In vitro metoder i forskning på drøvtyggere

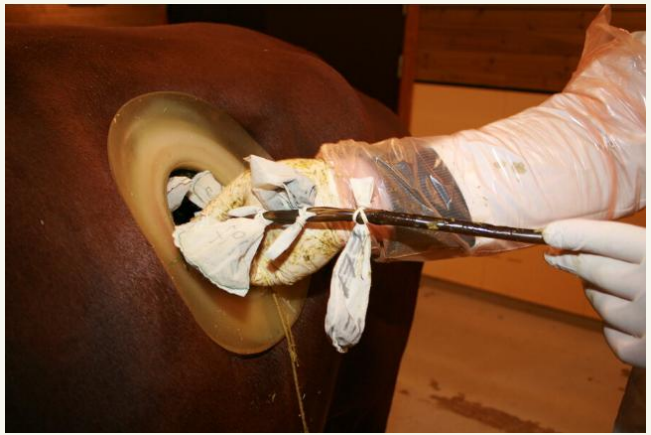
Angela Schwarm, professor i drøvtyggerernæring
Norges miljø- og biovitenskapelige universitet (NMBU)
angela.schwarm@nmbu.no



Erstatning av dyreforsøk – In vitro metoder i forskning og undervisning på drøvtyggere

Mitt arbeid og perspektiver relatert til 3R, med særlig fokus på alternativer til dyreforsøk:

- Forskning og undervisning i drøvtyggerernæring
- Alternativer til vomvæskesamling fra levende dyr (erstatte forsøk)
- Alternativer til forsøk med mange dyr (redusere / 'erstatte' dyreforsøk)



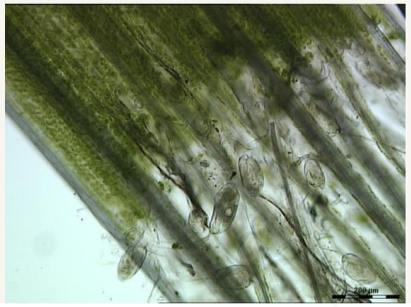


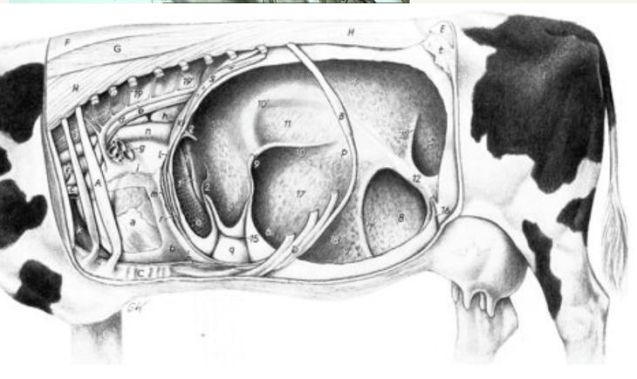
Jonas Løvaas Gjerstad



Senter for husdyrforsøk (SHF)

Ås gård – Livestock Production Research Center





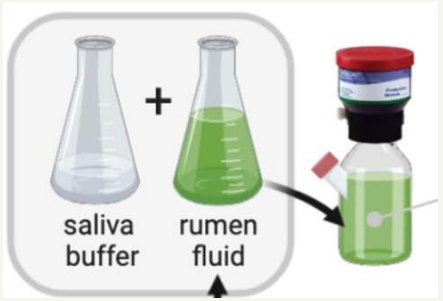


Norges miljø- og biovitenskapelige universitet



Senter for husdyrforsøk (SHF)

Alternativer til vomvæskesamling fra levende dyr



Can. J. Anim. Sci. **98:** 61–72 (2018) dx.doi.org/10.1139/cjas-2016-0238

NRC Research Press

ARTICLE

Utility of an in vitro test with rumen fluid from slaughtered cattle for capturing variation in methane emission potential between cattle types and with age

Shaopu Wang, Jana Pisarčíková, Michael Kreuzer, and Angela Schwarm



https://doi.org/10.3390/mps5040059

Forskning	Dyreforsøk (*in vivo*)	**Erstatning (*in vitro*)**
Fôrmidler's metanproduksjon, fordøylighet, fermentasjonsprodukter	Vomvæske … • fra kanylerte drøvtyggere • via spiserørslange	• **Vomvæske fra slaktede drøvtyggere** • **Ren kultur av *Methanobrevibacter ruminantium*** 



