

Feed characterisation to predict yield of nutrients arising from digestion

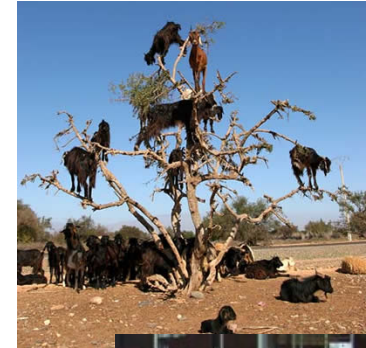


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Innovative and practical management approaches to reduce nitrogen excretion by ruminants

Chemical composition and nutritive value





Whole tract apparent digestibility

- Complete collection
- Indigestible markers
 - Chromic oxide, Titanium dioxide, Alkanes
- Administration of marker
- Quality of marker
- Representative samples of feed and faeces
- Does not measure yield of digested nutrients
 - Microbial or feed amino acids or peptides
 - SCFA
 - Biohydrogenation of fatty acids

Sites of digestion and nutrient flows



- Cannulated animals
 - Rumen: products not yields
 - Duodenum
 - Reticulum or omasum
 - Ileum and caecum
- Markers: dual or triple marker system (CoEDTA, YbAc, Cr mordants, INDF)
- What is digested and absorbed: portal vein; mesenteric artery and vein.
- Prediction from NIRS negates need to characterise feeds further?

