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The changing face of nutraceuticals – An overview

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Abstract

"Let food be thy medicine and medicine be thy food" were the words said around 2500 years ago by Hippocrates. Since ancient times mankind has believed in the role played by the appropriate amount of nutrition in maintaining proper health. The increasing concern of consumers regarding the potential toxic effects of synthetic drugs has helped the nutraceutical market to grow enormously in the past few years as consumers feel that it is a relatively safer way to good health. The market for these products is anticipated to increase even further in the years to come. However, there still exists ambiguity about the regulatory requirements related to nutraceuticals worldover. Stringent regulations related to the safety and efficacy of these products is imperative to create a conducive environment for the sustainable growth of the nutraceutical industry. This article attempts to trace the evolution of nutraceuticals over the years and a sneak peek into what may be the future of the nutraceutical industry.

Key-Words: Nutraceuticals, Dietary supplements, Regulation of nutraceuticals, Phytochemicals, Functional foods.

Introduction

"Let food be thy medicine and medicine be thy food" These were words said around 2500 years ago by Hippocrates, the Father of medicine. Since ancient times, human beings have always looked at natural products as a major source of nutrition in addition to being a predominant source of prophylactic agents for the prevention and treatment of various diseases and ailments. The growing interest of consumers in dietary supplements, nutraceuticals, functional foods or whatever you may like to call it, based on the concept of "personalised medicine" for health maintenance, has enormously spurred the growth of market of these products in recent years. This overview attempts to provide a thorough account of the evolution of nutraceuticals and functional foods with an emphasis on the regulations related to these products.

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Inception/ A Look into the history

Since a long time, even before the development of "Nutrition" as a distinct scientific discipline, physicians paid close attention to the role of the daily diet in health maintenance. During the 16th, 17th and 18th centuries, many crewmen on long voyages across the Seas often died because of scurvy. The 18th century sea captains (under the direction of the British Admiralty) explored the role of various foods and food practices in maintaining the health of seamen. Some foods provided the missing vitamins B and C, whereas others reduced the antiscorbutic effects of the seamen's diet [7]. Biomedical research during the past 20 years has revealed that diet plays an important role in the prevention and progression of many of the major chronic diseases, such as atherosclerosis and cancer [8, 41, 56, 35, 54]. In 1989, The Foundation for Innovation in Medicine (New York, U.S.), an educational foundation established in the US to encourage discoveries in medicine, coined the term ''Nutraceutical'', to provide the much needed name for this rapidly growing area of biomedical research. Dr. Stephen DeFelice (1992) defined nutraceutical as "any substance that may be considered a food or part of a food and which provides medical or health benefits including the prevention and treatment of disease". According to that definition the term Nutraceutical may include a whole range of products like isolated nutrients, dietary supplements, herbal products and other processed foods [2].

The growing dissatisfaction among the patients about the synthetic therapeutic agents and concern about their toxicologic profile gave birth to the "Dietary Supplements Health and Education Act" (DSHEA) in USA in 1994. According to the amendments made in the DSHEA, the materials that had been used or were being used in traditional medicine (and whose toxicities were 'known') as of October 15th 1994, or materials that were classified as dietary supplements were exempted from the regulatuions of FDA. [2]

The DSHEA legislation therefore opened the gates to a booming nutraceutical industry, with annual sales of dietary supplements in the USA rising to about US$18 billion in 2002. [2]

The present status

Nutraceuticals are gaining acceptance worldwide because of their ability to address several diseases (Fig. 1). An increasing demand for health-promoting food products as well as non-food products containing the active principles present in these health-promoting foods among the consumers has been shown by various marketing surveys carried out by different industries [18].

Vitamins, minerals and nutrients constitute about 85% of the global market while antioxidants and related products account for about 10%. The other segments such as herbal extracts occupy 5% of the market. The US has been the major market for nutraceuticals with India and China emerging as the fastest growing markets [27]. Traditional medicine is also finding its place in the present healthcare system in the form of herbal dietary supplements. Many known and also some novel bioactive phytochemicals have been isolated from the various herbal medicines used in Traditional Chinese Medicine and Ayurvedic Medicine [50, 31, 19]. Several phytochemicals present in the edible plant materials and plant extracts used in traditional medicine or in dietary supplements are freely available to the public e.g. isoflavones present in soyabeans and different phytosterols in *Cissus quadrangularis* [47, 49, 51]. The role of traditional soy-food in disease prevention and treatment has gained worldwide recognition because of its antidiarhoeal, hypolipidaemic, anticancerogenic and antiosteoporotic effects. Isoflavone phytoestrogens in soy, such as daidzein and genistein, are known to be responsible for the biological activities [2]. High soy food consumption has been linked with lower risk of breast and prostate cancer and is believed to improve bone mineral content [33, 1, 43, 6].

