Introduction to Herbaria

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The Herbarium

• A collection of dried plants
• A store of reference material
• A means of identification
• An arbiter of correct names
• A comprehensive data-bank

“The essential working tool for systematics”
Role of the Herbarium

- Identification
- Taxonomic research
- Data repatriation (including databasing)
- IUCN Conservation ratings
- Voucher specimens
  - Ecological
  - DNA sequencing
  - Phytochemical
Fieldwork and the Herbarium

• Field Identifications difficult
  – Tropical habitats very diverse
  – Family or genus level
  – Floras often not available (tropics especially)
  – Floras bulky

• Ecological fieldwork:
  – Plots, often sterile vouchers, shorter-term

• Taxonomic fieldwork:
  – General collecting, fertile material, long-term
Herbaria around the world

- General or international herbaria
- National and regional
  - E.g., Forest Research Institute Malaysia (FRIM)
    Forest Herbarium, Sarawak (SAR)
    Forest Research Centre, Sabah (SAN)
- University herbaria
- Local botanists = local contacts
- Index Herbariorum
Herbaria from around the world
Field to specimen
The Kew Herbarium

• Approx. 5 million specimens

• Comprehensive collections from all regions

Wing C - 1857  Wing A - 1903
The Kew herbarium contd.

• Specimen arrangement
  – Phylogenetic according to Bentham and Hooker (1880)
  – Re-arrangement with the new wing
    • Mabberley’s Plant Book (new edition)

• Staff ‘arrangement’
  – Regional teams
  – Systematic teams
Regional Teams

- South-East Asia and Pacific
- Drylands Africa
- Africa Wet tropics
- South America
- Temperate

- Name all material except systematic families
- Sorts, identification, field guides, and research
Systematic Teams

- Malpighiales (Euphorbs)
- Myrtaceae (Eucalypts etc.)
- Labiatae/Lamiaceae (Mints)
- Rubiaceae (Coffee)
- Leguminosae (Peas and beans)
- Monocots

- Monographic and phylogenetic research
Digitisation progress

Data repatriation of 4000 specimens from Mexico and Central America

Nearly 50,000 legume specimens on-line

32 legume “species pages”
Insect antifeedant furanocoumarins from *Tetradium daniellii*

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3.2. Plant material

Fruits of *Tetradium daniellii* (Benn.) T.G. Hartley were collected from plants growing at the Royal Botanic Gardens, Kew (Acc. no. 1977-6618). A small fragment of fruit of *T. daniellii* from a herbarium specimen (Forrest 14772) collected in Yunnan, China in September 1917 was also used for extraction and HPLC analysis.

Fig. 1. Structures of furanocoumarins 1-7 isolated from fruits of *Tetradium daniellii*.

Fig. 2. HPLC profile of furanocoumarins from fruits of *Tetradium daniellii*: (a) living material, (b) herbarium specimen.
Comparative study of field and laboratory evaluations of the ethnobotanical *Cassia sophera* L. (Leguminosae) for bioactivity against the storage pests *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae) and *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae)

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Some farmers report no activity from *Tephrosia*
Callosobruchus maculatus
Oviposition by fecund bruchid beetles on cowpea seeds treated with powdered plant @1% w/v after 48 h.
Rotenoids from *Tephrosia vogelii* leaves

- Deguelin $R=H$
- Tephrosin $R=\text{OH}$
- Rotenone $R=H$
- 12α-hydroxyrotenone $R=\text{OH}$
- Sarcobilobine
- Toxicarol
Is *T. candida* effective?

*Tephrosia vogelii*. Controls bruchids

*Tephrosia candida*. Promoted for soil improvement (*N₂* fixing & green mulch) and (assumed) pest control properties.

(growing at an International Agroforestry Centre)
Oh – its actually T. vogelii

**Tephrosia vogelii.** Controls bruchids

**Tephrosia candida**
Promoted for soil improvement (N₂ fixing & green mulch) and (assumed) pest control properties.

Plastid L*trn* region, ITS nuclear DNA sequences & morphology indicate both to be *T. vogelii*
Effect on *C. maculatus* of cowpea treated with acetone extracts of *T. vogelii* chemotypes after 48 h.

Sick insects are alive but paralysed.
LC-MS chromatograms of *T. vogelii* chemotypes 1 & 2

Compound IDs based on 700MHz NMR and Orbitrap HR-EI MS
Flavanones and flavones from *T. vogelii* chemotype 2 (inactive)

- Obovatin 5-methylether
- Deguelin $R=H$
- Tephrosoin $R=OH$
- Yukovanol 5-methylether *
- Z-tephrostachin
- *two of 6 new flavonoid aglycones
- Tephrosovogelone *

Stevenson et al., Phytochemistry (submitted)
Mildbraediodendron excelsum

Herbarium sheet:
Specimen collected by Johannes Mildbraed in 1928

Living specimen:
Grown from seed collected in 1996, Mt. Kupe, Cameroon
LC-UV Analysis of *Mildbraediodendron excelsum*

**Living specimen**

**Mildbraed 10643**

**ANALYTES:** 50% aq. MeOH extracts of leaflet material
MILDBRAEDIN: a flavonol tetraglycoside from *Mildbraediodendron excelsum*

Main phenolic component of:
(1) Herbarium leaf fragment (1928)
(2) Living specimen

Flavonol pentaglycosides of *Cordyla haraka*

**Ion current chromatogram**

- $m/z = 1033$
- $m/z = 1047$

**Electrospray mass spectrum**

- $m/z = 287$
- $m/z = 433$
- $m/z = 595$
- $m/z = 741$
- $m/z = 887$
- $m/z = 991$

**Relative Abundance**

- $t (min)$
- $\lambda (nm)$

*D. Du Puy*
Distribution of flavonol pentaglycosides in *Cordyla* s.l.

**CONCLUSIONS:**
- *C. haraka* allied with *C. pinnata* & *C. richardii*
- No support for transfer of *C. haraka* to *Dupuya*

Veitch, Kite & Lewis (2008) *Phytochemistry* 69, 2329