

## Survey on Medicinal Materials Used in Traditional Systems of Medicine in Sri Lanka: A Case Study

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### ABSTRACT

Demand for herbal products worldwide has increased at an annual rate of 8% and it is estimated that the global herbal market would be worth US\$5 trillion by the year 2050. In the present survey, information on raw materials, source of materials, plant parts used, heavily used/ rare materials, quality of materials, locally cultivable plant species, government involvement, problems faced and potential helpful organizations were investigated. Diverse range of materials including 325 species (65.92%) for dried plant materials, 64 (12.98%) fresh plant materials, 75 (15.21%) types of minerals, 12 (2.44%) animal materials, 7 (1.42%) marine materials and 10 (2.03%) other materials have been listed. All together 340 plant species belonging to 107 families dominated by family Leguminosae were found and out of them 44 heavily used (more than 10,000 kg/year) belonging to 33 families were recorded. The main herbal material source was local origin (71.13%), followed by imported (26%) while 2.87% was obtained either direct importation or from local collection. Leaves were considered as mostly used plant part (47.5%). High price, poor quality, absence of continuous supply and insufficient supply, adulteration, poor processing, high amount of impurities, wetness and microbial content have been identified as main constraints. Decreasing of available medicinal plants, lack of proper cultivation and processing protocols, incorrect identification and lack of proper quality control methodologies were identified as major challenges of the industry. Implementation of proper programmes for identification, cultivation, postharvest techniques, quality control and standardization and research and development programmes were suggested.

**KEYWORDS:** Ayurveda, Medicinal materials, Traditional systems of medicine in Sri Lanka

### INTRODUCTION

According to the World Health Organization, about 80% of the populations in developing countries are still dependent on traditional systems of medicine for their primary health care needs (WHO, 2008). Demand for herbal products worldwide has increased at an annual rate of 8% and it is estimated that the global herbal market would be worth US\$5 trillion by the year 2050 (Chaudhary and Singh, 2011). Sri Lanka has rich traditional systems of medicine (Ayurveda, Siddha, Unani and Deshiya Chikitsa), which play a significant role by fulfilling 60-70% of the rural populations' primary health care needs (Perera, 2012). There are 20,353 registered Ayurveda physicians and more than 8,000 traditional practitioners, who engage with public health care, which herbal products and materials are mostly employed (Anon, 2011).

Sri Lanka is considered as one of the most biologically diverse country in Asia, with about 29.66% of forest cover in 2010 (Anon, 2012). There are 3,771 flowering plant species, out of which about 927 (24%) of them are endemic to the country (Gunatilleke *et al.*, 2008). Sugathadasa *et al.*, (2008) reported that 1,430 species representing 181 families and

838 genera can be considered as medicinal plants. Out of total number of species, 174 (12%) are endemic to Sri Lanka. About 250 species of medicinal plants are commonly used in traditional medicine of which 50 species are heavily used (Pushpakumara *et al.*, 2002).

Ethno pharmacological/ botanical surveys play an important role in documentation of medicinal materials used by different systems of medicine. However, in Sri Lanka, available data on the national demand for herbal materials are scarce or too old. Therefore, identification of current national demand for herbal materials, most required materials, available sources of the materials and the materials which could be commercially cultivated in the country is necessary to formulate the national strategy, in order to resume the sustainability of the medicinal plant industry. Hence, this survey was undertaken to understand the present status of the medicinal plant industry in Sri Lanka.

### METHODOLOGY

This survey was conducted during January to April 2013, through a preparation of a questionnaire. Prior to the study, a pilot survey was conducted. The questionnaires were then distributed among main stakeholders

of the medicinal plant industry such as government hospitals, traditional and ayurvedic practitioners and manufacturers in the respective areas. In some instances, face to face interviews were also carried out.

Data were collected from 9 Provincial Departments of Indigenous Medicine (Western, Southern, North Western, Sabaragamuwa, Uva, Central, North Central, Eastern and Northern), which are representatives of 69 ayurvedic hospitals and 208 central dispensaries. Further, one ayurvedic teaching hospital and 2 ayurvedic research hospitals, which are administered through central government were used for the study. In addition, data were collected from 60 randomly selected ayurvedic drug manufacturers/ practitioners throughout the country. The data from total respondents were tabulated and analyzed.

## RESULTS AND DISCUSSION

Present study examined the current situation of medicinal plant industry in Sri Lanka, by using comprehensive up to date information. The respondents comprised medicinal plant cultivators, collectors, drug and cosmetic manufacturers, sellers, exporters and medical practitioners.

