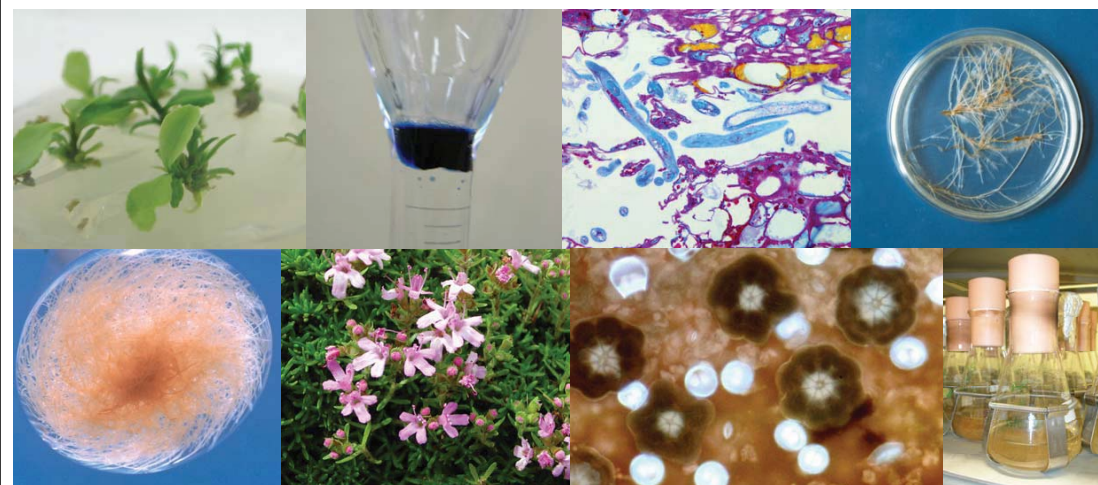




PBRG
Plant Biotechnology Research Group

Institute for Biotechnology and Bioengineering
Departamento de Biologia Vegetal
Faculdade de Ciências de Lisboa
Campo Grande
1749-016 Lisbon
Portugal

<http://cbv.fc.ul.pt>



Plant Biotechnology Research Group

Objectives

PBRG has been involved in the *in vivo* and *in vitro* production of secondary metabolites, aiming the evaluation of the National endemic aromatic/medicinal flora, prospecting bioactive components and characterization of plant secretory structures. As particular goals for 2010, the following topics have been pointed out:

Research Topics

1. a) Chemosystematic survey of Portuguese propolis volatiles for a better characterization of this resinous resource (col. CIMO-IPB/FCUP), b) evaluation of the phytochemical diversity in Portuguese *Mentha* species for its valorisation and conservation (col. CBAA/ISA, BPGV), c) assessment of *Foeniculum vulgare* chemotypes based on the volatile accessions in view to the correct chemical characterisation of this plant used as phytoceutical (col. BPGV), and d) chemical characterization of volatiles from liverwort species grown on the African Archipelago of São Tomé e Príncipe and on Madeira and Azores (col. CBA),

2. a) Establishment of *in vitro* co-culture model systems of micropropagated *Pinus* spp./*B. xylophilus* (Pine Wilt Nematode) and *Solanum tuberosum* hairy roots/*Globodera rostochiensis* (Potato-Cyst Nematodes) for characterization of the nematodes invasion mechanisms, and b)



establishment of micropropagated *Thymus caespititius* to assist on the molecular elucidation of essential oil production in this species,

3. a) Searching for TPS genes in *Thymus caespititius* based on conserved regions available for other Lamiaceae, starting with primer design and RACE-PCR, leading to cloning the full-sequence gene, and b) construction of a cDNA library of *T. caespititius* in order to establish its relationship with the different chemotypes in this species,

4. Study of the morphology, anatomy, histochemistry and ultrastructure of the secretory structures of medicinal and/or aromatic plants. This aims to gather information on the great variety of secretory structures that occurs in Angiosperms and to improve our understanding of the cell sites of synthesis, transportation and accumulation of the natural products secreted by plants,

5. a) Evaluation of the biological activities of aqueous plant extracts, infusions and decoctions, and isolated phenolic constituents, that could explain some of the traditional uses of the medicinal species (col. CQB-FCUL, CBA-FCUL), b) evaluation of essential oils and their components for diverse biological activities and for preserving quality in fresh and minimally processed fruit and vegetables, and reducing vegetable oils degradation when submitted to



high cooking temperatures, c) evaluation of biological activities of propolis collected in Algarve region, and d) study of anti-inflammatory activity of anthocyanins present in some fruits (col. CBME, IBB, Un. Algarve),

