Saccharomyces cerevisiae can alleviate the impact of subacute ruminal acidosis

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Outline

- Introduction
- Objective
- Materials and methods
- Results and discussion
- Conclusion
- Questions

Subacute Ruminal Acidosis

- Nutritional disorder
- Feeding readily fermentable carbohydrate leads lead to a lower ruminal pH
- Dairy cattle develop SARA due to accumulation of VFA
  - 5.0-5.6
  - > 3 hours/day below 5.6 (AlZahal et al., 2007)
- Impaired production, health, laminitis, rumenitis, ..
  - Extent of pH
  - Duration of pH drop

Modes of Action of Live Yeast

Hypothesized to:

- Accelerate the “maturation” of the rumen microbial ecosystem
  - Increase the establishment of cellulolytic bacteria
  - And rapidly establishment of ciliate protozoa
  - Reduces the risk of infection in calves, mortality, and economic losses
- “Stabilize” ruminal pH
  - Interaction with lactate metabolizing bacteria,
- Improve fibre degradation in the rumen
  - Stimulate the growth and/or activity of cellulolytic bacteria
  - Scavenge oxygen and create favorable ecological conditions

Chaucheyras-Durand et al., 2008

Impact of Live Yeast on Improving pH & Preventing Acidosis

- In vitro studies
- Numerous studies in beef steers
  - Improve ruminal pH and reduced lactate concentration in steers

    Williams et al. (1991)
- Less studies in dairy cattle
  - Improved average daily ruminal pH by 0.5 (Bach et al., 2007)

However,

Variations between studies due to strains, dosage, base diet, …

Objectives

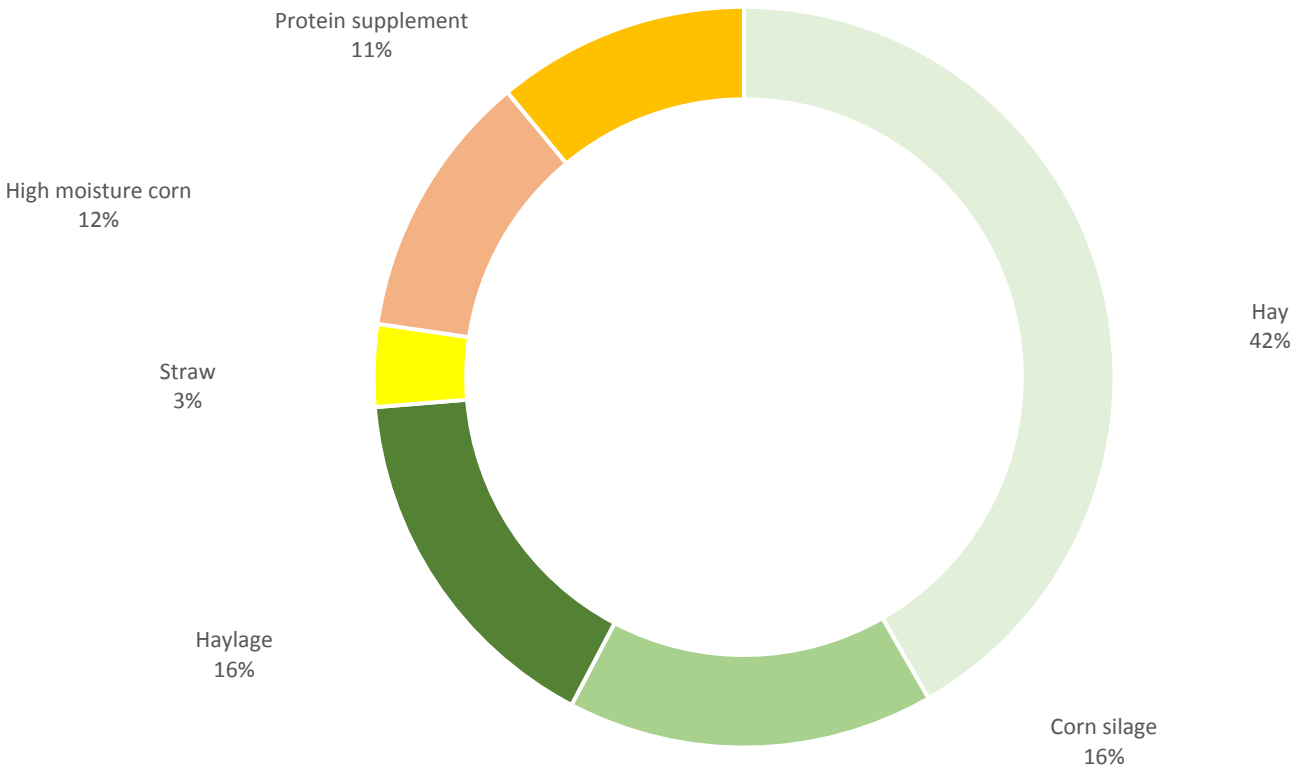
- To determine the effect of *S. cerevisiae* supplementation during SARA on:
  - DMI, milk yield and components, and ruminal pH
  - Rumen microbiome
  - Rumen epithelial metabolism and inflammation

Animals & Diets

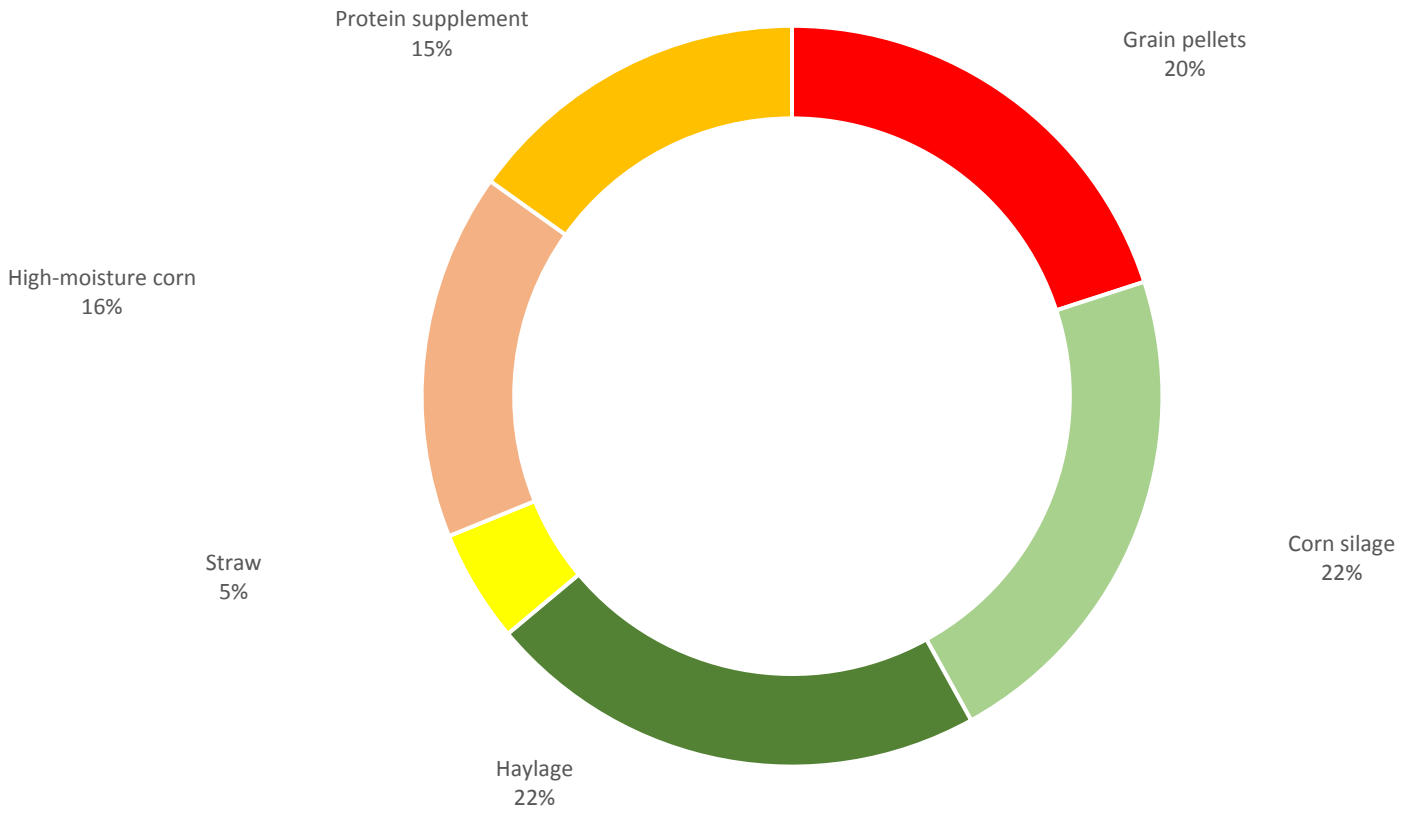
- Sixteen multiparous, rumen-cannulated, mid-lactation Holstein cows were randomly assigned to:
  - *S. cerevisiae* (4 g/d, AB Vista, Marlborough, UK) or
  - Placebo
  - Top-dressed during the morning feeding (2X TMR feeding)
- SARA was induced using a nutritional model