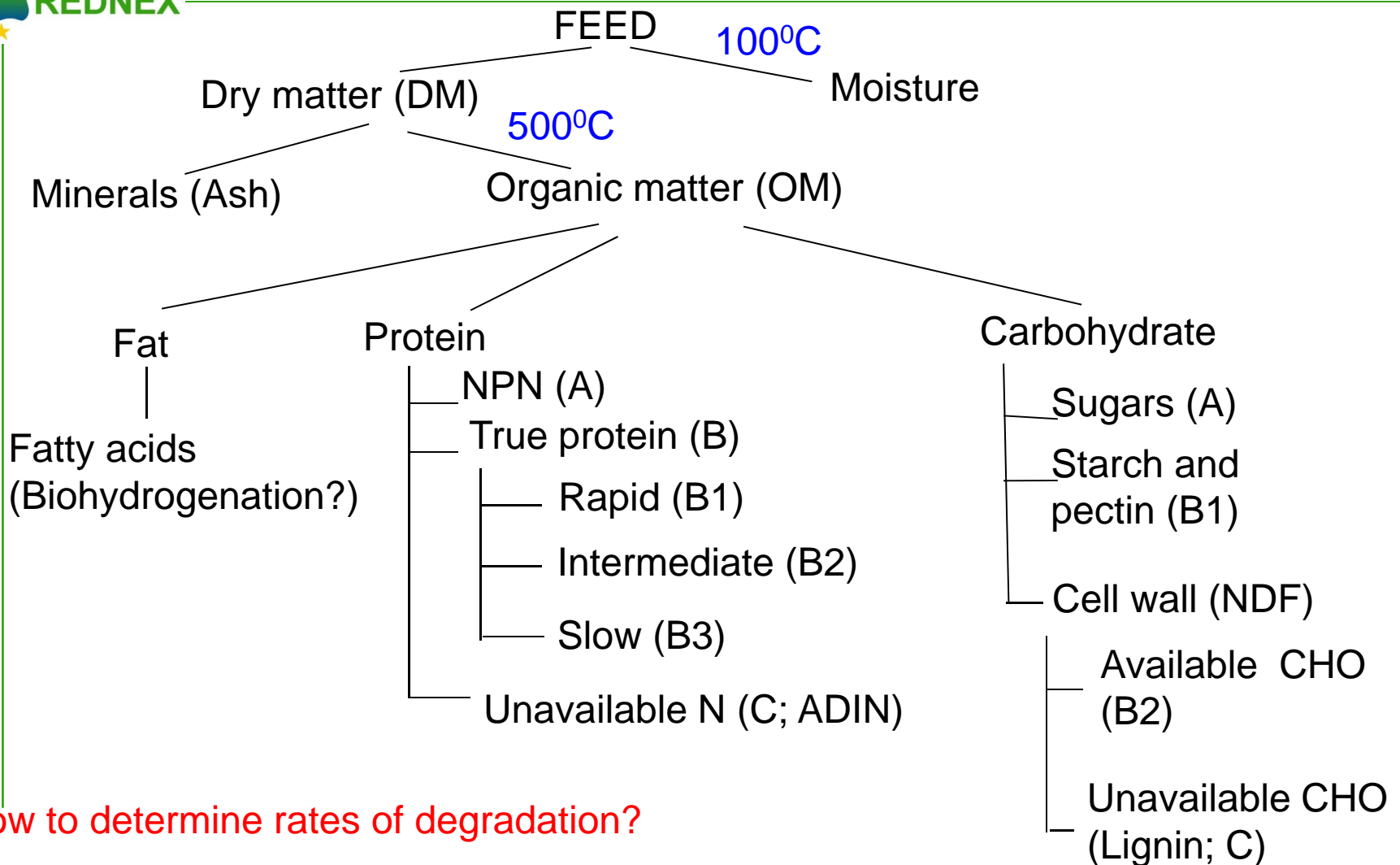


Feed characterisation approaches

- What nutrients might be supplied by different feeds?
- Trying to predict (rate) and extent, and products of digestion of feeds
- Three approaches:
 - Chemical characterisation
 - *In sacco* digestion
 - *In vitro* incubation
- Generalised feed evaluation, or characterisation of particular situation?



Chemical characterisation



How to determine rates of degradation?



In sacco digestion

- In situ: rate and extent of rumen degradation
 - Measure solubility (cold water or buffer) to correct for small particle loss



- Mobile bag: extent of post-ruminal digestion (improvement on ADIN?)



In vitro incubations

- Batch culture
- Continuous culture



Homogenous
Dried and ground?



Include rumen solids?
Removal of adhered
bacteria?
Blend?

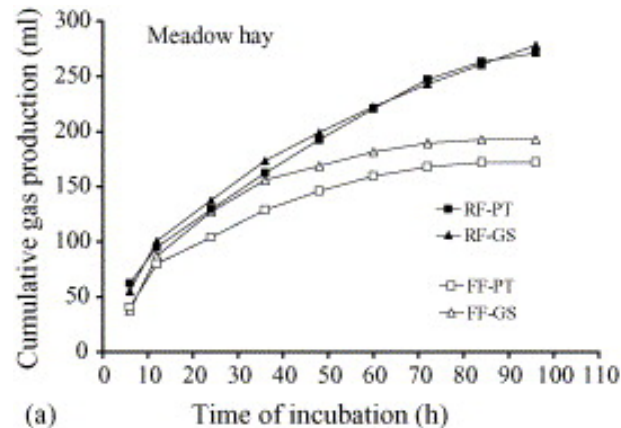


True protein or
NPN?
Carbonate buffer?
Toxic reducing
agents
Boil?
Add CO₂?

