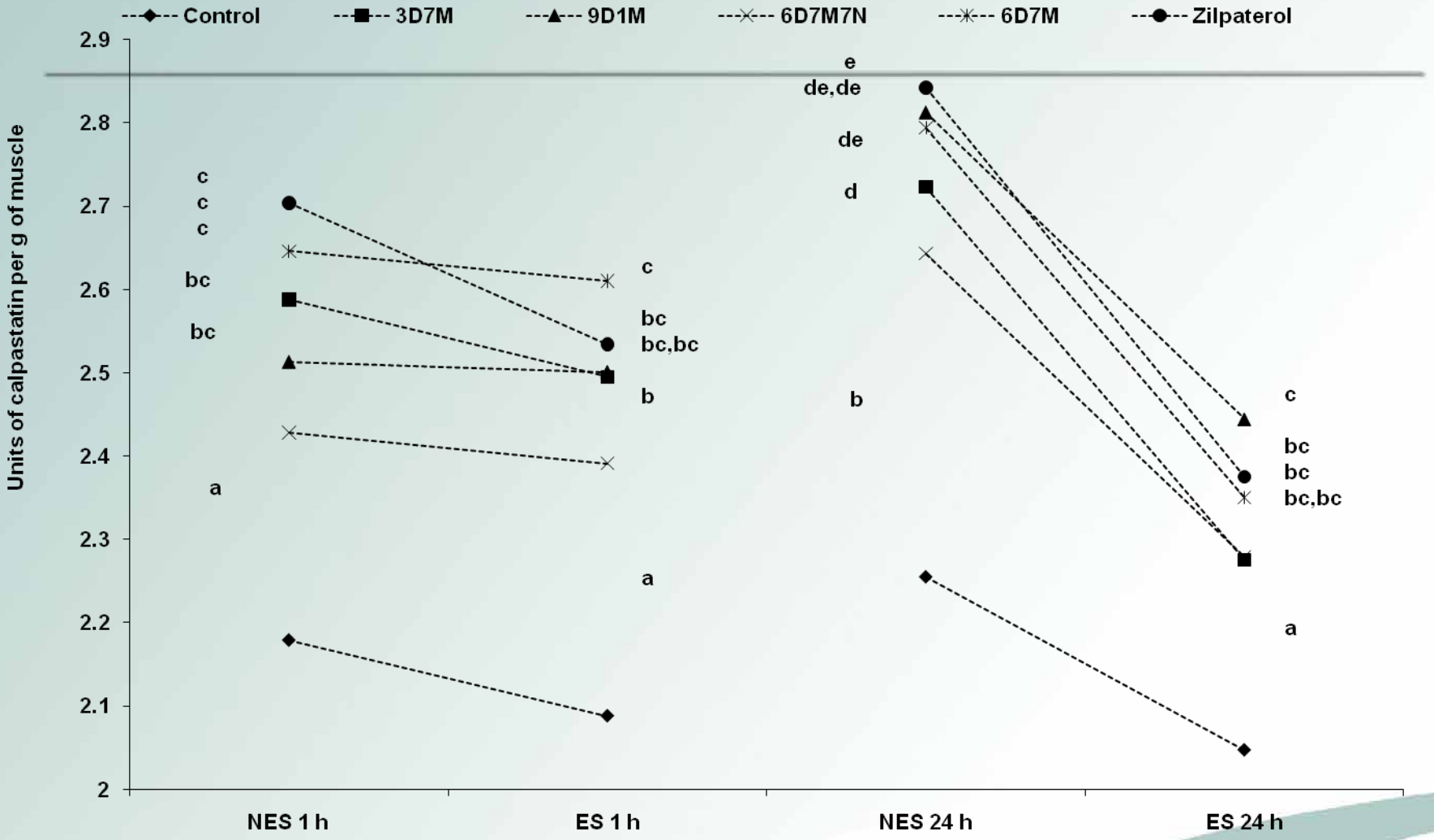


**Fig. 1c.** Interaction between treatment (Control, 3D7M, 9D1M, 6D7M7N, 6D7M, Zilpaterol), electrical stimulation (NES and ES) and time of measurement *post mortem* (1 h and 24 h) for Calpastatin activity.