SARA Induction Model: Dietary Regimen

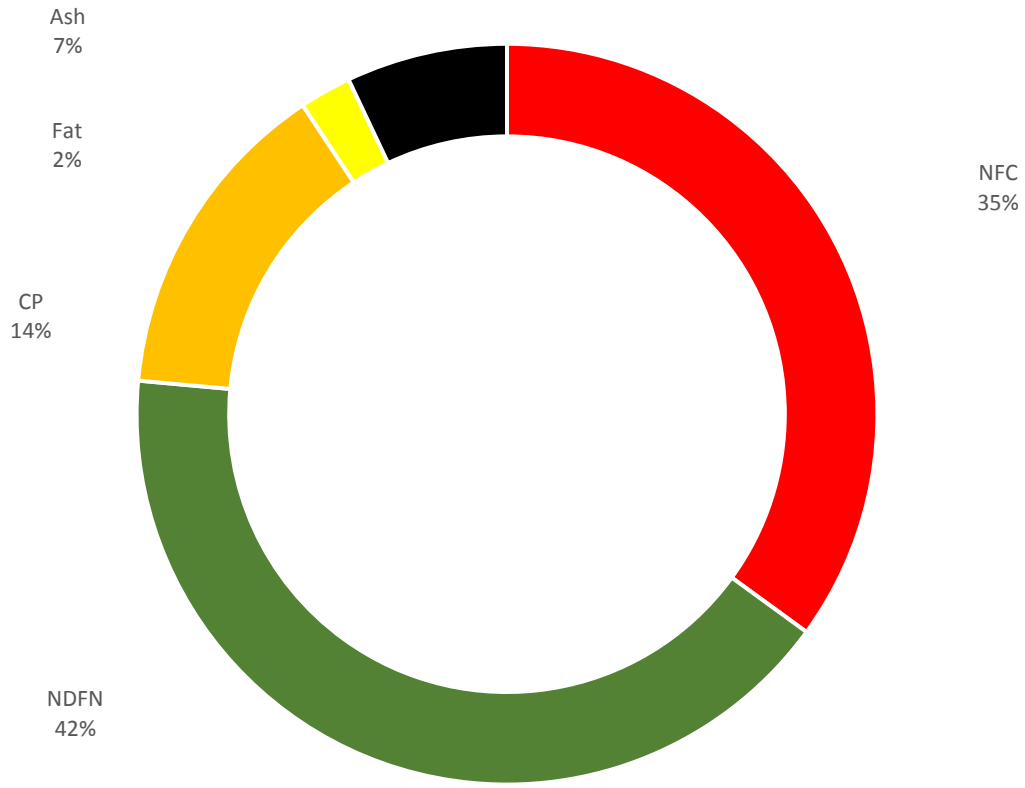
High-Fibre TMR, % of DM



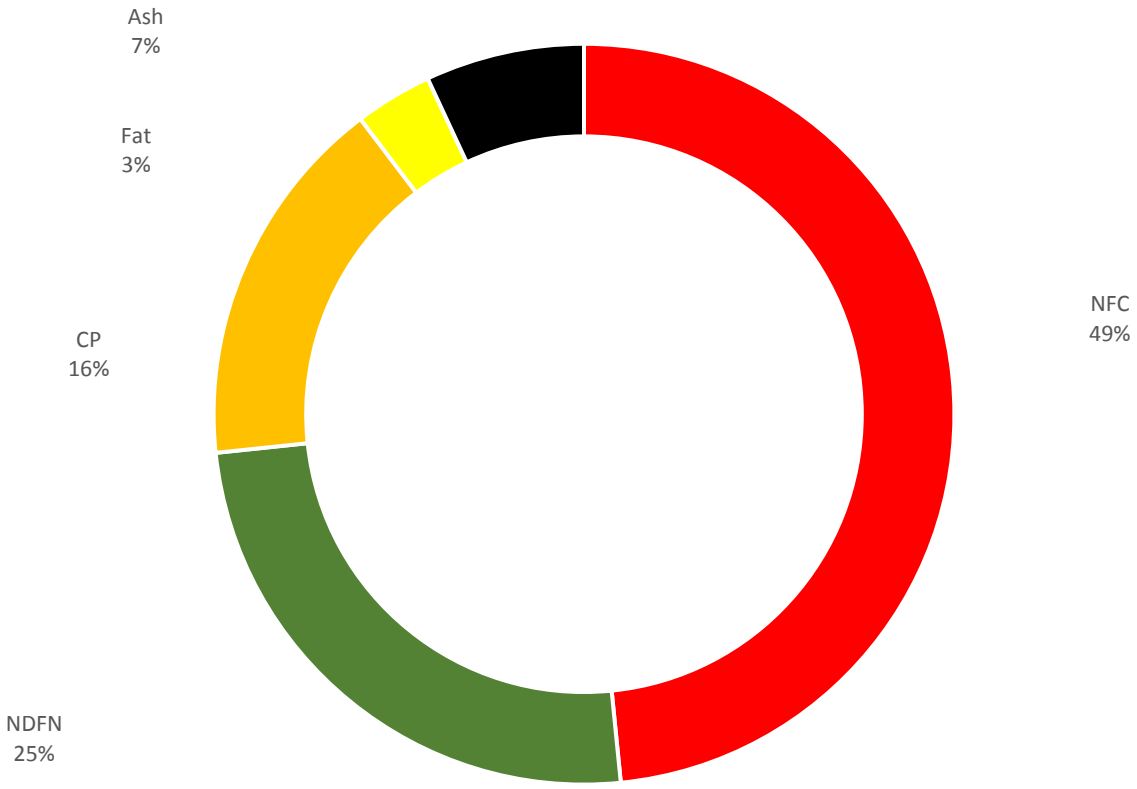
High-Grain TMR, % of DM



High-Forage TMR, % of DM

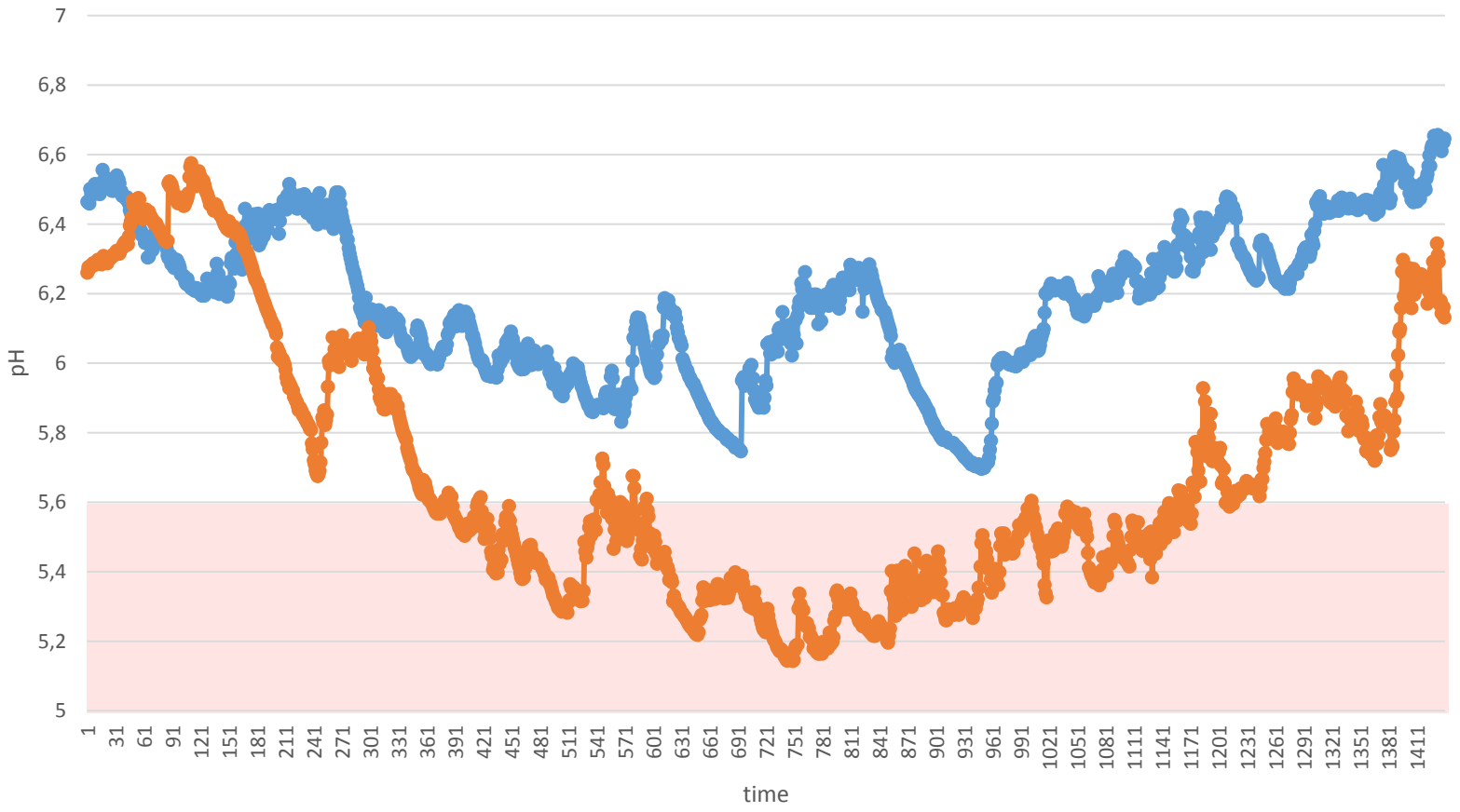


High-Grain TMR, % of DM

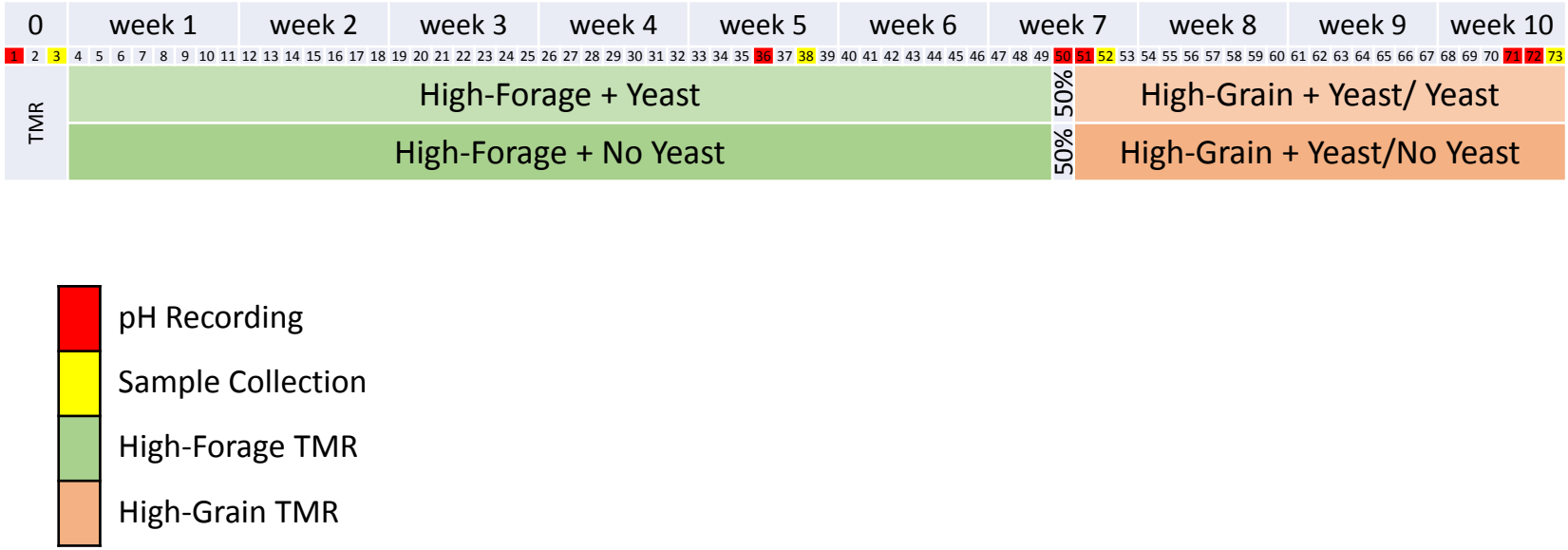


SARA Induction Model: pH Recording

24-h Ruminal pH



Lay-out


0
week 1
week 2
week 3
week 4
week 5
week 6
week 7
week 8
week 9
week 10
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73
TMR
High-Forage + Yeast
50%
High-Grain + Yeast/ Yeast
High-Forage + No Yeast
50%
High-Grain + Yeast/No Yeast

