

VIABLE MITIGATION STRATEGIES FOR ENTERIC METHANE

Alexander N. Hristov
Department of Animal Science, The Pennsylvania State University

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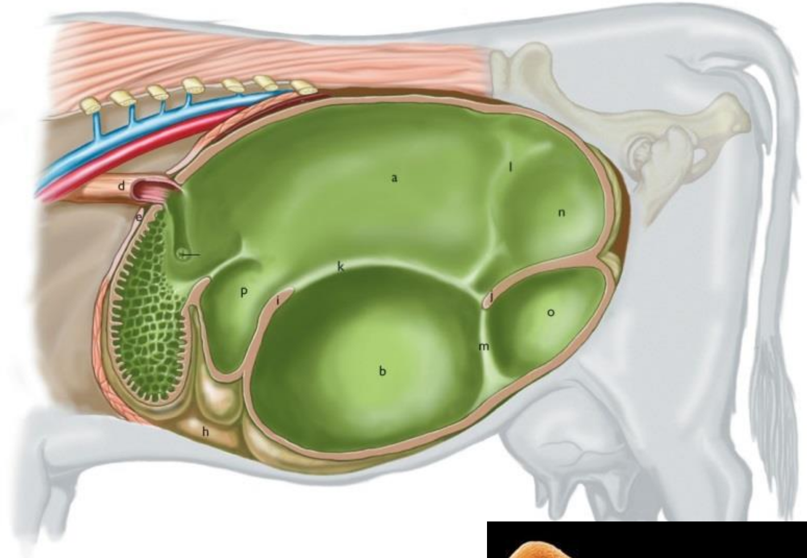
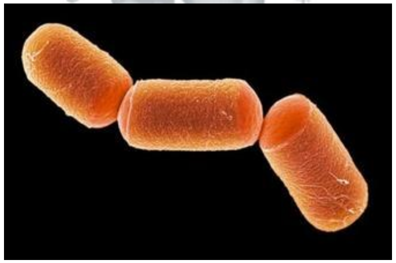
Methane emissions in ruminants

In dairy systems: probably close to half/half
In beef systems: the majority is enteric emissions



