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University of Indonesia
Depok, Jakarta

Proceeding of The Expert Group Meeting on Industrial Exploitation of Indogenous Medicinal Plants

Jakarta, 19 - 21 December 1995

Sponsored by:

United Nation Industrial Development Organization (UNIDO),
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RESEARCH AND DEVELOPMENT ON CULTIVATION OF MEDICINAL CROPS

D. Sitepu and Sudiarto

ABSTRACT

Generally the cultivation of medicinal plants in Indonesia is still traditional, which needs improved technology following the rapid growth of medicinal industries. Practicing improved technology to provide simplisia from plant origin, is the initial and strategic step in the development of medicinal industries. All raw materials taken by industries should consider quality, continuity and value of products, which means the role of farmers must be taken into account. Involvement of institutions, agencies, industries etc., in helping farmer to practice good cultivation is very essential. Medicinal plants are showing quick trend in diversifying products to other utilization i.e. cosmetic, perfume, body lotion, shampoo, food etc. Focus should also be put on local specific commodities in various places in Indonesia.

INTRODUCTION

In attempts to improve productivity, both quantity and quality of medicinal plants, improved technology of cultivation for specific agroecosystems has become serious consideration in research and development programmes in Indonesia. Research Institute for Spice and Medicinal Crops (RISMC), one of the three Research Institutes belonging to Research and Development Centre of Industrial Crops (CRIC), Agricultural Agency for Research and Development (AARD), MOA, is responsible in doing research of medicinal plants In doing the programmers and implementation of research activities, RISMC follows approach through integration of various disciplines: Agronomy, plant breeding, entomology, phytopathology, physiology, agro-economy and post harvest technology. A11 plants belonging to RISMC are grouped into four Commodity Programmes, i.e. : Research Programme (RP) of Medicinal Crops, RP Spice Plants, RP Essential Oils and RP Other Industrial Crops.

Due to the great number of medicinal species as well as technology to be improved, while on the other hand research resources are limited, research activities are done based on priority setting.

There is no doubt that the role of research and development in generating the medicinal industry, be very important, to improve productivity, sustain yields and to gear farmers' income as well as the welfare of the nation.

Indonesia is very concerned about the future of her mega biodiversity without real action in conserving the natural resources through economic and global perception, for which research and development findings are taking important part of the whole process. Together with the attempts to improve capability of farmers by providing technology on cultivation, the conservation and utilization of natural resources of medicinal plants receive very high priority in the research activities.

Generally the cultivation of medicinal plants in Indonesia is still traditional, even though the contributions of some cultivated crops give significant value (25,8 - 29,5%) to local farmers. Improved technology on cultivation, post harvest technology, product diversification and marketing would however give high contribution to the welfare of farmers involved in the whole chains of the medicinal industry. It is important to realize that a great trend has moved from medicines to other utilization of medicinal plants, such as food, cosmetic, perfume, body lotion, shampoo, etc.

This paper is aimed to inform the significant role of improved technology on cultivation of medicinal plants in providing plant materials suitable for medicinal industry in Indonesia.

OBJECTIVE OF RESEARCH AND DEVELOPMENT

Research and development on medicinal plants are aimed at improving the production systems and opportunity through well planned cultivation and participation of farmers to generate productivity and farmer income as well the welfare of the nation. Among important aspects that can be achieved by cultivation are : good quality and secure continuity of raw materials consisting of simplisia (herbal root leaf, cortex, etc., exudate or natural secondary metabolites such as essential oil, gum, sap etc.) and components of secondary metabolites (eugenol, menthol, kinidine etc.).

Realizing that the contribution of cultivation in yielding products is still very low (+ 30%) compared to other sources (+ 70%) i.e : collection or harvesting from natural resources, while on the other hand rapid growth occurs in all sectors of industry, i.e. : development of traditional drug industry, primary health care (self medication), number of people who rely on traditional medicine, trend in gearing phytopharmaca, poverty alleviation and the global competition.
Orientation of research and development on the improvement of cultivation is situated within the following accounts:

(1) Weakness

- Cultivation of medicinal plants is still in traditional methods,limited scale and scattered locations.
- General motivation of most farmers tend to be subsistence, poor knowledge and capital for initial inputs, and lack of market information.

(2) Threat

- Growing competition on marketing in line with the global realization.
- Requirement of high quality of product, influx of foreign transaction, etc.

(3) Opportunity

- Well Planned cultivation in accordance with industrial growth and world market.
- Competitive development of certain medicinal plants suitable for specific conditions of agro-ecosystems throughout Indonesia.
- The richness of agro-ecosystem and socio-economic conditions together with cultivation suggests that the need of good quality, right time and continuity of products may be fulfilled. Alternative systems of development practices on farmers' level provide choices depending on local conditions, i e.: small holding nucleus estate, intercrop, pekarangan crops etc.
- The desire to include traditional medicine into formal health care in term of phytopharmaca.

(4) Strength

- Some species. which are indigenous to Indonesia have been widely known and utilized i e. : *Orthosiphon stamineus*, *Curcuma xanthorrhiza*, *Cassia fistula*, *Piper retrofractum*, *Piper cubeba*, etc.
- Natural resources as potential sources for research and development.
- Increasing demand of traditional medicine for domestic consumption and other purposes in line with the population growth and good perception of back to nature issue, health foods, etc
- Various and supporting agro-ecosystems.
- Great traditional custom to use traditional medicine (jamu)

IMPROVED CULTIVATION OF MEDICINAL PLANTS

In general, medicinal crops are still cultivated in traditional methods, because of lack of technology, low perception of most farmers on improved cultivation, including high cost, planting materials and grading of product cultivation of medicinal plants could be improved mainly by (1) good planting materilas (2) suitable land and climate, and (3) cultivation. However good management, sufficient capital and market information are also important issues.

1. Good planting materials and propagation methods

The cultivation and utilization of medicinal plants are rooted in the history of the Indonesian heritage Knowledge of genetics and plant physiology in medicinal plants is not yet as developed as food crops, the survival of natural plant varieties can only be ensured, if industrial needs of their raw materials and derivatives is met through other means of production, at competitive prices.

Research and development efforts have also high access on germ plasms collection as well as their utilization, and at present time RISMC conserves about 420

species, most of them are medicinal plants Some local varieties of medicinal strateqic role,and for plants could provide for farmers income strategic role and for industry industry as well as for export. For examples: The cultivar Cileungsi of *Kaempferia galanga;* Gajah/Badak and red ginger of *Zingiber officinale.* and some cultivars/clones of *Orthosiphon aristatus.* Plant breeding programme is also aimed to avoid constraints such as disease problems through conventional and biotechnological approaches.

Plant propagation through traditional and micropropagation methods have met improvement and are still in progress

Research on micropropagation and *in vitro* conservation have shown good progress, with emphasis on some endangered species and also for some economically important species such as *Pimpinella pruatjan, Alyxiastellata, Rauvolfia serpentina* and *Zingiber officinale* (Table 3) Improvement through tissue culture is undertaken for *Zingiber officinale, Pogostemon* cablin and *Piper nigrum*

2. Suitability of soil and climate

General environments are influenced by abiotic factors (soil and climate) and biotic factors (weeds, pests and other plants) The abiotic factors for Indonesian indigenous plants can be studied *in situ* from each plant species habitat an *ex si*tu from the growth and development of the crop grown by farmers that can affect the quantity and quality of the yield Suitability of some abiotic factors for some Indonesian medicinal plants is listed in Table 2.

Further studies on the effect of soil and climate on yield (quantity and quality i e : its chemical constituent)should be done for more detailed information

3. Cultivation and cropping system

Cultivation of medicinal plants such as land preparation, fertilization, plant protection and harvesting have important role for getting good harvest effectively and efficiently. Research on methods of cultivation on some medicinal crops have shown improvement. For examples *(Angelica acutiloba)* showed that the optimum yield of dry root is found at 10 months after planting. At this stage of plant growth, dry root yield was 3,99 ton/ha and the ethanol extract content was 44,83%.

Cropping systems of medicinal crops provide many possible combinations between less economic crops and higher economic values during the crop life cycle Intercrop of *Orthosiphon aristatus* under papaya or other tree crops, however showed no sinensetine content, while under monocrop it showed sinensetine content on HPLC test. Table 2 also shows the conditions on whether a crop is determined by certain environmental factors.

CONCLUSION

Medicinal plants of Indonesia give great contribution to medicinal industries and welfare of the nation. Cultivation improved by recommended technology would provide raw materials in such a way that quality, quantity and Continuity be sufficient.

Research and development on medicinal plants at present conditions have not been able to meet good cultivation and harvests for most medicinal plants. An integrated approach would be the best solution in achieving the goal of the cultivation of medicinal plants, in line with the development of medicinal industries

REFERENCES

Anonymous, 1973. Laporan hasil penelitian study pemasaran dan analisis usaha tani tanaman obat Balittro, Bogor

Anonymous, 1993. Perkiraan pertumbuhan sektor pertanian selama Repelita VI (1993-1998) Dep.Tan R.I., Jakarta.

Hamid, A and D Sitepu, 1990, An understanding of native herbal medicine in Indonesia, International Congress on Traditional Medicine and Medicinal Plants, Bali, Indonesia

Mariska, I dan E.G. Lestari. 1995. Manfaat kultur jaringan dalam pelestarian dan produksi bibit tumbuhan obat. Forum Konsultasi Strategi dan Koordinasi Pengembangan Agroindustri Tanaman Obat. Balittro. Bogor : 10 hal.

Sitepu, D., S.M.D Rosita and M. Januwati, 1991. The contribution of medicinal plants as TOGA in pekarangan land. Proceedings Seminar on Pekarangan Land; Development Possibilities and Their Contribution to Farmers' Welfare. CASER, AARD-FAO/UN : 150 - 156.

Sudiarto, D. Sitepu, H Moko, S.M D. Rosita, M. Januwati, Emmyzar, H. Muhammad, O. Rostiana dan Y.T Yuhono, 1994. Perkembangan teknologi budidaya dan prospek pengembangan usahatani beberapa tanaman obat. Prosiding Simposium II Hasil Penelitian dan Pengembangan Tan. Industri. Puslitbangtri;

Wahid, P , 1993. Medicinal and aromatic plants in Indonesia. Proceedings. Medicinal and Aromatic Plants in Asia. FAO/UN. Rapat public 1993/19 Bangkok. Thailand; 131 - 137.

THE ROLE OF ETHNOBOTANY IN SUSTAINABLE UTILIZATION OF INDONESIAN MEDICINAL PLANTS

Harini Sangat-Roemantyo & Johanis P. Mogea

ABSTRACT

Indonesia is rich in species diversity of medicinal plants and many of those species have been used traditionally by Indonesian tribes. Javanese is the major tribes that since the ancient time very familiar with the medicinal plants and traditional medication system called "jamu". The link of pharmaceutical prospects with the conservation of plant resources and traditional medical system base on the ethnobotanical information provides will be useful for pharmaceutical and modern herbal industries. This condition will open the opportunity for research and development of the importance value of medicinal plants in the future.

INTRODUCTION

Indonesia is known as one of the countries with the richest flora in the world (IUCN, 1986). Recent estimation of about 80% people in the world still depending on the medicinal plants for the supporting their health. The biggest parts of the utilization of plants species due *to* their bio-active components of plants. Report from United State show that about 25 % of prescriptions contain the material originated from the flowering plants (Farnsworth and Soejarto, 1985). From that figures showed the very importance roles of the medicinal plants in the health development of every countries in the world.

Ethnobotany is the study of how people in traditional societies use plants. It's has a great potential to provide new and useful plants products for the benefit of the world. Many of the plants extracts used in western medicines were discovered through their uses in traditional societies, though not necessarily for the same purposes. The practices of ethnobotany are themselves being modified to ensure that the rights of traditional people benefit from any commercial discoveries made from their knowledge (Martin, 1995).

The increasing demand for natural products in the world and other human needs caused increasing exploitation of plant diversity. Direct effects of the uncontrolled exploitation are decreasing population of plants species in nature with the resulting ecological damages due to changes of the environment. Therefore which

exploitation of plant diversity must be accompanied by conservation measures, which mean that plant diversity must be consented if we want to preserve their utilization. According to Balick (1994), ethnobotany has became a recognized tools in the search for the new bio-active components. The links of pharmaceutical prospecting with the conservation of plants resources and the information of traditional medical system was very close. It illustrated the concepts of ethno-plant medical reserve and provides an opportunity both for the modern pharmaceutical and herbal industries to contribute to the conservation effort. Medicinal plant in the global context are used plants that arc recognized by people to have reliable and effective medicinal values. It's commonly used in treating and preventing specific ailments and diseases and play an essential role in health care (Srivastava, 1995).

Indonesian medicinal plants have been used traditionally by many tribes. Among them, Javanese is a major tribe that used since the ancient time, so Javanese especially who lives in the villages very familiar with the medicinal plants species, how to prepare, administer, dosage. Also they know when and where to collect medicinal plants and Javanese called of that as "jamu". The important role of jamu is significant, especially as an alternatives method on increasing the health quality of human resources in Indonesia.

MEDICINAL PLANTS DIVERSITY

Indonesia .as a country with the richest of plant resources in the world. The local knowledge on useful plants was vary according to the tribes and locations. Sangat-Roemantyo (1995) noted that old manuscripts contain many information on the utilization of plants species for medicine and health cares such as on manuscripts of "lontar husodo" in Jawa, "lontar usada" in Bali, "lontarak pabura" in South Sulawesi showed that Indonesian people already have knowledge on medicinal plants diversity since long time ago. Beside that there are still many local knowledge on traditional medication and medicinal plants but are not recorded. Until at present the potential not to be observe completely yet.

World Conservation Monitoring Centre (WCMC) reported that Indonesia is known as very important areas due to their contra of diversity of many medicinal plants located in this country (Grombridge, 1992). There are more than 1,000 species of plant were recorded Unused as medicinal plants in Indonesia (Zuhud, 1994) and the distributions were spread in all over the Indonesian Archipelago. One of the important location of the centre of diversity of medicinal plant is located in the Gede-Pangrango National Park. List of Gede-Pangrango flora were reported by Sunarno and Rugayah (1992).

Knowledge on plant diversity will very important on the potential development of the medicinal plants resources. Many scientists and leaders of government realize that medicinal plants resources will become as a capital fundamental of health development in the world. Indonesian medicinal plants diversity

already used widely both for traditional remedies (jamu, herbal medicines etc.) and for the bio-active sources of modern drugs, but this condition are not equitable With the knowledge of plants diversity. Until at present knowledge on medicinal plant diversities still not enough as a base for it's utilization. Therefore there are still many observations and research will done on medicinal plant diversity for support the potentials developing of Indonesian medicinal plants.

THE SEARCH FOR NEW DRUG BASED ON THE ETHNOBOTANICAL LEADS

Ethnobotanical .and ethnopharmacological approach are the basic methods for observation and develop the empirical/traditional knowledge and also collecting information the medical practices experiences insides to the traditional societies. The first important step on the developing drug originated from plants material are collecting and analyzing of all information about plant used by local people. Ethnobotanical and ethnopharmacological research can give an useful and important information as a pre-screen of pharmacological study (Farnsworth, 1990). The important items on the searching relation between bio-active component and ethnobotanical data was bio-assay test.

Indonesian medicinal plants attract many researchers both Indonesian and others countries due to potential of medicinal plants. Using NAPRALERT about 200 scientific articles of Indonesian medicinal plants published for the last of 10 years can be retrieved easily (Loud, 1985). Foreign researchers can use this network for searching Indonesian medicinal plants information. Researchers from Japan, Korea France, Netherland, Australia, Germany, Denmark, Switzerland, United Kingdom, and United State were very active to do research on Indonesian medicinal plants. The great interest of Japanese researchers to do research on Indonesian medicinal plants can be seen in the "Pharmacopea of Japan" 10th Edition consist of about 13.3% of the material were tested originated from Indonesian medicinal plants. On the "Chemical Pharmaceutical Bulletin" that published by Japan Pharmacy Association" there were special chapter discussed about Indonesian medicinal plants. On the last of 3 years (1992 - 1995) that bulletin already published bio-actives components of 6 species of Indonesian medicinal plants, although there are no information the components used for drugs. Probably that components still new and not yet test for its activities due to the limited material supplied in Japan.

Kardono (1992) showed that the ethnobotanical data of Indonesian medicinal plant about 54.5 % positively has directly related or match to their bio-active components and can be used for cure the illness. For example "sambiloto" (*Andrographis paniculata* Ness.) traditionally used for stomach troubles, phamacologically contains "adrographalide" bio active component that effective for anti-diarrhea.

According to Cox (1994), many of drugs were discovered from indigenous knowledge systems. Historically ethnobotanical leads have resulted in three different types of drugs discovery:

1. Unmodified natural plant products where ethnomedical use suggested clinical efficacy (e.g. digitalis).
2. Unmodified natural plant products of which the therapeutic efficacy was only remotely suggested by indigenous plant use (e.g. vincristine).
3. Modified natural or synthetic substances base on a natural product used in folk medicine (e.g. aspirin).

