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CURRENT SCENARIO OF HERBAL TECHNOLOGY WORLD WIDE: AN OVERVIEW

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ABSTRACT: This article addresses the basic concepts of herbal technology which is used worldwide. 21st century is the century of Biology mechanical and propelled by scientific knowledge and hi-tech expertise. Herbal technology, are going to be the most influential elements that are fundamental for success and welfare for the people of nations. Information on the herbal technology was collected via electronic search (using pub med, scifinder, Google Scholar and web of science) and library search for articles published in peer-reviewed journals. Furthermore, information also was obtained from some local books on ethnopharmacology. Nutraceutical are food or part of the food that grant medical or health benefits together with the prevention or cure of the disease. Cosmeceuticals are the largest accumulation to the health trade and are described as cosmetic products with drug; they are the fastest increased segment in the skin care market. Biopesticides are cost effective, safer, readily available, and ecological and therefore more environment- friendly and will offer substitute to conventional pesticides. Herbal drugs represent a major contribute to all the formally recognized systems of health in India. An upward trend has been experimental in the research on herbals. Export–Import reports reveal that the global trade of herbal technology and plant originated products is around US \$250 billion. In the present article, an attempt has been made to present an overview of the herbal technology in the international market and intends to throw in the knowledge about Herbal drugs, Nutraceuticals, Cosmeceuticals, and Biopesticides which comes under herbal technology.

INTRODUCTION: Herbal technology circumscribes all the advancing technical frontiers (except genes) meant to tap myriads of modes of manipulating plants around us. A large number of technologies have been developed to harvest the bountiful products that the plants manufacture, including natural dyes, biofertilizers, biopesticides and biofuel.

Herbal Technology was the first step in codifying principles and defining scientific methods of this new concept of profitably managing the plants around us¹. For over twenty years Herb Technology has been on the cutting edge of herbal therapy development.

Our team of Ayurvedic, Chinese and Western doctors has perfected the ancient art of herbal formulation. Incorporating modern scientific discoveries with traditional knowledge, Herb Technology professional formulas have set the standard for the clinical practice of herbal therapy². The herbal industry offers a unique and strategic investment opportunity that resulted in its rapid growth worldwide.

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Thus, Institute of Bioproduct Development is offering Master of Science (Herbal Technology) programme, a taught course modular-based master level programme. This programme, that tackles the technological part of the development of herbal based products, is expected to meet the needs of skilled manpower in herbal industry. Being the only programme of its kind in the world, this programme is anticipated to contribute significantly to the development of relevant human capital that will spur the growth of herbal industry in Malaysia, and the world³.

All technologies for the manufacture of value added plant products can be called as herbal technology are: Nutraceuticals, Cosmeceuticals, Biopesticides, Herbal drugs.

2. Nutraceuticals: About 2000 years ago, Hippocrates correctly emphasized "Let food be your medicine and medicine be your food". Currently there is an increased global interest due to the recognition that "nutraceuticals" play a major role in health enhancement. The term "Nutraceutical" was coined by combining the terms "Nutrition" and "Pharmaceutical" in 1989 by Dr Stephen DeFelice, Chairman of the Foundation for Innovation in Medicine⁴. "Nutraceutical" is a

marketing term developed for nutritional supplement that is sold with the intent to treat or prevent disease and thus has no regulatory definition⁵.

Hence a "nutraceutical" is any substance that may be considered a food or part of a food and provides medical or health benefits, encompassing, prevention and treatment of diseases^[6].

Nutraceutical can be broadly classified into the following 2 groups:

1. Potential nutraceuticals.
2. Established nutraceuticals.

A potential nutraceutical could become an established one only after efficient clinical data of its health and medical benefits are obtained^[7].

As mentioned earlier functional foods contain larger profit margins than conventional foods (30 to 500 percent higher). The global market size is estimated between 30 and 60 billion US\$, with Japan, US, and Europe occupying the biggest share. By 2010, the nutraceutical demand is forecast to touch \$197 billion⁸.

