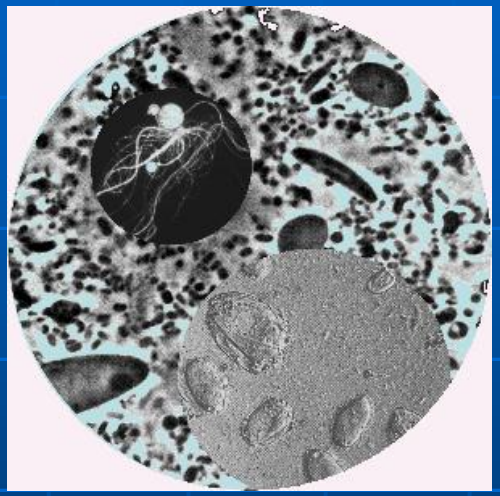
PRIFYSGOL ABERYSTWYTH UNIVERSITY

Sefydliad y Gwyddorau Biolegol, Amgylcheddol a Gwledig
IBERS ABERYSTWYTH
Institute of Biological, Environmental and Rural Sciences

The market for plant extract in ruminant livestock

Jamie Newbold

Fungi



Bacteria

Protozoa

Types of Rumen Microorganisms

BACTERIA

Ferment fiber, starches and sugars in feeds to VFA, H_2 and CO_2

Produce most of microbial cell protein, but also ferment feed proteins to VFA + NH_3

PROTISTS

Consume and ferment bacteria to VFA + NH_3

Sequester and ferment starch

Recycle N

ARCHAEA

Convert H_2 and CO_2 to methane

FUNGI

Assist in fiber digestion

The rumen

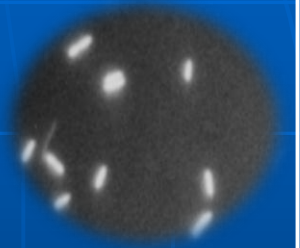
- Large and complex populations of micro-organisms.
- Essential for energy/ protein requirement.
- In balance in microbial community can lead to severe illness (acidosis, laminitis, liver abscesses, etc).
- Major contribution to GHG/ pollutant emissions

Bacteria

~300 species
10^{10} to 10^{11}cells/ml

Methanogenic Archaea

~6 species
10^{6} to 10^{8} cells/ml



Ciliate Protozoa

~40 species
$<10^{5}$ cells/ml

Anaerobic Fungi

~30 species
$<10^{5}$ cells/ml

Rumen manipulation

- Diet manipulation
- Antibiotics
- Other chemicals
- Fats
- Buffers
- Immunological
- Probiotics
- Plant extracts

- Livestock production is consumer focused
- EU regulation 1831/2003
- Definition of feed additive
  - Substances, micro-organisms or preparations, other than feed material and premixes, which are intentionally added to feed or water in order to perform, in particular, one or more of the functions mentioned in Article 5(3) of 1831/2003

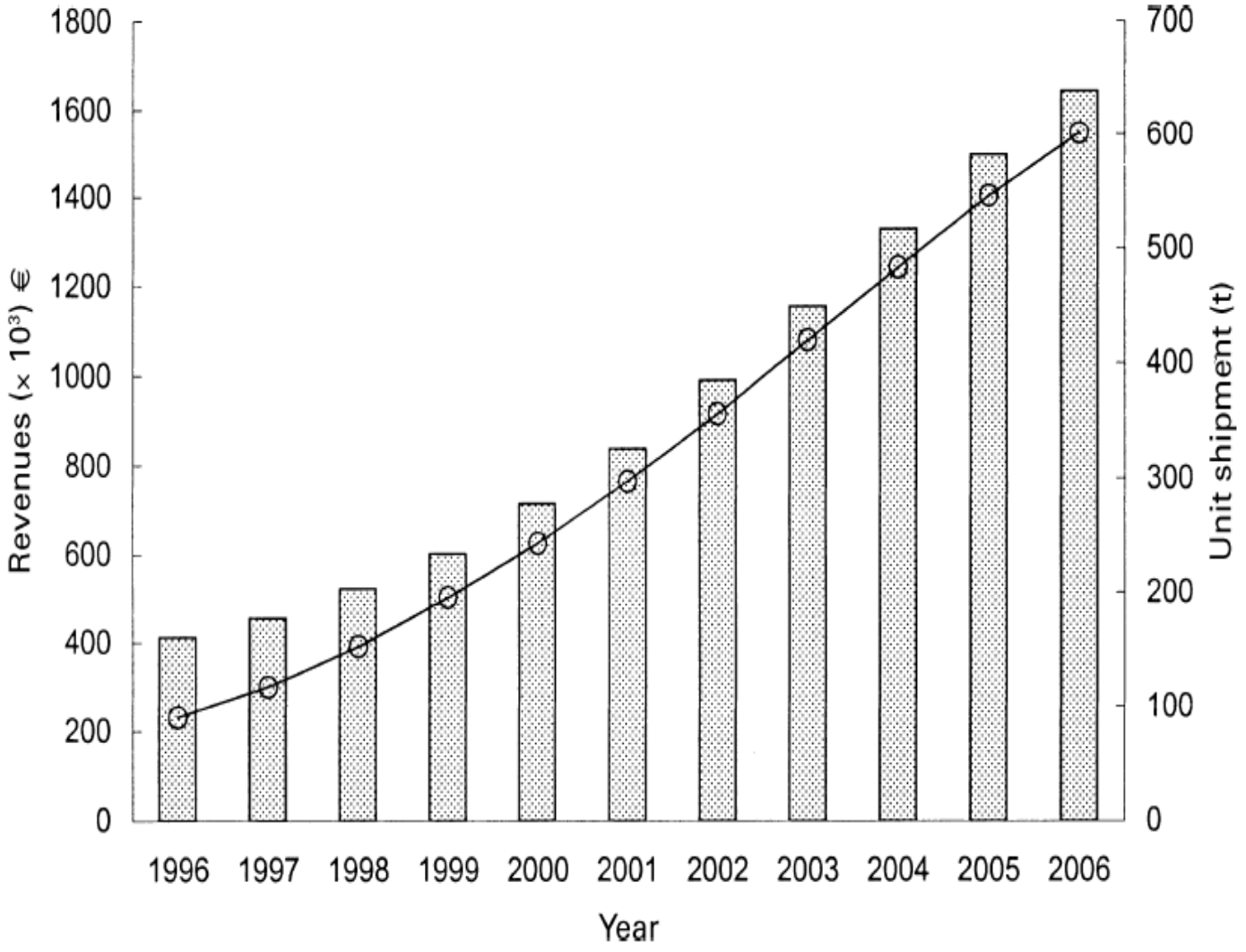
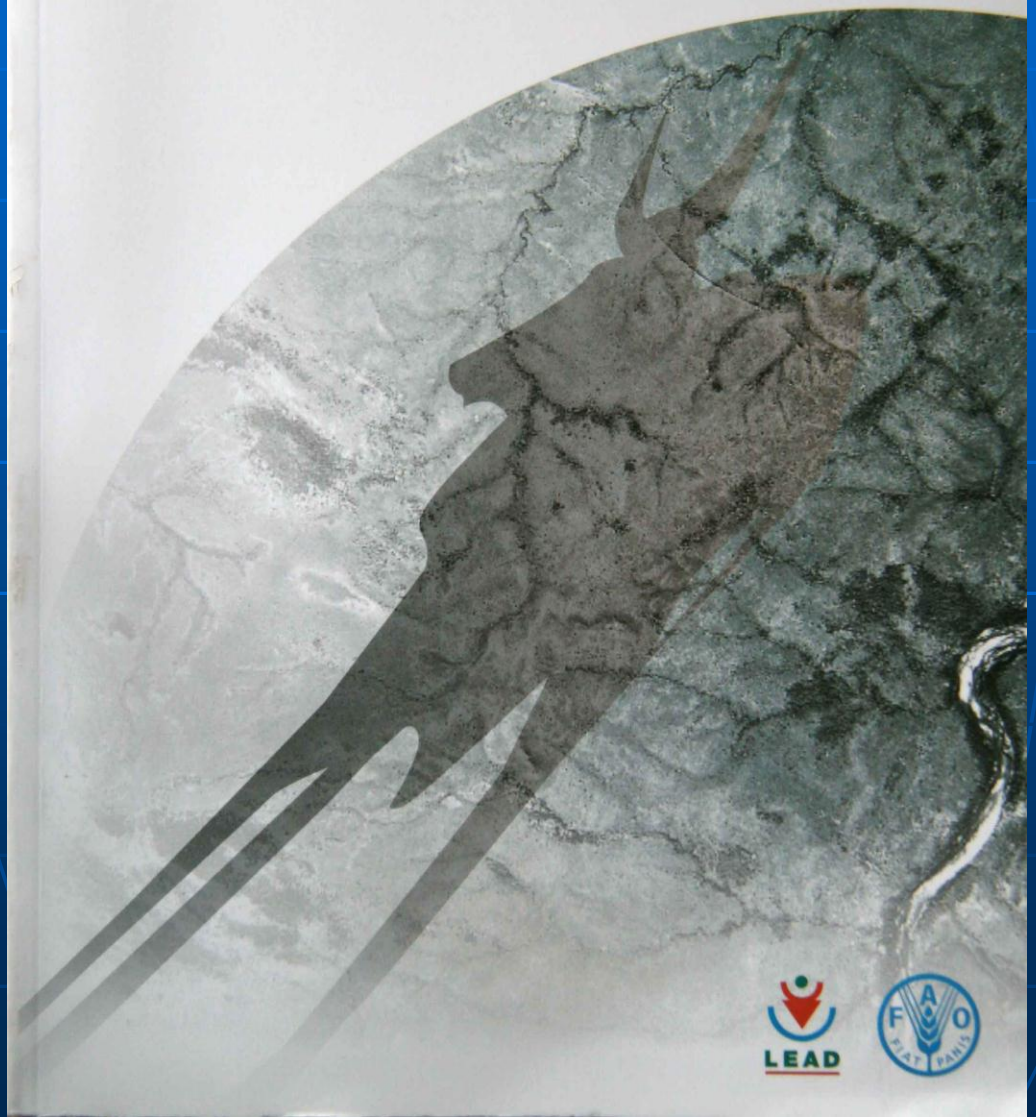


