Effect of sainfoin (*Onobrychis viciifolia*) silage on feed digestibility and methane emission in cows

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Introduction

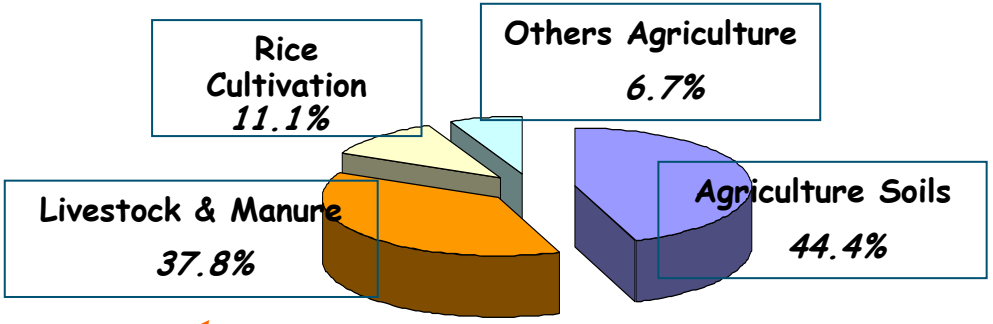
Fermentation end products

- VFAs
- Microbial Protein
- Methane

Energy loss up to 15%

(Johnson et al.,1993)

World methane gas emission by agriculture sector



World Resource Institute, (2000)

- Improve economic advantage
- Reduce global warming

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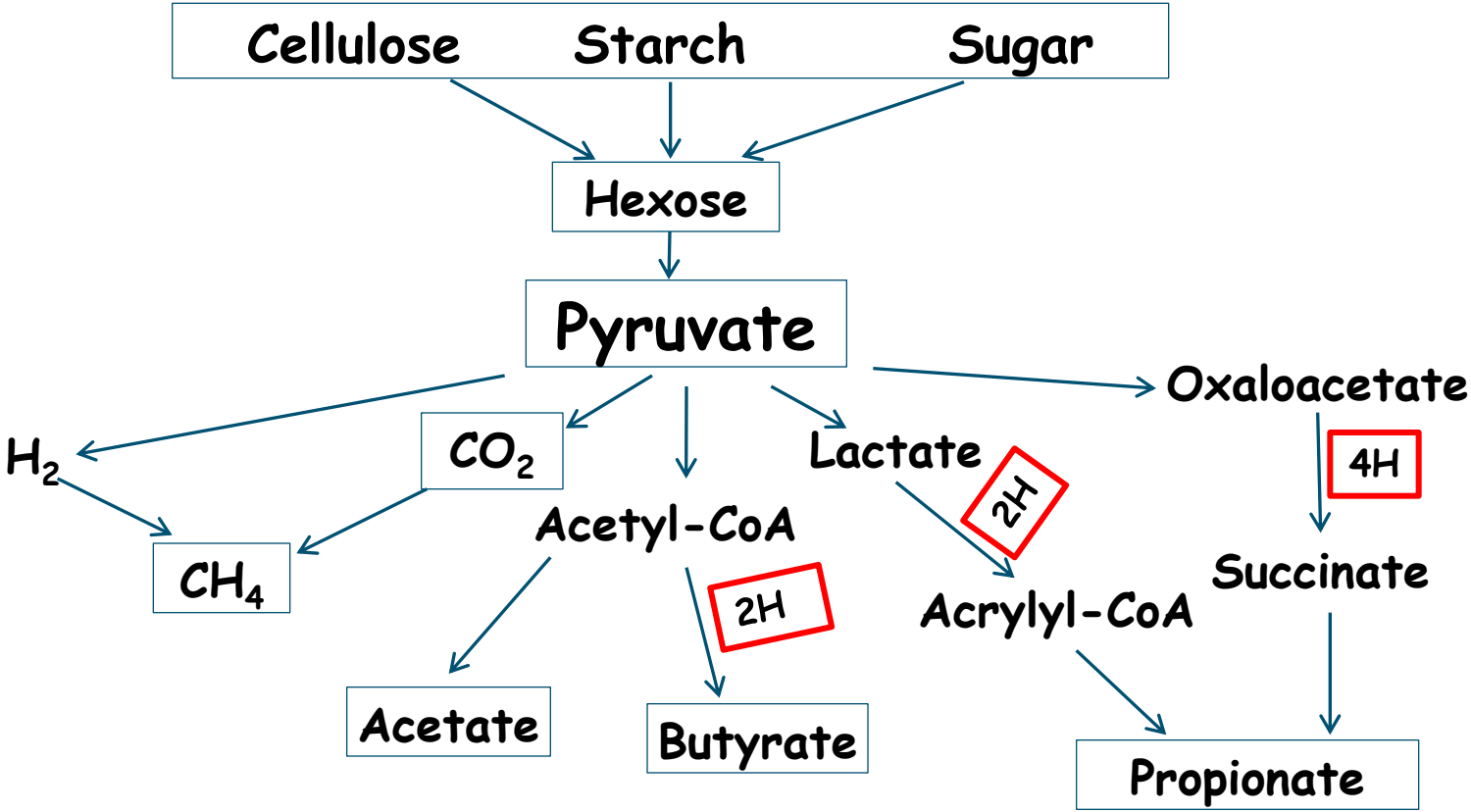
Rumen fermentation