TABLE 1: COMMON HERBALS AS NUTRACEUTICALS:

Herbal drugs	Biological name/ Family	Chemical constituents	Uses
Garlic	<i>Allium sativum</i> / Liliaceae	It contains S-allylcysteine, S-allyl mercaptocysteine, saponins, Nalpha-fructosyl arginin etc ⁹ .	It has a characteristic pungent, spicy flavor that mellows and sweetens considerably with cooking ^[10] .
Ginger	<i>Zingiber officinale</i> / Zingiberaceae	It contains zingerone, shogaols gingerols, β -sesquiphellandrene, bisabolene, farnesene, β -phellandrene, cineol, citral etc ¹¹ .	It used as spice, in recipes such as gingerbread, cookies, crackers, cakes, ginger ale, ginger beer, ginger tea ¹² .
Turmeric	<i>Curcuma longa</i> / Zingiberaceae	It contains curcumin, demethoxycurcumin, bisdemethoxycurcumin, turmerone, turmerone, Curcuminoids etc ¹³ .	It is used to color, and enhance the flavors of certain dishes, dairy products, orange juice, biscuits, popcorn color, sweets, cake etc ¹⁴ .
Aloes	<i>Aloe vera</i> / Liliaceae.	It contain Aloe-emodin, aloetic-acid, anthranol, barbaloin, isobarbaloin, emodin, Arachidonic acid, campesterol, etc ¹⁵ .	It has been used as a food products, for the production of gel-containing health drinks and beverages ¹⁶ .
Onion	<i>Allium cepa</i> / Liliaceae	It contains thioallyl compound, alliins, quercetin, disulfides, trisulfides, cepaene, and vinyl dithiins ¹⁷ .	It is used as an ingredient in various hearty warm dishes, or onion chutney, they can be baked, boiled, eaten raw in salads ^[18] .
Liquorice	<i>Glycyrrhiza glabra</i> / Leguminosae	It contain Glycyrrhizin, starch, glucose, asparagines, fat, resins, mannitol, gum	It is used worldwide as a natural sweetener, as well as a flavoring

		protein, volatile oils, bitter principles etc ¹⁹ .	additive in various cases ²⁰ . It is used to treat backache, hoarseness, mental illness, epilepsy, memory, anxiety, and attention deficit-hyperactivity disorder ²² .
Brahmi	<i>Bacopa monnieri</i> / Scrophulariaceae	It contain Bacoside A, Bacoside, Betulinic acid, D-Mannitol, Stigmastanol, b-Sitosterol, Stigmasterol ²¹ .	
Bael	<i>Aegle marmelos</i> / Rutaceae	It contains Aegelin, lupeol, cineol, citral, eugenol, psoralen, marmin etc ²³ .	It is used as the juice is strained and to make a drink similar to lemonade, sharbat, <i>Bela pana</i> a refreshing drink ²⁴ .
Ginseng	<i>Panax ginseng</i> / Araliaceae.	It contain ginsenosides, polysaccharides, polyacetylenes, peptides, amino acids, prosapgenin, and ginsenoside ²⁵ .	It is used as energy drinks or tisanes, hair tonics and cosmetic preparations, as well ²⁶ .
Gingko	<i>Ginkgo biloba</i> / Ginkgoaceae	It contain myricetin, quercetin, terpenoids, ginkgolides, bilobalides, biflavones, alkylphenols, 6-hydroxykynurenic acid, and polyphenols ²⁷ .	It is used in congee, and is often served at special occasions such as weddings, cooked seeds are often eaten along with other dishes ²⁸ .
Asafoetida	<i>Ferula asafoetida</i> / Umbelliferae	It contains resin, endogeneous gum, volatile oil, ash, asaresinotannols 'A' and 'B', ferulic acid, umbelliferone ²⁹ .	It is used as a digestive aid, in food as a condiment, and in pickles. It is used in Indian cuisine, in lentil curries, such as dal etc ³⁰ .
Goldenseal	<i>Hydrastis Canadensis</i> / Ranunculaceae	It contains hydrastine, berberine, berberastine, hydrastinine, canadine, tetrahydroberberastine, and canalidine ³¹ .	It is used as a multi-purpose remedy, digestion aid, and may remove canker sores when gargled ³² .
Valeriana	<i>Valeriana officinalis</i> / Valerianaceae	It contains valerenic acid, beta-sitosterol, ursolic acid, caryophyllene acid, valerane, naphthalene, linoleic acid, myrtenyl acetate ³³ .	It is used to distill into oils and ointments, or dried and used in teas or capsules, in the home medicine cabinet ³⁴ .
St. john's wort	<i>Hypericum perforatum</i> / Hypericaceae	It contains epigallocatechin, rutin, hyperoside, isoquercetin, quercitrin, quercetin, amentoflavone, astilbin ^[35] .	It is used in premenstrual syndrome, placebo, placebo-controlled trial, remedy for wounds, and muscle pain ³⁶ . It is used to treat snake bites, swelling of the lymph glands, toothaches, sore throats, diphtheria, and Meningitis ³⁸ .
Echinacea	<i>Echinacea purpurea</i> /Asteraceae	It contains arabinogalactan, xyloglycan, echinacin, inulin, caffeic acids, cichoric acid, echinacoside, cynarin ³⁷ .	

