ROSEMARY – UK cultivation of Rosemary to provide the raw materials for development of a new genre of bio-based antioxidants

Renewable Materials
LINK Programme

Project Summary

This Factsheet outlines the results of a research project sponsored under the Renewable Material LINK Programme.

Background

Antioxidants (AOs) are vital constituents of a broad range of materials. The wider use of renewable materials is creating an opportunity for natural antioxidants and their derivatives to replace synthetic antioxidants.

The ROSEMARY project examined aspects of the value chain for the synthesis and testing of high quality, environmentally-sustainable AOs from rosemary, grown and processed in the UK.

Results proved that it was possible to substitute existing synthetic AOs with bio-based alternatives. They also demonstrated that in some products rosemary derived AOs will be more effective than those made synthetically.

The project helped enable a totally green supply chain for lubricants, cosmetics and health care products. It also demonstrated that it was possible to manufacture 100% bio-based packaging materials.

Main research outcomes

The BioComposites Centre at Bangor University developed a rapid and reliable high-performance liquid chromatography (HPLC) method for accurately measuring antioxidant content in rosemary leaves.

The AOs of interest were major rosemary plant constituents: carnosic acid (CA), rosmarinic acid (RA) and carnosol. NIAB supplied over 300 rosemary samples of different origins from harvests over years 2007 to 2010. The AO content in different strains of rosemary was very diverse; this could be used to target a particular component if necessary.

ROSEMARY project partners at NIAB research fields, Cambridge, UK

Eight derivatives of rosmarinic acid (RA1 to RA8) and one derivative of carnosic acid were synthesised to make antioxidants more compatible with a range of applications.

NIAB tested 350 lines from two sources of material. They looked at the variation that could be found between plants collected from botanical gardens and other world collections along within 300 seeds collected from a wild population.

The lines were tested for 2 consecutive years. The controls have been tested over several years and locations showing consistent composition and content of AOs.

Project Manager:	Dr Viacheslav Tverezovskiy, BioComposites Centre, Bangor University (BC)
Project Duration:	1st February 2008 to 31st March 2011
Project consortium:	PPP (Aston University), BC (Bangor University), Boots UK, Co-op, Croda, Frontier Agriculture, Fuchs Lubricants, Horticultural Development Council, Incorez, Lubrizol, National Herb Centre, Uponor
Sponsor:	DEFRA (Department for Environment, Food and Rural Affairs)

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Lines were tested relative to known controls from the Scottish Executive funded Competitive Industrial Materials from Non-Food Crops (CIMNFC) Rosemary Antioxidants for the Pharmaceutical and Food Industries (RAPFI) project.

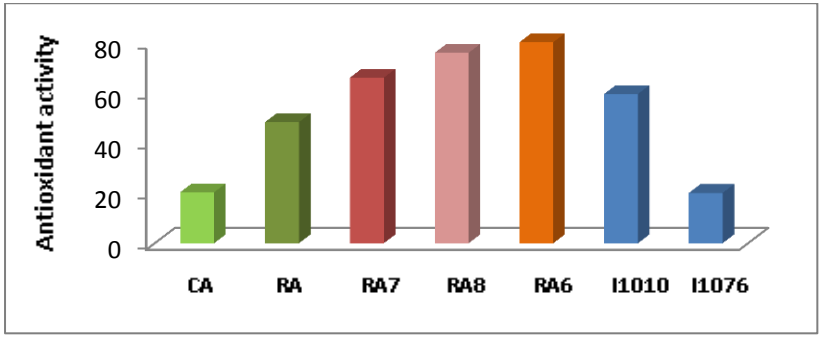
Many plants were eliminated because they were killed by the cold weather during the winters of 2008/09 and 2009/10 or the plants showed no productive vigour (leaf yield). Analytical results from the remaining 109 lines identified 3 strong candidates which were further evaluated.

NIAB Nursery, 10th September 2008 showing good early vigour

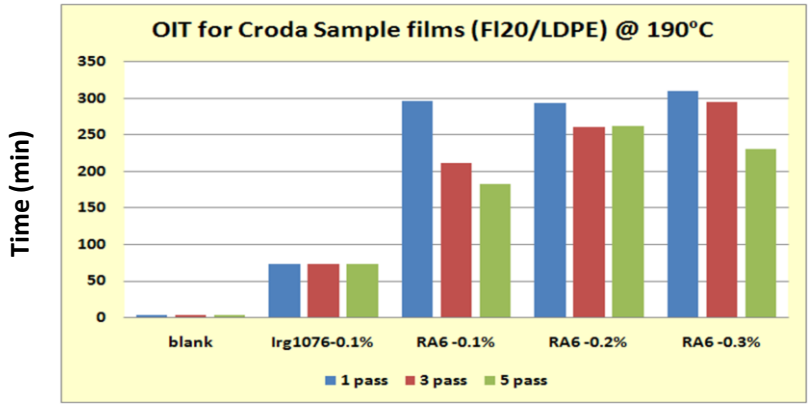
NIAB Nursery, 16th April 2010 showing winter damage

The Polymer Processing and Performance (PPP) Research Group at Aston University focused on examination of the antioxidant performance of AOs in polyolefins. The antioxidant activity of the parent RA and CA were examined, as well as that of the synthesised AOs for their free radical scavenging efficiency and in many other tests.

The synthesised derivatives showed higher free radical scavenging ability compared to the parent acids. Derivatisation of the parent acids is critical to achieving higher activity compared to synthetic commercial antioxidants, such as Irganox 1076 and 1010:



Industrial partner Croda produced polyethylene films with 0.1% content of novel AOs. The Oxidative Induction Times (OIT) of these films were greatly improved with the addition of RA6. The effect with 0.1% of RA6 is 2-3 times larger than with 0.1% of industry standard Irganox 1076:



This research has helped Bangor University with the successful funding of a European Regional Development Fund (ERDF) project worth £10 million. The new project will enable the BioComposites Centre to demonstrate the opportunities of biorefining to local companies.

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