For pharmaceuticals ranging from digitalis to vincristine the ethnobotanical approach to drug discovery has proven successful.
Ethnobotanical/ethnopharmacological information can be used to provide three level of resolution in the search for new drug:

a. as a general indicator of non specific bioactivity suitable for a panel of broad screen
b. as an indicator of specific bioactivity suitable for particular high-resolution bio-assays
c. as an indicator of pharmacological activity for which mechanism based on bio-assays have yet to be developed.

Despite all the progress in synthetic chemistry and biotechnology, plants from the wild floras of development countries are Still on indispensable source of medicinal preparations both preventive and curative. It is thought that more than 80 % of the world population rely primarily on plants for health cares. Such plants not only provide many people with their practical means of health cares, they have a large and growing market value in local and international trade. Although the significance of these plant seem likely not threatened by over-harvesting. Unless remedial measures are taken, some will soon become extinct. A greater understanding of this subject could be important to development efforts in general. Medicinal plants are "bridge" between sustainable economic development affordable health care and the conservation of biodiversity. When traditional knowledge is being study. it is important that the results must be return the benefit to the local culture and country where the plants originated. This is important for ensure that the resources are Still exist and can renewable naturally.

According to Farnsworth (1994) the process of drug development is generally recognized as a high risk/high pay-off endeavor. The experiences of the Merck Company, for every 10,000 substances that are evaluated of biological assays, twenty are selected for animal testing. Of these twenty, ten will be evaluated in humans and only one will be approved by the Food and Drug Administration (FDA) in the United State for sale as a drug. Merck also claims that this process requires about 12 years at a cost of US S 231 millions.

Utilization of medicinal plants in Indonesia especially in Java from the traditional method/"jamu" until the sophisticated production method will grow and marketed together. Tradition of "jamu" drunk almost everyday by many of Javanese is unique. Javanese drink "jamu" starting from they still baby until adult both when they are sick or healthy (Sangat, 1994). That system is very interesting to study through their bio active components tests besides new potential species exploratives should be evaluated. From the markets survey in Yogyakarta and Surakarta (origin sites for "jamu") on December 1994 and August 1995 were found about l 15 species of medicinal plants that sale both fresh and dried forms. Amongst of that about 15 species of medicinal plants were difficult to find in the nature or habitat (see table 1) .

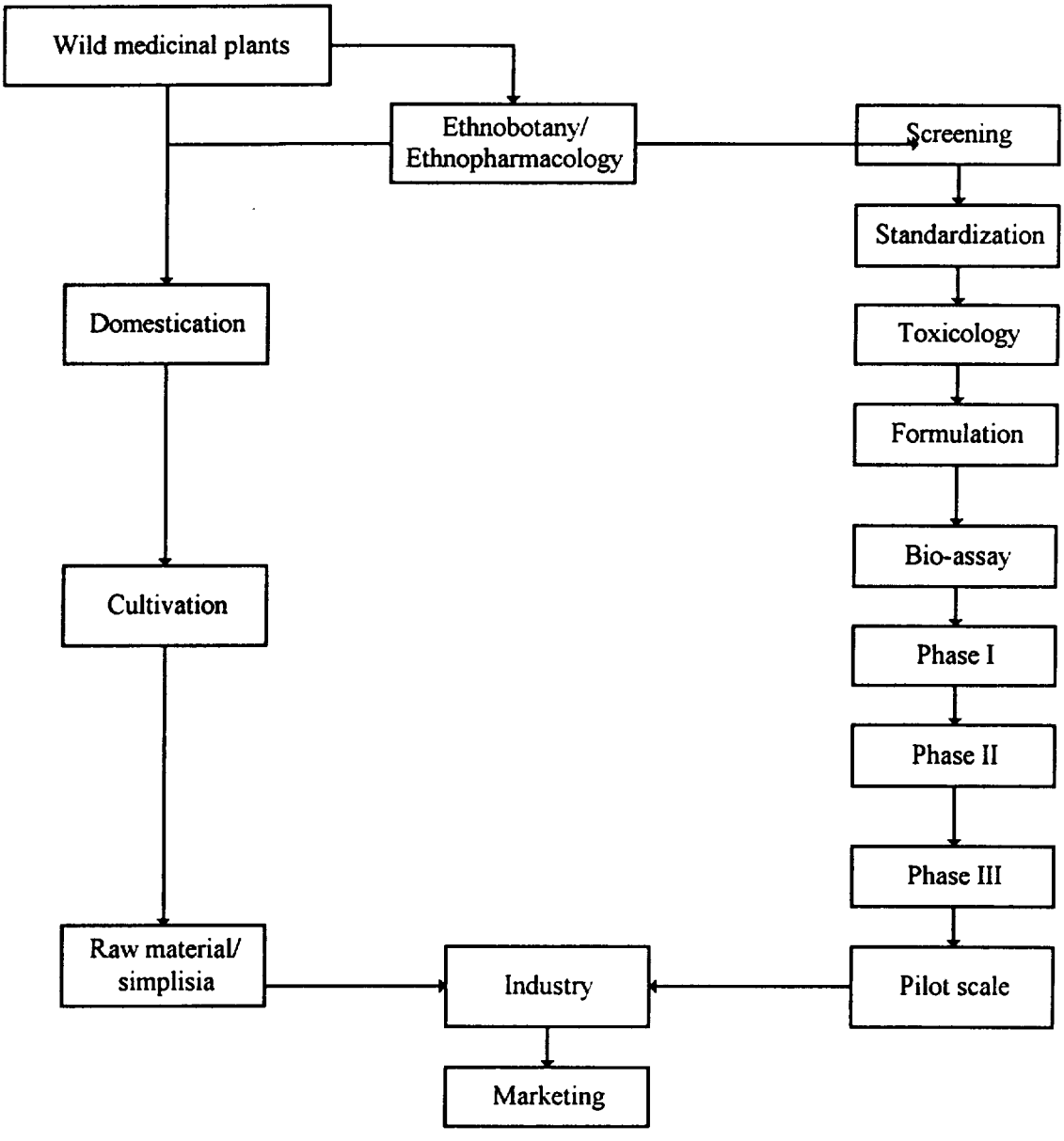
Table 1. Species already difficult to find in Java but their raw materials were sold in the markets

No.	Family	Scientific name	Local names
1	Apocynaceae	*Alstonia scholaris* (L.) R. Br.	Pule
2		*Rauvolfia serpentina* (L.) Bth. ex Kuntz	Pule pandak
3	Fabaceae	*Euchresta horfieldii* Benn	Pronojiwo
4		*Carthamus tinctorius* L.	Kembang pulu
5	Lamiaceae	*Coleus ambonicus* Lour.	Daun jinten
6	Lauraceae	*Cinnamomum sintoc* Bl.	Sintok
7		*Cryptocarya massoy* (Oken.) Kosterm.	Mesoyi
8	Lythraceae	*Woodfordia fructicosa* (L.) Kurz.	Sidowayah
9	Loganiceae	*Strycnos ligustrina* Bl.	Widoro laut
10	Malvaceae	*Abelmoschus moschatus* Medik.	Regulo
11	Santalaceae	*Santalum album* L.	Cendana
12	Sterculiaceae	*Scapium affinis*	Bunga tempayang
13	Usneaceae	*Usnea* sp.	Kayu angin
14	Zingiberaceae	*Curcuma heyneana* Val.	Temu giring
15		*Curcuma soloensis* Val.	Temu glenyeh

Besides developing jamu into the modern style, other traditional medicine is also to be develop through "fitofarmaka/phytomedicines". "Fitofarmaka" is a medicines made from plants that already scientifically tests by pharmacologists and used in the formal system of medication by medical doctors (see Scheme 1.)

Wild medicinal plants

Wild medicinal plants



Scheme 1: Production steps of traditional medicine in Indonesia

Table 2.: The prospective of several Indonesian "fitofarmaka"

No	Family	Scientific names	Local names	Parts used	Indications
1	Acanthaceae	*Andrographis paniculata* Ness	sambiloto	herbs	antiseptic, antidiabetic
2	Apiaceae	*Centella asiatica* Urhan	pegagan	leaves	diuretic, antiseptic, antihypertention
3	Araceae	*Acoruss calamus* L.	dlingo	rhizomes	sedatives
4	Asteraceae	*Blumea balsamifera* DC.	sembung	leaves	analgesic, antipyretic
5		*Sonchus arvensis* L.	tempuyung	leaves	diuretic, nephrolitiation
6	Cucurbitaceae	*Momordica charantia* L.	pare	fruits	antidiabetic
7	Combretaceae	*Quisquali. indica* L.	ceguk	seeds	ascariasis
8	Fabaceae	*Abrus precatorius* L.	saga	leaves	stomatitis
9	Menispermaceae	*Tinospora crispa* (L.) Diels.	brotowali	stems	antimalaria, antidiabetic
10	Myristicaceae	*Myristica fragrans* Houtt.	pala	fruits	sedatives
11	Piperaceae	*Piper betle* L.	sirih	leaves	antiseptic
12	Rutaceae	*Citrus aurantifolia* Swing.	Jeruk nipis	fruits	cough
13	Verbenaceae	*Vitex trifolia* L .	Iegundi	Leaves	antiseptic
14	Zingiberaceae	*Curcuma domestica* Val.	kunyit	rhizomes	hepatitis, antiseptic
15		*Curcuma xanthorrhiza* Roxb.	temu lawak	rhizomes	hepatitis

The progress of potential utilization of medicinal plant /"jamu" is very fast. Modernization production of jamus will open the competition between traditional of herbal medicine and western drugs in the market as an alternatives of health system for Indonesian society. The innovation on very nice packaging of jamu's should be got award because this is lifted the name of Indonesia Nation in general.

STRATEGY FOR SUSTAINABLE UTILIZATION

The idea advocated by the strategy of global biodiversity conservation action is saving (preserved and protect), studying (observe and research) and using (sustainable utilization). The goals of this strategy is to enrich the quality and quantity of species used in medicine in general or "jamu" in particular and to preserve other related usage based on the potential of local knowledge on utilization of plant diversity.

a. Preservation

The idea are maintaining-conserving the diversities, habitat and indigenous knowledge. The priority will be focused on the threatened and endemic species including taxa below species and the species that are widely used but not yet cultivated intensively or still depend on the wild stock in the forest or other natural habitats. Preservation of that diversity can be done by making a special garden called as Ethnobotanical Garden or planted that useful plant for medicines in the Botanical Garden based on genetic population. In that garden the plants will be evaluated for improving their potential value, genetic variations and their propagation method. Selecting for the traditional varieties/landraces and improving their value including their chemical or bioactive components and genetic variations should be done especially used as the genetic stock collections.

Indonesia consists of more than 17,000 islands, 195 million people with not less than 300 tribes which spread in all offer the islands. Every tribes has a tradition on the use of plants diversity for their daily needs. They have indigenous knowledge on how to collect, used and consumed those resources safely and continuously. Local knowledge usually are not written, just oral massage passed from generation to generation. The oral massages are easy to loose and sometimes they are passed in incomplete order (Sangat-Roemantyo & Riswan, 1990). The situation will be significant if one of the component of plant species (usually jamu/traditional medicines consist of more than one component) was difficult to find in the surrounding area. After that they will changed with the other similar species. It will be give a desired effects or probably the sides effects of this medicines have bad sides effect. So that the original information was very important when the ethnobotanical and ethnopharmacological information were collected from the societies.

Information from local people is very important for future used due to the many of the plant extracts are often used in the modern medicines discovered through their uses in traditional societies (Plotkin, 1988). By the extinction of plants in d e surrounding communities or villages, the utilization information on that plants also become threatened and after that will be extinct. Using the documentation system of indigenous knowledge can be conserved properly and assist the global strategy for conservation of Indonesian medicinal plants.

b. Production

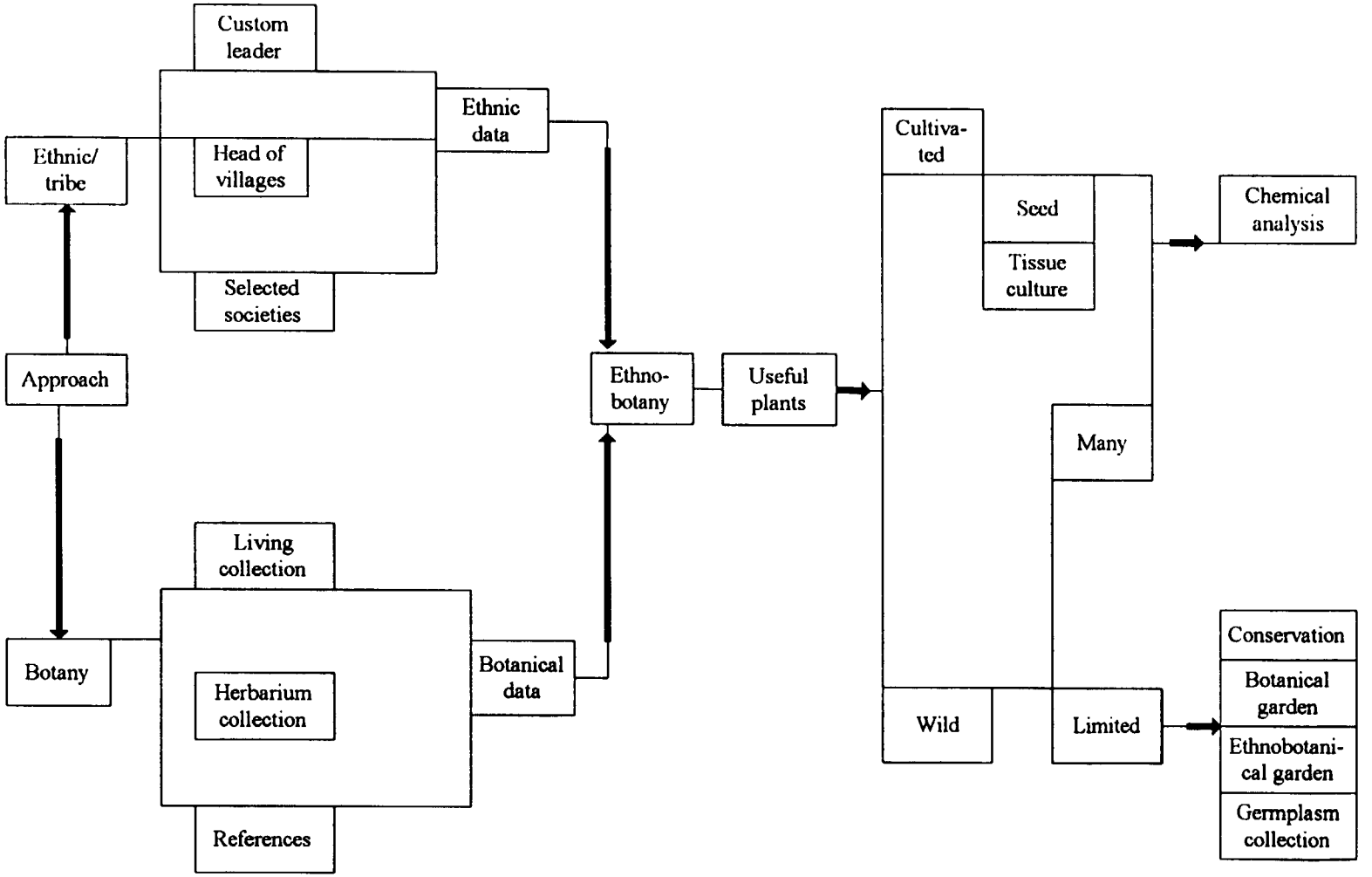
Cultivation of medicinal plants for supporting the needs of raw material jamu's, herbal medicines and bioactive component modern drugs are the best way to ensure for the sustainable use medicinal plant diversity. (Cultivation also will secured scientifically the quality of products, and from the pharmaceutical view, many advantages can be taken over those derived from widely growing source. Wildly collected material normally vary in quality and composition due to the environmental and genetic variation differences. The cultivated plants can be grown in areas of

similar climate and soil condition and the yields can be harvested in the same and right time.
The important items that should be know that medicinal plants are generally arc not known yet for how to propagate, because almost of the medicinal plant are wild species. The plants should be domesticated first and this works consumes time and cost. Collaboration research between leading institutes/universities and private companies should be set up to shorten the time and minimize the cost.

CONCLUSION

Indonesia is a country which richest plant diversity and indigenous knowledge should be manage under sustainable basis. Ethnobotany is a tools for describing the medicinal properties in remedies used by local people will be done in integrated manner in order to collecting information of usefull medicinal plant and documenting traditional medical practices (see scheme 2). Ethnobotanical and ethnopharmacological research can give an useful and important information as a pre-screen of pharmacological study. The important items on the searching relation between bio-active component and ethnobotanical data was bio-assay test.

Jamu is one of the Javanese traditional medicines and becoming very popular now because is easy to obtain, cheap and very useful for preventives, promotive and rehabilitative health cares of therapeutic uses. The significant role of jamu and other traditional medicines as an alternatives method on increasing the health of human resources of Indonesia should be accompanied by conservation measures, it's means that the production must be under sustainable basis. More over, if the plants is known as a sources of bio-actives component of modern drug. When the medicinal plants were potentially marketable and the product is developed, it is essential that the benefit must be return to the local culture and countries of origin.