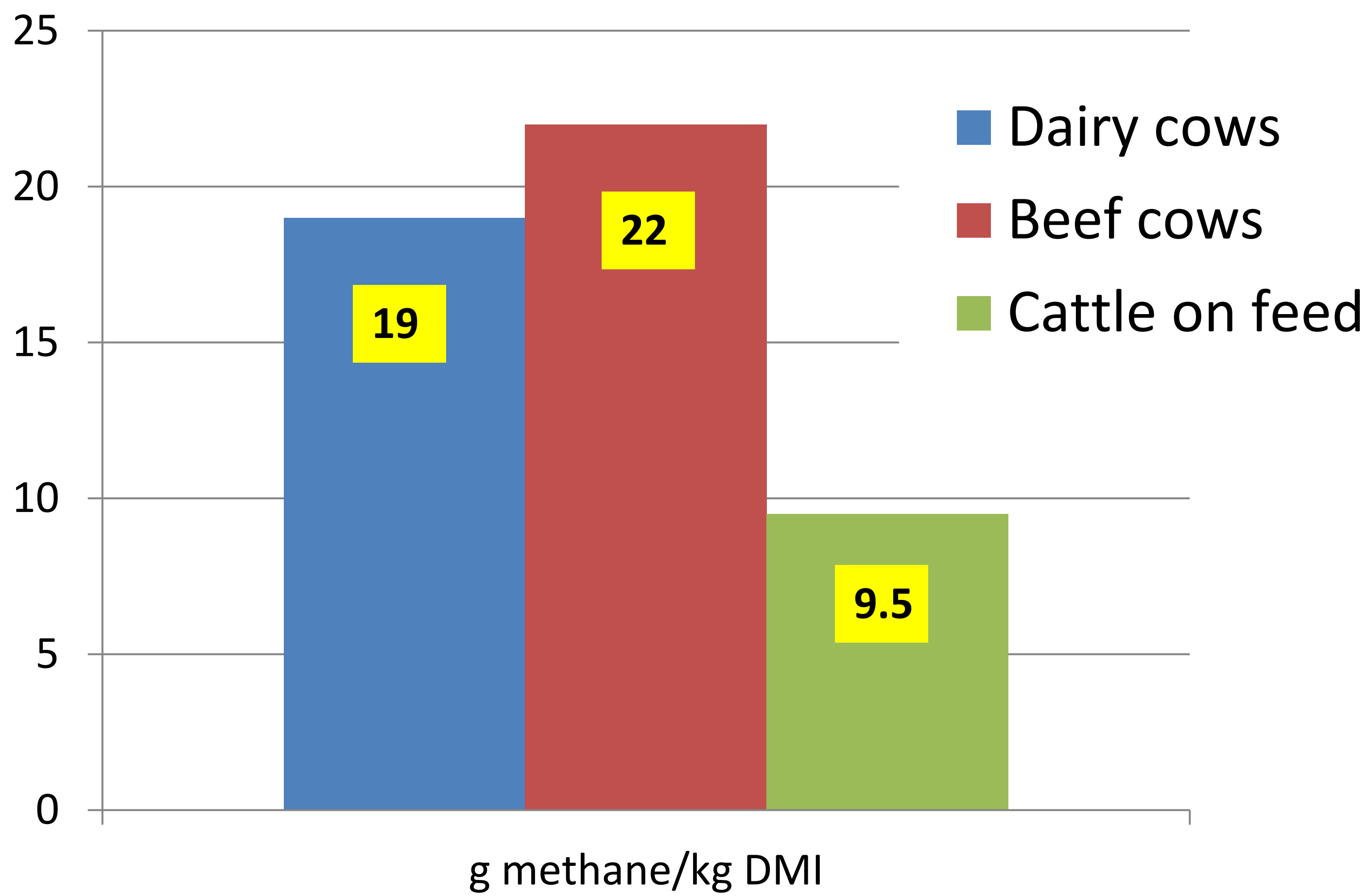
Methanobrevibacter



Hristov et al., 2018

More forage = more enteric methane

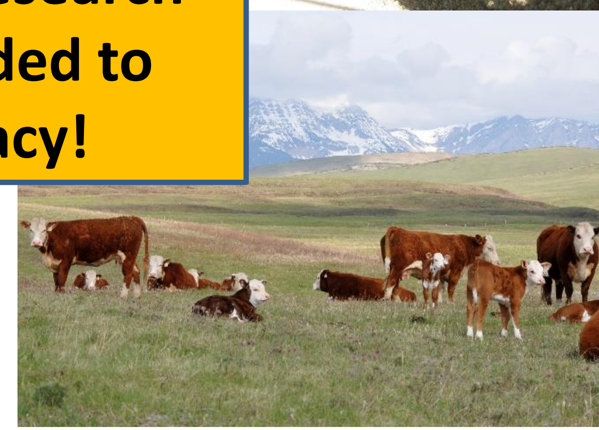
more grain and fat = less methane



Enteric methane mitigation strategies

- **Nutritional strategies**
  - Improving forage quality
  - Feeding concentrates
  - Lipids
  - Nitrates
  - Ionophores
  - Tannins & saponins
  - Methane inhibitors
  - Seaweeds
  - Precision feeding
- **Management strategies**
  - Immunization against methanogens
  - Manipulation of the rumen microbiome
  - Animal genetics, selecting for low-methane emission
  - Improving animal health
  - Lifetime productivity
  - IMPROVING ANIMAL FEED EFFICIENCY AND PRODUCTIVITY

With all these, well-designed and executed, independent research trials are needed to prove efficacy!



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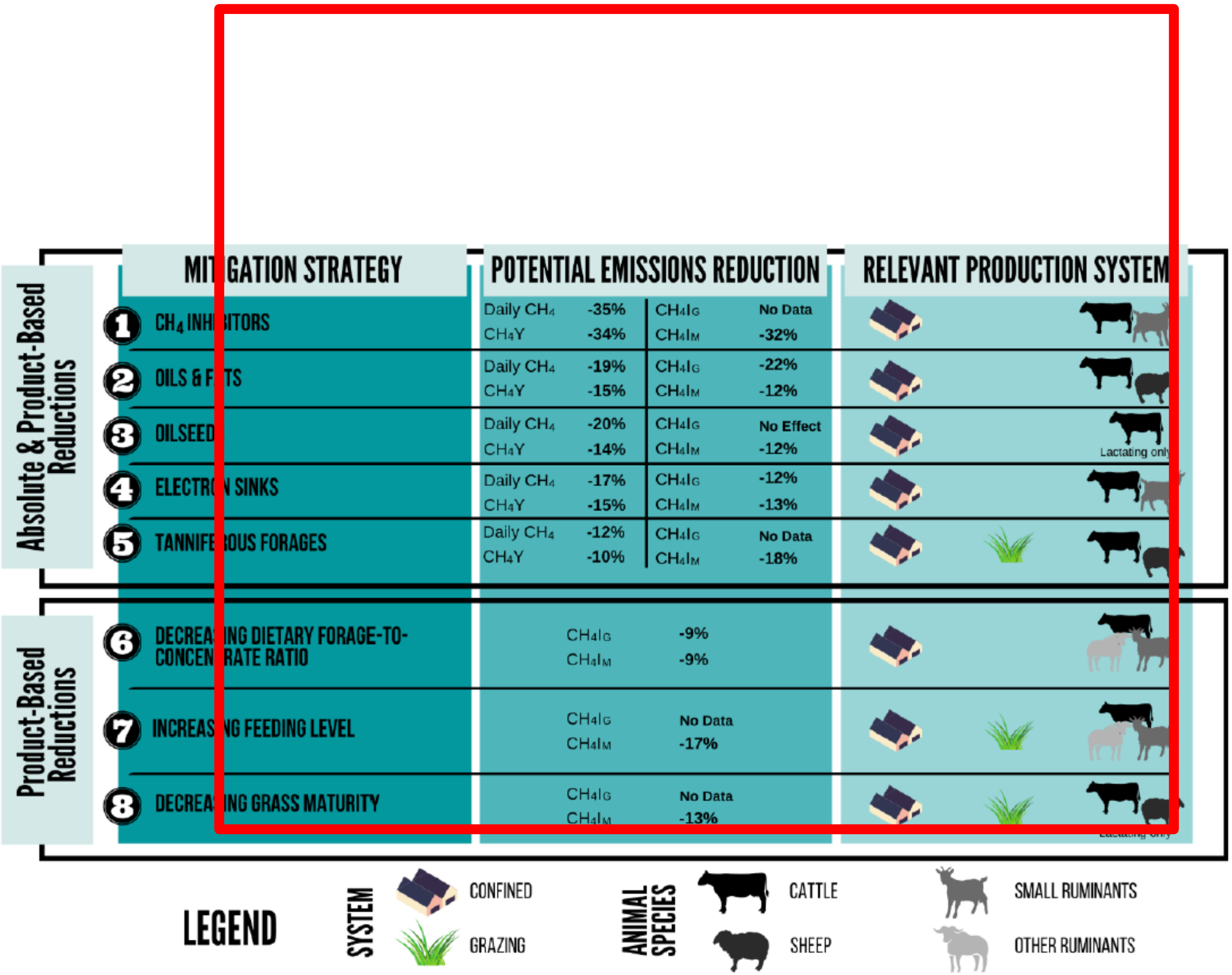
Arndt et al., 2022 (PNAS)

