

### Role of Actors and Networks in Nutraceutical Innovation and Regulation in India: An Overview

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*Abstract*— The paper presents a study on nutraceutical involving actors and networks for the product development. Nutraceutical is a food or component of food that is emerged from combination of nutrition and pharmaceutical words. It provides energy and is good for health. It is classified into functional foods, functional beverages and dietary supplements. There are nutraceutical players, agencies and institutions at national and global level. It also discusses the food regulation in developing standard for nutraceutical. The paper is also concerned with the global and Indian scenario in context to nutraceutical.

Keywords—Nutraceutical, Innovation, Actors, Networks, Regulation.

#### I. INTRODUCTION

Nutraceutical is a dynamic and an emerging concept that is originated from two words, "nutrition" and "pharmaceutical". It is a group of food or food products that aid in the prevention of diseases and beneficial for health. According to Stephen De Felice (1989), nutraceutical is, "a food (or a part of food) that provides medical or health benefits, including the prevention and/or treatment of a disease". Such products range from isolated nutrients, dietary supplements and specific diets to genetically engineered designer foods and herbal products [1][2]. The Indians, Egyptians, Chinese language, and Sumerians are only some civilizations which have furnished facts suggesting that ingredients can be efficaciously used as medication to deal with and save you disorder. Ayurveda, the 5,000-12 months-antique historic Indian health technological know-how, have additionally noted advantages of food for therapeutic reason. Documents trace that the medicinal blessings of food have been explored for hundreds of years [3]. According to a study conducted by the National Skill Development Corporation on Human Resource and Skill Requirement in the food processing sector, the requirement of annual human resource in the food processing industry is estimated at about 5.3 lakh people and in the next 10 years this number would reach a stunning figure of 53 lakh [4].



Fig.1. Relationship between Nutrition, Pharmaceuticals and Nutraceuticals [5]

#### **Classification of Nutraceuticals**

The definition of nutraceuticals and related products are classified into Functional Foods, Functional Beverages and Dietary Supplements. Functional food is a category which includes whole foods and fortified, enriched or enhanced dietary components that may reduce the risk of chronic disease. Functional foods are important to improve health, quality of life, or well-being. According to United States under the Dietary Supplement Health and Education Act (DSHEA), 1994, a dietary supplement is defined as a

product which is ingested and which has a "dietary ingredient" intended to supplement the diet.

 Table.1 Classification of dietary supplements with examples
 [6]

[0]	
Vitamins	Vitamin C, vitamin E, B vitamins,
	vitamin A and beta-carotene, niacin,
	folic acid, other single vitamins and
	multi-vitamin formulas
Minerals	Calcium, magnesium, chromium,
	zinc, selenium, potassium, iron,
	silica, manganese, boron, choline,
	iodine, phosphorous, copper etc.
Herbs and	Garlic, aloe, grape seed extract,
botanicals	ginger, cranberry, green tea,
	peppermint, turmeric, rosemary,
	mushrooms, alfalfa, red clover,
	fenugreek, barley etc.
Sports	Creatine, amino acids, protein
_	formulas, fat-burners, ribose etc.
Specialty	Melatonin, dehydroepiandrosterone
	(DHEA), probiotics, fish oil, honey,
	Co-enzyme and other amino acids,
	glucosamine, homeopathic remedies,
	probiotics and prebiotics



Fig.1. Sectoral System of Innovation in the Nutraceutical Industry in India [7] The goal of the research is to analyze the sectoral system of innovation of the nutraceuticals industry. National Pharmaceutical Pricing Authority administers the price control regime. The drug price control order came into existence in 1970 but it was modified in 1995. Central Food Technological Research Institute (CFTRI) has been set by the Government of India to focus on low cost-effective technologies, education, research and training. The institute has started its own R&D and is based in the areas of human resource development and R&D partnerships through linkages with the International institutions. There are different Government research institutes such as NIN, HADSA, and FDTRC involving in generating number of drug technologies for the growth of nutraceuticals. The Indian private firms are involved investing in R&D when TRIPS came into reality. Several companies are active in nutraceuticals research such as Dabur pharma, Parry's nutraceuticals, Abbott India, Himalaya drug etc. with a number of NCEs at different stages of development. Small scale industries don't have all skills or the financial assistance in the entire process of nutraceuticals development.

