Managing manure by a greater understanding of its metabolic profile?

Adopting new technologies

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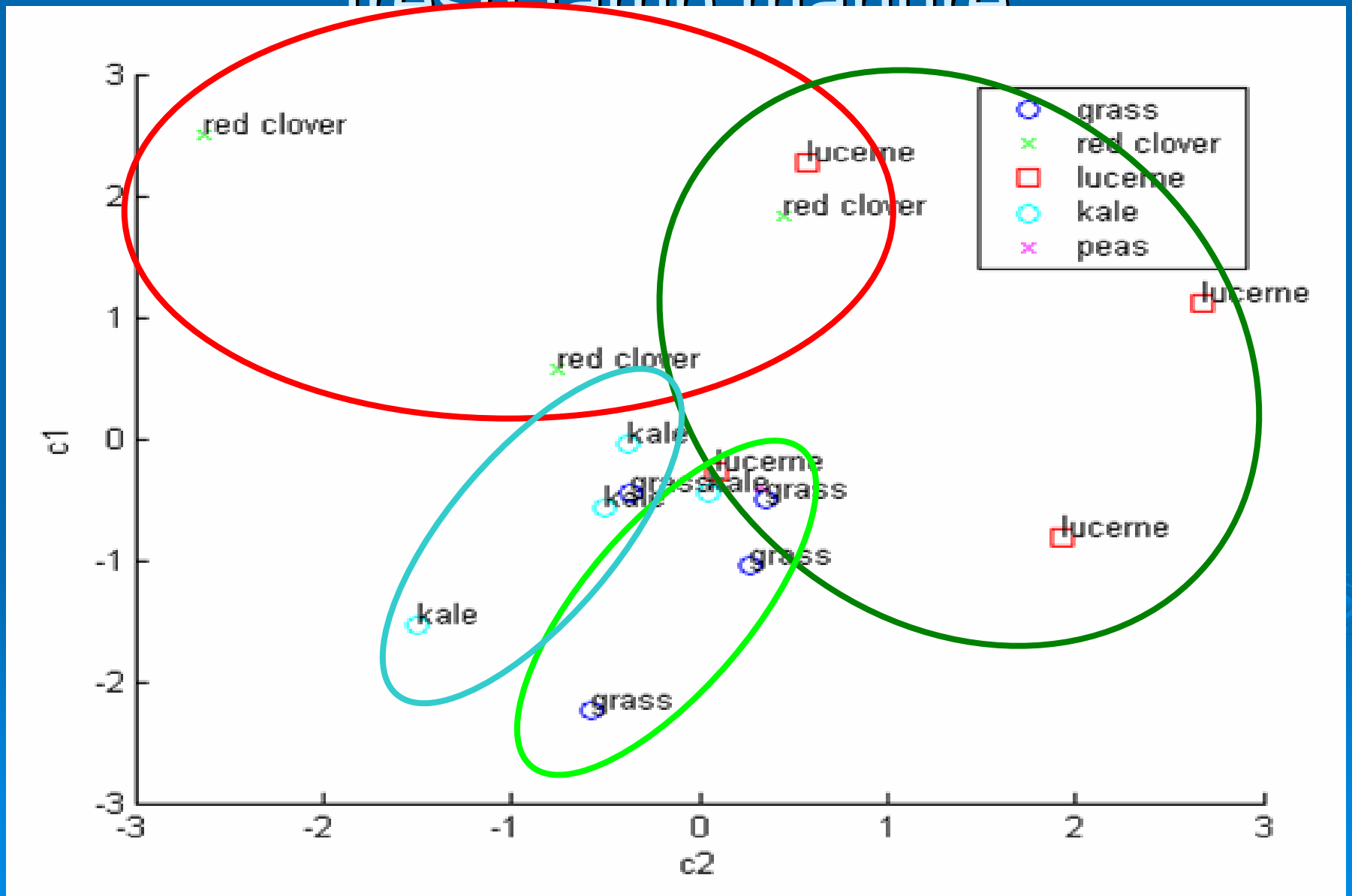
Summary

- Manure profiles
- Gut microbiota
- Modern analytical approaches
- Collecting the right data
- Interpreting the data
- Dietary intake preferences
- Monitoring health
- N transformations