### *Types of Raw Materials*

A diverse range of medicinal materials including plants, minerals and animals have been used in different medical systems practiced in different countries of the world. In the present study, different medicinal materials which are widely used in Sri Lankan traditional and ayurveda systems of medicine were surveyed. Summary of current usage of medicinal materials was presented in Table 1.

It was highlighted that traditional and ayurveda systems of medicine practiced in Sri Lanka expend about Rs. 670 million for the purchasing of approximately 2.8 million kg medicinal materials annually. Further, 71.13% of the medicinal plants/herbal materials were obtained from local sources, 26% was imported while 2.87% was obtained either direct importation or from local collection. The

results are in agreement with IUCN (2001), which reported that 68% obtained from local sources while 32 % were imported in 2000.

Analysis of the tabulated data indicated that plant materials (dry and fresh) contribute around 80 % medicinal materials to the herbal industry which implies, they play an important role in different systems of medicine. This is in evident with previous pharmacological survey conducted by Lev and Amar (2000). However, use of mineral and animal materials in the present day is less, compared to the plant materials. This may be due to its toxicity, complicated purification processes, less number of recipes in medical systems and attitudes towards animals and their uses in medicine (Lev and Amar, 2000).

### *Medicinal Plant Families*

Dry and fresh plant materials comprise 340 plant species, belong to 107 families. Out of them, family Fabaceae (Leguminosae) was predominated in terms of number of species of the commonly used medicinal plants (42 species), followed by Euphorbiaceae (14), Solanaceae (12), Poaceae (10), Rutaceae (9), Zingiberaceae (8), Asteraceae (8), Apiaceae (8) and Lamiaceae (7).

### *Plant Parts Used*

The mostly used plant part was leaves (47.5%) followed by roots (39.8%), seeds (29.7%), bark (27.2%), fruit (20.6%), whole plant (18.6%), flowers (14.2%), heartwood (3.6%) and gums (3%). High usage of leaves may be due to the availability of large quantities, easy access and higher production of secondary metabolites in leaves (Miraldi *et al.*, 2001; Ghorbani, 2005).

### *Available Plant Materials*

Information on the medicinal plants used in Sri Lanka were gathered under several aspects; Most demanded plant materials, Most valued materials, Heavily used materials, Rare materials, Materials mainly from local sources, Major importing materials and Locally cultivable medicinal plant species.

**Table 1. Summary of current usage of medicinal materials**

Type of Material	No. of Materials	Percentage (%)	Total Quantity (10 <sup>3</sup> kg)	Total Value (10 <sup>3</sup> Rs.)
Dry plant materials	325	65.92	1,857.37	509,221.51
Fresh plant materials	64	12.98	840.99	70,761.96
Minerals	75	15.21	26.40	28,292.90
Animal	12	2.44	72.35	49,982.99
Marine	7	1.42	1.30	195.00
Other	10	2.03	58.15	12,308.17
<b>Total</b>	<b>493</b>	<b>100</b>	<b>2,856.56</b>	<b>670,762.53</b>