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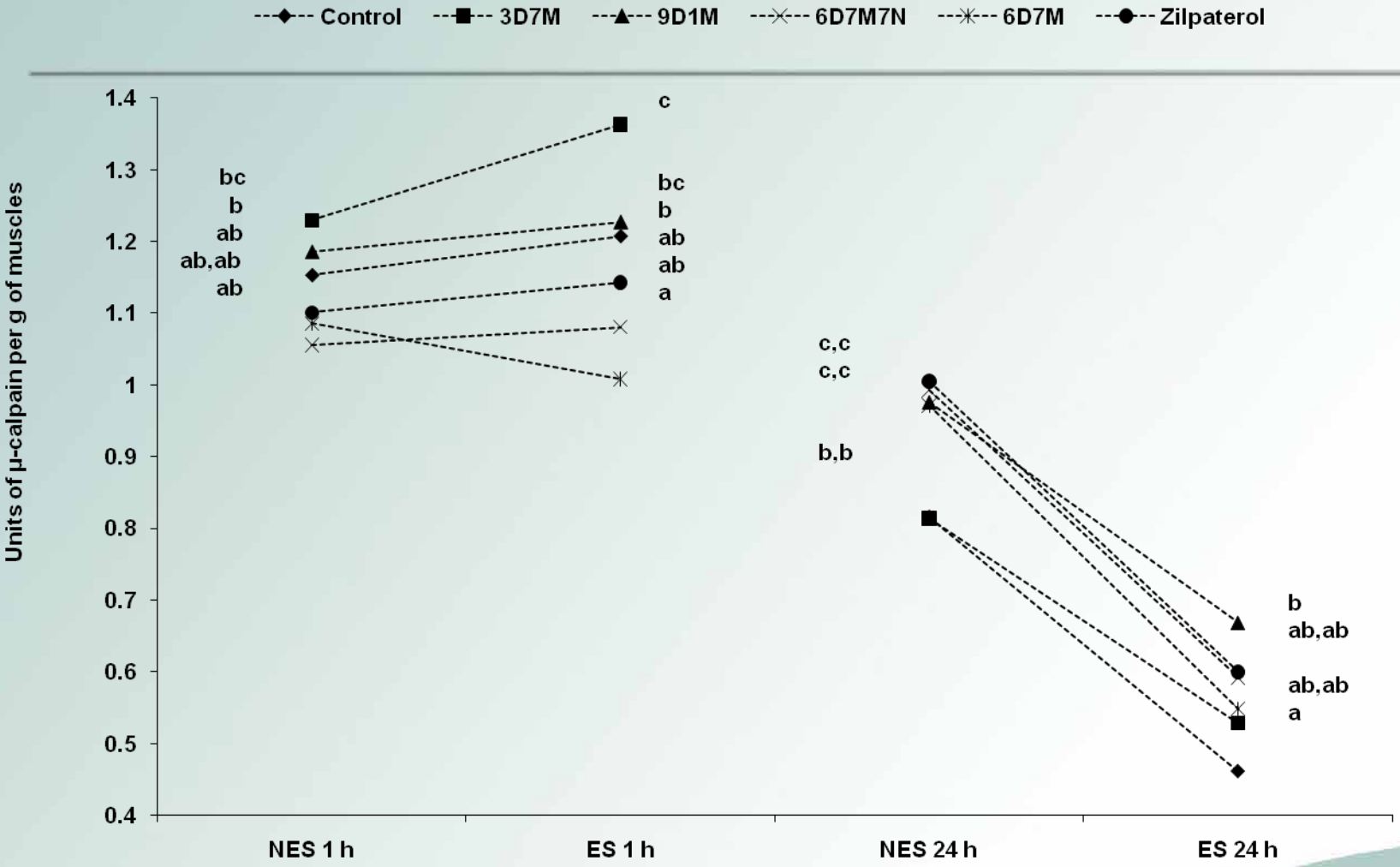


**Fig. 1d.** Interaction between treatment (Control, 3D7M, 9D1M, 6D7M7N, 6D7M, Zilpaterol), electrical stimulation (NES and ES) and time of measurement *post mortem* (1 h and 24 h) for µ-calpain activity.

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# Conclusion

- High levels of vitamin $D_3$ supplementation does not seem to be a viable option for improving meat tenderness in beta-agonist treated beef.

- Only a shorter but higher dose (3D7M) and a longer but lower dose (9D1M) of vitamin $D_3$ showed small but significant improvements in tenderness, under conditions of no electrical stimulation.

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- The benefit of using electrical stimulation on its own should be less costly and show better results on improving beta-agonist treated beef compared to any vitamin $D_3$ treatment with no stimulation.

- Furthermore, with electrical stimulation, no added advantage of feeding vitamin $D_3$ is achieved.

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- While age of the animal is still an important contributing factor to tenderness and meat quality, alone it is not an accurate predictor of meat quality and other pre- and post harvest factors also need to be taken into account.

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# Thank You

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