A meta-analysis of mitigation strategies for enteric methane



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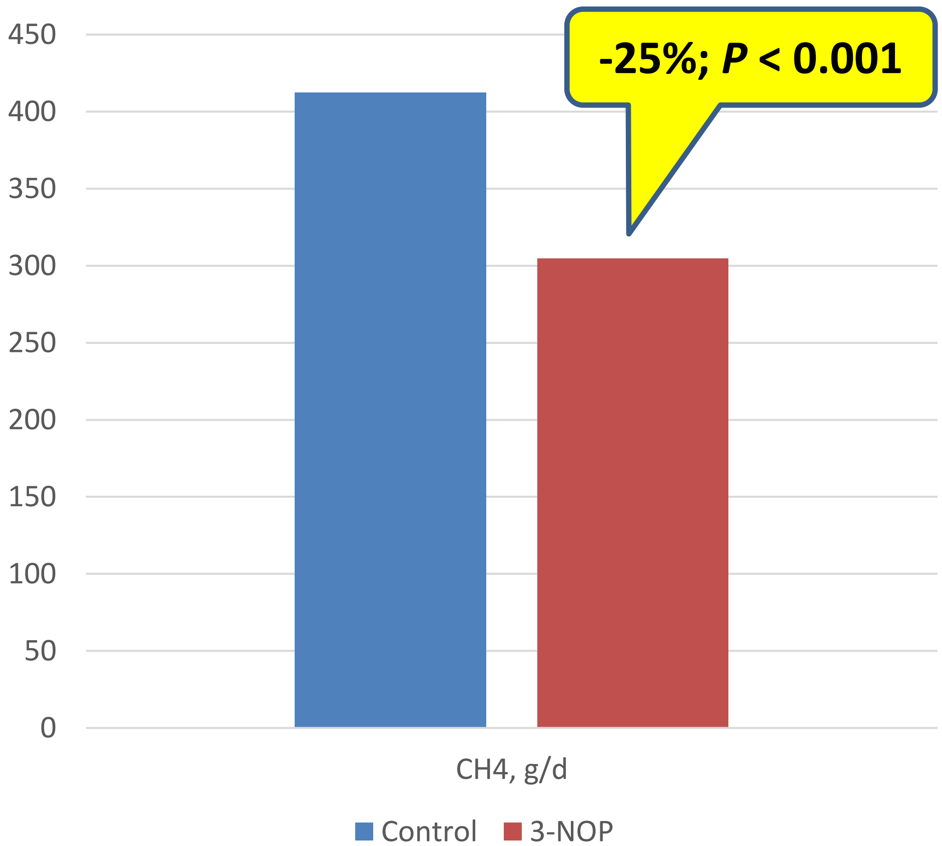
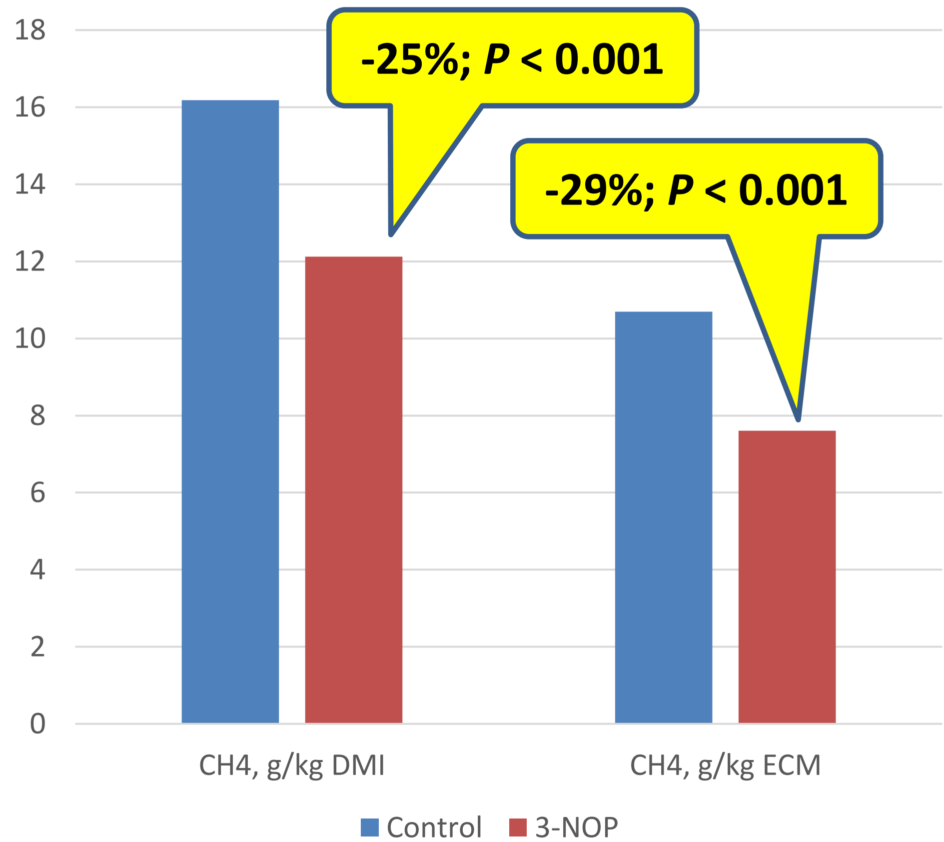
Melgar et al., 2019