Mitigation strategies for methane emission

Improve nutrients:

High levels of starch-based concentrate ⬇ CH_4, by ⬆ C3 (Beauchemin and McGinn 2005)

Feed additives

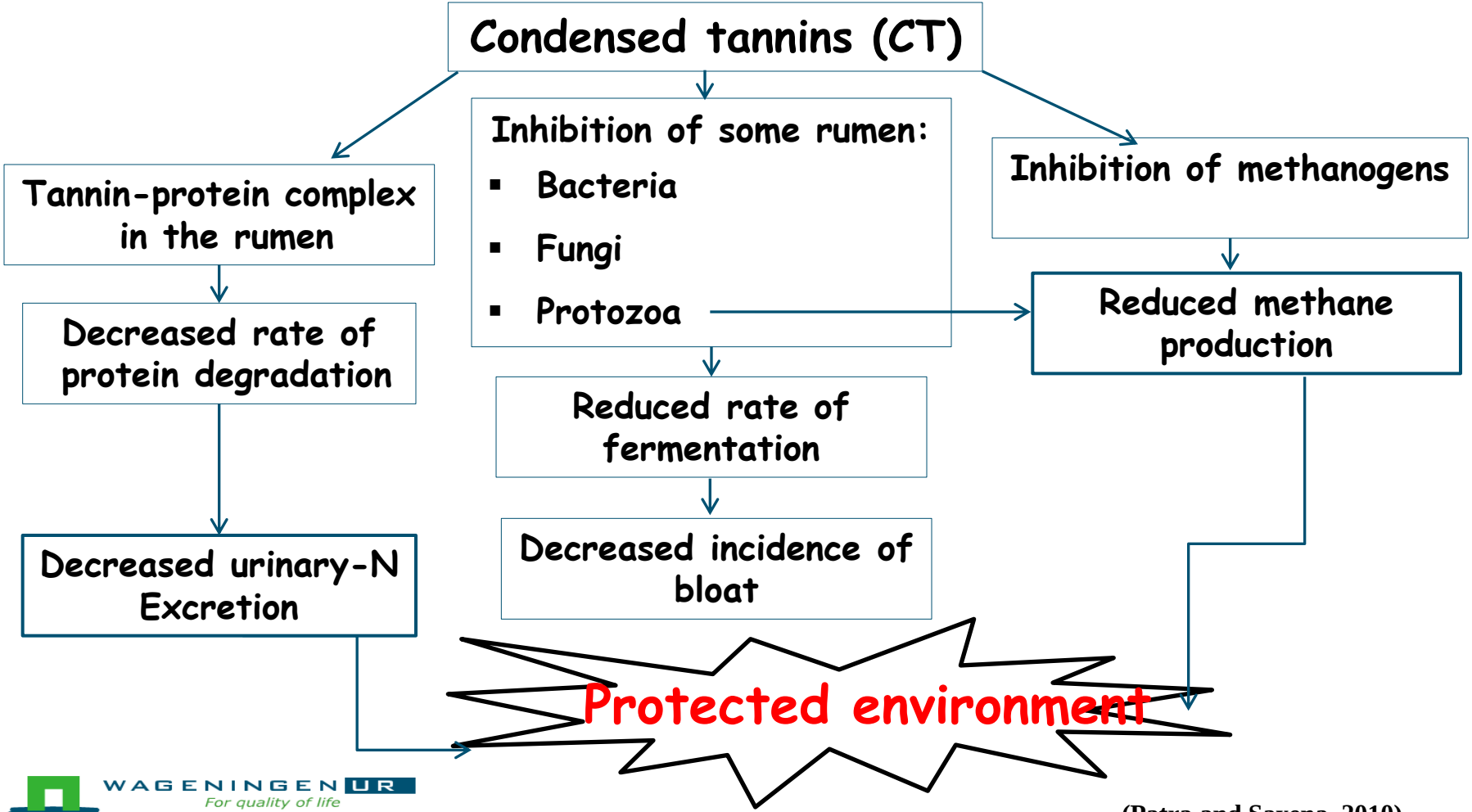
Essential oils

⬇CH_4 by up to 46%. Chiquette and Benchaar (2005)

Oil were toxicity of methanogen and protozoa cell membrane (Machmüller et al. 1998).

Plants secondary metabolite compounds

Plants rich in condensed tannins, saponin have been shown to ⬇ CH_4 by ⬇ rumen methanogenesis in sheep and cattle (Waghorn, 2002).



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(Patra and Saxena, 2010)

Introduction

Sainfoin (Onobrychis viciifolia)

+ Adapt well to dry hilly environments on calcareous soils
+ Biomass about 10-15 ton/ha/year
+ 20-22% CP (Guglielmelli et al., 2011)
+ Rhizobial bacteria → Binds nitrogen in the soil
+ Low phosphor need
+ Contain condensed tannin (CT)

(Guglielmelli et al., 2011)

Positive effects of sainfoin:

- High palatability
- High nutritive value
- Better protein utilization
- Anthelmintic function
- Bloat resistant
- Reduce methane production

(Carbonero et al., 2011)

Objective