Global demand of nutraceuticals:

1. The nutraceutical industry lies under three main segments which include functional foods, dietary supplements, and herbal/natural products ^[39].
2. Global nutraceutical market is estimated as USD 117 billion (INR 5148 billion) ^[40].
3. In 2007, nutraceuticals sale is projected to reach \$74.7 billion at an AAGR of 9.9%. This assumes a world economic recovery in 2003 and an end to price competition ^[41].
4. According to a recent report, the total market for nutraceuticals in India is growing at 21 percent per annum. It is currently valued at INR 44bn (€621 m), but could be worth more than INR 95bn in four years ^[42].
5. As a concept, "Nutraceuticals" is still in its stage of infancy in India. But it has been growing much faster than global rates at CAGR of 18% for the last 3 years driven by functional food and beverages categories ^[43].
6. The most rapidly growing segments of the industry were dietary supplements (19.5 percent per year) and natural/herbal products (11.6 percent per year) ^[44].

7. Globally the nutraceutical market was estimated to be US\$ 140.1 billion in 2010. Of this USA and Europe formed the largest markets accounting to 36 percent and 25 percent respectively. Exhibit 1 portrays global nutraceutical market ^[45].
8. US: In 2010, the US nutraceutical market stood at US \$ 50.4 Billion and was by far the largest nutraceutical market in the world. The dietary supplements segment was growing at roughly 3.1 percent while the functional food and beverages segment was growing at 5.6 percent ^[46].
9. Europe: The total European industry was valued at US \$ 35 Billion in 2010. Companies in Europe believe that product and ingredient innovation is the way forward for the nutraceutical industry ^[47].
10. India: In 2010, the Indian nutra industry was estimated at US \$ 2 Billion, roughly 1.5 percent of the global nutraceutical industry ⁴⁸.

biologically active ingredients purporting to have medical or drug-like benefits.

Dermatological research suggests that the bioactive ingredients used in Cosmeceuticals have benefits beyond the traditional moisturizer. The "Cosmeceuticals" label applies only to products applied topically, such as creams, lotions and ointments. Products which are similar in perceived benefits but ingested orally are known as nutricosmetics ⁴⁹.

Tracing the origin of cosmetics, the first recorded use of cosmetic is attributed to Egyptians, Circa 4000 BC ⁵⁰.

Some Cosmeceuticals are naturally derived while other are synthetic, but all contain functional ingredient with either therapeutic, disease fighting or healing properties ⁵¹.

However, according to the United States Food and Drug Administration (FDA), the Food, Drug, and Cosmetic Act "does not recognize any such category as "Cosmeceuticals." A product can be a drug, a cosmetic, or a combination of both, but the term "Cosmeceuticals" has no meaning under the law" ⁵².

Cosmeceuticals: Cosmeceuticals are future generation of skin care. Cosmeceuticals refers to the combination of cosmetics and pharmaceuticals. Cosmeceuticals are cosmetic products with