Table.2 Key Nutraceutical Players at Global Level:

USA based	Amway, AMYRIS, Mead Johnson
	Nutrition, Coca Cola, PEPSICO,
	Kellogg's, Heinz
Europe based	GSK, Danone, Nestle, DSM, BASF,
	Unilever, Bayer
China based	INFITUS, KINGDOMWAY
India based	Parry Nutraceuticals, SANOFI, Bafna

This paper consists of six sections. Section I describes the introduction part. Section II describes role of actors and networks and section III tells about key agencies involved in nutraceutical development. Section IV describes the Indian and global market scenario. Section V discuss about institutions' role in regulation and standard for nutraceuticals. Section VI concludes the research work.

#### II. ROLE OF ACTORS AND NETWORKS IN THE DEVELOPMENT OF NUTRACEUTICALS

There are diverse set of players which are involved in the emergence of nutraceuticals in India. This chapter explores the status overview of nutraceuticals development with regard to key players, government research agencies, infrastructure, and collaboration between the players in India. It maps the different actors having interactions with each other. The chapter represents the expenditure on R&D by various stakeholders.

Firms are key actors in innovation and production. They are characterized by specific learning process, capabilities and

organizational structure, as well as by beliefs, expectations and goals [8][9][10]. It is connected through market and non-market relationships in various ways. Science and technology organizations such as universities research

non-market relationships in various ways. Science and technology organizations, such as universities, research institutes and public research and development organizations constitute an important component of the science and technology system of a nation. Industry is an important arena in which the knowledge is translated into goods and services.

Different stakeholders are involved to gather information about pharma, research academia, consultancy, biotech and other significant professionals related to their geographical market, appropriate nutraceutical strategic fields and challenges they are facing in the nutraceuticals.

#### 1. Government

Department of Biotechnology is the coordinating nodal department for nutraceuticals in India. It covered major areas such as food processing using biotech interventions, nutrition biology, health care products, nutraceuticals, dietary food supplements, and probiotics for holistic health. The various government departments or scientific agencies have linkages with nutraceuticals development such as DBT, CSIR.

#### 2. Academia

Universities and colleges are adopting nutraceuticals in their course curriculum at various degree level including doctoral programmes. CFTRI and NIN has explored more aggressively towards nutraceuticals research.

# 2.1. Central Food Technological Research Institute (CFTRI)

Central Food Technological Research Institute (CFTRI), Mysore Mysore (a constituent lab of Council of Scientific and Industrial Research, New Delhi) appeared amid 1950 with the immense vision of its authors, and a system of researchers. The focal point of the Institute has been towards minimal effort successful advancements, use of indigenous crude materials, bio-accommodating procedures with accentuation on incorporated innovation and abnormal state interest for add up to innovation with supporting of sustenance wellbeing, wellbeing and nourishment to all areas of the populace. The Institute has created its R&D and effect of the globalization has given great profits with a substantial number of remotely financed ventures from national and worldwide offices. The part of CFTRI is situated in the territories of human asset improvement and R&D organizations esteemed through the universal linkages with foundations such as the Institute of Food Technologists (USA), UN University (Tokyo), European Economic Commission (Belgium), National Science Foundation (USA) and many more.

#### 2.2. National Institute of Nutrition (NIN)

NIN established in 1918, one of the main changeless research organizations of the Indian Council of Medical Research (ICMR), a self-ruling body under the Ministry of Health and Family Welfare, Government of India. Organization's exercises are thorough based and it has left the establishment for inquire about on human sustenance in India. There is a nearby blend in its exploration exercises between the research facility, the centre and the group.

#### 3. Research Organizations

Public funded research organizations have been the major stakeholders in developing the knowledge capacity in the country. CSIR, ICAR, DRDO, NIPER is playing a major role in nutraceuticals research.

# 3.1. Council of Scientific and Industrial Research (CSIR)

CSIR established in 1942 is a self-governing body and India's most noteworthy modern Research and Development (R&D) association with an enthusiastic arrangement of 38 national labs, 5 units, 39 outreach focuses and 3 Innovation buildings the country over.