Scheme 2. Method of Ethnobotanical Research

REFFERENCES

Balick, M.J. 1994. Ethnobotany, drug development and biodiversity conservation exploring the linkage. Ethnobotany and the search for new drug. Ceiba Foundation Symposium. John Willey & Sons. Chichester - England.

Cox, P.A. 1994. The ethnobotanical approach to drug discovery: strengths and limitations. Ethnobotany and the search for new drugs. Ceiba Foundation Symposium. John Willey & Sons. Chichester- England.

Farnsworth, N.R. and Soejarto, D.D. 1985. Potential consequence of plant extension in the United State on current and future availability of prescriptions drugs. Economy Botany (39): 231 240.

Farnsworth, N.R. et al. 1990. Medicinal plant on therapy. Bulletin WHO 6;3: 965 - 981

Farnsworth, N.R. 1994. The ethnobotanical approach to drug discovery. H-ethnobotany and the search for new drugs. Ceiba Foundation Symposium. John Willey & Sons. Chichester England.

Groombridge, B. 1992. Global Biodiversity; Status of the Earth's Living Resources. Chapman & Hall. London.

IUCN, 1986. Plant in Danger. What Do We Know. Davis S.D. et all (Eds) International Union for Conservation of Nature and Natural Resources, Gland, Switzerland.

Kardono, L.B.S. & S. Tsauri, 1992. Analisis hubungan kandungan senyawa-senyawa bioaktif dengan data etnobotani beberapa tumbuhan obat di Indonesia. Proseding Seminar dan Lokakarya Nasional Etnobotani. Perpustakaan Nasiona RI., Jakarta.

Loub, W.D. et al. 1985. NAPRAI ERT: Computer handling of natulral product research data. J. Chem. Inf. Comput. Sci. 25: 99 - 103.

Martin, G.J. 1995. Ethnobotany. Great Britain University Press. Cambridge.

Plotkin, M.J. 1988. Traditional Knowledge of Medicinal Plant. The Search fo New Jungle Medicines. In: Conservation of Medicinal Plants. Akarele, O. et al (Eds.) Cambridge University Press.

Rifai, M.A., Rugayah dan E.A. Widjaja, 1992. Tiga puluh tumbuhan obat langka Indonesia. Sisipan Floribunda 2: 1 - 28. Pengalang Taksonomi Tumbuhan Indonesia dan WWF. Bogor.

Sangat-Roemantyo and S. Riswan, 1990. Javanese medicinal plants, their distribution and uses. Proceeding the International Congress on Traditional Medicines and Medicinal Plants. Faculty of Medicines, Udayana University, Denpasar.

Sangat -Roemantyo, H. 1995. Studi pendahuluan dalam penelaahan naskah lontar yang terkait dengan etnobotani jamu. Prosiding Seminar Nasional Biologi ke XI, vol. I. Universitas Hasanuddin Ujung Pandang.

Sangat, H., G. Soemaatmadja dan Roemantyo, 1994. Keanekaragaman tumbuhan obat; strategy pemanfaatannya secara lestari. Seminar sehari Implementasi Konservasi Keanekaragaman

Sustainable Utilization of Medicinal Plant in Indonesian Tropical Forest

By: Ervizal AM. Zuhud

The conservation of the utilization of medicinal plant biological diversity in Indonesia tropical forest is an integrated activities, which involve many institutions, various scientific disciplines and has three objectives which are interrelated and support each other, namely:

1. Sustainable utilization of medicinal plant biological diversity in Indonesian tropical forest;
2. Conserving the potency of medicinal plant biological diversity in Indonesian tropical forest; and
3. Studying the tropical plant biological diversity in Indonesian tropical forest.

Those three objectives are in line with the union of three basic elements in the strategy of biological diversity conservation namely: protection (save), analysis (study), and utilization (use).

Achieving the objectives mentioned above, understanding on the present problems of conservation of medicinal plant utilization and anticipation of future problems are necessary. Studying which is conducted based on the result of general study, indicates light general problems encountered in the effort of conserving the utilization of medicinal plant, namely:

1. Although it is known (based on utilization by the people) that the potential of medicinal plant species in Indonesian tropical forest is very high, but for each location of distribution the status of the population in nature, is still unknown. On the other side, the rate of forest destruction (deforestation) tend to increase from year to year and it is worrisome that excessive harvesting will threaten the continued existence of the medicinal plant species in the forest.
2. Medicinal plant utilization is unique for each region / ethnic group and different to each other, either in the point of view of species, number of species or composition of the formulation. This constitute an incentive for the development of medicinal plant utilization which is advantageous from the economic point of view due to the availability of product diversification. However, this phenomena on also create condition which stimulates a light of medicinal plant harvesting from nature and at the same time widens the geographic extend of the problem encountered in the effort to conserve its utilization.

3. The rapid development of traditional medicine and "jamu (herbal medicine) is also followed by demand for medicine raw material (simplisia) originating from the forest. On the other hand, the effort to regulate the harvest of medicinal plant from nature and cultivation of medicinal plant has not been undertaken. This condition can become a causal agent of the extinction of medicinal plant species whose utilization causes death and obstruction of its regeneration or growth.
4. The unavailability of accurate data concerning the present level of demand and the trend of its increase up to the year 2000, constitute a critical point in the effort to conserve the medicinal plant utilization in Indonesia. The appropriate measures in overcoming the problem at appropriate time, constitute plant utilization in Indonesia, either in ecological point of view (extinction), socio-culture or economy.
5. The policy concerning medicinal plants is still focused on utilization efforts and has not clearly dealt with the effort of conserving the medicinal plant as raw material.
6. The institutional aspect of medicinal plant utilization and trade is still dominated by informal institution which trend to be subsistent. This situation is clearly not advantageous from the point of view of conservation of medicinal plant utilization and improvement of people's welfare.
7. Present research on medicinal plant is focused on the aspects of pharmacology/ phytochemistry which effectively stimulates the development of medicinal plant utilization. On the other hand, the weakness in other aspects of research (ecology, cultivation, socio-economics, post harvest technology, and marketing) cause little attention toward medicinal plant conservation.
8. In its relation with strategy of biological diversity conservation, the imbalance between elements of conservation, namely: protection (saving), analysis (studying) and utilization (using), is very significant. In this case, the utilization element has the highest proportion, so that it can be predicted that the utilization efforts has not followed the principle of sustainability.

Beside that, to make the effective effort in achieving the objective of conservation of medicinal plant utilization in Indonesia, there is a need to identify the supporting factors. The result of general study as presented, shows some supporting factors in conserving the utilization of medicinal plants in Indonesia, namely:

1. The diversity of medicinal plants and the big chance of discovery of new medicinal plants species, constitute a strong incentive for implementing the effort to conserve the medicinal plant utilization in Indonesia.
2. The utilization of traditional medicinal plant and "jamu" (herbal medicine) as national cultural heritage has been deeply rooted in Indonesian society.
3. The industry of traditional medicine and "jamu" which has developed at present, require absolutely the raw material in the form of medicinal plant, either of the plants which have been cultivated or those which have not been cultivated. The

threat of scarcity for medicinal plant as industrial raw material, provide a great stimulus for private sector to participate in the conservation effort.

4. Institution at the national level, namely National Working Group on Indonesian Medicinal Plants has been established in November 4, 1990, with the objectives to create network of research and development of medicinal plant and is supported by various institutions dealing with research and industry. The establishment of this institution constitute an important supporting factor for implementing the integrated conservation of medicinal plant utilization in Indonesia.
5. The utilization of traditional medicinal plant and "jamu" has been a national policy expressed in outline of State Policy 1993. This indicates a strong political commitment of Indonesian Government in supporting the effort of conserving medicinal plant utilization.

For the purpose of achieving the objectives of conservation of medicinal plant utilization in Indonesia, the inventory of general problems and supporting factors as mentioned above, will end up in the efforts to formulate measures to overcome the problem and enhance the effectivity of existing supporting factors for playing their role in appropriate time scale. For this purpose there is a need for further identification of key problems which are more specific and useful in formulating action to overcome the problem. In this context, the key problems in conserving the medicinal plant utilization in Indonesian tropical forest, can be categorized into 4 aspects, namely: (1) conservation aspect, (2) utilization aspect, (3) research aspect, and (4) policy and institutional aspect of medicinal plant management. The key problems which can be identified based on this general study, will be described in detail as follows, together with alternative actions to overcome them:

1. Conservation Aspects

1.1. Conservation of biological natural resource in Indonesia has begun since the Dutch colonial period, and at present has become the priority program of Indonesian government. However, in fact, the concern for biological natural conservation, including that for medicinal plant is still limited only to those circles which deal with this field and a small portion of the society.

1.2. Factors which threaten the sustainability of medicinal plant in the tropical forest are: (1) excessive harvesting, (2) habitat destruction due to forest encroachment, forest conversion into other uses, and timber exploitation, (3) cultivation effort which is still nonexistent (4) weakness in the implementation of law and legislative. The detailed description about the threat on medicinal plant sustainability can be read on Chapter 1 and IV of this book.

1.3. Natural ecosystem utilization which cause habitat alteration is progressing rapidly in Indonesia, so that it is supposed that there is a process in which various medicinal plant species whose direct benefit have not been known are becoming scarce. The role of such species has not been known in the ecosystem

because they have disappeared without any written record that they have ever existed.

1.4. Actions to overcome all of the above mentioned problems should give priority on:

a. Improving of the management of conservation area, especially in terms of boundary arrangement and safeguarding of the area.

b. Developing the diversification of forest product by including medicinal plant as one of the alternative product.

c. Increasing people's awareness on the importance of medicinal plant conservation.

d. Promoting the people's role in medicinal plant conservation.

e. Regulating the harvest of medicinal plant, either in national, provincial or local level.

f. Improvement of law and legislation in the field of medicinal plant conservation and their implementation mechanism.

2. Utilization Aspect

2.1. The utilization of medicinal plant has developed into a business sector which interest many investors, starting from the scale as little as home industry, small industry, up to large scale industry. This condition cause the demand for medicinal plants increase progressively from year to year, and stimulate further the excessive harvest from the nature, and threaten the sustainability of various medicinal plant from its natural habitat (forest or other natural areas) has not been based fully on regenerative capacity of the plant (see Chapter III and IV). Examples of medicinal plant species whose existence are threatened are among other things: gaharu wood *(Aquilaria rnalaccensis)*, pule pandak *(Rauwolfia serpentina)* and pule sari *(Alyxia reindwartil)*.

2.2. Up to now, there is still difficulty in formulating the plan for procurement of raw material for traditional medicine or for phytopharma modern medicine, to be supplied for industry, due to unavailability of reliable data on number of industry and their need either totally for one year or seasonally with its fluctuation. This is mainly due to the lack of openness on the part of the industry of traditional medicine or phytopharma modern medicine in disclosing information on the amount of their raw material need.

2.3. Up to now, the technological engineering for medicinal plants which has been developed by universities or research institution is more useful for and utilized by large capital industry. Because a significant breakthrough has not occurred yet in cultivation (for instance the invention of new superior varieties of medicinal plant), then the small farmers can not enjoy the profit resulted from the development of traditional medicine industry in the last two decades. Beside

that, because of institutional structure which is still informal and subsistent for medicinal plant harvesting and the lengthy chain of trading of traditional medicine raw material, then local people surrounding the forest who serve as gatherer of raw material has not enjoyed an appropriate profit/reward because of very cheap purchasing price by the middlemen.

2.4. Actions to overcome the problem of medicinal plant utilization to achieve the sustainable system of utilization, need to be focused on:

a. Development of culture techniques and breeding of medicinal plant.

b. Development of harvesting techniques of medicinal plant from nature, which are based either on quota or yield regulation based on regenerative capacity to ensure its sustainability.

c. Searching of substitute for medicine raw material originated from rare medicinal plant.

3. Policy and Institutional Aspect

3.1. Law and legislation on nature conservation, including the management of biological diversity, in national level has been sufficient, but the implementation is not appropriate yet, for instance there has been no any development of implementation guidelines which can be easily applied in the field, the existing law has not been widely popular and there has been no clearly sanction imposed to those who violate the law. For this reason, law enforcement need to get high priority in the whole series of conservation effort of medicinal plant utilization.

3.2. There are overlapping of authority and law between central and provincial government, between one sector and others, between public needs and the needs of a certain society around conservation forest area.

3.3. The biological diversity of Indonesian tropical forest medicinal plant will have important role as one of the basic capital for second long term National Development, so that the policy of its utilization conservation require serious consideration and full political support from the government. Total evaluation of policy of medicinal plant utilization to improve it to achieve the sustainable utilization system, need to be conducted step by step.

3.4. There is a need to consider the improvement of management of Indonesian tropical forest medicinal plant diversity, through rearrangement of the existing institutional aspect. Any policy which will be implemented require support from appropriate institutional system.

4. Research Aspect

4.1. Information on the biological diversity of tropical forest medicinal plant, obtained from survey and research, are scattered on various institutions which

conduct the research/survey. Many of the survey and research results have not been printed in accordance with publication procedure, although it is not uncommon that those results have been presented as papers in national level meeting, tracing of such information need much energy and time. To make the information tracing efficient, and integrating the conservation movement of medicinal plant utilization, development of data bank for diversity of medicinal plants is absolutely necessary to fulfill the need of scientific society, planners, users and society in general. Such data bank should be active and assuming the management function of information system and network. Beside that, such institution must function as information analysis institution which enable it to play a role in bridging between the aspect of basic research, applied research and technology development.

4.2. The conservation concept of utilization of biological diversity of Indonesian medicinal plant has not been developed based on holistic scientific approach. Problems faced in the research on biological diversity of medicinal plants are among other things: the very wide scope of research, many of the researcher are partial and do not completely answer the problem, the research is concentrated on a certain aspect which emphasize utilization aspect (phytochemistry), and lack of research on natural potency, biology, ecology and culture of medicinal plant. Research support on policy making and actions to overcome the conservation problem of medicinal plant utilization is at present appear to be far from appropriate. Because of this, several umbrellas of research which involve various scientific disciplines and related institutions, need to be developed. Beside that, support from private sector for the research, need to be developed as well.

4.3. To overcome the problem of limitation of research personnel and ability of each institution, and to make effectively the research on conservation of medicinal plant utilization, there is a need to establish national consortium of medicinal plant research in Indonesian tropical forest.

4.4. In general, the socio culture aspect obtain less than appropriate portion in the research on medicinal plant biological diversity in Indonesian tropical forest, whereas in fact this aspect plays an important role in medicinal plant, development of alternatives of culture technology, development the medicinal plant utilization, and development of medicinal plant industry. For this reason, research on socio-cultural aspect need to be enhanced in the future.

CENTRAL TOPICS OF RESEARCH NEEDED FOR SUSTAINABLE UTILIZATION OF MEDICINAL PLANTS AND ANIMALS IN INDONESIAN TROPICAL FORESTS

Research program needed for sustainable utilization of medicinal plants is the implementation of medicinal plant research systematically approach,

comprehensively/integrated, continuously and comprising all aspect of research supported by appropriate and efficient founding. Such research programs are: study of ethnopharmacology (medicinal plants and medicinal animals), inventory of potency, biology and ecology, economic resources, curing effect and safety, culture, post harvest technology, phytochemistry and pharmacology, pharmaceutical technology, marketing, quality control and management, etc.

1. STUDY ETHNOPHARMACOLOGY (MEDICINAL PLANTS AND ANIMALS)

This study is aimed at searching information an how native people around forest, utilize the diversity of forest flora and fauna for medicinal purpose, in all over Indonesia. This information is potential to discover new medicine as product of flora and fauna. According to experience, many plant extracts used for western medicine, have their origin from the knowledge of native people around the forest. Traditional medicine which has been tasted for their curing effect has been produced commercially with applied technology, and therefore native people around the forest should get their profit share from this commercialization.

2. RESEARCH ON FEEDING BEHAVIOR OF PRIMATES FOR DISCOVERING NEW MEDICINAL PLANT AND ANIMAL

This research is important as an effective method beside medicinal ethnobotany or ethnozoology (ethnopharmacology) to discover new medicinal plant and animals. As in Africa for example, research on chimpanzee feeding behavior in its natural habitat/forest, has discovered the species *Aspilia sp.* which contain bioactive substance thiarubrine A which can kill parasitic worms. Initially it is known from the fact that the chimpanzee ingest the leaves of this species at certain periods.

3. INVENTORY OF MEDICINAL PLANTS AND ANIMALS FROM TROPICAL FORESTS

This research activity is base line study of forestry, is very important to know definitely the potency of medicinal plants and animals of Indonesian Tropical forest, after the study of medicinal ethnobotany and ethnozoology has been conducted. This research activity searches the following information: species diversity, distribution, and standing crop or population condition in nature. Such activity should use the facility of geographical information system, so that the potency of medicinal plat resources can be surveyed properly in an information management system such as *Information Center for Natural Medicinal Material of Indonesia.*

4. RESEARCH ON BIOLOGY AND ECOLOGY OF PRIORITY SPECIES

This research activity comprise mainly the following question: What agent which functions as natural pollinator and seed dispersal; phenology; productivity regeneration characteristic; identification of potential pest and disease; environmental parameter or condition (physical, chemical, and biotic) which affect the growth and production of bioactive substance in each species of medicinal plant. For medicinal fauna, the following information should be investigated: population potency and distribution, population dynamics, reproduction of active substance, optimal condition of environmental/habitat for the species etc. Such information is valuable for population management in its natural habitat, or for its culture/breeding.

