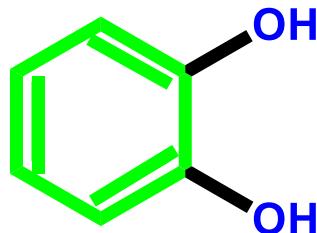




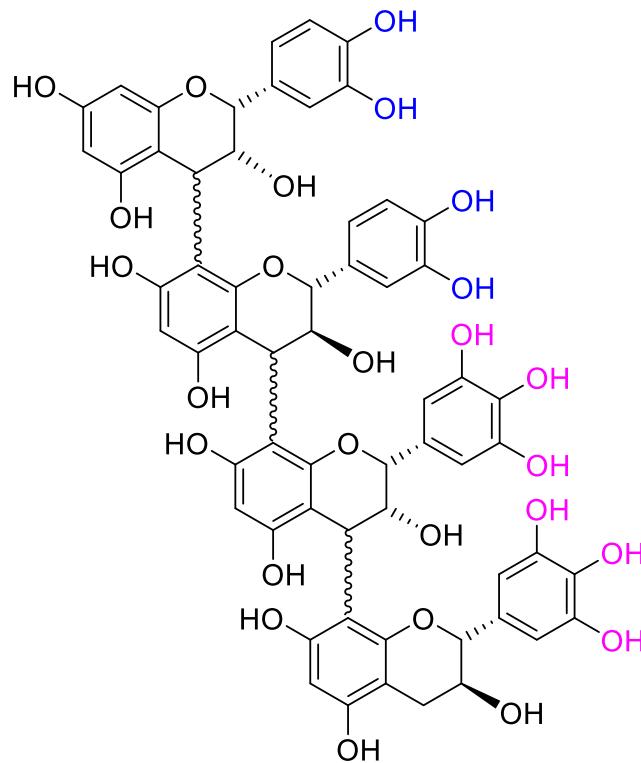
**Benefits of
plant tannins on
ruminant nutrition,
health & environment**

Sokratis Stergiadis & Irene Mueller-Harvey

What are tannins?



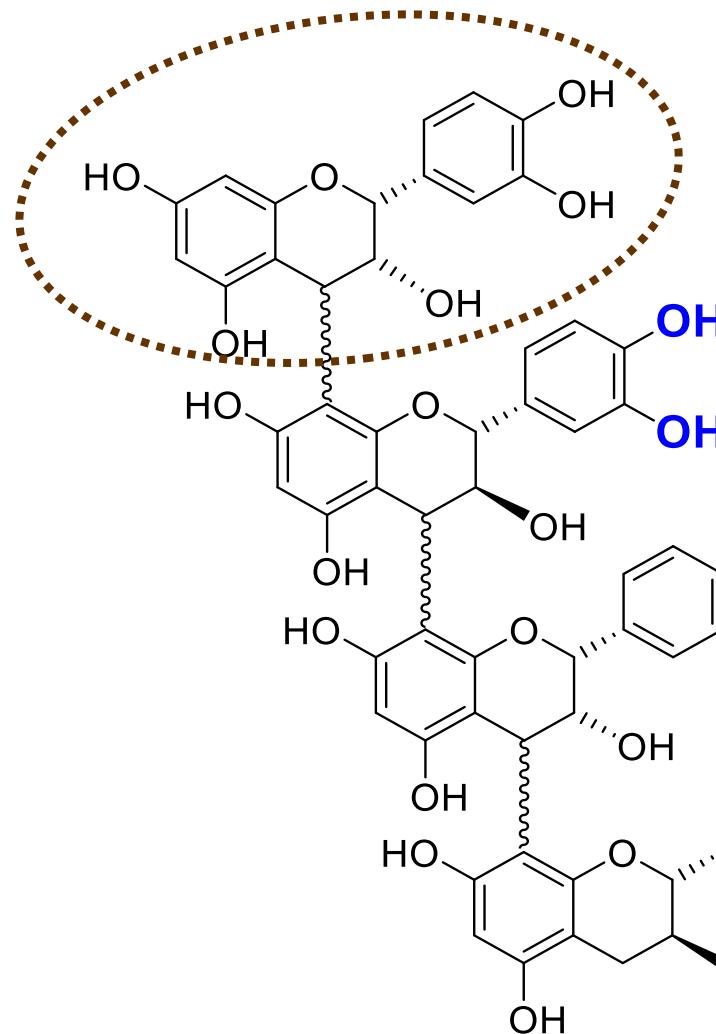
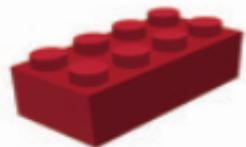
= Tannins are polyphenols
(= many **aromatic rings** + OH groups)