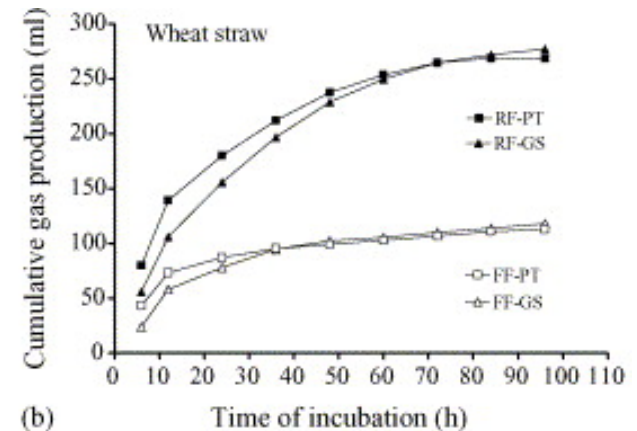


Use of faeces as inoculum

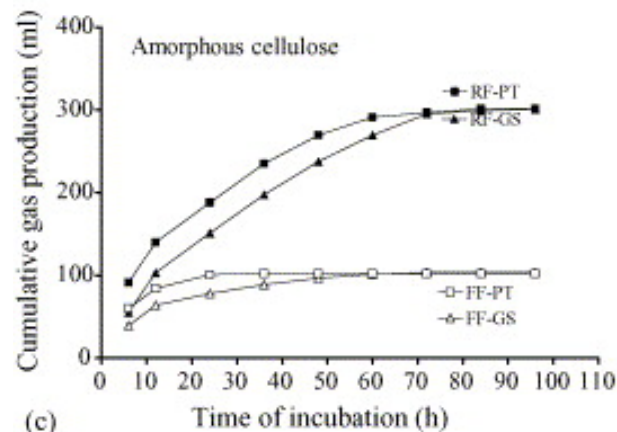
- Endpoints related, rates not
- Mathematical adjustment proposed



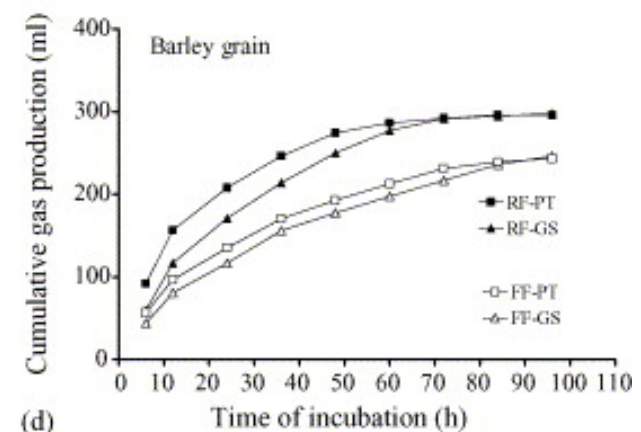
(a)



(b)