#### 3.2. Defence Research and Development Organization (DRDO)

DRDO works under the Ministry of Defense. It is working in different territories of nutraceuticals which expect to improve the item e.g. Advancement of execution upgrading nutraceuticals from Cordyceps sinensis and Ganoderma lucidum, high therapeutic esteem mushrooms and innovation e.g. Green House Technology for off-season vegetable development.

# **3.3.** National Institute of Pharmaceutical Education and Research (NIPER)

It is the primary national level institute in pharmaceutical sciences. Its principle objective is to end up a focal point of greatness for cutting edge studies and research in pharmaceutical sciences. The Government of India proclaimed NIPER as an 'Establishment of National Importance'. It is an individual from Association of Indian Universities and Association of Commonwealth Universities

#### 4. Industry

Associated Chambers of Commerce and Industry in India (ASSOCHAM) and Federation of Indian Chambers of Commerce and Industry (FICCI) are two major industrial associations involved in the promotion of nutraceuticals in India.

#### III. KEY AGENCIES IN NUTRACEUTICALS DEVELOPMENT

Nutraceuticals are evolving and emerging market initiatives by different key players such as policy agencies and R&D organizations. Department of Science and Technology is the nodal department for organising, coordinating and promoting S&T activities. Several other agencies including National Institute of Nutrition (NIN), Health Foods and Dietary Supplement Association (HADSA), agencies under the Ministry of Family Health and Welfare.

#### 1. Department of Science and Technology (DST)

Department of Science & Technology (DST) was established in May 1971, with the objective of promoting new areas of Science & Technology and to play the role of a nodal department for organising, coordinating and promoting S&T activities in the country. (http://www.dst.gov.in/)

#### 2. National Institute of Nutrition (NIN)

NIN established in 1918, one of the main permanent institute of the Indian Council of Medical Research (ICMR), a self-governing body under the Ministry of Health and Family Welfare, Government of India. Organization's exercises are completely based and it has left the establishment for a look into on human nourishment in India. There is a nearby mix in its examination exercises between the research facility, the centre and the group.

#### 3. Indian Council of Medical Research (ICMR)

The Indian Council of Medical Research (ICMR), New Delhi, the apex body in India for the definition, coordination and advancement of biomedical research, is one of the most seasoned therapeutic research bodies on the planet. The ICMR is subsidized by the Government of India through the Department of Health Research, Ministry of Health and Family Welfare. The Council's examination needs match with the National wellbeing needs, for example, control and administration of transferable illnesses, fruitfulness control, maternal and kid wellbeing, control of dietary issue, creating elective techniques for human services conveyance, regulation inside security points of confinement of ecological and word related medical issues; inquire about on non-transmittable ailments major like growth, cardiovascular ailments, visual impairment, diabetes and other metabolic and haematological issue; emotional wellbeing exploration and medication investigate (counting customary cures)

### 4. Defence Research and Development Organization (DRDO)

It works under Department of Défense Research and Development of Ministry of Défense. It bolsters confidence in Défense Systems and embraces plan and improvement prompting the creation of world-class weapon frameworks and gear as indicated by needs and the subjective necessities set around 8 administrations. It is working in various fields of innovation that incorporate life sciences.

### 5. Health Food and Dietary Supplements Association (HADSA)

The Health Food and Dietary Supplements Association (HADSA), is national non-benefit affiliation works in light of a legitimate concern for nutraceutical industry and shopper. HADSA help to advance instructive and preparing program and centred as a team with other industry affiliations and administrative organizations was to incorporate Nutraceutical/Dietary supplements as Food for Special Dietary Application under Chapter IV of the Food Safety Standard Bill, 2005. Under this new law, a Food Safety and Standard Authority of India (FSSAI) has been constituted will connect which with concerned administrative offices, industry affiliations, organizations and specialists in giving direction and science-based models for the article of sustenance. These controls give rules to assembling, stockpiling, conveyance, deal and imports of items characterized in the new law, in this manner guaranteeing accessibility of safe nourishment article for human utilization.