Fig. 1. Total EU market and forecasts for essential oils as feed additives: unit shipment (o—o) and revenue (▤). (Adapted from Frost & Sullivan, 2000.)

livestock's long shadow

environmental issues and options



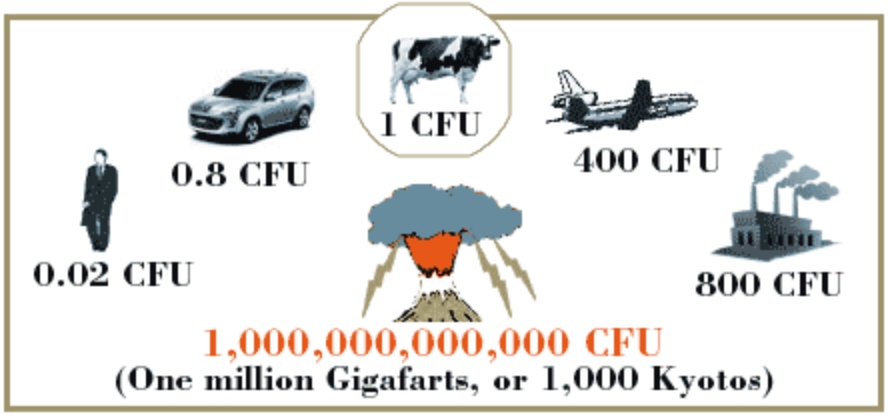
LEAD

FAO

United Nations

Approved Universal Standard in Measuring Greenhouse Gases and Carbon Credits

Cow Fart Unit (CFU)



1,000,000,000,000 CFU

(One million Gigafarts, or 1,000 Kyotos)

1,000 Cow Farts = 1 Megafart
1,000,000 Cow Farts = 1 Gigafart
1,000,000,000 Cow Farts = 1 Kyoto (1 billion farts)

