INTRODUCTION
1. INTRODUCTION

Plant based medicines are being used by mankind since time immemorial. According to the report of World Health Organization, over 80 per cent of the world population relies on the traditional system of medicine, largely plant based, to meet their primary health care. Ayurveda as a science has witnessed many changes which is acquiring global acceptance. Ayurvedic sciences are expected to play significant role in future healthcare system. The medicinal plants are an important resource for all major systems of medicine/healthcare, nutraceuticals and cosmetics. The medicinal plant based drugs have the added advantage of being simple, effective and offering a broad spectrum of activity with emphasis on the preventive action of drugs. In our country nearly 7500 plant species are being used in the formulation of medicinal plant based-health care products. The increasing acceptance of world wide interest in medicinal plants and the traditional systems of medicine has resulted in a surge in the number of pharmacies throughout the country. Considering the tremendous upsurge of worldwide interest in medicinal plants and their products in the past decade, the World Health Organization (WHO) has recognized the importance of Traditional Systems of Medicine (TSM) and the Folk-lore remedies, which mainly depend on plants in the treatment, cure, prevention and immunity development. India has a long history and most diverse cultural traditions
associated with the use of herbal medicines and have developed a unique system for using it. Ayurveda, Siddha and Unani are the three important traditional systems in practice in India which are being called as Indian Systems of Medicine, in which Ayurveda is the oldest and widely popular and practicing system. The major raw materials used for these systems are plants and their derived products. The major plant parts including roots, stems, barks, heartwoods, leaves, flowers, fruits, seeds and exudates constitute the chief portion of the drugs used in these systems of medicine. Standardization of Ayurvedic medicine has attracted some attention only in recent times. But without establishing the proper standards for raw materials, it would be very difficult to evolve standards for Ayurvedic formulations. The quality and efficacy of these preparations depend largely on the quality of the raw materials used. Increase in the reported incidence of toxicity, indiscriminate use, easy availability of herbal preparations and food supplements make it imperative to lay down standards which could ensure their quality parameters for medicinal plants for the production of quality ensured standardized herbal drugs (Gupta, 2003, Chauhan et al., 2005).

In Ayurveda about five hundred medicinal plants are widely used in the manufacture of various formulations. Besides their increasing demand in Ayurveda, many of the plants are in great demand all over the world for plant derived chemicals, health care products, neutraceuticals, cosmetics, natural coloring and flavouring agents
etc. As a result, there has been a quantum jump in the volumes of plant material extracted and traded within the country and exported. More than 90 % of the medicinal plants are collected from the wild. The extensive destruction of forests, conversion of land to crop based agriculture; over exploitation and unscientific extraction of medicinal plants have led to the extinction of very valuable plants and the shrinkage of habitat of many. The non availability of genuine herbs in required quantities force the collectors and suppliers to adulterate or substitute this with easily available and spurious drugs. This will affect the efficacy of medicine adversely and, ultimately erode the credibility of the system in public minds.

The major threat being faced by the Ayurvedic industry are (i) The state of medicinal plant resource base for Ayurveda and (ii) Standardisation of raw/crude drugs used in the manufacture of medicines. (Sivarajan & Balachandran, 1994)

Lack of standards with regard to the plant sources of various drugs is the major problem faced by the Ayurvedic industry. Usually the plants/ plant parts are procured from professional herb collectors and suppliers. The adulteration/substitution occurs either due to the non availability of genuine drugs in required quantities or due to the ignorance of the correct identity of the genuine drug. For e.g. the annual consumption of ‘Bilva’ (Aegle marmalos) root/bark, a member of the dasamoola group and an ingredient of about 60 Ayurvedic formulations is more than 109.96 tonnes/year and Nimba
bark (*Azadirachta indica*) is 168.34 tonnes/year in Kerala state alone. Most often a similar looking tree *Atlantia monophylla* belonging to the same family is supplied in the place of 'Bilva' and *Melia azadirach* (Malavepu) for Nimba. Instead of the actual asoka bark (*Saraca asoca*) which is a good uterine tonic, the bark of ornamental asoka ie. *Polyalthia longifolia, Shorea robusta, Bauhinia* sps. etc. are supplied by the dealers and used by many manufacturers. The adulterants are widely different from the genuine drug and they lack the medicinal properties attributed to the real drug and this situation leads to deterioration of the quality of medicines. (Sivarajan & Balachandran, 1994; Sarin, 1999; Sasidharan & Muraleedharan, 2009 & Remashree *et al.*, 2004, 2008).