Milk fat percentage was increased (*P* = 0.04) by 0.19%-units; yield was increased (*P* = 0.06) by 90 g/d

Meta-analysis of Penn State's 3-NOP data with dairy cows





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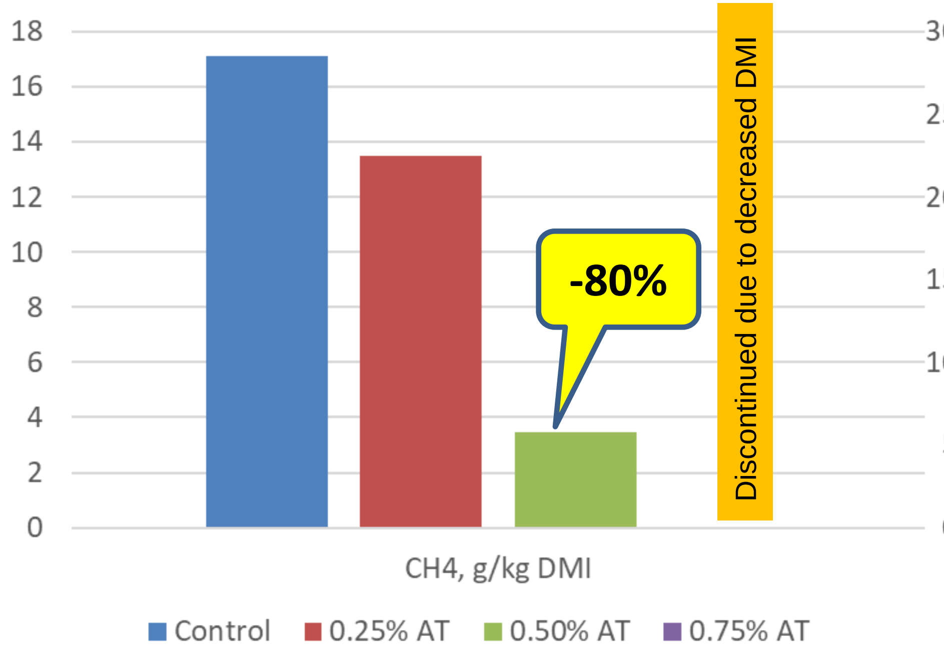
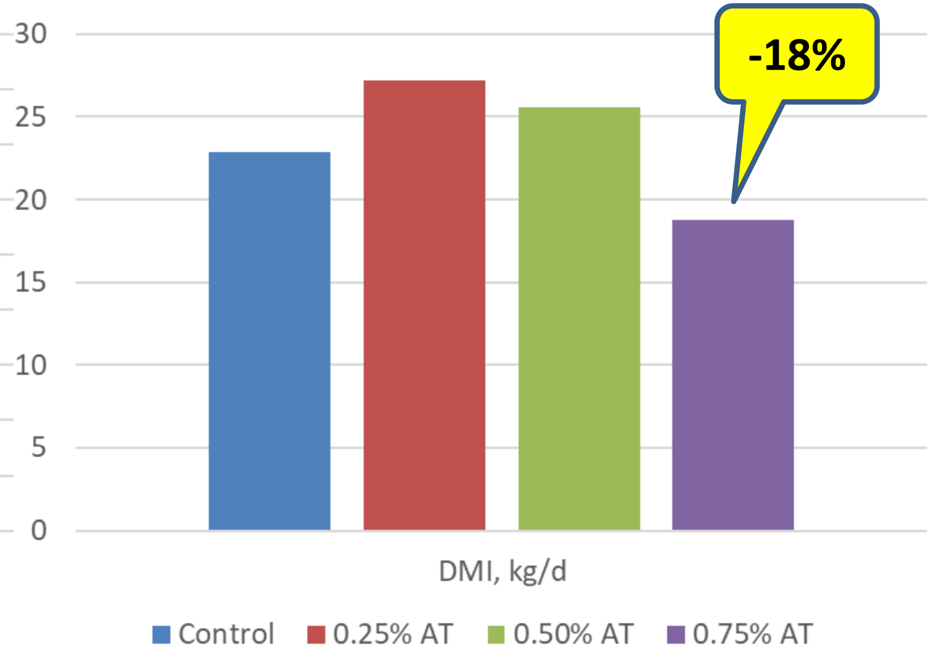
Large reduction in methane emission with *Asparagopsis taxiformis* in dairy cows