5. BREEDING/CULTURE OF MEDICINAL PLANTS/ANIMALS

Great concern for germ plasm resources, is an important part in the breeding/culture and genetic improvement of medicinal plant and animal which is aimed at increasing productivity, quality and continuity of raw material. Breeding /culture and genetic improvement of medicinal plant and animal, need strong support and integration from infrastructure, facilities and human resources in this country for appropriate management of natural resources.

Research on breeding/culture and genetic improvement of medicinal plant and animal should constitute a continuation and correction of existing research and development. This is important because there is a lot of technological data which need to receive follow up action for the sake of development. Up to now, medicinal plants and animals (such as rhinoceros) are produced directly from natural forest in huge amount, so that scarcity for certain species occurs. Research result on culture of priority species can be utilized for developing *multiple use forest,* agroforestry or silvopasture approach.

6. POST HARVEST TECHNOLOGY

Post harvest technology is an important asset for medicinal plant and animal conservation, because it is related with quality, content of active material, packing and the aspect of yield loss during processing. Program of post harvest research and development for medicinal plant and animal is very important and strategic in the future.

7. OTHER IMPORTANT ASPECTS

Other important aspects which need to be studied for sustainable utilization medicinal plant and animal are phytochemistry, zoochemistry, technology, stability of preparation, efficacy, efficiency and semi synthesis.

8. INSTITUTIONAL ASPECT

Institution needed for sustainable utilization of medicinal plant and animal is that which have the following function:

1. Studying the result of researches which have ever been conducted and formulating topic of follow up researches which are still needed for developing a certain product.
2. Coordinating a national umbrella research which has been agreed before.
3. Distributing research fund proportionally and evenly, and list the name of researcher and who and what to do. The institution also encourage that each research institution handle research in a team work (interdisciplinary), completely to achieve and develop product which is ready to be commercialized. The research can also be conducted until certain stage which is ready to be continued by other researcher group, so that a final product for commerce.

SOURCES

Book: Pelestarian Pemanfaatan Keanekaragaman Tumbuhan Obat Hutan Tropika Indonesia. Editor: Ervizal AM. Zuhud and Haryanto (1994) Publisher: Department of Forest Resources Conservation, Faculty of Forestry, IPB and The Indonesian Tropical Institute (LATIN).
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R & D ON MEDICINAL PLANT PRODUCT AND THEIR PRODUCTS

STRATEGY ON THE RESEARCH AND DEVELOPMENT OF TRADITIONAL CHINESE DRUGS

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In China, traditional Chinese drugs (TCD), as all aware, play a very important role in the general health service, and is by no means inferior to the drugs of the Western medicine. Much attention has been paid to the strategies of research and development recently. They are:

1. Multilevels of development: a three-fold development program has been practised, i.e., primary development towards enlarging the resources and improving the quality of TCD; secondary development towards developing new and improved preparations or products from TCD and tertiary development towards searching of new drugs originated from TCD. Several relevant examples are presented.
2. Multidisciplinary research: including botanical, pharmacognostical, chemical, pharmacological and clinical investigations are stressed, particularly the biotechnological and computer techniques are involved.
3. Multilateral utilization: TCD are being integrated to the food, cosmetic and agricultural industries as well, and their increased external application for the treatments and prevention of certain internal diseases also emerged.

Introduction

In China, traditional Chinese drugs (TCD), as all aware, play a very important role in the general health service, and is by no means inferior to the drugs of the Western medicine. The fact is well embodied in the latest edition of the Chinese Pharmacopoeia (1990 edn.), of which the first volume is completely devoted to TCD and their preparation, in all a grand total of 784 kinds. Furthermore, the patent TCD marketed have reached 4,000 items, and TCD along with their preparations are estimated to account for around 40% of the total medicament consumption. Thus, much attention has been paid recently to the strategies of research and development of TCD as follow:

Multilevels of Development

A three-fold development program (Fig. I) has been practiced. Primary development is aimed to enlarge the resources and improve the quality of TCD, either of foreign origin or wild growing ones, which have been had to be imported or are in short supply in the market from natural resources only. As to the important exotic species, *Panax quinquefolium*, *Amomum kravanh*, A. *compactum* and *Crocus sativus* have successfully been introduced and got the farm productive level. As to the important wild growing ones, *Gastrodia elata*, *Cistanche deserticola*, *Dendrobium* spp., *Poria cocos* and *Polyporus umbellatus* have been cited as successful examples for introduction and cultivation.

Secondary development is for the purposes of developing new and improved preparations or products. For instance, *Sandthom*, *Hippophae rhamnoides* is a wild medicinal plant widely distributed in China. The fruit is rich in nutrients, containing up to 12% fructose and glucose, and 3-4% organic acids. Vitamins C, B1, B2, D, E and P, as well as carotene are also found in the hit. The vitamin C contents are 868.3-1253 mg/100 g. The content of Vitamin E on seed oil is 200 mg/100 g and carotene 100 mg/100 g. Several flavonoids, e.g., isorhamnetin, isorhamnetin-3-amino-b-D-glucoside, isorhamnetin-3-b-rutinoside, as well as a few oligosides of quercetin and kaempferol have been isolated from the fruits. Pharmacological investigation showed the fruit juice is beneficial for the cardiovascular and respiratory systems. As a result, a healthy soft drink has been developed recently. Furthermore, the seed oil revealed an action to accelerate the healing of ulcer and wound, it potentially be further developed as a new preparation. Tertiary development is focused on the searching of new drugs. There are about two hundred new drugs originated directly or indirectly from TCD since 1949, of which nearly one half are from single drug, or its active principle(s), and its synthetic modification, or its active fraction, or even the total extract, while more than one half are from composite prescriptions. Only a few examples are presented in Table 1.

Multidisciplinary Research

Including botanical, pharmacogllosucal, chemical, pharmacological and clinical investigations are stressed, particularly stressed is the importance of correct identification of the botanical original plants and genuine crude drugs of TCD, since it is close related to both the quality and efficacy of TC:D. Concerning the biological technology, that of cell culture, tissue culture, rapid propagation, fermentative production and another culture in vitro are included. For instance, *Cordyceps sinensis* has been produced commercially by means of fermentative culture.

Multilateral Utilization

TCD are being integrated to the food, cosmetic and agricultural industries as well (Fig. 3). They are used as:

- Sweetener: *Glycyrrhiza uralensis*, G. *glabra* (rt, rhz), *Rubus suavissimus* (1), Siraitia grosvenovii (fr);
- Bitterness: *Humulus lupulus*, *Gentiana scabra*, *Swertia japonica*, *Citrus aurantium*, *Taraxacum mongolicum*;
- Spices: *Foeniculum vulgare* (fr), *Illicium verum* (fr), *Cinnamomum cassia* (bk), *Capsicum annum* (fr), *Piper nigrum* (fr), *Zingiber officinale* (rhz), *Zanthoxylum bungeanum* (fr), *Amomum kravanh* (fr), *A. villosum* (fr);
- Natural colouring matter: *Curcuma longa* (yellow), *Gardenia Jasminoides* (yellow), *Hippophae rhamnoides* (orange), *Lithospermum erythrorrhizon* (.violet), *Capsicum annum* (red), *Carthamus tinctorius* (red, orange);

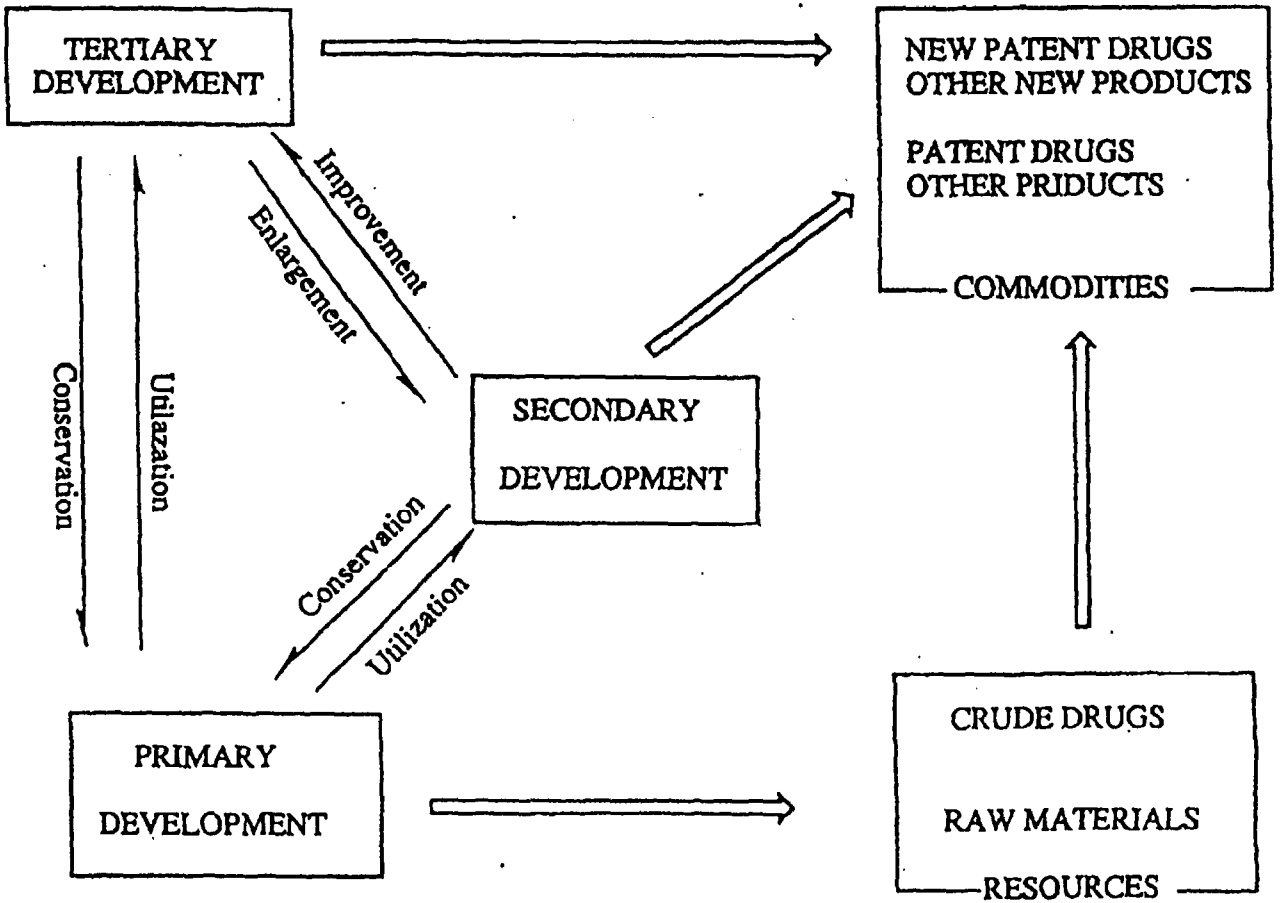

Fig. 1 A three-fold development program of TCD

Table 1. Examples of new drugs originated from TCD

Name of drug	Clue originated	Indication
Hupelzine A	*Huperzia serrata* (pl)	Improving memory for myasthesia gratis
Biphenyl dimethoxy-dicarboxylate (BDD)	*Schisandra chinensis* (fr)	Lowering SGPT
Yu-Feng-Ning-Xin Tablet	*Pueraria lobata* (rt) total isoflavonoids	Relieving sympcause by hypertensive disease
Jin-Qiao-Mai Tablet	*Fagopyrum diborys* (rhz)	Antitumor; for pulmonary abscess
Lei-Gong-Teng Tablet	*Tripterygium wilfordii* (rt)	For rheumatoid arthritis
Yin-Haung Potion	*Lonicera japonica* (fl-bud); *Scutellaria Jaicalensis* (rt)	Upper respiratory tract infection and various infection
Compound Danshen ¶ Tablet	*Salvia miltiorrhiza* (rt) *Panax notoginseng* (rt)	For cardiovascular illness
Huan-Jing-Jian potion	A compound prescription	Antisenility agent

- Natural insecticides: *Chrysanthemum roseum*, *Melia azedarach*, *M. toosendan*, *Derris trifoliata*, *Sophora flavescens*, *Tripterygium wilfordii*, *Celastrus angulatus*, Artemisia apicea;
- Healthy drinks:; *Actinidia chinensis* (fr), *Chrysanthemum morifolium* (inflor), *Crataegus pinnatifidus* (fr), *Hibiscus sabdariiffa* (calyx), *Hippophae rhamnoides* (fr), *Psidum guajava* (fr), *Ribes nigrum* (fr), *Rosa roxburgii* (fr), *Tamarindus indica* (fr), *Vaccinium uliginosum* (fr), *Zizyphus jujuba* (S);
- Healthy foods and general tonics: *Panax ginseng* (rt), *P. quinquefolium* (rt), *Astragalus mongholicus* (rt), *Cordyceps sinensis* (dead caterpillar), *Ganoderma lucidum* (fruit body), *Zizyphus jujuba* var. inermus (fr), *Dioscorea opposita* (rhz), *Lycium barbarum* (fr), *Tremella fusiformis* (pl), *Acanthopanax senticosus* (rt);
- Cosmetics: *Rosa rugosa* (fl), *Narcissus tazetta* vaz. *chinensis* (fl), *Pogostemon cablin* (pl), *Panax ginseng* (rt, pl), *P. quinquefolium* (rt, pl), *Salvia miltiorrhiza* (rt), *Angelica sinensis* (rt), *Polygonum multiflorum* (rhz), *Hippophae rhamnoides* (sd-oil).

