

# Concentrate of polyphenols such as natural tannins and flavonoids from willow and hemp as organic feed additive for methane reduction in dairy cows

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Project ECOCO2W: Aarhus University is heading a new project to investigate whether willow and hemp have potential as bioactive feed additives, which can inhibit methane emission from cattle. The project is carried out in collaboration with the Innovation Centre for Organic Farming, Ny Vrå Bioenergy, Bio2Products, Danish Technological Institute and SEGES

## Green Transition Idea

- The primary idea is to develop a new feed additive as an important climate initiative for organic cattle producers to reduce the enteric methane production in dairy cows with 30%.
- This is expected to be achieved by adding plant extracts from organically grown willow and hemp, plants with a high content of polyphenols such as tannins and flavonoids that inhibit methanogenic microorganisms.

## Project step-by-step

Step 1. Screening of willow- and hemp varieties for best yield of polyphenols. Varieties suitable for cultivation and biorefining in DK → **Results**

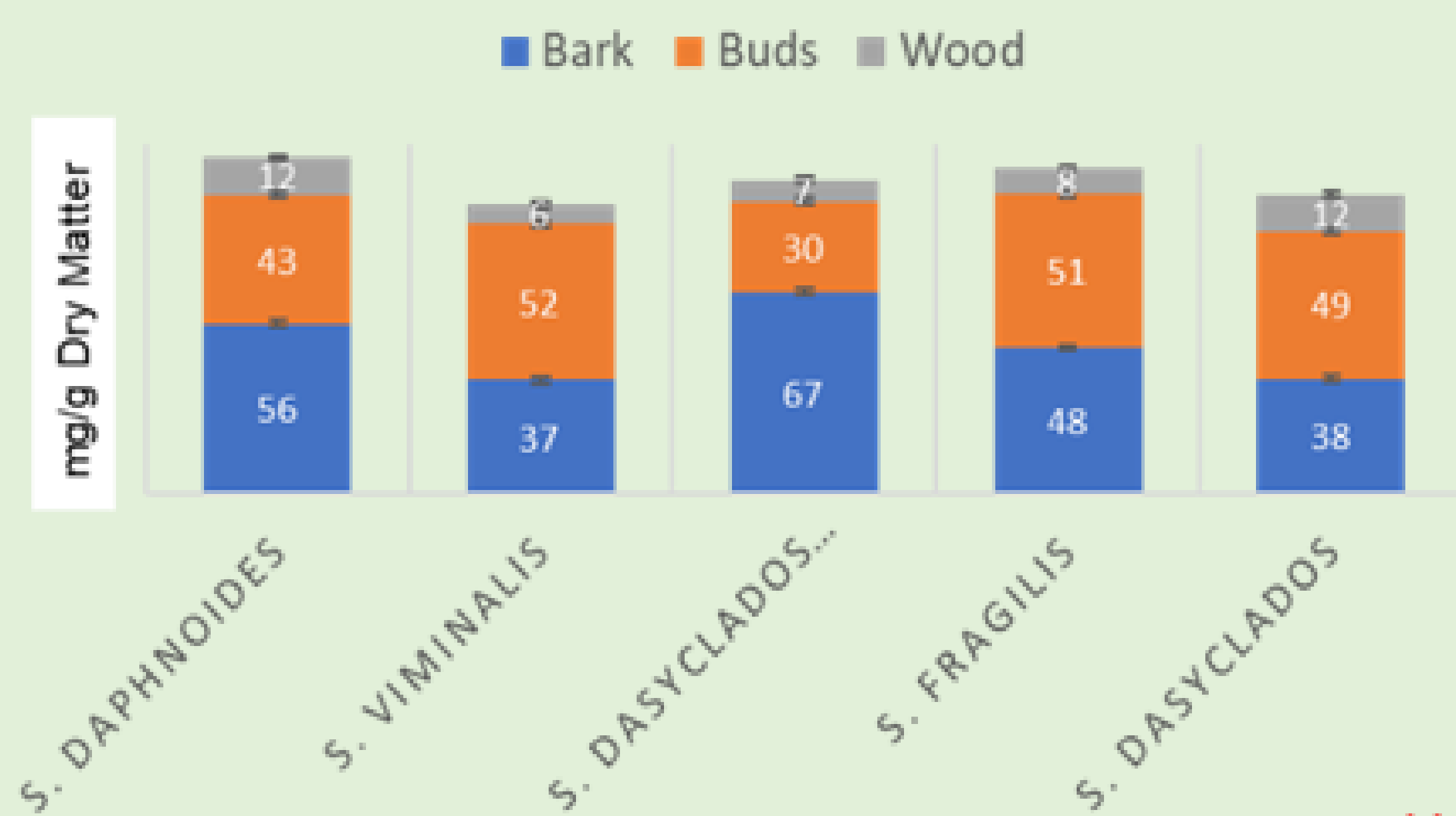
Step 2. Test of mechanic/thermic extraction and, possibly, drying/pelleting/crushing of residual product / bedding product → **In process**

