Introduction
The nutraceutical revolution – Revisited

"Nutraceuticals are food or parts of food, that provide medical or health benefits, including the prevention and treatment of disease".

*Nutraceutical Categories includes;* Dietary supplements including botanicals: vitamins, minerals, co-enzyme Q, carnitine, gingsing, gingko biloba, saint john’s wort, saw palmetto. Functional foods: oats, bran, psyllium and lignin’s for heart disease and colon cancer prebiotics- oligofructose for control of intestinal flora omega-3 milk in prevention of heart disease canola oil with lowered triglycerides for cholesterol reduction stanols (benecol) in reduction of cholesterol adsorption and Medicinal Foods: transgenic cows and lactoferrin for immune enhancement. Transgenic plants for oral vaccination against infectious diseases. Health bars with added medications
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The nutraceutical revolution is in full swing and will dramatically change the nature of the food industry by the year 2015. It will lead us into a new era of medicine and health, in which a food industry will become research-orientated similar to pharmaceutical industry.

The revolution began in the early 1980s, when the actual or potential clinical benefits of calcium, fiber and fish oil were supported by clinical studies published in distinguished medical journals, and when physicians began to educate their colleagues and consumers about these substances via the mass media. A continuous stream of published clinical studies followed, defining the potential benefits of a growing range of products on a rapidly expanding array of specific disease processes. Examples include the use of β-carotene to prevent certain types of lung cancer, niacin to prevent recurrent heart attacks, pyridoxine to treat and prevent depression, vitamin A to treat measles, magnesium to treat hypertension, garlic to reduce atherosclerosis, fish oil for hypertension, cranberry juice to prevent urinary tract infections, antioxidants to reduce damage from heart attack and countless others.

For the first time physicians - convinced by the published clinical data-joined consumers in their broad belief that foods or parts of food have medical value. This marked the entry of nutraceuticals into the mainstream of clinical practice, giving rise to an increasingly urgent need to rationalize the scientific and medical development of these

Apple
(Malus pumila)

Since at least 6500 B.C., humans have eaten apples. Ancient Egyptians, Romans and Greeks loved apples and developed dozens of new varieties. Now there are more than 6000 kinds of apples grown around the world and many cultures have created a rich lore around this fabulous fruit — think of Eve, Johnny Appleseed and Halloween. And we've all heard, "An apple a day keeps the doctor away," but have you ever wondered why? Not only are they a source of dietary fiber, apples contain pectin that may help maintain healthy cholesterol levels.
products, their commercial availability and the communication of information about them to the primary dual audience of physicians and consumers. Nutritionists, armed with more clinical as well as preclinical data, will play a more critical role in bringing about an effective physician-consumer interface.

The promise of nutraceuticals should be considered in two ways - potential nutraceuticals and established nutraceuticals. A potential nutraceutical is one that holds a promise of a particular health or medical benefit; such a potential nutraceutical only becomes an established one after there are sufficient clinical data to demonstrate such a benefit. Thus, folic acid was a potential nutraceutical until sufficient clinical evidence for its role in the prevention of neural tube defects was generated to make it an established one, whereas ginseng tea remains a potential nutraceutical because of a lack of sufficient clinical evidence for any indications [1].

The food industry is presently comfortable with basic research but almost totally ignorant of the clinical research process. The basic ingredients of any innovative or discovery processes are: first, having an idea and second, testing it. The innovative process in assessing a nutraceutical, however, is considerably more difficult. It involves the identification of the nutraceutical substance (the idea), and its clinical evaluation (testing it). In order to join the nutraceutical revolution, the food industry must take a giant step into an unknown area – the clinical evaluation of its products for medical and health benefits and look for plant kingdom as a great treasure.
I.1. Treasure hunt in plant kingdom

Plants have long been a source of therapeutic agents used by man. Some 80% of the world's populations still rely upon plants for primary health care; even today in Western medicine, and despite progress in synthetic chemistry, some 25% of prescription medicines are still derived either directly or indirectly from plants. The use of plants in medicines ranges from crude preparations or extracts, to refined extracts and single molecular species. In terms of categories of use this encompasses food supplements, herbal medicines, botanical drugs and prescription medicines. Increased interest in plants as a source of novel pharmacophores recognizes their chemical diversity and versatility, not matched by synthetic chemistry libraries. In spite of the surge of activity in synthetic chemistry over the last 30 years or so, almost half the some 850 small molecules introduced as drugs were derived from plant sources.