Ayurvedic texts are not helpful in deciphering the identity of genuine herbs, because, in most cases, they give only names and no character details of the plants based on which one could have correctly spotted them out. The use of many synonyms and homonyms has led to a lot of confusion with regard to the choice of herbs in Ayurveda. For eg. the Sanskrit name *abhaya, langali, rajani, neelika, pootana* etc are applicable to more than one plant. The term *Jivanti* is a homonym of several other drugs like *Guduchi, abhaya, meda, kakoli* and *vrikshadani*. As a result, different plants are being used in different places under one name and one plant is used under different names. This has led to a number of ‘controversial drugs’ ie.
drugs of doubtful identity. So the first and the foremost need of the hour is to have a uniform pattern in the selection of herbal sources of drugs (Sivarajan & Balachandran, 1994).

This is an alarming situation to the whole ayurvedic industry. The non-availability of the genuine plants/ parts in sufficient quantities leads to adulteration and substitution with spurious drugs which in turn deteriorate the efficacy of medicine. All these conditions lead to wide variation in quality and therapeutic efficacy of Ayurvedic medicines. Consequently the health care system suffers and the very confidence in the system gets eroded.

Major criteria that can be used for standardization of raw drugs are pharmacognosy and phytochemistry. These are species-specific characters and can be exploited in developing ‘anatomical and chemical finger prints’ of each raw drug. In Ayurvedic formulation, Churna is one of the most commonly used preparations. It may be a single drug or a combination of raw drugs and microscopical evaluation of such chumas is the authentic and easiest method for identifying the genuineness of the material used. (Chauhan et al., 2005, Sukh Dev, 2006, Anarthe et al., 2010).

Pharmacognostic studies on many medicinal plants were carried out in the past at national and international level. The pharmacognostical parameters studied may be used as a tool for the correct identification of the plant and also to test the substitutes/adulterants (Youngken, 1950). Pharmacognosy of
Ayurvedic drugs was carried out by Iyer & Kolammal, (1960). The recent reports are mentioned here. Okuda et al., (2001) published “The applications of scanning electron microscope for pharmacognostic studies and identified long needle crystals in dicotyledons compared to monocots. Park & Whangs, (2001) used microscopic studies to identify 17 kinds of powdered crude drugs in Chinese patent medicine. The Chinese crude drug ‘Yong Dam” is derived from the roots of Gentiana species but there is no pharmacognostic conformity on it. To clarify the botanical origin of Yong Dam from Korea, the anatomical characteristics of Gentiana species growing in wild in Korea, (ie. 5 species) from market samples were examined and the origin of Yong Dam from Korea was proved. Park et al., (2001) studied and identified the 18 powdered crude drugs used in” Hae Chrong Whan’, a Chinese patent cough preparation, using microscopic methods. Park & Kim, (2001) studied Korean folk medicine ‘Koaeng I Bab’ used to cure hemorrhoid. To identify the drug, morphological and anatomical characteristics of the leaves of Oxalis species (4 sps) growing in Korea were studied and proved the botanical origin. Kawamura et al., (2002) studied the anatomy and morphology and found out distinguishing characters for 14 Datura taxa.

