



By RICHARD A. PASSWATER, Ph.D.

The Nutrigenomics Revolution: The Science of Personalized Nutrition

An Interview with Dr. Robert Keller

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Readers may remember our chat with “The Nutrition Reporter,” Jack Challem, about his book, *Feed Your Genes Right* (March 2005). I mentioned then that we would be discussing more about nutrigenomics (the interactions of nutrients and genes) in future columns. Challem’s book points out that although we’re stuck with the genes we inherit from our parents, the actuality is that our genes are not “cast in bronze.” The fields of biochemistry and genetics have found that our genes actually depend on many nutrients to do their assigned jobs. Nutrients can affect the genetic array your parents have provided you with by either “turning on” (expressing, up-regulation) or “turning off” individual genes.

Nutrients interact with genes to regulate many types of gene behavior such as starting or halting a process leading to cancer. *Feed Your Genes Right* explained in simple language how our genes depend on good nutrition, as well as how “bad” genes can be improved through the selective use of nutritional supplements. As the book points out, “your genes, of course, are the biological programs that govern much of how your body functions or, as the case may be, malfunctions and causes disease. But to the surprise of many scientists, recent research has revealed that your genes are not rigid, unchanging determinants of your health. Rather, you can improve your genetic heritage and the way your genes function. Quite simply, you can offset disease-causing genetic defects and age-related genetic damage with certain eating habits, nutritional supplements, and other lifestyle improvements.” This is one aspect of nutrigenomics—one side of the equation, so to speak.

There is another important aspect as well—the other side of the equation, and this is what we will chat with Dr. Robert Keller about. Nutrigenomics can show us how to compensate for bad genes that we have inherited. Each of us has a unique array of disadvantaged genes that affect our individual nutritional needs. If we know which genes are disadvantaged, we can take specific nutrients targeted to compensate for each disadvantaged gene. Our unique array of disadvantaged genes is why we have unique individual nutritional needs. What may have sounded like science fiction dreaming a few years ago is now hard scientific fact thanks to our recent determination of the human genome.

I have always emphasized individual needs over average needs. I learned this from Dr. Roger Williams. Dr. Williams made eloquent presentations showing how human biochemistry has significant variation depending on one’s individual

genes in his books, *Biochemical Individuality* (1956) and *You Are Extraordinary* (1967).

In my 1975 book, *Supernutrition: Megavitamin Revolution*, I presented my “Supernutrition Plan” which utilized a “Supernutrition Score” to help an individual find his/her personal needs. But, now we have elaborate DNA analysis that very accurately pinpoints the genetic variations of each of us and we understand how to compensate for disadvantaged genes.

WholeFoods Magazine established this column in 1985 with the mission of informing retailers of new developments in nutrition and to further educate readers about nutritional supplements. Recently, products have been introduced in the health food retail market involving nutrigenomics. These products involve both sides of the nutrigenomics equation. As briefly mentioned earlier, one side of the nutrigenomics equation is how specific nutrients interact with specific genes in some people (although it may be unclear as to which people may be thus affected). We will be seeing more and more nutrigenomics products as this exciting field develops.

We can learn more about this new field of nutrigenomics from Robert P.K. Keller, M.D. Dr. Keller, is the co-founder of Keller International Corporation; founder and chief executive officer of KMI; and chief executive officer of Keller Physician Management Group. Dr. Keller has been a practicing physician with over 38 years of clinical experience in medicine. In addition, he has been a medical director of Community Hospital and the Pebble Beach Corporation, Monterey, California; Department Chairman of three emergency rooms; and CEO of Acute Medical Services, employing 37 healthcare providers. Through his research on anti-aging and cosmetic medicine, Dr. Keller has contributed to the development of preventive medicine, including the collection and banking of adult stem cells for possible future therapeutic uses. Dr. Keller maintains a teaching facility for training physicians in new technologies and life stem cell collection. Currently, he sits on numerous medical and scientific boards and committees. Dr. Keller has appeared several times on national television and radio; he also is a published author and national speaker. Dr. Keller’s new book, *Your Genetic Compass*, is scheduled to be published and released in May 2008.

