

- (1) The value of the current plant-based pharmaceuticals, and
- (2) The value of potential plant-based pharmaceuticals, which are yet to be introduced.

The values of these drugs are described both in terms of their market value and their economic value.

**Market value** is a subset of economic value, which includes all benefits to society. Market value of the drugs is attributable to the plants raw materials, development and manufacturing costs as well as the incorporation of research cost for the failed efforts and above all the existence of consumer's surplus.

**Economic value** represents all the social benefits of particular type of product including market value. Economic value can be viewed as an expression of the total benefit of a product.

The relationship between the economic value of a medicinal plant species and market price of the drugs derived from it, is not a direct one. However, it is true that the market prices are minimum valuations assuming that:

- The demand for the drug is inelastic, and
- That it is appropriate to value an essential input as its own cost plants.
- The economic rent obtained from it plus the associated consumer's surplus.

For example, the market value of a stand of forest could be measured by translating the wood volume there in into an equivalent quantity of paper and then taking the market value of the paper. In contrast, economic value to society includes not only the value of the paper (or whatever the other commodity is selected), but also what may be referred to as the "in situ" benefit of trees as forest that is the contribution as:

- The forest checks the soil erosion, stabilizing the water table, converting carbon dioxide into oxygen (environmental effects);

- Providing protection to wild life, and;
- Providing recreational opportunities, hence, the economic value is much larger in magnitude but also much more difficult to quantify. For example:

An economic value for medicinal plant species would be examining the current cost to society of a disease whose impact might be diminished in the future by drug derived from plants e.g. in the case of cancer disease which is the major cause of about 5 lakhs deaths per year in United States and cost about US\$ 14 billion annually in treatment, where as the value of each life estimated to be about US\$ 8 million, then the total value will be about US\$ 4 trillion annually. **Anti-cancer** drugs save about 75,000 lives annually in the United States (an estimated 15% of 500000 lives) and plant-based drugs comprises about 40% of total group of anticancer drugs. Combining those estimates approximately 30,000 lives are saved annually in United States as result of the use of plant-based drugs. Multiplying the lives saved by the value per life, the annual **economic value** of plant-based drugs in the United States alone is estimated to be about US\$ 250 billion. Since this estimate reflect only a part of the total economic value of all plant-based pharmaceuticals, moreover these values include none of the non-pharmaceuticals benefits provided by the plants responsible for these drugs, the above mentioned data is on the basis of information by Violette and Chestnut 1986, in EPA-230-06-86016 Feb. 1986 and information available from the economic value of biological diversity among medicinal plants. OECD environment monograph. These values would be tripled to US\$ 750 billion annually to account for anticancer application in all OECD countries (The countries which are members of organisation for economic cooperation and development).

This reflects that medicinal plants and their products have taken an increasing medical and

formulary includes all three species under the name *Plantago* seed. The BP describes seeds of *Plantago afra* and *P. indica* under the name (title) Psyllium and the husk of *P. ovata* seeds are included under the name of Ispaghula husk.

The seeds of *Plantago afra* and *Plantago indica* are known in commerce as Spanish or French psyllium. The seed of *Plantago ovata* are known as blond psyllium, ispaghula.

The seeds are used for laxative purposes due to the mucilage contents present in the epidermis of the testa.

As per the information available on the International trade in medicinal plant, it is reported that during 2001-02, India exported about 20,000 tonnes of psyllium husk and 5000 tonnes of seed, valued in Indian Rupees about 1620.28 million and about 165.20 million, respectively.

### BRAN

**Bran** consists of the coarse outer coat or hull of wheat grain, *Triticum aestivum* Linn. (Gramineae) technically it comprises the pericarp, the integuments and the nucleus of the seed.

Bran contains about 26.7% of dietary fibre. The therapeutic value of bran (crude fibre) is in the treatment of certain gastrointestinal disorders, such as constipation, appendicitis and haemorrhoids and is also recommended as preventive measure for cardiovascular disorders.

**World supply** of the bran is made by USA, Australia, China and India.

### SENNA

The commercial drug consists of dried, green leaves and shells of nearly dried and ripe pods of *Cassia acutifolia* Delile and *Cassia angustifolia* vahl, belonging to Leguminosae.