Pharmacognostic studies were carried out on many crude drugs and source plants, for getting informations Srivastava, (1995). Research papers on the subject are found scattered in various national and
international journals. Bagchi & Puri, (1985) published a bibliography on survey of anatomical studies on Indian medicinal plants. Mitra, (1985) made an attempt on compiling the bibliography on pharmacognosy of medicinal plants. Srivastava et al., (1995) revised the above review and published a bibliographic survey of anatomical studies of medicinal plants. Dhar, (2002) studied and recommended the factors causing drug adulteration and substitution, and the need for evolving pharmacopoeial standards of controversial drugs. Pharmacognostic and phytochemical studies on roots of *Aegle marmelos* and *Atlantia monophylla* were studied for developing quality standardization parameters (Remashree et al., 2005). Moorthy et al., (2002) carried out the pharmacognostic studies of *Moringa oleifera* with respect to morphology, histology, linear measurements and quantitative microscopy such as stomatal index, vein termination, vein islets and palisade ratio to fix up its pharmacopoeial standards. Remashree et al., (2008) also reported the comparative anatomy of six species of *Sida* for the quality checking of raw drugs available from the market samples. Ushir et al., (2010) reported the comparative Pharmacognostical standardization of genus *Anisomeles* in India.

Pharmacognosy of Indigenous drugs were carried out by Raghunathan & Mitra, (1982). Ismail & Sulthana, (2008) carried out the standardization of *Morinda umbellata* L. Poornima et al., (2009) carried out studies to determine anatomical features of root, rhizome,
stem, leaf and phytochemical analysis for evaluating *Oxystelma esculentum*, an important medicinal plant used in the traditional systems of medicine. This study provides referential pharmacobotanical and phytochemical information for correct identification of this plant. Anarthe *et al.*, (2010) reported pharmacognostic standardization of the fresh, powdered and dried stems of *Dendrophthoe falcata* L. He studied the macro and microscopical characters and also some of its quantitative chemical parameters, which are useful towards establishing standards for identification, purity, quality and classification of the plant, which is gaining relevance in plant drug research. Recent compilations such as Herbal Pharmacopoeia (Sukh Dev, 2006), Quality standards of Indian Drugs (Gupta, 2003), Compendium of Indian Medicinal Plants (Rastogi & Mehrothra, 1969-1994) present the phytochemical aspects for the quality testing. Ayurvedic Pharmacopoeia (Anonymous, 2001) also attempted to give pharmacognostic and Phytochemical keys to Indian medicinal plants. However, all the above attempts have handled the problem only for individual plants and a holistic approach is still required in this area.

Lack of uniformity in the use of the source plants for a given raw drug is increasing day by day. Particularly there is a great north-South divide in this area. Even the ayurvedic pharmacopoeia has recognized the state of confusion that exists, but did not provide any answer or solution. This is an evasion of the problem and till now no
sincere effort has been made to declare identity of plants which would be accepted uniformly all over the country” (Sharma, 2001). In the absence of a genuine drug, a substitute is often used, or even a substitute’s substitute, without knowing the qualities of the substitute. The table (Table 1) illustrates the confusion existing in this area - which drug - which source! This information is collected from the earlier studies carried out in this line by Vaidya, (1982), Sarin, (1999), Sivarajan & Balachandran, (1994). The use of substitutes has become so prevalent in ayurveda. It has gone to such an extent that plants that belong to different genera, family, order or even class are used as substitute sources of a single raw drug. Scientific attempts to study which of these substitutes have comparable properties are meagre. Without this knowledge there is no justification for using them as substitute for a genuine source (Sivarajan & Balachandram, 1994; Dhar, 2002 & Sukh Dev, 2006).

The present objectives were selected in the background of (i) confusion in the identity of raw drugs and their source plants (ii) rampant practice of substitution and adulteration of raw drugs (iii) north and South regional variation in selection of raw drug source plant (iv) absence of comparative studies on anatomical and chemical fingerprinting of raw drugs and their source plants (v) absence of correct quality standardization parameters for the correct and easy identification of genuine herbs.
The above listed problems have not been seriously analyzed so far. Further studies for evolving methods of standardization and establishing quality control parameters for herbal drugs, can be achieved through pharmacognostic and phytochemical investigation using modern techniques. A systematic evaluation of plant material of both authentic and market samples and comparison of all properties for eluting the key characters as a marker tool are needed in this areas.