Passwater: *Dr. Keller, nutrigenomics is in the mainstream news more and more. Just what is “nutrigenomics”?*

Keller: Nutrigenomics is an emerging science

that utilizes “personal DNA-based information” to help people better determine nutritional changes and/or lifestyle changes that may best serve their individual needs in the areas of preventive health and aging. It’s been estimated that over half of the U.S. population is taking nutritional supplements, yet I’d predict that the vast majority of people are still uncertain as to what they really need in order to best supplement their diet to help protect their overall health. This uncertainty often leads to a “shotgun” approach and to over (or under) consumption of vitamins, minerals or other nutrients. For the most part, the very nutrients the body craves never make it in to the shopping cart. Nutrigenomics will become a very useful science to help quantify a person’s genetically determined nutritional needs. Nutritionally speaking, nutrigenomics represents a shift away from epidemiology and physiology research to molecular biology and genetics research.

Passwater: *What drew your interest to nutrigenomics?*

Keller: More patients are asking about vitamins, supplements and what foods are best to consume to help maintain their health. In the past, many doctors have been poor resources for answering these questions, partly because we had no real training or credible scientific information about the subject. Now, with a simple cheek swab, physicians can tell patients which supplements may be needed. This takes nutrition and supplementation into a whole new dimension as far as allopathic doctors are concerned. Nutrigenomics changes nutrition from being subjective to objective. We can measure and monitor what to eat, what to add to our diets and which elements of nutrition are required for optimal health. With nutrigenomics, medicine has moved into the 21st century by becoming highly personalized and what is more personalized than what we eat?

Passwater: *What can our genes tell us about our individual biochemistry?*

Keller: Life, in one aspect, is a continual series of biochemical reactions. In order for these reactions to occur properly, proteins, enzymes and substrates are needed. Our genes give us the necessary tools to make the biochemical reactions occur. Consider this analogy. The body is like a factory. Genes created the blueprint to produce the production machinery to make widgets. The imaginary factory comes complete with all the equipment needed to make these widgets. But

that is not enough. We need raw materials to build the widgets, specific raw materials determined by what our genetic machinery needs to construct our widgets. When the factory gets its delivery of raw materials, the machines can put together our products and throw out supplies not necessary and discarding the by-products of manufacturing the widgets. Our body is like this factory but every human being has a unique factory that produces its own widgets in a unique way. Therefore, each human factory needs different amounts of nutrients and building blocks to create our "widgets." Nutrigenomics help the physician see the blueprints of the machinery and study the inventory list of potential raw materials needed for that individual's optimal health. So, in answer to your question about biochemistry, imagine your body as a complex factory where you produce biochemical widgets necessary to live. Each of us has a unique apparatus determined by our genes and therefore specific materials used by your one-of-a-kind machine. Nutrigenomics lets us know how to order the raw materials required by our exclusive machinery. In short, by measuring specific genes, we can often compensate for its less-than-optimal function by making nutrient adjustments.

Passwater: *Please explain a little more about genes and single nucleotide polymorphisms (SNPs).*

Keller: Genes are given to us by our parents. Mom gives us one gene. Dad gives us the other. Genes are coded instructions that tell our factories which proteins to make so that we can live and be healthy. We manufacture millions of different proteins that do a million different jobs in our bodies. Proteins form our muscles and internal machines like the kidneys, heart and liver. Proteins also make up our immune system, skin and just about everything on the outside and inside of our bodies. When proteins come together, things happen. SNPs (pronounced "snips") are subtypes of different genes. One person's DNA may have a blueprint for creating blue eyes, yet by changing a single unit of the DNA molecule, the DNA makes brown eyes. This single change in a "nucleotide" is called an SNP and accounts for why we are uniquely different, and why people may have different "nutrient" requirements for optimal individual biochemical functions.

Passwater: *Can you tell us a little about the frequency of these disadvantaged SNPs?*



Dr. Robert Keller

Keller: Most of the disadvantaged SNPs are fairly common among the general population. North American and/or patient. From the information, a nutritional wellness plan can be personalized for the patient. No more guessing about what to eat or which vitamins or minerals to take or which doses are correct. Recommendation can be summarized and typically accompany the DNA analysis report.

strate frequencies for the disadvantaged SNPs in the 10–40% range.