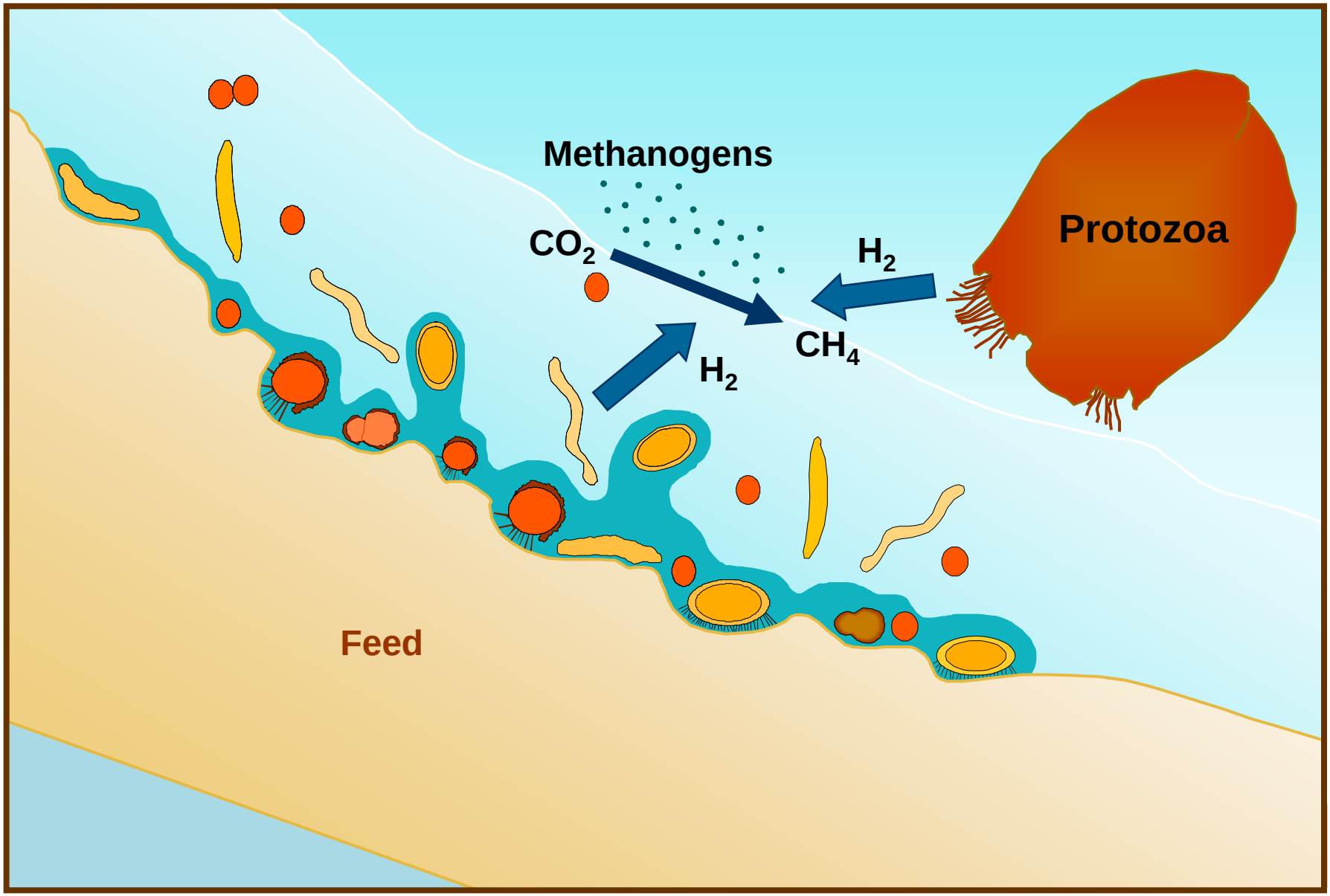
UNIPCF

Intergovernmental Panel on Cow Farts

ThePeoplesCube.com

Ruminants lose between 3 – 8% of GE as methane

Methane production: a microbially driven process to remove hydrogen

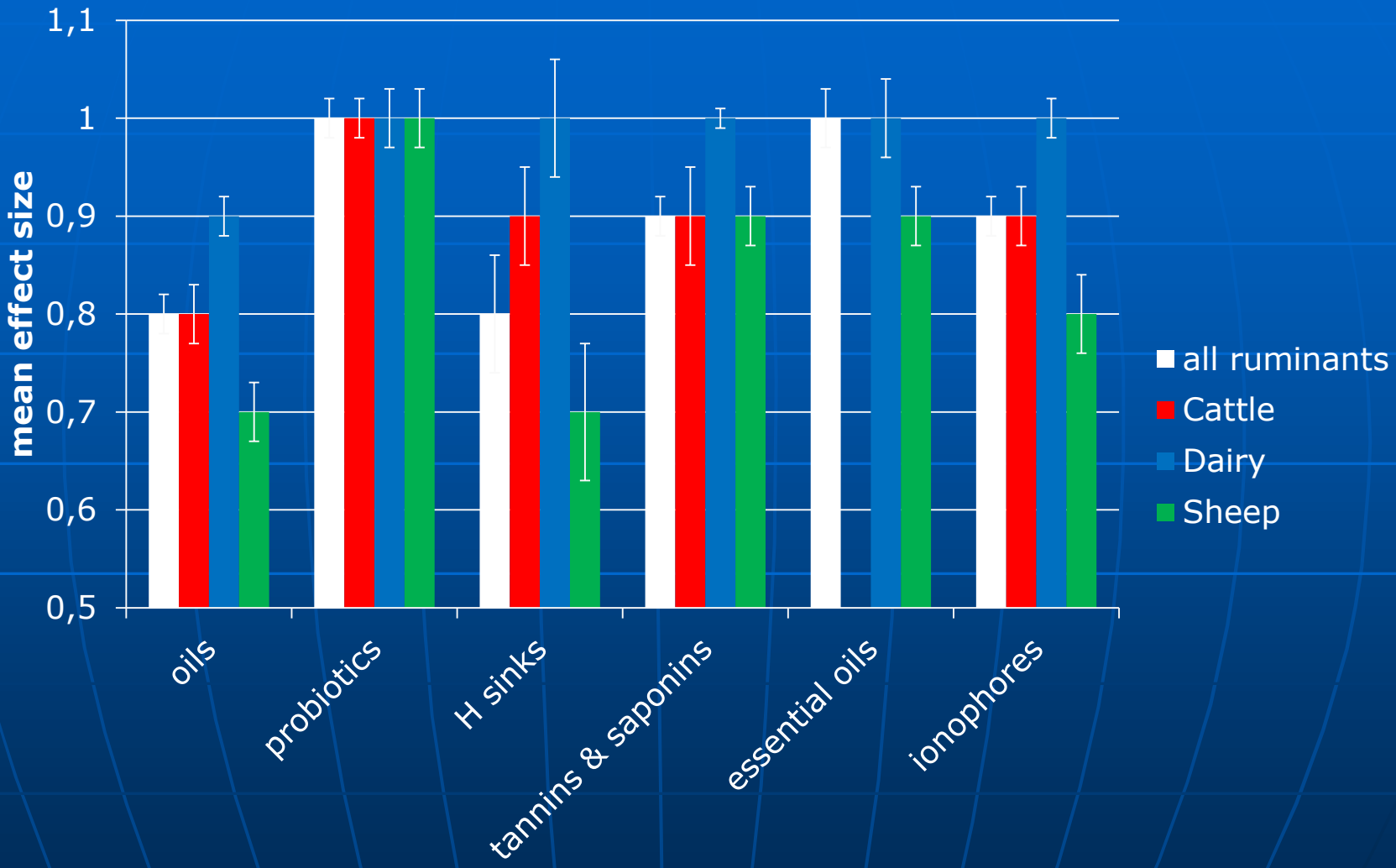


Mitigation database - global

- Global database search
- Wide scope of key words
- 1400+ potential references identified
- Limited by
  - Access
  - Selection criteria

Database so far…

- 232 references
- Ruminants only
- Global coverage


mean effect size
1,1
1
0,9
0,8
0,7
0,6
0,5
oils
probiotics
H sinks
tannins & saponins
essential oils
ionophores
all ruminants
Cattle
Dairy
Sheep

Major constraints limiting uptake of plant extracts

- the need to standardise and report the concentration of active component
- stability of the compounds in practical conditions
- persistence of the effects/adaptation of the rumen ecosystem
- lack of in vivo data over a range of livestock production systems
- effect of extract on the perceived quality of milk products
- a lack of production data on which to base calculations of market prices

