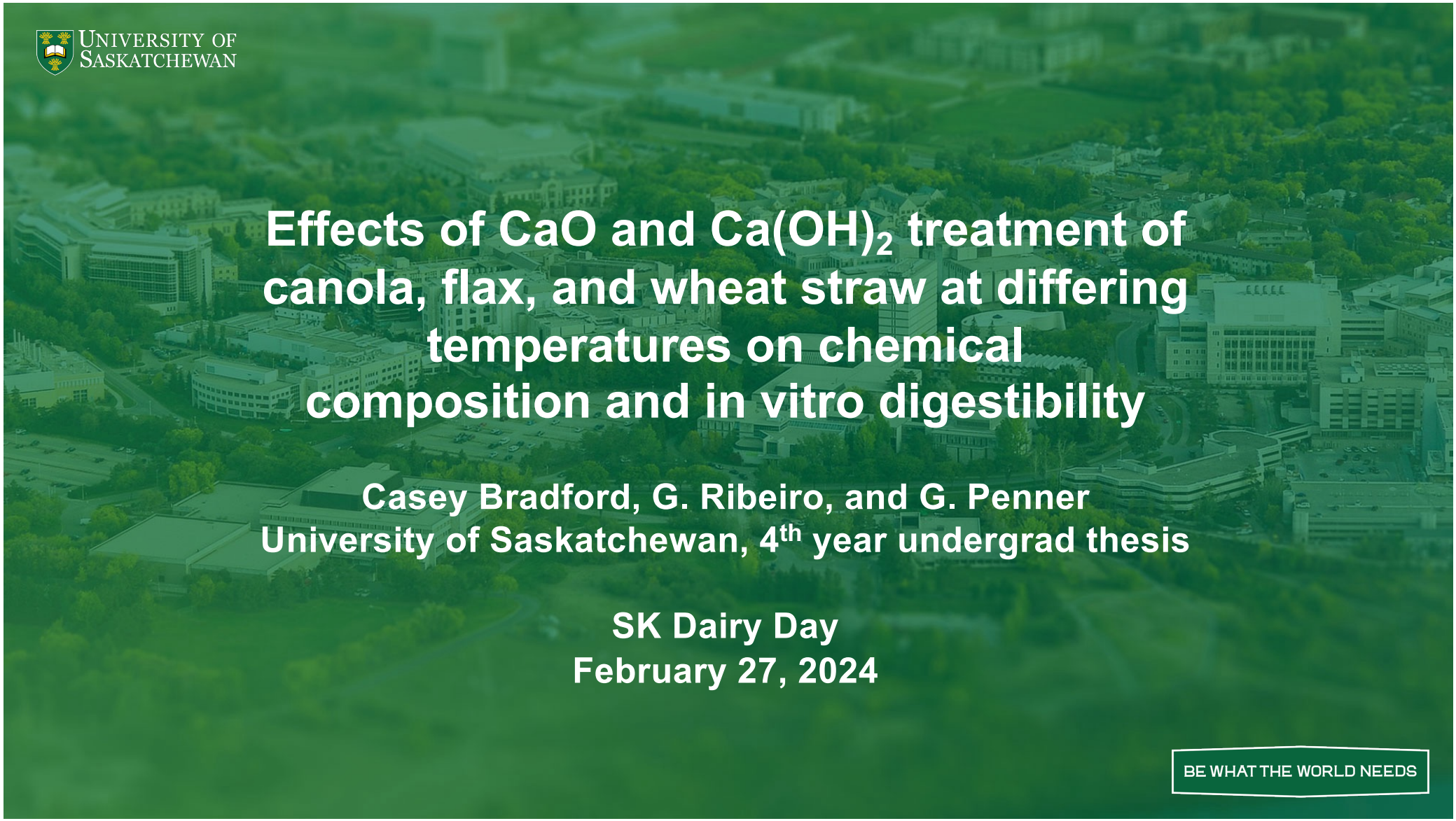

Effects of CaO and $Ca(OH)_2$ treatment of canola, flax, and wheat straw at differing temperatures on chemical composition and in vitro digestibility

Casey Bradford, G. Ribeiro, and G. Penner
University of Saskatchewan, 4th year undergrad thesis

SK Dairy Day
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Why consider straws as a forage source?