Defining manure profiles

- Livestock dependencies
  - Diet, Genetic traits, Age, Sex, Health status, Herd status
  - Gut microbiota
- Manure storage dependencies
  - Bedding type –straw, paper etc.
  - FYM mostly anaerobic
  - Slurry – Anaerobic

Gut microbial community profile – fresh lamb manure



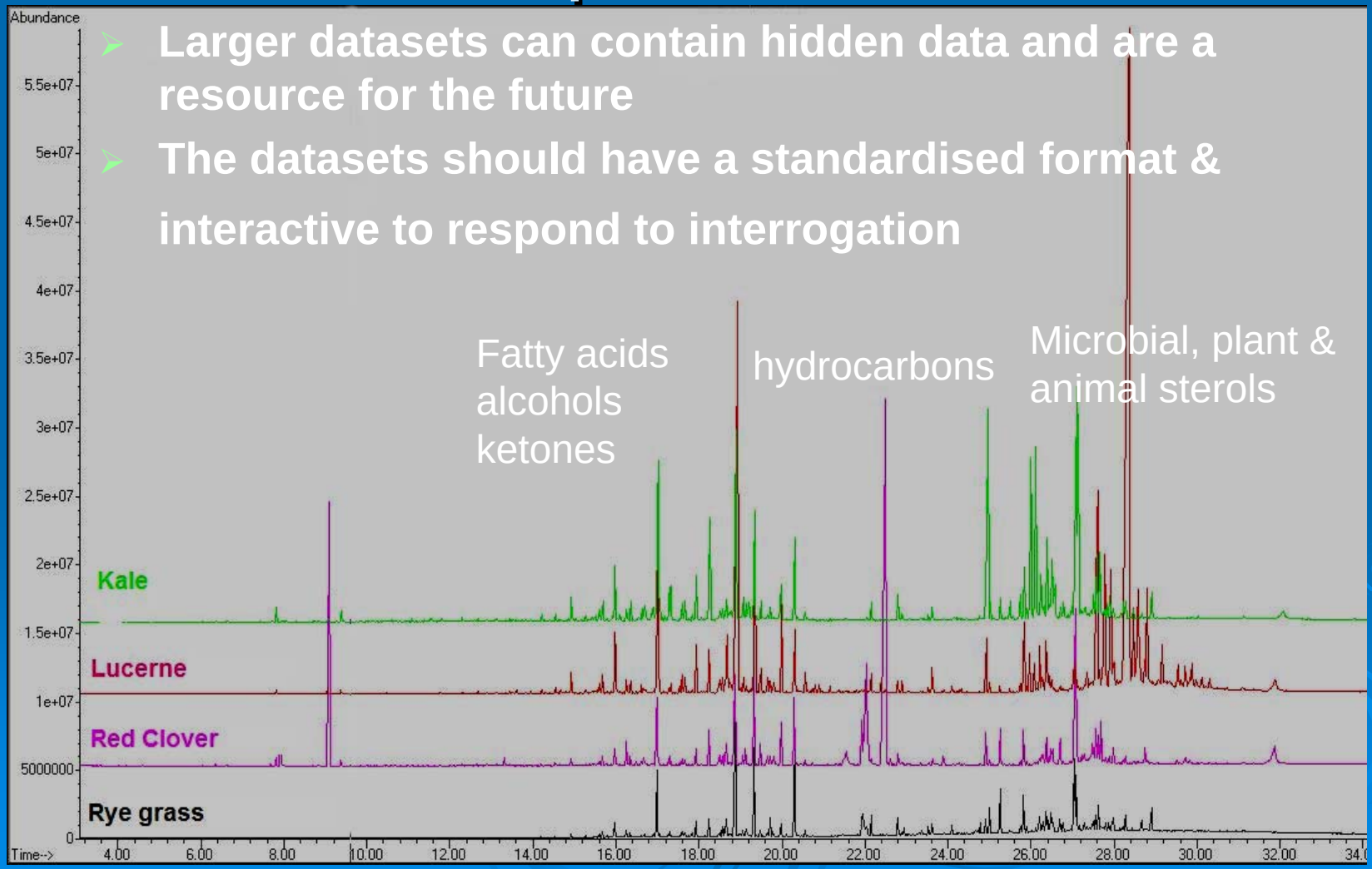
Technologies required

- Gas & Liquid chromatography – mass spectrometry
- Nuclear magnetic resonance ^{1}H or ^{15}N
  - Nearer to non-parametric datasets
- Near infrared spectroscopy
  - Used to determine nutrients in manure as well as complex nitrogen containing molecules such as proteins