pH Recording
Sample Collection
High-Forage TMR
High-Grain TMR

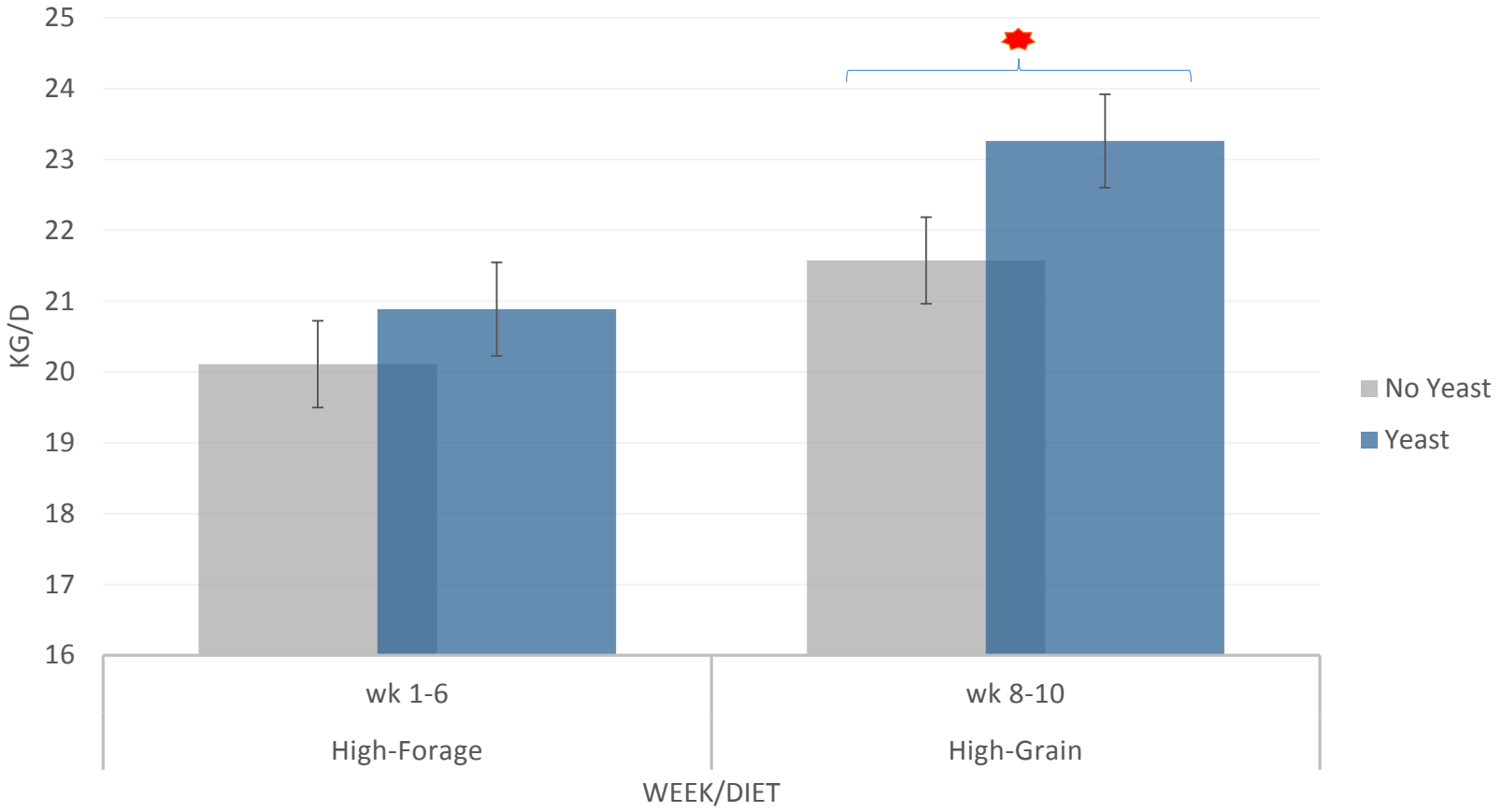
Experimental Measurements

- DMI
- Milk yield and milk components
- Ruminal pH
- Biopsies
- Ruminal samples
  - Genomic DNA, fluid, particles, adherent bacteria
  - RNA

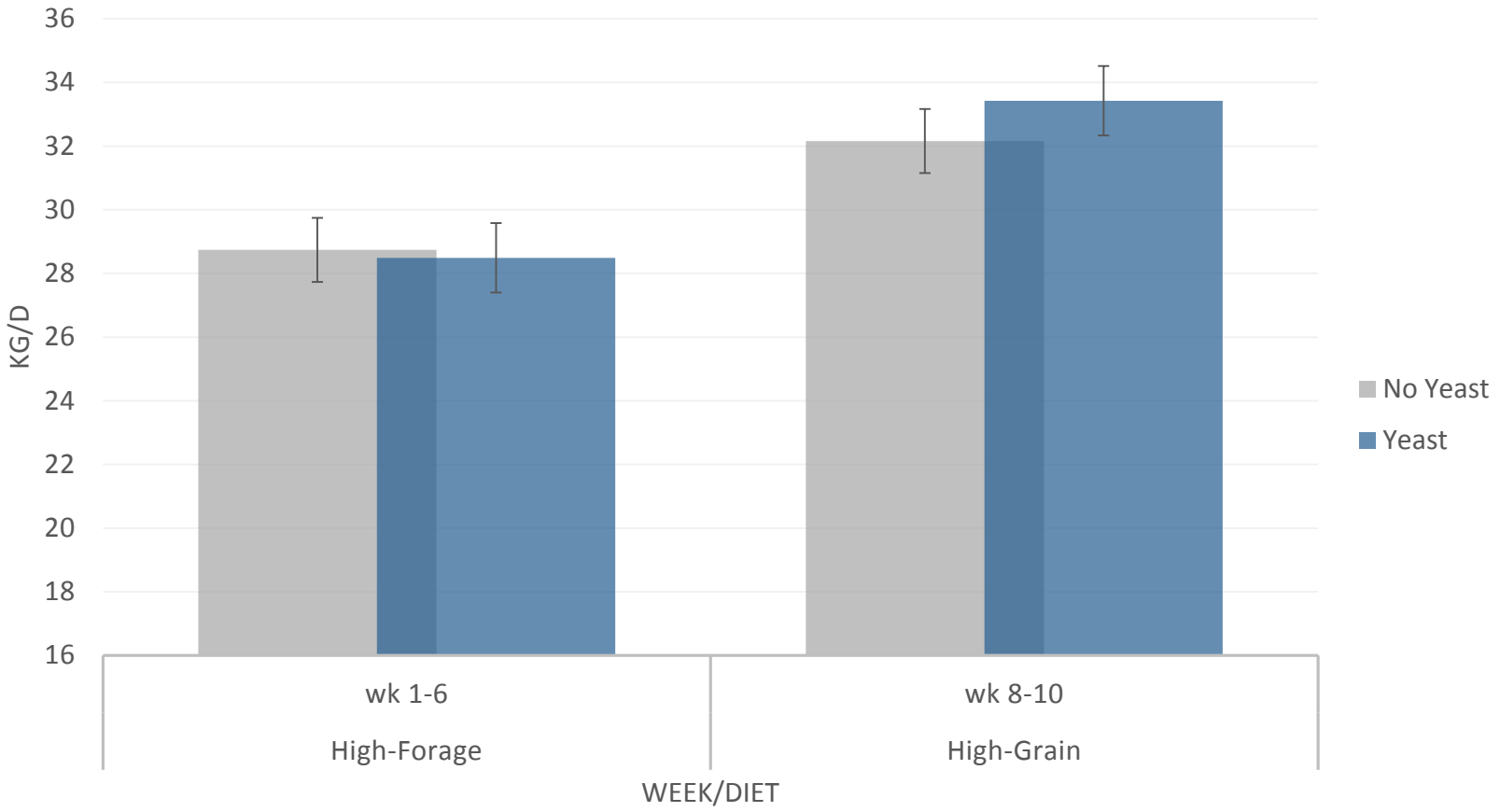
Statistical Analysis

- Data summarized by feeding phase i.e. HF, 50:50, and HG
- Proc Mixed of SAS (v9.3)
  - Treat (no yeast vs. yeast)
  - Week as fixed
  - Interactions
  - Covariate (Time 0, for performance data; for milk yield and DMI)
  - Repeated measurement with cow as the subject
- Orthogonal polynomial contrasts
    - Feeding phase across treatment
- T-test to test the difference of rumen pH from 0 and 300 min/d