Over 100 small molecules derived either directly or indirectly from plants are currently at some point in the clinical trials process. It is argued that the present use of plant derived drugs and remedies only scratches the surface of what is a major reservoir of untapped potential, the level of biological and chemical diversity possessed by plants having much to offer in the drive for novel therapeutic agents in the fight against disease.

Blackberry (fruit and leaves) (Rubus fruticosus)

Juicy, delicious blackberries have been eaten by people (and bears!) for thousands of years. In addition to just plain tasting good, blackberries have long been believed to have certain good-for-you qualities (among humans, at least). Ancient Greeks were so certain that blackberries helped their gout, these fruits were actually called "goutberries" in Europe well into the 18th century. The leaves have been used similarly to those of raspberry canes, especially for their astringent properties. During the Middle Ages, blackberry leaves were also applied to soothe the skin. These berries grow wild in Eastern Europe and are welcomed by people AND bears all over the world.
Novel developments in plant biotechnology and molecular biology add further dimensions to the use of plants in the production of therapeutic agents. Society of Chemical Industry for Millennia has utilized the properties of plants not just for food and shelter but also for health and well-being. Herbal extracts and preparations, for a long time the mainstay of the healer and physician's 'tool kit', still comprise the major part of primary health care for some 75-90% of the world's rural population; even in relation to Western medicine, plants still provide the basic raw materials for some 25% of prescription drugs [2-3]. After the ascendancy of synthetic chemistry over natural product drug discovery and development during the latter part of the 20th century there are signs of a reawakening of interest in the sector, with the pharmaceutical industry once again beginning to look at the plant kingdom as a source of chemical scaffolds for drug synthesis, often coupled to highly innovative molecular approaches seen in many of the small biopharmaceutical companies [4]. Coupled to the sometimes stunning advances in molecular biology and genetic engineering, plants are also increasingly seen as potential 'factories' for the production of a wide range of high-value therapeutic agents. It is the purpose of this chapter to try to capture something of the nature of these developments and the possible renaissance of the triangle; plants, medicines and human beings.
1.3. Plants to Phytochemicals

"Phytochemicals" means plant chemicals. Plants have the ability to synthesize mixtures of structurally diverse bioactive compounds with multiple and mutually potential therapeutic effects. The plants have the capacity of manufacturing the secondary products. Phytochemicals with antioxidant properties tend to be brightly colored because they contain chromophores, a series of alternating single-bonded and double-bonded carbons. Isoprene is often the building block of such units. The darkest green vegetables contain the most chlorophyll, and vegetables with the most chlorophyll require the most antioxidants. Green will mask the other colors, when other-colored antioxidant Phytochemicals are present. Hundreds of Phytochemicals are currently being studied. Many are believed to have a major positive impact on human health [5]. Important plant secondary metabolites have been isolated over a period of time from natural sources. The phytochemical may belong to

Cayenne Pepper
(Capsicum annuum)

The chilis from which this delightful pepper is made are native to Central and South America, but most of the pepper now used here comes from India and Africa. People in the southwest U.S. have long eaten dried chili peppers to support digestion and to soothe their throats. Cayenne red pepper contains a compound called "capsaicin" that can support your defense system and reduce sensitivity to pain. The healthful use of cayenne has excited some scientists about as much as red pepper excites your taste buds.
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the following categories: terpenoids, phenolic compounds, alkaloids, glycosides, carbohydrates, lipids, proteins, nucleic acids, etc. Some of the phytochemical from the plants are listed in Table I.1 and structures of some of them are given in Figure I.1. [5].

I.4. Herbs through ages

50000 years ago the body of a Neanderthal man was laid to rest in a cave (the Shanidar Cave) on the border of northern Iraq and Iran. Around the body were placed eight different species of herbs, all of which we now know to possess medicinal properties. Of those eight herbs, seven are still found growing in the same locality today, and one of them, Ephedra, gave us the potent bronchodilator "ephrdrine". Today, this medicine is produced through chemical synthesis.