Journal of Applied Microbiology

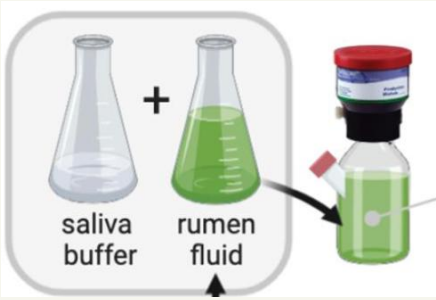
Journal of Applied Microbiology ISSN 1364-5072

ORIGINAL ARTICLE

Influence of pH and the degree of protonation on the inhibitory effect of fatty acids in the ruminal methanogen *Methanobrevibacter ruminantium* strain M1

X. Zhou[1], J.O. Zeitz[1,2], L. Meile[3], M. Kreuzer[1] and A. Schwarm[1]

Alternativer til vomvæskesamling fra levende dyr



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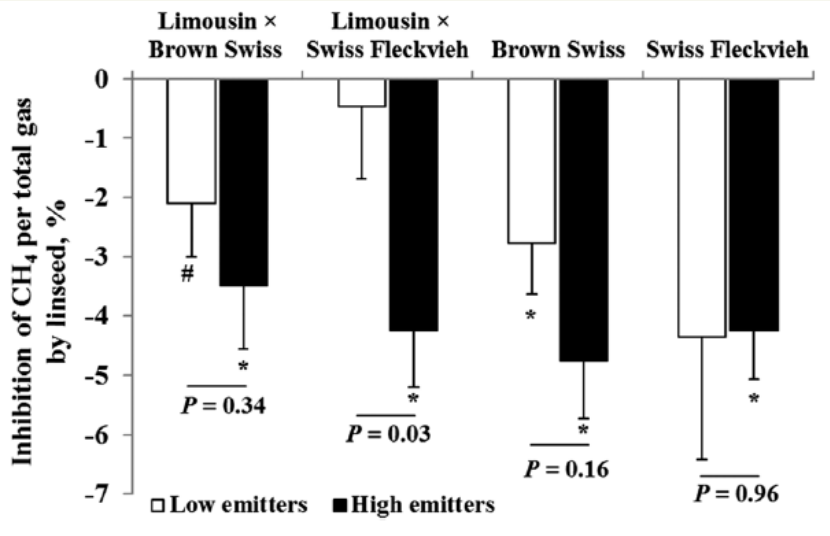
Shaopu Wang, Jana Pisarčíková, Michael Kreuzer, and Angela Schwarm



https://doi.org/10.3390/mps5040059

+ Vomvæske fra slaktede drøvtyggere kan brukes

- Fôret og fôropptak av slaktede dyr ukjent



Animal Feed Science and Technology 216 (2016) 1–18

Contents lists available at ScienceDirect

Animal Feed Science and Technology

journal homepage: www.elsevier.com/locate/anifeedsci

ELSEVIER

Review article

Design, implementation and interpretation of *in vitro* batch culture experiments to assess enteric methane mitigation in ruminants—a review

Yáñez-Ruiz D.R.[a,*], Bannink A.[b], Dijkstra J.[c], Kebreab E.[d], Morgavi D.P.[e], O'Kiely P.[f], Reynolds C.K.[g], Schwarm A.[h], Shingfield K.J.[i,j], Yu Z.[k], Hristov A.N.[l]

Alternativer til forsøk med mange dyr

+ Vomvæskesamling redusert fra 3 dager × 3 dyr (anbefalt) til 1 dag × 3 dyr

- Pilotstudie bare, kan ikke publiseres i journal Anim Feed Sci Technol,

  men lavere impact journaler som AAS

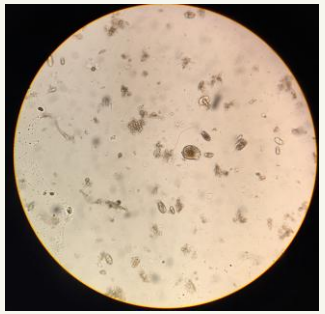
+ Vitenskapsbasert utdanning, 'living-lab'