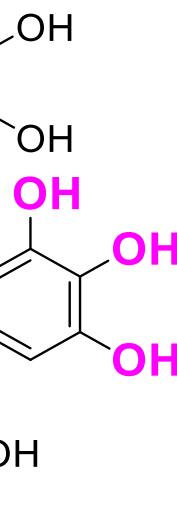
OH groups make tannins 'sticky'

- *tannins stick to fibres*
- *tannins stick to proteins*

1a. Tannin types



Procyanolitrin tannins



Prodelphinidin tannins

Different tannins create different effects after ingestion

Where can we find tannins?



cfs.nrcan.gc.ca



Trees

Corylus
Malus
Populus
Prunus
Quercus
Salix
etc, etc

Shrubs

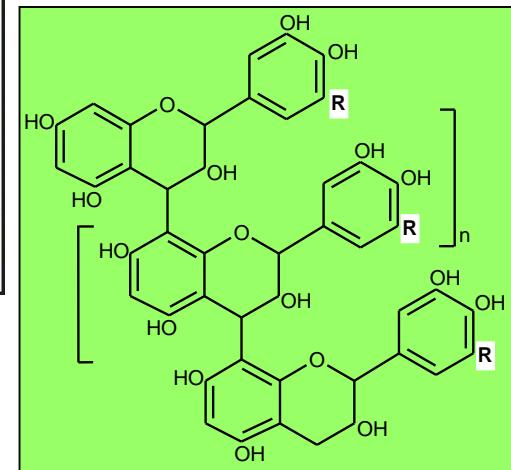
Calluna
Ribes
Rubus
Vaccinium
etc, etc



BENEFITS: 1. Tannins prevent bloat

Bloating forages:

- *Some lush grasses*
 - *Medicago sativa*
 - *Trifolium repens*

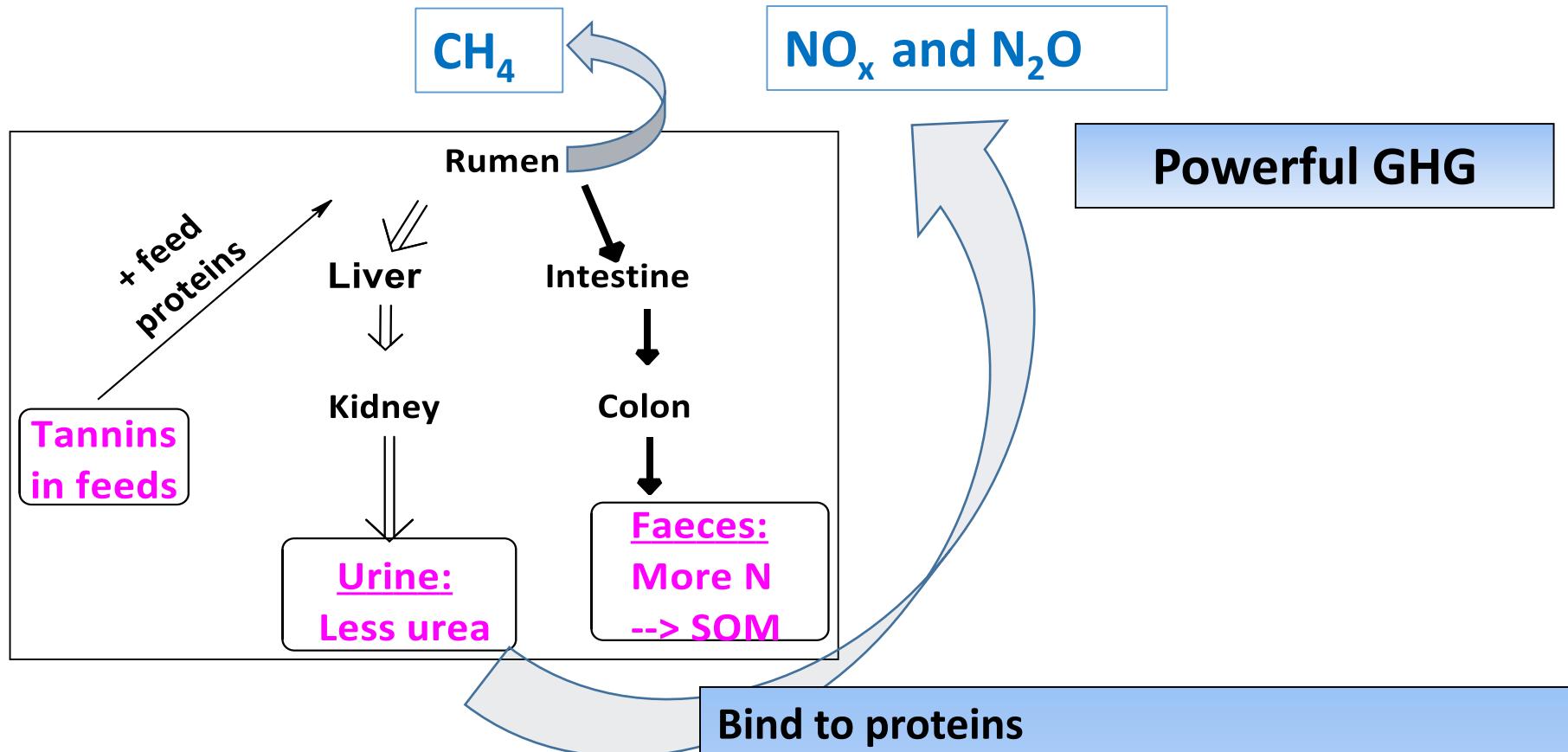


Bloat-safe forages:

- *Lotus corniculatus*
 - *Onobrychis viciifolia*
 - *Trifolium dubium*
 - *Rumex obtusifolius* (dock)

Bloat safe

BENEFITS: 2. Tannins can improve nutrient use, reduce GHG



Bind to proteins

Increase Faecal N / Urine N

Up to 50% more absorption of essential AA

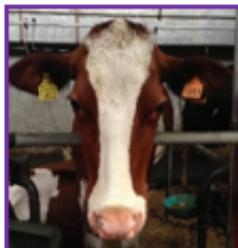
Bind to fibre & act against methanogens

Reduce methane emissions

Some – *but not all* – tannins can reduce GHG

Source of Tannins/Feeds	Ruminal gas production	N_2O	CH_4	Affected microbes	Potential
Mimosa Quebracho	Less	Less	Less	All	No
Grapeseed	Less		Less	All	No
Tea flavanols	No effect		No effect	None	No
Tara	No effect		No effect	None	No
Chestnut	No effect	Less	No effect	None	Perhaps
Valonea	No effect	?	Less	Methanogens	YES
Myrabolan	No effect	?	Less	Methanogens	YES
Sainfoin		Less	Less	Methanogens	Yes
Willow	?	?	?	?	?

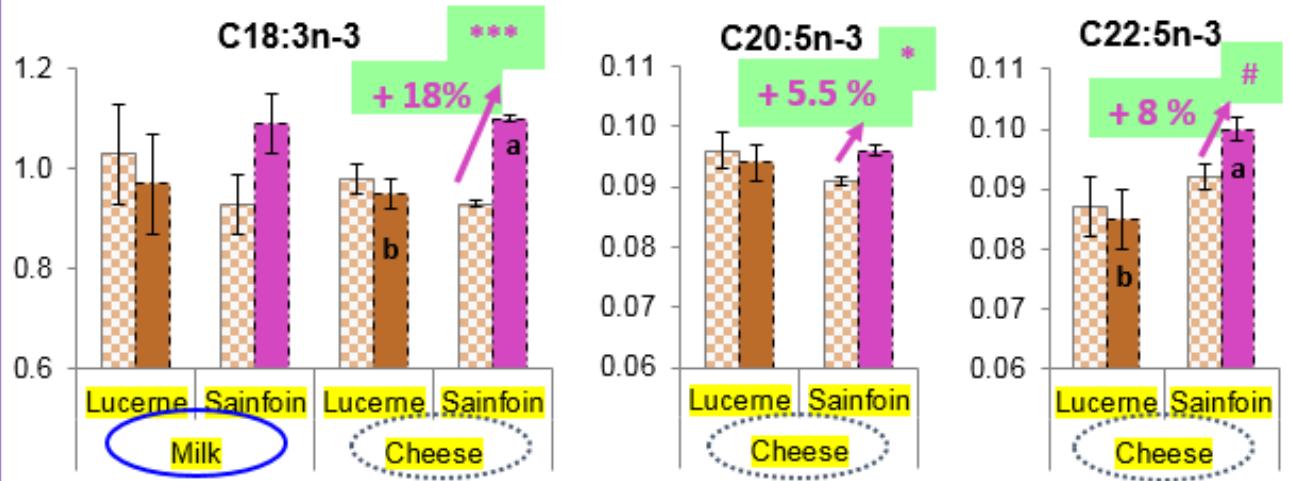
BENEFITS: 3. Tannins increase ω -3 fatty acids in milk and cheese