- Straw is typically used to increase diet bulk fill & control dietary energy content, however low palatability & digestibility limit dietary inclusion rates (Shaver & Hoffman 2010; Sufyan 2021; Wang et al. 2022).
- Crops produced for human consumption also produce large quantities of residues that can be utilized for animal feed (Government of SK; Stats Canada, accessed 2023).
- Currently, drought is also influencing cropping decisions and feed sources.

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Why alkali treatments

- Alkali treatments have the potential to increase the digestibility of low-quality residues, allowing increased DMI and thereby higher or equivalent gains as other, better-quality forages (Cameron et al. 1990; Donnelly et al. 2018; Stehr et al. 2021).
- These treatments can increase the nutrient value of these sources for cattle, allowing producers to utilize an available, potentially lower-cost fiber source (Wanapat et al. 1985; Canale et al. 1988; Donnelly et al. 2018; Stehr et al. 2021).
- If low-cost forages can be treated to increase forage quality, this may provide a cost-effective option for the producer, as well as an option for optimizing low-quality forages produced in poor cropping years.

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How does alkali treatment work?

- Reasonable simple process, following 3 main steps
  a) Hydrate forage (necessary to activate $CaO/Ca(OH)_2$)
  b) Mix alkali
  c) Pile and store anaerobically
- Labour intensive process, may be challenging if treating forages during winter months.
- Temperature may have impact on alkali treatment, as seen with ammoniation.
- Many feeds successfully treated with alkali compounds (various straw types, distillers grains, corn stover, etc).

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Objectives

- Hypotheses: The use of CaO or $Ca(OH)_2$ to treat wheat, flax, and canola will decrease the NDF concentration and increase in vitro digestibility when treated at temperatures above 0° C.
- Objectives: To characterize effects of treating wheat, flax, and canola straw with CaO or $Ca(OH)_2$ at differing temperatures (-20, 4, or 20° C) on the NDF concentration and in vitro digestibility.

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Experimental Design

- Straw (wheat, flax, canola) samples were collected from 7 farms in Saskatchewan.
- Samples were hydrated to 50% DM and exposed to 1 of 3 treatments
  1. Control (only hydrated)
  2. CaO added at 5% DM
  3. $Ca(OH)_2$ added at 5% DM
- Samples were treated at either
  1. +20°C (control)
  2. +4°C
  3. -20°C
- Samples were maintained at their temperature for 48 h with anaerobic storage.

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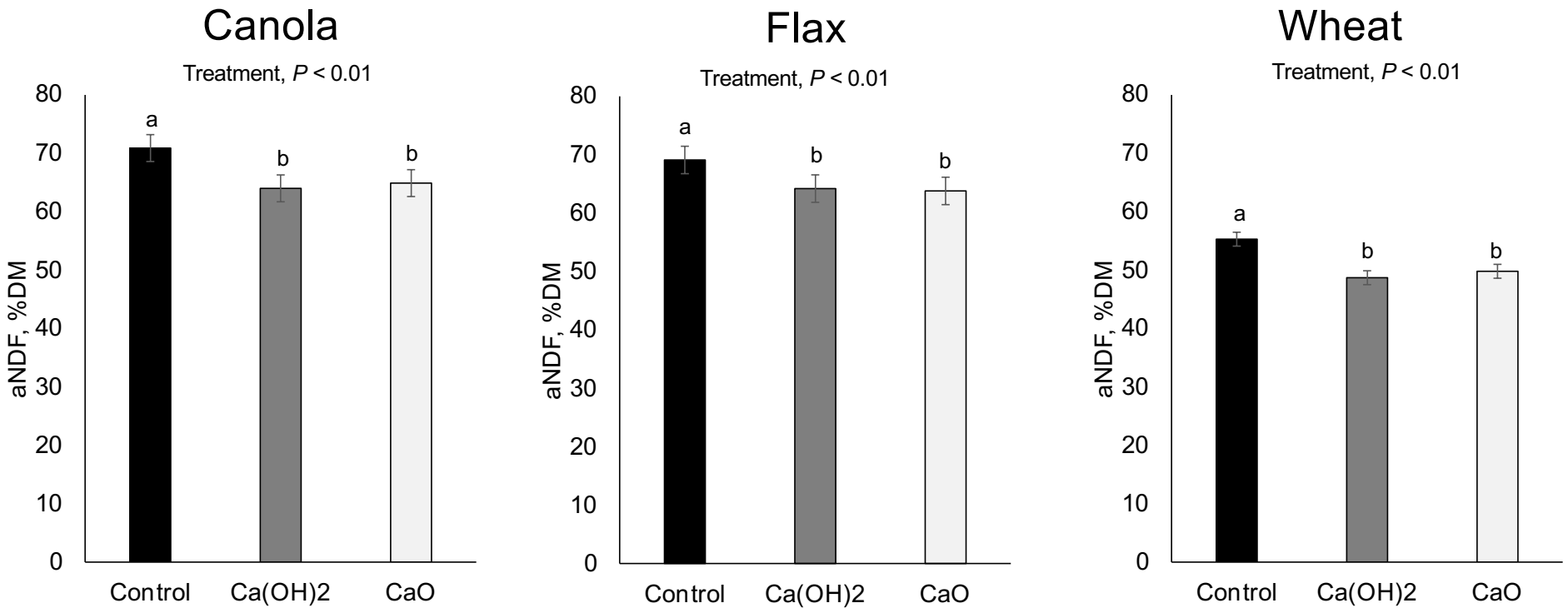
Alkali treatment decreased aNDFom concentration