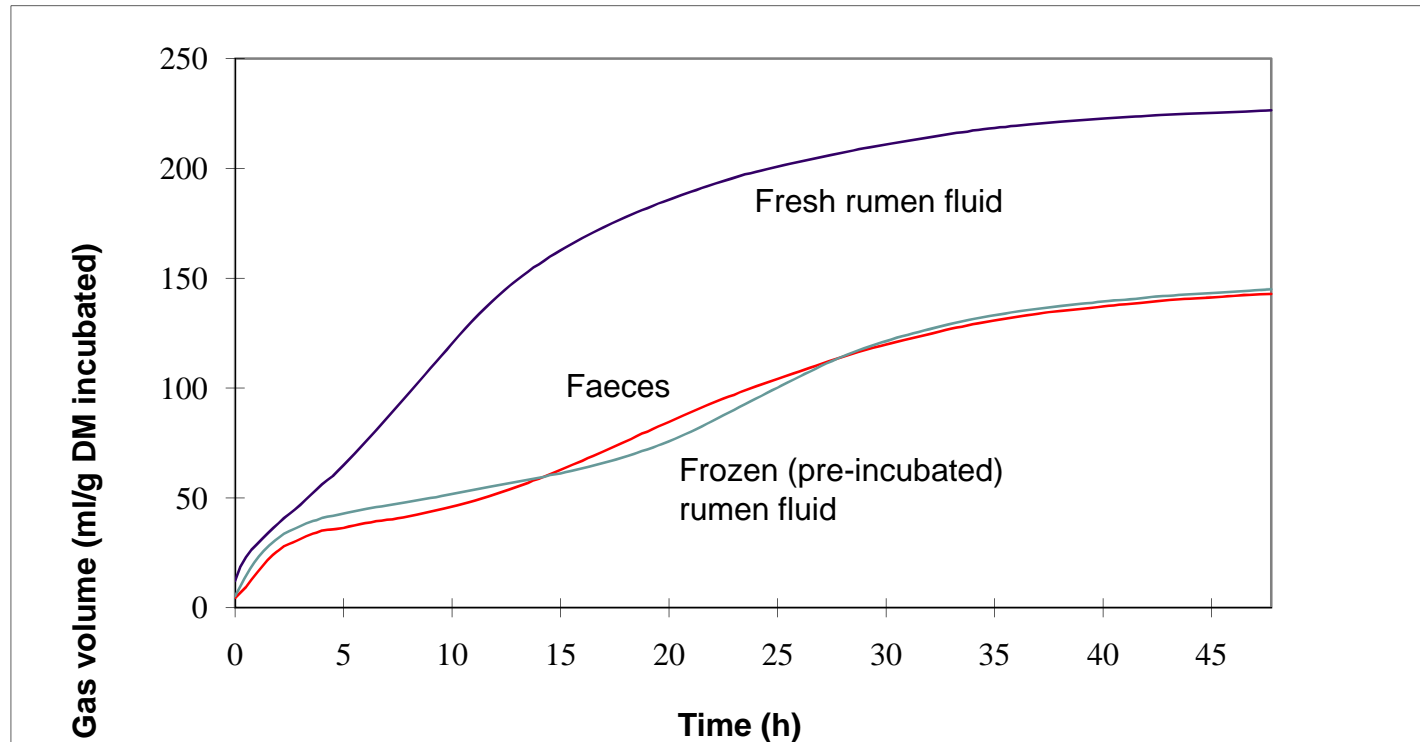


(c)



(d)