Another area which has received considerable attention in the recent times is that of the prebiotics and polyunsaturated fatty acids (PUFAs) [38]. Prebiotics are non-digestible food ingredients, which beneficially affect the host by stimulating growth, activity or both of specific intestinal bacteria [57]. The possible beneficial effects of prebiotics include the control intestinal transit of time and bowel habits, and reduction of risk of atherosclerosis, osteoporosis, obesity, type-2 diabetes, cancer, infections and allergies, although their effectiveness in humans is still controversial [57].

PUFA are fatty acids that contain more than one double bond, which are separated from each other by a single methylene group [38]. Diets rich in PUFAs have been shown to positively influence immune function, blood pressure, cholesterol and triglycerides levels, and cardiovascular function in animals and humans [58, 34, 62, 12].

Nutraceutical regulation- The ambiguity

Although the nutraceutical market is expected to reach new heights in the coming years an ambiguity still exists about the regulation of nutraceuticals around the world. A comprehensive account of the history and evolution of regulations related to nutraceuticals can be found in a review by Buchman [59]. The U.S. has been the major market of nutraceuticals since the last few decades. There existed very little regulations related to nutritional supplements until the establishment of Food, Drug and Cosmetic Act of 1938. In 1990, FDA passed the Nutritional Labelling and Education Act (NLEA) which allowed the FDA to carry out rigorous validation about any health claims made by the nutritional supplements [10].

The U.S. Congress in 1994 passed an act named, "The Dietary Supplement Health and Education Act" (DSHEA). Through this act the U.S. Food and Drug Administration (FDA) laid down a new framework for the regulation of dietary supplements. The increasing popularity amongst the people about the dietary supplements and significant health benefits offered by them prompted the U.S. Congress to put forward this act so as to facilitate access of public to these Dietary supplements. DSHEA offered several advantages to the manufacturers of dietary supplements including the provision to give information about possible benefits of the product on labels [73].

However, according to Zeisel and Steven, although DSHEA has fostered a situation that encourages continued market growth, it has not been able to develop an atmosphere conducive to continuous quality improvement through an investment in research, as this act makes it easy for a relatively small enterprise to create and market a product without investing the time and money which may be typically needed to prove the safety and efficacy of the product [73]. Patrick Coppens

et al., in their article, have given thorough information about the regulations on nutraceuticals, dietary supplements and functional foods in the European Union [14]. India is also one of the emerging markets for nutraceuticals with a CAGR (Compounded Annual Growth Rate) of 18 %. Indian parliament in 2006 passed the "Food Safety and Security (FSS) Act" and in 2008, the "Food Safety and Standard Authority of India (FSSAI)" was established. The FSSAI has been conferred upon the task of framing rules and regulations for implementation of FSS Act 2006, which is still in its pre-publication stage. The FSSAI is set to address a number of issues including the packaging and labeling of nutraceuticals, restriction of advertisements and claims made by nutraceutical manufacturers etc. Effective implementation of the FSS Act 2006 will open up new opportunities for nutraceutical manufacturers in India and can help the Indian nutraceutical industry to grow further [26].

Nutraceuticals- The future

The dietary supplements and nutraceutical market is projected to achieve a global market size of about Rs. 90 billion in 2013 at a CAGR of 20.24% [9]. There has been resurgence in the area of nutraceutical development in past few years especially because of the development of highly sophisticated and advanced analytical techniques for the determination and quantification of various nutraceuticals [9]. Many phytochemicals have created a lot of excitement among the researchers as well as consumers in the past few years. Resveratrol and proanthocyanidins, the two polyphenols found in the grapes have been in the forefront of many research studies [5, 44, 68]. Resveratrol (a stilbene) has been found to extend the life of wildtype yeast, by increasing the activity of Sir2 (a yeast gene, member of the sirtuin family, whose absence eliminated the effects of caloric restriction), through elevated levels of NAD [24, 70]. Anthocyanins and berry extracts have been shown to increase the cognitive performance, reduce oxidative ischemic damage to brain and enhance the memory [32, 60]. Isoflavones (especially genistein) have also attracted considerable attention because of their possible beneficial effects in the post-menopausal symptoms like osteoporosis and hot flushes [69, 28].

The genetic revolution brought about by the Human Genome Project and subsequent identification of single nucleotide polymorphisms (SNPs) within populations which has played a major role in predicting individual response to drugs i.e. pharmacogenetics has given birth to a new branch called Nutritional genomics. It includes; "Nutrigenomics", which is the study of interaction of dietary components with the genome and the proteonomic and metabolomic changes taking place as a result of that; and "Nutrigenetics", which mainly deals with understanding the gene-based differences in response to the dietary components and using the data of individual genetic makeup to develop nutraceuticals that are most compatible with health [63].