Passwater: *I have been an advocate of "personalized nutrition" since 1970. Dr. Roger Williams chatted with me about biochemical individuality then. Do you see nutrigenomics as a new tool to help us determine our individual nutrient needs?*

Keller: Absolutely! Why give our factories the wrong materials and fuel. It's analogous to putting automobile fuel in a jet engine. As you know better than anyone, we are what we eat. When we supply our machinery with the incorrect raw materials, waste products junk up the works. Incomplete or bad food causes toxic by-products, which accelerate the aging and disease process. The free radicals produced by non-specific foods and supplements wreak havoc on our bodies. Now, for the first time in medical history, we can individualize our nutrition to fit what we were born to eat.

Passwater: *Please give us an example of what nutrigenomics can tell us about our individual needs?*

Keller: One of my favorite examples is oxidative stress. Most people have heard of antioxidants and most people understand on some level that people need antioxidants to help combat free radicals (called reactive oxygen species or ROS), which can damage our bodies. From the moment we are conceived until the day we die, this oxidation of critical proteins, lipids, nucleic acids and sugars occurs in every cell of our bodies. Most scientists believe that uncorrected oxidative events result in the deterioration of cellular function, which leads to specific vulnerabilities to age-related diseases. What most people don't know is that we can now measure a person's predicted "genetic capacity" to protect and defend against specific types of oxidative stress. One SNP for example, SOD-2, is a front-line defender against oxidative stress and we can now analyze a person's DNA to see if they have this SNP. If they do, we can provide nutrient formulations to help compensate for a "sluggish" or less than optimal genetic capacity in this area. People may take antioxidants in general, but the question is: Are they taking the right antioxidants in the right amounts, specific to their personal genetic predispositions? Bottom line: Antioxidants play a major role in activating genes and it's important to pay attention to that biochemical function on a more personal level.

Passwater: *How is this information obtained?*

Keller: The DNA sample collection is simple. A cotton swab is brushed against the inner cheek just like on the TV show CSI. The swab is mailed to the lab, the DNA is extracted and analyzed, and the report is mailed back to the physician and/or patient. From the information, a nutritional wellness plan can be personalized for the patient. No more guessing about what to eat or which vitamins or minerals to take or which doses are correct. Recommendation can be summarized and typically accompany the DNA analysis report.

Passwater: *Can this analysis tell us about how well we convert folic acid into methylfolate, the active form needed to convert homocysteine into methionine? If so, why is this important?*

Keller: We could likely dedicate an entire discussion to this area (and maybe we should in the future). In a nutshell, however, the gene-SNP, MTHFR, relates to a person's ability to efficiently convert or metabolize folic acid. Biochemically speaking, this is the methylene tetrahydrofolate reductase pathway that, among other functions, helps a person maintain healthy homocysteine levels. Fortunately, if an individual has a SNP in this area, we can compensate for its "less than optimal function" by substituting a much more bioavailable and/or active form of the nutrient.

Passwater: *The question of efficiency in converting ubiquinone into ubiquinol is of interest to many. Can a SNP analysis tell us this?*

Keller: Yes. This is a very interesting and important area. We are gathering information about the importance of coenzyme Q10 (CoQ10) in such areas as Alzheimer's disease, vasculitis, auto-immune and heart disease. Yet, a debate (and potentially misinformation) is raging about the value or importance of ubiquinol versus ubiquinone. The truth is the body needs both forms of this important enzyme. About 30% of the population has the SNP (NQ01), which indicates that this individual has an inefficient mechanism for converting ubiquinone into ubiquinol. The jury's still out on this question, but I lean towards recommending ubiquinol supplementation only after we know if an individual has an inefficient SNP for the conversion process. Otherwise, I think most people can benefit nicely from appropriate doses of the less expensive ubiquinone, providing it's known to be of a high quality.

Passwater: *Where is your nutrigenomics research headed? What is on the horizon?*

Keller: In addition to my work with the Keller Medical Institute, I'm on the scientific advisory board for GeneLink BioSciences. GeneLink is a pioneer in the science of creating and offering DNA-based assessments as the nucleus for personalized health and wellness products and services. GeneLink's research is focused on several important areas such as SNPs that indicate DNA integrity and repair, neuro and cardiovascular health and so on. We're continuing to focus on increasing evidence that oxidative stress has a major impact on a person's overall health so we're examining specific gene-SNPs that predict a variety of oxidative stress related functions. Just as important, we're focusing on the research and development of nutrients that can help modulate or compensate for these disadvantaged functions.

Passwater: *Oxidative stress just happens to be one of my favorite topics as well. Thank you for sharing your knowledge of nutrigenomics with our readers. WF*