No effect of temperature at the time of treatment

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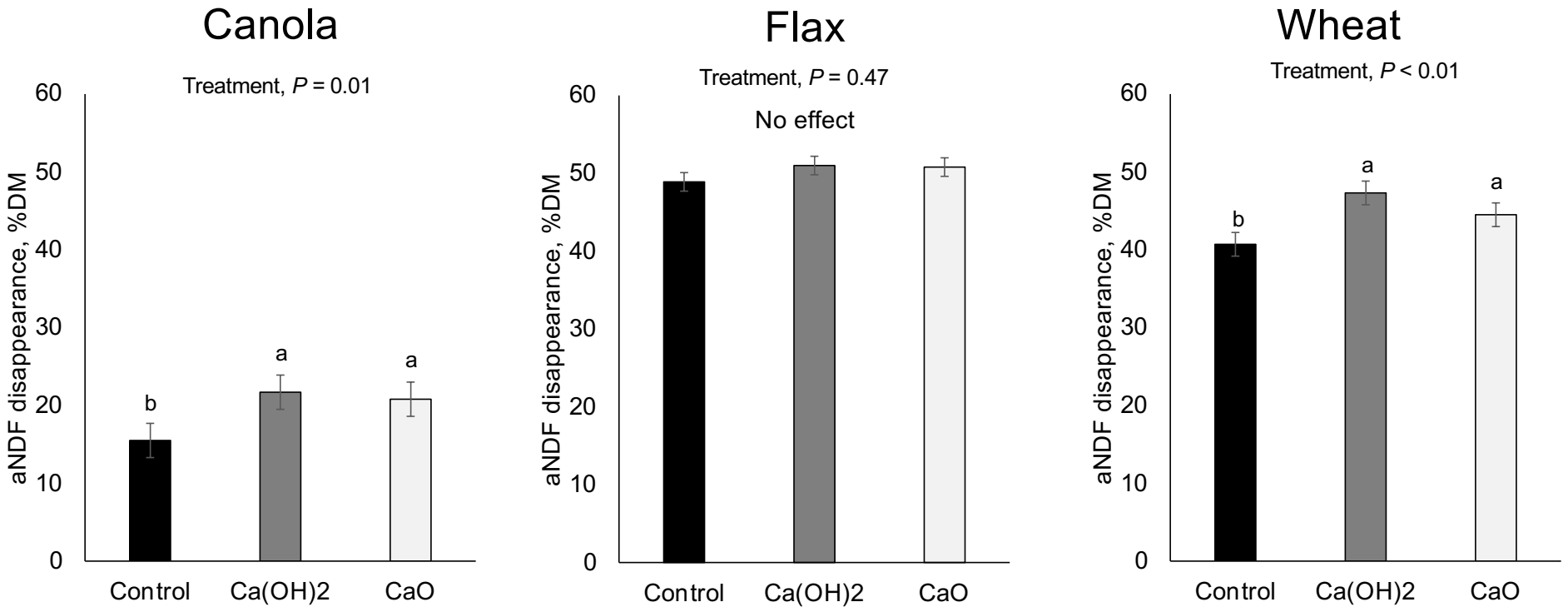
Alkali treatment increased 48-h in vitro aNDFom disappearance for canola and wheat