Nutrigenomics and nutrigenetics can pave the way for a whole new era of the nutraceutical and dietary supplement market worldover (Fig. 2). The future of the nutraceutical industry is bright but it is necessary to safeguard the consumer through proper regulation of these products in order to create a sustainable market for these products.

Conclusion

"If we could give every individual the right amount of nourishment and exercise, not too little and not too much, we would have found the safest way to health"- Hippocrates. This little quotation by Hippocrates long time ago, even today, summarizes the past, present and the future of nutraceuticals. Since ancient times people have been aware of the importance of the "right amount of nutrition" in maintaining a healthy lifestyle. Nutraceuticals and dietary supplements have come a long way from the time of its inception. The quest for the "safest way to health" and the increasing awareness among consumers about the potential benefits of the nutraceuticals, a relatively safer alternative as compared to the synthetic medicines, has led to the growth of this industry worldwide. The future of the nutraceutical industry continues to grow brighter as many surveys have clearly predicted the manifold growth of the nutraceutical market in the years to come. However ambiguity on the regulative requirements, overall safety and efficacy of nutraceuticals still exist. "Not too little and not too much"- is the stand we could follow in the upcoming years as we strive to enforce stringent regulations on the safety and efficacy of these products which would in turn create the environment conducive for the sustainable growth of the nutraceutical industry.

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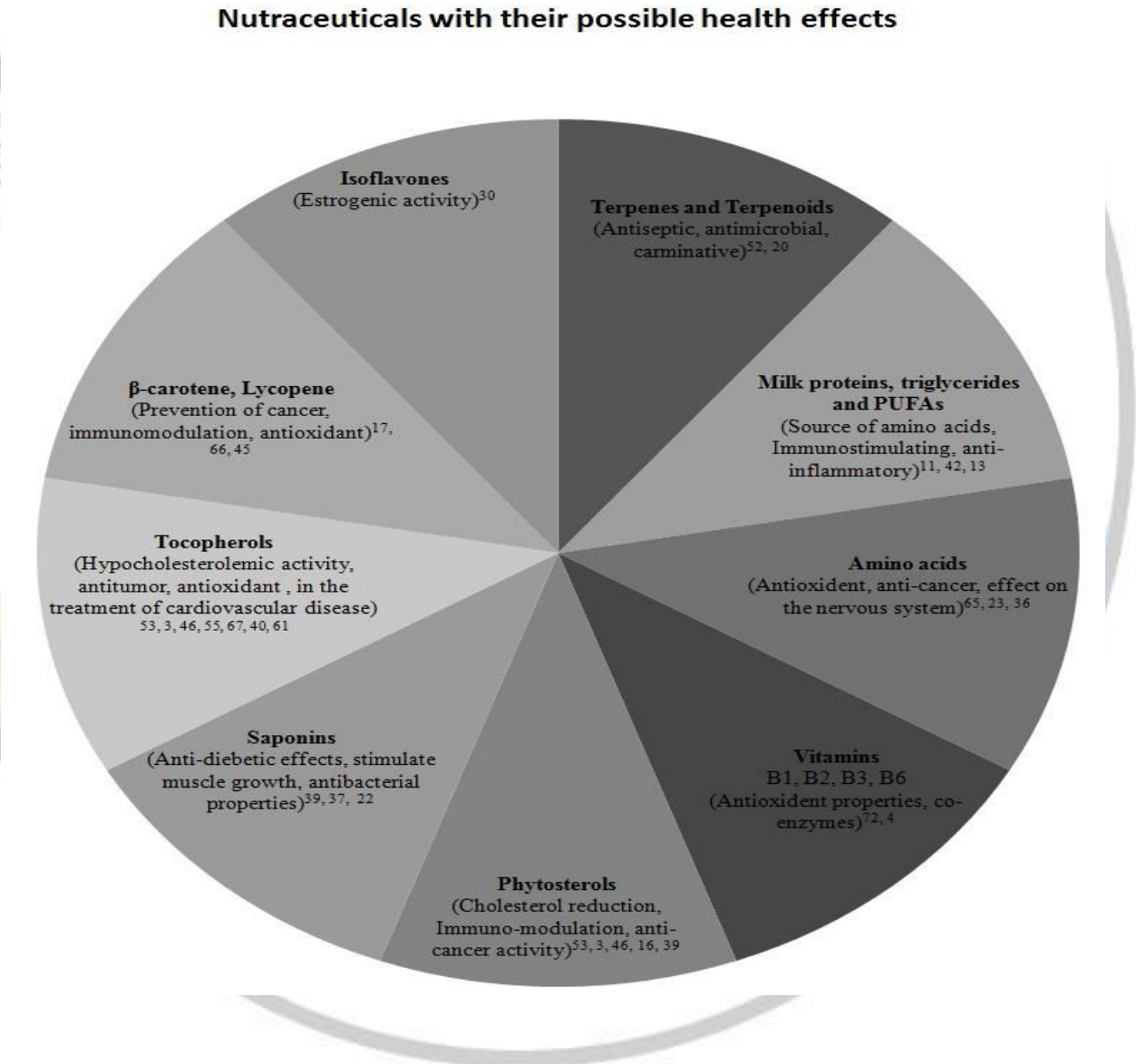