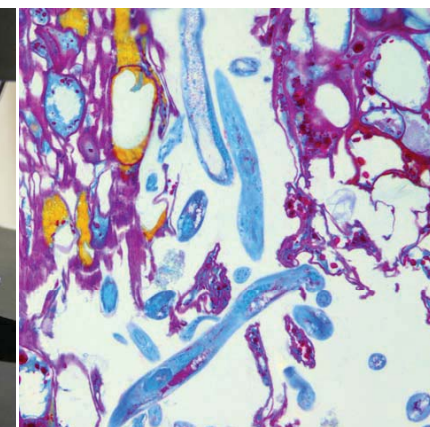
6. a) Evaluation of the potential of essential oils as nematocides, namely in the control of the pine wood nematode, *Bursaphelenchus xylophilus*, b) chemical characterization of Portuguese *Pinus pinaster*, *P. pinea* volatiles both from healthy plants and from *in lab* mechanically wounded uninoculated and inoculated individuals with *B. xylophilus* and c) evaluation of the histological and cellular changes induced in

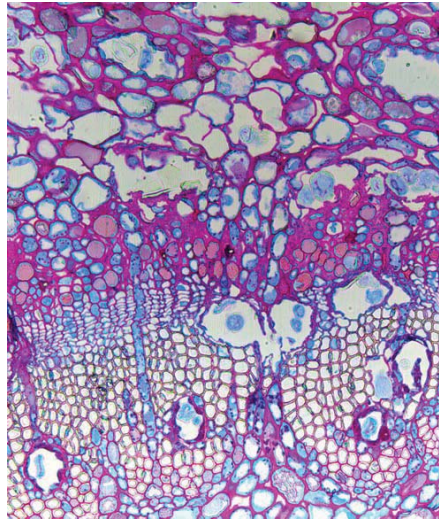


pine tissues (*P. pinaster* and *P. pinea*) by a virulent strain of *B. xylophilus* (col. NemaLab – ICAM, Univ. Évora).

Major Achievements

- Portuguese fennel (*Foeniculum vulgare* Mill. subsp. *vulgare*) accessions were evaluated for morphological traits and essential oils variability. Although respective cluster analysis did not gather the accessions in similar groups, it was possible to discriminate accessions significantly according to their possible genetic, agricultural or economic use. (col. BPGV).
- The volatiles from *Plicanthus hirtellus* and *Radula boryana* grown in the African Archipelago of São Tomé e Príncipe were studied (col. CBA) and the results were already published.
- Micropropagation of *Thymus caespititius* was accomplished. Glandular trichomes were similar to other Lamiaceae-like trichomes. Carvacrol was the main component detected in the essential oil from the field grown plants while in the essential oil from *in vitro* plants, carvacryl acetate occurs at high relative amounts.
- Submission to GenBank of the genomic sequence for *TPS1*, a putative sabinene synthase, comprising information on 8 different plants from *Thymus caespititius*.





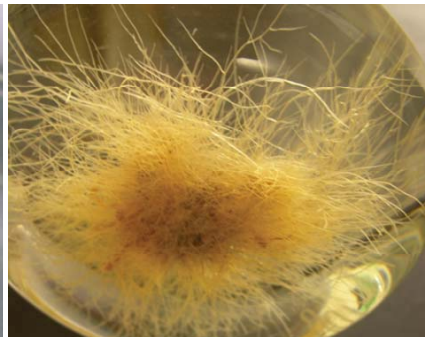
- The nematocidal activity of five essential oils (*Cymbopogon citratus*, *Origanum vulgare*, *Satureja montana*, *Thymbra capitata* and *Thymus caespititius*) could be confirmed and the subsequent assessment of nematocidal activity of their fractions are in progress (col. NemaLab – ICAM, Univ. Évora).
- The *in vitro* gastrointestinal metabolism of the herbal tea from *Plectranthus barbatus* leaves show that there was no appreciating compound degradation and that the antiacetylcholinesterase and antioxidant activities were kept constant after gastric juice digestion. In the presence of pancreatic juice, de-

gradations varied from negligible (flavonoid glucuronides), to almost complete (coleon E) and the digested extract contained only 50% of its initial biological activities. The action of Caco-2 cells on the extract revealed that neither rosmarinic acid, the main compound of the extract, nor the other components present in minute quantities were metabolized by the intact cells. Rosmarinic acid could be found inside Caco-2 cells, although in trace amount. Glucuronidase from *Escherichia coli*, a gut bacterium, was able to hydrolyze the flavonoid derivatives, thus the aglycones were formed and permeate the Caco-2 cells. The AChE inhibition activity found during the gastrointestinal digestion may explain, at least, the purgative effect found for this tea. (col. CQB, FCUL, UL).