Other alternative sources of inoculum

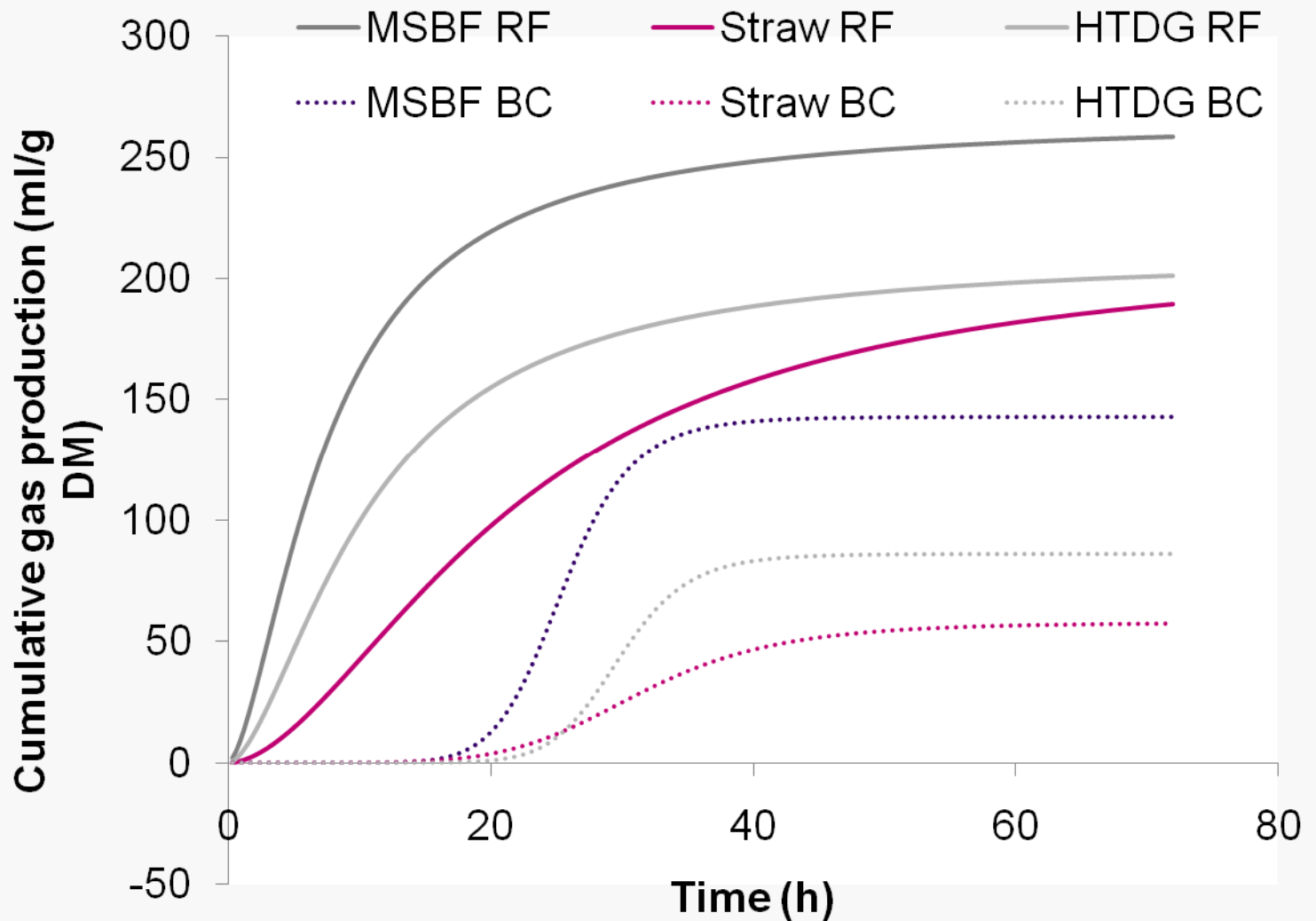


Frozen rumen fluid

- Cell free enzymes?
- Good for end point determinations



Pure bacterial cultures





Applications of *in vitro* techniques





Estimation of OMD

- Tilley and Terry
- Degradability following gas production measurement
- Pepsin/cellulase solubility
- Rate of digestion?
- Yield of digested nutrients?

Prediction of legume silage OMD (*Rinne et al., 2006*)

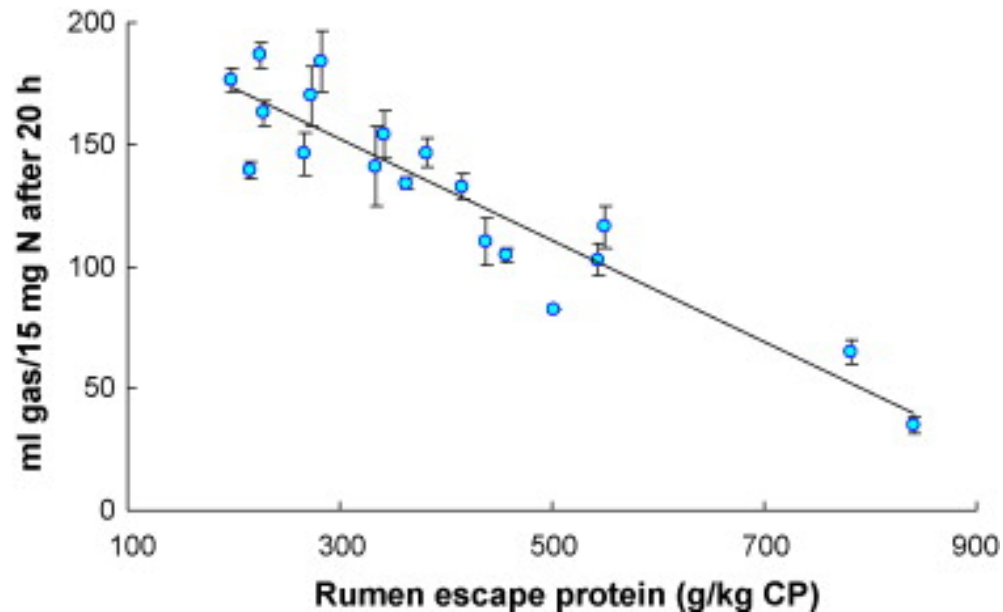
	RMSE	Adjusted R ²
[ADF]	0.178	0.925
Lignin	0.021	0.885
Cellulase solubility	0.011	0.965
OMD (T&T)	0.015	0.940
OMD (Gas)	0.015	0.944