TABLE 2: COMMON HERBALS AS COSMECEUTICALS

Herbal drugs	Biological source/Family	Chemical constituents	Uses
Areca palm	<i>Areca chatechu</i> / Piperaceae	It contains Arecaidine, arecoline, arecatannins, querceti, liquiritigenin, resveratrol, ferulic acid, vanillic acid, beta-sitosterol, cycloartenol ⁵³ .	It is used for treatment of a mental disorder called schizophrenia, an eye disorder called glaucoma; as a mild stimulant, and as a digestive aid ⁵⁴ .
Green tea	<i>Camellia senensis</i> / Theaceae	It contains epicatechin, epigallocatechin, epicatechin gallate, epigallocatechin gallate, kaempferol, quercetin, and myricetin ⁵⁵ .	It is a powerful antioxidant and provides effective protection from the sun. The health benefits come into the body by drinking hot tea or cold ⁵⁶ .
Turmeric	<i>Curcuma longa</i> / Zingiberaceae	It contain oleoresin, curcuminoids, curcumin, sesquiterpenes, demethoxycurcumin, bisdemethoxycurcumin, and α -turmerone ⁵⁷ .	It is used to make the skin fair, soft. In almost all the Indian wedding ceremonies, turmeric is applied to both, the groom and the bride, to make them look good with refreshed glowing skin ⁵⁸ .
Liquorice	<i>Glycyrrhiza glabra</i> / Leguminosae.	It contain Glycyrrhizin, starch, asparagines, fat, resins, mannitol, gum protein, a trace of tannin, bitter principles etc ⁵⁹ .	It is used for skin depigmenting , skin lightening , antiaging, emollient , anti-acne and photoprotection ⁶⁰ .
Saffron	<i>Crocus sativus</i> / Iridaceae	It contain Gentisic, gallic acids, lycopene, picrocrocin, safranal, crocin, zeaxanthin, α - and β -carotenes ⁶¹ .	It is used as a spice, adding its faint, delicate aroma, pleasing flavor, and magnificent yellow color to enhance palatability ⁶² .
Aloe	<i>Aloe vera</i> /Liliaceae	It contains Aloe-emodin, aloetic-acid, anthranol, triglycerides, triterpenoid,	It is used in cosmetic and toiletry industry, production of creams,

		potassium sorbate, aldopentose etc ⁶³ .	lotions, soaps, shampoos, facial cleansers and other products ⁶⁴ .
Rosemary	<i>Rosemarinus officinalis</i> /Lamiaceae	It contains α -pinene, camphor, 1.8-cineole, camphene, β -pinene, limonene, borneol, α -terpineol and cymene ⁶⁵ .	It is used in in shampoos, shaving products, skin care products, bath products, cleansing products, hair conditioners ⁶⁶ .
Ginkgo	<i>Ginkgo biloba</i> / Ginkgoaceae	It contains ginkgolides A, B and C ⁶⁷ .	It is used in lotions, creams and ointments ⁶⁸ .
Amla	<i>Embillica officinale</i> / Phyllanthaceae	It contains gallic acid, elagic acid, phyllemblic acid, emblicol and vitamin 'C', phyllantine ⁶⁹ .	It is used in Pro-oxidation, free cascading antioxidant, promotes skin lightening agent and reduces hyperpigmentation ⁷⁰ .
Lemon	<i>Citrus limonus</i> / Rutaceae	It contain a-pinene, camphene, b-pinene, sabinene, myrcene, a-terpinene, linalool, nerol and neral ^[71] .	It is used in a cream or lotion to clear congested skin. The astringent properties are great for oily skin conditions ⁷² .
Buckweed	<i>Fagopyrum esculentum</i> / Polygonaceae	It contains potassium, phosphorous, calcium, iron, zinc, vitamins B, E and rutin ^[73] .	It is used for high quality edible oil, natural cosmetics, food additive, and health-care food ⁷⁴ .
Centella	<i>Centella asiatica</i> / Apiceae	It contain centellin, asiaticin, centellicin, brahminoside, centelloside, madasiatic acid, centic acid, cenellic acid ^[75] .	It is used in skin care, collagen production, reduce fine lines and wrinkles, sun damage repair, scar care, , anti-oxidant ⁷⁶ .
Psorolia seed	<i>Psorolia corylifolia</i> / Fabaceae	It contain corylinin, isopsoralen, psoralen, sophoracoumestan A, daidzin and uracil ⁷⁷ .	It is used to Improve Skin Tone, Vegetarian Liquid Formula, to use for Dull Skin, and Aging ⁷⁸ .
Chamomile	<i>Matricaria chamomilla</i> /Asteraceae	It contains α -bisabolol, bisabolol oxides, chamazulene, and enyndicycloethers etc ⁷⁹ .	It is used in skin cosmetics to serve as an emollient, and enhance the color of blonde hair ⁸⁰ .
Garlic	<i>Allium sativum</i> / Alliaceae	It contain trisulfide, di-2-propenyl; disulfide, di-2-propenyl; trisulfide, methyl 2di-2-propenyl and diallyl disulfide ⁸¹ .	It is used in cosmetic compositions for topical application for the beauty or the skin care, for the prevention of topical cellulite ⁸² .
Grape Vine	<i>Vitis vinifera</i> / Vitaceae	It contain Resveratrol, viniferin, balanocarpol, B-glucopyranosyl 8-balanocarpol ⁸³ .	It is used as an anti-caries agent, anti-dandruff agent, anti-fungal agent, antioxidant ^[84] .
Carrots	<i>Daucus carota</i> / Apiaceae	It contain Petroselinic, linoleic, palmitic, carotol, daucene, germacrene D, trans-a-bergamotene, selinene, daucol and copaenol ⁸⁵ .	It is used tosmoothes wrinkles, gives skin more intensive color and freshness, protects it from harmful UV rays ⁸⁶ .
Tomato	<i>Lycopercicon esculantum</i> / Solanaceae	It contain germacrene A, guaia-6,9-diene, germacrene B, beta-caryophyllene, alpha-humulene ⁸⁷ .	It is used as neoplastic disorder, metastatic cancer, an angiogenesis-dependent cancer or tumor ⁸⁸ .
Witch Hazel	<i>Haemamalis virginiana</i> / Hamamelidaceae	It contain gallic acid, catechins, gallotannins, hamamelitannins, flavonoid, phenolic acids, saponins, safrole ⁸⁹ .	It is used as anti-aging, treatment of acne, after-shaves and facial care products make use of the astringent properties ⁹⁰ .
Buch-Hum	<i>Crataevea murula</i> / Capparidaceae	It contain lupeol and its acetate, ceryl alcohol, friedelin, cadabicine, diacetate, betulinic acid and diosgenin ⁹¹ .	It is used in kidney and bladder stones (inhibit the formation of stones), fever, vomiting and Contraceptive ⁹² .

