PROTA 3: Dyes and tannins
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A sector very much alive worldwide:
INTERNATIONAL SYMPOSIUM / WORKSHOP ON NATURAL DYES
Hyderabad, India, November 2006
organised by UNESCO/Crafts Council of India
700 participants from 60 countries: professional dyers, artists, industrial managers
(colorant extraction, textile industry, cosmetics)
Plant dyes, an integral part of the cultural heritage of Tropical Africa: 1. Art
Plant dyes, an integral part of the cultural heritage of Tropical Africa. 2. Symbolic/religious role

Madagascar
Dyeing of *lambamena* (ritual shrouds) with *nato* bark
Plant dyes, an integral part of the cultural heritage of Tropical Africa. 3. Medicinal properties: *Basilan* and *Bogolan*.
Plant tannins, an integral part of the cultural heritage of Tropical Africa: availability, cheapness, importance of leather crafts.
Why natural dyes and tannins are regaining a greater importance in our present global society

- Increasing awareness of environmental degradation and toxicity associated with some synthetic dyes and tanning processes

- Accelerated exhaustion of the fossil material that synthetic colorants and syntans are made from.

- Consumer preference is shifting to natural products, particularly biologically produced, as substitutes for synthetic substances

A challenge for the future

- The use of natural fibres and leather and the use of natural organic colorants represent strategic choices, for the economies of both industrialised and developing countries.

- These choices should be considered in a global perspective of sustainable development and rational management of natural resources.
How the PROTA programme can contribute to the sustainable development of the sector

PROTA publications and databases facilitate

- the selection of plant sources and types of colorants in relation with potential markets.
  This helps put into focus:
  - the research gaps
  - the bottlenecks in regulations (national, international)
  that are presently preventing the take off of the sector in different markets

- the selection of dye and tannin species
  - in which the parts used (leaves, fruits) allow sustainable use
  - that can be cultivated efficiently

PROTA ’s comprehensive approach to plant uses facilitates

- the identification of potentials for colorant extraction from waste products of other sectors
Natural dyes: what colours, what colorants, for what markets

1. Textiles

- **Richness in anthraquinones**
  - Rubia cordifolia
  - international

- **Combination colorants + mordants**
  - Danais spp., Pentanisia spp., Acridocarpus spp., Pauridiantha rubens, Pterolobium stellatum
  - local + international?

- **Dye woods = bulk quantities, combination colorants + tannins/mordants**
  - Pterocarpus spp., Baphia nitida
  - international + local

- **Direct dyes**
  - Cochlospermum tinctorium, Curcuma longa, Cryptolepis sanguinolenta
  - local + international?

- **Combination colorants + mordants (aluminium accumulators, tannins)**
  - Craterispermum spp., Anogeissus leiocarpa, Combretum glutinosum
  - local + international
Indigoids, very fast

Indigofera spp., Philenoptera spp., tropical indigo plants from other continents

Tannins with associated mordanting and medicinal properties

Hundreds of African plants

Naphthoquinones + tannins

Diospyros spp., Euclea spp.

local + international?

local

local + international?
Natural dyes: what colours, what colorants, for what markets

2. Cosmetics

- Fat soluble naphthoquinones + skin protection
  - Arnebia hispidissima, Alkanna spp.
  - make up international

- Combination colorants + mordants
  - red sorghum, Acridocarpus spp.
  - make up, hair dye international

- Dye woods = combination colorants + tannins/mordants + skin protection
  - Pterocarpus spp., camwood, sappanwood
  - make up international

- Direct dyes + skin protection
  - Cochlospermum tinctorium, annatto, turmeric, waras
  - make up local, international

- Combination colorants + tannins + skin protection
  - Anogeissus leiocarpa, Aloe spp.
  - make up, hair dye local, international

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  - make up, hair dye local, international
Direct blue/black dyes, uncharacterized

Tannins with associated mordanting and medicinal properties

Naphthoquinones + tannins skin/hair protection


Hundreds of African plants

Henna, Impatiens spp., Diospyros spp., Euclea spp.

Hair dye, make up, international market
Natural dyes: what colours, what colorants, for what markets

3. Food colorants

- Annual growth of the food colorant global market 10 to 15%
- Consumer demand for natural colorants growing
- Bottle-neck: regulations
- Very little demand for other colours
Sustainable development of plant dyes and tannins in Africa

- Intensified research into botany and chemistry of groups of dye plants
- Domestication and cultivation of promising dye and tannin plant sources

Juice of fruit of *Rothmannia whitfieldii* used as facial paint

*Photo: C. Puff*

*Photo: M. Ichikawa*
Sustainable development of plant dyes and tannins in Africa
Cultivation of major dye and tannin sources

**Madder Rubia tinctorum**
- Yields of dried roots: ± 2.24 tonnes/hectare/year
- Maximum yield: 5.55 tonnes/hectare
- Yield of colorant extract: 200 kg/ha (top quality) to 800 kg/ha (standard)
  - 1 ha enough to dye 10 to 40 t wool

**Indigo Indigofera spp.**
- **India**: 19th c. reports of 22–100 t green matter/ha/year = 135–325 kg/ha/year of indigo cakes;
  - *l. tinctoria* crops: green plant material: 10–13 t/ha/year = 22-55 kg/ha/year indigo cakes
- **El Salvador**: *l. micheliana* crops give 12-18 kg of indigo/ha the 1st year; **20-39 kg/ha/year** from the 2nd year on

Indigo plantation programme started by Noorjehan Bilgrami in Pakistan

In Ségou, an important workshop where 15 artists work used about 1500 kg of dry leaves in 2004, allowing 5000 m² (= 1800 kg) cloth to be dyed. Total demand for leaves in Ségou is estimated at 6000 kg (more than 20,000 m² dyed cloth). During recent years Bamako exported about 520 t of dyed cloth annually. This corresponds to 430 t dried leaves, estimated to be about 20% of the total quantity used in Mali.
Plantation of Anogeissus, Koro, Burkina Faso

Anogelline, a concentrate of active molecules
Sustainable development of plant dyes and tannins in Africa: Extraction of colorants from waste products of plants with other primary uses

Timbers, fuel plants, medicinal plants, vegetables and fruit, etc.

- *Acacia mearnsii* plantations: 130,000 ha in South Africa, 14,000 ha in Zimbabwe; only bark and timber used
- *Pterocarpus angolensis*: in 1996, 5,500 m³ exported from Mozambique, 5000 m³ from Zambia
- *Pterocarpus soyauxii*: from 2000 to 2003, 120,000 m³ exported from Gabon, 6,500 m³ sawn timber from Cameroon
- Leaves, branches, bark, chips, sawdust available in considerable amounts
Sustainable development of plant dyes in Africa: improved extraction technologies

Solar indigo extraction prototype inaugurated 18th September 2007 at Botanical Garden of Dye Plants, Lauris (Provence, France); conceptors Michel Garcia and REUS for Association Couleur Garance

• 2 extraction vats can be filled/day with same solar boiler
• 200-300 litres volume of leaves/vat
• Estimated yield: 1 kg indigo powder/vat
• Cost: 2500 euros
Conclusion
PROTA 3 Natural dyes and tannins in Tropical Africa: from a glorious past into a promising future through intensive interdisciplinary research, adapted technologies and adequately targeted marketing
« The beautiful colours »
Song and dance composed by the participants to the Workshop on natural dyes for raffia, National Park, Ankarafantsika, Madagascar, May 2005

Thank you for your attention!