Pholasin®-Based Antioxidant Assays for Cosmetics, Cosmeceutical and Nutraceutical Product Development

Author: Jan Knight, Ph.D., Knight Scientific Ltd, Plymouth, UK

Introduction

The "cosmeceutical" category of the personal care market, which covers cosmetic products intended to have therapeutic effects on the body, is considered to be the fastest growing sector of the cosmetics industry. Its value has been forecast to be $5.8 billion by 2008[1]. It is therefore not surprising that so many companies are actively involved in research and development of new products to satisfy this growing demand.

Consumer preferences in personal care products are being influenced by consumer trends in the food and beverage industry and vice versa. Natural organic products, vitamins and multipurpose products are gaining in popularity among consumers. And while the claims made for dietary supplements cannot be applied to cosmeceuticals, the consumer perceives the same kind of benefit irrespective of whether she or he "eats it or wears it".

There is much confusion over what types of products and what kinds of claims are possible. Many people think that cosmeceuticals are analogous to dietary supplements and make similar claims to therapeutic benefit. The cosmeceutical category, however, is not recognised by the FDA; as a result these products are in regulatory limbo between cosmetics and drugs. While the presence of dietary supplements has made indirect claims possible for cosmeceuticals, there are important limitations that must be observed. As more and more cosmeceutical products are developed, there is greater need to substantiate claims made by inference.

It is probably only a matter of time before such products will be required to substantiate directly any claims made. For example skin lotions with added botanicals being marketed to counter the effect of ageing and creams containing antioxidants marketed to protect against exposure to free radicals will probably need to have data to support these alleged actions. With tremendous competition in the personal care market, manufacturers are focusing on the benefits of new ingredients and new delivery systems and on consumer demand for so-called natural products.

Products and ingredients with alleged antioxidant activity will need to be tested in a variety of ways in order to match their proposed applications. For example products designed to deal with free radicals derived from endogenous sources within the body will need to be tested in ways different to those designed to combat the effects of free radicals derived from exogenous sources such as UV light and chemicals in the environment. Similarly, tests will need to be used for hydrophobic as well as hydrophilic ingredients. And in addition to their actions as antioxidants, many ingredients, especially those derived from natural sources, will need further to be measured for batch to batch uniformity and the products tested during and after manufacture to ensure no changes occur in their performance as a result of treatment during production. Some very surprising things can occur when substances tested as antioxidants can lose their antioxidant activity and even become pro-oxidant as a result of exposure to free radicals generated during manufacture. And dose responses may not always follow predictions.

We introduce here some of the ABEL® (Analysis By Emitted Light) tests based on a unique light-emitting protein, Pholasin®. These tests are currently being used in food, nutraceutical and cosmetics research[2] for assessing antioxidant and pro-oxidant activity of ingredients and finished products as well as the effect of these materials when in contact with living cells that produce free radicals.

Free Radicals and Antioxidants[3,4]

Free radicals (molecules with unpaired electrons) and other reactive oxygen containing species (ROS) are highly reactive (see also Appendix 1). They are continually produced in the body and are continually destroyed by a range of substances known collectively as antioxidants. They have very important functions in the body, especially those produced by white blood cells, in such activities as killing bacteria and removing foreign agents.

However, there are occasions when ROS production gets out of control and oxidative stress occurs. This is especially noticeable at sites of inflammation where billions of ROS-producing white blood cells accumulate. When this happens these reactive chemical species, together with enzymes released from granules within the white blood cells injure or even kill cells, damage DNA