

2025: global trends to improve human health

From basic food via functional food, pharma-food to pharma-farming and pharmaceuticals

Part 1: Basic Food, Functional Food

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It is of course obvious that to live everybody must eat. Nevertheless, this fundamental necessity was globally addressed by the United Nations in the Universal Declaration of Human Rights in 1948, Article 25: "Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary services..." (1).

At the beginning of the Third Millennium, we are all aware, that this human right is not being realized worldwide.

FOOD SECURITY 2025 - A GLOBAL CHALLENGE

Within the next 30 years, world food requirements will more than double as a result of population growth and dramatically changing consumption patterns, which means, we will have to produce more food worldwide during this period than over the last 10,000 years put together (2).

Individuals decide several times a day what to eat and what not to eat. This is done by 5.55 billion people worldwide. It is often assumed that obtaining food is a simple matter. But in practice this is not such a simple matter. In many developing countries where starvation is an ever present threat - 0.9 billion people suffering from calorie and protein deficiency - food is not just one need among others, but an absolute need on which all else depends. Food means survival and is a life-or-death issue. For these people, food security is a key challenge. The issue is well symbolized by Chinese characters in figure 1 (3).



MINIMAL BASIC NUTRITION

Due to intensive cultivation methods, the production of 1kg of flour by plant photosynthesis in Central Europe requires an area of about 2m² and approximately 900 litres of water, which flows on this area as evaporation moisture. One kilogram of flour is obtained from about 1.8kg of dry, threshed cereal grains, and contains 3,700kcal. This minimum basic diet provides only enough energy to keep one person alive for just 2 days, i.e. to prevent him or her from starvation. Under current production conditions, the photosynthetic activity of an

area of about 365m² must be available for the needs of one person. Furthermore, the survival of this person can be ensured only if sufficient water, a suitable climate, and effective and efficient agro technologies are available for the area in question. These calculations do not include the amounts of calories needed for physical and intellectual activities. At the beginning of the twenty-first century, it must be stated that on the basis of present-day calorie requirements, no country with less than 0.07 hectares available per person is in a position to feed its own population adequately. By 2025, more than half of the world's population will fall below this area criterion.

CONSUMER PURCHASING POWER

As incomes rise for certain urban professional groups, people move further up the food chain, i.e. they consume more livestock products, the production of which either requires more grain or absorbs waste land.

Below US\$ 5,000 a year, subsistence foods such as cereals, fats, oils and vegetables dominate in the diet. Above US\$ 5,000 a year some of these foods are replaced by meat, and in the first instance by cheaper cuts and ground beef.

Above US\$ 15,000 a year, increasing amounts of packed food are sold and the emphasis shifts to quality, variety and branding; sales of beef shift towards cuts of greater convenience, such as steak, and towards smaller sized packages; consumption away from home also becomes more frequent.

Above US\$ 20,000 a year, there is a demand for fresh foods and health foods (4).

LIFE STYLE AND EATING HABITS, HEALTH PROBLEMS

Eating is one of our principal everyday actions: each person consumes an average of 80,000 meals over the course of his or her life, with a total consumption of 60 tonnes of food.

These are purely statistical figures.

Food consumption and eating habits are closely linked to particular life styles. And, diets are changing almost everywhere throughout the world. Contrary to popular assumption, this dietary transition is not just affecting the affluent. In the US, for instance, approximately 300,000 people died in 2003



from obesity-related illnesses, and obesity-related health care costs ranged from US\$ 97 to 130 billion.

Obesity and related diseases are now problems for poor countries and poor people. Currently, low- and middle-income countries account for 80 percent of global mortality from cardiovascular diseases. Obesity and chronic diseases are also on the rise in developing countries still suffering from hunger and infectious diseases. It will be essential to redirect the diet transition from hunger to health (5).

Furthermore, there is growing evidence that diet plays an important role in certain mental health problems including Attention Deficit Hyperactivity Disorder (ADHD), types of depression, schizophrenia and Alzheimer's disease.

Worldwide, 450 million people suffer from mental health problems. For example, the UK costs of mental ill-health are now approaching US\$ 180 billion a year (6).

It is obvious that there is a close link between food and health, and new and effective food-based strategies will have to be developed to reduce the risk of diet-related diseases such as obesity, arthritis, cardio-vascular disease, diabetes, cancer, osteoporosis, and mental health problems.

