Research & Development

Tobacco Blend Style

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British American Tobacco

Tobacco Blends

100% lamina tobaccos:

Virginia
Burley (uncased)
50:50 Virginia/Burley Mix
Oriental

Examined:

Blend component differences

Relationships between blend components and Hoffmann analyte yields while keeping the cigarette design constant

Flue-Curing : *Virginia*

Significant amount of reducing sugars

Lower levels of protein nitrogen
Up to 25% undergoes hydrolysis

Predominant amino acids:

- **Proline**
- **Asparagine**
- **Glutamine**

Lower levels of TSNAs

Air-Curing : *Burley*

Carbohydrates virtually depleted

Higher levels of protein nitrogen
Up to 50% undergoes hydrolysis

Predominant amino acids are:

- **Aspartic acid**
- **Asparagine**
- **Glutamic Acid**

Highest mineral constituents

Highest levels of TSNAS

Sun–Cured - *Oriental*

Limited supply of nutrients and water

Higher production of carbohydrates, aromatic acids and resins at expense of nitrogen constituents.

Significant amount of reducing sugars

Very low levels of TSNAs

Chemistry is intermediate to that of air-cured and flue-cured tobacco. Lower in nitrogen than Burley and lower in carbohydrate than Virginia

Blend Tobacco Type Comparisons

Blend Measurement (% Dry Weight Basis)	Virginia	Burley	50:50 V/B Mix	Oriental
Total Nitrogen	2.7	4.7	3.8	2.6
Protein Nitrogen	1.2	2.0	1.7	1.2
NH_3 Nitrogen	0.01	0.54	0.19	0.03
Nitrate Nitrogen	0.02	0.40	0.21	0.03
Total Sugars	13.2	0.1	6.0	12.5
Reducing Sugars	12.2	0.5	5.7	11.2
Nicotine	2.80	2.60	2.69	1.14
TSNAs (ug/g)	1.89	7.30	4.68	0.22
Cellulose	10.2	13.0	11.8	8.8
Lignin	3.7	4.2	3.9	3.2
Polyphenols (Chlorogenic Acid + Rutin)	1.63	0.04	0.89	1.16
Ash	11.9	20.3	15.8	18.6

Mainstream Smoke

Precursor

Cellulose (→ all)
Sugars*
Pectin†

Amino Acids (→ all)
Proteins*

Polyphenols (→ all)
Alkanes*, Lignin†

Sterols & Terpenoids

Carboxylic & Fatty* Acids
Isoprenoids†

Nitrate

Alkaloids

Analyte

Benzene, Toluene, Styrene
Volatile Carbonyls*
PAHs*, Phenolic compounds†

Volatile Hydrocarbons
Aromatic Amines*
Pyridine*, Quinoline*
Acrylonitrile*, NO*, NH_3*, HCN*
Heterocyclic Amines*

Benzene, Toluene, Styrene*
PAHs*, Phenolic compounds†

PAHs

Volatile Hydrocarbons*†
Phenolic Compounds

Aromatic Amines, TSNAs
Acrylonitrile, NO, NH_3, HCN

Pyridine, TSNAs

Hoffmann Data

Hoffmann analyte data generated by the 100% lamina cigarettes of the three blends and the 50:50 Virginia/Burley Mix with a constant cigarette design:

Filter PD: 80 mmWG
Paper permeability: 55 CU
Filter ventilation: 35%

Blend measurements reported as: **% Dry Weight Basis (DWB)**

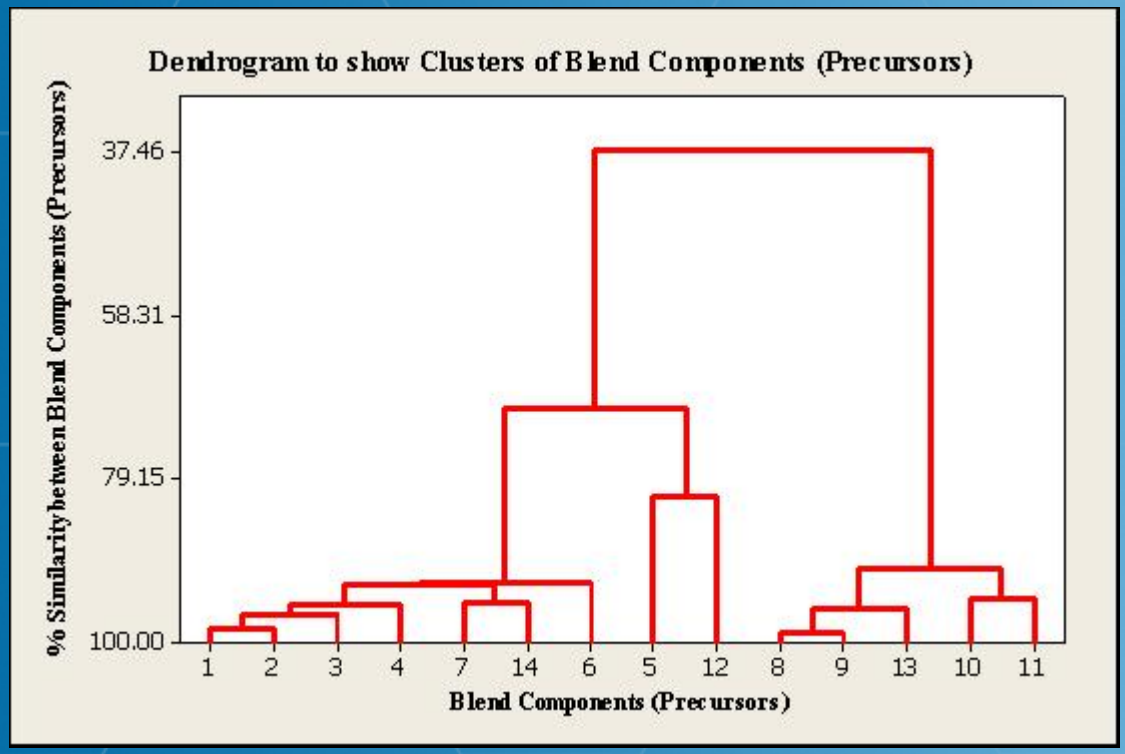
Hoffmann analyte yields expressed as: **per g tobacco burnt (DWB)**

Only four data points available across the blends

Data Analyses

- **Standardised scores** (blend components and Hoffmann analytes) to normalise data
- **Correlations** of blend components versus Hoffmann analytes
- **Cluster analyses** on correlations to see whether any groups of blend components or Hoffmann analytes were closely related

Blend Component Clustering



Total Sugars (8)
Reducing Sugars (9)
Rutin (13)

Chlorogenic Acid (10)
Caffeic Acid (11)

Total Nitrogen (1)
Protein Nitrogen (2)
Nitrate Nitrogen (3)
Ammonia Nitrogen (4)

Cellulose (7)
Blend TSNAs (14)
Lignin (6)

Blend Nicotine (5)
Scopoletin (12)

Hoffmann Clustering

Major Group 1

Sub-Group 1
- Ammonia
- 3-aminobiphenyl
- NAT
- 4-aminobiphenyl
- NNN
- NAB
- Acetone
- Pyridine
- Nitric Oxide
- Hydrogen cyanide
- Quinoline*
- NNK
- Styrene