n-3 PUFA
(g/100 g of total fatty acids)



Control period: lucerne pellets Experiment: lucerne or sainfoin pellets



Period effect: *** $P < 0.001$; * $P < 0.05$; # $P < 0.1$

Girard et al., 2015

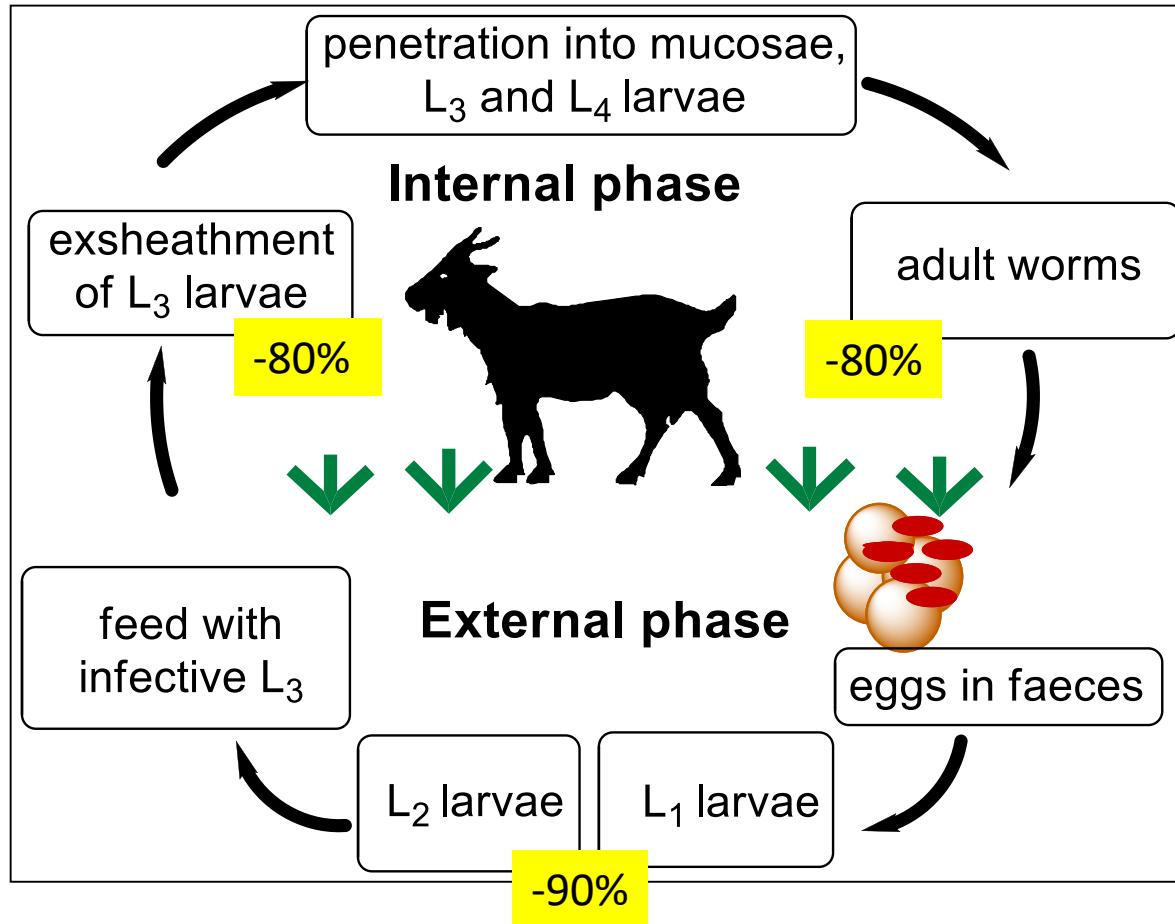
→ **Sainfoin:** ↑ beneficial PUFA in milk and cheese