No effect of temperature at the time of treatment

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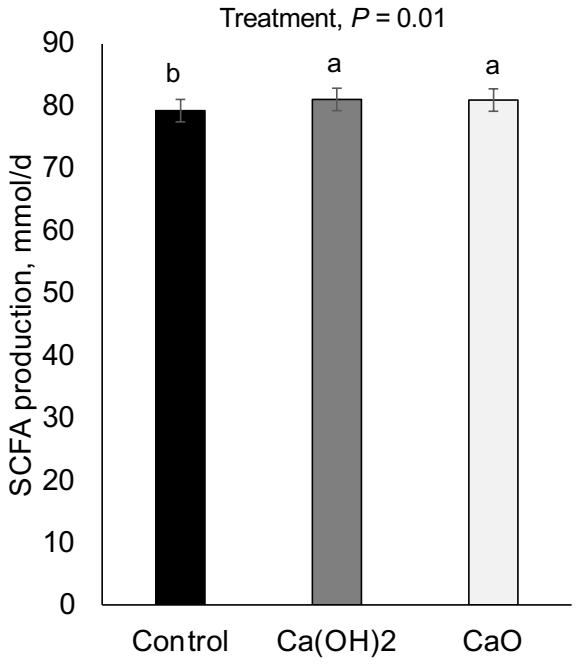
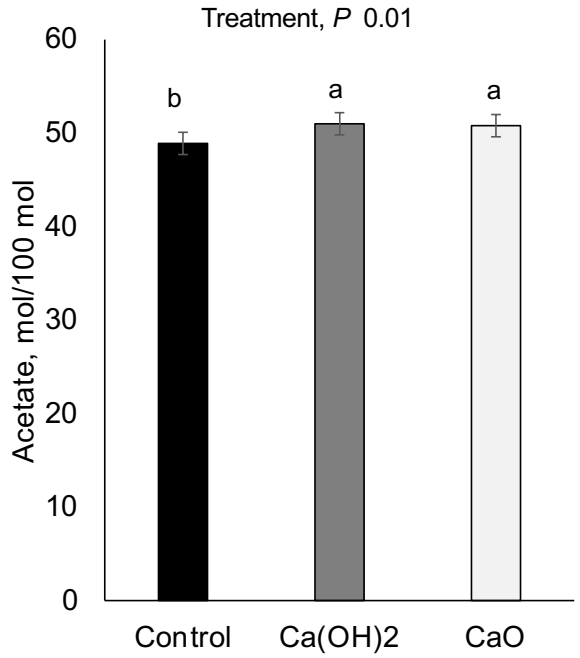
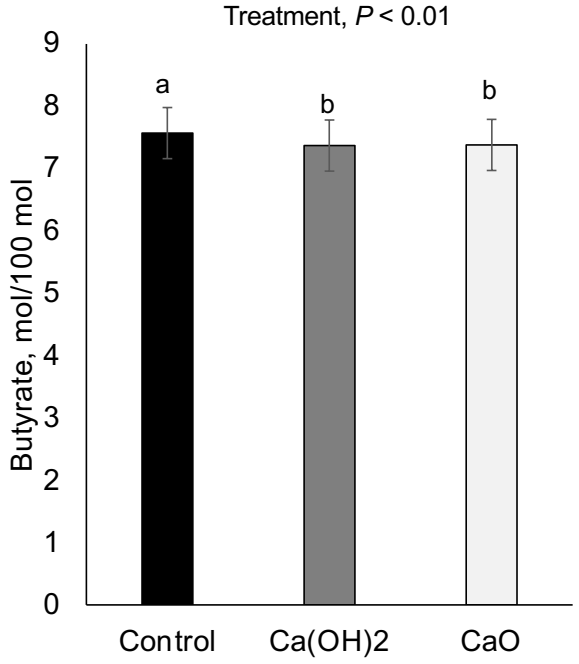
Alkali treatment increased in vitro short-chain fatty acid production and composition for canola