## 6. Food and Drug Toxicology Research Centre (FDTRC)

The Food and Drug Toxicology Research Centre (FDTRC), set up in the year 1978 to explore foodborne ailment flareups and for toxicological assessment of sustenance and medications. FDTRC, situated at NIN, is a noteworthy national community for inquiring about in parasitic poisons, deposits, pesticide sustenance added substances. pharmacokinetics overwhelming metals, and and supplement sedate cooperation. The Centre is occupied with ecological observing and in addition, bio-checking to contemplate human exposures to cancer-causing agents/poisons in nature and their organic effect. The middle offers certain basic offices like hardware, library and so on., with NIN.

#### 7. National Nutrition Monitoring Bureau (NNMB)

As indicated by WHO nourishment checking is the estimation of the adjustments in the wholesome status of a populace or a particular gathering of people after some time. The NNMB movement is a synergistic exercise between the Indian Council of Medical Research and the separate State

governments. The Bureau put under the managerial control of the State Nutrition Officer so that the NNMB group gets important help and collaboration from the nearby organization staff for execution of field reviews. In the States of Andhra Pradesh, Madhya Pradesh, Orissa and Uttar Pradesh, the NNMB units are however working to the ICMR Institutes/Regional Centres. In every one of the above States, the NNMB group gathers data on dietary admissions and healthful status of the populace in provincial regions on a delegate test, by embracing endorsed standard systems and utilizing the exact hardware. Study system, improvement, pre-testing and conclusion of study instruments are worked out at Central Reference Laboratory (CRL), National Institute of Nutrition, Hyderabad. The examiners of the NNMB units are prepared and institutionalized at NNMB-CRL.



Fig.2. Number of research articles published dealing with nutraceutical from 1989–2009[11]

The rising enthusiasm for this field can be seen in Fig.2 in which the exponential developing of research papers managing nutraceuticals and functional foods over the most recent 20 years has appeared. It is additionally intriguing to specify that in excess of 150 modification works identified with nutraceuticals and useful functional foods have been distributed in a similar timeframe.

#### IV. SCENARIO OF NUTRACEUTICAL MARKET DEVELOPMENT IN INDIA

Among the various markets nutraceutical market is one of the emerging markets in India. The boom in this segment of market leads to the diversification of various industry players into this market. The growth of the nutraceutical market in India is 21 percent annually. Some other factors which lead to the growth of this market are support from the government bodies and increasing demand from the consumers. The country's demand for these compounds will increase 8.0 percent annually to \$1.1 billion in 2013. The Indian market is one of the largest food, beverages and pharmaceutical market in spite of its underdeveloped primary health care system and developing economic status. There are many big firms in this industry in India among which the leading once are Britannia Industries (baked goods and dairy products), Nestle India (milk, nutritionals, functional drinks, prepared dishes and confectionery products), and Tata Tea (conventional and specialty teas). Spurred by trends in the domestic production of end-use products, demand for herbal and non-herbal extracts in India is forecast to advance 7.5 percent annually to \$128 million in 2013 [12].



Fig.3. Indian Nutraceutical Market from 2011-2016 (in millions) [13]

According to fig.3 it indicates that in 2011, Indian Nutraceutical market valued at \$1480 Million and it is categorised into functional foods, functional beverages and dietary supplements which accounts 24% USD 350 Mn, 12% USD 180 Mn and 84% USD 950 Mn respectively. According to the report by Frost and Sullivan in 2009, there is an increased awareness and preventive mind set of the rising ageing population, life style of the people and increased purchasing power are the key demand generators for nutraceuticals in India. An absence of mindfulness alongside the absence of appropriate marketing and circulation, value skimming and low spending on nourishment look into are significant difficulties which upset development of Indian nutraceuticals market. The key difficulties to the market are absence of institutionalization, poor framework, showcasing and dissemination challenges, high evaluating and absence of mindfulness. A few patterns have likewise been recognized in the market and this has been given in the following area. The key patterns incorporate invigorated nourishments, ayurvedic nutraceuticals, outside tie-ups, players instructing shoppers, embodiment. An area on government directions in the business has additionally been incorporated. It examines the Food Safety and Standards Act 2006 that directs the business.



