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New developments in strawberry flavour research

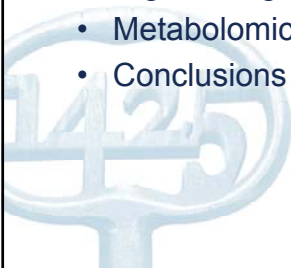
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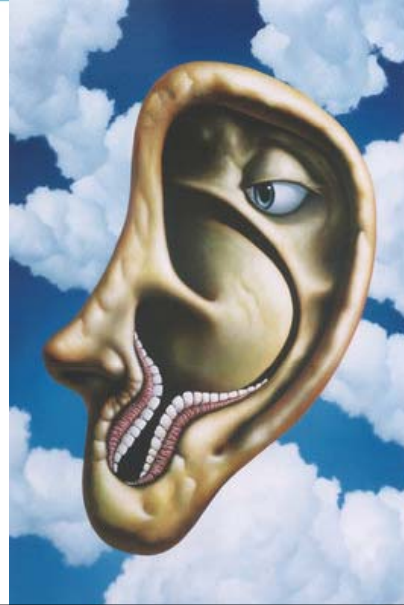
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- Flavour
- Flavour analysis
- Strawberry aroma
- Flavour changes during ripening
- Postharvest flavour changes
- High throughput flavour analysis
- Metabolomics
- Conclusions



Flavour

- Combination of
 - Taste:
 - Perceived by tongue
 - Sweet, sour, bitter, salty, umami
 - Aroma
 - Perceived by nose
 - Orthonasal vs retronasal
 - Texture
 - Perceived by tactile senses
- Flavour is multimodal !
 - Effects of color, sound during chewing



Flavour analysis

- Sensory panel
 - Typically 10+ panellists
 - Trained in quantifying taste components
- Consumer panel
 - Typically 100+ panellist
 - Not trained



Source: S. Buysens, PCG, Kruishoutem, Belgium

- Instrumental analysis
 - Taste: refractometer, titrator, HPLC
 - Aroma: GCMS
 - Texture: penetrometer, universal testing machine,...



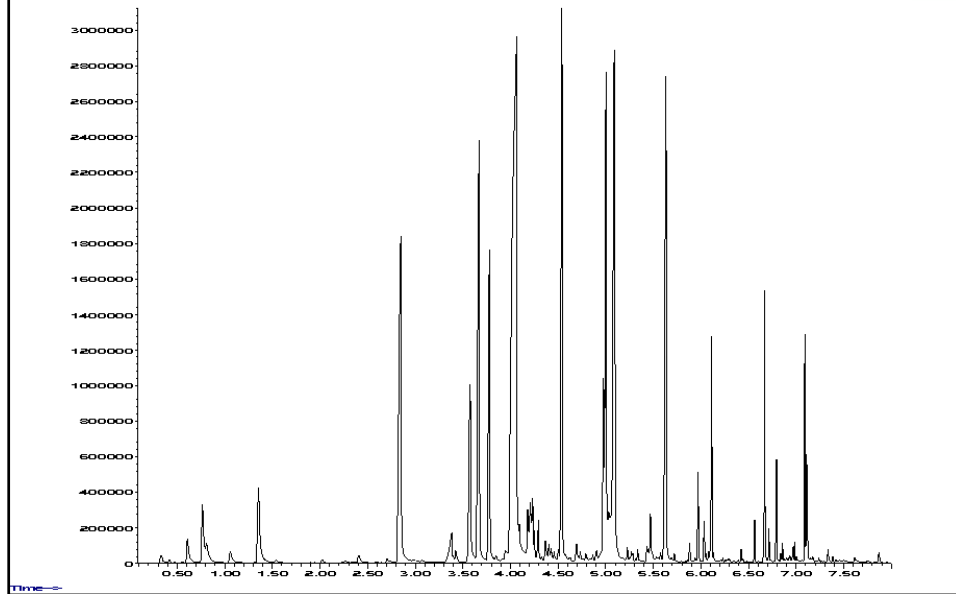
Strawberry aroma

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- ± 360 volatile compounds from which 20 are important for sensory impression
- Several chemical classes:
 - acetals
 - alcohols
 - aldehydes (hexanal, hexenal)
 - esters
 - furanones
 - ketones
 - lactones
 - organic acids
 - phenols
 - sulfur compounds
 - terpenes (linalool)



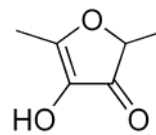
- Typical gas chromatogram



- Most important volatiles

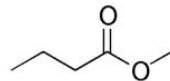
- Furanones, e.g. furaneol (DHF)