Global demand of Cosmaceuticals:

1. According to our research report, "Global Cosmaceuticals Market Analysis", the global Cosmaceuticals market offers huge potential in the Asian countries, such as Japan, China, and India, which are also set to attract major

players in future. Japan has already made a niche mark in the global cosmetics market and its position in the Cosmaceuticals (having quasi drug status) segment is effectively improving. Therefore, in the back of such a strong foothold among the Asian countries, the global Cosmaceuticals market is

- anticipated to grow at a CAGR of over 9% during 2012-2014⁹³.
- 2. In 2011, the market was estimated to reach \$30.5bn and looks likely to augment at a rapid pace in the coming years, growing at a CAGR of around 7.7 per cent during 2012-2016^[94].
- 3. Among the global Cosmaceuticals industry, skin care is the most important segment and is expected to grow significantly in the years to come as increasing number of people entering the middle age of life will create more demand for Cosmaceuticals product⁹⁵.
- 4. US demand for Cosmaceuticals products is expected to increase 5.8% annually through 2015⁹⁶.
- 5. The global Cosmaceuticals market has been forecast to increase at a compound annual growth rate of 4.6% over the next five years, increasing from a valuation of \$30.9 billion in 2011, to hit a market value of \$42.4 billion by 2018⁹⁶.
- 6. Anti-aging and skin nourishing products totalled nearly \$ 17.7 billion in worldwide retail sales in 2008, according to Euromonitor. The firm projects that this segment will go to \$ 22.1 billion in worldwide retail sale in 2013. US based cosmetic firm Avon products leads the antiaging/skin nourishing segment with approximately \$ 1.16 billion in 2008 worldwide retail sales, followed by UD peer Proctor & Gamble, with \$ 1.1 billion for its Olay product line⁵⁰.
- 7. In 2009 the top five countries of origin for import of cosmetics and skin care products into Hong Kong were France (25 percent), Japan (17 percent), China (15 percent, United States of America (15 percent) and the United Kingdom (35 percent)⁵⁰.

- 8. The expected market growth for 2007 to 2012 is established to be 6 percent. Western Europe and Australia which spend a combine \$ 7.7 billion on wrinkle reducing facial creams in 2007, according to Euromonitor Internationals new 2008 cosmetic and toiletries database⁵⁰.
- 9. In the recent years, men have become more conscious about their image than ever before, resulting in sales on male grooming products to increase by 18 percent globally between 2006 and 2011⁹⁷.

Biopesticides: Biopesticides, a contraction of 'biological pesticides', include several types of pest management intervention: through predatory, parasitic, or chemical relationships. The term has been associated historically with biological control - and by implication - the manipulation of living organisms. Regulatory positions can be influenced by public perceptions.

- a) In the EU, biopesticides have been defined as "a form of pesticide based on microorganisms or natural products"⁹⁸.
- b) The US EPA states that they "include naturally occurring substances that control pests (biochemical pesticides), microorganisms that control pests (microbial pesticides), and pesticidal substances produced by plants containing added genetic material (plant-incorporated protectants) or PIPs"⁹⁹.