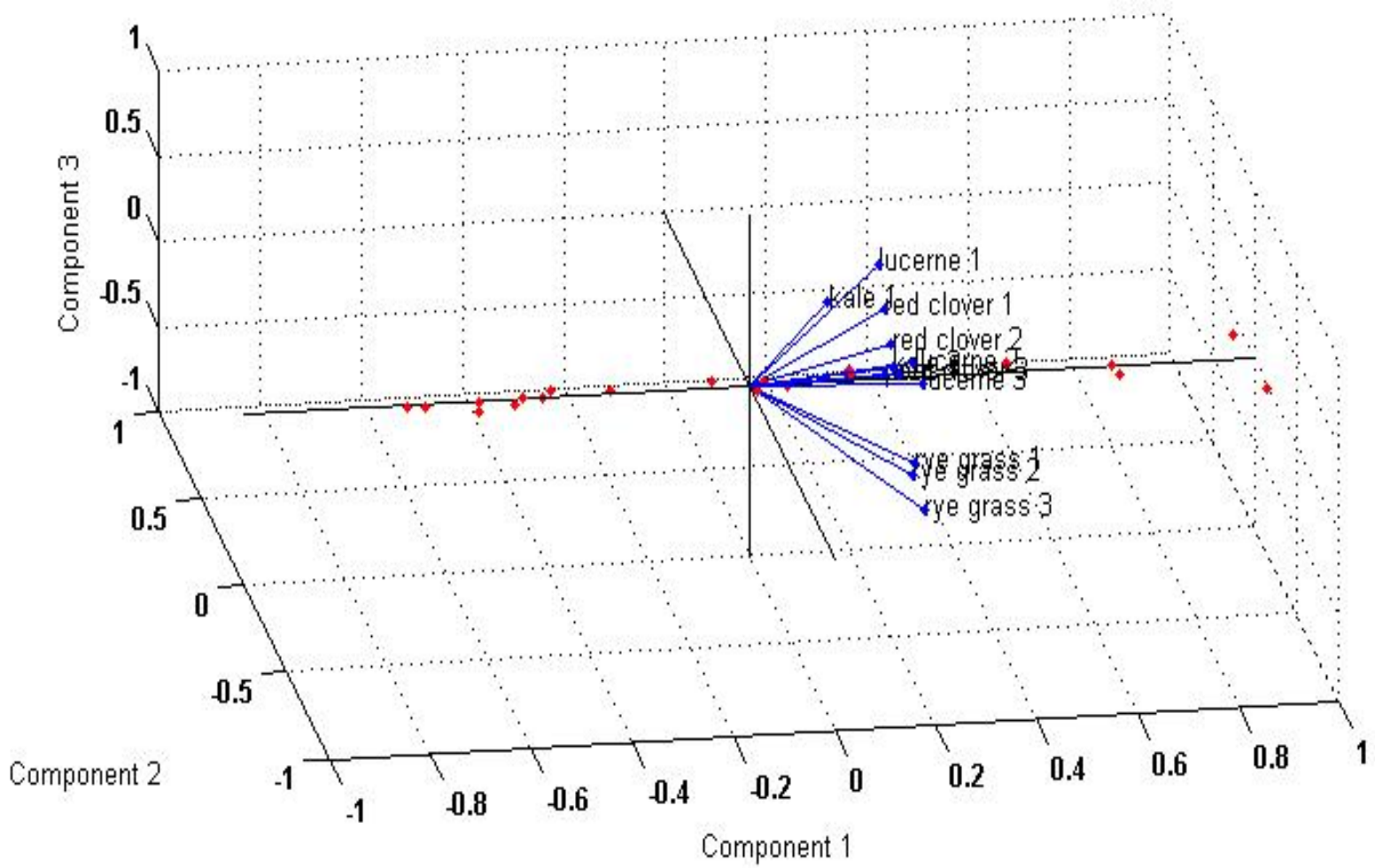
- Data can include metabolic and microbial gut profile, protein content as well as non-parameteric data
- Statistical interpretation e.g.
  - Data reduction c.f. mountain photo - highest top peaks only