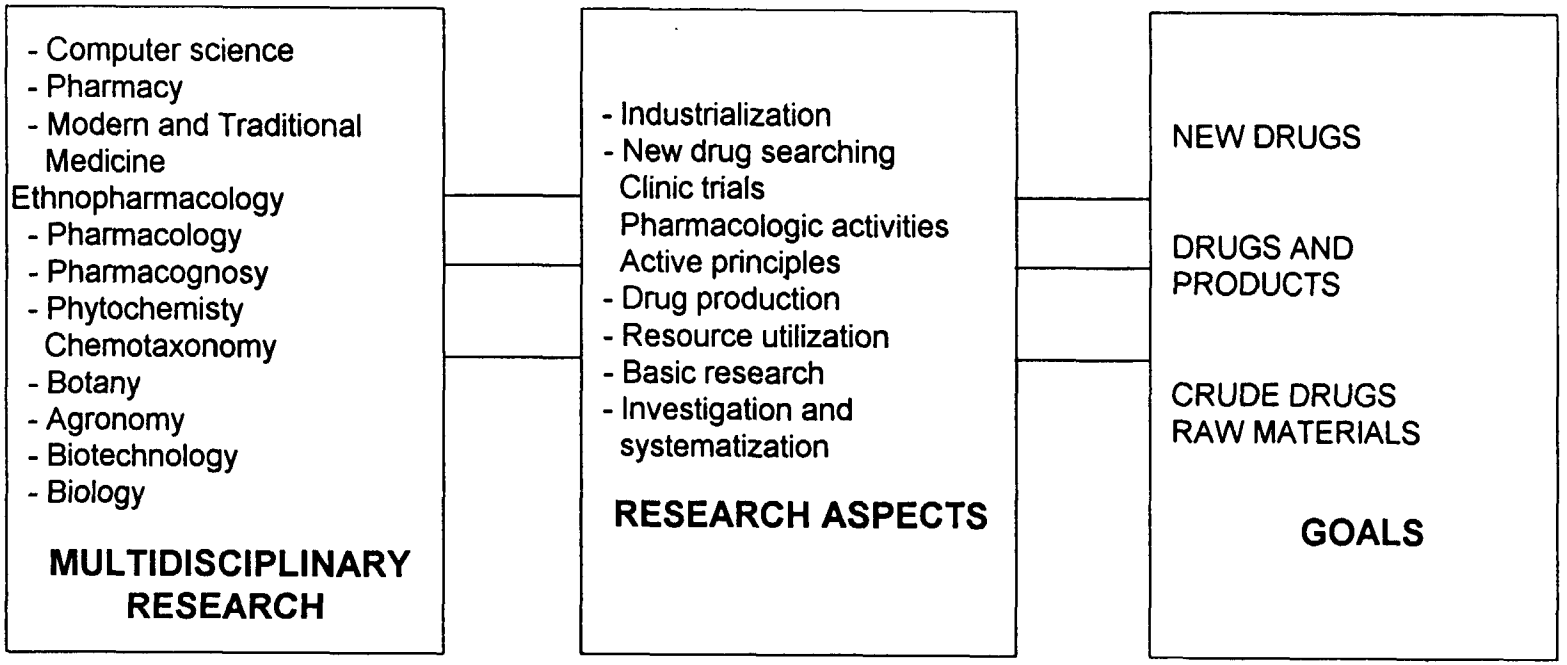

Fig. 2 Diagram of multidisciplinary research of TCD

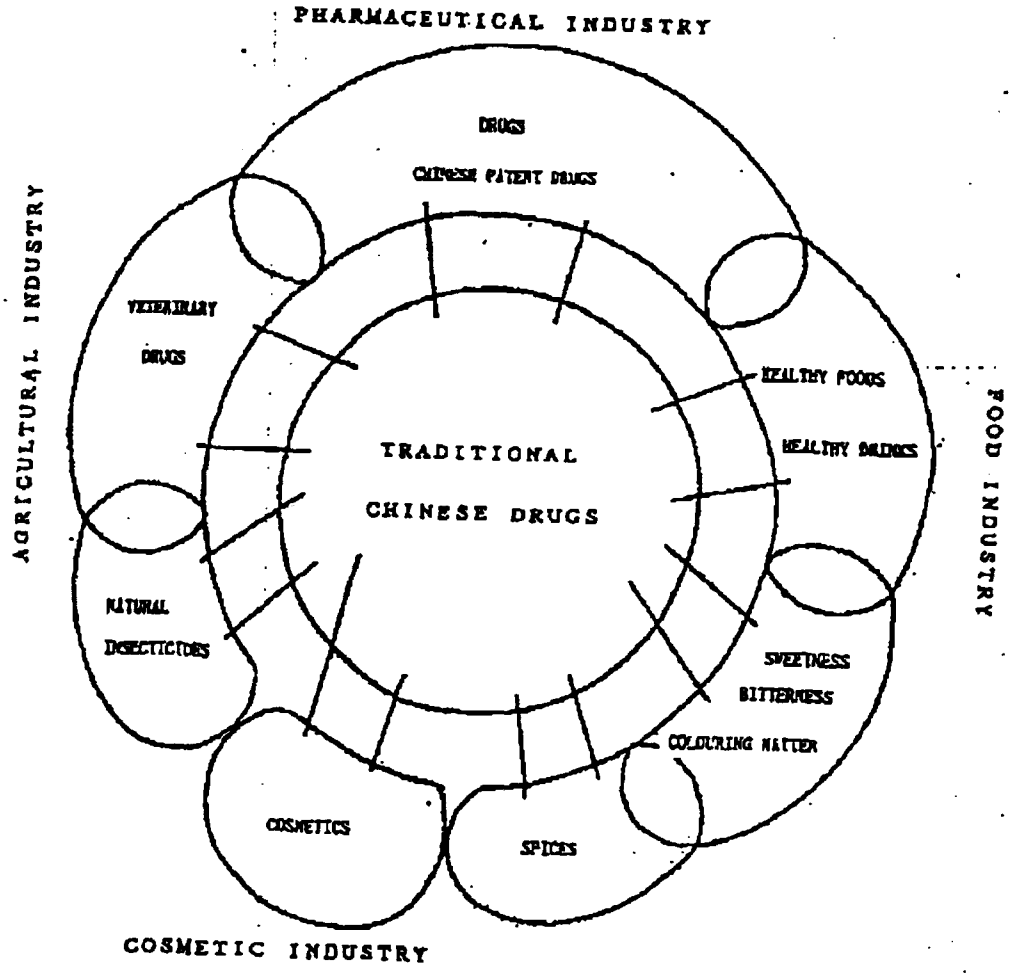

Fig. 3 Diagram of multilateral utilization of TCD

Conclusion

As a trend worldwide today that human-being favours the way of life back to nature, the transition of the medical model from treatment towards prevention of diseases, the prevalence of natural therapy and traditional medicine are becoming more and more predominates Thus, further development of the TCD, will spontaneously be integrated into people's daily life, particularly, the healthy food diets as a measure of prophylactic agents. This no doubt, entails the research and development of TCD deeply.

References

1. Xiao Pei-Gen: The Chinese Approach to Medicinal Plants-Their Utilization and Conservation.: In: **The Conservation of Medicinal Plants**, (Akerele 0., Heywood V. and Synge H. Eds.) pp 305-313, 1991. New York: Cambridge University Press
2. Xiao Pei-Gen New Advances in the Research of Traditional Chinese Herbal Medicines. In**: Proceeding of International Congress on Traditional Medicine** (Beijing 91) --pp 16-23, 1991. Beijing: State Administration of Traditional Chinese Medicine, People's Republic of China.
3. Xiao Pei-Gen and Peng Yong: Product Development of Medicinal plants, Spices and other Natural products in Chintz In: **Proceeding of Seventh Asian Symposium on Medicinal Plants, BSpices and other Natural Product**. (in Press) 1992. Manila, The Philippines.
4. Xiao Pei-Gen: The Role of Traditional Medicine in the Primary Health care System of China. In: **Economic and Medicinal Plant Research**, (Wagner H., Fansworth NR. Eds.) Vol. 4, pp 17-26, 1990. Academic Press.
5. Xiao Pei-Gen et al.: Studies on Utilization of Sandthom (*Hippophae rhamnoides* L.), **Proc. CAMS and PUMC**., 1(3): 187-188, 1986.
6. Xiao Pei-Gen: Traditional Medicine and New Drug Development. In*: Herba Polonica* (in Press) 1992.

R & D ON MEDICINAL PLANT PRODUCTS AND THEIR PRODUCTS

Drs. Soemantri Endardjo

I INTRODUCTION

Indonesia consists of five major islands and numerous small islands totaling 17.000 stretching between 95 E. longitude and 141 E. longitude along the equator. The varying land conditions as well as customs among its population and habitation of plant species, have their own specific feature in each different area, and as such the variety of species with curative qualities command different values of popularity among traditional medical communal in each part of the archipelago.

An inventory has been made on medicinal plants in Indonesia which according to estimate total 7500 species. About 1100 species can be used as raw material for medicines whilst 900 - 1000 species are so far used as traditional medicines in Indonesia (1).

National-wise, Indonesia has already the facilities/infrastructure as well as the necessary manpower available for R&D purposes in the field of medicinal plants which facilities are spread among 26 research institutions for medicinal plants. However, research activities are conducted in a manner that still require a better system of coordination in supporting efforts of making new discoveries in the medicinal field in order to meet the prevailing need for support of the health policy of the government.

The research conducted by the respective institutions are still dominated by a high priority in pursuing a performance in the science, and therefore it is felt that measures should be taken in coordinating the use of resources that are available in the institutions to be directed to the ultimate objective to make products that can be immediately utilized in line with the policies of the government in the health sector.

Human resources in the field of research still meet such constraints where nationalwise the number of researchers, according to government records, remain at such level as 1,8 researcher per 10.000 heads which is considered too low compared to the standard maintained with developed countries with minimum 10 researchers per 10.000 heads. Moreover the majority of research manpower are found with government owned research institutions and higher educational institutions.

It is for that reason that a facility is needed in Indonesia which exclusively implements and coordinates R&D activities for medicinal plants and is therefore highly

product oriented. The establishment of this facility is now under way with the assistance of UNIDO.

Research facilities with manufacturing establishments are in general restricted to big industrial corporations and said research is not realized at required stages of medicinal research as it is subject to high costs, apart from the fact that these establishments are also lacking the necessary research manpower.

Therefore a great deal of the research stages are commissioned to government research institutions as well as educational institutions however the research policies of these institutions, are far from being product oriented and therefore fail to meet the expectations of those establishments that have placed the orders related to their need of launching new products.

Research works that are performed by the major industrial establishments generally are concentrated for establishing toxicity, assessment of pharmacology effects, standardization and formulation.

II EXPERIENCE IN THE RESEARCH OF MEDICINAL PLANTS.

Research of plants for making medicines should be directed to the goal that the product should have the criteria of a certain level of safety, efficacy and of high quality. Therefore the need for standardization bears a wide impact and even starts at the stage where the plant is sown. Therefore agronomical research such as the selection of species, propagation method, cultivation and harvesting, quality control ranging from raw material through processing, post harvest treatment, storage and security precautions are matters that are essential.

At this stage government institutions and industrial sectors perform little comprehensive agronomical research that cover all aspects (2) because problems of priority policy and lack of know how and therefore some ways must be found in order to solve conditions where the government who is more capable and has better means of acquiring land, generates a more substantial role in this matter.

At the moment, to meet their need of raw materials, industrial sector is still much dependent on traditional collectors as such it may be assumed that it is not possible to expect a satisfactory quality consistency of the plant raw materials. For example *Sonchus arvensis*, a plant which in its natural habitat is wild , substantial difference of impurities content between materials delivered by traditional collectors and from our cultivation affects the separation costs in the manufacturing Process of the end products.

For big scale production to meet rapidly increasing demands, the propagation method is very important. Several plant species can create problems, in this instance among others, plants which are propagated by seed that possess very though skin such as *Abrus precatorius* needs a separate experiments.

Research to validate therapeutically effect claims through pharmacological tests on animals often cause problems because the variants with cultivation, plant parts that are used as well as methods of extraction may influence its pharmacological effect, at this very stage there is substantial work involved in efforts to achieve standardization, and this has been experienced by us with the research on *Psidium guajava*.

At the stage of big scale production technology some problem may emerge with the presence of impurities and the stability level of its phytochemical components, several species contain impurities which present a problem during the spray drying process, and some for example are capable of causing corrosive damage on the rotary feeder. Such problem may be alternatively solved by means of selecting alternative cultivation techniques which reduce impurities content or induces the separation process of impurities in fabrication.

In the formulation stage, where the raw materials are fabricated to pharmaceutical products research efforts on stability are required for such purpose as to establish the resistance of the product against transportation, storing as well as against the climate.

Products which originate from plants tend to have hygroscopic character and within a relatively short time will change color and develop fungus and this requires an accurate study to establish a reasonable self life level for the product concerned.

Because raw materials that are produced through means of cultivation by the industrial establishments is still inadequate, a research pursuant to means of accepting the plant raw materials delivered by the supplier has become essential to establish the best ways of determining the level of acceptance permissible on the part of the industries so that the end product maintains the criteria of safety, efficacy and quality.

MEDICINAL PLANT RESEARCH BY INDUSTRIES

So far an approximate number of 150 plant species have been recorded in Indonesia which are used by the traditional medicine producers (3), most of their products are produced in powder form which is directly made from the simplisia of the plant species, and packed in paper or plastic bags of 7 grams. In addition the products are also offered in the form of minced pieces or chips and packed in big plastic bags, these have to be boiled by the users.

Traditional medicine products in extract form are still very little compared to medicinal products in powder form. The extract form is normally produced and used for tablets and capsules. This type of traditional drugs are generally used on indication of promoting health conditions.

In the field of modern medicine in Indonesia the government has imposed regulations for phytopharmaca (4), giving guidance from research stage through the

production of phytopharmaca and this subject will be presented in detail by another speaker.

However a conclusion of all researches conducted on medicinal plants which are fragmented throughout the various research institutions, has resulted in a recommendation package which calls for the development of 31 plant species to be developed as phytopharmaca (see annex 1) and 19 indications suggested to be treated with phytopharmaca (see annex 2).

Plant species which so far have been studied by modern drug manufacturers and allocated in the group of phytopharmaca is still substantially small. these among others are :

1. *Curcuma xanthorrhizae*
2. *Curcuma domesticae*
3. *Piper betle*
4. *Sonchus arvensis*
5. *Strobilanthes crispus*
6. *Abrus precatorius*
7. *Orthosiphon stamineus*
8. *Psidium guajava*
9. *Momordica charantia*
10. *Allium sativum*
11. *Oldenlandia corymbosa*
12. *Anacardium occidentale*
13. *Centella asiatica*

CONCLUSION

1. Indonesia is rich in medicinal plant species due to a supportive climate and these medicinal plants have been traditionally used by the population and became increasingly popular with the prevailing "back-to-nature" trend among the society.
2. Research and Development of medicinal plants are now in progress with 26 government research institutions however research policies in institutions are not in line with the expectations of the product oriented industrial sector. Therefore a central is needed which conducts researches that are aimed at producing medicines and which coordinates research orders placed by the industrial establishment to the government research institutions.
3. Research and development activities in traditional medicine makers are still very limited and in many cases are still limited to testing of toxicity, assessment of effectiveness on animals, standardization and formulation.
4. The government has established regulations in studying medicinal plants aimed at producing medicines for formal medication, namely phytopharmaca. From results of research in government institutions it is concluded that 31 species have been

selected as a potential resource of phytopharmaca. Furthermore 19 indications have been suggested to be treated with phytopharmaca.

REFERENCES

1. Siswoyo, Zuhud.EAM., Sitepu.D, (1992) : *"Perkembangan dan Program Penelitian Tumbuhan Obat di Indonesia"*, dalam Lokakarya Pelestarian Pemanfaatan Tumbuhan Obat Hutan Tropika Indonesia.
2. Suhirman.M (1991): *"Program Perkembangan Tanaman Obat"*, dalam Prosiding Seminar Nasional Tumbuhan Obat.
3. Directorate General of Drugs & Food Control (1993) : *"Simplicia For Domestic Use 1993"*.
4. Ministry of Health (1992) : Decree of The Ministry of Health No.760/Menkes/ Per/IX/1992

ANNEXURE 1

LIST OF PLANTS SUGGESTED TO BE DEVELOPED AS PHYTOPHARMACA

No	MEDICINAL PLANT	PART USED	POTENTIAL INDICATION
1	Temulawak (*Cureuma xanthorrhiza* roxb)	Rhizome	Chronic hepatitis
2	Kunyit (*Cureuma domestica* Val)	Rhizome	Chronic hepatitis, arthritis, antiseptic
3	Bawang putih (*Allium sativum* Linn)	Rhizome	Candidiasis, hiperlipidemia
4	Jati Blanda (*Guazuma ulmifolia* Lamk)	Leaf	Hyperlipidemia
5	Handeuleum (Daun ungu) (*Graptophyllum pietum* Griff)	Leaf	Haemorrhoid
6	Tempuyung (*Sonehus arvensis* Linn)	Leaf	Nephrolitiasis, diuretic
7	Ketibeling (*Strobilanthes erispus* BI)	Leaf	Nephrolitiasis, diuretic
8	Labu merah (*Cucurbita mosehata* Dueh)	Seed	Taeniasis
9	Katuk (*Sauropus androgynus* Merr)	Leaf	Breast milk stimulator
10	Kumis Kueing (*Orthosiphon stamineus* Benth)	Leaf	Diuretic
11	Soledri (*Apium graveolens Linn*)	Leaf Whole plant	Hypertension
12	Pare (*Momordica charantia* Linn)	Fruit Seod	Diabetes mellitus Male contraceptive
13	Jambu biji (klutuk) (*Psidium guajava* Linn)	Leaf	Diarrhea
14	Ceguk (Wudani) (*Qulsqualis Indica* Linn)	Seed	Ascariasis, Oksiriasis
15	Jambu Mede (*Anacardium occidentale* Linn)	Leaf	Analgesic
16	Sirih (*Piper betle* Linn)	Leaf	Antiseptic
17	Saga telik (*Abrus preeatorius* Linn)	Leaf	Stomatitis aphtosa

No	MEDICINAL PLANT	PART USED	POTENTIAL INDICATION
18	Sembung (*Blumea balsamifera* D.C.)	Leaf	Analgesic, antipyretic
19	Benalu teh (*Loranthus spec.* div.)	Stem	Anti Cancer
20	Pepaya (*Carica papaya* Linn)	Latex Leaf Seed	Source of papain Anti Malaria Male contraceptive
21	Brotowali (*Tinospora rumphii* Boen)	Stem	Antimalaria, diabetes melitus
22	Pegagan (Kaki Kuda) (*Centolla asiatica* Urban)	Leaf	Diuretic, antiseptic, Antikheloid, hypertension
23	Legundi (*Vitex trifolia* Linn)	Leaf	Antiseptic
24	Inggu (*Ruta graveolens* Linn)	Leaf	Antiseptic, antipyretic
25	Sidowayah (*Woodfordia floribunda* Salisb)	Leaf	Antiseptic, diuretic
26	Pala (*Myristiea fragrans* Houff)	Fruit	Sedative
27	Sambilata (*Andrographis panieulata* Nees)	Whole plant Leaf	Antiseptic Diabetes mellitus
28	Jahe (Halia) (*Zingiber officinale* Rose)	Rhizome	Analgesic, antipyretic, inflammation
29	Delima Putih (*Punica granatum* Linn)	Fruit Pericarp	Antiseptic, antidiarrhea
30	Dringo (*Acorus calamus* Linn)	Rhizome	Sedative
31	Jeruk Nipis (*Citrus aurantifolia* Swingk)	Fruit	Anti Tussive

ANNEXURE 2

DECREE OF THE MINISTRY OF HEALTH NO.760/MENKES./PER/IX/I992 ON PHYTOPHARMA

Therapeutic Class which should be developed:

1. Anthelmintic
2. Anxiolytic
3. Anti Asthma
4. Anti Diabetic
5. Anti Diarea
6. Anti Chronic Hepatitis
7. Anti Herpes Genitalis
8. Anti Hiperlipidemia
9. Anti Hipertension
10. Anti Hyperthyroidism
11. Anti histamine
12. Anti Inflammatory (Anti Rheumatic)
13. Anti Cancer
14. Anti Malaria
15. Anti Tuberculosis
16. Anti Tussive
17. Disentry
18. Dispepsia (Gastritis)
19. Diuretic

PROCESSING OF MEDICINAL PLANTS

PROCESSING OF MEDICINAL PLANTS IN INDIA

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Major efforts in India during the last few decades have been directed towards ensuring adequate supply of important medicinal plants, standardization of drugs used in traditional systems of Indian medicine and development of new drugs based on the drugs of traditional systems or other natural products including the marine flora and fauna. The stress has been on use of standardized extracts rather than single active constituent even after the later has been identified and characterized.

