Grower Summary

CP 51
HortLINK CSA7608/LK0823

Use of rosemary to provide the raw materials for development of a new genre of Bio-based antioxidants

Final 2011

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Use of pesticides

Only officially approved pesticides may be used in the UK. Approvals are normally granted only in relation to individual products and for specified uses. It is an offence to use non-approved products or to use approved products in a manner that does not comply with the statutory conditions of use, except where the crop or situation is the subject of an off-label extension of use.

Before using all pesticides check the approval status and conditions of use.

Read the label before use: use pesticides safely.

Further information

If you would like a copy of the full report, please email the HDC office (hdc@hdc.ahdb.org.uk), quoting your HDC number, alternatively contact the HDC at the address below.

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HDC is a division of the Agriculture and Horticulture Development Board.

The following are members of the Consortium for LINK project LK0823:

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Bangor University
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NIAB

Project Number:	CP 51 HortLINK LK0823
Project Title:	Use of rosemary to provide the raw materials for development of a new genre of Bio-based antioxidants
Project Leader:	Bangor University
Report:	Final Report, 2011
Publication Date:	14th October 2011
Start Date:	01 January 2008
End Date:	31 March 2011
Project Cost (total project cost):	£36,000 (£818,762)

Headline

Three lines of rosemary that are hardy and suitable for commercial exploitation yielded high antioxidants. Derivatives of these antioxidants have great potential for industrial use in lubricants, cosmetic and health care products and polymers.

Background

Antioxidants are vital constituents of a broad range of materials. The wider use of renewable materials is creating an opportunity for natural products and their derivatives to replace synthetic antioxidants. This project has shown that totally green supply chain for lubricants, cosmetics/health care products and polymers is achievable. The biggest benefits are for using rosemary derived antioxidants in packaging materials where 100% natural formulations are now possible.

The project examined aspects of the value chain for the synthesis and testing of high quality, environmentally-sustainable antioxidants from rosemary, grown and processed in the UK. These were substituted for existing synthetic antioxidants and in some products it was demonstrated that they were more effective than synthetic alternatives.

Summary of the project and main conclusions

The BioComposites Centre at Bangor University developed a rapid and reliable HPLC method for an accurate measurement of antioxidant (AO) content in rosemary leaves. The AOs of interest were major rosemary plant constituents: carnosic acid, rosmarinic acid 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 which could be used for targeting particular component if necessary.

8 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 with 300 seeds collected from a wild population. This was all tested relative to known controls from the original Scottish Executive funded CIMNFC (RAPFI) project.

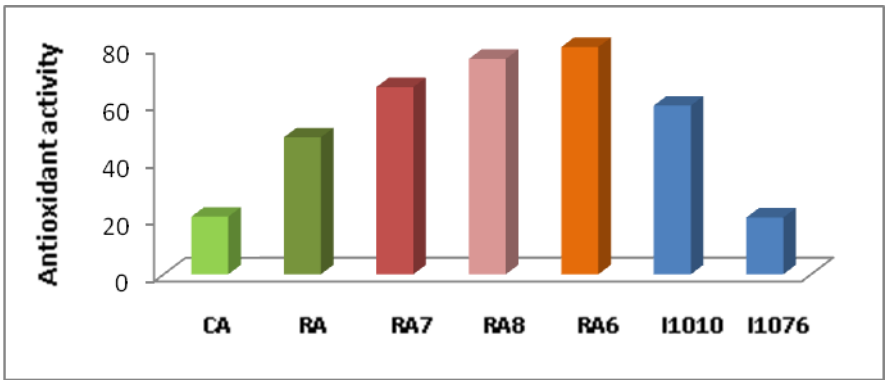
Many plants were eliminated because they were killed by the cold weather during the two winters of 08/09 & 09/10 or the plants showed no productive vigour (leaf yield). Analytical results from the remaining 109 lines identified 3 strong candidates which were further evaluated.

NIAB Nursery, Sept 10th 2008
showing good early vigour

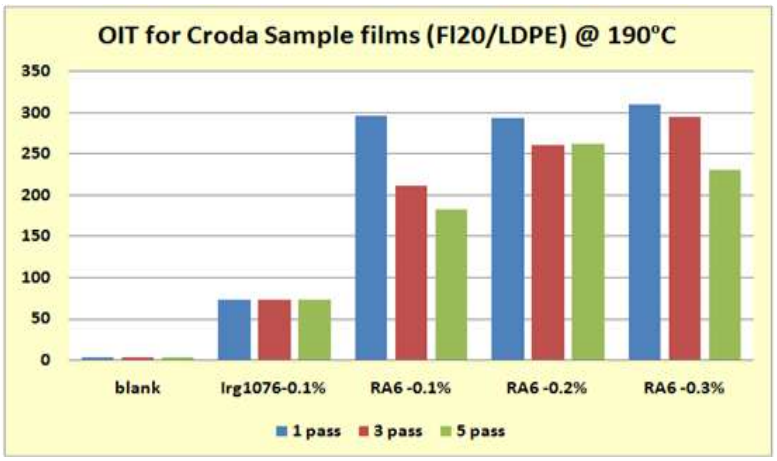
NIAB Nursery, April 16th 2010
showing winter damage

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 rosmarinic (RA) and carnosic (CA) acids 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 achieve higher activity compared to synthetic commercial antioxidants such as Irganox 1076 and Irganox 1010:



Industrial partner **Croda** produced polyethylene films with 0.1% content of novel AOs. The oxidative induction times of these films are greatly improved with addition of RA6. The effect with 0.1% of RA6 is 2-3 times larger than with 0.1% of industry standard Irganox 1076:



Financial benefits

This project showed that the use of rosemary in non-culinary applications is possible. The sustainability advantage of using natural resources is widely recognised in industrial sectors. This recognition is driving innovative consideration of renewable chemicals such as these. In addition, more stringent environmental and pollution laws now require use of less potentially toxic ingredients, even if they are present in relatively small quantities.

Antioxidants sourced from rosemary have the added benefit of being intrinsically more active in some application areas than most synthetic and bio-based alternatives in the tests that we carried out. There is evidence that rosemary grown in the UK contains significantly higher levels of antioxidants than current sources in southern Europe and has great potential for production at competitive prices.

Action points for growers

We have discovered that there are very significant differences between breeding lines, both in terms of quantity and quality. Some of the highest yields are coming from the most prostrate small plant types. These would be almost impossible to harvest using machines currently available and would probably yield a lower quantity of antioxidants per hectare than the bushier lines with lower percentage content.

The work on the germplasm that has been collected and tested within the project indicates that a future project for the consortium could be the identification or breeding of an upright bushy type of rosemary which is hardy, not too woody and contains high levels of the best antioxidants.

A further vital consideration is the date at which antioxidant levels peak. It looks as if this will be in midsummer, but it is likely that the optimum harvest time will be decided by a combination of plant maturity, genetics and weather.