Investigating dietary influences GC-MS Data collecting-metabolic profile

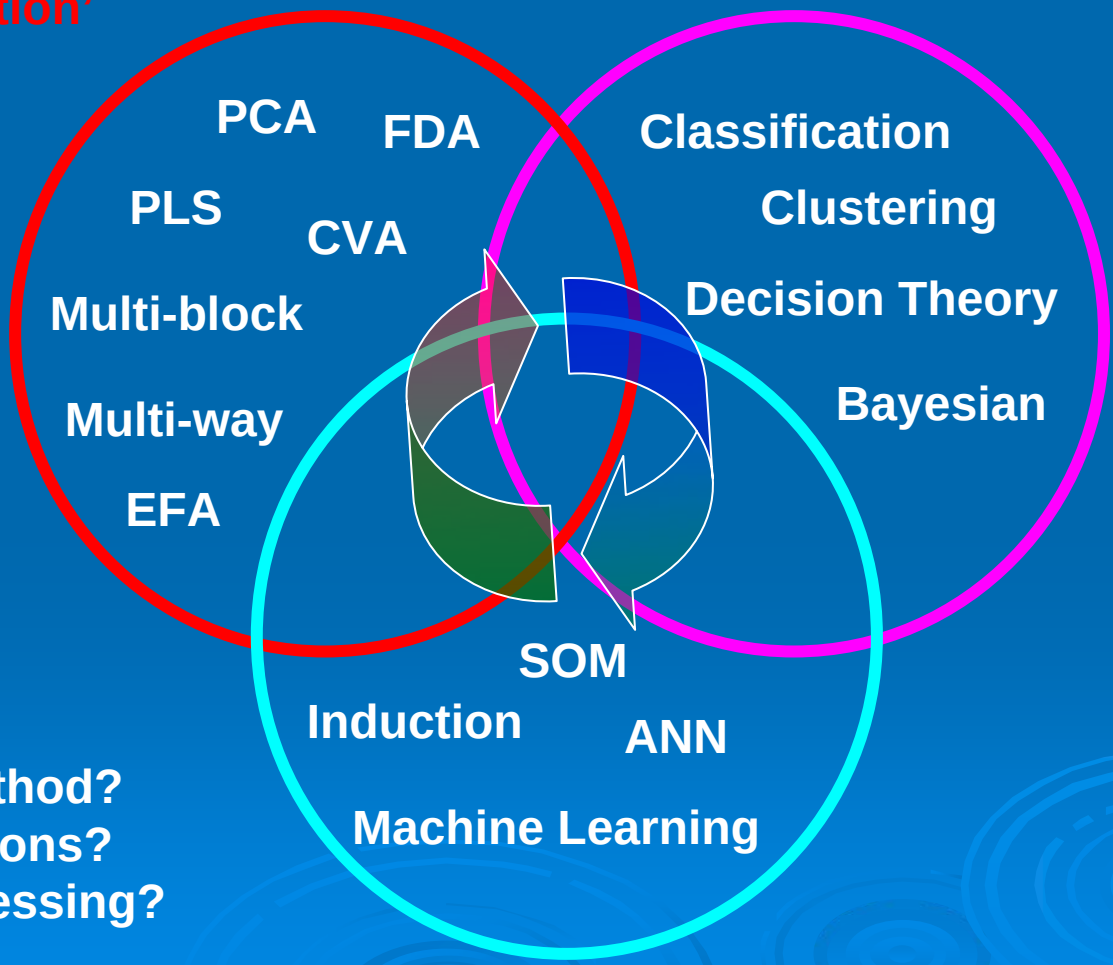
- **Larger datasets can contain hidden data and are a resource for the future**
- **The datasets should have a standardised format & interactive to respond to interrogation**



