DNA Microarrays: Application to Personal Health Care and Cosmetic Industries

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Abstract

While DNA microarrays have been widely used in many areas of research, their application to screening materials for use in the Personal Health Care and Cosmetic industries is relatively new. This article is intended to provide an overview of the DNA microarray procedure to those newly acquainted with the technique and also to provide items of consideration to aid in designing an array-based experiment. The advantages of using DNA microarrays to screen active ingredients for biological effects and the limitations of arrays will also be discussed.

Introduction

Skin care research is continually taking advantage of advanced technologies as they become available. As Personal Health Care and Cosmetic companies strive to screen materials for beneficial biological effects which can be marketable, the use of new technological advances in human skin tissue equivalents and *in vitro* testing methodologies has been a great asset in the screening process. In recent years, technological advances have produced another highly valuable tool for skin care research, the DNA microarray.

DNA microarrays are extremely powerful tools that allow users to analyze changes in gene expression by monitoring changes in the mRNA of hundreds to thousands of genes in a single experiment. All cells function by using their genes to make protein products. This process starts by making an mRNA copy of the gene through a process called transcription. The mRNA copy is then translated into a protein that plays a functional role within the cell or the cell's environment. Since the process of gene expression is highly regulated, the amount of mRNA can be a good indicator of the level of activity for a specific gene. For many years gene expression research was limited to studying a handful of genes in a single experiment through a process called Northern Blotting. However, with the introduction of DNA microarrays skin care researchers can now rapidly obtain a much more global view of what is happening inside of a cell since the results of one or two array experiments can potentially generate data on changes in gene expression across the entire known human genome.

Microarrays come in many forms, however the most popular form is comprised of glass slides which have been spotted with a large number of DNA fragments called *features*. Each feature contains a nucleotide sequence that corresponds to a single specific gene. With the DNA chips that we use, each feature on the chip is approximately 120 μm in diameter, or roughly the size of a single human cell. This small feature size is what allows for thousands of different gene sequences to be printed in an array pattern on the DNA microarray chip. Within our laboratory DNA microarrays are most commonly used to compare cells or human skin tissue equivalents that have been treated with an active ingredient to untreated cells or tissues.

Overview of DNA Microarray Procedure

The first step in the microarray process is to decide which cell or tissue type to use as the model. For example, if one wishes to look at the effect of a material on keratinocyte gene expression then one can use a keratinocyte cell culture model (keratinocytes grown in a monolayer), a simple keratinocyte tissue equivalent (keratinocytes grown in a three dimensional tissue model), a full thickness tissue equivalent (keratinocytes and fibroblasts grown in a three dimensional model), or a pigmented tissue equivalent (keratinocytes and melanocytes grown in a three dimensional model). In the first two examples, the microarray will show only the changes in keratinocyte genes. In the latter two examples, the microarray will show the combined changes that occur in keratinocytes and fibroblasts or keratinocytes and melanocytes, respectively. It should be noted in the latter two examples that if the tissues are processed as a whole it is not possible to detect changes in only one of the two cell types.