III. Nutraceuticals

A further important field of innovation in the production of processed food are nutraceuticals. A nutraceutical is defined as "any substance that may be considered a food or part of a food, and provides medical or health benefits, including the prevention and treatment of disease."[346] Nutraceuticals range from isolated nutrients, dietary supplements and diets to genetically modified food, herbal products and processed food such as cereals, soups and beverages. A nutraceutical maintains, supports and normalizes any physiologic or metabolic function. Nutraceuticals can also potentiate or antagonize physiologic or metabolic functions. Drugs are pharmacologically active substances that potentiate, antagonize and modify any physiological or metabolic function. Thus, the differentiation between nutraceuticals and drugs is becoming more difficult.[347] The ongoing research softens the distinction between food and drugs. Public health authorities consider prevention and treatment with nutraceuticals as a vital tool in maintaining health by addressing nutritionally induced acute and chronic diseases.[348]

Nutraceuticals represent the fastest growing segment of the food sector. The market is estimated at U.S.$30 billion, growing 5% yearly.[349] This increase is "a horror vision for one - a fantastic fulfillment, indeed, for others."[350]

One class of nutraceuticals is represented by polyunsaturated fatty acids, the so-called PUFAs. Current interest is devoted to fish oils containing a high share of omega-3 fatty acids, eicosapentaenoic and docosahexaenoic acids. These fatty acids exercise a protective effect on the development of cardiovascular and inflammatory diseases. Fish oils could play a key role in the treatment of dermatitis and psoriasis. Premature infants have limited dietary support of the omega-3 fatty acids required for the normal composition of brain and retinal lipids. Fish oils influence tumor-derived lipolytic and proteolytic factors, receptors and enzymes of cellular signaling.[351]

The essential amino acid tryptophan has often been employed as a drug. The non-essential amino acid arginine has the potential to improve cellular immune response, phygocytosis and maintenance of T-cell function. Arginine retards tumor growth and formation of metastases. Arginine also acts on immunomodulation comprising cellular response, trauma-induced reduction in the T-cell function and phagocytosis.[352]

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346 The Foundation for Innovative Medicine, The Nutraceuticals Initiative: A Proposal for Economic and Regulatory Reform, 46 Food Technology 77 (1992), available at www.fimdefelice.org/archives/arc.revolution.html.

347 *Hardy*, Nutraceuticals and Functional Foods: Introduction and Meaning, 16 Nutrition 688 (2000).

348 *Andlauer&Fürst,* Nutraceuticals: A piece of History, Present Status and Outlook, 35 Food Research International 171 (2002).

349 *Hardy*, Nutraceuticals and Functional Foods: Introduction and Meaning, 16 Nutrition 688, (2000).

350 *Andlauer&Fürst,* Nutraceuticals: A Piece of History, Present Status and Outlook, 35 Food Research International 171, 175 (2002).

351 *Fürst&Kuhn,* Fish Oil Emulsions: What Benefits can they Bring?, 19 Clinical Nutrition 7 (2000).

352 *Andlauer&Fürst,* Nutraceuticals: A Piece of History, Present Status and Outlook, 35 Food Research International 171, 173 (2002).

Glutamine effects catabolic states. Native glutamine is poorly soluble in water. Synthetic glutamine in the form of stable and highly soluble dipeptides enriches food in order to attenuate the expansion of extracellular and total body water. Besides, glutamine influences stress-induced accumulation of extracellular fluid by affecting membrane function, and changes the cellular hydration state. This suggests therapies for extracellular edema. It can also be used to treat insulin resistance, such as diabetes mellitus, sepsis, and trauma. Finally, glutamine (dipeptide) is proposed as a suitable cardioprotective and rescue agent.[353]

Phytochemicals can be used as nutraceuticals. Glucose and insulin regulation is an important feature of phytochemicals. *Agrimonium eupatoia* extract carries on insulin-like activity and stimulates incorporation of glucose into glycogen. New hypoglycemic compounds have been proposed like castanospermine, neomyrtillin (bilberry) and myricetin (tea, berries, fruits). To sum up, more than 1,000 plants have been claimed to offer special benefits in the treatment of diabetes. Lentinan[354] from mushrooms activates the host's immune system and has antitumor and antiviral activity due to an induction of interferon-γ production. It reduces the toxicity of AZT.[355] Prevention of the onset of AIDS symptoms through potentiation of host defense is presently being investigated.[356] Flavonoids and phenolic acids from honey possess antimicrobial activity. Isoflavone phytoestrogens, such as daidzein and genistein, in soy have antidiarrheal, hypolipidemic, anticarcinogenic and antiosteoporotic effects. The consumption of high soy food is associated with lower breast and prostate cancer risks and it improves the bone mineral content.[357]

C. Consumer acceptance of innovation in the food sector

Consumer acceptance is by far the most critical point of the application of biotechnology in the food sector besides the technological feasibility of biotechnological applications. Consumer acceptance of genetically modified food is extremely difficult for several reasons. First of all, the food sector is the subject of great public attention. Negative news from one company can affect the entire food sector. Additionally, the media are interested in sensational negative news about genetically modified food, thus amplifying public controversy about genetically modified food.

353 *Andlauer&Fürst,* Nutraceuticals: A Piece of History, Present Status and Outlook, 35 Food Research International 171, 173 (2002).
354 A polysaccharide characterized as?-1,3-glucan having branching of the 1,6 bonds.
355 A drug commonly used for treating HIV carriers and AIDS patients.
356 *Andlauer&Fürst,* Nutraceuticals: A Piece of History, Present Status and Outlook, 35 Food Research International 171, 174 (2002).
357 *Andlauer&Fürst,* Nutraceuticals: A Piece of History, Present Status and Outlook, 35 Food Research International 171, 174 (2002).