ROLE OF FOOD IN TRANSITION

Since beginning of human mankind food is in transition, food is the fuel for transition, food is more and more 'cultivated nature', and finally, food is substantial for changes. It is worthwhile, to think about that. Food is defined as any substance or product, whether processed, partially processed or unprocessed, intended to be, or reasonably expected to be ingested by humans (EC 178/2002) (7). In this context questions are: "How much time has the reader invested for obtaining food? How much time was needed for



picking, digging, hunting or fishing for the last meal? How long did it take to peel, grind or cut up? If the food was cooked - how long did you need to collect the fuel and

light the fire?" People in the Western world never think about questions like these - nevertheless they are well fed all the same. Thanks to the use of convenience foods, the time needed to enjoy a main meal (including cooking, serving and eating) has been drastically shortened. If people in Germany in the 1930s still needed about 2.5 hours, the time has now been reduced to only a few minutes. With the use of meal delivery services, times of just under 10 minutes have been forecast for 2010 (8). Another interesting example is sugar, a key food item which played a decisive role in world history. Sugar was, among other things, a central element in a whole configuration of factors, which, taken together, helped to create a whole new life style of permanent nerve stimulation. Consumption of these stimulants - coffee, cocoa, tea, rum, tobacco and (in China) opium - was a historical phenomenon. Luxury goods centring round "the nervous system" were a major theme during the eighteenth century. Nowadays,

particularly in Europe, there is a great call for bitter tastes - never has there been such a demand for curly endive, chicory, rucola,



black chocolate, dry wines or strong coffee (8). Now, at the beginning of the twenty-first century, the food industry is setting its sights mainly on "health" and "anti-aging". Food in its traditional role is changing from "survival and pleasure" to that of food as medicine. Antioxidants, such as carotenoids, vitamins E and C, flavonoids and glutathione, which are thought to play a role in the body's defences against cardiovascular disease, cancer, arthritis and visual impairment, are associated with names such as "nutraceuticals, functional foods, dietary supplements, nutritional supplements, medical foods, fortified foods, foods for special dietary use, health foods, pharmafoods, cropceuticals, bioactive foods" (9). As an example here, current margarines use plant oils as a basis. Plant oils are healthier for cholesterol content than animal fats, due to their higher level of unsaturated fatty acids. However, because oils are too fluid and unstable they often have to be "hydrogenated" or "shortened". This process unfortunately produces more saturated fats and also so-called trans-fats. These trans-fats have similar effects on cholesterol as saturated fats. Although there are oils available from specialty canola that can largely overcome this problem, their application is limited, due to low production efficiency. Using molecular breeding technologies, Bayer CropScience has found a way to improve its top-yielding canola hybrids (Invigor™). Ultimately, these canola hybrids will make it possible to produce more healthy margarine (10). In general, "functional food" is perceived as processed food which not only feeds consumers, but promises additional benefits related to the preservation and improvement of physical and mental well-being as reducing the risk of falling ill from nutrition-related diseases. It is estimated that nutraceuticals and functional foods will be a multi-billion US\$ business in the near future.

TRANSFORMATION OF THE FOOD INDUSTRY

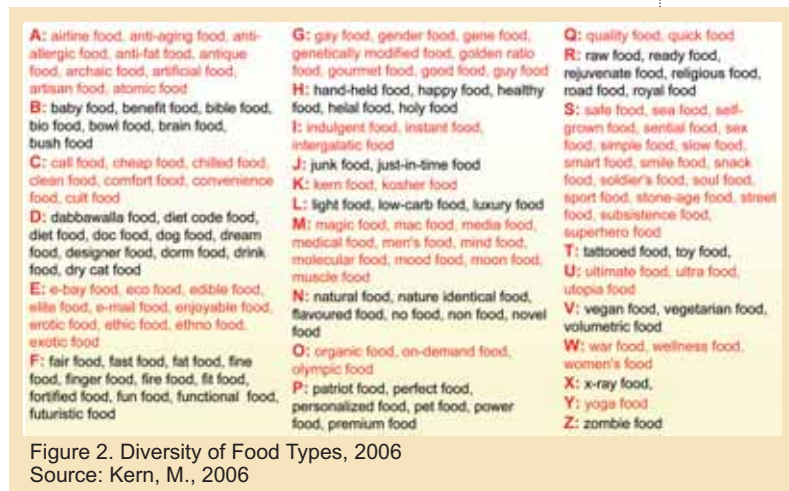
Consumers seek more goods not necessarily tied to simple survival. Consequently, key stakeholders of the food chain are undergoing a transition. Nestlé, for example has published: "We (Nestlé) are moving from an agri-food business to an R&D driven nutrition, health and wellness company" (11).

Key driving factors for the food industry in moving functional foods and nutraceuticals into the corporate mainstream are: aging populations; increasing interest in "healthy living"; increasing affluence and education among world populations; increasing understanding of the link between nutrition and health; emphasis on preventive measures to control health care costs; increased acceptance and utilization of "alternative" treatments; general consumer dissatisfaction with conventional treatments, therapies and drugs; greater acceptance among doctors, pharmacists and other health professionals; an expanding body of scientific and clinical

research to validate effectiveness and safety; expanding press coverage of such research; increased marketing and advertising activities by suppliers; evolving public policy and regulatory environments; an increasingly large market.