Fig.4. Comparison of Global and Indian Nutraceuticals Market during 2007-2013 [14]

The worldwide Nutraceuticals market has seen huge development in the most recent decade. In the last few years, the Annual Average Growth Rate doubled from 7.3% in 1999 to 14.7% in 2010. US, Europe and Japan are the most created nutraceuticals markets while India, China and Brazil have tremendous potential for development. Estimates predict that the global nutraceuticals market will reach \$250 Billion by 2018. After comparing both Global and Indian nutraceuticals market during 2007-2013, it shows that there is radical growth in market from 2007 to 2013 in foods, beverages and supplements. Globally nutraceuticals market in 2007 i.e. functional foods as 39.9 US\$ billion, functional beverages contribute to 38.4 US\$ billion and dietary supplements as 39 US\$ billion but during 2013 it can be seen that functional foods increased to 56.7 US\$ billion, beverages to 71.3 US\$ billion and supplements became 48.8 US\$ billion. Likewise, Indian nutraceuticals market had been increased to 18.75 billion in 2007: in 2009 it became 44 billion and in 2013 it turn into 95 billion. Therefore, it is clearly seen that there is demand of nutraceuticals market in India.

#### V. ROLE OF INSTITUTIONS IN REGULATING NUTRACEUTICAL STANDARDS IN INDIA

The study shows that nutraceuticals do not yet constitute a legal entity or specific object of regulation in any country. Instead, the term has largely been used and promoted by representatives from the global food industry, for whom the nutraceutical's association with scientific evidence and medicine generates additional economic value. Indeed, nutraceuticals might be defined as food products that have been created solely for the capacity to make health claims about them [15] [16]. As indicated by Ernst and Young report, Indian nutraceutical market in 2008 evaluated the US \$ 1 billion. Out of this functional food, dietary supplement and functional beverages market are assessed 54%, 32% and 14% individually. In any case, in 2013 the worldwide nutraceutical advertise is relied upon to demonstrate the

development rate of 7% CAGR and in India, it is required to indicate 11% CAGR in the dietary supplement showcase. As indicated by FICCI provide details regarding nutraceuticals, it is normal that functional food & beverages and dietary supplement market are relied upon to be of US \$ 57 49 and 71 billion separately in 2013. In any case, in Indian nutraceutical market, the useful sustenance showcase is biggest trailed by dietary supplement market. As indicated by this report the normal increment in the GDP of India up to 1.2% by 2015 identified with the nutrition-related disorder [17].

#### 1. History of food regulations in India

India is the world's second biggest makers of foods grown from the ground, yet just a little measure of perishable farming items is prepared at roughly 2% in contrast with 80% in the United States. Boundaries to development in the food sector segment incorporate poor foundation and coordination and tight food regulation. The assortment of nourishment direction arrangement creators and authorization organizations winning in various parts of the food industry added to impressive disarray among the shoppers, makers and retailers and business and is adverse to the development of the useful nourishment and nutraceutical industry. By the mid-1990s the food processing sector laws were confined in a veritable network of direction including a multitude of state laws as well as the following national laws:

- Export (Quality Control and Inspection) Act 1963
- Solvent Extracted Oil Control Order 1967
- The Insecticide Act 1968
- Meat Food Products Order 1973
- Prevention of Food Adulteration Act (PFA) 1954 rules (Ministry of Health and Family Welfare) with last amendments in 1986
- Bureau of Indian Standards Act 1986
- Environmental Protection Act 1986
- Pollution Control Act 1986
- Milk and Milk Products Order 1992
- The Infant Milk Substitutes Feeding Bottles and Infant Food (Regulation of Production, Supply) Act 1992 and Rules 1993
- Food Product Order 1995
- Agriculture Produce Act
- Essential Commodities Act 1995 (Ministry of Food and Consumers Affairs)
- Industrial license
- Vegetable Oil Product Control order 1998

## 2. The Food Safety and Standard Authority of India (FSSAI)

Food Safety and Security (FSS) Act was passed by the parliament in 2006. In 2008, FSSAI came into existence. It has prepared the draft rules and regulations for implementation of FSS Act 2006 which is going through

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process of pre-publication consultation. The FSSA has 12 chapters with 101 sections and two schedules. The FSSA incorporates the salient provisions of the Prevention of Food Adulteration Act 1954, and is based on international legislations, instrumentalities, and the Codex Alimentarius Commission.