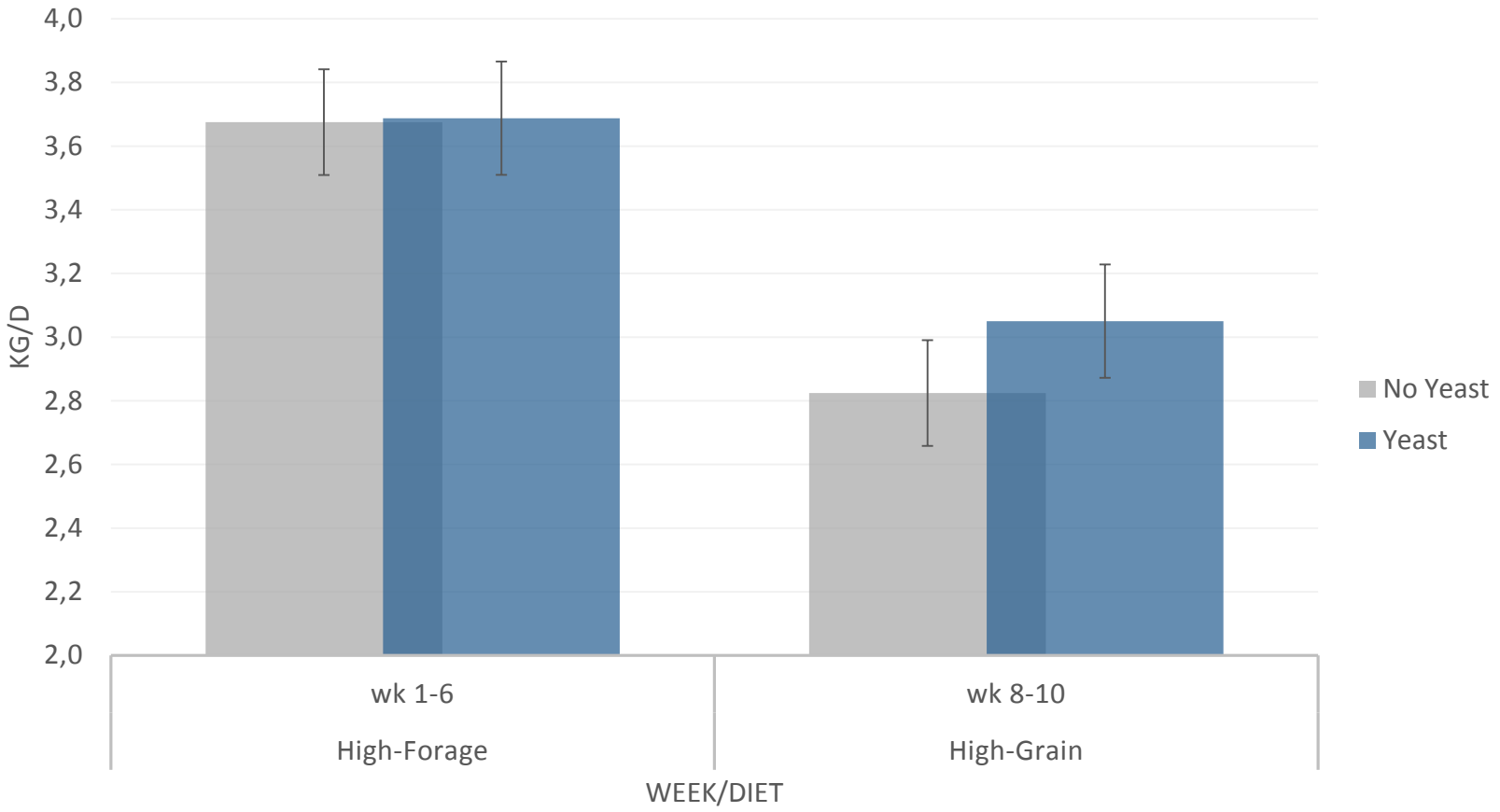
DMI


25
24
23
22
21
20
19
18
17
16
KG/D
wk 1-6
High-Forage
wk 8-10
High-Grain
WEEK/DIET
No Yeast
Yeast

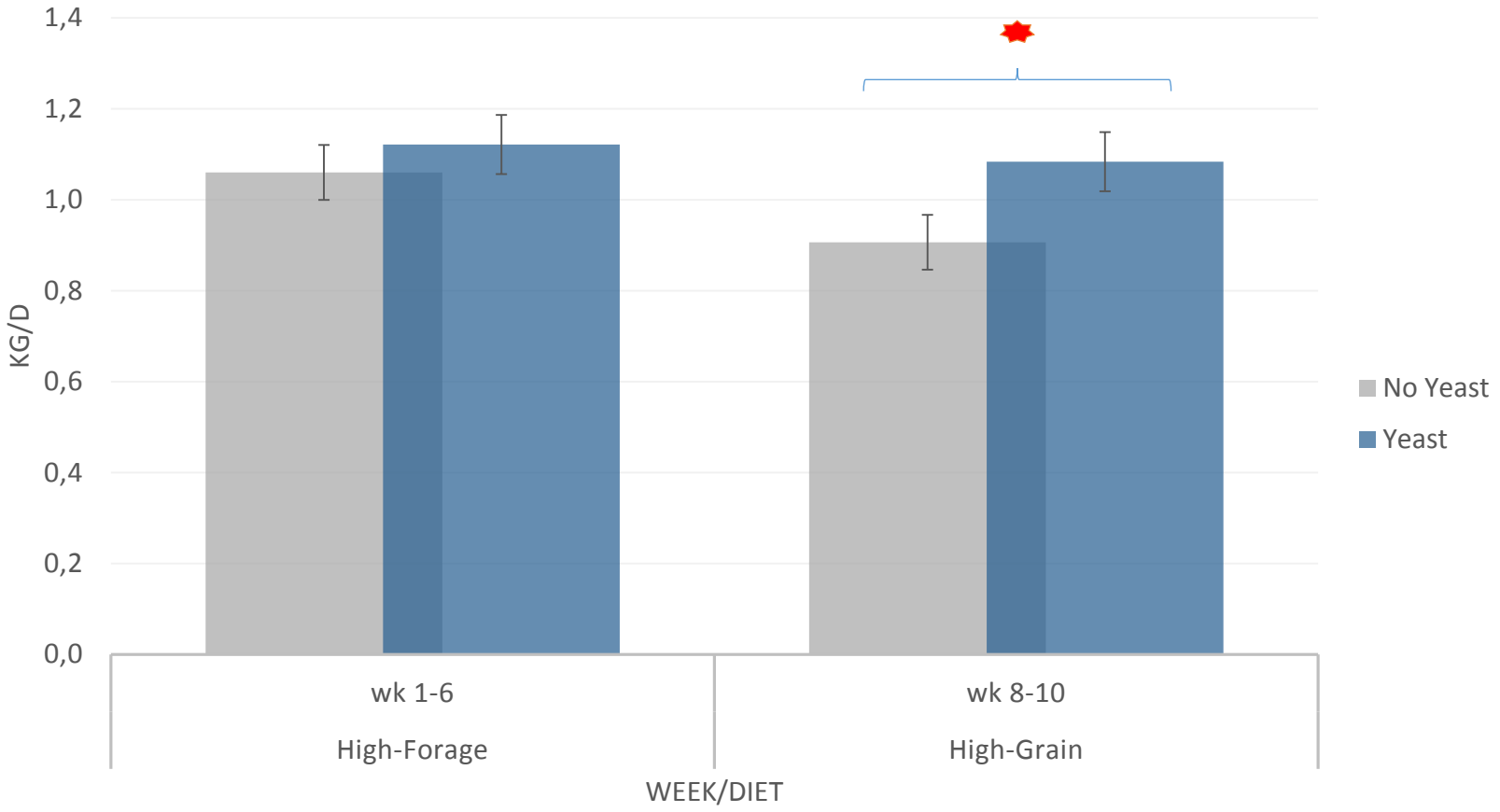
Milk Yield


36
34
32
30
28
26
24
22
20
18
16
KG/D
wk 1-6
High-Forage
wk 8-10
High-Grain
WEEK/DIET
No Yeast
Yeast