Caramel-like, sweet, floral, fruity notes,
Typical strawberry aroma, also pineapple



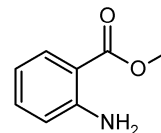
- Esters, e.g., methyl butanoate

Floral, fruity notes
Butanoates and hexanoates make up 50-80 %
of all volatiles in strawberry



- Methyl anthranilate

Grape smell



- Aroma types
 - DHF-type (furanol)
 - Elsanta (medium to poor aroma)
 - Ester-type
 - Polka (pleasant aroma)
 - MA-type (methyl anthranilate)
 - wild species and old cultivars
 - *F. vesca*, Mieke Schindler



Flavour changes during ripening

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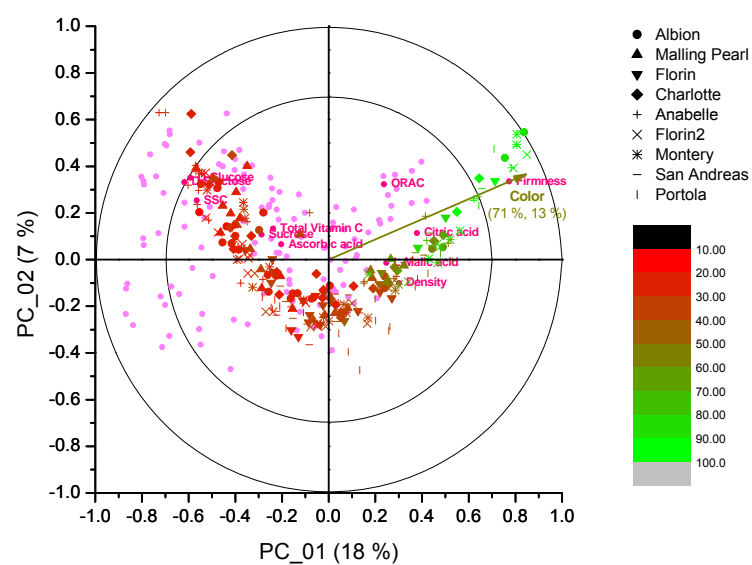
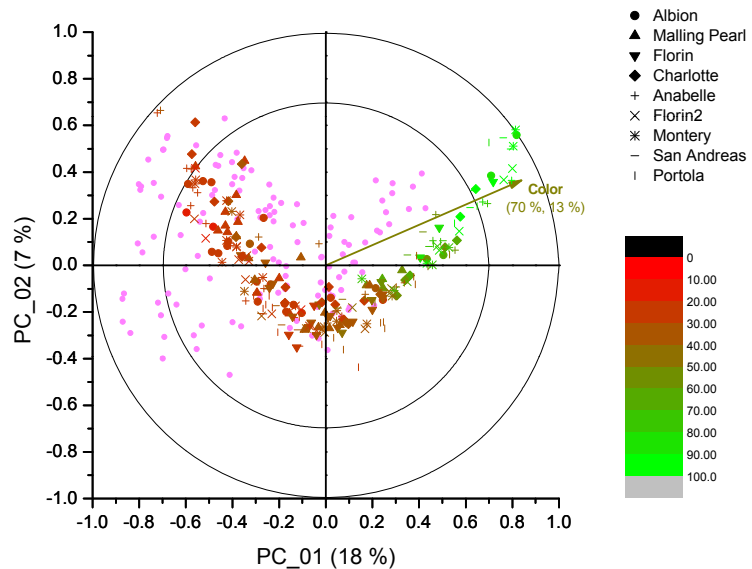
- Experimental design
 - 10 cultivars (Albion, Malling Pearl, Florin, Charlotte, Anabelle, Florin2, Monterey, San Andreas and Portola // Elsanta) (Pamel experimental station)
 - Ripeness series



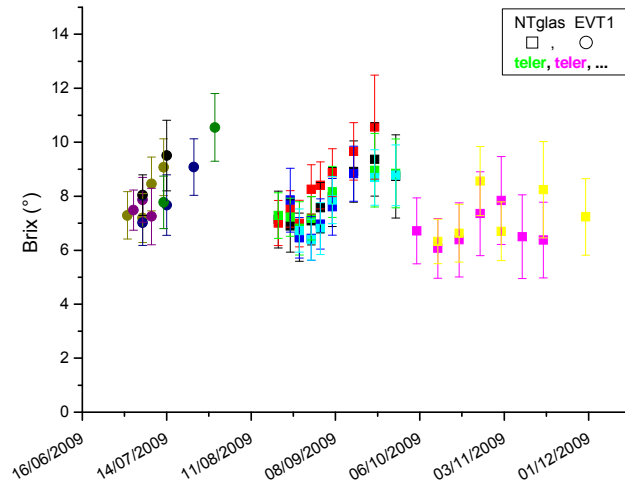
- Measured attributes: color, wrinkles, green/red ratio, firmness, sugars, acids, aroma, ORAC, ascorbic acid