Asparagopsis taxiformis **(source: Penn State)**

Stefenoni et al., 2021





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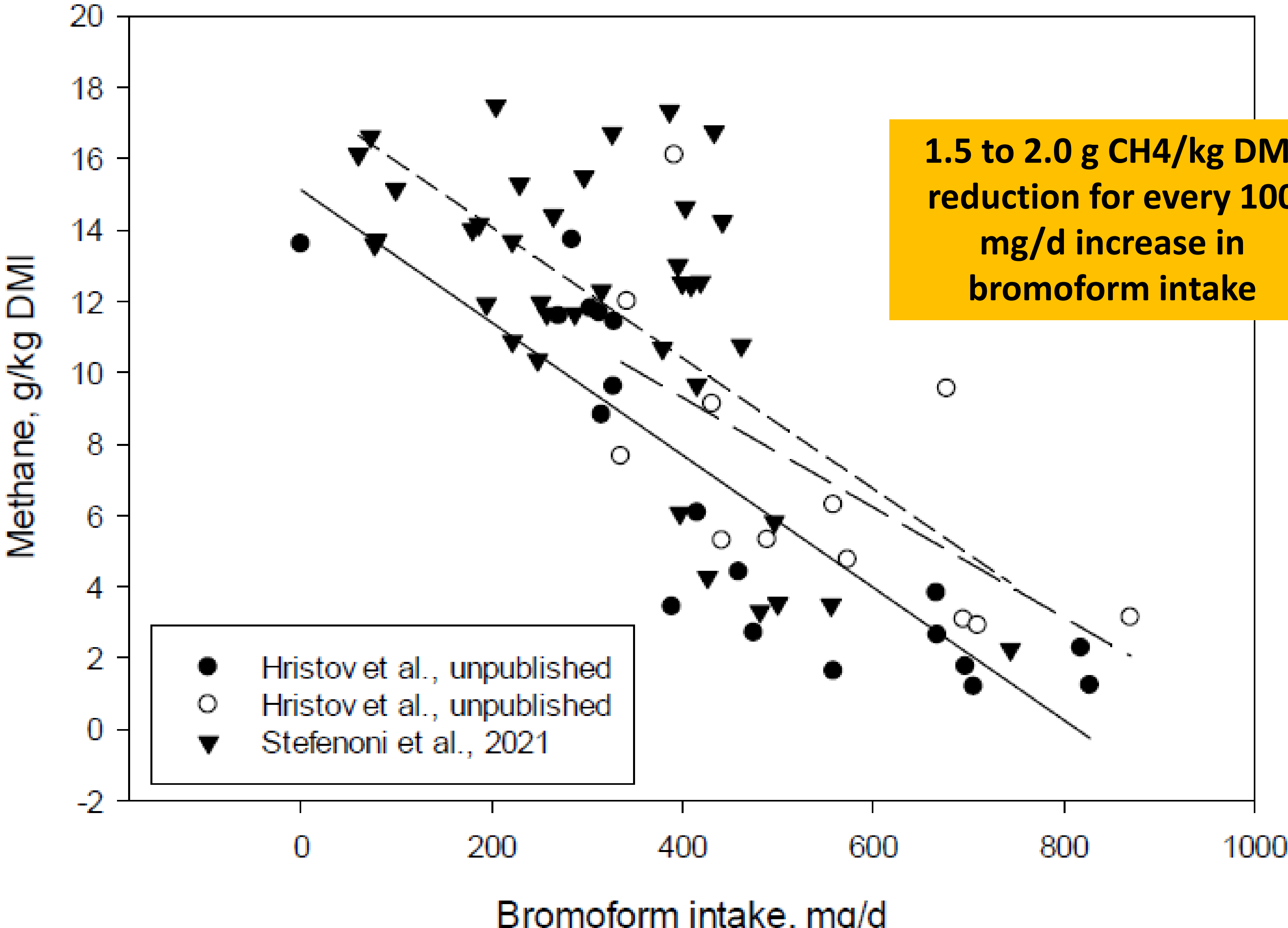
Bromoform intake and methane yield