The discovery of the grave with its herbal treasures has provided one of the earliest indications of the importance of plants to man as a source of therapeutic remedies. Down the millennia the use of a wide variety of plants by humans to satisfy a range of therapeutic needs grew. Recorded history provides reference to the use of medicinal plants from many parts of the world, as far apart as China, Greece, India, Rome and the Middle East. The use of medicinal plants was particularly well developed in China. One of the earliest known Chinese herbalists, Shen Nung, who lived around 2800 BC, described some 350 medicinal or herbal plants.

Contemporary herbalists suggest cinnamon for supporting healthy circulation and digestion. Isn't it nice to know you can calm your stomach and warm your heart with an herb you're sure to keep on your spice shelf?
Table I.1: List of some of the Phytochemicals with the name of the plants

<table>
<thead>
<tr>
<th>Class</th>
<th>Compound</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkaloid</td>
<td>Piperine</td>
<td><em>Piper nigrum</em></td>
</tr>
<tr>
<td>Alkaloid</td>
<td>Cocaine</td>
<td><em>Elythroxylum coca</em></td>
</tr>
<tr>
<td>Alkaloid</td>
<td>Colchicines</td>
<td><em>Gloriosa superba</em></td>
</tr>
<tr>
<td>Alkaloid</td>
<td>Berberine, hydrastine</td>
<td><em>Hydrastis canadensis</em></td>
</tr>
<tr>
<td>Complex mixture</td>
<td>Latex</td>
<td><em>Aloe vera</em></td>
</tr>
<tr>
<td>Flavonoid</td>
<td>Catechin</td>
<td><em>Camellia sinensis</em></td>
</tr>
<tr>
<td>Monosaccharide</td>
<td>Fructose</td>
<td><em>Vaccinium spp.</em></td>
</tr>
<tr>
<td>Organic acid</td>
<td>b-Resercyclic acid</td>
<td><em>Cannabis sativa</em></td>
</tr>
<tr>
<td>Polyphenol</td>
<td>Tannin</td>
<td><em>Eucalyptus globules</em></td>
</tr>
<tr>
<td>Phenolics</td>
<td>Gallic acid</td>
<td>* Lawsonia inermis*</td>
</tr>
<tr>
<td>Phenolic acid</td>
<td>Lupulone, humulone</td>
<td><em>Humulus lupulus</em></td>
</tr>
<tr>
<td>Sulfoxide</td>
<td>Allicin, ajoene</td>
<td><em>Allium sativum</em></td>
</tr>
<tr>
<td>Terpenoid</td>
<td>Essential oil</td>
<td><em>Aegle marmelos</em></td>
</tr>
<tr>
<td>Terpenoids</td>
<td>Essential oils</td>
<td><em>Ocimum basilicum</em></td>
</tr>
<tr>
<td>Terpenoids</td>
<td>Essential oils</td>
<td><em>Laurus nobilis</em></td>
</tr>
<tr>
<td>Terpenoid</td>
<td>Terebinthone</td>
<td><em>Schinus terebinthifolius</em></td>
</tr>
<tr>
<td>Terpenoid</td>
<td>Essential oil</td>
<td><em>Barosma setulina</em></td>
</tr>
<tr>
<td>Terpenoid</td>
<td>Essential oil</td>
<td><em>Anethum graveolens</em></td>
</tr>
<tr>
<td>Terpenoid</td>
<td>Asiaticoside</td>
<td><em>Celltella asiatica</em></td>
</tr>
<tr>
<td>Terpene</td>
<td>Trichorabdal A</td>
<td><em>Rabdosia trichocarpa</em></td>
</tr>
<tr>
<td>Thioxin</td>
<td>Fabatin</td>
<td><em>Vcia faba</em></td>
</tr>
</tbody>
</table>
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Figure 1.1: Structure of few phytochemicals [5]
Sumerian ideograms from around 2500 BC provide a detailed account of a wide range of herbs used for their medicinal properties, and are noteworthy for mention of the opium poppy, still the source of one of the most powerful analgesics in the pharmaceutical armamentarium today, but at that time called the 'plant of joy', indicating perhaps rather different use! A particularly detailed and extensive record was produced under the direction of Hammurabi, King of Babylonia from 1728 to 1686 B.C. known as the Code of Hammurabi, the records contained many herbal remedies that we recognize today, and are remarkable for their details. That there was an early trade in medicinal plants is to be seen from the descriptions of medicinal plants from Syria in the temples of Karnak in Egypt dating from around 1500 B.C.