• PCA analysis of aroma changes



- Large variability due to time, effect of producers smaller

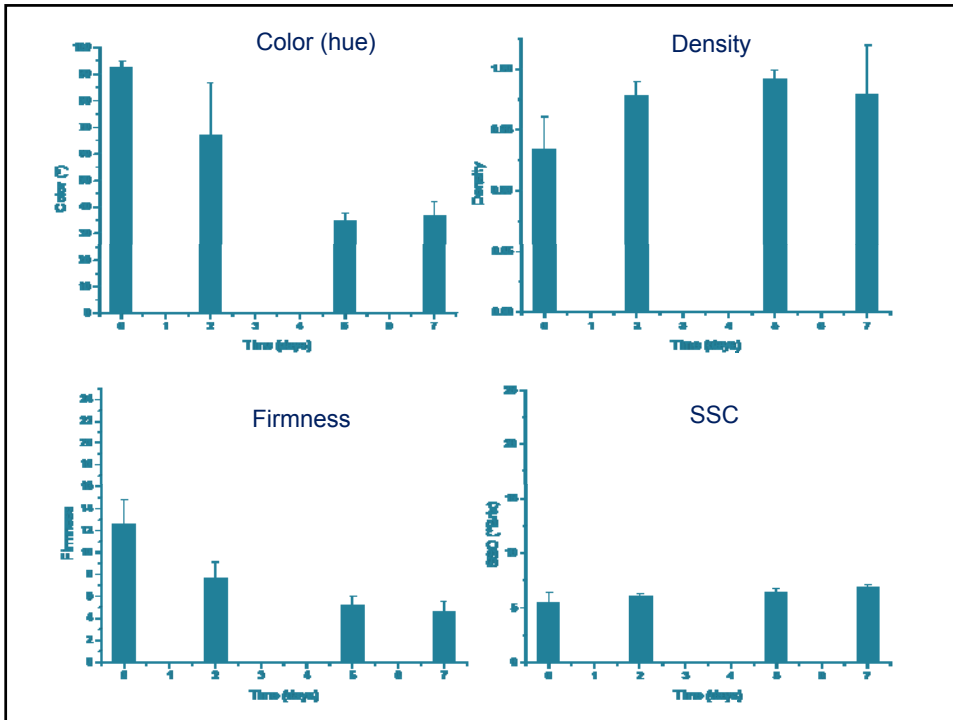


Postharvest flavour changes

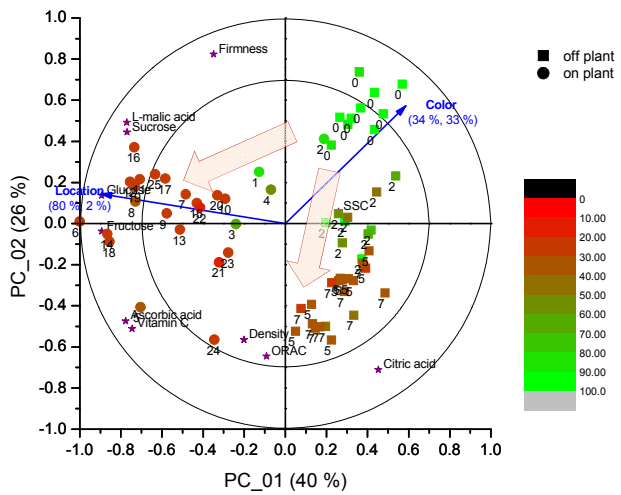
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- Strawberry is nonclimacteric fruit
- Color, however, also develops after harvest
- How about flavour ?
- Experimental setup
 - One cultivar (Albion): proeftuin Pamel, Belgium
 - Strawberries ripened on / off plant

