Personalized nutrition: an integrative process to success

O. da Costa e Silva · R. Knöll · M. Jäger

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The results of a 2005 study conducted by the International Food Information Council in the United States on Functional Foods [Dave Schmidt, personal communication] have shown that 66% of the interviewees have the feeling of being in control of their health. Almost 70% see nutrition as playing a central role in maintaining and improving health. The sales of functional foods and genetic tests as tools for nutrition recommendations are seen positively by 83 and 73% of the interviewees, respectively. Taken together, these results show that consumers are aware of the benefits and opportunities of new developments in the food industry and supporting sciences, e.g., genetic testing, for guidance towards maintaining better health. And, what is most important, consumers will take action.

Another study [Ian Newton, personal communication] gives support to the role of functional foods in health/wellness management. These foods are also an important component of “personalized” nutrition and its many uses: The most important reasons for buying functional foods from the consumer’s perspective are to prevent diseases and help maintain health (31%), followed by a short-term optimization of wellness (21%). The prevention of dis-

eases—oriented according to target groups—will play an important role in concepts for future health systems. Innovative technologies will be used with clinical studies and screenings to identify individual propensities. This will also form the basis for “personalized” nutrition and product positioning in the food market.

New scientific technologies are making it possible to identify genetic differences with regard to nutrient-related metabolic processes within the body; everyone can benefit from this. While individual genetic variations can occur with greater frequency in particular population groups (for example, variations relating to lactose intolerance or the ability to metabolize alcohol), in recent years, scientists have discovered a multitude of inter-individual differences in genes, which suggest that there are different nutritional needs among individuals. This means that recommendations for optimal nutrient intake apparently must be different from individual to individual.

Nutritional substances affect our genes by acting directly or indirectly on the DNA structure, the expression of certain genes, and/or on metabolism. Many genes that are related to nutrition are likely to play an important role in the development of diseases. A person’s individual genetic profile determines the extent to which nutrition can affect the balance between health and disease. Therefore, optimal nutrition should be matched to the general need for nutrients as well as to the person’s individual nutritional status and genotype (“personalized” nutrition). In this way, the supply of nutrients to the body can be optimized, the risk of food incompatibilities and diseases can be reduced, and a major contribution can be made to disease-prevention and good health.

The presence and expression of biomarkers in the human organism exhibit natural variance. As long as this

O. da Costa e Silva (✉) · R. Knöll
BASF Future Business GmbH,
67063 Ludwigshafen, Germany
e-mail: Oswaldo.da-costa-e-silva@basf-ag.de

M. Jäger
Strategic Marketing Human Nutrition, BASF,
Aktiengesellschaft, 67117 Limburgerhof, Germany

variance remains within its natural range, it can be assumed that the individual is and will remain healthy. However, if the variance goes outside of its normal range, then early biomarkers indicate the genesis of diseases. Late biomarkers are traditionally used to select suitable drugs and to monitor treatment. Our understanding of the molecular mechanisms, that underlie wellness, the maintenance of good health and the development of diseases, is constantly expanding. Using this knowledge, it will be possible in the future to adapt the general recommendations for the intake of nutrients, which are issued by various organizations on a national level, to match the needs of specific genetic groups in the population. The first step in this direction is provided by the new official nutritional recommendations from the USDA in which individual differences in physical activity are taken into account in addition to age and gender. It can be expected that such personalized recommendations will be used throughout the world in the future.

The integration of an extremely varied source of information and data is needed in order to offer to the consumers valuable products based on personalized nutrition. The BASF Group has realized this necessity and is building the required competencies and partnerships, scientific and business, to bring real valueadding products to the marketplace.

Today, individual companies are offering genetic profile analyses that are used to make personalized recommendations for improved lifestyles, optimal nutrition and nutritional supplementation. BASF is playing a leading role in the field of individualized nutrition. In an extensive research project (“POSIFood”) that the Fine Chemicals operating division is conducting with the Fonterra company in New Zealand, a marketing system is being developed in which freshly prepared beverages oriented toward specific target groups are being offered for each consumer type through the use of automatic equipment. This highly innovative project is taking a first step toward individualized functional foods. In addition, Metanomics Health (Berlin, Germany), a subsidiary of BASF, is one of the world’s leading centers of metabolome research.