Step 3. Screening of plant extracts/pure phenols in in vitro fermentation model → methane is measured in relation to control. The goal is 30% methane reduction → **Results/In process**

Step 4. Feeding experiments with fistulated cows → most effective feed additives will be tested in a larger herd → **First trial is planned in 2024**

## Results until now

### TOTAL PHENOLIC CONTENT



Willow: Collected February



### Dose-response with maize and grass silages

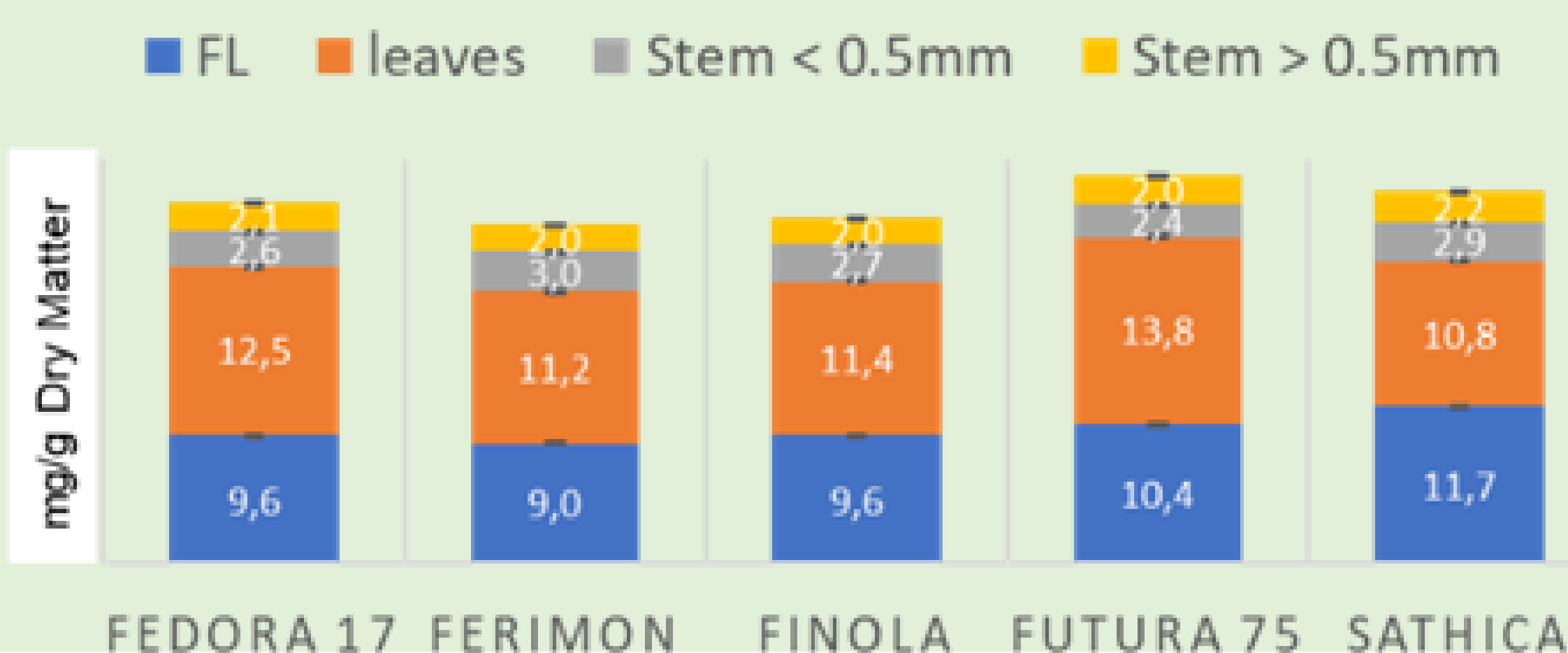
- Methane reduction > 50% with pure polyphenol (3 og 6% inclusion on Dry Matter basis)