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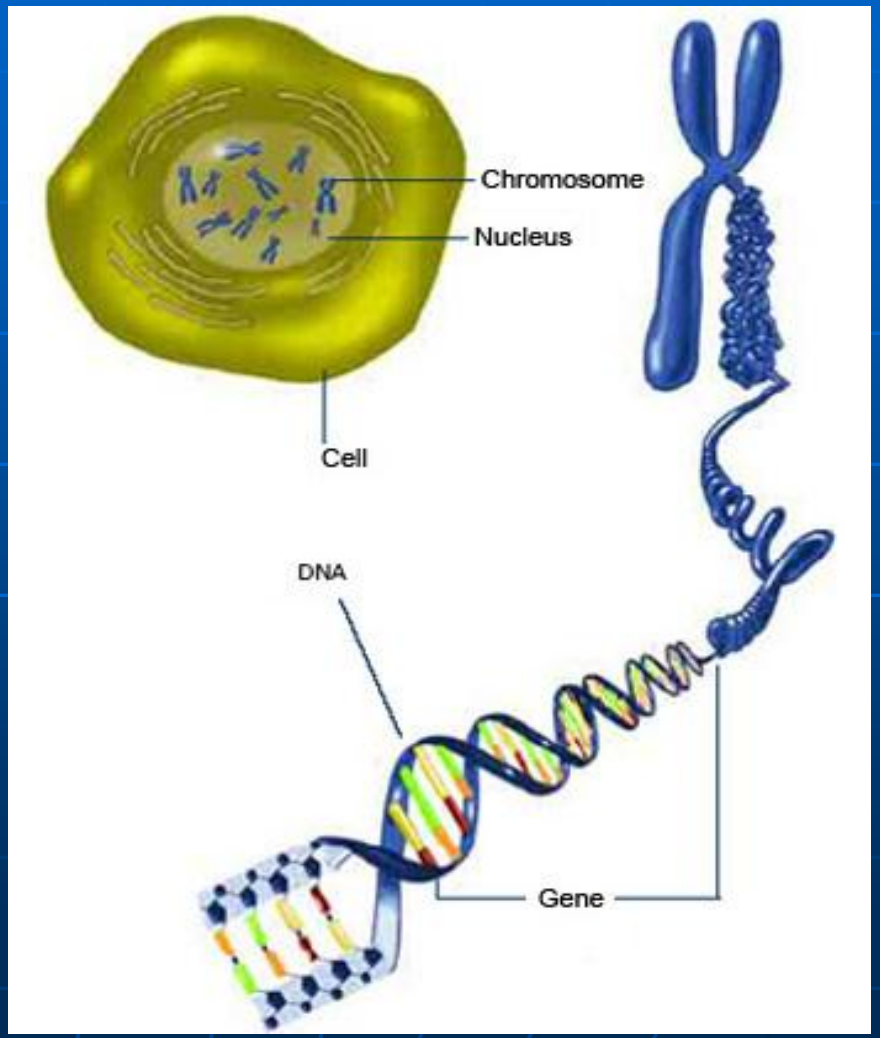
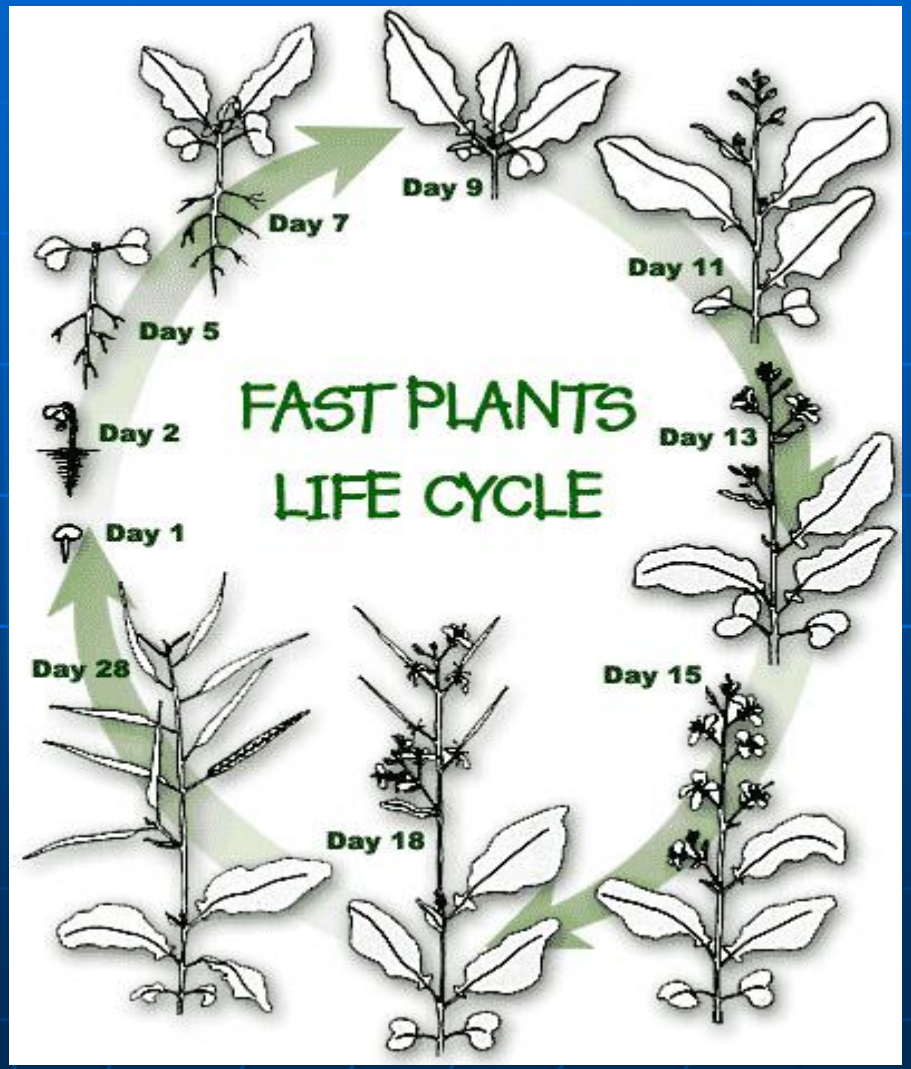
Genotypes

Variation commonly occur in plants containing volatile oils, e.g. Thyme (*Thymus vulgaris*) – has 7 different chemotypes, each with slightly different types & amounts of volatile oils.



Growth cycle

Proportions of the different constituents of a volatile oil may vary greatly throughout its development. Wide ranges are commonly found in fennel, carrot and coriander (linalool is higher in ripe fruit than unripe fruit). *Mentha* (peppermint) is also greatly affected by the vegetative cycle.



Environmental factors

Temperature, humidity, duration of daylight (radiation), and wind patterns all have a direct influence on volatile oil content.

e.g. Peppermint: long days & temperate nights → higher yields of oil & menthofuran. Cold nights lead to an increase in menthol.

Environmental factors

Cultivation practices also play an important factor to the yield & quality of the final product.

Fertilization and the amounts of N, P and K have been studied for various species.

The watering regiment also plays an important role.