It is a well known drug in the Unani system of medicine and has been included in I.P., U.S.P.

and B.P. as a purgative. The drug from India is known as **Tinnevely senna** and that from Arabian countries is known as **Alexandrian senna**. Presently it is used both in the Ayurvedic and Allopathic systems of medicine and is also a household medicine.

Senna is an erect shrub, upto 1.8 m in height, highly drought resistant and may be suitable for desert. It is largely cultivated on a marginal land in 10,000 hectare both as rain-fed and irrigated crop, mainly in Tamil Nadu (Tirunelveli, Ramanathapuram, Tiruchchirapalli and Madurai District and to a lesser extent in Salem District). It is also cultivated in Andhra Pradesh, Karnataka and Maharashtra. It is also found occurring wild in Cuddapath District of Andhra Pradesh and Bhuj District of Gujarat. Trials conducted at Jammu, Rajasthan and Delhi have given encouraging results of cultivation.

The leaves, pods and roots contain rhein, chrysophanol, emodin and aloe-emodin. Two active anthraquinones, sennosides A and B (optical isomers) have been isolated from leaves and pods. Besides these sennosides presence of sennosides C, D and G has also been reported.

The chief **centres of trade** in India are Tuticoin, Madurai, Mumbai and Calcutta. **India is the major supplier of the leaves and pods as well as the glycosides to the world market.** Approximately 75% of senna product in India is exported. The most important markets are Germany, Japan, Czechoslovakia, USA, Hong Kong, Spain, Italy, France and United Arab Emirates. In 1987-88, India had exported about 6000 tonnes valued about 35 lakh rupees. Presently, India export is more than 10,000 tonnes of drug @ Rs.50.00 per kg.

### CASCARA BARK

**[Cascara sagrada (sacred bark)]**

**Cascara** is the dried bark of *Rhamnus purshi-*

[*Fagopyrum esculentum* (*Polygonaceae*)]. It is included in dietary supplements and claimed to be benefit in treating conditions characterized by capillary bleeding.

**Sennosides A & B** – This is anthraquinone glycoside obtained from *Cassia senna* and is used to treat habitual constipation.

**Taxol (Paclitaxel)** – This is diterpene ester obtained from *Taxus* species (e.g. *T. brevifolia* and *T. wallichiana*; *Taxaceae*) used as anti-cancer agent.

**Xanthotoxin** – This is furanocoumarin obtained from *Ammi majus* and *Heracleum candicans* – used in leucoderma and other skin problems.

### Indian Medicinal Plants used in Cosmetic and Aromatherapy

Following is the list of few Indian medicinal plants, which are in demand in the domestic as well as international market being useful in herbal cosmetic and in aromatherapy.

- *Aloe vera* (Kumari),
- *Rosa damascena* (Rose),
- *Pelargonium graveolens* (Geranium),
- *Matricaria chamomilla*,
- *Ocimum basilicum* and *O. sanctum*,
- *Lawsonia intermis* (Mehandi),
- *Hibiscus rosa-sinensis* (Japa),
- *Mesua ferrea* (Nag-Keshar),
- *Mentha arvensis* (Mint oil),
- *Mentha piperita* (Peppermint oil),
- *Eucalyptus globulus* (Eucalyptus oil)

### Indian Medicinal Plants in Crude Form

The list of Indian medicinal plants having export potential in the **crude form** as well as their phyto-pharmaceutical products.

- *Aconitum* spp. (Vastanabh),
- *Acorus calamus* (Vacha),
- *Adhatoda vasica* (Vasa),
- *Berberis aristata* (Daruhaldi),
- *Cassia senna* (Senna),
- *Colchicum luteum* (Colchicum),
- *Hedychium spicatum* (Kapur Kachri),
- *Heracleum candicans* (Kaindal),
- *Inula racemosa* (Pushkarmool),
- *Juglans regia* (Akhrot),
- *Juniperus* spp. (Aarar),
- *Plantago ovata* (Isabgol),
- *Picrorhiza kurroa* (Kutki),
- *Podophyllum hexandrum* (Bankakri),
- *Punica granatum* (Anar),
- *Rauwolfia serpentina* (Sarpagandha),
- *Rheum australe* (Revandchini),
- *Swertia chirata* (Chirata),
- *Valeriana wallichii* (Tagar),
- *Zingiber officinale* (Adrak)