Biopesticides are typically microbial biological pest control agents that are applied in a manner similar to chemical pesticides. In order to implement these environmentally friendly pest control agents effectively, it can be important to pay attention to the way they are formulated and applied¹⁰⁰.

A major growth area for biopesticides is in the area of seed treatments and soil amendments¹⁰¹.

TABLE 3: COMMON HERBS AS BIOPESTICIDES:

Herbal drug	Biological source/family	Chemical constituents	Uses
Tobacco	<i>Nicotiana rustical</i> Solanaceae	It contains Anabasine, l-nornicotine, l-anabasine, l-nicotine and etc ¹⁰² .	It is effective against aphids, whitefly, bollworms, thrips, green leafhopper, grups ¹⁰³ .

ginger	<i>Zingiber officinale</i> / Zingiberaceae	It contains beta-sitosterol palmitate, isovanillin, p-hydroxybenzaldehyde, adenine, 6-gingerol ¹⁰⁴ .	It is effective against Root knot, burrowing, and lesion ¹⁰⁵ .
Castor oil	<i>Ricinus communis</i> / Euphorbiaceae	It contain palmitic acid, linoleic acid, ricinoleic acid ¹⁰⁶ .	It is effective against acaricidal, insecticidal activities, hematophagous, <i>Hippobosca maculate</i> ¹⁰⁷ .
Neem	<i>Azadirachta indica</i> / Meliaceae.	Melianol, Desfurano-6 α – hydroxyazadiradione, Zeeshanol, Meliacinol, Meliatetraone, Odoratone, Nimocinol ¹⁰⁸ .	It is effective against nematodes, white ants, bird repellent, especially for sparrow ¹⁰⁹ .
Lonchocarpus	<i>Lonchocarpus utilis</i> / Fabaceae.	It contain rotenone and deguelin ¹¹⁰ .	It is effective against Lonchocarpus urucu, commercial insecticide and piscicide (fish poison) ¹¹¹ .
Lonchocarpus root	<i>Lonchocarpus urucu</i> / Fabaceae.	It contains rotenone, deguelin, rotenolone, and tephrosin ¹¹² .	It is effective against as a commercial insecticide and piscicide (fish poison) ¹¹³ .
Derris	<i>Derris elliptical</i> / Fabaceae.	It contains pipercolic acid, tubaic, β -tubaic acids, imino alcohol, deguelin, tubaic and β -tubaic acids ¹¹⁴ .	It is poisonous to fish, larvicidal and insecticide, poisonous to cattle, Ipoh arrow-poison ¹¹⁵ .
Common Mullein	<i>Verbascum Thapsus</i> / Scrophulariaceae	It contains Verbascose, verbascoside, verbasterol, thiamin, ribpflavin ¹¹⁶ .	It is used for hair dye, insecticides and etc ¹¹⁷ .
Turraea	<i>Turraea wakefieldii</i> / meliaceae	It contains Rohitukin, prierurianin and etc ¹¹⁸ .	It is effective against mosquito larvicidal activity, third-instar larvae of Anopheles ¹¹⁹ .

Global demand on biopesticides:

1. The global pesticide market was valued at approximately \$40 billion in 2008. This figure increased to nearly \$43 billion in 2009 and is expected to grow at a compound annual growth rate of 3.6% to reach \$51 billion in 2014¹²⁰.
 2. Biopesticides represent a strong growth area in the global pesticide market. This segment is expected to grow at a 15.6% compound annual growth rate from \$1.6 billion in 2009 to \$3.3 billion in 2014¹²⁰.
 3. Synthetic pesticides represent the greatest market share, valued at \$41 billion in 2009. This market will be worth an estimated \$48 billion in 2014, a compound annual growth rate of 3%¹²⁰.
 4. Projections for biopesticides use will be offered for geographical regions including the Americas (i.e., U.S., Canada, Central America [including Mexico], South America); Europe, Middle East, Russia, and Africa (EMRA); and Asia (Japan, China, India, Australia, New Zealand, other Oceanic countries)¹²¹.
 5. The global market for biopesticide was valued at \$1.3 billion in 2011 and is expected to reach \$3.2 billion by 2017, growing at a CAGR of 15.8% from 2012 to 2017¹²².
 6. North America dominated the global biopesticide market, accounting for around 40% of the global biopesticide demand in 2011¹²².
 7. Europe is expected to be the fastest growing market in the near future owing to the stringent regulation for pesticides and increasing demand from organic products¹²².
- Herbal drugs:** Herbal drugs constitute a major share of all the officially recognized systems of health in India viz. Ayurveda, Yoga, Unani, Siddha, Homeopathy and Naturopathy, except Allopathy¹²³. Millions of Indians use herbal drugs regularly, as spices, home-remedies, health foods as well as over-the-counter (OTC) as self-medication or also as drugs prescribed in the non-allopathic systems¹²⁴. In the last few years there has been an exponential growth in the field of herbal drugs and these drugs are gaining popularity both in developing and developed countries because of their natural origin and less side effects¹²⁵.