To determine effect of Sainfoin silage in TMR diet on feed digestibility and CH_4 emission

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Materials and Methods

Experimental design:

Sainfoin

Making silage

Ingredients (kg/100kg DM)	Dietary treatment	
	CON	SAIN
Grass silage	56.35	26.19
Sainfoin silage	0	33.27
Maize silage	10.41	9.66
Concentrate	26.61	24.72
Linseed	6.63	6.16

Periods	Dietary treatment	
	CON	SAIN
Period 1 (25 days)	Cow 1	Cow 4
	Cow 2	Cow 5
	Cow 3	Cow 6
Period 2 (25 days)	Cow 4	Cow 1
	Cow 5	Cow 2
	Cow 6	Cow 3

Materials and Methods

Measurement nutrition digestibility, nitrogen utilization, CH_4 production:

21 days for adaptation

4 days for measurements

- ✓ Feed intake and residues : morning + afternoon
- ✓ Feces: during 4 days measurements
- ✓ Milk production: morning + afternoon
- ✓ CH_4 production using respiration chambers for 4 days
- ✓ Parameters: DM, OM, NDF, ADF, N, and GE

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Table 1.Chemical compositions of the CON and SAIN diet

Items	Dietary treatment	
	CON	SAIN
Chemical composition (g/kg DM)		
DM, g/kg product	444.9	357.2
GE, MJ/kg DM	19.5	19.0
OM	918.9	891.4
CP	162.6	171.9
NDF	395.7	359.1
ADF	236.8	244.5