Fig. 1: Nutraceuticals with their possible health effects.

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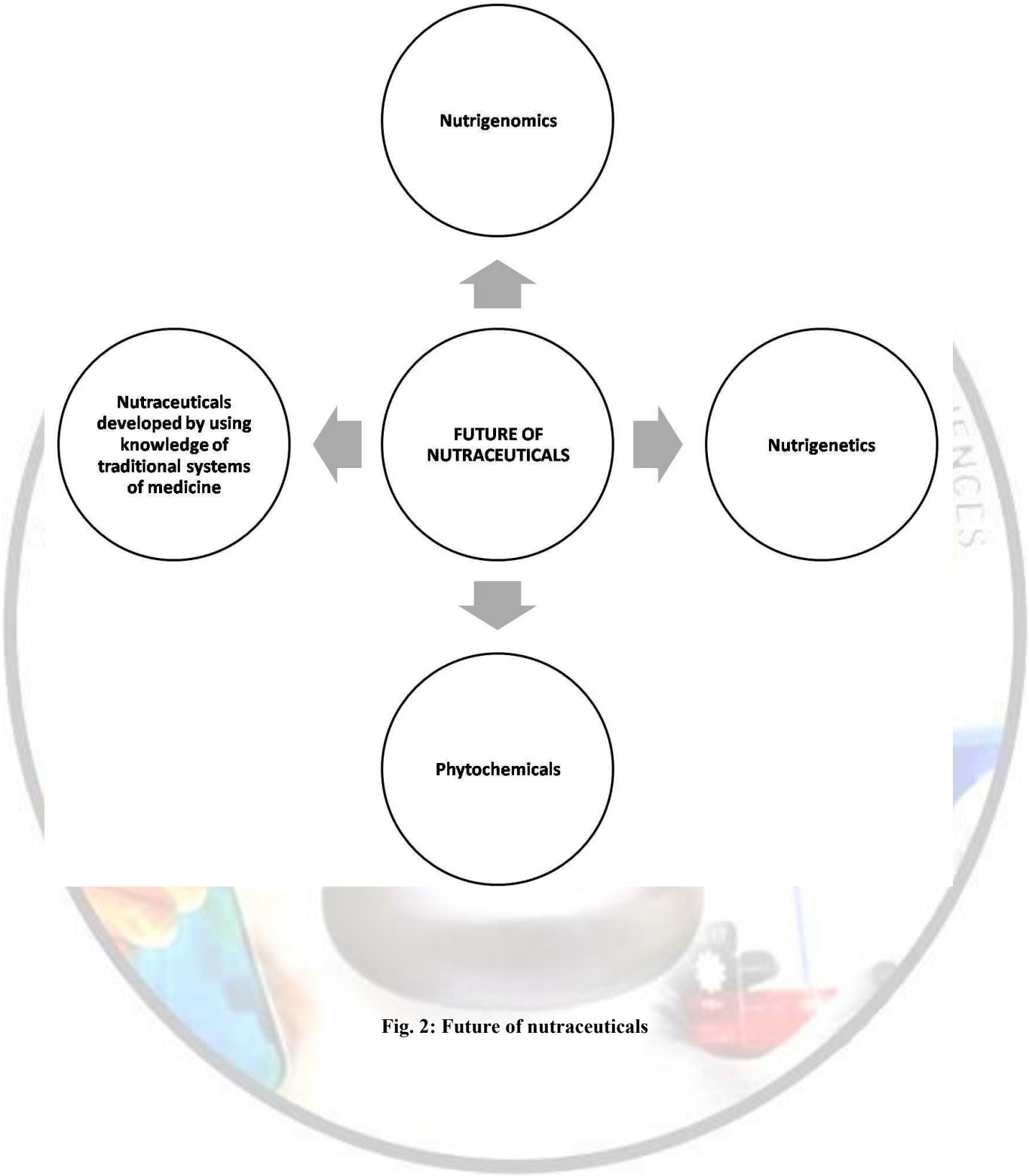

Fig. 2: Future of nutraceuticals