1.5 to 2.0 g CH4/kg DMI reduction for every 100 mg/d increase in bromoform intake

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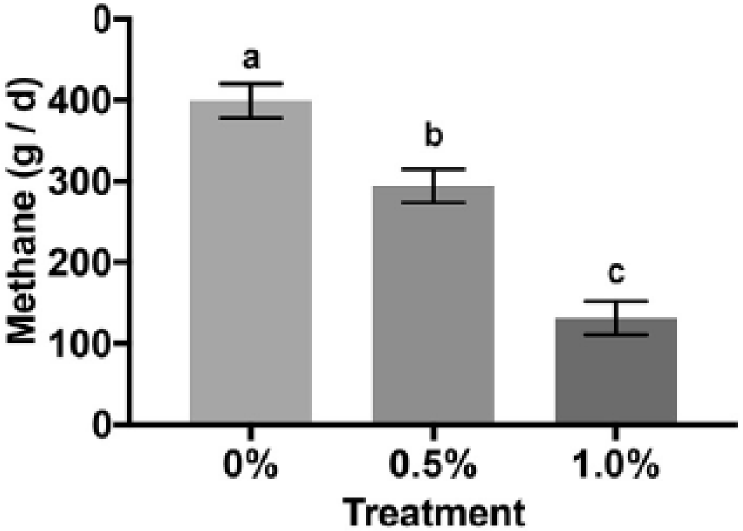
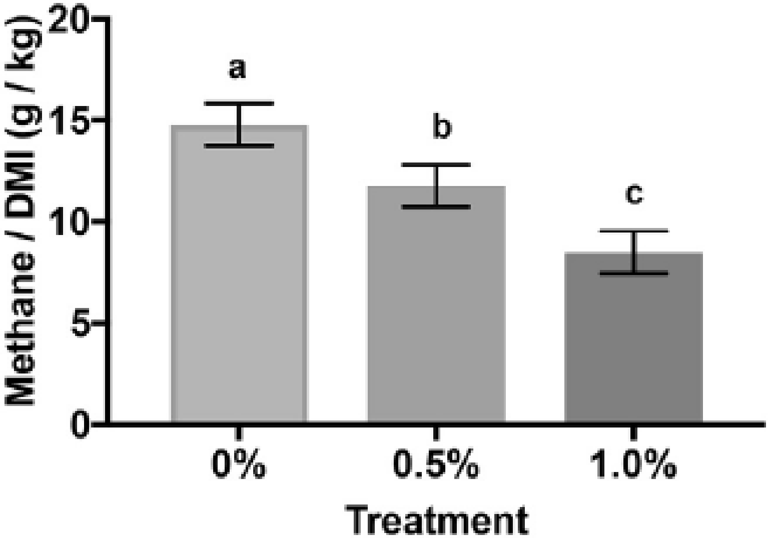
Roque et al., 2019

Similar results at UC Davis with *A. armata*





Many unanswered questions…

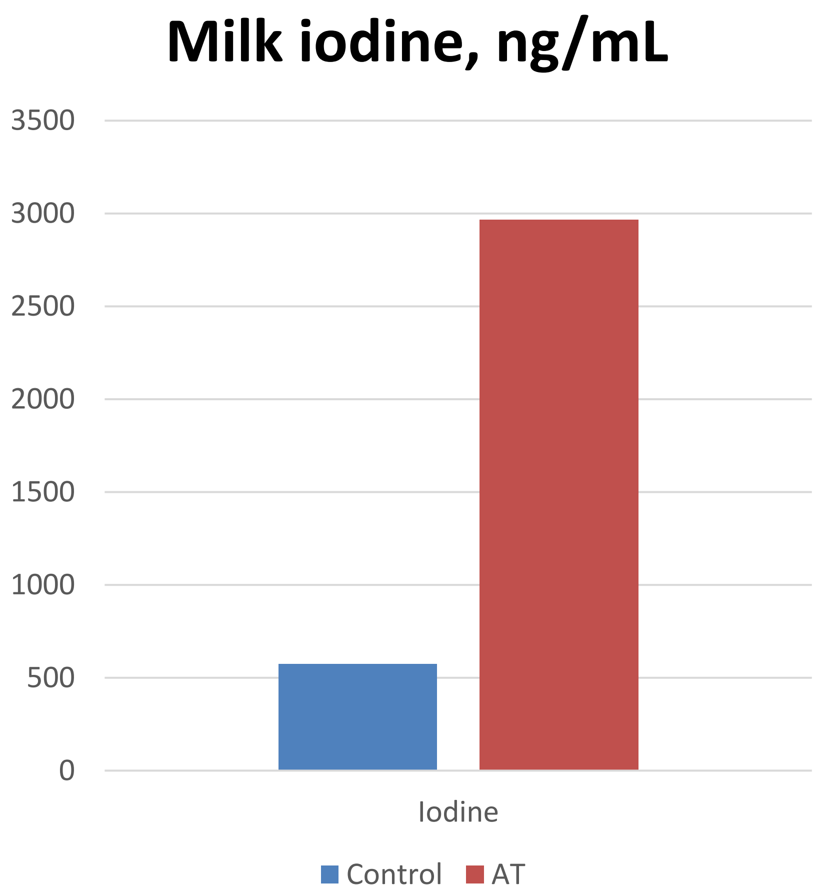
- How are bromoforms affected by:
  - Harvest, sunlight, transportation, processing & storage