Amino acid profile - fresh lamb manure

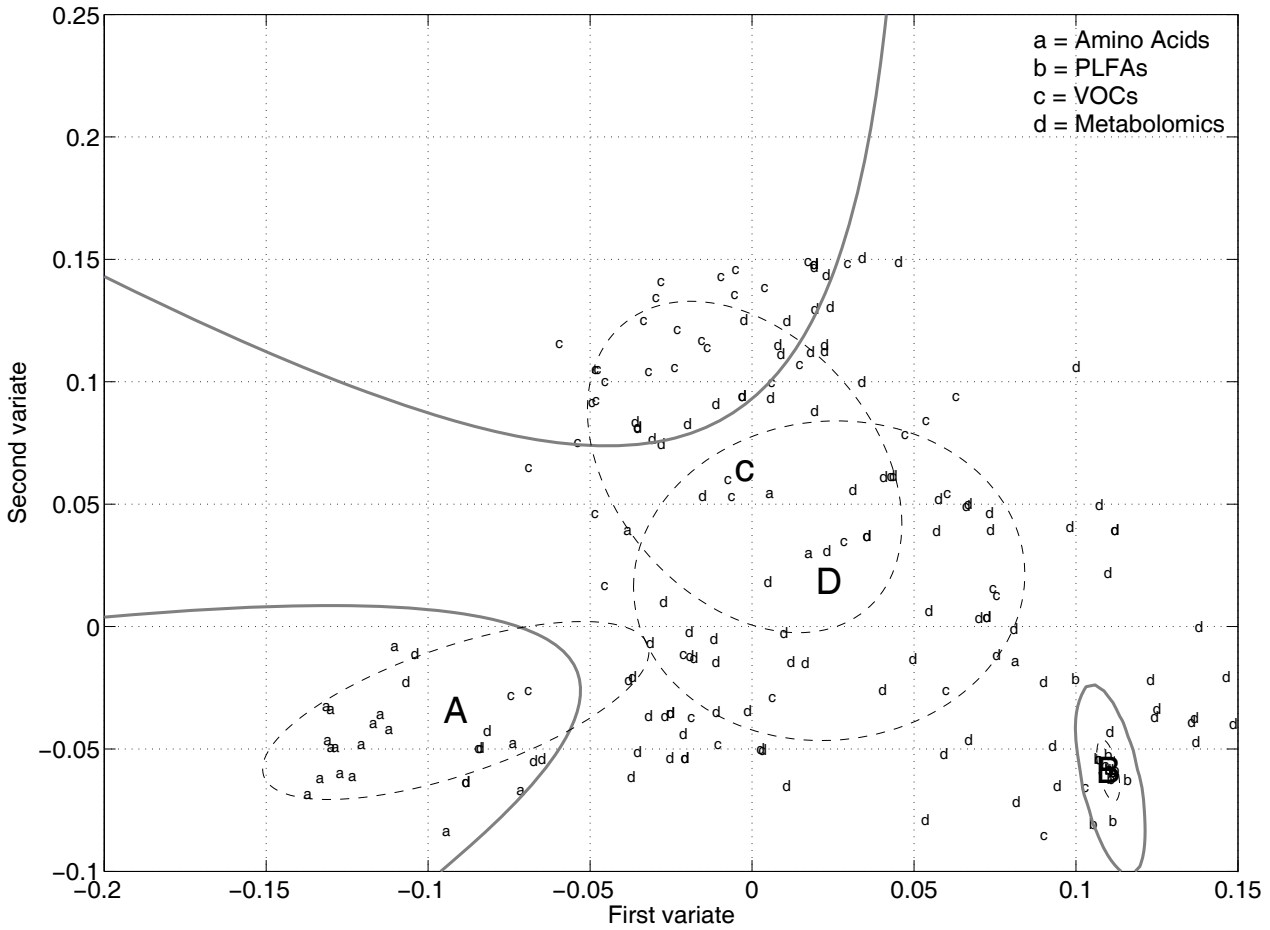


Data-interpretation methodologies



- Which method?
- Combinations?
- Data processing?