Sub-Group 2
- 2-aminonaphthalene
- p-cresol
- Propionaldehyde
- Nicotine
- CO

>0.80 Blend Nicotine

>0.80 Total, Protein, Nitrate, Ammonia Nitrogen

*0.744 Ammonia Nitrogen

Hoffmann Clustering

Major Group 2

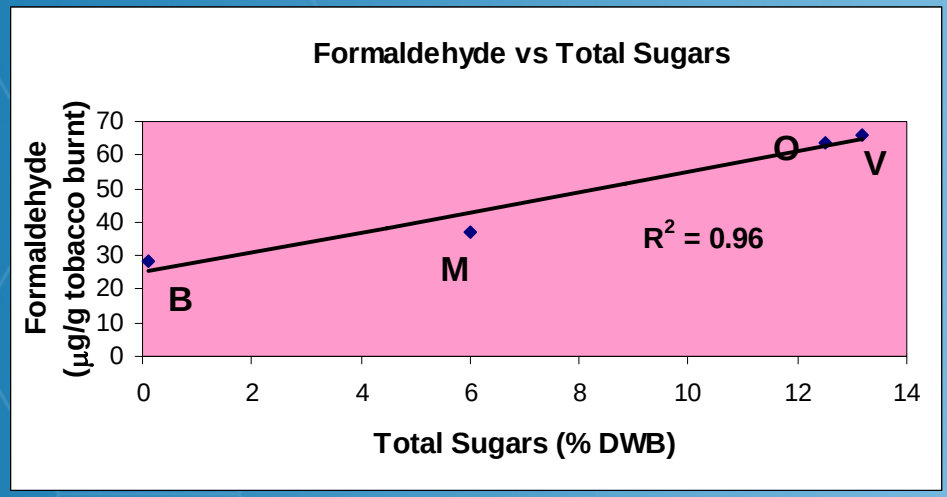
Sub-Group1
Benzo(*a*)pyrene
Formaldehyde
Catechol
1,3 Butadiene

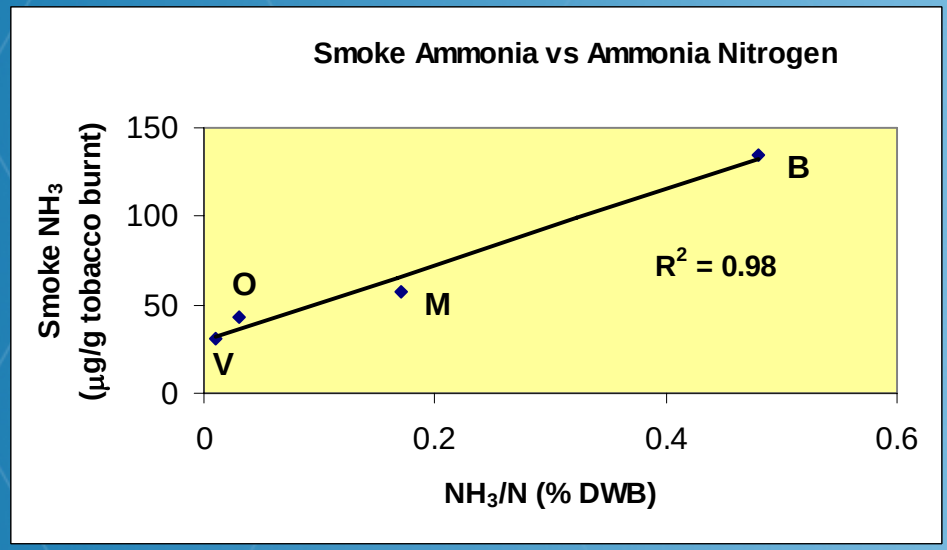
Sub-Group 2
Acrolein
m-cresol
Phenol
Resorcinol
Isoprene
Crotonaldehyde
Hydroquinone

>0.85 Total Sugars
Chlorogenic Acid
>0.70 Cellulose
>0.95 Rutin

All Major Group 2 compounds
>0.80 Caffeic Acid

Linear Regressions





Conclusions

- **Leaf chemistry** can influence **Hoffmann analyte yields**
- **Various blend components** appear to be **precursors** to a particular **Hoffmann analyte**
- **Blend components** + **cigarette design parameters** could be used to calculate multiple regressions to predict Hoffmann analyte yields