

## Exploring the predictive power of chemiluminescence method in determining the antioxidant activity of plant extracts in cosmetic formulations

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### Abstract

There is an increasing demand for natural ingredients in cosmetics, which has led to the consideration of plant extracts as antioxidants. Their standardisation requires an accurate and reproducible method for the assessment of antioxidant activity, both in pure form and in cosmetic formulations. In addition, it would be of practical importance for cosmetic formulators if they could predict the antioxidant activity of the final formulation on the basis of the known activity of its ingredients.

The aim of this study was to assess the predictive power of the chemiluminescence method known as ABEL<sup>®</sup> (Analysis by Emitted Light) by assessing the antioxidant activity of a range of ingredients on their own and in the o/w cosmetic emulsion.

ABEL<sup>®</sup> represent a range of antioxidant assays with pholasin, a protein that emits light in the presence of free radicals and other non-radical reactive oxidant species (ROS), whereby the test material is challenged by a range of ROS. When a particular ROS is generated in the presence of both Pholasin<sup>®</sup> and a sample containing potential antioxidant activity, a competition for the ROS generated occurs, leading to a reduction in the amount of light detected compared to the no sample control. The results are expressed as antioxidant standard equivalents or ABEL<sup>®</sup>-RAC (Relative Antioxidant Capacity) scores. The score is a reciprocal of the EC<sub>50</sub> (the concentration of sample that reduces the light of pholasin by half) multiplied by 100.

Firstly, two individual antioxidants (rosmarinic acid and tocopherol) and two plant extracts (green tea extract and rosemary extract in a range of solvents) were evaluated using a halogenated oxidant assay and a singlet oxygen assay. This was the first use of the singlet oxygen assay on cosmetic ingredients. It was established that the powdered and oil soluble extracts of rosemary were the two best performers amongst the rosemary extracts, with the ABEL<sup>®</sup>-RAC scores in the halogenated oxidant assay of 1,700 and 1,070, respectively. Green tea extract was the best performer, with the scores of 190,000 and 807,000 from the halogenated oxidant and singlet oxygen assay, respectively, while tocopherol scores were unexpectedly low (2,760 and 481).

Secondly, rosmarinic acid, the two rosemary extracts and green tea extract were incorporated into a standard o/w emulsion base. The powdered rosemary extract performed better than the oil extract (ABEL<sup>®</sup>-RAC 696 and 69, respectively), while the green tea extract was the best overall performer in the emulsion (6,690). The three market products have obtained low scores. The ABEL<sup>®</sup>-RAC tests have shown a good level of accuracy in predicting the antioxidant capacity of the formulation on the basis of the previously established antioxidant capacity of individual actives.

In conclusion, this study has shown that the chemiluminescence method based on pholasin could be successfully used to assess the antioxidant efficacy of plant extracts and other antioxidant ingredients, as well finished cosmetic products. The study has confirmed that it is

possible to accurately predict the antioxidant effect of the formulation on the basis of the antioxidant activity of its active ingredients.