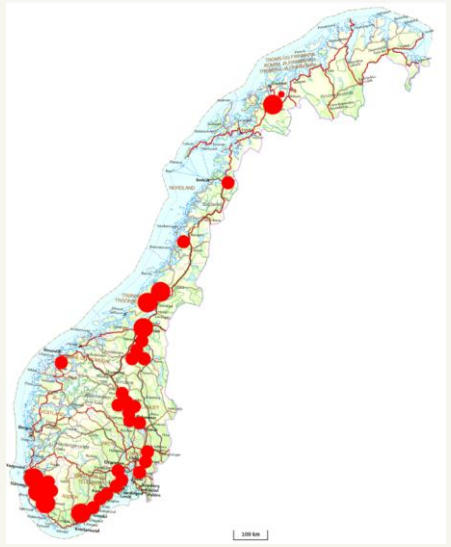
Alternativer til forsøk med mange dyr

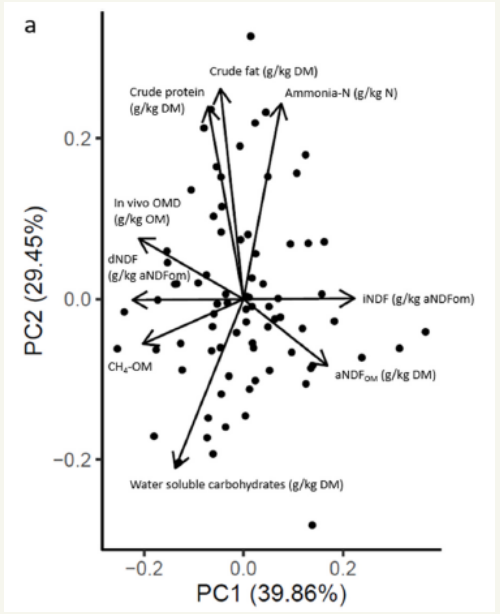
In vitro screening av 78 type grovfôr med vomvæske fra 2 kyr,

in situ/in sacco forsøk av 78 type grovfôr med 2 kyr (for iNDF),

in vivo forsøk av 78 type grovfôr med 3 sau (for OMD),

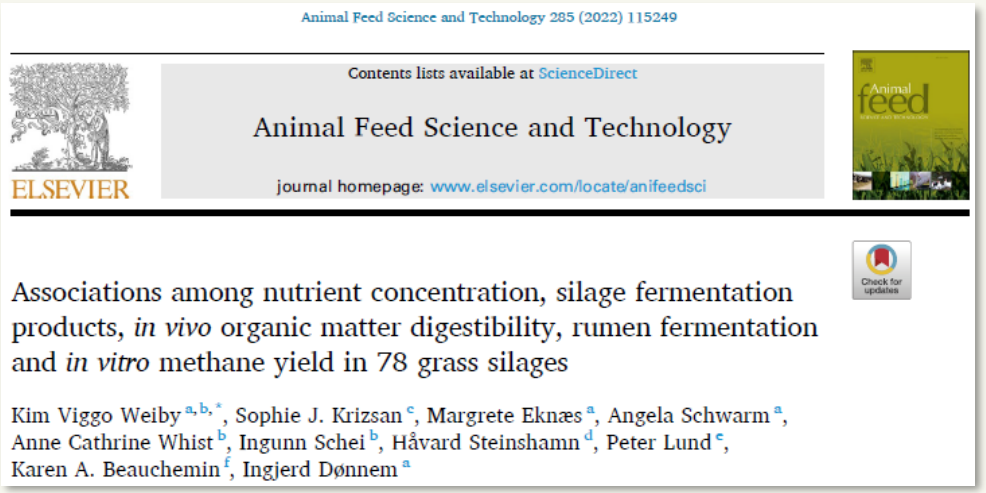
in vivo forsøk med 4 typer grovfôr med 40 kyr