## Medicinal Materials Used in Traditional Systems of Medicine

**Table 2. Information on some of the available medicinal plants/ plant materials**

Family	Scientific Name	Vernacular Name	Description	Amount (kg/ Year)
Acanthaceae	<i>Hygrophila spinosa</i> T. Anders	Neeramulliya	HLC	15,323.00
	<i>Andrographis paniculata</i> Nees.	Kirata	L	7,583.50
Acoraceae	<i>Acorus calamus</i> L.	Wadha-kaha	HIC	12,173.75
Aloaceae	<i>Aloe vera</i> (L.) Burm. f.	Komarika	HLC	25,600.00
Amaranthaceae	<i>Aerva lanata</i> (L.) Juss. ex Schult.	Polpala	HLC	19,514.00
Apiaceae	<i>Trachyspermum roxburghianum</i> (DC.) Craib.	Asamodagam	DHIC	59,893.00
	<i>Centella asiatica</i> (L.) Urban	Gotukola	DHLC	366,795.00
Apocynaceae	<i>Hemidesmus indicus</i> (L.) R. Br.	Iramusu	HIC	20,384.00
	<i>Rauwolfia serpentina</i> (L.) Benth. ex Kurz	Ekaweriya	LR	3,929.00
Asparagaceae	<i>Asparagus racemosus</i> Willd.	Hatawariya	DHLC	74,039.63
Bignoniaceae	<i>Oroxylum indicum</i> (L.) Vent.	Thotila	HLC	11,419.50
	<i>Stereospermum suaveolens</i> DC.	Palol	HLC	10,286.00
Brassicaceae	<i>Brassica juncea</i> (L.) Czern.	Aba	HLC	20,495.50
Combretaceae	<i>Terminalia chebula</i> Retz.	Aralu	DHLC	123,322.20
	<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Bulu	DHLC	100,218.20
Convolvulaceae	<i>Ipomoea mauritiana</i> Jacq.	Kiribadu	HLRC	10,922.00
Cucurbitaceae	<i>Trichosanthes cucumerina</i> L.	Dummella	L	8,573.20
Euphorbiaceae	<i>Phyllanthus emblica</i> L.	Nelli	DHIC	81,488.19
	<i>Ricinus communis</i> L.	Endaru	HLC	16,167.45
Fabaceae	<i>Indigofera tinctoria</i> L.	Nil-awariya	HLRC	39,448.00
	<i>Sesbania sesban</i> (L.) Merr.	Senehe-kola	HIC	19,751.50
	<i>Cassia auriculata</i> L.	Ranawara	HLC	10,568.50
	<i>Glycyrrhiza glabra</i> L.	Wel mee	HI	10,382.50
	<i>Macrotyloma uniflorum</i> (Lam.) Verdc.	Kollu	I	7,087.00
	<i>Pterocarpus santalinus</i> L. f.	Rath handun	R	3,908.00
Hippocrateaceae	<i>Salacia reticulata</i> Wight	Kotala- himbutu	HLC	13,733.00
Hypoxidaceae	<i>Curculigo orchiooides</i> Gaertn.	Binthal	HIC	14,476.50
Lamiaceae	<i>Vitex negundo</i> L.	Nika	HLC	39,952.26
	<i>Plectranthus zatarhendi</i> (Forssk.) E. A. Bruce	Iriwariya	L	6,480.00
	<i>Plectranthus amboinicus</i> (Lour.) Spreng.	Kapparawalliya	L	4,953.00
	<i>Pogostemon heyneanus</i> Benth.	Kollan kola	LR	6,154.75
	<i>Ocimum tenuiflorum</i> L.	Maduruthala/Thulsi	L	7,382.50
	<i>Woodfordia fruticosa</i> (L.) Kurz	Malitha	HIC	25,524.00
Malvaceae	<i>Hibiscus micranthus</i> L. f.	Bebila	HLC	37,641.00
	<i>Abelmoschus angulosus</i> Wall. ex Wight & Arn.	Kapukinissa	RL	1,258.75
Meliaceae	<i>Azadirachta indica</i> A. Juss.	Kohomba	DHLC	57,181.20
	<i>Munronia pinnata</i> (Wall.) Theob.	Bin kohomba	VL	3,812.50
Menispermaceae	<i>Coscinium fenestratum</i> (Gaertn.) Colebr.	Venivel	HLC	31,379.70
	<i>Tinospora cordifolia</i> (Willd.) Hook. f. & Thoms.	Rasakinda	HLC	26,984.20
Myristicaceae	<i>Myristica fragrans</i> Houtt.	Sadikka	VL	2,599.00
Pedaliaceae	<i>Sesamum indicum</i> L.	Thala	DHLC	136,971.50
Piperaceae	<i>Piper longum</i> L.	Thippili	HIC	20,634.69
Plumbaginaceae	<i>Plumbago indica</i> L.	Rath nitul	I	6,294.25
Poaceae	<i>Vetiveria zizanioides</i> (L.) Nash.	Sevendara	HIC	17,665.25
Rubiaceae	<i>Pavetta indica</i> L.	Pawatta	DHLC	55,701.00
Rutaceae	<i>Aegle marmelos</i> (L.) Correa	Beli	HLC	41,633.00
Santalaceae	<i>Santalum album</i> L.	Sudu handun	HLRC	24,374.75
Sapindaceae	<i>Cardiospermum halicacabum</i> L.	Wel penela	HLC	11,136.00
Sapotaceae	<i>Madhuka longifolia</i> (L.) Macbride	Mee	HLC	25,541.75
Scrophulariaceae	<i>Bacopa monnieri</i> (L.) Pennell	Lunuwila	HLC	10,798.00
Solanaceae	<i>Solanum melongena</i> L.	Elabatu	HLC	38,453.20
	<i>Withania somnifera</i> (L.) Dunal	Amukkara	HIC	38,320.50
	<i>Solanum virginianum</i> L.	Katuwelbatu	HIC	33,795.20
	<i>Solanum trilobatum</i> L.	Wel-tibbatu	LR	2,993.00
Vitaceae	<i>Vitis vinifera</i> L.	Muddarappalam	H	13,172.00
Zingiberaceae	<i>Zingiber officinale</i> Roscoe	Inguru	DHIC	350,561.20
	<i>Kaempferia galanga</i> L.	Inguru piyali	I	5,470.25
	<i>Alpinia calcarata</i> Rosc.	Araththa	HLC	16,282.00
	<i>Elettaria cardamomum</i> (L.) Maton	Enasal	VL	2,926.90
Zygophyllaceae	<i>Tribulus terrestris</i> L.	Nerenchi	HL	22,703.50