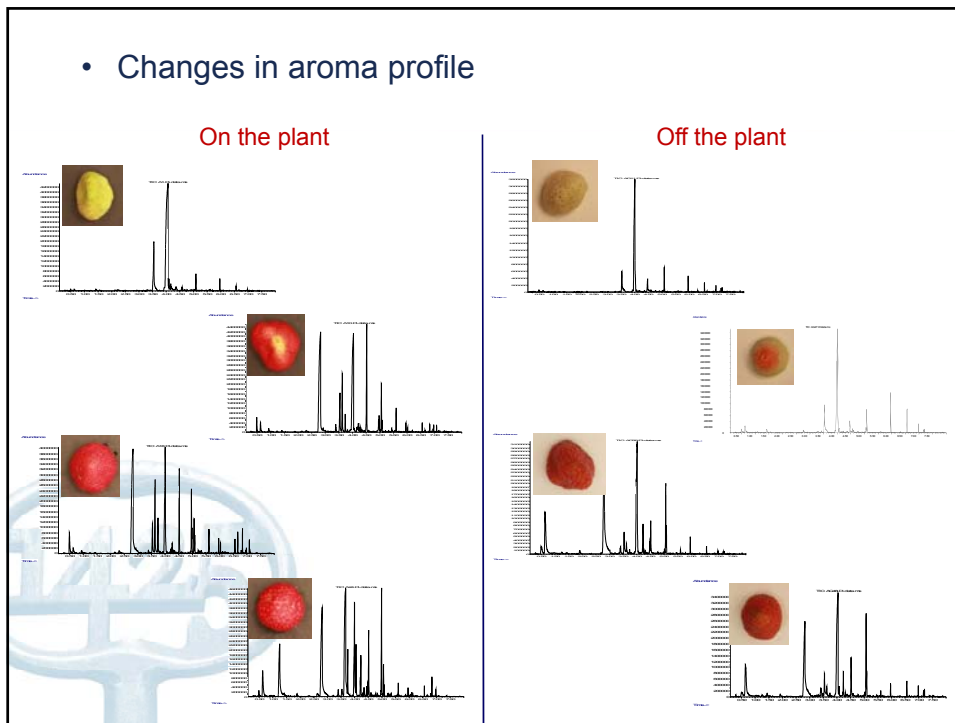




• PCA of quality attributes



- Changes in aroma profile

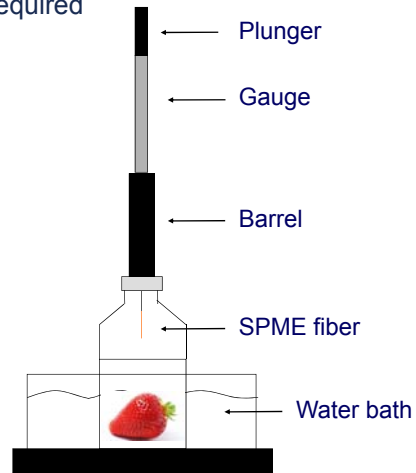


High throughput flavour analysis

- Disadvantages of traditional methods for flavour
 - Sample preparation
 - Measurement time
- Flavour analysis is bottleneck in rapid phenotyping
 - Breeding
 - Commercial quality systems

➔ High throughput methods

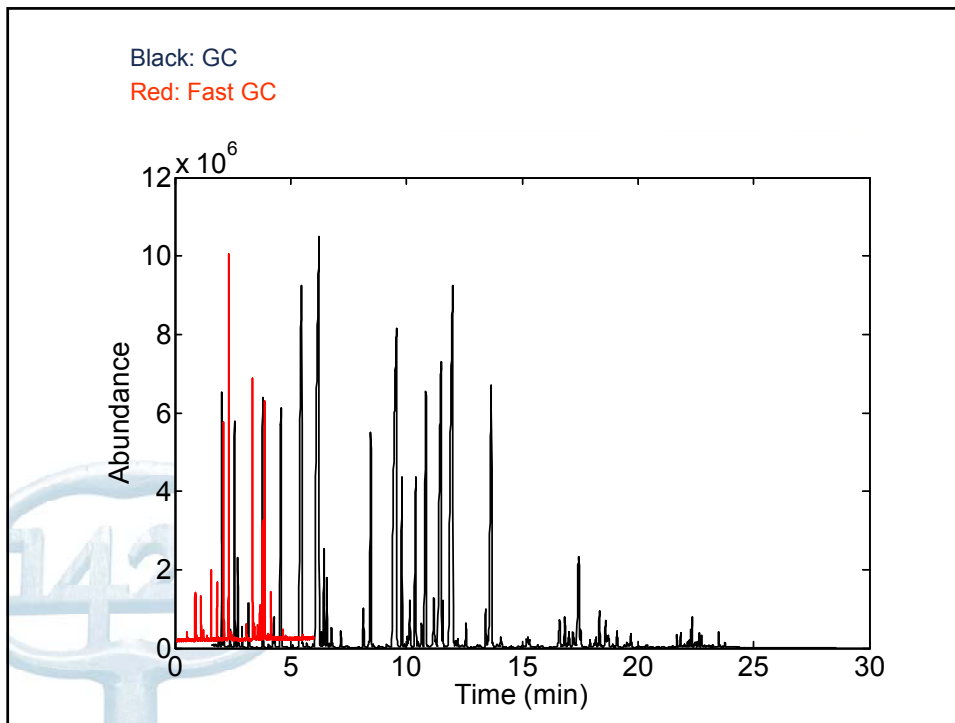
- Solid phase micro extraction (SPME)
 - Major speed-up compared to other headspace sampling techniques
 - Optimisation required