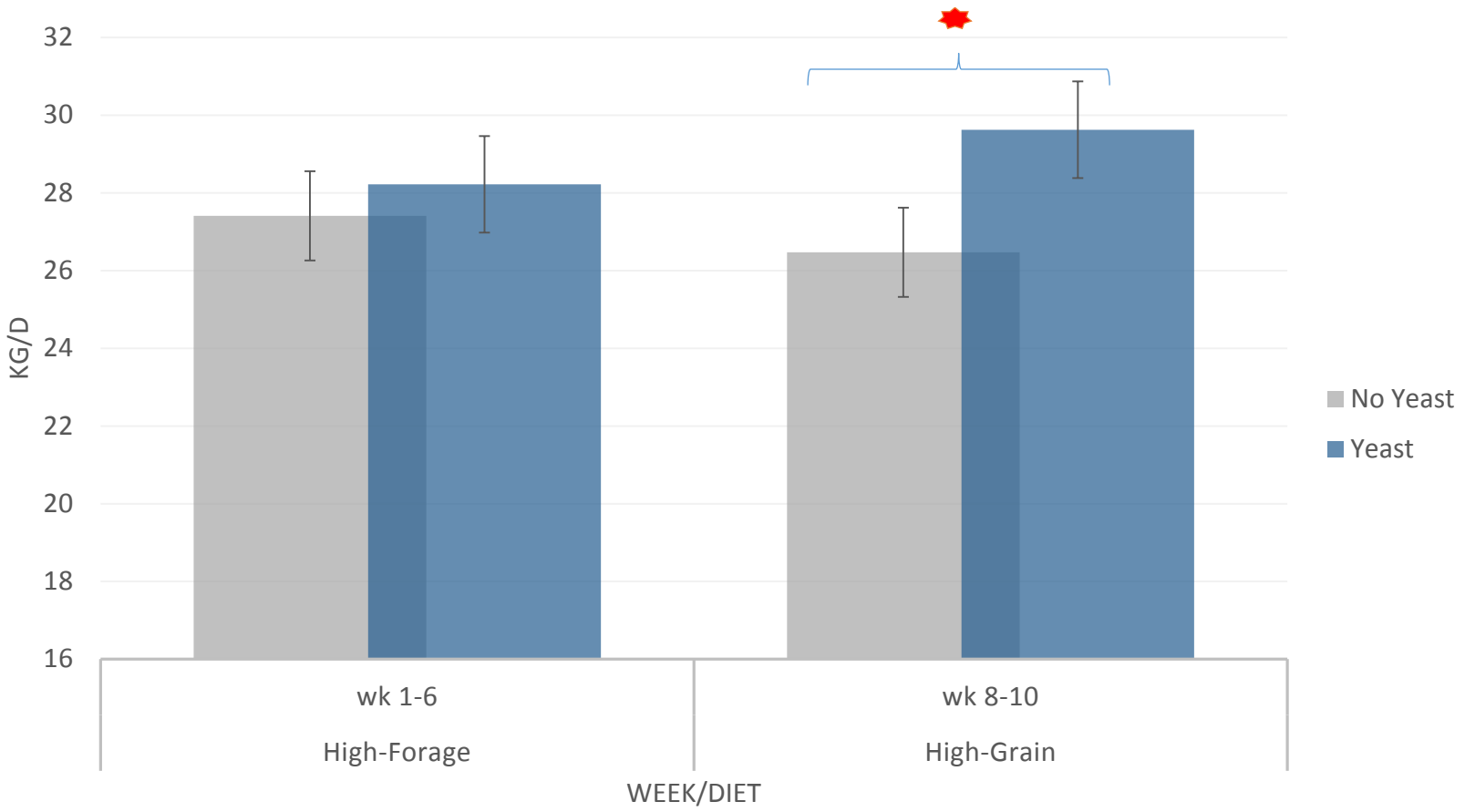
Fat %


4,0
3,8
3,6
3,4
3,2
3,0
2,8
2,6
2,4
2,2
2,0
KG/D
wk 1-6
High-Forage
wk 8-10
High-Grain
WEEK/DIET
No Yeast
Yeast

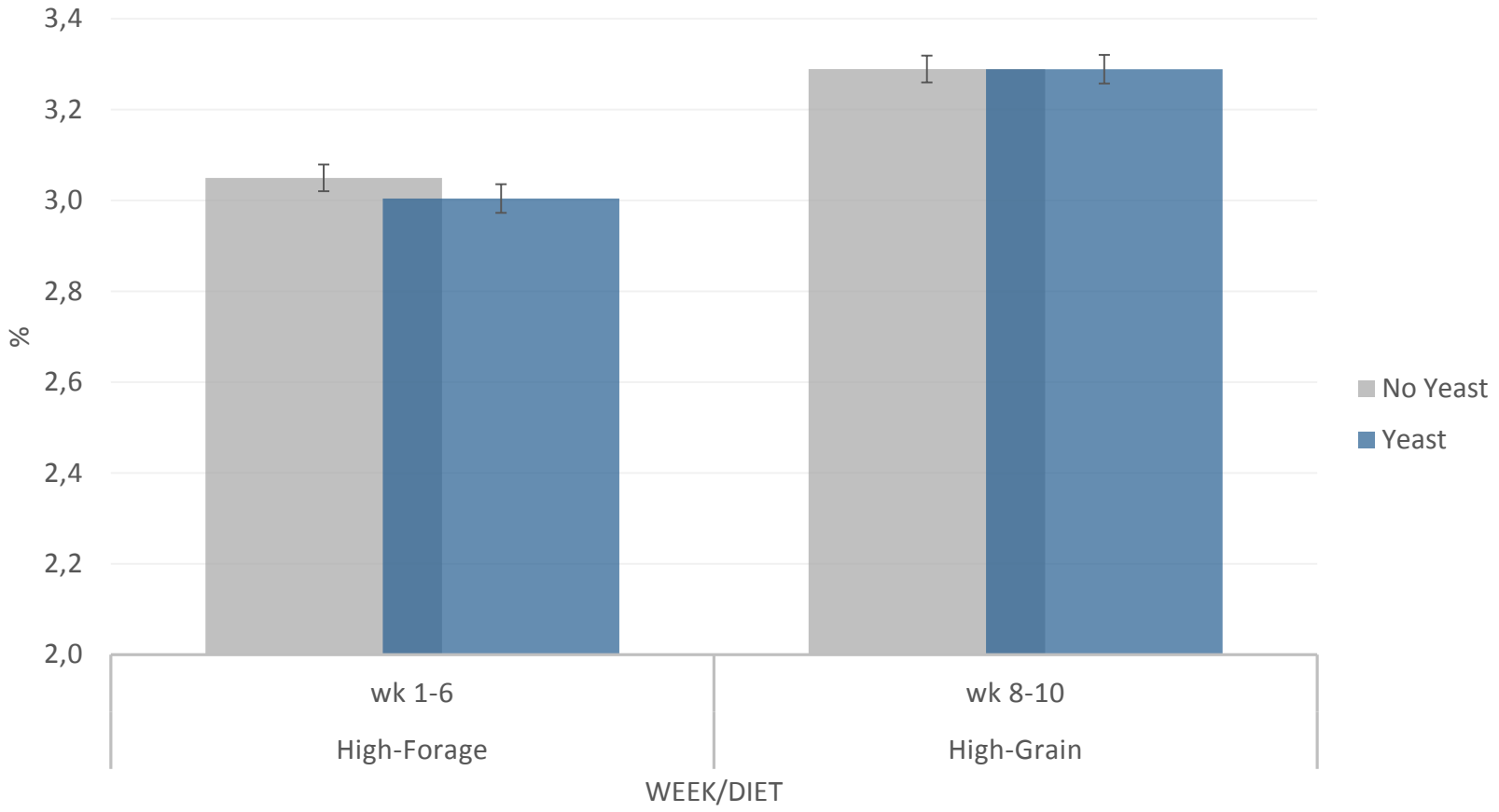
Fat Yield


1,4
1,2
1,0
0,8
0,6
0,4
0,2
0,0
KG/D
wk 1-6
High-Forage
wk 8-10
High-Grain
WEEK/DIET
No Yeast
Yeast