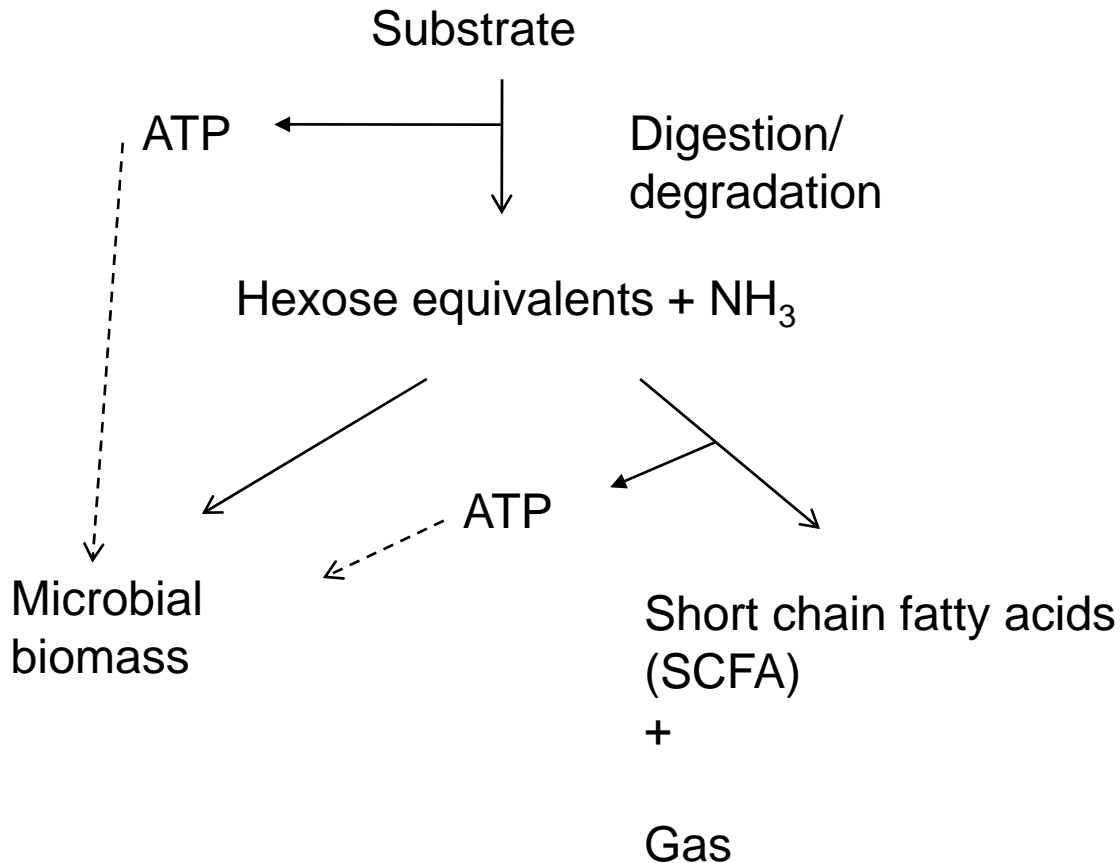
REDNEX

Rate of degradation/ fermentation

- Gas production: rate of fermentation (relation to in vivo?)
- N degradation:
 - ANKOM Daisy
 - Amino acid production
 - Modified GP technique (N poor medium)