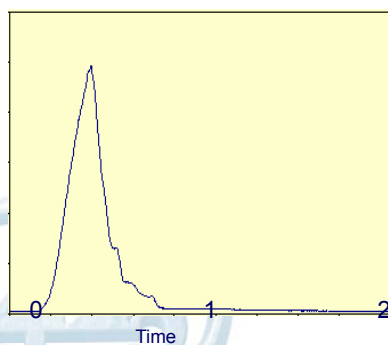
- Fast GC-MS
 - External column
 - Resistive heating
 - Increased pressure
 - Small diameter

E.g., Mach-System (Gerstel)

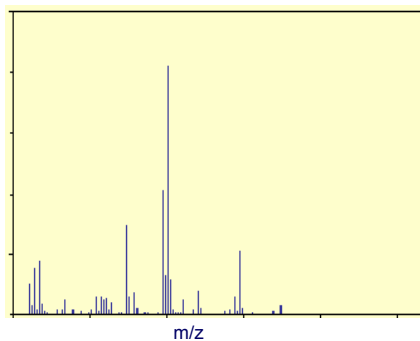




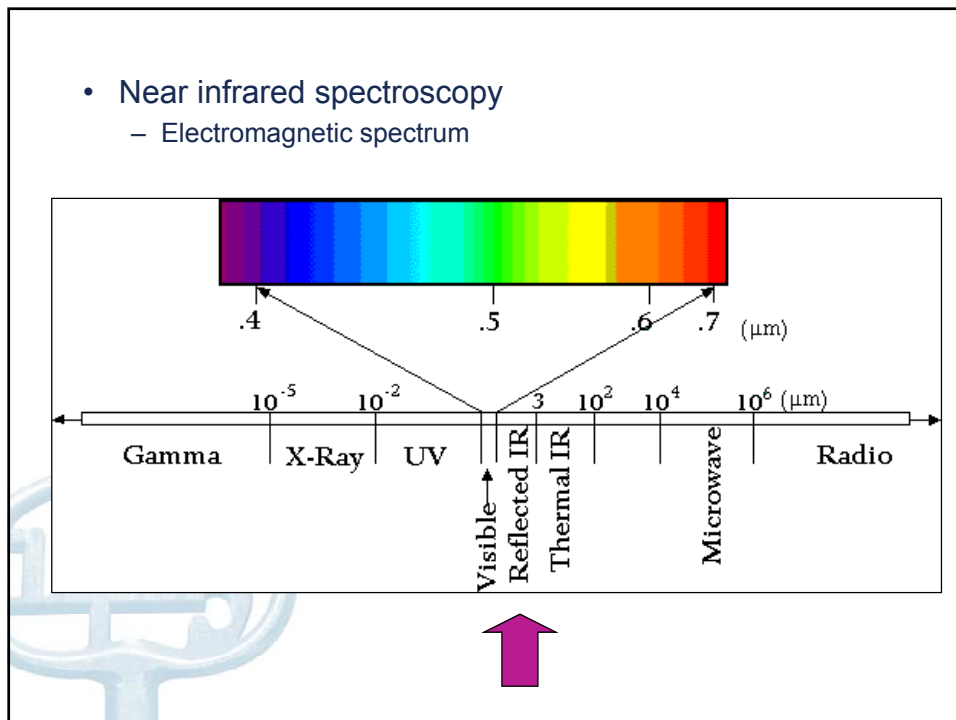
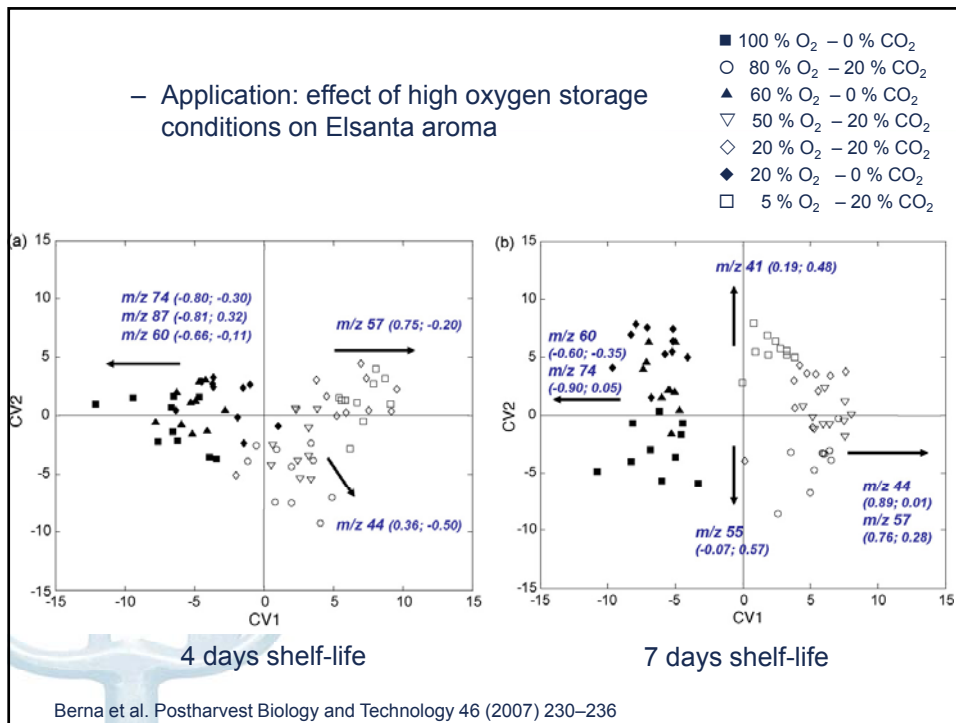
- Headspace fingerprint mass spectrometry
 - No GC separation of volatiles
 - Fingerprint mass spectrum statistically correlated with, e.g., sensory panel analysis