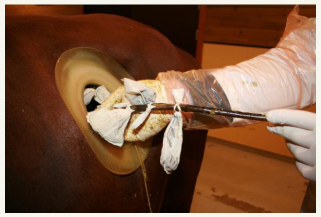














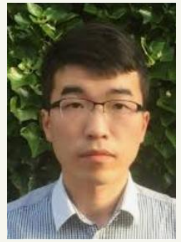


Alternativer til forsøk med mange dyr

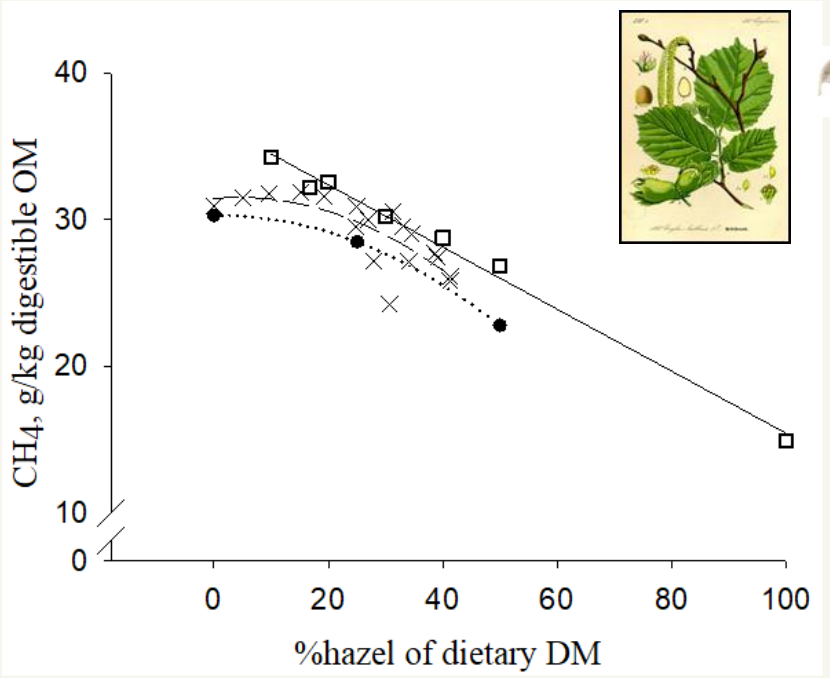
In vitro screening av 18 planter, fôropptak med 6 planter, sauforsøk med 1 plant, kuforsøk med 1 plant, like resultater *in vitro* og *in vivo* for metanproduksjon ifm haselblad (*Corylus avellana*)



M Terranova



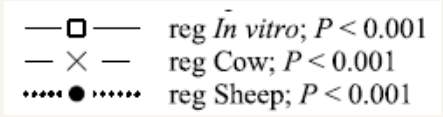
S Wang











The Journal of Agricultural Science
cambridge.org/ags
Animal Research Paper

In vitro screening of temperate climate forages from a variety of woody plants for their potential to mitigate ruminal methane and ammonia formation

M. Terranova[1], M. Kreuzer[1], U. Braun[2] and A. Schwarm[1]

Animal (2020), 14:3, pp 538–548 © The Animal Consortium 2019
doi:10.1017/S1751731119002076
animal

Dose-response effects of woody and herbaceous forage plants on *in vitro* ruminal methane and ammonia formation, and their short-term palatability in lactating cows

M. Terranova[1,†], S. Wang[1,a], L. Eggerschwiler[2], U. Braun[3], M. Kreuzer[1] and A. Schwarm[1,4]

www.nature.com/scientificreports
SCIENTIFIC REPORTS
OPEN

Supplementation of Pelleted Hazel (*Corylus avellana*) Leaves Decreases Methane and Urinary Nitrogen Emissions by Sheep at Unchanged Forage Intake

Received: 17 November 2017
Accepted: 12 March 2018
Published online: 03 April 2018

Shaopu Wang[1], Melissa Terranova[1], Michael Kreuzer[1], Svenja Marquardt[1], Lukas Eggerschwiler[2] & Angela Schwarm[1]

Animal Feed Science and Technology 276 (2021) 114790
Contents lists available at ScienceDirect
Animal Feed Science and Technology
journal homepage: www.elsevier.com/locate/anifeedsci
ELSEVIER

Increasing the proportion of hazel leaves in the diet of dairy cows reduced methane yield and excretion of nitrogen in volatile form, but not milk yield

M. Terranova[a,b,*], L. Eggerschwiler[c], S. Ortmann[d], M. Clauss[e], M. Kreuzer[a], A. Schwarm[a,f]

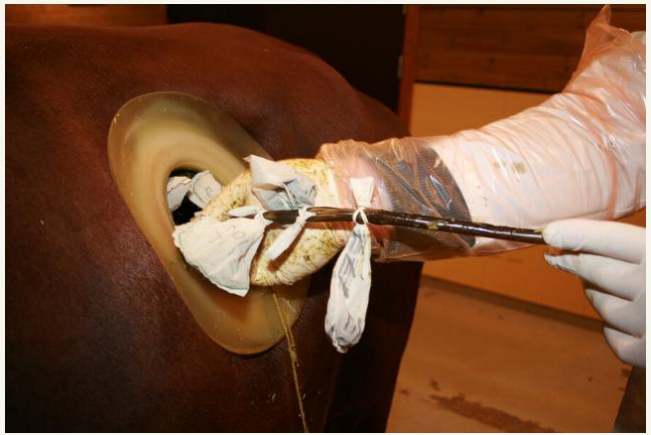
In vitro metoder i forskning på drøvtyggere

+ Mulighet å screene mange fôrprøver, metaninhibitorer, mekanismer

+ Vomvæskesamling fra få levende dyr kan erstatte forsøk med mange dyr

+/- Vomvæskesamling fra slaktede dyr kan delvis erstatte samling fra levende dyr

- Absorption av flyktige fettsyrer og effekt på melkeproduksjon savnes *in vitro*





Jonas Løvaas Gjerstad



Senter for husdyrforsøk (SHF)