No effect of temperature at the time of treatment

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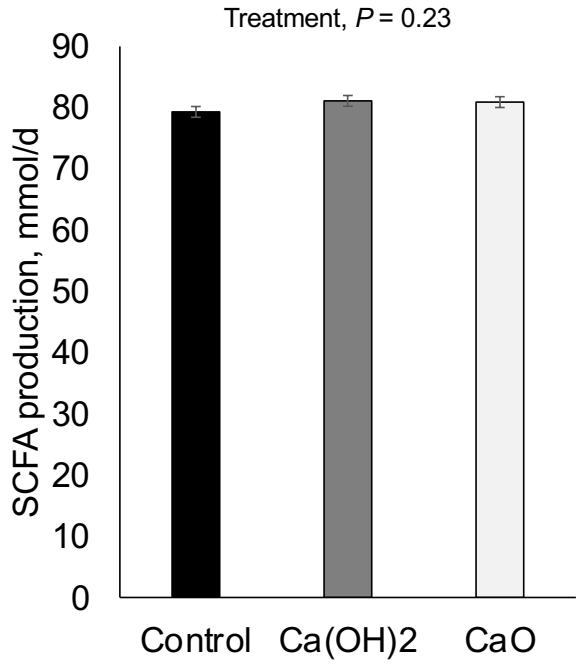
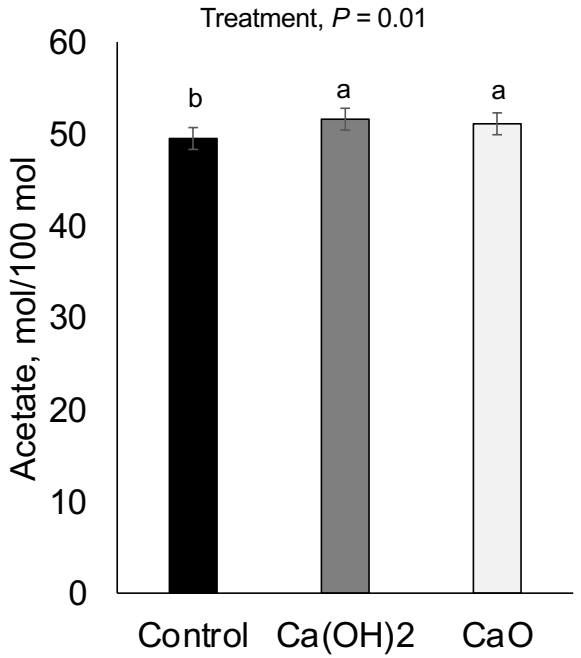
Alkali treatment did not affect in vitro short-chain fatty acid production but altered composition for flax