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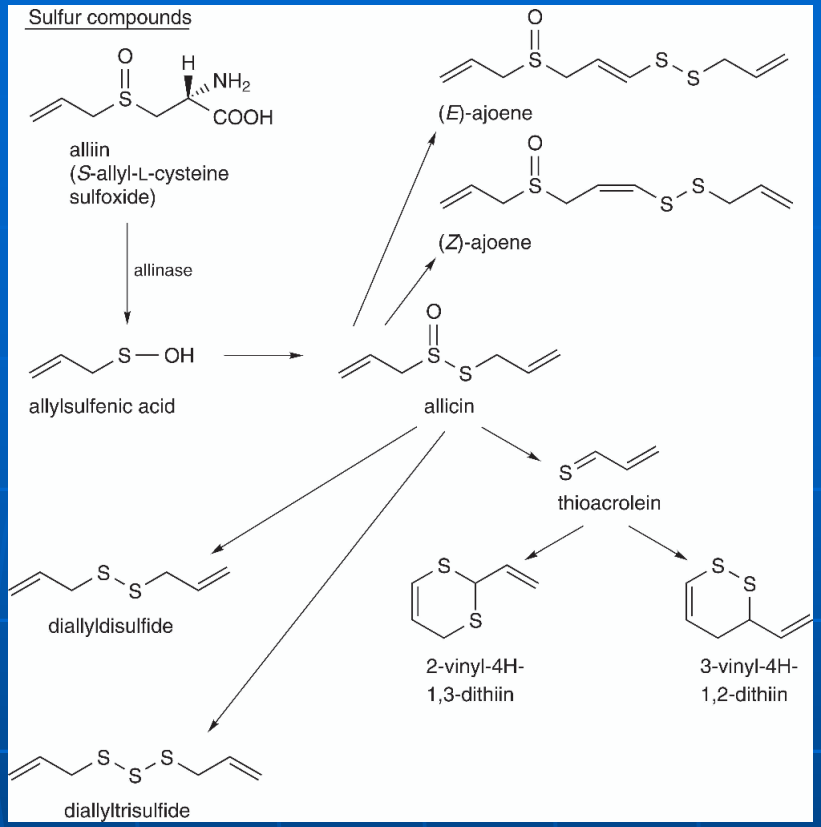
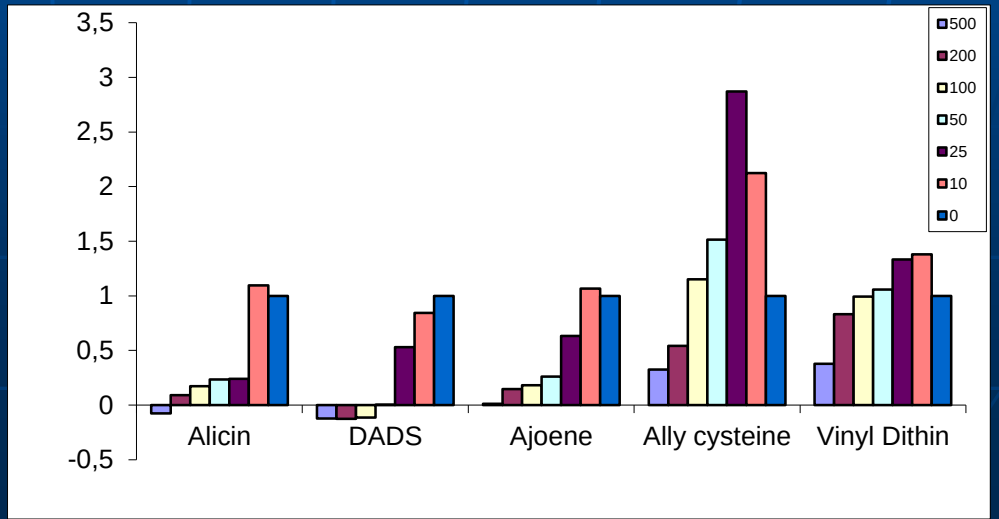

Sulfur compounds
alliin
(S-allyl-L-cysteine
sulfoxide)
allinase
allylsulfenic acid
(E)-ajoene
(Z)-ajoene
allicin
thioacrolein
diallyldisulfide
2-vinyl-4H-
1,3-dithiin
3-vinyl-4H-
1,2-dithiin
diallyltrisulfide


3,5
3
2,5
2
1,5
1
0,5
0
-0,5
Alicin
DADS
Ajoene
Ally cysteine
Vinyl Dithin
500
200
100
50
25
10
0

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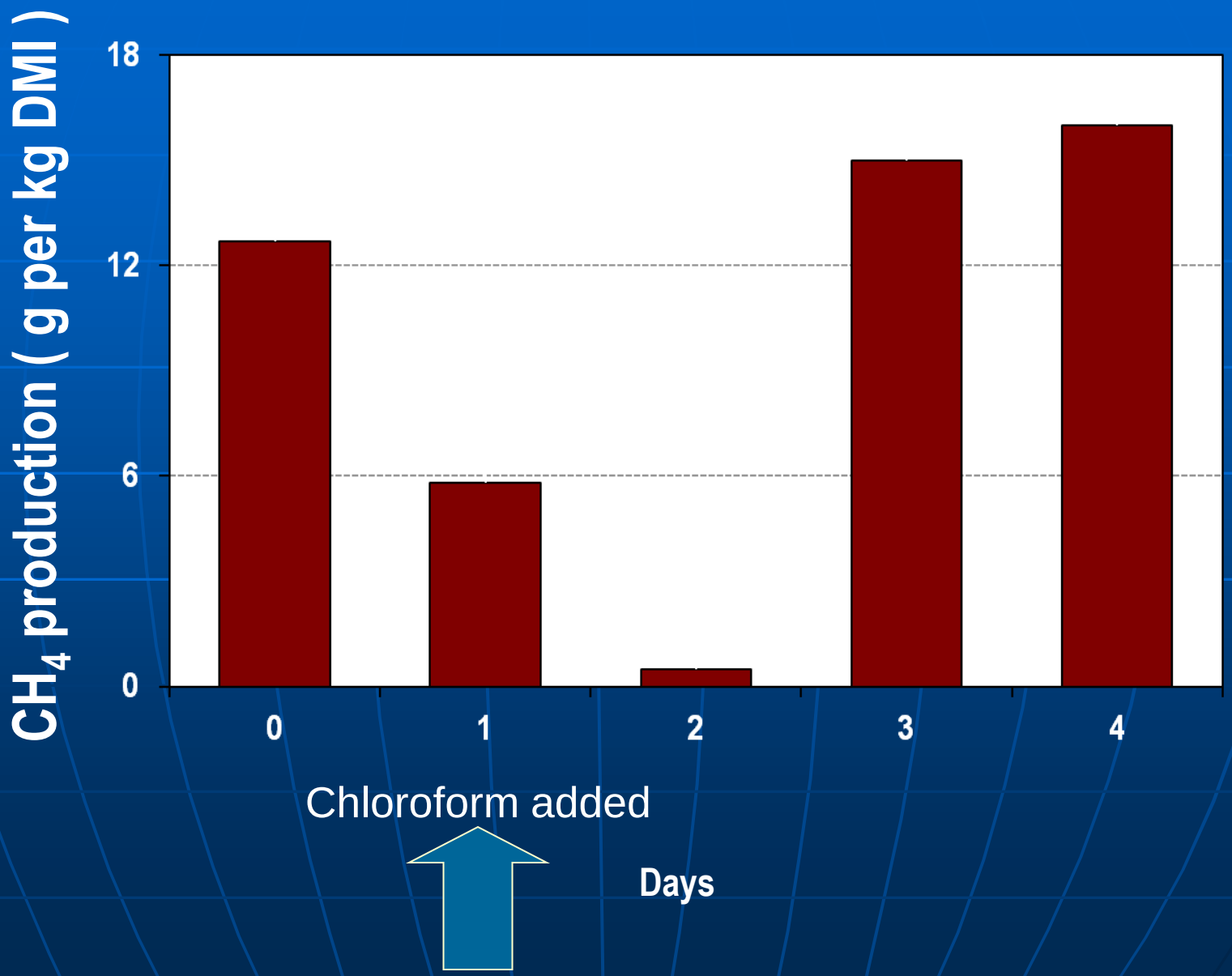
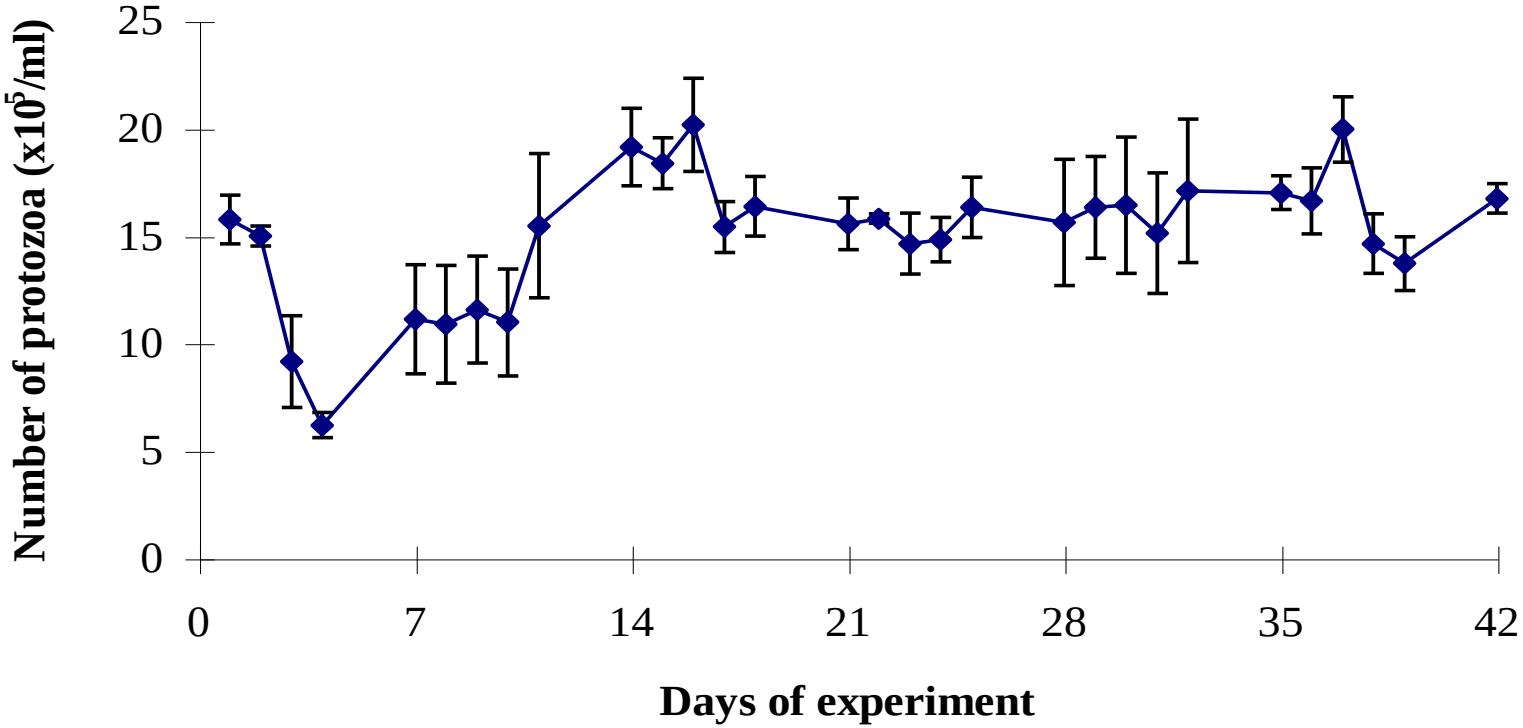