TABLE 1. Areas of research on medicinal plants in India

Code	Areas of research	CSIR Labs	Other agencies
1	Improved agronomical practice	5	2
2	Pharmacognosy	4	3
3	Introduction of new species	2	2
4	Tissue culture propagation	4	1
5	Industrial technology for pure or purified products	5	1
6	Isolation and Characterization of constituents	9	3
7	Biogenesis	3	1
8	Pharmacological evaluation and follow up	3	4
9	Toxicity studies	2	1
10	Clinical trials	2	5
11	Standardization of traditional preparations	2	5
12	Ethnomedical studies	2	4

The main areas in which research on medicinal plants has been focused have been listed in Table 1 which also gives the number of involved laboratories of the

Council of Scientific and Industrial Research (CSIR) as well as other agencies. It will be evident from the data in this Table that CSIR laboratories have played a major role in the processing of medicinal plants. Their Contributions range from development of higher yielding strains, better agronomical practices, post harvest technology, chemical processing and biological and clinical evaluation. The major laboratories and their areas of interest have been shown in Table 2. Table 3 lists other institutions/agencies and their areas of work.

These multidisciplinary efforts has resulted in development of several new plant based drugs which are being marketed or clinically evaluated. The important products have been briefly described in Table 4.

TABLE 2. Research on Medicinal and Aromatic Plants in CSIR Laboratories

Laboratory	**Area of research**
Central Drug Research Institute, Lucknow	2,5-12
Central Food Technological Research Institute, Mysore	5
Central Institute of Medicinal and Aromatic Plants, Lucknow	1-6, 11
Indian Institute of Chemical Biology, Calcutta	6, 8
National Botanical Research Institute, Lucknow	2-4, 6, 12
National Chemical Laboratory, Poona	4-6
Regional Research Laboratory, Bhubaneshwar	1, 6
Regional Research Laboratory, Jammu	1, 2, 5, 6, 8-12
Regional Research Laboratory, Jorhat	1, 6, 11

TABLE 3. Research on Medicinal and Aromatic Plants by other Indian agencies

Agency	Areas of Research
A. GOVERNMENTAL AGENCIES	
Botanical Survey of India	1-3
Central Council of Research in Ayurveda	8, 10-12
Central Council of Research in Unani Medicine	8, 10-12
Department of Biotechnology	1, 3, 4, 5
Department of Ocean Development	2,6,8-10
Department of Environment	12
Indian Council of Agricultural Research	1-3
Indian Council of Medical Research	6,8,10-12
B. OTHER INSTITUTIONS	
Universities (Dept. of Botany, Chemistry & Pharmacy)	2,4,6,7,12
Medical & Veterinary Schools	8-10
Industrial Research Centres	3,5,8-11

TABLE 4.New Plant based Drugs Developed outside CDRI

Plant and Active Constituent	Activity	Institution
A. BEING MARKETED		
1. Boswellia serrata (Boswellic acids)	NSAID	RRL, Jammu
2. Mucuna prurata (L-Dopa)	Parkinsonism therapy	Zhandu, Bombay
3. Cyanopsis tetragonoloba (Guar Gum)	Hypolipidemic	CFTRI, Mysore
B. CLINICAL TRIAL COMPLETED		
4. Ksharsootra (Medicinal thread)	Anal fistula therapy	ICMR, New Delhi
C. UNDER CLINICAL STUDIES		
1. Adhatoda wasica (Vascicine)	Oxytocic	RRL, Jammu
2. Azadirachita indica (oil)	Spermicide	DIPAS, Delhi
3. Piser longum (Piperine)	Bioavailabity enhancer	RRL, Jammu

Several agencies have now developed more sharply focused programmes in selected areas of processing medicinal plants and have been following a task-force approach. Thus, Department of Environment has a National Programme on Ethnopharmacology to generate data on drugs used by various tribes and ethnic groups and then plan more intensive studies on selected agents. The Department of Ocean Development (DOD) has a multilaboratory programme on the Marine organisms in which 11 laboratories are participating. The Department of Biotechnology has its programme focussed on preservation and propagation of important medicinal plants. It has set up 3 centres of germ plasm and is funding projects on 15 important plants to develop higher yielding strains as well as more efficient methods of propagation including tissue culture and hairy root culture. The Indian Council of Medical Council has successfully utilised the strategy of controlled multicentric trials with carefully selected traditional remedies in Anal fistula, Bronchial asthma, Diabetes, Filaria, Urolithiasis and Viral Hepatitis. The trial of drugs are manufactured using GMP norms and parallel work on standardization and experimental evaluation is also initiated.

The Central Drug Research Institute at Lucknow has been the major Indian laboratory engaged in developing new drugs from natural sources. The ICMR Advanced Centre for Research on Traditional Remedies and the Centre of Marine Pharmacology of DOD are also located at the Institute. It has adopted a multipronged strategy using a judicious mixture of following 5 approaches:

1. Specific tests for drugs -used in traditional systems of medicine.
2. Broad based biological screening of terrestrial plants and marine organisms using a battery of 120 in vitro and in vivo tests. Over 4000 plants and 800 marine organisms have been screened.
3. Special tests based on chemical structure of isolated compounds.
4. Preparation of semisynthetic derivatives to optimise activity.
5. Initial clinical trial of drugs used in the traditional systems followed by chemical and experimental studies.

This has been very rewarding strategy and several products have already reached the market while others are under clinical studies or advanced pre-clinical assessment. In most cases stress is on development of Purified fractions standardized on the basis of their contents of active constituents. This optimises the requirement of plant material, improves efficacy ue to synergistic activity of several constituents and generally utilizes simpler technology. A summary of the salient achievements has been given in Table 5.

TABLE 5. Drugs from Natural Products Developed at CDRI

Drug	Plant	Activity
A. Being Marketed		
Gugulipid	Commiphora weightei	Hypolipidemic
Isaptent I	Plantago ovata	Cervical Dilator
Peruvoside	Thevetia nerifolia	Cardiotonic
Psoralen	Psoralea coryfolia	Leucoderma
B. Clinical Trials Completed		
Isaptent II	Plantago ovata	Cervical Dilator
Hyatin Methiodide*	Cissampelos pareira	Muscle Relaxant
C. Under Clinical Trials		
PHASE III		
Curcumin	Curcuma longa	Nonsteroidal anti-inflammatory
CONSAP	Sapindus mukorossi	Spermicide
α–β Artether*	Artemesia annua	Anti-malarial
PHASE II		
Picroliv	Picrorhiza kurroa	Hepatoprotective
Bacosides	Bacopa monniera	Nootropic
D. Preclinical Assessment		
1. Streblofil	Strebulus asper	Filaria
2. Sphingosides	Ulva fasciata**	Antiviral

* Semi-synthetic

** Marine Alga

It will be evident from this brief report that in harnessing care needs of its case value added products and formulations are being prepared for export purposes also. There are adequate facilities for Human resource development and the country is aware of the need to preserve biodiversity. The threatened species have been identified and effort are being made to conserve them. Priorities are being defined for diseases where new drugs need to be developed. Another area receiving attention is evaluation of biological activity of endemic plant species to ensure Preservation of adequate quantities of their germ plasm. India will be happy to collaborate with other Asian countries to optimise the benefit from this rich resource to provide adequate health care to the large population of the continent.

SELECT BIBLIOGRAPHY

1. Current Research on Medicinal in India. Ed. B.N. Dhawan. Indian National Science Academy, New Delhi, 1986.
2. Research and Development of Indigenous Drugs. Ed. P.C. Dandiya and S.H. Vohora, Institute of History of Medicine and Medical Research, New Delhi, 1989.
3. The Medicinal Plant Industry. Ed. R.O.B. Wijesekera, CRC Press, Boca Raton, 1991.
4. Herbal Medicine for Human Health. R. Roy Chaudhury, WHO Regional Office for South East Asia, New Delhi,1992.
5. Efficacy and Safety Evaluation of Herbal Medicines and the Development of New Plant-based Drugs. B.N. Dhawan. UNIDO, Vienna Document No ID/WG.540/1 (Spec.) for the UNIDO Expert Group Meeting at Brazzeville, 20-23 November, 1995.

APPENDIX

HERBAL DRUG MARKET (INDIA)

S.No	Materials	Marketed by NRD/RM	Nature	Approx. sales value (Rs. in crores) 1993	Total Market value estd. (Rs. in crore) 1993
1	Formulations	NRD	-	-	
		RM	Hepatoprotective	25	
			Cardiotonics	3	
			Antiulceragents	3	
			Nervine tonics	4	
			Antiinflammatory	2	
			Pain blam	40	
			Antitussives & cough preparation	26	
			Inhalants	2	
			Cold preparation	6	
			Hypocholesteric tonics	1.5	
			Ginseng	32	
			Laxatives	7.5	
			Geriatrics	3.2	
			Antacids	14	
			Tonics	0.15	
			Others	3	
			Skin preparation	15	
					200
2	Extracts	NRD	-	-	-
		RM	Oleoresins	70	70
			Herbal extracts		
		Export	Oil from condiments	5.4	5.4
3	Raw herbs	NRD	-	-	-
		RM	540 herbs used		
			150 exported	92	92
			Spices	382	382
4	Food supplements		Chyavanprash	50	50
5	Phyto-Chemicals	RM	Alkaloids (Including imported)	20	20
					819.4

Source:ORG, PHARMATIMES, CHEMEXIL, IDMA BULLETIN
NRD = Non Recognised Dealers
RM = Recognised Manufacturers

UTILIZATION OF INDIGENOUS MEDICINAL PLANTS IN NEPAL

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INTRODUCTION:

Nepal, with its unique geography is a country rich in biodiversity. The climate ranges from sub-tropical to alpine, depending upon the elevation, as one moves from south to north. Over 5,400 species of vascular plants have been recorded in Nepal (HMG/IUCN, 1988). About 700 species of medicinal plants are indigenous to Nepal (HMG/IUCN,1988).

In Nepal, the rural population has been involved in the collection of naturally occurring medicinal plants since ancient times. In the hilly and mountainous regions, this activity has supplemented their meagre income from subsistence agriculture; however, in most instances, these true collectors have not been able to benefit fully because of exploitation by middlemen and herb traders.

The country currently consumes approximately two billion rupees worth of pharmaceuticals annually, about 85% of which is met through imports (the bulk from India). The ancient, or traditional, practice of Ayurveda is still prevalent; the share of Ayurvedic medicines in the total consumption of pharmaceuticals is about 10% (Pradhan,1995).

The global resurgence in the consumption of `green', or organic products is a very positive scenario. Developing countries such as Nepal should, indeed, avail of this excellent opportunity to utilize their natural resources.

PRODUCTION AND TRADE:

At present approximately fifty species of medicinal plants are traded; they are mainly exported to India. These species or their parts are harvested form the natural environment. Table 1(Annex) depicts the quantity of major species of medicinal plants collected in Nepal while Table 2 (Annex) shows the revenue collected by the Department of Forests as royalty.

The Department of Plant Resources (formerly the Department of Medicinal Plants) stared the experimental cultivation of some medicinal plants, which included

both indigenous as well as exotic species, in its herbal farms located at different altitudes and climatic zones as shown in Table 3 (Annex) [Bashyal et al, 1994].

Research in tissue culture by DPR led to successes in the development of the methods of mass production of different plants of ornamental and economical significance. Despite its success, the experiment has been limited mostly the laboratory. However DPR's work on phytochemical screening and pharmacological study of medicinal and aromatic plants and studies on essential oils are noteworthy [Bashyal et al, 1994]

Poor harvesting and post-harvesting practices, adulteration, historical market control by outsiders (India), and lack of international reputation and uses for Nepal's products are major obstacles (Rawal, 1995).

TRADITIONAL UTILIZATION:

Since the Nepalese population is chiefly rural, it has a strong tradition in the use of medicinal plants. Traditional usage is either through local faith healers ('JHANKRIS') or Ayurvedic physicians - 'VAIDYAS'. Although Ayurveda is a well developed medical science having ancient roots, it remains much of a mystery since most of the Vaidyas prescribe and formulate drugs, the formulas of which have been handed over the generations from father to son. It is only in relatively recent times that this sector has taken an organized look, especially with the modernization of the big Ayurvedic pharmaceutical companies in neighboring India. Singha Durbar Vaidyakhana, in the public sector, is the pioneer in local, organized manufacture of Ayurvedic medicines. Plans are under way for its modernization and it has been converted to an autonomous development board (committee). Notable Ayurvedic concerns in the private sector are Krishna Aushadhalaya, Piyusvarshiya Aushadhalaya.

Gorkha Ayurveda company (P) Ltd. was initially set up as a joint venture with a French organization. It has succeeded in exporting a sizeable quantity of herbal tea to Europe, i.e., Rs.3.5 million worth of herbal tea. Recently the giant Indian Ayurvedic concern Dabur has set up a manufacturing plant in Nepal (Dabur Nepal Ltd.) for the manufacture and export of tooth powder, tooth paste, herbal candies, herbal hair oils, etc.

POTENTIAL MEDICINAL PLANTS FOR INDUSTRIAL UTILIZATION:

Table 4 (Annex) depicts the indigenous and exotic (cultivated) medicinal plants which have the potential for industrial utilization. Some of these plants are already being utilized but there is scope for a greater degree of utilization, as highlighted below:

1. *Aconitum spicatum*, (local name: BIKH):

It is an erect herb (up to 1.5 m tall) distributed throughout the alpine zone of the Himalayas from 3000-3600m. Externally aconite is used for neuralgia and rheumatism; internally it acts as a cardiac depressant and also relieves pain. Herbs Production and

Processing Company Ltd. at present produces an alcoholic extract for formulation into an externally applied liniment manufactured by a public-sector pharmaceutical company (Royal Drugs Ltd.).

2. *Adhatoda vasica* (local name: ASURO):

It is a shrub occurring from the Terai plains up to 1200 meters. The leaves are used in cough, chronic bronchitis, and asthma. Vasaka extract prepared by HPPCL is incorporated into expectorants manufactured by Royal Drugs Ltd.

3. *Artemisia vulgaris* (local name: TITEPATI):

It is a common herb occurring between 1500 to 3600m. The herb is believed to have anthelmintic, antispasmodic and stomachic properties. The essential oil has insect-repelling properties and has been formulated into an insect and leech repellant by HPPCL.

4. *Acorus calamus* (local name: BOJHO):

It is an erect, aromatic, perennial herb, occurring at 1800m. The rhizomes are emetic, stomachic. The essential oil has carminative properties and is used to flavour liquors, beverages and confectionery. Distillation of the essential oil and its export are carried out by HPPCL and Natural Product Industries (a private-sector company).

5. *Nardostachys grandiflora* (local name: JATAMANSI,BHUTLE):

It is an erect herb distributed throughout the alpine region at altitudes of 3300-5100 metres. In traditional medicine, the rhizome is used as a bitter tonic, stimulant, antiseptic and is also employed for the treatment of epilepsy, hysteria, convulsions. It is also believed to be useful in intestinal colic because of its antispasmodic properties. Due to the presence of the essential oil, the rhizome also has carminative properties. The essential oil is distilled on a commercial scale in large manufacturing establishments (HPPCL,NPI) or in smaller field distillation units in the mountains (Humla, Jumla). The oil finds a ready market in India, Europe, USA for use as an aroma therapy ingredient, flavour or fragrance raw material.

6. *Valeriana jatamansi* (Local name: SUGANDHAWAL):

It is an erect, perennial herb occurring at 1200-3000m. throughout Nepal. The root is stimulant, antispasmodic; because of its sedative properties, it is useful in hysteria, epilepsy. Since the essential oil content is rather low, an oleoresin has been extracted for sale to the perfumery industry. The oleoresin has wide potential for use as a medicinal extract as well as a flavour raw material.

7. *Zanthoxylum armatum* (local name: TIMUR):

It is a thorny shrub or small tree occurring throughout the Mahabharat and Himalayan regions of Nepal at altitudes of 1500-2400m. Traditionally, the seeds and bark are used as an aromatic, tonic in fever, dyspepsia and cholera. The fruits, branches and thorns are used as a fish poison; they are also used as a remedy for toothache and are considered to have carminative and stomachic properties. The fruits yield an essential oil (2-3%) on distillation, which is rich in linalool (50-60%) and also containing other constituents like limonene, cineole, methyl cinnamate. Investigations have been carried out at University of Dusselldorf and Innsbruck University on the anti-inflammatory properties of the fruit and the essential oil (present in the pericarp). The essential oil is distilled for sale to the fragrance-flavour industry. It has been recently formulated into analgesic and insect-repellant herbal formulations.