No effect of temperature at the time of treatment

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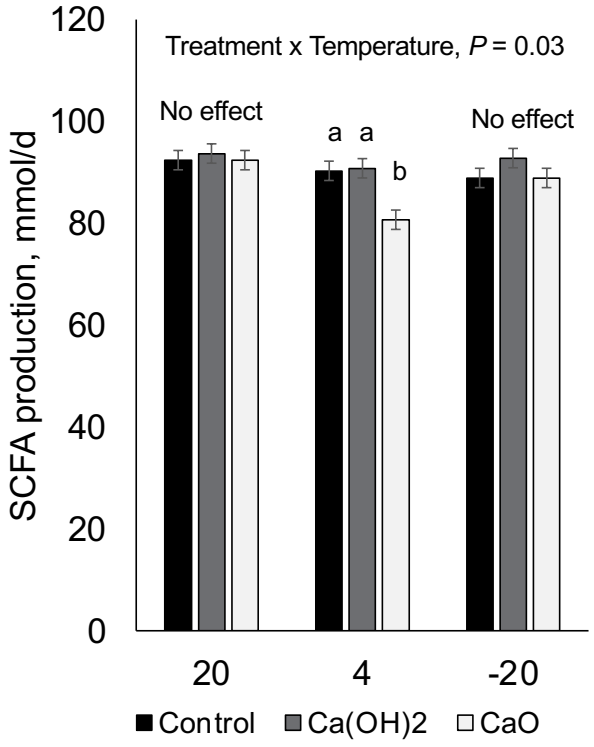
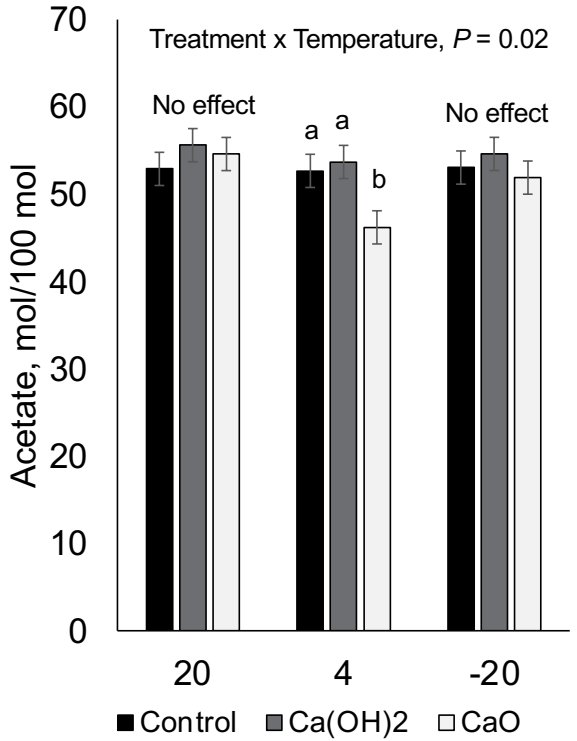
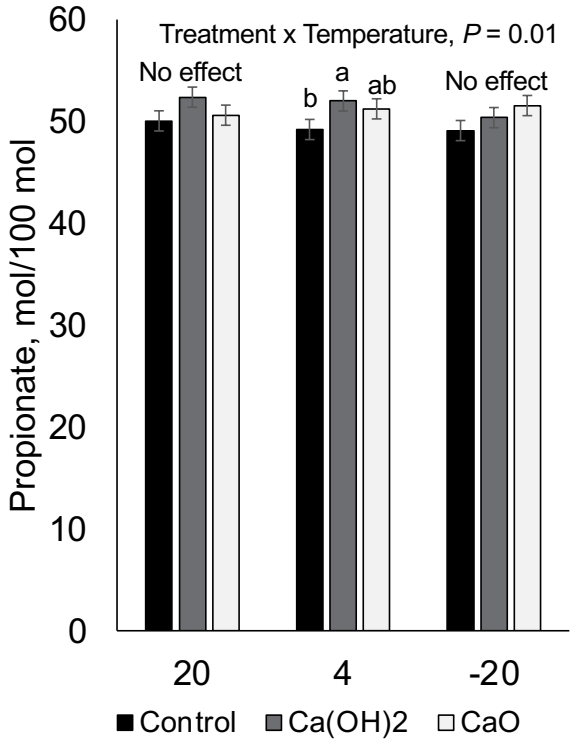
Alkali treatment interacted with temperature for wheat







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Conclusions

- Alkali treatment of crop residues has potential to increase the digestibility of canola and wheat straw
- There appears to be little effect of temperature on alkali treatment responses
- Alkali treatment may provide an opportunity for producers to use less used and more abundant straw sources

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Considerations with Implementation

- Alkali compounds are caustic
  - Respiratory protection
  - Potential damage to mixing and feeding equipment.
- Potential cost of alkali compounds
  - Should be used as a replacement for other Ca sources
- Substrate specificity (no effect for flax) will require further study to develop the best strategies for on-farm usage

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Further Research

- Future studies will need to look at 3 main areas
  a) Substrate specificity
  b) Economic impact of implementation
  c) Metabolism and performance studies to confirm practicality of use in live cattle

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Questions?

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