Descriptions of the use of medicinal plants in India were often to be found alongside poetry and verse, particularly in the Vedas of 4500 BC. There is evidence of extensive use of medicinal plants by the indigenous peoples of North and South America. Europe also had a foundation of Celtic herbal medicine, largely lost in the mists of time. Throughout the Middle Ages and well into the 19th century within Europe, as in other parts of the world, herbal medicines provided the mainstay of primary health care. Single-entity prescription medicines which dominate Western primary health care today began to appear in the later part of the 18th century. While the 19th century marked a complete transition from complex mixtures and extracts to single-substance prescription medicines.
medicines. Plant extracts and botanically derived drugs continued to provide the mainstay of the general physician's armamentarium well into the 20th century [6].

1.5. A forgotten chapter

The transition from herbal preparations to defined, single chemical entity prescription medicines is well illustrated and marked by the discovery of the cardiac glycoside digitalis from the foxglove, Digitalis purpurea. The use of the foxglove in the British Isles and elsewhere goes back well before recorded history, to Celtic times, perhaps 2000 years ago and possibly derived from earlier Druidical influence. The earliest known detailed written record of use goes back to the Physicians of Myddfai, herbal doctors who lived in South Wales as we know it today and who certainly administered to the Princes of Wales for well over a thousand years. Sometime in the 12th or 13th century these Physicians of Myddfai were persuaded to write down much of their herbal medicine knowledge. These ancient records were translated into English during the 1860s and are available for all to see, from the original Welsh texts to the English translations. In those early records or 'pharmacopoeia' foxglove is described as being used for paralysis or hemiplegia. The 'modern' story is to be picked up from about 1770, when a young Edinburgh-trained physician named William Wittering, then practising in Birmingham, fell in love with and married one of his patients who he was treating for dropsy, a painful circulatory condition. His wife told him of an old woman who lived in the county of Shropshire, close to where the Physicians of Myddfai had

If you liked "jawbreaker" candies as a child, thank coriander and the British. In England, coriander seeds are sugar-coated to make "comfits," a popular confection which became jawbreakers in America. It's no wonder someone dreamt up making candy out of this delicious seed, given its unique flavor of citrus and sage. The leaves, better known as "cilantro," are also popular in salads and other cuisine. Besides simply tasting good, coriander has been used to aid digestion for thousands of years.
been active, and who used herbs to treat the condition. He visited the old herbalist, found that she used an extract of foxglove and gained the recipe from her. Wittering then set about refining the preparation, finding that there were great variations in the content of the active component in the foxglove tissues and that great care was needed to make a standard preparation which was not only efficacious but also possessed a non-lethal dose level, extracts of foxglove being quite toxic to humans if not carefully controlled and administered. (It is often forgotten that plants produce some of the most potent toxins known to man, ranking with those such as snake venoms in potency and speed of action. Following Wittering's work and that of others the active components of foxglove, digitoxin (β-methyl form) and digoxin were isolated and have since been used as the primary treatment for dropsy and a range of heart conditions. Mode of action is exclusively through action on cardiac muscle.

From Wittering's time and the identification of β-methyl digitoxin as the prime active constituent of foxglove, identification of the active component of a number of other medicinal herbs followed, including for example ephedrine from _Ephedra_, the analgesic acetylsalicylic acid (aspirin) from willow, and the potent analgesics morphine and codeine from the opium poppy, _Papaver somniferum_. Advances in synthetic chemistry were to take the process one stage further with the use of chemical synthesis to produce such drugs rather than have them derived from plant material. Such an approach avoided the vagaries of supply and quality and has now
been applied to a number of previously plant-derived drugs [6].

1.6. 20th century scenario

In spite of the advances of synthetic chemistry and its contribution to pharmaceuticals discovery and development during the later part of the 20th century, the use of herbal remedies and plant-derived drugs remains substantial. According to recent trade statistics, it is apparently growing. From a classical study in the 1970s Farnsworth and his colleagues estimated that some 25% of all prescription medicines in the USA were plant derived at some level. Similar figures have also been mentioned anecdotally in relation to use in the European Union [3].

In the beginning of 21st century the WHO estimated that 11% of basic and essential drugs were 'exclusively' of flowering plant origin. This corresponds to 28 major drugs. Other recent estimates suggest that 89-120 drugs are derived from plants for use in Western nations, this in turn would correspond to roughly 5-10% of the total [7].