Herbal drugs are the synthesis of therapeutic experiences of generations of practicing physicians of indigenous systems of medicine for over hundreds of years while nutraceuticals are nutritionally or medicinally enhanced foods with health benefits of recent origin and marketed in developed countries¹²⁶.

In almost all Member States, herbal medicinal products are considered as medicinal products, and are, in principle, subject to the general regulations for medicines as laid down in the various national medicine laws¹²⁷.

TABLE 4: COMMON HERBS AS HERBAL DRUGS:

Herbal drugs	Biological source/ Family	Chemical constituents	Uses
Ginkgo	<i>Ginkgo biloba</i> / Ginkgoaceae	It contains myricetin, quercetin, terpenoids, ginkgolides, bilobalides, and polyphenols ¹²⁸ .	It is used in Alzheimer's disease, Improving thinking problems, Raynaud's syndrome, Glaucoma ¹²⁹ .
Horse chestnut	<i>Aesculus hippocastanum</i> / Hippocastanaceae.	It contains Aescin, prosapogenin. alpha- and beta-aescin, cryptoaescin, hippoesculin ¹³⁰ .	it is used as anti-oedema, antioxidant, anti-inflammatory, cancer, obesity ¹³¹ .
Kava-kava	<i>Piper methysticum</i> / Piperaceae	It contain arylethylene, pyrones, chalcones, yangonin, methysticin, dihydromethysticin, kavain, dihydrokavain ¹³² .	It is used as anxiolytic, psychosis, depression, migraines, chronic fatigue syndrome, tuberculosis and cancer prevention ¹³³ .
St. John's wort	<i>Hypericum perforatum</i> / Hypericaceae	It contains epigallocatechin, rutin, hyperoside, amentoflavone, astilbin, miquelianin ¹³⁴ .	It is used in wounds, abrasions, burns, muscle pain, inflammatory skin diseases ¹³⁵ .
Myrtle	<i>Myrtus communis</i> / Myrtaceae	It contain α -pinene, 1, 8-cineole, myrtenyl acetate, 1, 8-cineole ¹³⁶ .	It is used as anti-cancer, anti-inflammatory, diabetics, Alzheimer disease ¹³⁷ .
Stinging nettle	<i>Urtica dioica</i> / Urticaceae	It contains Histamine, acetylcholine, choline, serotonin, oleanol acid, sterols ¹³⁸ .	It is used as arthritis, benign prostatic hyperplasia, rubefacient, galactagogue ¹³⁹ .
Saw palmetto	<i>Serenoa repens</i> / Arecaceae	It contains caproic, caprylic, linolenic; anthranilic acid, sterols including β -sitosterol, β -sitosterol, campesterol, lupeol ¹⁴⁰ .	It is used in prostate gland, benign prostatic hyperplasia, bladder disorders, hair loss, hormone imbalances, and cancer ¹⁴¹ .
Milk thistle	<i>Silybum marianum</i> / Compositae	It contains silybin (silibinin), silychristin (silichristin), silychristin B, silidianin, neosilyhermin ¹⁴² .	It is used in jaundice, chronic inflammatory liver disease, chronic hepatitis, heartburn complaints ¹⁴³ .
Soya beans	<i>Glycine max</i> / Fabaceae	It contains phytic acid, alpha-linolenic acid, isoflavones, cellulose, hemicellulose, and pectin ¹⁴⁴ .	It is used in sedative, anti-spasmodic, diaphoretic, anti-pyretic properties, fever, and restlessness ¹⁴⁵ .
Mistletoe	<i>Viscum Album</i> / Loranthaceae	It contains quercetin, chalcone, oleanic acid, beta-sitosterol, ursolic acid, lupeol ¹⁴⁶ .	It is used in cancer, lower blood pressure, arthritic pain, Sleep/Insomnia, headache, hepatitis ¹⁴⁷ .
Chamomile	<i>Matricaria chamomilla</i> / Asteraceae	It contains apigenin, apigenin apigenin-7-O-glucoside, apigenin quercetin, rutin luteolin, patuletin, and quercimeritrin ¹⁴⁸ .	It is used in anti-inflammatory, antihyperglycemic, antigenotoxic ¹⁴⁹ .
Comfrey	<i>Symphytum officinale</i> / Boraginaceae	It contains allantoin, caffeic acid, chlorogenic acid, lithospermic acid, and silicic acid ¹⁵⁰ .	It is used in cuts, bruises, pulled muscles and ligaments, fractures, sprains, and osteoarthritis ^[151] .
Eucalyptol	<i>Eucalyptus globulus</i> / Myrtaceae	It contains 1.8-Cineole, Sabinene and alpha-Terpinyol acetate, α -Pinene, alpha-Phellandrene and trans-/beta-osimen ¹⁵² .	It is used in mouthwash, cough suppressant, as well as an inactive ingredient in body powder, insecticide and insect repellent ¹⁵³ .
Black cohosh	<i>Cimicifuga racemosa</i> / Ranunculaceae	It contains 26-deoxyactein, cimigoside, cimifugoside M, cimicracemosides ¹⁵⁴ .	It is used in anxiety, and cough, menopause, premenstrual syndrome, and painful menstruation ¹⁵⁵ .
Bromelain	<i>Ananas comusus</i> / Bromeliaceae	It contains bromelain, ananain, and comosain, glycoproteins, carbohydrates, peroxidases, phosphatases ¹⁵⁶ .	It is used in inflammation, hay fever, swelling, ulcers, pulmonary edema, muscle contractions, preventing cancer ¹⁵⁷ .