#### VI. CONCLUSION

Nutraceutical is a new and evolving sector in which India contributes around 1% of the global economy. There is a need of intense effort would be required on the part of research organizations and industry to involve technologies. Private sector is exploring the opportunities in nutraceuticals especially in health sector addressing diseases such as CVD, anaemia, osteoarthritis, eye health, mental health, immune symptoms, weight management etc. DBT, ICMR, DRDO, CSIR, MoHFW play a major role in undertaking leading programs, major investments, enhancing laboratory facilities, developing human resources and building international collaboration. Nutraceuticals development in India is an emerging industry where intense effort would be required on the part of research organizations and industry to effectively involve with different technologies in food and nutrition sector. FSSAI regulates various firms and set guidelines and standards.

#### REFERENCES

- [1]. De Felice L.S., The nutraceutical revolution: its impact on food industry. Tr Food Sci Tech: Vol. 6 (1995), pp. 59-61.
- [2]. Rishi, R. K., Nutraceutical: borderline between food and drug. Pharma Review, 2006, Available at http://www.kppub.com/articles/herbal-safety-pharmareview-004/nutraceuticals-borderline-between-food-anddrugs.html, retrieved on 12 February, 2016.
- [3]. Gupta, S.K., Yadav, S.K. and Patil, S.M., Nutraceutical–A Bright Scope and Opportunity of Indian Healthcare Market. Intern J Res Develop Pharm Life Sci. 2(4): 478-481, 2013.
- [4]. Bhinde, J., Great scope for nutra industry with friendly initiatives, 2015, available at http://www.nuffoodsspectrum.in/inner\_view\_single\_details\_print.
- [5]. Dharti, S. T., Gandhi, S. and Shah, M., Nutraceuticalsportmanteau of science and nature, International Journal of Pharmaceutical Sciences. Review and Research, Vol. 5, Issue 3, pp. 33-38, 2010.
- [6]. Tallon, M. J., 2011. The dietary supplements regulatory and market outlook: growth opportunities in Europe and the US and market forecasts to 2015. Business Insights, BI00044-001.
- [7]. Mani, S., The Sectoral System of Innovation of Indian Pharmaceutical Industry, in Centre for Development Studies, Working Paper No. 382, 2006, available at http://www.cds.edu/download\_files/wp%5B1%5D382.pdf, retrieved on 22 June, 2012.
- [8]. Dosi, G., Nelson, R. R., Winter, S.G., 2000. The nature and dynamics of organizational

capabilities, Oxford University Press, New York.

- [9]. Nelson, R. R. and Winter, S.G., An Evolutionary Theory of Economic Change, Belknap Press, Cambridge, 1982.
- [10]. Teece, D., Pisano, G., "The dynamic capabilities of firms: an introduction", Industrial and Corporate Change, Vol. 3(3), pp. 537-556, 1994.
- [11]. Bernal, J, Mendiola, J.A., Ibáñez, E., Cifuentes, A, Advanced analysis of nutraceuticals *Journal of Pharmaceutical and Biomedical Analysis*. Volume 55, Issue 4, 25 June 2011, Pages 758-774, 2010, https://doi.org/10.1016/j.jpba.2010.11.033
- [12]. Freedonia.com, World of Nutraceutical Ingredients: Industry Study with Forecasts for 2013 & 2018, retrieved on 20 November, 2012.
- [13]. www.mmactiv.in/pdf/Nutra\_2014\_Overview
- [14]. http://blog.premarkhs.com/global-nutraceutical-market-projectedto-reach-250-billion-by-2018/.
- [15]. Katan M., Roos N., Promises and problems of functional foods Critical Reviews in Food Science and Nutrition ,369–377, 2004, 10.1080/10408690490509609.
- [16]. Schneider, T., 2005. Functional Foods: Are they sociologically interesting? Conference paper presented at the TASA conference, University of Tasmania.
- [17]. FICCI & Ernst Young Report, Nutraceuticals critical supplement for building healthy India. Page no. 5, 29, 25 and 30, 2008.

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