Note: D = Most demanded plant materials (Required amount > 50,000 kg per year), V = Most valued materials, H = Heavily used materials (Required amount > 10,000 kg per year), R = Rare materials, L = Materials mainly from local sources, I = Major importing materials, C = Locally cultivable medicinal plant species

As shown in Table 2, there were 44 heavily used (more than 10,000 kg/year) medicinal plants belong to 33 families. The results are almost in accordance with Pushpakumara *et al.*, (2002), who reported 50 heavily used medicinal plant species in ayurveda and traditional systems of medicine in Sri Lanka. Out of 44 species, 41 belong to 31 families were identified as easily cultivated plants in prevailing soil and climatic conditions in Sri Lanka. Moreover, *Munronia pinnata* (Rs. 6190.95/kg), *Elettaria cardamomum* (Rs. 4914.37/kg) and *Myristica fragrans* (Rs. 2905.01/kg) were identified as the most valued medicinal plant materials.

#### **Major Importing Materials Required in Large Amounts**

Results revealed that there were 16 plant materials of 12 families as frequently importing materials in large quantities (Table 2). *Withania somnifera*, *Trachyspermum roxburghianum*, *Hemidesmus indicus* and *Curculigo orchioides* which have the highest imported percentages, were accounted for 95.45%, 90%, 73.68% and 72.22% respectively. However, the data demonstrated that the majority of plant materials required for the country's medical systems including heavily imported materials are in local origin and well adapted for prevailing soil and climatic conditions in the country.

#### **Quality of Raw Materials**

Majority of stake holders commented that medicinal plant materials purchased from locally grown/cultivated without synthetic chemical fertilizers possess high quality, efficacy, reliability and they are reasonably cheap with compared to imported plant materials. However, lack of continuous supply of good quality materials was the main constraint faced by the industry. Therefore, stakeholders strongly emphasized that the establishment of commercial cultivation is essential in order to ensure the supply of high quality raw materials (both fresh and dry forms). Conversely, the most of the stakeholders pointed that import of high quality plant materials which are not grown in Sri Lanka is also essential to maintain the sustainability of the industry. Further, most of the manufacturers put forwarded their serious concern on drawbacks of available raw materials such as adulteration, pest and diseases, presence of impurities and fungal bodies and excess wetness, which are directly affect the quality of their products. Nevertheless, some respondents highlighted the need of appropriate processing techniques

for medicinal plant materials such as *Zingiber officinale* and *Curcuma longa*.

#### **Problems Faced by the Medicinal Plant Industry**

Higher prices of available raw materials, poor quality, absence of continuous supply and insufficient supply were discovered as main problems, which are individually or collectively affect the slow growth of the herbal industry. In addition, lack of knowledge on proper identification of plants or plant parts, decline of availability of medicinal plants due to extinction and limited lands, legal barriers on cultivation of certain species (eg. *Cannabis sativa*), lack of proper cultivations, restrictions to harvest from forests i.e. *Coscinium fenestratum*, *Syringa reticulata*, *Munronia pinnata*, *Santalum album* and *Pterocarpus santalinus*, seasonal harvesting, unavailability of proper raw materials in required nature (dry or fresh state) and lack of appropriate research and development programmes were also identified as constraints.

#### **Government Involvement in Developing of Medicinal Plant Industry**

Survival of any kind of industry mainly depends on government involvement. The present study attempted to obtain the views on government involvement of different stakeholders of the medicinal plant industry. Results clearly highlighted that over 70% responded negatively while around 30% respond positively to the government contribution for improving the industry.