CH_4 production (g per kg DMI)
18
12
6
0
0
1
2
3
4
Chloroform added
Days

Influence of *Sesbania sesban* on protozoal numbers in the sheep rumen



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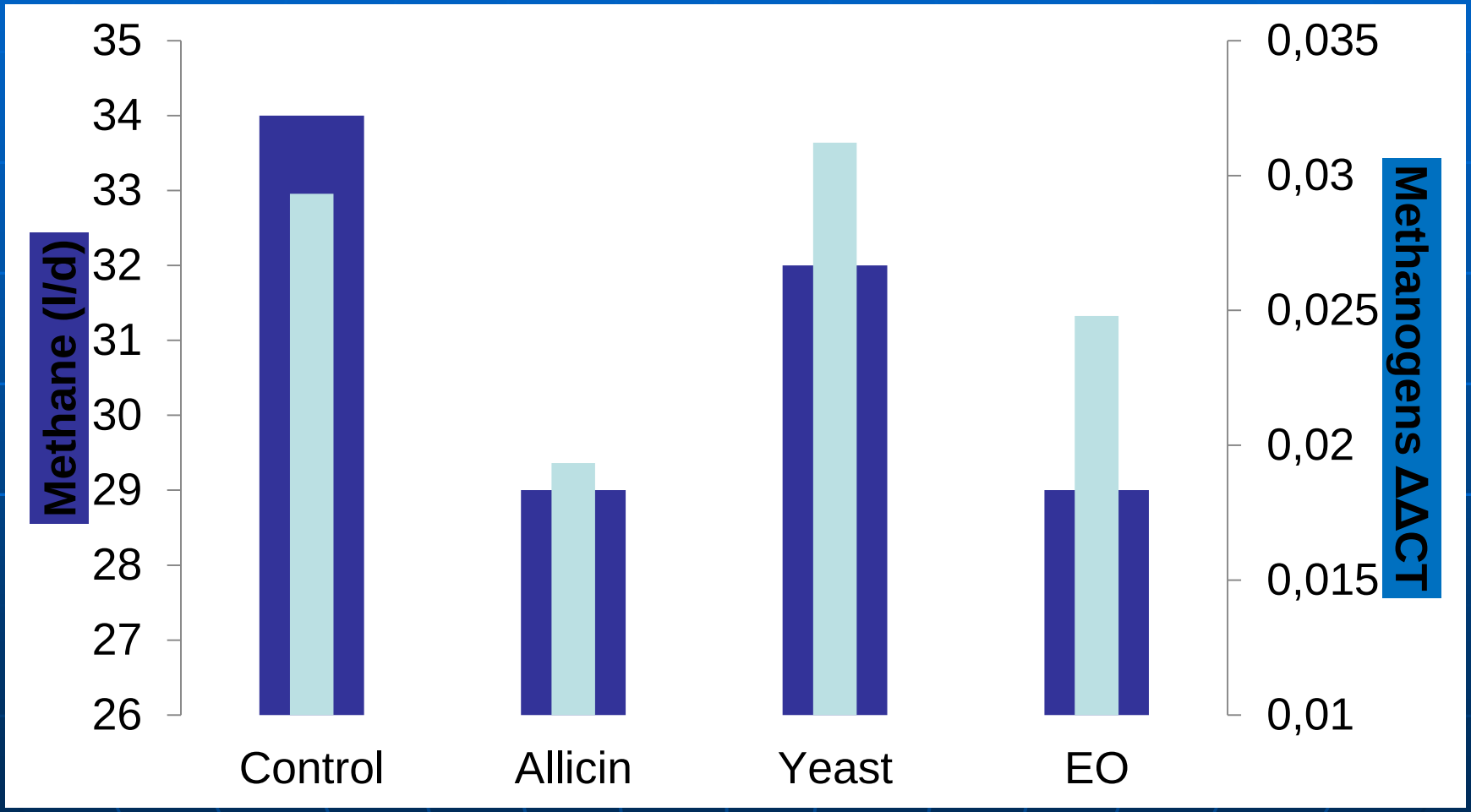
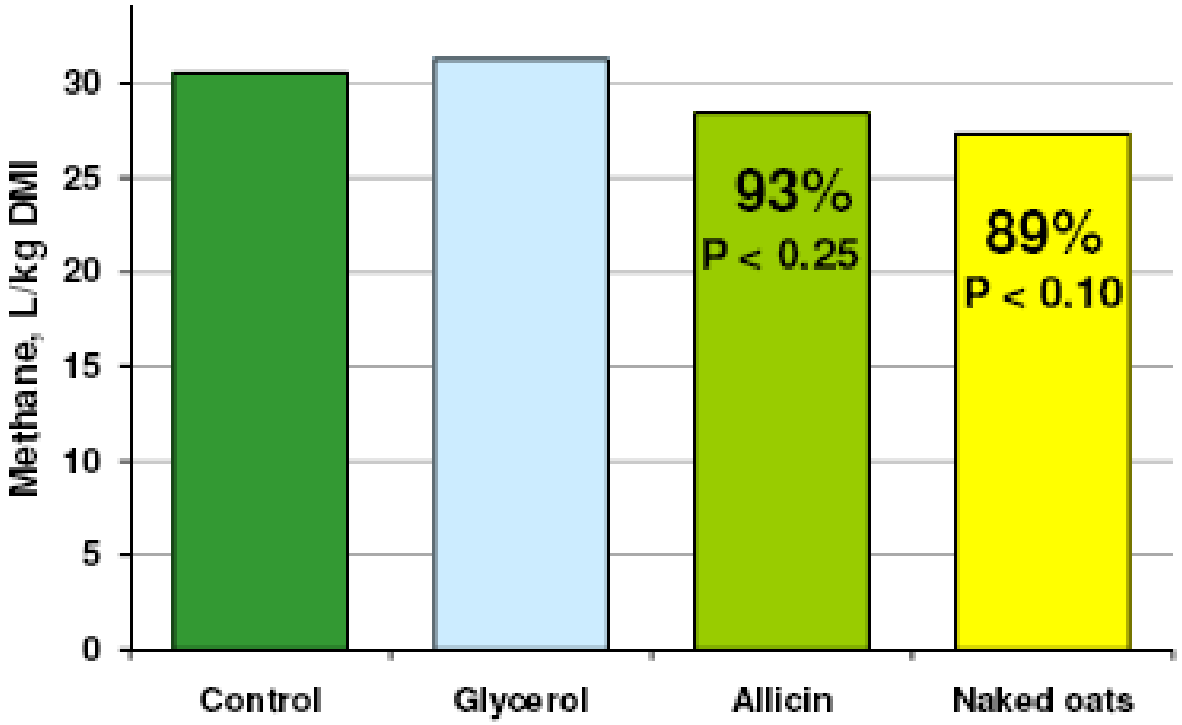
The effect of a yeast based probiotic, Allicin an extract from garlic and the essential oil analogue on methane production by and methanogen numbers in the rumen of store lambs