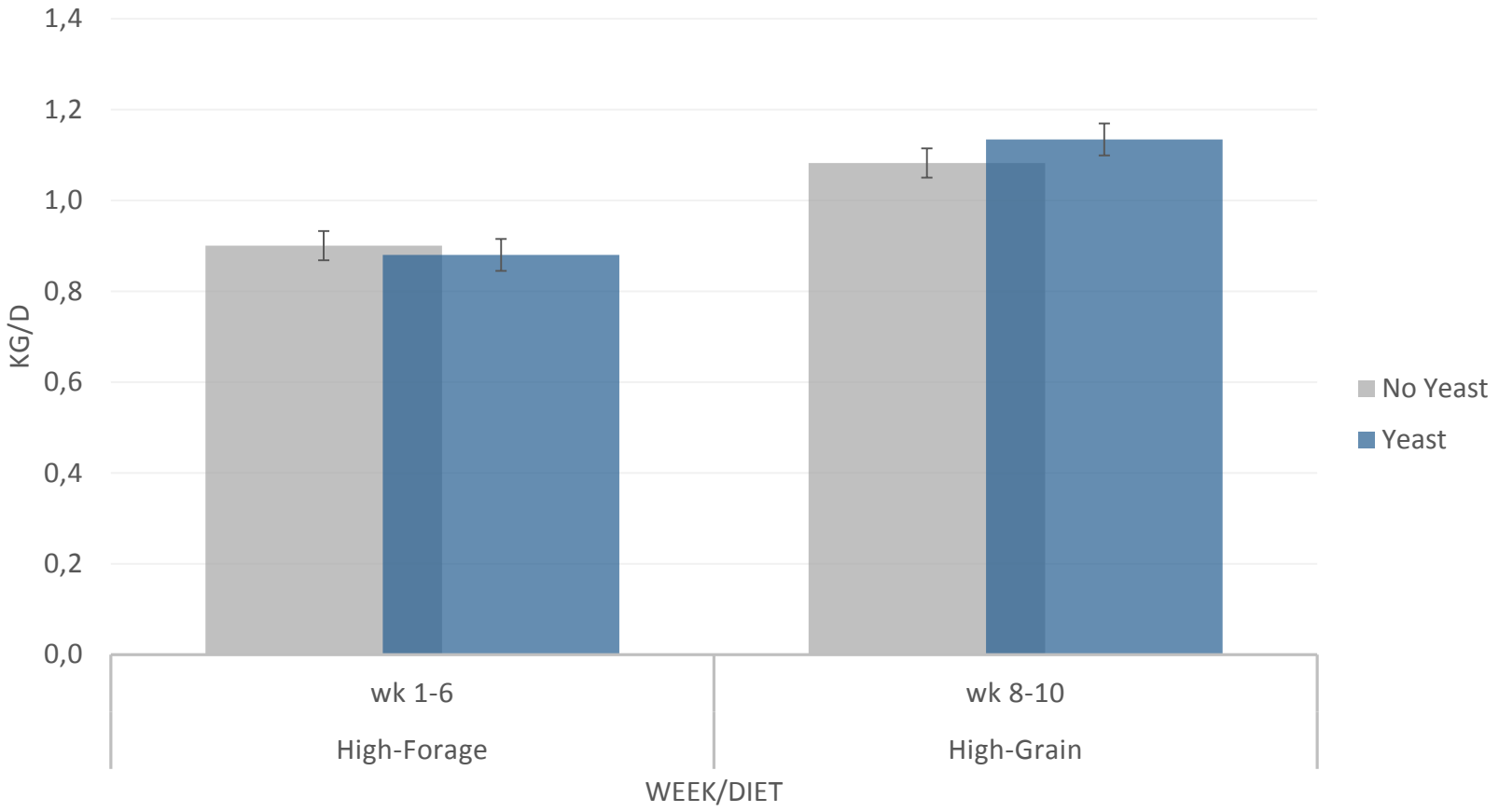
4% Fat-Corrected Milk Yield



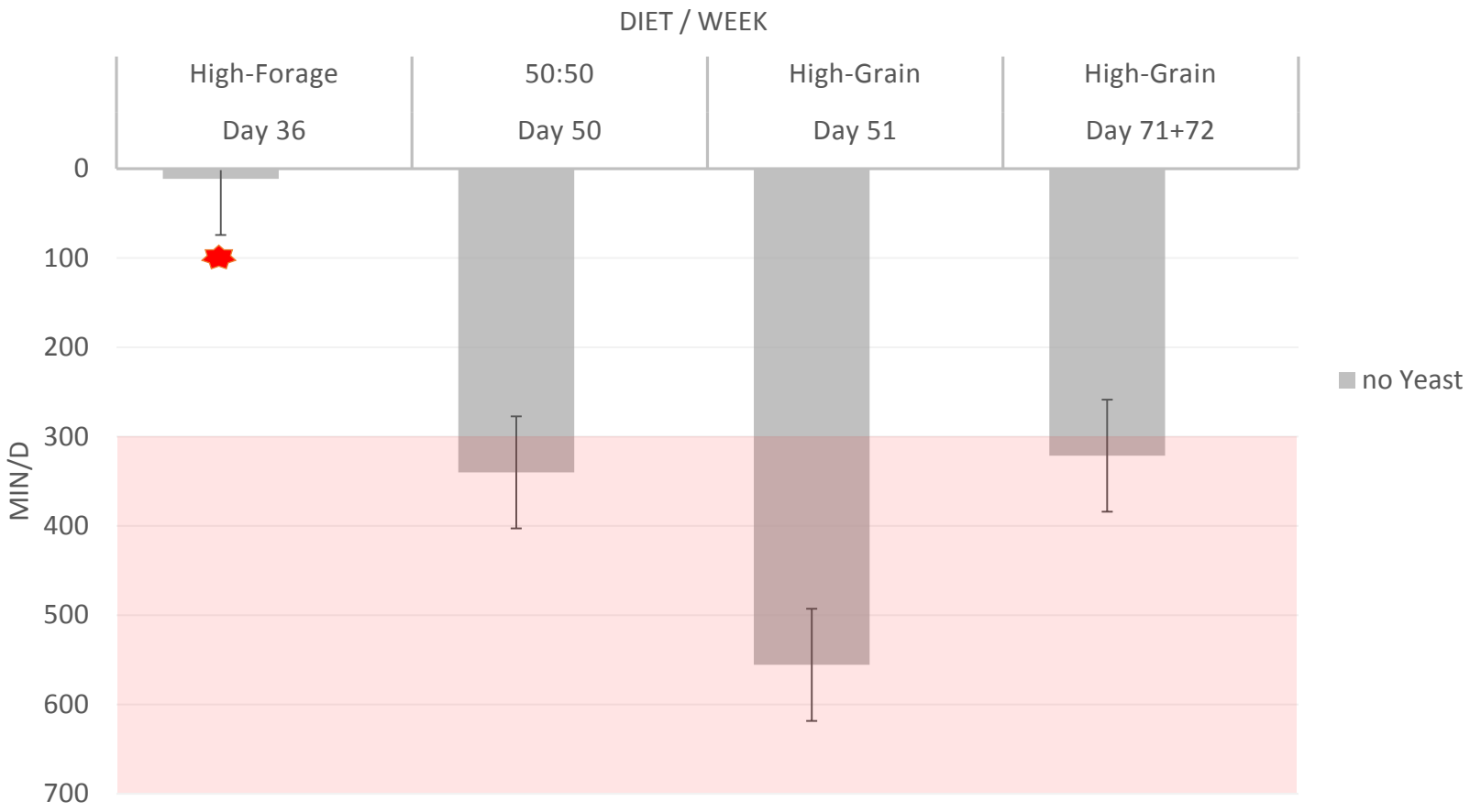
Protein %


3,4
3,2
3,0
2,8
2,6
2,4
2,2
2,0
%
wk 1-6
High-Forage
wk 8-10
High-Grain
WEEK/DIET
No Yeast
Yeast