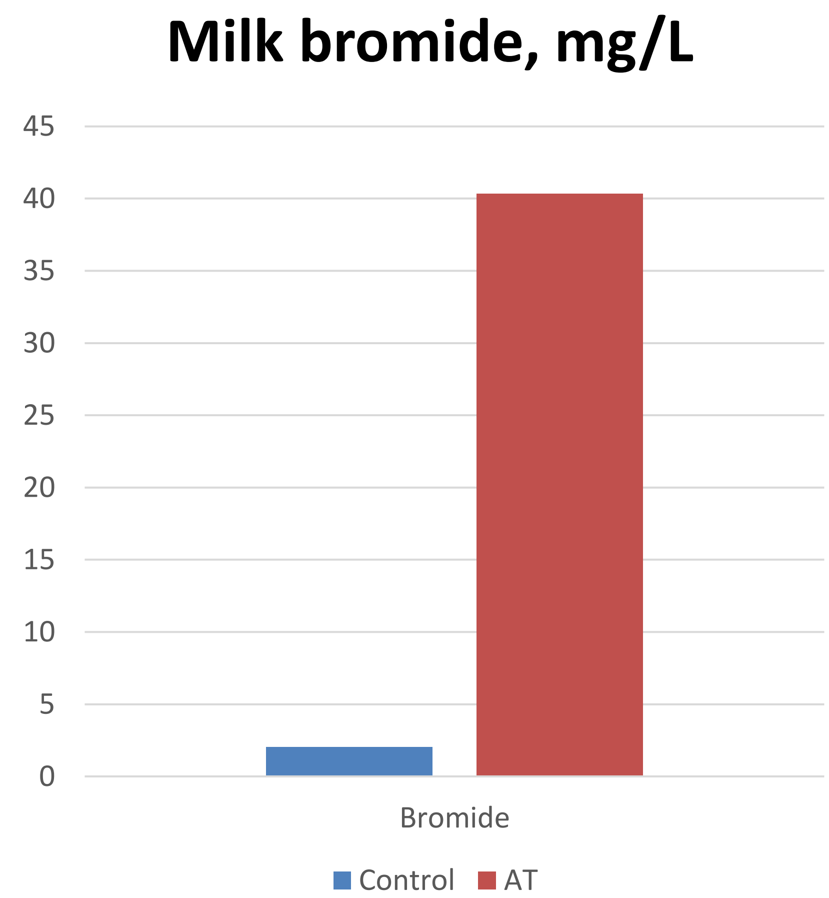
- Aquaculture production
- Rumen adaptation
- Doses/practicality
- Feasibility
- Long-term production effects
- Milk quality – I, Br
- Consumer acceptance