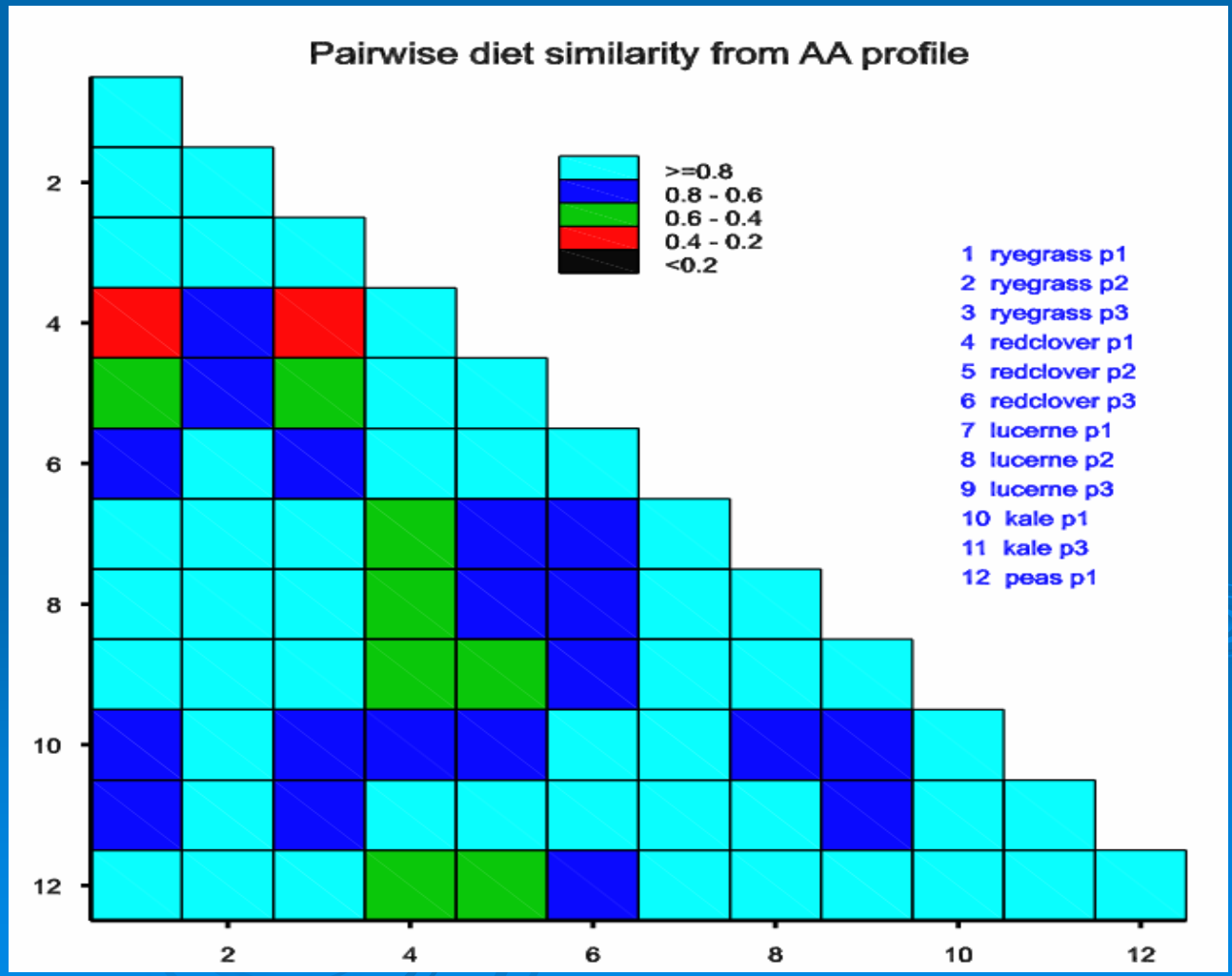
Selecting meaningful databases



Comparing databases with different dimensionality

- Data needs to be reduced to show the differences.
- This can be achieved by data compression or component analysis e.g. PCA PLS or similar.
- Hydrolysed protein can contain 23 amino acids in a profile reduced to 12 dimensions
- Compared using Mantel analysis

Comparing databases with the same dimensionality- Mantel analysis



Results

- specific markers that differentiated diets
  - cystine and cysteine - kale diet;
  - AAs -aspartic, glutamic glycine and alanine for - red clover diet
  - Alkane profile C31 and C33 hydrocarbons –grazing preferences

- Potential indicators of health status included
  - Methyl sulphides – meat quality and anaemia
  - Cysteine – wool growth
  - Fatty acids – dietary health and meat quality
  - Methenamine- good healthy diet
  - C18:2 unsaturated phospholipid - poor diet

Conclusions

- individual or holistic metabolic markers can be identified in fresh manure samples to differentiate diet
- Changes in the fresh manure protein profile lead to understanding N transformations
- Microbial community structure varies with animal and diet with fungal activity being a distinguishing factor
- Detection of sub-clinical health and welfare possible