The market in plant-derived drugs was estimated to be US $20 billion in 2002, with a roughly equal split between prescription medicines and over-the-counter (OTC) preparations An indication of the current levels of growth being achieved for key groups of plant-derived chemical families which contribute the major part of the drugs (please see Table I.1).
The major increase seen in the use of terpenoids is probably largely due to increased use of taxol, a major anti-cancer agent, and its derivatives. Such increases as outlined in Table I.2 are also to be seen in the trade levels in the raw materials for herbal medicines.

<table>
<thead>
<tr>
<th>Chemical family</th>
<th>1997</th>
<th>2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terpenoids</td>
<td>7.6</td>
<td>12.4</td>
</tr>
<tr>
<td>Glycosides</td>
<td>7.3</td>
<td>9.2</td>
</tr>
<tr>
<td>Alkaloids</td>
<td>3.6</td>
<td>4.0</td>
</tr>
</tbody>
</table>

The interest in natural products as a source of novel pharmacologically active pharmacophores was generated during the two decades from 1960 to 1980 [7]. Following that period the balance swung heavily towards synthetic chemistry libraries, which provided many of the major drugs entering prescription use in the later part of the 20th century [4]. A further factor was also the impact of high-throughput screening, together with the then perceived promise of combinatorial chemistry. In spite of massive investment by the pharmaceutical industry in these new technologies, the numbers of new drug leads anticipated are not there to be seen, and indeed there is increasing concern throughout the industry at the lack of druggable leads in company pipelines.

Eleuthero

(Commonly called “Siberian ginseng.” Eleuthero is not technically a species of ginseng, although it does share many of the same qualities. It is best known as an adaptogen, which means that Eleuthero can help keep your body in the natural balance necessary for optimal functioning. Russian athletic coaches have been known to prescribe Eleuthero for their Olympic contenders, probably due to its reputation for aiding stamina and mental alertness. Modern herbalists often recommend Eleuthero to women, in particular)
Against this background there is evidence of a gradually growing renewal of interest in natural products and in particular plant sources. Such renewal of interest is based on four overlapping factors:

- Indications that large pharmaceutical companies are showing interest in natural products as a source of chemical scaffolds and pharmacophore leads as their synthetic pipelines become restricted and the promise of combinatorial chemistry appears less than once anticipated [4].

- Increased consumer interest in herbal preparations fascination with 'traditional' medicine.

- A coming together, to a degree, of Eastern and Western medical traditions, and a recognition on the part of Western pharmaceutical companies. The traditional medicines of China, India, and elsewhere have much to offer to Western medicine through identification of novel therapeutic agents which have been used for millennia.

- Vastly improved technology relating to extraction systems for plant material, chemical characterization, rationalization and standardization of complex plant mixtures, coupled with improved quality, availability and reproducibility/consistency of source material [6].

Eucalyptus
(Eucalyptus globules)

The Australian koala wouldn't consider living without this healthful herb... literally. Eucalyptus leaves are the fuzzy marsupial's sole food source. Native to Australia, eucalyptus trees have also been vital to the survival of the aboriginal people there since earliest times. They chew the roots for their water in the dry outback and drink tea made from the leaves. A director of Melbourne's Botanical Gardens introduced this beneficial herb to Europe in the 1800s, where its oil became popular to support the respiratory system. Eucalyptus can be especially comforting when you have a cold. Remember, a little bit goes a looong way!
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1.7. Resurgence of Ayurveda

Ayurveda, the traditional Indian medicine (TIM) and traditional Chinese medicine (TCM) remain the most ancient yet living traditions. These are the two 'great traditions' with sound philosophical, experiential and experimental basis. Increased side effects, lack of curative treatment for several chronic diseases, high cost of new drugs, microbial resistance and emerging diseases are some reasons for renewed public interest in complementary and alternative medicines.

- It has been postulated that by 2010 at least two-thirds of the United States population will be using one or more of the alternative therapeutic approaches.

- Use of indigenous drugs of natural origin forms a major part of alternative therapies.

- More than 1500 herbals are sold as dietary supplements or ethnic traditional medicines.

- Pharmaceutical companies have renewed their strategies in favor of natural product drug development and discovery.

- In Europe, AnalytiCon Discovery has stressed on drug discovery based on natural product chemistry.

