Towards Developing Plants for Production of Useful Tannins

I. Mueller-Harvey,[1] E. Stringano,[1] L. Falchero,[1] C. Hayot-Carbonero,[2] L. Smith,[2] S. Hanley,[3] I. Shield,[3] A. Karp[3]

[1]Department of Agriculture, University of Reading, Reading RG6 6AT, UK. [2]NIAB, Cambridge CB3 0LE, UK; [3] BBSRC RothamstedResearch, Harpenden, UK.
Contact: i.mueller-harvey@reading.ac.uk

INTRODUCTION

Tannins are the 4th largest group of natural products after cellulose, hemicellulose and lignin. They offer great potential for various practical applications due to numerous biological activities, but hardly any effort has been directed towards selecting or breeding plants with optimised tannin composition or contents. The aim is to grow **plants as tannin manufacturers.**

OBJECTIVE **To develop chemovars with optimised tannin contents for nutritional, environmental, veterinary and medicinal benefits.**

Tannin Bioactivities

- **Health and medicinal effects**
  - CT tannins (**Fig 1**) improve cardiovascular function
  - Acutissimin A, an ET tannin, is 250-times more effective than Etoposide, an anti-tumour drug
  - EGCG, a major green tea tannin, prevents cancers.
  - GT tannins are anti-asthmatic and reduce blood pressure
  - CT & ET tannins are selective anti-bacterials and probiotics
- **Deworming activities**
  - Drug resistance of parasitic worms is a worldwide problem (worth £ billions)..... CTs can reduce nematode burdens
- **Environmental benefits**
  - Ruminants produce greenhouse gases ... CTs can reduce CH_4, N_2O emissions from ruminants
  - Ruminants use plant protein inefficiently... CTs can improve amino acids absorption from feeds ...and prevent deaths from bloat

What is the Problem?

- Plants & trees produce complex tannin mixtures [1,2] – but varieties with more uniform compositions exist (**Fig. 2 & 3**)
- Complexity has hampered elucidation of structure-activity relationships
- Environmental influences on tannin mixtures (contents, composition) are not yet understood [3]

What Opportunities exist?

- **Tannin-containing feeds**
  - Against weaning diarrhoea in pigs and calves (to promote gut health; to cope with EU ban on routine use of antimicrobials in animal production)
  - As organic nematicides
  - As anti-bloating agents
- **Tannins as drugs**
  - Herbal drugs
  - Lead compounds for new drugs

Fig. 1. Examples of CT, ET, GT and EGCG tannins

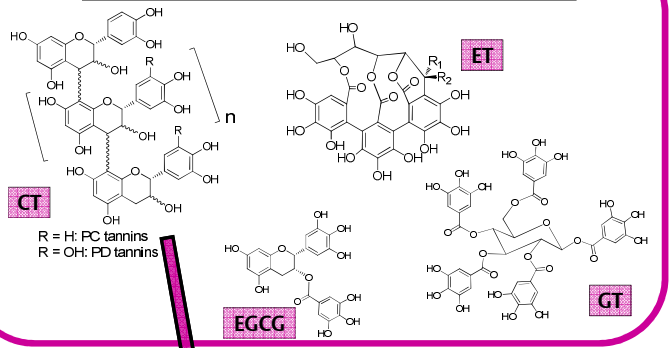


Fig. 2: CT PC/PD ratios in NIAB sainfoin collection

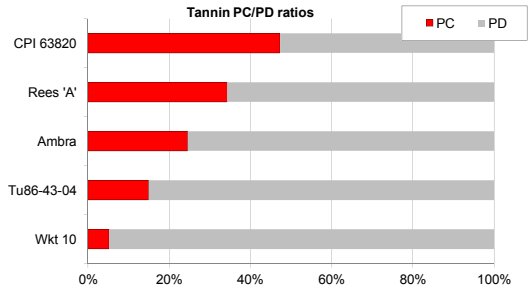
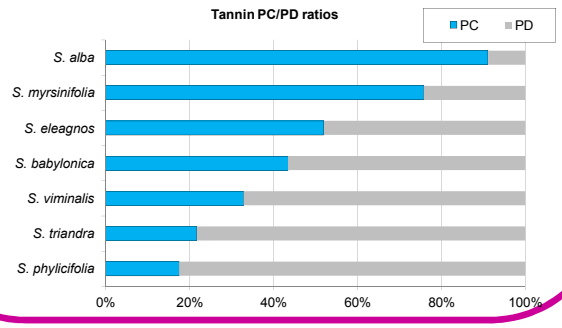


Fig. 3: CT PC/PD ratios in UK National Willow collection



ACTIONS FOR THE FUTURE

- To solve the puzzle of tannin synthesis in plants.
- To develop genetic markers to underpin breeding programmes for optimised tannin composition.
- To select model plants with well-defined, stable tannin composition for research on structure-activity relationships & product quality.
- To develop chemovars with optimised tannin contents for nutritional, environmental, veterinary and medicinal benefits.

REFERENCES [1] Mueller-Harvey *Biologist* 2009, *56*, 22-27; [2] Mueller-Harvey *J. Sci. Food Agr.* 2006, *86*, 2010-2037; [3] Theodoridou *et al* 2010 *Anim. Feed Sci. Technol.* (*accepted*)

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