8. *Taxus wallichiana* (local name: LAUNTH SALLO, BURMA SALLO, PATE SALLO):

This tree is commonly known as the Himalayan yew and occurs between 1800-3400 meters in the temperate belt. Traditionally, the leaves have been used in asthma, bronchitis, hiccough, for indigestion and epilepsy. The leaves have been found to yield a resin upon extraction with appropriate solvents; the resin contains taxanes that can be converted to taxol, a known, potent anti-cancer agent especially effective against ovarian and breast cancer.

9. *Pinus roxburghii* (local name: RANI SALLO or KHOTE SALLO):

This large tree (up to 33m in height) is distributed mainly in the warm temperate belt, at altitudes of 800-2200m. The resin is collected for the production of turpentine oil and rosin (colophony). Approximately 6,000 tons of resin is processed every year and this could well be increased several fold. The turpentine oil distilled is mainly used in the paint industry and aroma chemical industry, the bulk of it being exported to India. Similarly, rosin is also chiefly exported to India and finds applications in the rubber industry, paper industry, synthetic resin industry and pharmaceutical industry.

10. *Gaultheria fragrantissima* (local name: DHASINGARE or PATPATE):

It is a stout shrub distributed between 1500 to 2400m. The leaves yield an essential oil (Oil of Gaultheria, or Wintergreen oil), rich in methyl salicylate. Medicinally, Wintergreen oil is used to treat rheumatism, neuralgia and other musculoskeletal afflictions. The oil is widely used as a flavouring ingredient in toothpastes, mouthwashes, non- alcoholic beverages, candies, chewing gums. It also finds applications in the perfumery industry. At present, annual production of Wintergreen oil is between 1,000-1500 kg, with the total involvement of rural households. The oil is exported to Western Europe, Australia. For local consumption, it has been formulated into a massage oil.

11. *Tinospora cordifolia* (local name: GURJO):

It is a climbing shrub used as a bitter, stomachic, and antipyretic. It has been formulated into herbal tea using flavours such as mint, lemon grass and chamomile. the bulk of this tea is exported to Europe.

Other important species are given in Table 4 (Annex).

B. CULTIVATED SPECIES:

The species mentioned below are at present cultivated for their essential oil content which chiefly finds applications in the fragrance-flavour industry.

1. *Cymbopogon flexuosus* (Lemon grass):-

Owing to high citral content (70-80%), Lemon grass oil is used by bulk producers for the manufacture of B-ionones which are converted to Vitamin A. About 1.25 to 1.5 tons of Lemon grass oil is produced by HPPCL annually in its own plantations.

2. *Cymbopogon winterianus* (Citronella):

4 to 5 tonnes of Citronella oil is produced by HPPCL every year. The oil is distilled from plant material cultivated in HPPCL's farms and extension areas in the Terrain (plains). Scope exists for multiplying production and ultimate use of Citronella oil for manufacture of insecticides. Local soap manufacturers use some of the oil as a perfume.

3. *Mentha arvensis* (Japanese mint):

Annual production of Oil of *Mentha arvensis* ranges between 0.75 to 1.5 tons. This oil is produced by HPPCL and finds applications in the manufacture of toothpastes, tooth powder, candies. It has been incorporated into herbal pharmaceutical preparations for the relief of cough, common cold, headache, nausea, foul mouth. The entry of joint-venture pharmaceutical firms and cosmetic and consumer- product manufacturers such as Hoechst Nepal Pvt. Ltd., Nepal Lever Ltd., Dabur Nepal Pvt. Ltd., etc., has indeed increased the local demand for Oil of *Mentha arvensis*.

4. *Tagetes minuta* (Wild marigold):

The crop is at present cultivated for production of small quantities of essential oil (25-50 kg/yr.). With proper research, the oil could find use in the manufacture of insecticides. However due regard should be given to its potential phototoxic properties.

5. *Matricaria chamomilla* (German chamomille):

Only 10 to 20 kg of Matricaria oil is produced by HPPCL. This quantity could be increased and the essential oil could be utilized by cosmetic manufacturers. The oil has

anti-inflammatory properties which could be exploited by the local pharmaceutical industry. Its carminative and antispasmodic effects could also be utilized.

POTENTIAL AND CONSTRAINTS IN COMMERCIAL AND INDUSTRIAL UTILIZATION OF MEDICINAL PLANTS:

According to a recent survey conducted by the American Herbal Products Association (AHPA), the retail value of plant-derived products such as herbal tea, dietary supplement and traditional medicine in the USA was of $ 1.3 billion in 1991; this figure had exceeded $ 1.5 billion by 1994. The estimates for Japan and Europe are believed to be around US $ 4 billion (Gupta, 1995). Thus, bright prospects are definitely there for the developing countries by way of export of plant-derived products.

As already seen from many of thee examples cited above, the potential for utilization of naturally occurring medicinal plants or cultivated species in Nepal is evident.

However, in order to realize this potential, numerous constraints have to be overcome. The major constraints are listed below:

1. The bulk of the medicinal plants utilized for processing is collected from the wild, or from natural source.
2. For the above reason the availability of the plant is not ensured. This affects the sustainability or viability of any industrial venture. Some plants are facing the danger of complete elimination.
3. The percentage of active constituents, or quality of the medicinal plant, is not homogenous in the case of collected plants.
4. Contamination or adulteration is a frequently experienced phenomenon. It is often difficult to identify and sometimes practically impossible to remove the impurities.
5. The agrotechnology for domestication of many of the naturally occurring species has not yet ben developed.
6. There is a lack of research on the development of high yielding varieties in the case of cultivated species. It is often very difficult to secure good-quality, or superior, planting material.
7. The harvesting practices and post harvest treatment are not optimum.
8. Lack of access to efficient, cost-effective processing technology.
9. Lack of access to latest technological and market information.
10. Lack of local market for primary processed products (extracts, resins, etc.)
11. Difficulties in marketing products internationally.
12. Lack of trained personnel and equipment.
13. Lack of financial resource, loans, credit facilities

CONCLUSION:

Despite numerous existing constraints (as cited above) in the development of medicinal and aromatic plants (MAPs), more collective efforts in terms of R&D and management are needed to gear up systematic production, harvesting, trading, value-addition, utilization and marketing (Rawal et al, 1995).

There is an urgent need to develop agrotechnology for the domestication of naturally occurring medicinal and aromatic plants, especially those species exploited heavily (Rawal, 1994).

RECOMMENDATIONS:

1. National priority should be given to medicinal plants. A separate policy should be formulated to encompass medicinal and aromatic plants.
2. Adequate research should be conducted with the specific aim of solving problems related to medicinal plants.
3. The collection, or harvesting, of medicinal plants from the naturally regenerating forest should be streamlined and monitored for effective control on indiscriminate collection.
4. The Department of Forests should take a leading role in the regeneration of medicinal plants. Plantations should be developed in the appropriate ecological zones for replenishing the growing stock simultaneous to collection or harvesting from the natural resource base.
5. It is desirable to formulate an integrated resource development plan for effective and sustainable management of medicinal plants.
6. There is the urgent need to develop agrotechnology for the domestication of naturally occurring medicinal plants, especially those species exploited heavily.
7. Special protection should be provided to forest areas where the danger of depletion of medicinal plants is high.
8. Collectors need to be trained on proper post-harvest techniques (drying, storage) in order to minimize wastage and unnecessary losses.
9. Access to commercially feasible processing technology is very important. Value-addition may be enhanced by product diversification and manufacture of finished formulations (pharmaceuticals, cosmetics)
10. The trade and marketing practices with regard to medicinal plants and products derived from them should be improved. Local and regional markets must not be overlooked. Joint- ventures with foreign, or trans-national, companies should be encouraged only after carefully weighing the pros and cons and studying thoroughly the potential benefits to the developing country concerned.

11. Sustainable benefits can only be realized if the local population is educated about the economic benefits of the medicinal plants and the need to conserve them for future generations.

REFERENCES:

1. Bashyal, B.P. et al (1994), Role of Research and Development in Commercial Utilization of NTFPs : Medicinal and Aromatic Plants, National Seminar on Non-timber Forest Products : Medicinal and Aromatic Plants, Sept. 11-12, 1994, Kathmandu.
2. Gupta, R. (1995), Farming Medicinal and Aromatic Plants as Sources of Raw Materials for Industrial Development in SAARC Countries, SAARC Meeting of Experts on Cultivation/Utilization of Medicinal and Aromatic Plants, Oct. 18-20, 1995, Colombo, Sri Lanka.
3. Building on Success - The National Conservation Strategy for Nepal (1988), HMG - Nepal/IUCN, Kathmandu.
4. Pradhan, J. (1995), Country Report:
   Utilization of Medicinal and Aromatic Plants in the Pharmaceutical and Related Industries in Nepal, Training Programme on the Utilization of Medicinal and Aromatic Plants in Pharmaceutical and Related Industries, Anadolu University Medicinal and Aromatic Plant and Drug Research Center, Eskisehir, Turkey, 4-27 sept., 1995.
5. Rajbhandary, T.K. and Bajracharya, J.M. (1994), National Status Paper on NTFPs: Medicinal and Aromatic Plants, National Seminar on Non-timber Forest Products: Medicinal and Aromatic Plants, Sept. 11-12, 1994, Kathmandu.
6. Rawal, R.B. (1994), Commercialization of Aromatic and Medicinal Plants in Nepal, Regional Expert Consultation on Non-wood Forest Products: Social, Economic and Cultural Dimensions, FAO Regional Office for Asia and the Pacific, Nov. 28-Dec. 2, 1994, Bangkok, Thailand.
7. Rawal, R.B. (1995), Constraints to the Development of Non-timber Forest Products in Nepal, Voices from the Field: Sixth Workshop on Community Management of Forest Lands, Feb. 6- Mar. 17, 1995, Program on Environment, East-West Center, Honolulu, Hawaii, U.S.A
8. Rawal, R.B., Bashyal, B.P. (1995), Medicinal and Aromatic Plants (MAPs) in Nepal (Country Paper), SAARC Meeting of Experts on Cultivation/Utilization of Medicinal and Aromatic Plants, Oct.18-20, 1995, Colombo, Sri Lanka.

ABBREVIATIONS:

DPR : Department of Plant Resources
HMG : His Majesty's Government
HPPCL : Herbs Production and Processing Company Limited
IUCN : International Union for the Conservation of Nature and Natural Resources.
MAPs : Medicinal and Aromatic Plants
NPI : Natural Product Industries

ANNEX

Revenue Collection of Major Species

Table-2 (NRS. in thousand)

S.No.	Scientific Name	Local name	89/90	90/91	91/92	92/93	93/94
1	Acorus calamus Linn.	Bojho	11.00	19.00	27.00	17.00	9.00
2	Acacia concinna DC.	Sikakai	29.00	5.00	21.00	28.00	20.00
3	Aconitum heterophyllum Wall. ex Royle	Atis	6.00	4.00	70.00	28.00	11.00
4	Asparagus racemosus Willd.	Satawari	104.00	82.00	58.00	288.00	75.00
5	Bergenia ciliata (Haw) Sternb	Pashanved	45.00	115.00	96.00	131.00	34.00
6	Cinnamomum tamala (Buch-Ham) Nees & et Eberm	Tejpat	15.00	11.00	27.00	213.00	87.00
7	Cinnamomum zeylanicum Blumee	Dalchini	130.00	176.00	536.00	291.00	578.00
8	Dioscorea deltoidea Wall.	Bhyakur	7.00	16.00	57.00	21.00	22.00
9	Elaeocarpus sphaeericus (Gaertnn) K.Schum	Rudrakshya	246.00	89.00	246.00	137.00	134.00
10	Lycopodium clavatum Linn.	Nagbeli	73.00	84.00	127.00	163.00	58.00
11	Lichen sp.	Jhyao	170.00		142.00	565.00	519.00
12	Nardostachys grandiflora DC.	Jatamansi	777.00	827.00	493.00	1423.00	793.00
13	Picrorhiza scrophulariae flora Pennell	Kutki	111.00	20.00	132.00	287.00	200.00
14	Paris polyphylla J.E. Smith.	Satuwa			4.00	6.00	11.00
15	Rubia manjith Roxb ex Fleming	Majitho	7.00	60.00	45.00	61.00	61.00
16	Rheum emodi Wall ex Meisn	Padamchal	6.00	45.00	26.00	896.00	331.00
17	Swertia chirata (Roxb) Fleming Kartson	Chiraito	285.00	360.00	187.00	347.00	438.00
18	Sapindus mukorossi Gaertn.	Rittha	262.00	14.00	478.00	357.00	628.00
19	Valeriana jatamansi Jones	Sugandhawal	48.00	65.00	56.00	62.00	1074.0
20	Zanthoxylum armatum DC	Timur	640.00	1121.0	1301.0	1069.0	1039.0
	Total		2972.0	3113.0	4129.0	6390.0	6122.0

Source: Dept. of Forest (ass cited in Rajbhhandary, T.K. and Bajracharya, J.M. -1994)

ANNEX

Table 3: Medicinal Plants Experimentally Cultivated by Department of Plant Resources (formerly Dept. of Medicinal Plants).

Chrysanthemum cinerariaefolium
Atropa belladonna
Valeriana jatamansi
Asparagus racemosus
Acorus calamus
Podophyllum hexandrum
Costus speciosus
Cymbopogon winterianus
Cymbopogon flexuosus
Claviceps purpurea
Mentha arvensis
M.piperita
Dactylorhiza hatagirea
piper longum
Digitalis lanata
D.purpurea
Nardostachys Grandiflora
Picrorhiza scrophulariiflora
Rheum australe
Aconitum spicatum
Swertia chirayita
Rauwolfia serpentina
Catharanthus roseus
Santalum album
Mucuna prurieens

ANNEX

Table 4: Potential Medicinal Plants for Industrial Utilization

A. INDIGENOUS	B. CULTIVATED
Acacia concinna	*Cymbopogon flexuosus*
Aconitum spicatum	(Lemongrass)
Acorus calamus	*Cymbopogon winterianus*
Adhatoda vasica	(Citronella)
Artemisia vulgaris	*Mentha arvensis*
Asparagus racemosus	*Tagetes minuta*
Berberis aristata	*Matricaria chamomilla*
Centella asiatica	
Dioscorea deltiodea	
Emblica officinalis	
Ephedra gerardiana	
Gaultheria fragranfissima	
Nardostachys grandiflora	
Picrorhiza scrophulariiflora	
Pinus roxburghii	
Podophyllum hexandrum	
Rheum australe	
Rubia manjith	
Sapindus mukorossi	
Swertia chirayita	
Terminalia chebula	
T.bellerica	
Taxus wallichiana	
Tinospora cordifolia	
Valeriana jatamansi	
Zanthoxylum armatum	

THE RESEARCH & DEVELOPMENT ACTIVITIES ON MEDICINAL PLANTS & THEIR PRODUCTS AT CEYLON INSTITUTE OF SCIENTIFIC & INDUSTRIAL RESEARCH

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INTRODUCTION

Sri Lanka is a small island , approximately 65610 sq. kilometers in areas The climate is tropical with high relative humidity and the temperature varies from 14 - 28 C with altitude. The total land area amounts to 6.56 million hectares of which one fifth is forest and forest reserves. Sri Lanka despite its small size has a flora of great richness and diversity. Over 3350 species of flowering plants have been described and as much as 23 % of the species of flowering plants are endemic

Sri Lanka has two parallel systems of medicine. One is the western medical system which is highly developed and the second is the tradition systems of medicine which includes mainly Ayurvedic system of medicine which originated from India and also Unani and Siddha to a small extent

The Ayurvedic system in Sri Lanka has a history of over 2500 years in Sri Lanka. Despite vast advances in western medicine still a large percent of the population in Sri Lanka depends on Ayurvedic system of medicine for their primary health care needs. Due to its importance the Govt. of Sri Lanka has established a Ministry for Indigenous medicine. There two degree awarding institutes for traditional medicines several teaching institutes leading to diploma in Ayurveda, one research institute, 41 hospitals and 100 dispensaries all manned with people trained in Ayurvedic medical system. The Ayurvedic Drugs Corporation which is now know as Sri Lanka Herbal Products Company is the biggest manufacturer of herbal drugs in the country. In addition to this there are about 84 other registered herbal drug manufacturers in the Country

A large quantity of medicinal plant medicinal plants used in Ayurvedic medicines are gathered from the forests or imported to the country from India. Annually Sri Lanka imports around US $ 620,000 worth medicinal plants through the Ayurvedic Department. Sri Lanka also supplies raw materials to foreign pharmaceutical countries where they are processed and re exported to developing

countries as pharmaceuticals at very high prices. The demand for phytopharmaceutical product is increasing rapidly in the international market. Therefore there is an urgent need for cultivation of medicinal plants in the country as the wild sources are declining fast due to over exploitation.

The Ceylon Institute for Scientific & Industrial Research has launched a research & development programme on medicinal plants. The Research & Development studies on medicinal plants carried out at CISIR can be broadly categorized under the following headings.