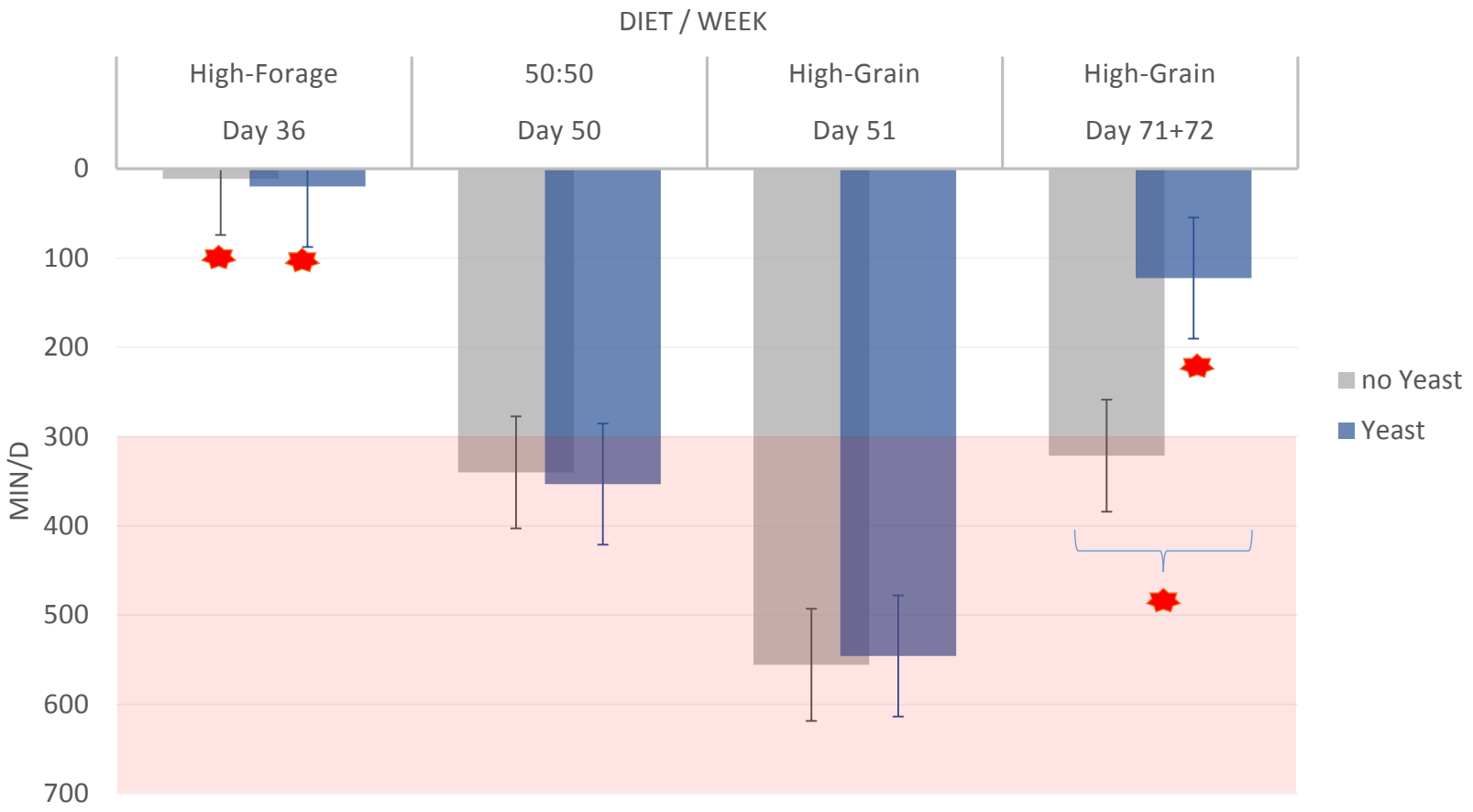
Protein Yield



Ruminal pH Below 5.6 (minute/day)



Ruminal pH Below 5.6 (minute/day)



Conclusion

Supplementation of live *Saccharomyces cerevisiae* has the potential to attenuate SARA in lactating dairy cows

Acknowledgement

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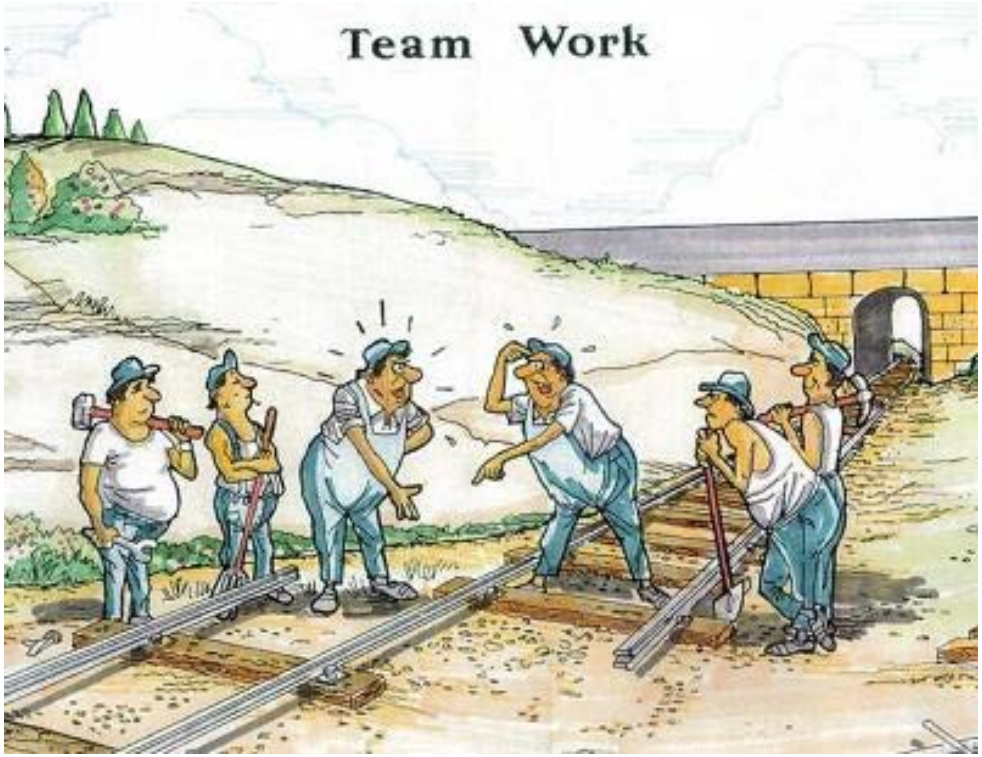
- Natural Sciences and Engineering Research Council of Canada (NSERC)

Questions?



http://utias.utoronto.ca/~ogulder/ResearchGroup.htm