- In the Asia-Pacific region, MerLion Pharmaceuticals in Singapore has comprehensive structures and capabilities necessary for natural product based drug discovery.

Ginger

(Zingiber officinale)

Ginger is a perennial herb originally grown in tropical Asia and now cultivated extensively in the West Indies. The root has an exotic, spicy taste that has been used in many cultures to flavor foods. For at least two (some say up to FIVE!) thousand years, the Chinese have used ginger to soothe stomachs. To aid digestion after big meals, the ancient Greeks ate ginger roots wrapped in bread, which eventually evolved into gingerbread. Ginger is believed to support the circulatory system and digestion, but its most "tried-and-true" use is to soothe the stomach when you're in motion.
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➢ China has successfully promoted its own therapies over the globe with a science-based approach.

➢ Growing popularity of TCM can be evidenced by the rapid increase in number of licensed Chinese medicine providers in the United States.

➢ The Chinese government has pledged to create several export-oriented TCM giants in the coming years.

➢ Continuous efforts in promotion of the indigenous therapies by China have put TCM in a commendable position.

➢ Global acceptance of Ayurveda is gearing up and there has been a steep rise in the demand for medicinal plants from India.

➢ The Pharmaceutical Research and Development Committee report of Ministry of Chemicals, Government of India also underscores the importance of traditional knowledge.

➢ The increasing use of traditional therapies demands more scientifically sound evidence for the principles behind therapies and for effectiveness of medicines.

➢ Recent advancements in the analytical and biological sciences, along with innovations in genomics and proteomics can play an important role in validation of these therapies.
Western scientific community views traditional medicines cautiously and stress the concerns related to research, development and quality [7].

I.8. Nutraceuticals – the only alternative

The resurgence of TIM and TCM and growing awareness of health-care world over has resulted in increased use of nutraceuticals. The use of nutraceuticals, as an attempt to accomplish desirable therapeutic outcomes with reduced side effects, as compared with other therapeutic agents has met with great monetary success. The preference for the discovery and production of nutraceuticals over Pharmaceuticals is well seen in pharmaceutical and biotechnology companies. Some of the pharmaceutical and biotechnology companies, which commit major resources to the discovery of nutraceuticals include Monsanto (St Louis, MO), American Home Products (Madison, NJ), DuPont (Wilmington, DE), Abbott Laboratories (Abbott Park, IL), Warner-Lambert (Morris Plains, NJ), Johnson & Johnson (New Brunswick, NJ), Novartis (Basel, Switzerland), Metabolex (Hay-ward, CA), Genzyme Transgenic, PPL Therapeutics, Interneuron (Lexington, KY), Sami Labs (Bangalore, India).


The global pharmaceutical market was worth US $550 billion in 2004 and is expected to exceed US $900 billion by the year 2008. The herbal industry shares about US $62 billion with good growth potential. The World Bank reports trade in medicinal plants, botanical drug products and raw materials is growing at an annual growth rate between 5
and 15% [8]. Within the European community, botanical medicine represents an important share of the pharmaceutical market [9].

The nutraceutical sector is also growing rapidly. In 2001, US $17.8 billion was spent in the United States on dietary supplements. US $4.2 billion of it for botanical remedies [10]. In India the value of botanicals related trade is about US $10 billion per annum with annual export of US $1.1 billion [11] while, China's annual herbal drug production is worth US 48 billion with export of US $3.6 billion [12]. Presently, the United States is the largest market for Indian botanical products accounting for about 50% of the total exports. Japan, Hong Kong, Korea and Singapore are the major importer of TCM taking 66% share of China's botanical drugs export.

Globally, there have been concerted efforts to monitor quality and regulate the growing business of herbal drugs and traditional medicine. Health authorities and governments of various nations have taken an active interest in providing standardized botanical medications. United States Congress has fuelled rapid growth in the nutraceutical market with passage of the Dietary Supplement Health and Education Act in 1994. US Food and Drug Administration (FDA) has recently published Harmonization guidance Common Technical Document addressing concerns related to quality of medicines that also includes herbs [13]. The national Center for Complementary and Alternative Medicine has been inaugurated as the United States Federal Government's lead agency for scientific research in this arena of medicine. Its mission is to explore complementary

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Hawthorn
(Crataegus spp)