Additive	Inclusion dose % DM	TGP mL/g DM	TGP mL/g dDM	CH4 mL/g DM	CH4 mL/g dDM	CH4% TGP	CH4:CO2%	dDM%
CTRL	0	125	174	7,53	10,6	7,07	29,8	71,5
Polyphenol	1,5	124	181	7,68	11,3	6,84	27,2	68,6
	3	109**	164	3,53**	5,02**	3,91**	20,1**	65,5**
	6	96,7**	172	1,69**	3,06**	2,42**	14,1**	56,4**

\*\* , statistically different values compared to the Control (p < 0.05); Total Gas Production (TGP); Methane (CH<sub>4</sub>); Dry Matter (DM); degradable DM (dDM)

Hemp: Collected in September

### TOTAL PHENOLIC CONTENT



- Ammonia reduction with pure polyphenol (3 og 6% inclusion on Dry Matter basis (DM))
- No Volatile Fatty Acids (VFA) or pH changes

Additive	Inclusion dose % DM	pH	Total VFA mmol/L	Acetic acid %	Propionic acid%	Butyric acid%	Ammonia mM
CTRL	0	6,82	67,7	67,8	18,2	9,56	15,2
Polyphenol	1,5	6,77	64,9	68,1	18,3	9,51	14,3
	3	6,8	65,3	67,9	19,1	9,25	13,4**
	6	6,78	62,5	68,6	18,3	9,72	12,4**

\*\* , statistically different values compared to the Control (p < 0.05)

## Conclusion

- Willow and hemp contain bioactive polyphenols and tannins
- Pure polyphenols inhibited methane production by >50% and ammonia by >12% with only slight decrease in feed degradability of 8% and no effect of production of volatile fatty acids in vitro
- Further in vivo experiments will be performed in the near future

## Funding

Project "Tannins of willow and hemp as organic feed additive for methane reduction in dairy cows (ECOCO2W) is part of the Organic RDD 7 program, which is coordinated by the International Center for Research in Organic Food Systems (ICROFS). It has received grants from the Green Growth and Development program (GUDP) under the Danish Ministry of Food, Agriculture, and Fisheries.

NY VRAA

Innovationscenter for Økologisk Landbrug

Bio2Products Aps



TEKNOLOGISK INSTITUT

SEGES

AARHUS UNIVERSITY

ICROFS Organic RDD

Ministeriet for Fødevarer, Landbrug og Fiskeri  
gudp

# ECOCO2W projekt

## Udtræk fra Pil og hamp hæmmer metan i malkekvæg

Planteudtræk med tanniner og flavenoider udnyttes til fremstilling af foderadditiv til malkekøer



### Hvorfor opkoncentrere til foderadditiv, når vi kan fodre med råvaren?

- Af hensyn til sikker reduktion af metan året rundt
- Kan tildeles via foderminerale
- Pil og hamp dyrkes allerede og bioraffineres på økologiske gårde til flere formål.
- Pilekstrakt er allerede på listen over fodertilsætningsstoffer og som naturmedicin til heste, kæledyr og mennesker.

### Andre fordele:

- Let at dyrke og forarbejde lokalt, højt tørstofindhold og højt indhold af aktive stoffer !
- Mulig udnyttelse af hele planten: Tanniner, strøelse til dyr, kompost, energi, biokul, tekstil, kompositter, emballage, strøelse til husdyr
- Pil er en flerårig afgrøde – Mindre klimaaftryk end korn i mark og mindre udvaskning af N.

### Resultater:

- Metan reduceret med 34- 43 % I forsøg med koncentrerede aktive stoffer, der hæmmer metanproduktion I vommen.
- Endnu højere reduktion, når 2 udvalgte stoffer kombineres: Flavenoid + tannin (Patent anmeldt)

**Næste skridt:** Forsøg med levnede dyr i januar 2024.