DIVERSITY OF FOOD

Today, food is available in great variety such as the world has never seen before. There are food types for every letter of the alphabet - a: *airline food, anti-aging food, anti-allergic food, anti-fat food, antique food, archaic food, artisan food, atomic food, ...f: fair food, fast food, fat food, fine food, finger food, fire food, fit food, fortified food, fun food, functional food, futuristic food, ...y: yoga food, z: zombie food.* Key characteristics for more or less all listed types of food are: *safe, healthy, sufficient, enjoyable, and a well sounding story* (figure 2).



All these types of food are available except for the poor, who are excluded, because they have to fill their belly.

INFORMATION ABOUT FOOD

Worldwide, there are over one billion cookbooks sold every year, over 3 million per day. This translates into over US \$ 10 billion sales, more than double the sales of 10 years ago (12). Nevertheless, this does not mean that everyone is using food in the right way. Now that consumers are more aware about the connection between food and health, they are under increasing pressure to learn more about the subject. Providing information about food will become more important for all industrial segments of the industry. Product declarations, redesigned supermarket displays and shop formats, as well as the creation of new, objective sources of information that explain the chances and risks to customers



are becoming more important. Last but not least, it will be essential that tomorrow's eating habits safeguard a healthy and

enjoyable life. In many countries it is no longer enough to be informed about the contents of the food on sale. As a result, industry is having to declare not only the ingredients but also where the raw materials come from, and the course taken from its origins to the final product. Complete transparency is an essential aspect of global sourcing, and all stages in this process will be documented down to the last detail. From producer to distributor, they are all partners in a process extending from *'farm to fork'*, in which they are all collectively responsible for the quality and safety of the product. Food safety will become one of the most important topics of the food-production chain worldwide. Presently, especially in Europe, people seem to be quite trusting, however, they place their trust not in a market which ensures quality, but in a certificate which asserts quality. They are evidently more willing to trust certificate-mongers than their own suppliers.

Nevertheless, traceability has become obligatory in EU food legislation since the beginning of 2005; documentation of farm activities is the base layer that must be provided when anyone wishes to trace food back to farms in accordance with EU legislation (13). GIS (Geographical Information System) -based applications for farmers (e.g. *integrated AGOffice-technology*, PROGIS Company, Villach, Austria) and food producers have been developed and are currently in process of being implemented (14).

There are two other dynamic trends, one is known as 'Nano Food'. There is "nano-indicator" which turns milk red in the packaging if it has gone sour. Chicken breasts turn blue in the packaging to show that they are past the "use by" date or that the packaging is no longer airtight. Nanotechnology makes it possible to obtain longer storage life, safer packing, better

product traceability, more healthy foods and enhanced production safety (15). Nano food products have today achieved a worldwide market volume of about US\$ 2.4 billion. This is expected to increase to over US\$ 20 billion by 2012. It would thus seem that nanotechnology will become a central motor of innovation and growth in the food sector. The other new technology under development to monitor food quality is called '*Biophotonics*'. It is a technology to register delayed luminescence of food.

By using this optical technology, it is possible to determine the microstructure of food as well as the biological, chemical and functional qualities of food. Within a couple of minutes the freshness of fish can be analyzed having a variation of +/- one day only.

A new book, edited by Popp and Strehle, titled "*Biophotonics*" with the subtitle "Visions for Better Health Care" in 2006, describes the use of the most advanced optical technologies in biological and medical research, including advanced microscopy and spectroscopy methods (16). '*Biophotonics*' will significantly contribute to improve food quality and to improve health care in future.

DEMOGRAPHIC SHIFT, POPULATIONS ARE AGING

With the overall demographic shift, populations are aging or suffering from insufficient rejuvenescence. This applies especially to highly industrialized countries (Japan will have 1 million 100 year old people in 2050; Germany has only 1.3 children per family), but will in future also apply to developing countries, since the median age of about 26 years today will

increase over the next 50 years at global level to over 44 years. Global life expectancy has grown more in the last fifty years than over the previous five thousand years. This was only possible by having modern technologies available in food production, medicine, and public health. A challenge in front of us is, that within the next 25 years, world population of elderly people (65+) will more than double reaching a total of 1 billion, or almost 12 percent of the future world population.

In a second part that will be published in the next issue of *Agro-Food-Industry Hi-Tech*, global trends to improve human health will be shown giving focus on the transformation of health care, pharmaceuticals from plants, transformation of the production of pharmaceuticals, plant-made pharmaceuticals, plant bio-pharming, pharma-farming, transformation of crop production, nanobiotechnology and Vision 2025.



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