You've surely already heard of hawthorn, although you may not realize it. This small tree is also called a "mayflower," like the pilgrims' ship. And remember the thorny hedge that grew around Sleeping Beauty's castle in the fairy tale? That was a hawthorn hedge. Ancient Greeks and Romans linked hawthorn with marriage and hope, aspects of the "spiritual heart." How interesting that this same herb is helpful to the physical heart, too! Hawthorn flowers, fruits and leaves produce a compound that can support your cardiovascular system. Hawthorn is widely used in German medicine for this purpose. One note, though — unlike Sleeping Beauty's hedge (which sprouted up overnight), hawthorn's benefits are believed to be long-term and sustained, rather than quick-acting.
and alternative healing practices in the context of rigorous science, support sophisticated research, train researchers, disseminate information to the public on the modalities that work and explain the scientific rationale underlying discoveries. The center is committed to explore and fund all such therapies for which there is sufficient preliminary data, compelling public health need and ethical justifications [14,15]. World Health Organization (WHO) is keen regarding traditional medicine that has been active in creating strategies, guidelines and standoff botanical medicines. The global scenario uses vividly both promise and challenges presented by the western medicines. India needs to identify the extent to Ayurvedic therapeutics is safe and effective so that it wid get wide global acceptance

1.1.0. Summary

The vastness of the potential nutraceutical market will be substantially more persuasive for much-needed change than the failed common sense and historical precedence approach. I am fairly sure that once this vastness is adequately understood and believed - in one way or another - nutraceutical research will begin to flourish mightily owing to the energy and creativity of corporate capitalism.

The resurgence of corporate capitalism has made numerous drugs to enter the international market through exploration of ethno pharmacology and traditional medicine. Progress in genomics and proteomics has opened new gateways in therapeutics and drug discovery and development. Better understanding of the human genome has helped in understanding scientific basis of individual variation. Drug
targets have evolved during the last decade, but the industry remains target-rich and lead-poor trapped in the old mindset and strategies. TIM although scientific studies have been done on a large number of Indian botanicals, a considerably smaller number of marketable drugs or phytochemical entities have entered the evidence-based therapeutics. China has successfully promoted its own therapies and drugs like ginseng, ma huang and gingko with scientific evidences acceptable for the global community. Approach of integrative medicine by selective incorporation of elements of TCM alongside the modern methods of diagnosis has achieved a great success in China.

India needs a clear policy for such integration without compromise on the strategies that are science-based. Efforts are needed to establish and validate pharmacoepidemiological evidence regarding safety and practice of Ayurvedic medicines. Pharmacoeconomic studies on TIM and TCM are rare, but can help in understanding cost-effectiveness and cost benefit of traditional medicine. In all such attempts, TCM examples would help India at various levels including policies, quality standards, integration practices, research models and the complementary integration where public health is kept at the central position. Both TIM and TCM are great traditions with strong philosophical basis and could play an important role in new therapies, drug discovery and development processes.

When Sir Edmund Hillary and Tensing Norkay set out to scale Mt. Everest, they made sure to pack enough lemon powder for their journey. These famous mountaineers used it to make lemonade, which they drank for energy. Lemons are a rich source of Vitamin C, believed to support your body's natural defense system. Lemons have also been used by sailors to prevent scurvy since at least 1700, when an English law decreed that every ship leaving port for foreign lands must have a supply of lemon or lime juice on board. That's how sailors first got the name "limeys," in fact. Whether you're climbing mountains or stairs, a bit of lemon might help make the trip to the top a bit more sunny!
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References


Objective of the thesis

- An attempt to shift the university research from functional academics to need-based-academics.

- To give value-addition to the agricultural waste and to attempt to transform waste to wealth.

- To isolate phytochemicals from agro-industrial residues.

- To study the effect of solvent and mixtures of solvents under varied conditions to enhance the yield and purity of the extracted phytochemicals from agricultural residues.

- To study antioxidant activity of the extracts through in vitro models such as free radical scavenging activity using 2,2-diphenyl-1-picrylhydrazyl (DPPH) method, β-carotene-linoleate model system and iron(III) reduction method.

- To study the antimicrobial activity of the extracts by pour's plate method.

- To study the application of extracted phytochemicals for its antioxidant property in refined sunflower oil.

- To develop newer and easy-to-use spectrophotometric methods for the determination of certain commercial nutraceuticals.