Relation between degradation and fermentation

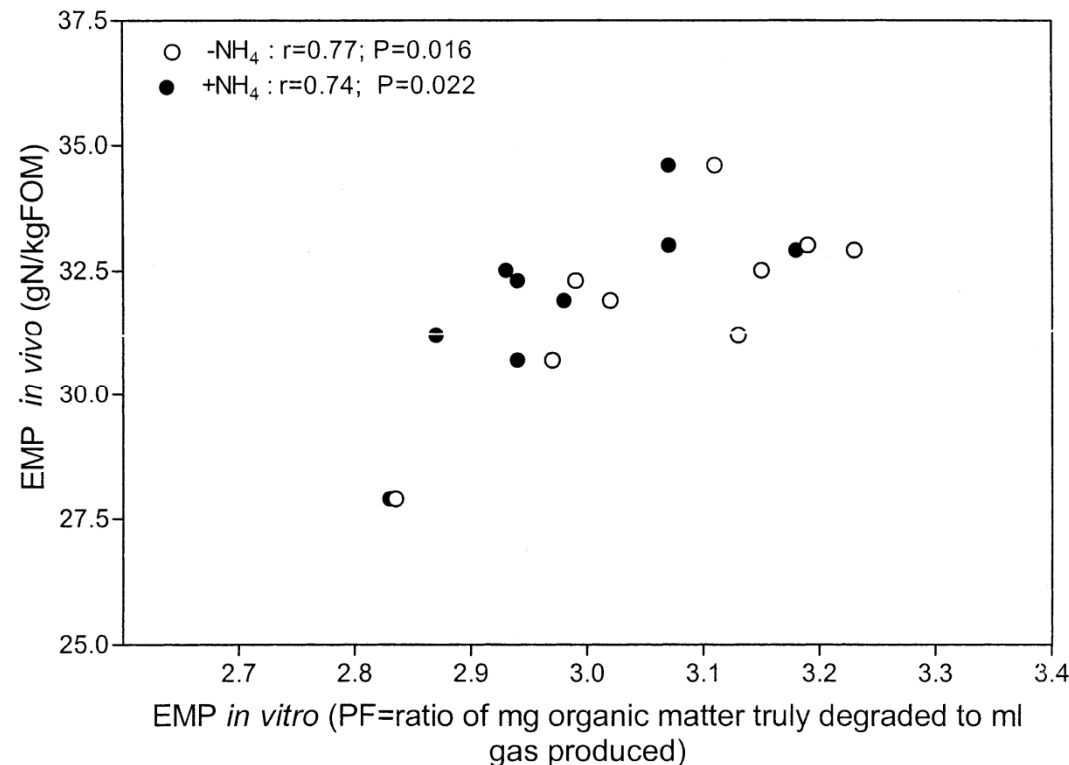


Why would in vitro and in situ determinations be related?

Microbial biomass/protein synthesis



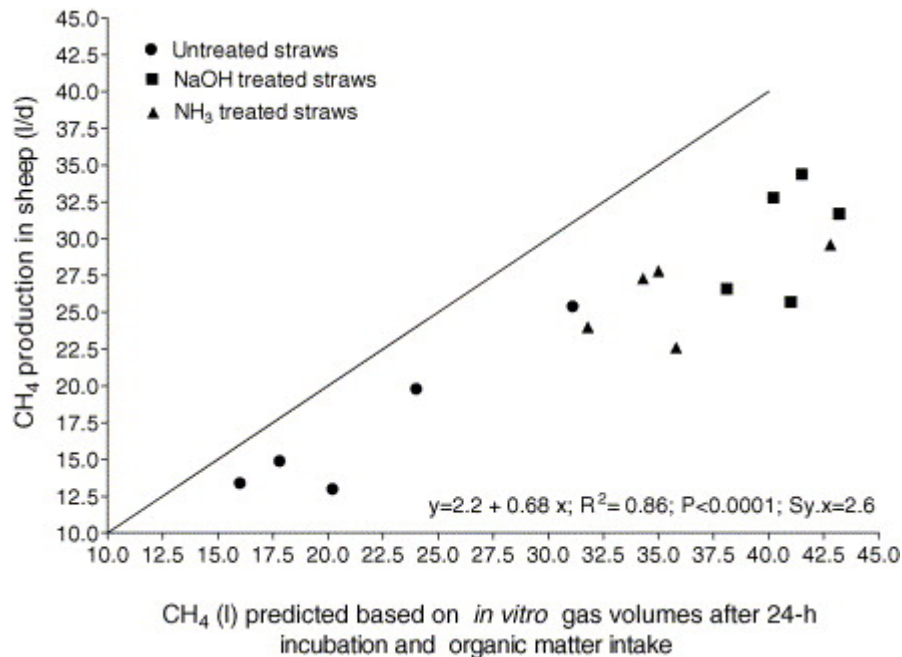
- FiM: estimate SCFA production to estimate ATP (and microbial) yield
- Measures of microbial yield in continuous culture outflows
- Partitioning factor





Other applications

- Methane production



Blümmel et al., 2005

- FiM: Estimate of acidogenicity
- Rate and extent of biohydrogenation of lipids



Summary

- Feed characterisation can provide details on mechanisms of nutrient supply
- Techniques have great potential, as well as limitations
- Source of relevant relative, not absolute, data
- How reliable are in vivo data against which in vitro data are compared?

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It does not necessarily reflect its view and in no way anticipates the Commission's future policy in this area.



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