Asparagopsis taxiformis **(source: Wikipedia)**

Stefenoni et al., 2021

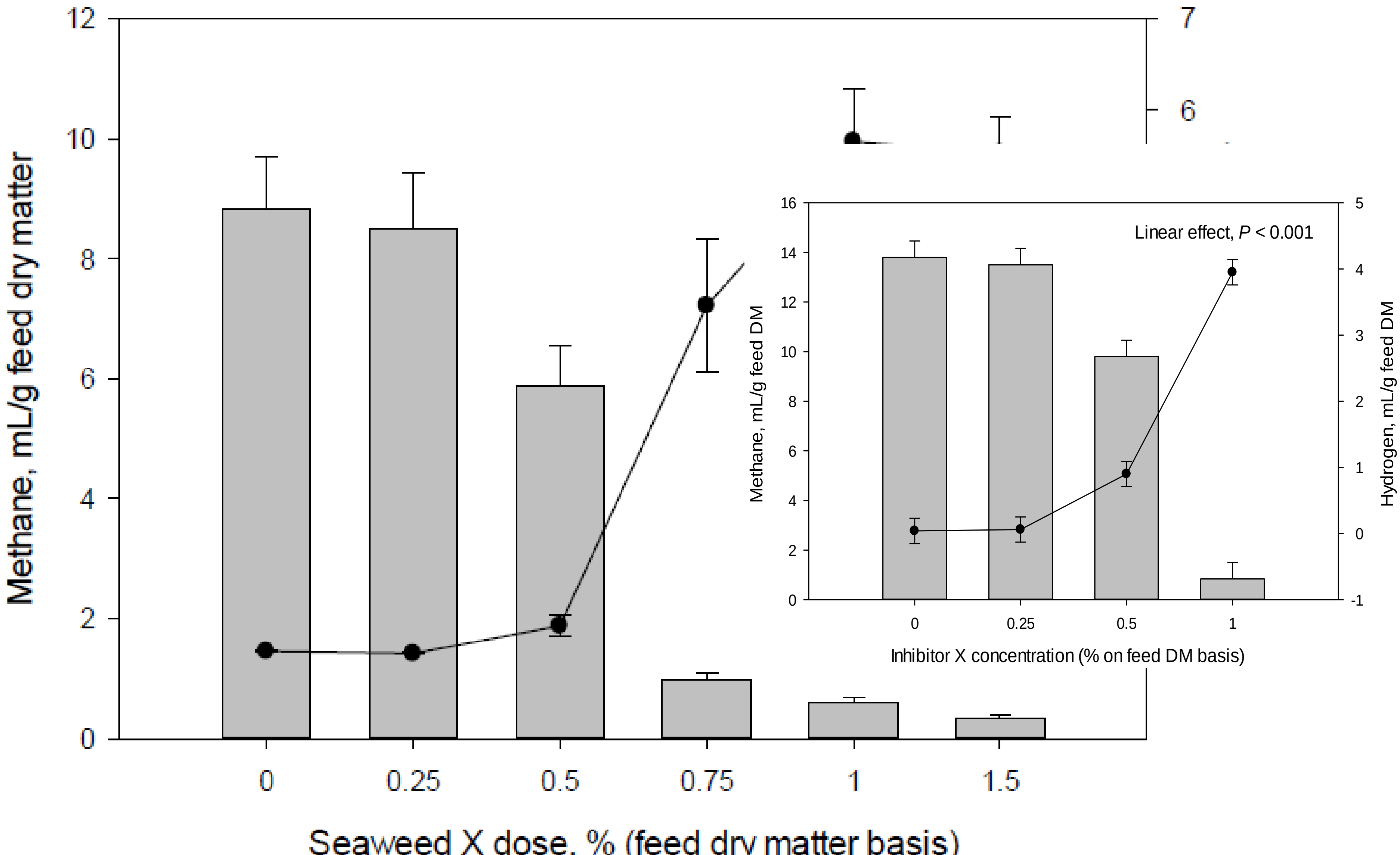
Milk quality





Wasson et al., 2021

Efficacy of new inhibitors or non-bromoform



Cannot be recommended until independent research is available to verify claims. The effect, if any, is unlikely to exceed 10%.

Plant extracts

- Numerous experiments
- Many in vitro, not followed up by animal trials
- Several commercial products:
  - **Mootral** (garlic/citrus extract) – one study with beef cattle showed 23% reduction in CH_4 yield at the end of the experiment (12 wks)
  - **Agolin** (a blend of essential oils) – a meta-analysis showed an overall 2% decrease in CH_4 yield and 13% beyond 28 d of treatment
  - **AVT** (capsicum & botanicals) – 5% decrease in CH_4 yield
  - Adaptation may be needed to show effects

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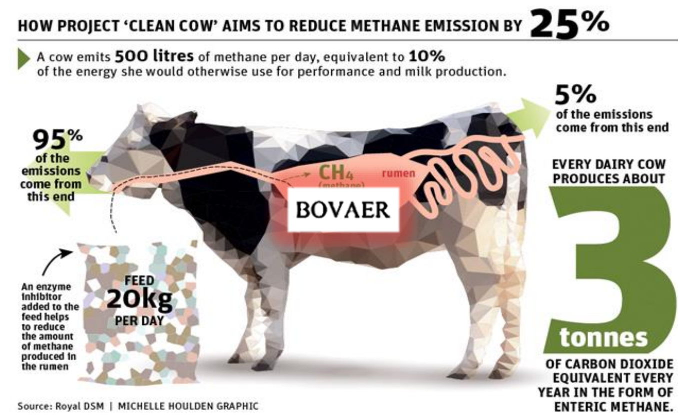
Take-home message

- Only 2 strategies have a pronounced mitigation effect on enteric methane – **need long-term, full lactation studies**
  - 3-Nitrooxypropanol (Bovaer), *Asparagopsis* spp.
- Oils can decrease methane by up to 20%
- Nitrates are also effective (15-19% decrease)
- Tannins may be effective, but more research is needed



- Combining mitigation practices may deliver an estimated 40% reduction
- So far, no evidence of any other feed additives with a consistent mitigation effect of over 10%
- Major constraints going forward:
  - Production responses to effective methane mitigants (co-benefits)
  - Practicality with some of the effective additives
  - Long-term effects and consistent responses with various diets are largely unknown
  - Delivery in grazing systems is challenging