Agroscope



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

BENEFITS. 4. Tannins can reduce gastro-intestinal parasites



Drugs kill 99.9% of parasites but...

Resistance:

- \$\$\$ billion losses
- Animal welfare
- **USA, S. Africa:**
drugs Do NOT work



➤ Tannins

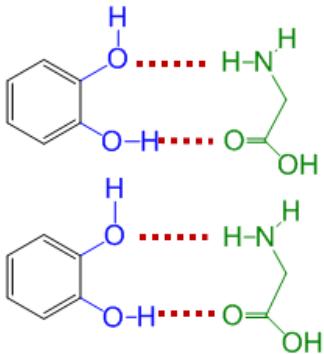
less effective but interfere in this cycle

Mechanism: sticky tannins coat proteins



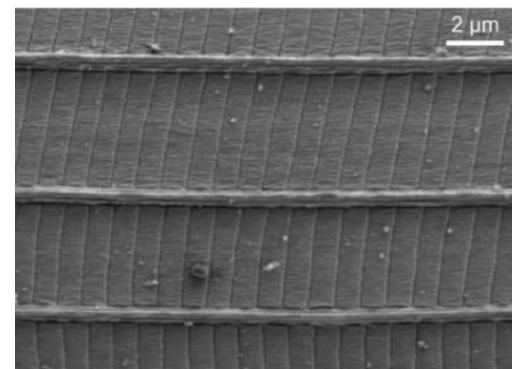
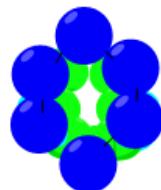
Collagen = major protein in parasite cuticle

Ostertagia ostertagi, adult worms, fed sainfoin pellets for 58 days

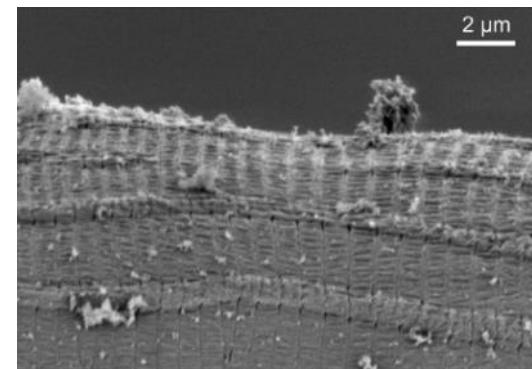


= Zip

Tannin coated protein:



grass/clover control
No tannins



sainfoin
With tannins

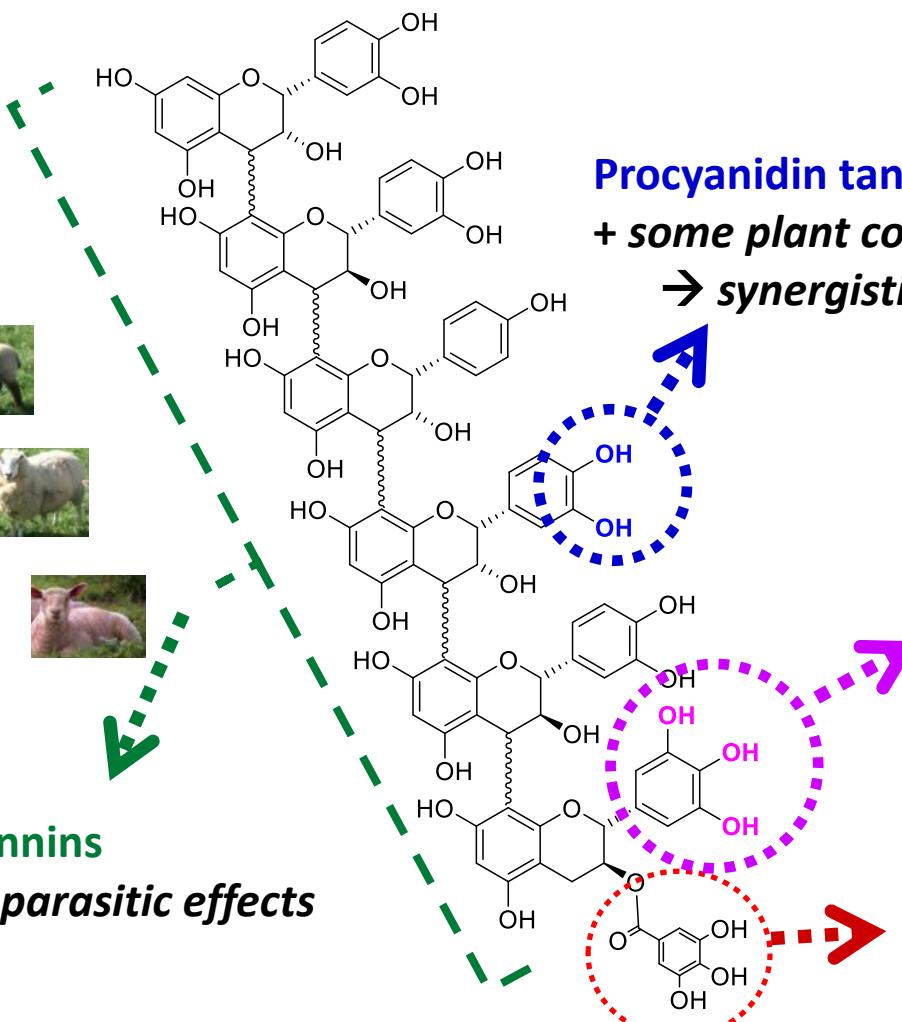
➤ tannins coat parasites

4. Summing up



Long tannins

→ anti-parasitic effects



Procyanidin tannins
+ some plant compounds
→ synergistic effects

Prodelphinidin tannins
→ anti-parasitic effects

Galloylated tannins
→ potent anti-parasitic effects

Parasitic nematode studies

- *Haemonchus contortus*
- *Trichostrongylus colubriformis*
- *Teladorsagia circumcincta*
- *Ostertagia ostertagi*
- *Cooperia oncophora*
- *Hymenolepis diminuta*
- *Ascaris suum*

Desrues et al 2016; Quijada et al 2015; Dhakal et al 2015; Williams et al 2014; Novobilsky et al 2013; Mechineni et al 2014

CAUTION: tannins vary between accessions/varieties

(Rothamsted National Willow Collection)

Willow Accessions (123 samples)	Tannin content (% DM)	Tannin length	% PD- types	% <i>trans</i>- types
	3 - 20	5 - 12	48 - 81	48 - 87

→ Need to identify trees with best tannin types

Future: veterinary fodder banks?



Farming → Pharming
for Farmaceuticals?

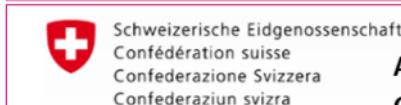
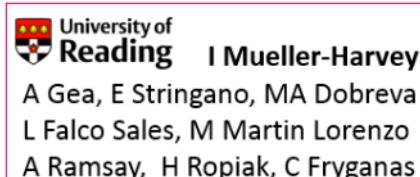


Pharming^{Ltd}
Capturing plant power

5. Conclusions

- ❖ Trees are a rich source of different tannin types
- ❖ Tannins are bioactive compounds with great potential
- ❖ Benefits include:
 - Better use of nitrogen
 - Less methane and nitrous oxide
 - Improving productivity and nutritional composition of milk, cheese and meat
 - Cattle do not suffer from bloat
 - Ruminants and non-ruminants: less parasitic worms

Thank you, EU, partners...



Agroscope
A Luescher, R Koelliker, C Malisch, K Kempf
G Bee, F Dohme-Meier, M Girard, A Grosse Brinkhaus



J Aufrere, V Niderkorn, K Theodoridou, G Copani
H Hoste, F Manolaraki, J Quijada, B Azuhnwi



Ron
Brown
Chris
Drake



... other participants



Further Information

<http://legumeplus.eu>



<http://www.wormx.info/resources>