With this background the quality standardization work was undertaken in 3 important ayurvedic medicinal plants listed under controversial group. The selected herbal drugs are Citraka, Jivanti and Rasna Table 1.

**Table I. Selected raw drugs and their plant sources for the present study**

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Raw drug (Sanskrit Name)</th>
<th>Plant source used/Substitutes</th>
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<tbody>
<tr>
<td>1</td>
<td><strong>Citraka</strong></td>
<td>1. <em>Plumbago indica</em> L. (Plumbaginaceae)&lt;br&gt;2. <em>Plumbago zeylanica</em> L. (Plumbaginaceae)</td>
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<tr>
<td>3</td>
<td><strong>Rasna</strong></td>
<td>1. <em>Alpinia galanga</em> (L.) Sw. (Zingiberaceae)</td>
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</table>
The drugs selected for the present study are Citraka, Jivanti and Rasna. Citraka is a reputed drug in ayurvedic medicines. This drug is an esteemed remedy for leucoderma and other skin diseases according to Ayurveda. The synonyms of fire like agnih, vahnih etc attributed to this drug indicate the burning action of the root, causing blisters on the skin. Roots of Plumbago indica L. and Plumbago zeylanica L. of Plumbaginaceae are used in Ayurveda as source plants of Citraka. Ayurvedic physicians of Kerala recognize two varieties of citraka viz. the white flowered Plumbago zeylanica used in North India and red flowered Plumbago indica, which is the accepted source of citraka in Kerala. (Iyer & Kolammal, 1960; Sivarajan & Balachandran, 1994; Anonymous, 2001; Gupta et al., 2008).

Jivanti, is considered to have the property to bestow health and liveliness to the consumer. Caraka treats it as an important rasayana drug capable of maintaining the youthful vigour and strength. Vagbhata includes it among the ten drugs that constitute
the vitalizing group. The botanical identity of the drug is highly disputed. Kerala physicians identify *Holostemma ada-kodien* as *Jivanti*. The roots of these plants are being used as *Jivanti* in Kerala. Yet others consider an Asclepiadaceae plant, *Leptadenia reticulata* W&A. as the source of this drug. (Kolammal, 1979; Sivarajan & Balachandran, 1994; Anonymous, 2008).

*Rasna* is an important ayurvedic drug. The aromatic rhizome of *rasna* is capable of maintaining the youthful vigour and strength. The officinal part is the rhizome. Studies on the market samples reveal that two types of *rasna* are sold in the South Indian markets—one with light brown colour and highly aromatic as the *Alpinia calcarata*, locally called *peraratta* and the other less aromatic, *Alpinia galanga*, known as *aratta*. These two species are used as the drug sources of *rasna* in Kerala. In greater parts of North-West India, *rasna* is *Pluchea lanceolata*, and the ayurvedic drug dealers supply *P. lanceolata* as *rasna*. (Raghunathan & Mitra, 1982; Sivarajan & Balachandran, 1994; Gupta, 2003).

The present objectives envisage thorough comparative botanical, pharmacognostical and phytochemical studies and compilation of pharmacological data of 3 important raw drugs and their various plant sources. Special emphasis was given for pharmacognostical and chemical finger printing of genuine raw drugs and their source plants using modern analytical techniques like HPTLC, HPLC, GC and GCMS. An attempt has also been made for a thorough market
survey to study the extent of variability in the choice of raw material in Kerala raw drug markets. It is earnestly anticipated that this will give comparative information on the quality standard parameters and pharmacological efficacy of the various source plants of these three raw drugs used by Ayurvedic physicians. *The study will have wide implications such as clearly identifying the most suitable source plant for the three raw drugs and substitutes / adulterants.* We hope that the result from this study will lead to the development of standards of 7 medicinal plants and help to differentiate the genuine drugs and the spurious ones from dried raw drugs. It is also expected that this will benefit the herbal drug industry, academicians, researchers and health professionals.