Global demand on Herbal Drugs:

1. Total global herbal market is of size 62.0 billion dollars, in this India's contribution is only one billion dollars. European Union is the biggest market with the share 45% of total herbal market. North America accounts for 11%, Japan 16%, ASEAN countries 19% and rest of European Union 4.1%¹⁵⁸.
2. Increasing demand for botanical remedies is both a national, and international, trend. In fact, the global herbal supplement and remedies market is expected to reach \$93 billion by 2015, according to a new report by San Jose, CA-based Global Industry Analysts, Inc¹⁵⁹.
3. **U.S.A:** In the U.S., sales of herbal supplements increased more than 3% in 2010, reaching more than \$5 billion, according to a new report published in *HerbalGram*, ABC's quarterly journal¹⁵⁹.
4. It's no surprise that botanicals addressing age-related health concerns topped the U.S. sales charts in 2010¹⁵⁹.
5. **EUROPE:** As of January 2011, the U.K. Medicines and Healthcare products Regulatory Agency (MHRA) recorded 187 traditional herbal applications, of which 84 have been granted¹⁵⁹.
6. **ASIA :** While Europe may represent one of the largest regional markets, "in terms of growth rate, the Asia-Pacific market, led largely by China and India, is set to pave the way with the highest CAGR (compound annual growth rate) of [nearly 11%] through 2015," according Global Industry Analysts' most recent report¹⁵⁹.
7. India's share in medicinal plant export in global trade is very low about 8.13% as against 28% of China¹⁶⁰.
8. The demand for medicinal plant-based raw materials is growing at the rate of 15 to 25% annually worldwide. Global market size for herbal and medicinal plants is estimated at US\$ 60 billion and is projected to reach US\$

5 trillion by 2050 (source WHO 2003). About 75% to 80% of the total exports of crude drugs come from India¹⁶⁰.

9. The trend growth rate of India from the year 1991 to 2002 shows 4.95% growth of world export value of medicinal plants. Similarly the trend growth rate of China from 1991-2002 is 7.38%¹⁶⁰.

CONCLUSION: Several drugs have entered the international market through study of ethnopharmacology and traditional medicine. Cosmeceuticals are the products that forms interconnect between the drug and cosmetics. Cosmeceuticals are found to be a new rising market not only for males but also for females. Nutraceuticals have established health benefits and their utilization will keep diseases away and allow humans to sustain an overall good health. There is rich biodiversity of medicinal plants worldwide where many species of both medicinal and biopesticides plants are utilized. There is a necessary to educate and sensitize the younger age group on the potential and importance of conserving the local biodiversity, native knowledge and practices.

In India almost all generations use herbal drugs for their health benefits. These herbal drugs and Indian medicinal plants are also rich sources of beneficial compounds including antioxidant, anti-inflammatory, antiseptic and antimicrobial properties and other components that can be used in functional foods.

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