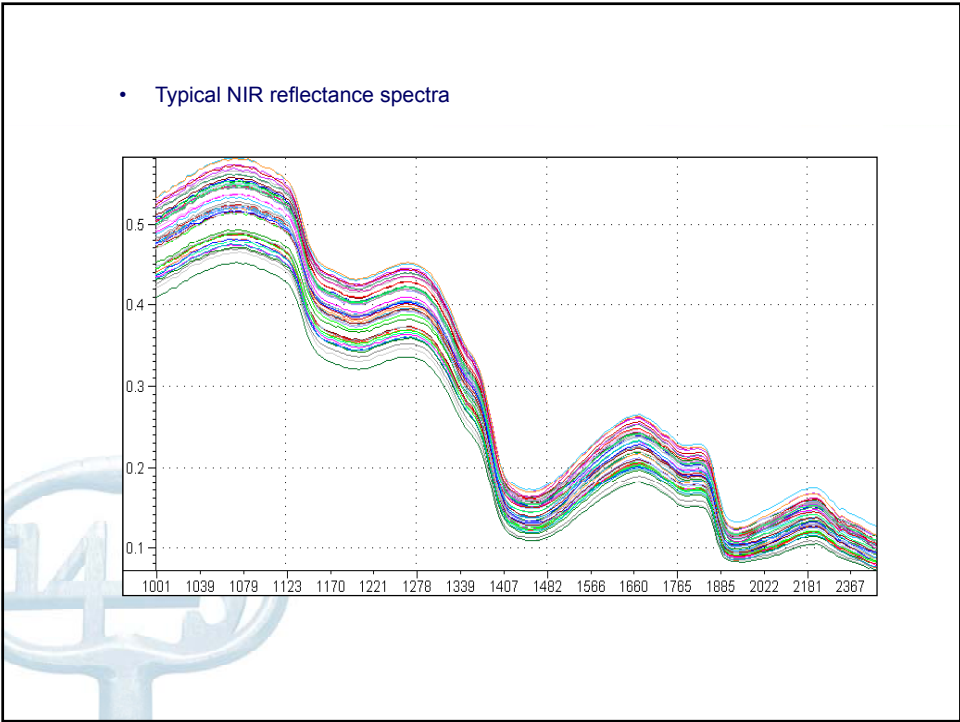
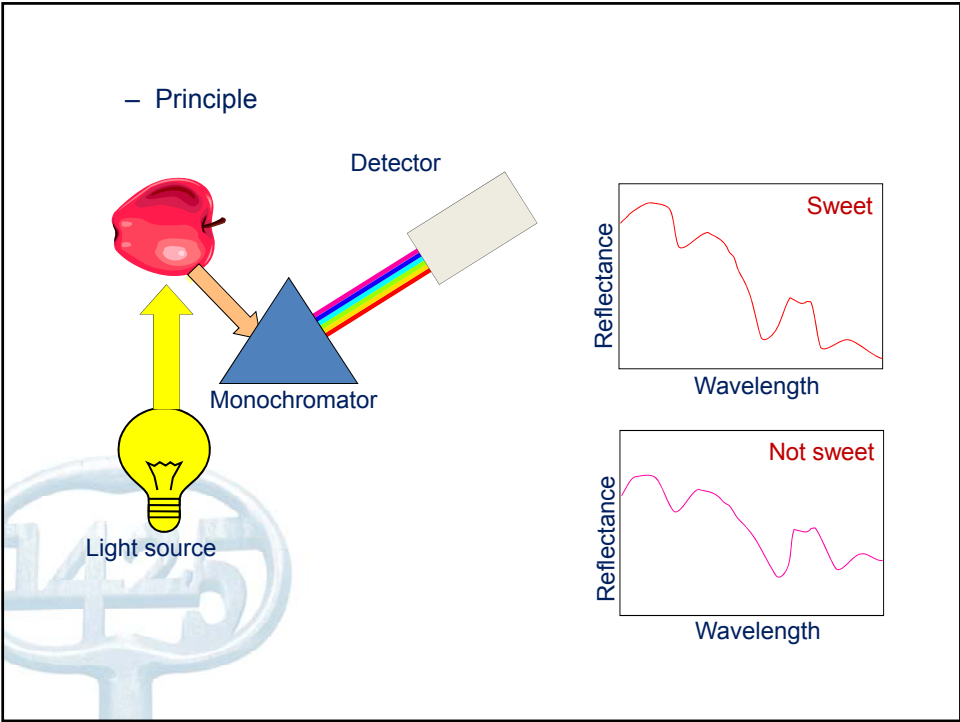