Effect of Supplements on Methane Production by Lactating Dairy Cows



DEFRA Project AC0209

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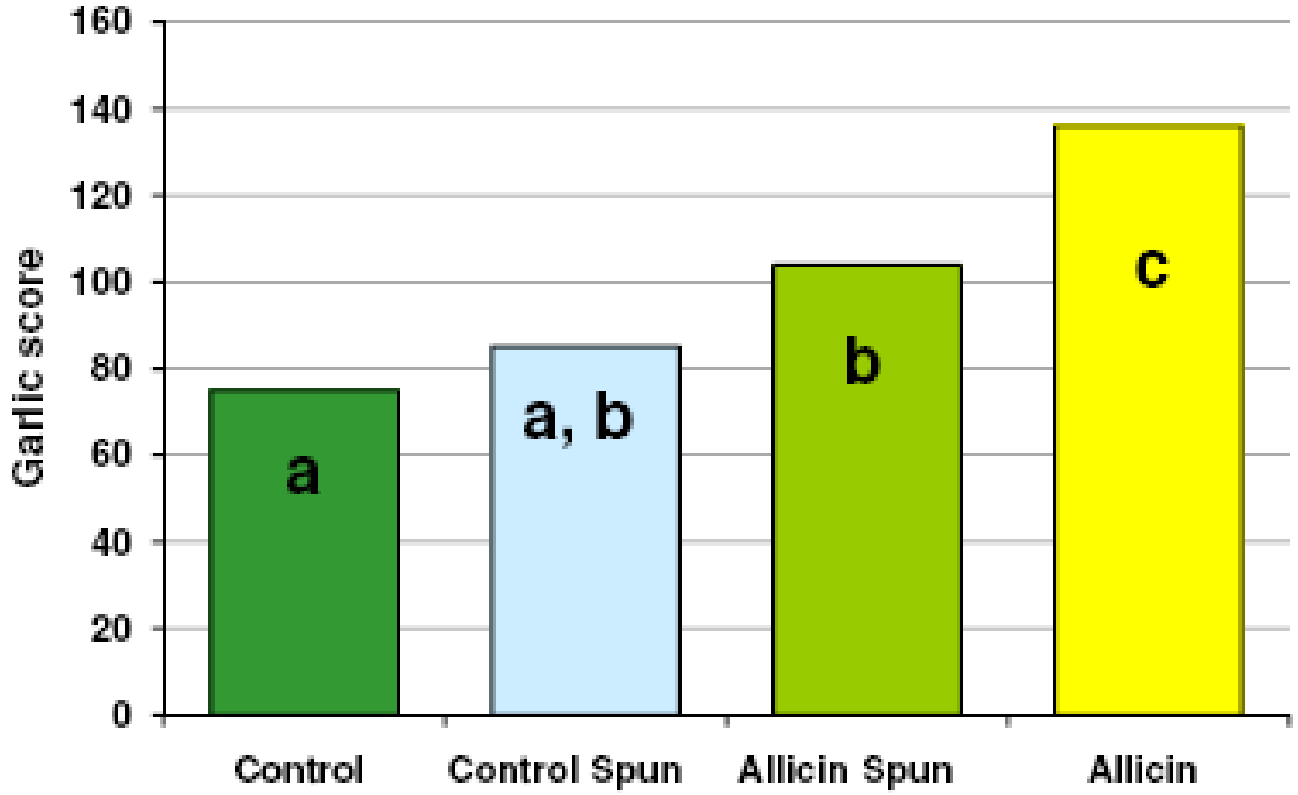
Effect of Allicin and Spinning Cone Column Processing on Garlic Flavour Score



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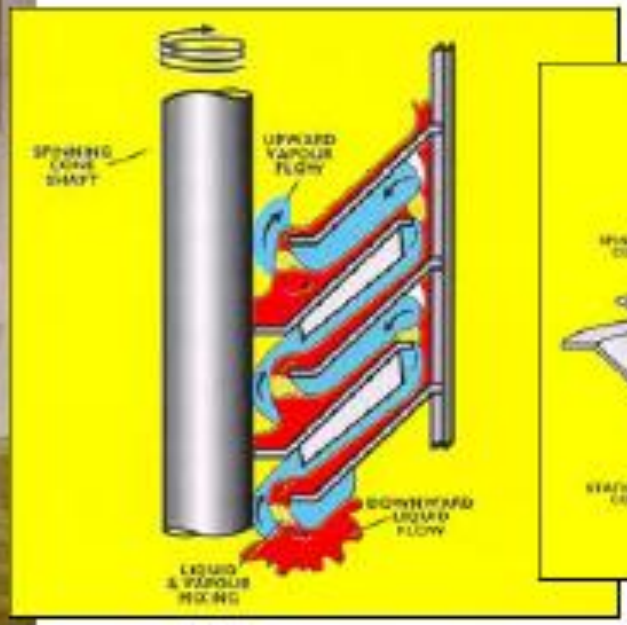
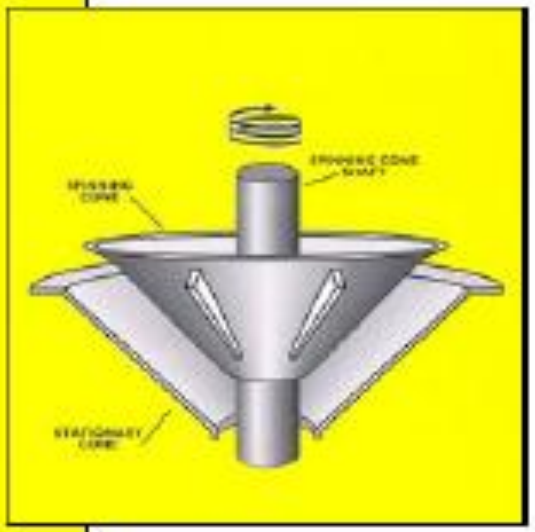
Removing Taint From Milk?????