#### **Main Organizations Should Involve in Uplifting the Industry**

Sri Lanka has number of organizations which are directly or indirectly involve in the medicinal plant industry. Great majority of respondents (more than 40%) expressed that Department of Ayurveda (DOA) should play a leading role, while the Industrial Technology Institute (ITI) was selected by near 21%. However, around 40% stated that DOA, ITI and universities should take leading role in order to ensure the sustainability of the industry. In addition, Department of Agriculture, Provincial Departments of Indigenous Medicine, Custom of Sri Lanka, Rural Development Authorities, Department of Wild Life Conservation, Forest Department, Department of Education, Cultural Department, Forest Conservation Department and National Institute of Traditional Medicine were named as other institutions which should actively contribute for the betterment of the medicinal plant industry.

**Suggestions for the Improvement of Industry**

In order to rectify above drawbacks, commencement of medicinal plant popularization programmes, development of protocol for proper identification of plant species, supply of planting materials, provision of credit/loan facilities, development of cultivation and processing techniques, protocol formulations for quality control and standardization of herbal materials/ products in terms of efficacy and safety were suggested in order to ensure the smooth development of the industry.

**CONCLUSIONS**

This survey is considered as a comprehensive activity carried out to address major issues of the medicinal plant industry in Sri Lanka. Information generated through the survey could be effectively used for the preparation of national strategy for the improvement of medicinal plant industry in Sri Lanka.

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**REFERENCES**

Anon. (2011). Ministry of Indigenous Medicine Annual Statistics Report, Ministry of Indigenous Medicine, Sri Lanka. Available from: <http://www.indigenousmedimini.gov.lk/Sstatistics.html> (Accessed 28 March 2011).

Anon. (2012). World Bank Annual Report, World Bank Indicators - Sri Lanka - Land use. Available from: <http://www.Tradingeconomics.com/SriLanka/forest-area-percent-of-land-area-wb-data.html> (Accessed 25 March 2013).

Chaudhary, A. and Singh, N. (2011). Contribution of world health organization in the global acceptance of Ayurveda. *Journal of Ayurveda and Integrative Medicine*, 2(4), 179-186.

Ghorbani, A. (2005). Studies on pharmaceutical ethnobotany in the region of Turkmen Sahra, north of Iran (Part 1): general results. *Journal of Ethnopharmacology*, 102, 58-68.

Gunatilleke, N., Pethiyagoda R. and Gunatilleke, S. (2008). Biodiversity of Sri Lanka. *Journal of the National Science Foundation of Sri Lanka*. 36 Special Issue: 25-62.

IUCN. (2001). Statistics on the National Demand for Medicinal Plants. Report No.MPP/R/21, Sri Lanka Conservation and Sustainable Use of Medicinal Plants Project, IUCN- The World Conservation Union, Sri Lanka.

Lev, E. and Amar, Z. (2000). Ethnopharmacological survey of traditional drugs sold in Israel at the end of the 20<sup>th</sup> century. *Journal of Ethnopharmacology*, 72 (1-2), 191-205.

Miraldi, E., Ferri, S. and Mostaghimi, V. (2001). Botanical drugs and preparations in the traditional medicine of West Azerbaijan (Iran). *Journal of Ethnopharmacology*, 75, 77-87.

Perera, P.K. (2012). Current scenario of herbal medicine in Sri Lanka. Speech presented at 4th Annual Herbal International Summit cum Exhibition on Medicinal & Aromatic Products, Spices and finished products (hi-MAPS), NSIC, Okhla Industrial Estate, New Delhi.

Pushpakumara, D.K.N.G., Kotagama, H.B., Marambe, B., Gamage, G., Silva, K.A.I.D., Gunaratne, L.H.P., Wijesundara, C. and Karaluvinne, S.S.D.K. (2002). Prospects of Pharmaceutical Prospecting to Finance Biodiversity Conservation in Sri Lanka. *Sri Lankan Journal of Agricultural Economics*, 4 (1), 39-71.

Sugathadasa, K.S.S., Jeevandara, P.M., Devanarayana, A. and Pushpakumara, D.K.N.G. (2008). A checklist of medicinal plants in Sri Lanka. Bandaranaike Memorial Ayurvedic Research Institute, Department of Ayurveda and ICRAF Sri Lanka Program.

World Health Organization (WHO). (2008). Traditional Medicine. Fact sheet No 134. Available from: <http://www.who.int/mediacentre/factsheets/fs134/en/> (Accessed 4 April 2013).