In a third area of activity, BASF Venture Capital is investing in the U.S. startup company Sciona (Boulder, USA), which is performing polymorphism research in various population groups. Sciona is successfully marketing a genetic profile analysis kit for consumers. In the same direction, DNA LandMarks (Montreal, Canada), a subsidiary of BASF Plant Science has established one of the centers of excellence for DNA mapping. Nutritional and behavioral recommendations for the final consumer can be derived from these analyses. Personalized nutrition aims at future, longterm developments in science and in the nutritional sector. In parallel to this implementation development, BASF is also interested in innovative

nutritional concepts that are based on strong current market trends.

BASF Plant Science is developing innovative plant varieties with poly-unsaturated fatty acids ($\omega 3$ and $\omega 6$) in their oil. BASF Venture Capital is also investing in the U.S. startup company Advanced BioNutrition (Columbia, USA). This company sells the same poly-unsaturated fatty acids extracted from either microalgae or other microbes. These endeavors will secure a renewable supply form for this important food supplement, i.e., whole seeds and vegetable oils as well as microbes, respectively.

“Beauty from the inside out” has become a watchword in the food industry; an increasing number of functional foods are being marketed in this category. This concept is also benefiting from the positive image relating to the marketing of beauty that is being fostered by the cosmetics and advertising industries and the high consumer acceptance that already exists. A large number of possible options are available given that the positioning of the product in the food industry is still in an early phase. Substances that traditionally have been used in cosmetic products to benefit the skin—products that the consumer already trusts are now being used in functional foods. Such is the case, for example, with aloe vera and the coenzyme Q10.

BASF is conducting research on the effect of vitamins in the skin. In this way, functional foods can be marketed together with new scientific discoveries. In a clinical study that BASF carried out in cooperation with the University of Jena, Germany, it was shown for the first time that the consumption of vitamin E leads to an increase of the concentration of this vitamin in the surface of the skin and that it thus supports the protective mechanism of this organ, which defends the body from UV radiation and adverse environmental factors.

Although the Western world has problems in many areas due to an overabundance of food (intake of calories, fat and carbohydrates), it is still experiencing nutrient-related problems, ones that go largely unnoticed. This applies in particular to individual population groups such as young women, pregnant and breast-feeding women with respect to vitamin A and folic acid. Here too, BASF is actively engaged in scientific studies to discover the basic principles of disease pre-vention. In one study, in which BASF participated in cooperation with the University of Hohenheim (Stuttgart, Germany), and the University Hospital in Ulm, Germany, an effort was made to find out whether vitamin A deficiency could be a problem in Germany. Most people assume that this is not the case (in contrast to developing countries, where vitamin A deficiencies are a well-identified problem). In this study, in the risk group of pregnant women expecting multiple births, or women who have had a closely spaced series of births, it was found that

approximately 33% of the women were receiving inadequate supplies of vitamin A, a substance that plays a large role in child development. The supply of vitamin A with pregnant women is of critical concern since they are generally advised not to consume vitamin-A-rich foods (in particular liver). The purpose of the study is to make this “risk group” more conscious of the need for adequate vitamin A intake and to optimize nutrition accordingly (for example through functional drinks enriched with provitamin A).

In a further clinical study, the role of functional ingredients in prevention was demonstrated using carotenoids as an example. The study was conducted with healthy senior citizens in cooperation with the Tufts University (Boston, USA). For two months, the participants took a mixture of carotenoids with the goal of reducing the DNA damage in

blood cells caused by environmental pollution. This effect was documented here for the first time in human beings. After just two weeks, DNA damage was reduced by 20%. After two months, the reduction of damage reached a maximum of 36%, and remained at this high level.

In summary, it can be stated that functional foods can contribute to the health and wellness of consumers. Such foods offer the industry numerous opportunities for product innovation. Vitamins and minerals are among the leading functional ingredients (“essential nutrients”). BASF is aware of the challenges to successfully add value to consumers through personalized nutrition and is dealing accordingly and timely. BASF is pushing ahead aggressively with innovative nutritional research in order to be able to reach this goal.