flavourtech





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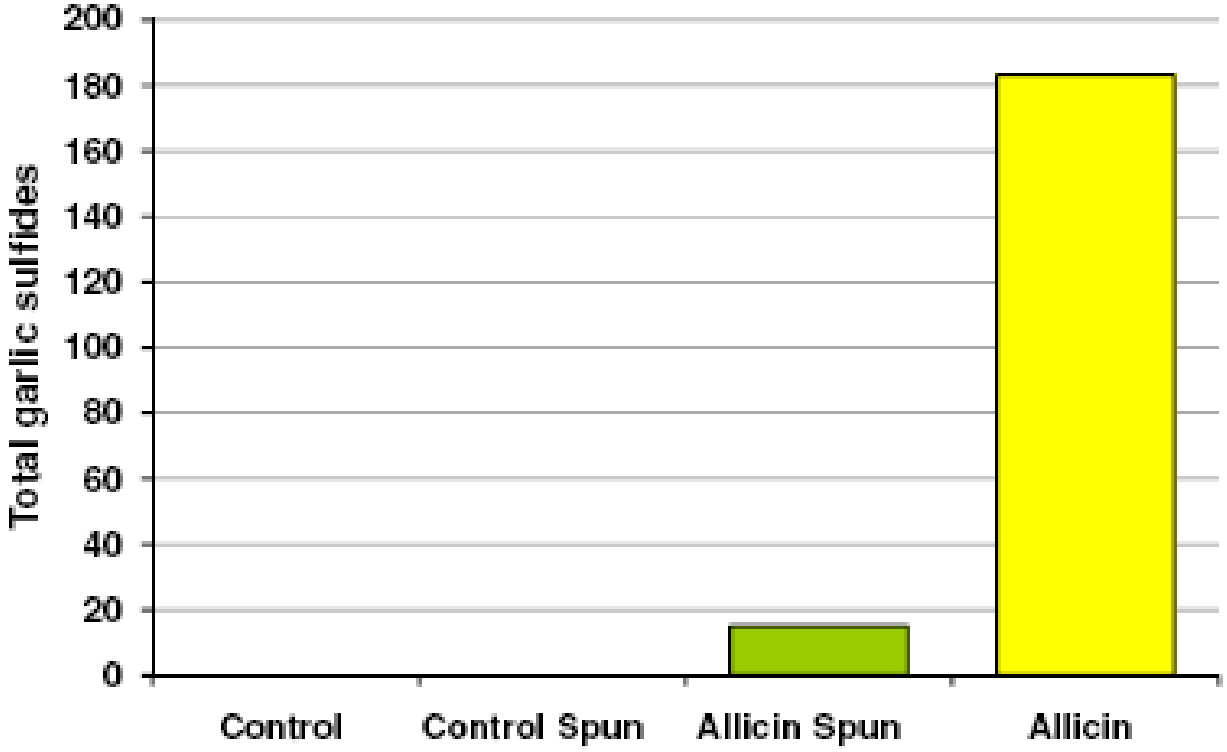
Effect of Allicin and Spinning Cone Column Processing on Volatile Garlic Sulfides in Milk (ng/50 mg milk)



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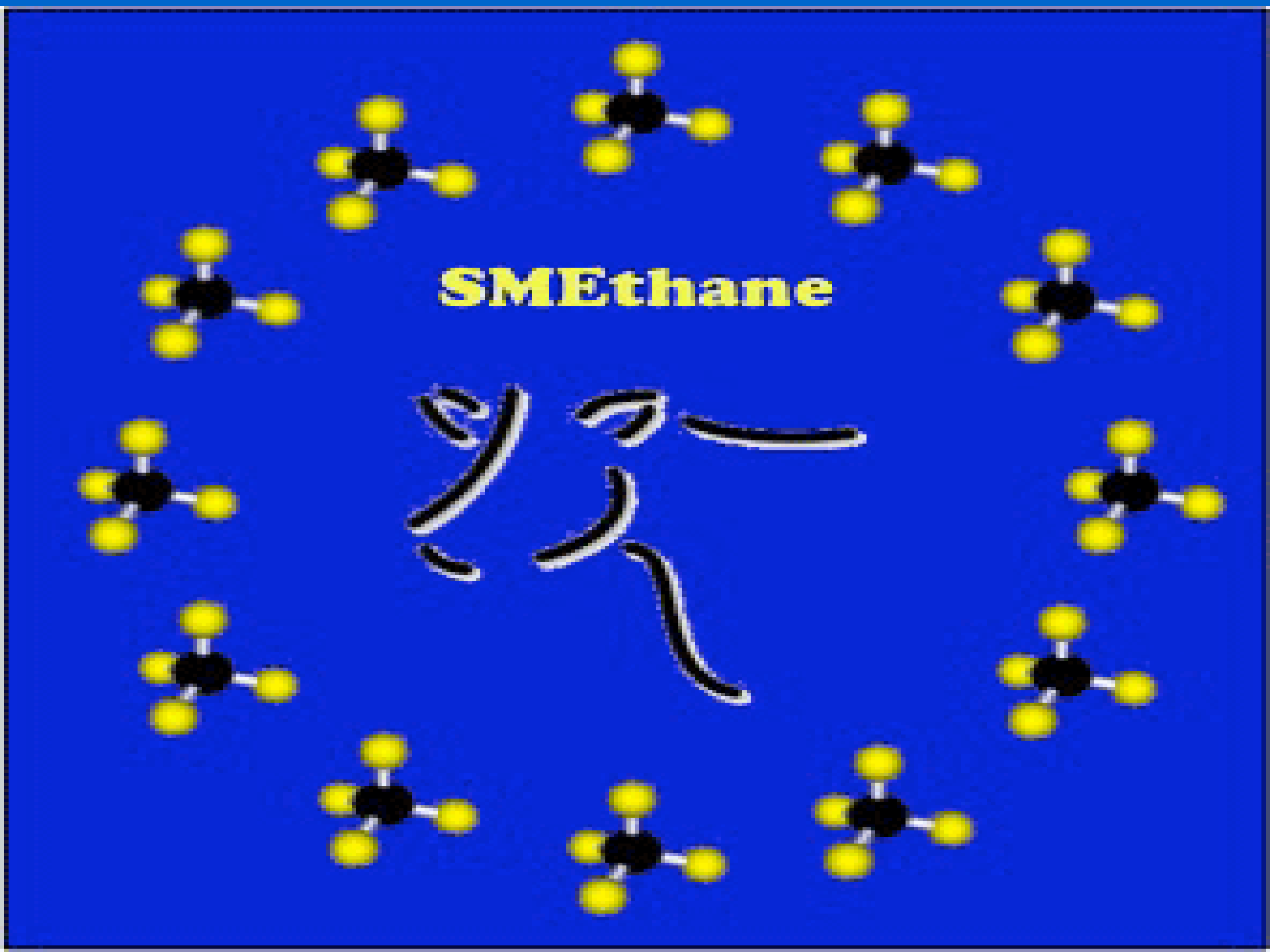
FLATULENCE
TAX
WHAT NEXT?


SMEthane
シラー
シス