Chemical compositions *were similar* between the two diets

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Table 2. Effect of sainfoin silage on feed intake

Items	Dietary treatment		SEM	P-value
	CON	SAIN		
Nutrient intake, (kg/d)				
DM	17.8	18.7	1.04	0.16
OM	16.3	16.6	0.94	0.53
Nitrogen	**0.47**	**0.52**	**0.03**	**0.03**
NDF	7.0	6.7	0.38	0.09
ADF	**4.2**	**4.6**	**0.25**	**0.05**

- **DM, OM and NDF intake *were similar* between the two diets**
- **Nitrogen and ADF intake *were higher* in the SAIN diets**

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Table 3. Effect of sainfoin silage on nutrients digestibility

Items	Dietary treatment		SEM	P-value
	CON	SAIN		
Digestibility				
DM (g/kg)	727.9	688.2	0.4	0.002
OM (g/kg)	746.7	717.7	0.3	0.002
NDF (g/kg)	667.9	577.3	0.7	0.0004
ADF	658.2	573.5	1.3	0.009
Nitrogen	661.6	650.7	13.1	0.57

- The DM, OM, NDF and ADF digestibility were lower in the SAIN diet

Table 4 Effect of sainfoin silage on milk yield and composition

Items	Dietary treatment		SEM	P-value
	CON	SAIN		
Milk yield (kg/d)				
Milk	**22.0**	**24.1**	2.84	**0.04**
Milk/OM digested (kg)	**1.8**	**2.0**	0.11	**0.03**
FPCM	24.1	25.7	2.73	0.08
Milk composition (g/kg)				
Fat	48.5	47.0	1.43	0.21
Protein	35.4	33.9	2.20	0.07
Lactose	44.5	45.0	0.90	0.34

- **Milk yield *was highest* in the SAIN diet**
- **Milk compositions *were similar* between the two diets**

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Table 5. Effect of sainfoin silage on methane emission

Items	Dietary treatment		SEM	P-value
	CON	SAIN		
CH_4, g/d	365.5	360.8	19.85	0.68
CH_4, g/kg DMI	**20.6**	**19.4**	0.30	0.005
CH_4, g/kg milk	17.6	15.5	1.71	0.16
CH_4, g/kg FPCM	15.8	14.4	1.18	0.22
CH_4, % of GEI	**5.9**	**5.7**	0.09	0.06

- **CH_4 *was lowest* in the SAIN diet**
- **CH_4 as a percentage of GEI *tended to be lower* in the SAIN diet**

Discussion

➢ Nutrients digestibility

- Scharenberg et al. (2007) also found that ***the apparent digestibility of OM, NDF and ADF were lower for lambs fed sainfoin silage*** (contained about 5g CT/kg DM), compared with lambs fed grass-clove silage. ***In our study, CT=8.8 g/kg DM***

- CT may make ***complex with lignocellulose***, thus ***preventing microbial digestion***. CT could directly ***inhibiting cellulolytic microorganism and activities of fibrolytic enzymes*** (Patra and Saxena, 2009)

➢ Methane production

- Woodward et al. (2002) found that **CH_4 emission per kg DM in take was lower in the cows fed Hedysarum coronarium (CT-containing forage),** compared with cows fed perennial ryegrass.

- Saifoin contains CT, a plant secondary metabolite that have been show to **reduces ruminal methanogenesis and decrease ruminal protozoa number** in some study (Tavendate et al., 2005; Batta et al., 2009)

- Decrease fibre degradation ➔Reduced acetate ➔ **reduced H_2 for CH_4 production** (Beauchemin et al., 2009)

Take home message

- Sainfoin silage could be used in TMR diet to improve milk production and reduce CH4 per kg DM intake

EU Marie Curie Initial Training Network

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Thank you kindly for your attention!

Vietnamese lotus flower

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