### List of medicinal plants which are on the Europe and USA export list.

- *Aloe* spp. (Aloe),
- *Allium sativum* (Garlic),
- *Centella asiatica* (Gotukola, Mandukparni),
- *Cimicifuga racemosa* (Black cohosh),
- *Echinacea* spp. (Echinacea),
- *Eleutherococcus senticosus* (Eleuthero),
- *Ginkgo biloba* (Ginkgo);
- *Hydrastis canadensis* (Goldenseal),
- *Hypericum perforatum* (St. Johnswort),
- *Mentha piperita* (Peppermint),
- *Panax* spp. (Ginseng),

health products, which include, health foods, nutraceuticals and personal care products.

### **Health Food**

Health food are the food products supplemented with herbal ingredients. Vitamins, minerals and nutrients or ingredients isolated from plants. They have physiological benefits and reduce the risk of chronic diseases.

### **Nutraceutical**

**Nutraceutical** is a latest term for health food, first innovated by Stephen Deffice, founder of the Foundation for Innovation in Medicine of New Jersey, USA. The word **nutraceutical** is an amalgamation of the term “**nutrition**” and “**pharmaceutical**” or it can be more correctly defined as parts of a food that have a medical or health benefit including the prevention and treatment of disease. The three main constituents, which make-up nutraceuticals are **herbal and related extracts, vitamins, minerals and nutrients**.

Antioxidant and herbal teas also form an important part of the nutraceuticals market. The leading **antioxidant phytochemicals in demand are Vitamin A, C and E; carotenoids and flavonoids**.

The US demand for nutraceuticals increased from US\$ 830 million in 1987 to US\$ 1.7 billion in 1996 and was expected to reach US\$ 4.5 billion in 2005.

Japan is the third largest producer of nutraceuticals in the world and largest in the Asia pacific region. About half of all patents for nutraceuticals have been developed in Japan.

Nutraceuticals are the most progressing sector for health food and pharmaceutical industry based on plants. Many functional food/nutraceutical companies are part of larger food or pharmaceutical industries. A number of large food and

pharmaceutical companies, such as Abbott Laboratories, Smithkline Beecham, Glaxo, Ledrle, Dabur, Himalayas, Zandu pharmaceuticals, Allen laboratories and Aimil pharmaceuticals are also manufacturing nutraceuticals. Recently Ranbaxy Pharmaceutical Industry has also started its herbal research and development units.

### **Herbal Cosmetics and Personal Care Products**

Cosmetic and personal care products containing natural products have rapidly growing trend in the market. Beginning in the early 1990's, cosmetic manufacturers began to use the term cosmeceuticals to describe the OTC skin care products. Claiming therapeutics benefits, the cosmeceutical products contain phytoconstituents in the extracts form or in the purified form such as  $\alpha$ -hydroxy acids, vitamins, antioxidants and emollient oils rich in vitamin A and E. The items, which are on more demand in cosmetics and coppicing industry are Aloe extracts, botanical extracts, plant acids/enzymes and essential oils.

**Botanical extracts** are canola (*Brassica napus*); chamomile (*Matricaria chamomilla*) dry extract, marigold (*Calendula officinalis*) dry extract, echinacea (*Echinacea* supp.), bilberry (*Vaccinium myrtillus*) dry extract, pumpkin seed (*Cucurbita pepo*) lipophilic extract, ivy (*Rhus toxicodendron*) soft extract, peruvian bark (*Cinchona succirubra*) fluid extract; ginkgo (*Ginkgo biloba*); *Centella asiatica* (leaf extract of *Centella asiatica*); hawthorn (*Crataegus* spp.) and willow herb.

### **PRODUCTION AND UTILIZATION OF MEDICINAL PLANTS IN INDIA**

Herbal industry in India uses over 800 medicinal plants. Most of the plant material used by more than 9000 manufacturing units is produced in the country. India, with its rich and long culture of