- The effect of temperature on essential oil of *Thymus capitatus*, stored in darkness during 37 days in an oven, at 60°C was studied and, with some minor fluctuations, carvacrol was always the major component. α -Terpinene and γ -terpinene decreased over time, whereas *p*-cymene increased. Despite this storage period at 60°C, *T. capitatus* essential oil still showed high antioxidant and stable antimicrobial activity.
- Remarkable and worrying differences, in terms of quality and safety, were detected in the essential oils from commercial aerial parts and fruits *Foeniculum vulgare*. Actually, at higher concentrations and using the TBARS method for assessing antioxidant activity, fennel essential oils showed pro-oxidant properties.



- Thymol, carvacrol and the corresponding β -cyclodextrin complexes were evaluated for their antioxidant properties using several methods. With only one exception, the activity of pure compounds and of their β -cyclodextrin complexes was similar.
- The antioxidant activity of propolis samples collected at three main areas of Algarve was evaluated. The results closely correlated this property with the levels of total phenols, flavones and flavonols in samples.
- *Thymbra capitata* essential oil was evaluated on its capacity to prevent lipid oxidation in bovine meat. The treatment with essential oil prevented meat oxidation even after one month of storage at -17°C and showed a dose-dependent activity.
- The effect of treatment with ascorbic acid or calcium chloride on the quality parameters of fresh-cut kiwifruit prepared from fruit previously stored for 3 months, was evaluated. Both ascorbic acid and CaCl₂ were effective on preserving or improving nutritional properties mainly in the first 4 days of shelf life. CaCl₂ had a further beneficial effect until 8 shelf life days.
- The volatiles from *Santolina chamaecyparissus* and *Thymus vulgaris*, tested for herbicidal activity against four crops and two weeds species, showed to be promising alternatives to the synthetic herbicides.



Selected Publications

- Barbosa P., A.S. Lima, P. Vieira, L.S. Dias, M.T. Tinoco, J.G. Barroso, L.G. Pedro, A.C. Figueiredo, M. Mota, *Journal of Nematology* 42: 8-16.
- Bounatirou S., S. Smiti, M.G. Miguel, L. Faleiro, M.N. Rejeb, M. Neffati, M.M. Costa, A.C. Figueiredo, J.G. Barroso, L.G. Pedro, *Acta Alimentaria* 39: 299-307.
- Figueiredo A.C., Garcia C., M. Sim-Sim, C. Sérgio, L.G. Pedro, J.G. Barroso, *Flavour and Fragrance Journal* 25: 219-222.
- Miguel M.G., C. Cruz, L. Faleiro, M.T.F. Simões, A.C. Figueiredo, J.G. Barroso, L.G. Pedro, *Natural Product Communications* 5: 319-328.
- Porfírio S., P.L.V. Falé, P.J.A. Madeira, M.H. Florêncio, L. Ascensão, M.L.M. Serralheiro, *Food Chemistry* 122: 179-187.



Publications

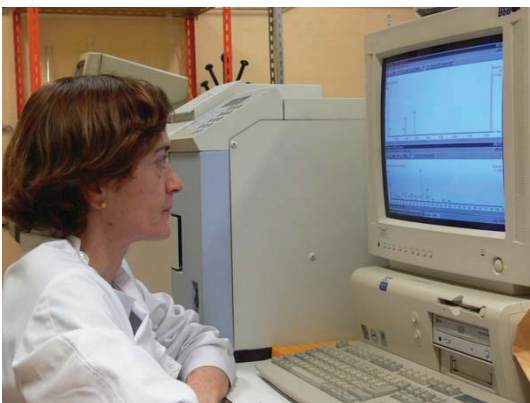
Articles in International Peer-Reviewed Journals

Antunes, M.D.C., A.M. Cavaco, The use of essential oils for postharvest decay control. *Flavour and Fragrance Journal* 25: 351-366.

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M.Sc. Thesis

Diogo Geraldes, "Biotransformação de monoterpenos por raízes transgênicas de *Anethum graveolens*". Mestrado em Biologia Celular e Biotecnologia (FCUL). Supervisor: Ana Cristina Figueiredo (CBV, FCUL, UL).

Inês Margarida Vieira da Silva, "Estruturas Secretoras e Aplicações Biocidas em Espécies de *Hypericum* (Clusiaceae) da Flora Portuguesa". Mestrado em Biologia Celular e Biotecnologia (FCUL). Supervisor: Lia Ascensão (CBV, FCUL, UL).

Leticia José Aguiar Freitas Silva, "Atividades Biológicas e Estruturas Secretoras em *Artemisia campestris* e *Helichrysum stoechas* (Asteraceae)". Mestrado em Biologia Celular e Biotecnologia (FCUL). Supervisors: Lia Ascensão, (CBV, FCUL, UL) Luísa Serralheiro (CQB, FCUL, UL).



Oral Communications

International Conferences

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