Gas chromatogram

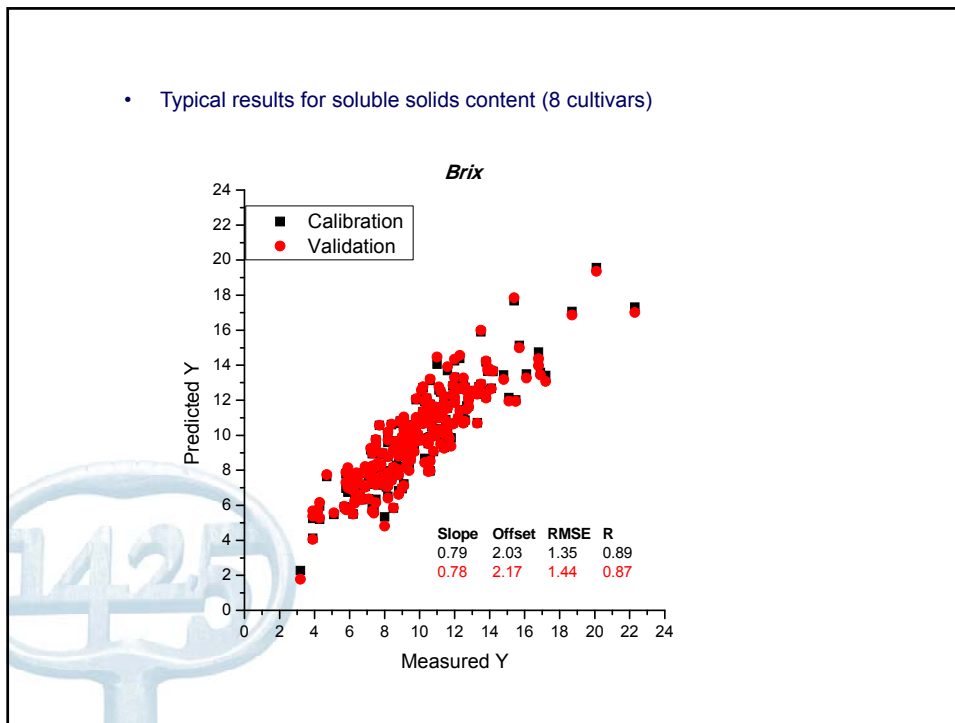


Headspace fingerprint
Mass spectrum

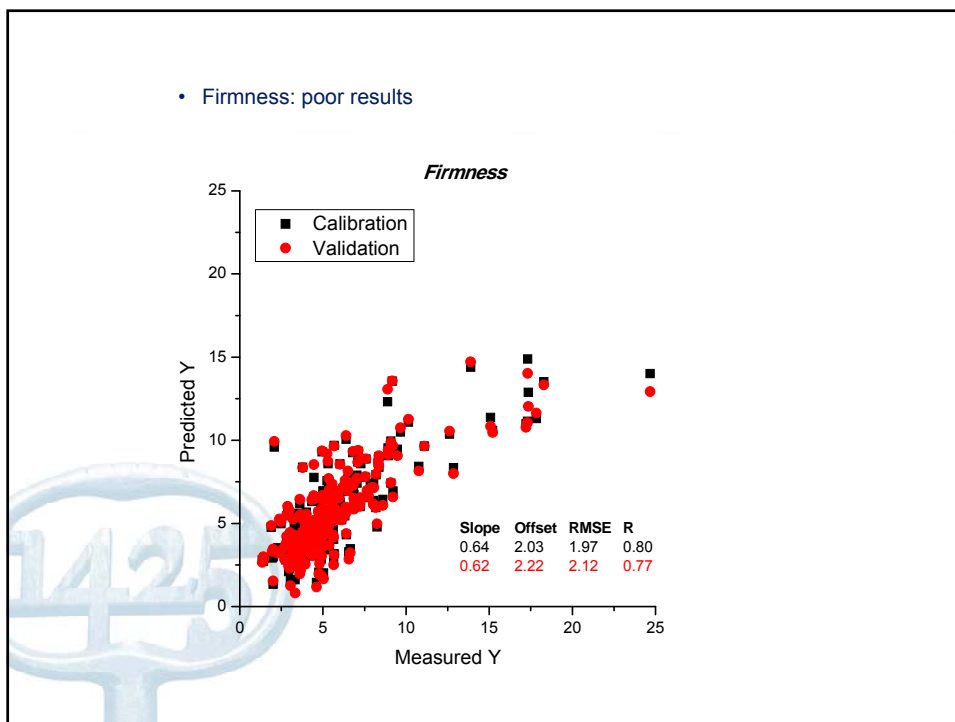




- Typical results for soluble solids content (8 cultivars)



- Firmness: poor results



- Biosensor arrays

- Biological recognition system attached to physical or chemical transducer

- Enzymatic recognition system:

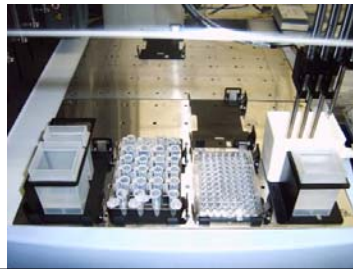
- E.g. for glucose:



- Optical transducer

- NADPH absorption measured at 340 nm

- Automatic dispensing system



Metabolomics

- Metabolomics

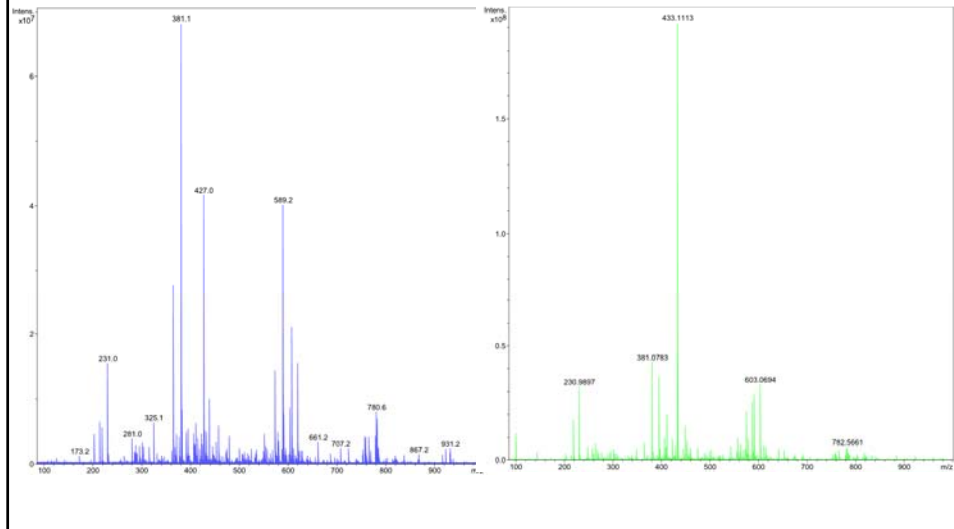
- Exhaustive analysis of metabolites in cells
- High throughput techniques (mass spectrometry)
- Basis for models for aroma biosynthesis in strawberry
- Useful information for breeding

- Ion cyclotron resonance FT mass spectrometry

- ESI or APCI ionisation



- Preliminary results



Conclusions

- Genetic erosion of flavour traits in commercial cultivars: opportunity for strawberry breeders
- Large variability of flavour throughout season
- Strawberry quality does not improve after harvest
- Metabolomics may provide clues to understanding flavour biosynthesis and how to manipulate this
- High-throughput flavour techniques provide opportunities for rapid phenotyping



Acknowledgements