1. Analytical studies
2. Agronomical studies
3. Phytochemical and pharmacological studies
4. Preparation of value added products
5. Evaluation of Ayurvedic drugs

ANALITICAL STUDIES

The objectives of the analytical studies are to :

1. Determine the quality of medicinal plants growing in the country and to select suitable plants for future propagation.
2. To study the seasonal and geographic variation in the chemical constituents of the local medicinal plants.
3. To establish quality control services to help the exporters by supplying quality control reports and local drug industry by selecting correct harvest time of the plants and standardization of medicinal preparation

Analytical studies on *Cinchona, Rauwolfia serpentine, Gloriosa superba, Catharanthus roseus, Adathoda vasica, Cassia angustifolia, Solanum xanthocarpum and Strychnos nux vomica* grown in Sri Lanka have been carried out to determine the quality of the local plants. Adathoda vasica is widely used in Ayurvedic medicine as an expectorant The five parts of this plant namely inflorescence, leaf, petiole, root and the stem bark are used in the decoction. Vasicine is the major constituent of the plant. It possess slight hypotensives appreciable bronchodilatory and respiratory stimulant activities. We studied the seasonal variation of vasicine in the five parts of the plant. The highest content vasicine is found in the inflorescence throughout the year and all the parts contained the highest yields in the months of July to Sept. These studies indicate that the best part of the plant to harvest in order to obtain the maximum yield of vasicine is inflorescence and that this will not lead to destruction of the plant.

Quality control studies on Ayurvedic drugs and other herbal preparations are being carried out for herbal drug manufacturers at a request one drug manufacturer quality control parameters for over twenty Arishtas and Asavas (herbal wines) were laid down to ensure the consistency of the quality of the products.

AGRONOMICAL STUDIES

The agronomical studies were carried out to

1. Determine the suitable agroecological regions and seasons for cultivation of medicinal plants.
2. To study the optimum time to apply the fertilizer and harvest the plant to obtain maximum yields to determine the effects of different fertilizers and spacing on the yields.
3. To introduce high yielding medicinal plants to the country and to supply planting materials and technical know to growers and promote cultivation of medicinal plants in the country.

These efforts will enable the supply of quality raw materials to the local and export market, earn foreign exchange to the country, increase the income of farmers and rural folks. Also these efforts will lead to protection of the biodiversity of the country. The plants that were studied are *Catharanthus roseus, Gloriosa superba, Cassia angustifolia, Solanum xanthocarpum, Hibiscus abelmoschus, Plectranthus zeylanicum, Piper tongue, Sithania somnifera, Plumbago indica and Kaempheria galanga.* The cultivation trails were conducted at CISIR farm at Girandurukotte. Some trials are presently being carried out at Walpita farm of the Coconut Research Institute.

Charanthus roseus (is. Minimal) is a well known medicinal plant. The leaves contain vinblastine and vincristine which are being used as anticancer agents and the roots contain ajmalicine which has hypotensive and vasodilator activities. The plant is known in indigenous system of medicine for its diuretic activities. As this plant has a good export potential cultivation trials on this plant were carried out. Our preliminary studies indicated that the best time to harvest the plant in order to obtain maximum dry matter and alkaloid yields is when the plant was 10 months old. We studied the effect of 'Maxi crop' a foliar application of plant nutrients on the dry matter and the alkaloid yields and observed that significant increases can be obtained by foliar application of plant nutrients containing micro elements and growth hormones. It was observed that it is economically feasible to practice this treatment. Studies were also carried out determine the effects of cattle manure, NPK, NPK and micro elements cattle manure and microelements on the yields. Significant increases in the dry matter and total alkaloid yields were observed in the plants treated with NPK and micro elements. Our studies are useful to the farmers to improve the yields and the quality of the plants

Cassia angustifolia (S. senehe) is an important plant laxative used in Western as well as in Ayurvedic treatments. The sennosids are the active ingredients of this plant. We studied the contents of the sennosides in the leaves, pods and the stem bark and observed the highest yield in the pods followed up by leaves and stem bark. The studies the variation of the sennoside contents in the leaves with maturity indicated that the most appropriate time to harvest the leaves is when they are 95 days old and

bluish green in colour. In the case of the pods the highest sennoside yields were observed at the age of about 125 days just before the pods start turning black. Field trials were conducted to study the effect of nitrogen fertilizer on sennoside contents The optimum level of N fertilizer was found to be 120 kg/ha.

Solanum xanthocarpum (s. Katuwelbatu) is another plant imported from India for use in the Ayurvedic medicine as an expectorant. The expectorant property is due to the alkaloids present in the plant. Solasodine is one of the commercially important alkaloids present. The glycoalkaloid and the solasodine contents in different parts of the plant were estimated by TLC- densitometric method developed in our laboratory The highest content of glycoalkaloids and solasodine contents were found in the berries followed by foliage and roots. The alkaloid contents in the berries were found to increase as they matured. The effects of fertilizers and plant spacing on the dry matter and the alkaloid yields were investigated Though the maximum solasodine content was observed 4 months after transplanting, maximum dry matter yields can be seen in 3 1/2 months after transplanting. Considering both these it is concluded that the best time to harvest the plants is when they are 3 1/2 months old and the optimum level of fertilizer is 60 kg /ha.

PHYTOCHEMICAL & PHARMACOLOGICAL STUDIES

The objectives of the phytochemical and pharmacological studies are to determine the chemical constituents of local medicinal plants and to determine whether the economic value of lesser known plants can be enhanced by using them as new sources of medicinal plants, as starting materials or intermediates in the synthesis of imported drugs. The plants that were studied were *Hunteria zeylanica, Alstonia macrophylla, Alstonia scholaris, Tabernaemontana divaricata, Rauwolfia canescens, Rauwolfia densiflora.*

For a long time Rauwolfia serpentine roots have been used as hypnotic and sedative in neuropsychiatric disorders. *Rauwolfia canescens* is a common plant in Sri Lanka and is reported to be used in the treatment of snake bite poisoning. *Rauwolfia densiflora* is a shrub growing in the mist forests of Sri Lanka go we carried out phytochemical, pharmacological and antimicrobial studies on these two plants. The results of the pharmacological studies carried out using rats on hole board performance indicated significant sedative activities in R. canescens and densiflora. Therefore these two plants have the potential to be used as substitutes for R. serpentine thus enhancing the economic value of the plant.

PREPRATION OF VALUE ADDED PRODUCTS FROM MEDICINAL PLANTS

The preparation of value added products from medicinal plants is another area covered by CISIR. The objectives of this are to

1. Prepare extracts and other products from medicinal plants so that freight charges can be reduced and high income can be earned by exporting less bulky products of high value instead of raw materials.
2. To prepare various medicinal plant based products to local industry.

Pilot plant scale extraction procedures have been worked out for preparation of total alkaloid extracts of *Catharanthus roseus*, *Gloriosa superba* and *strychnos nux vomica*. Also medicinal plant based formulations have been developed to prepare ginger, Iramusu and Welmi lozenges, Supirivicky and other herbal toothpastes, Aloe Vera, dill & lime, Godapara, Tea root and Visaka shampoos, cold creams moisturizers and burn creams based on Aloe Vera, tablets, granules and syrups of senna etc.

These developments not only provide value added herbal products to local and export market but also improve the economy of the producers and exporters Thus in our efforts to improve the medicinal plant based industry in Sri Lanka CISIR has contributed conservation of the biodiversity and enhancement of the economy of the country.

EVALUATION OF AYURVEDIC DRUGS

A programme of work to evaluate selected Ayurvedic drugs have commenced at CISIR. Three Ayurvedic drugs used in the treatment of arthritis was selected by interviewing Ayurvedic physicians randomly selected from 10 districts. The quality control, pharmacological, clinical and toxicological evaluation of the drugs are in progress at presented. This work is being carried out in collaboration with Institute of Indigenous medicine, University of Colombo.

The other organizations in Sri Lanka that are involved in R & D work on medicinal plants are :

Dept. of Chemistry, University of Sri Jayawardenepura
Dept. of Chemistry, University of Peradeniya
Medical Research Institute
Bandaranayake Memorial Ayurvedic Research Institute
Institute of Fundamental Studies
Institute of Indigenous medicines, University of Colombia

The Dept. of Chemistry, University of Sri Jayawadenepura conducts research work on Ayurvedic drugs as well as bioactivity directed phytochemical studies.

The bioactivity directed phytochemical studies on medicinal plants are being carried out at Medical Research Institutes Institute of Fundamental Studies and Dept. of Chemistry, University of Peradeniya. The Bandaranayake Memorial Ayurvedic Research Institute is conducting clinical research on diseases such as diabetes asthma, piles, arthritis etc. In addition to this the laying down of standards for Ayurvedic drugs is being carried out by the quality control laboratory and identification and cultivation of medicinal plants by Botany and Agriculture sections.

CONSTRAINTS

Some constraints encountered in commercial exploitation of medicinal slants in Sri Lanka are out lined below :

1. Lack of systematic cultivation of medicinal plants in the Country.
2. Lack of product standards and specifications.
3. Inadequate sponsorship and inputs for research.
4. Lack of direct access to information data bases including market information.

RECOMMENDATIONS

1. To conduct plant breeding for industrial use.
2. Formulation of strategies for marketing.
3. Exploration of new markets for med. plants & their products.
4. Interaction between research organizations and industries.
5. Establish modes for exchange of information.
6. Establish joint research programmes.
7. Publication of information updates on research.
8. Formulate legislation to safeguard locally processed products

COUNTRY PAPER

CHEMISTRY OF MEDICINAL PLANTS

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INTRODUCTION

In the course of our chemical studies on the biologically active compounds of medicinal plants, we have examined the chemical constituents of the whole plant of *Germ japonicum* Thunb. and the seeds of *Alpinia zerumbet* (Pers.) Burtt & Smith.

The whole plant of *G. japonicum* has been used as a diuretic in traditional Chinese medicine. In searching for natural products as antiviral agents, we have screened more than 100 different crude drugs for their activity against HIV- 1 protease. From the results of screening, G. *japonicum* was selected for further study because its MeOH extract showed a strong anti-HIV- 1 activity. Several chemical constituents, including tannins and triterpenoids have been isolated from this plant, but there have been very few pharmacological and biological studies on this plant, especially its antiviral activity.

Through fractionation of the MeOH extract followed by bioassay, a new triterpene acid along with five known triterpene acids were isolated and three of them showed inhibitory activity against HIV- 1 protease.

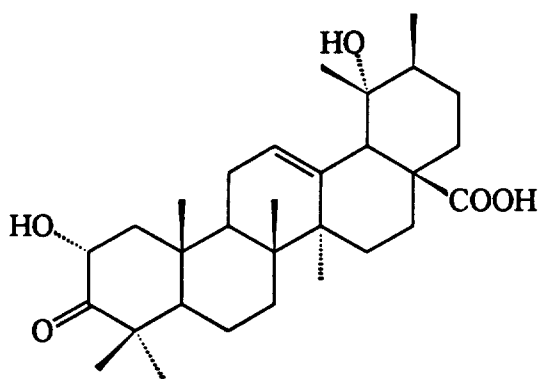
A. zerumbet, which is also known as *Alpinia speciosa K.* Schum., is a medicinal plant growing in southeast and southwest China. Its seeds, which have a strong aromatic odor, have been used for stomach ailments and for the treatment of pain in China and Japan. Itokawa *et al* have reported the isolation of two diterpenes, (E)-labda-8(17),12-diene- 15,16-dial and (E)-15,16-bisnorlabda-8(17),1 1-diene-13-one, from the rhizomes of A . *speciosa. As* a result of our chemical investigation of its seeds, we report here the isolation and structure determination of three new labdane diterpenes from the dried seeds of the plant. This is the first report of the diterpenes from the seeds of A. *zerumbet.*

RESULTS AND DISCUSSION

(1) Triterpene acids from G. *japonicum* and their anti HIV-1 protease activity.

The dried whole plant of G. *japonicum* was extracted with MeOH at room temperature for 7 days and the MeOH extract was fractionated to give hexane, EtOAc, BuOH and water-soluble fractions. Biological evaluation of the extract and

fractions indicated that most of the activity against HIV- 1 protease was in the EtOAc soluble fraction. The active. EtOAc soluble fraction was then subjected to silica gel column chromatography to yield a new triterpene acids together with five known compounds. The structure of the new compound was determined by various spectral means including ^{1}H- ^{1}H COSY, HMQC, HMBC and NOE experiments to be 2α, 19α-dihydroxy-3-oxo- 1 2-ursen-28-oic acid (**1**). The other known compounds, ursolic acid (3,β-hydroxy-12-ursen-28-oic acid) (**2**), epipomolic acid (3α, 19α-dihydroxy- 12-ursen-28-oic acid) (**3**), maslinic acid (2α, 3β - dihydroxy-12-oleanen-28-oic acid) (**4**), euscaphic acid (2α, 3α, 19α-trihydroxy-12-ursen-28-oic acid) (**5**) and tormentic acid (2α, 3β, 19α-trihydroxy-12-ursen-28-oic acid) (**6**), were identified by comparing their MS, ^{1}H and ^{13}C NMR data with those reported in the literature. They were further confirmed by 2D NMR spectra. Among these known triterpene acids, compounds **2**, **3** and **5** have been isolated from G. *japonicum* for the first time.



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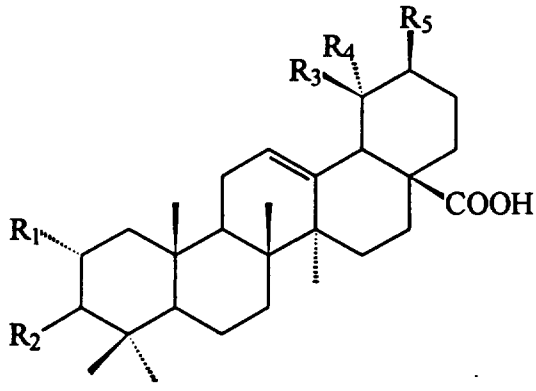
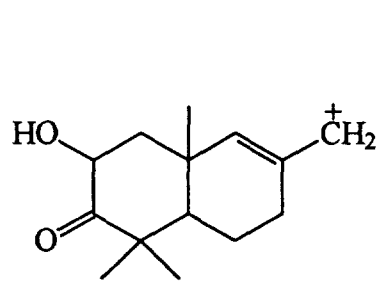


	R_1	R_2	R_3	R_4	R_5
2	H	β-OH	CH_3	H	H
3	H	α-OH	CH_3	OH	H
4	α-OH	β-OH	H	H	CH_3
5	α-OH	α-OH	CH_3	OH	H
6	α-OH	β-OH	CH_3	OH	H

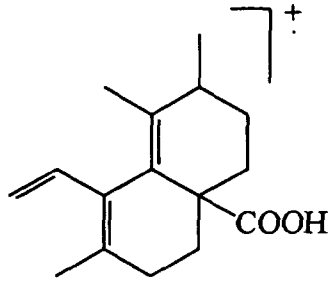
Figure 1. Structures of Triterpene Acids from G. *japonicum*.

Table 1. 13C NMR Spectral Data of Compound **1** (in pyridine).

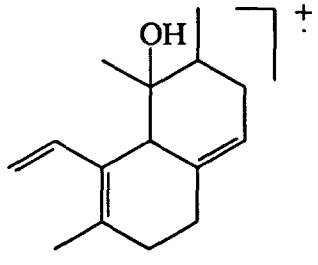
C	δ	C	δ	C	δ
1	50.10 *t*	11	24.12 *t*	21	26.92 *t*
2	69.73 *d*	12	127.55 *d*	22	38.45 *t*
3	216.41 *s*	13	140.07 *s*	23	25.28 *q*
4	48.10 *s*	14	42.16 *s*	24	21.77 *q*
5	57.67 *d*	15	29.26 *t*	25	17.30 *q*
6	19.55 *t*	16	26.31 *t*	26	16.77 *q*
7	33.14 *t*	17	48.25 *s*	27	24.66 *q*
8	40.37 *s*	18	54.56 *d*	28	180.65 *s*
9	47.33 *d*	19	72.67 *s*	29	27.06 *q*
10	37.90 *s*	20	42.35 *d*	30	15.95 *q*



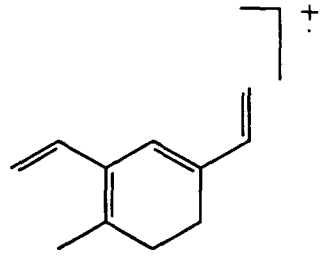
m/z 220



m/z 246



m/z 218



m/z 146

Scheme 1. The Characteristic Mass Spectral Fragments of Compound **1**.

Table. 2 ^{1}H-^{13}C Correlation Detected in the HMBC Spectrum of Compound **1**.

Proton	Correlated C
1.01 (H-24)	216.41 (C-3), 48.10 (C-4), 57.67 (C-5)
1.09 (H-26)	33.14 (C-7), 40.37 (C-8), 47.33 (C-9), 42.16 (C-14)
1.12 (H-30)	72.67 (C-19), 24.12 (C-21)
1.15 (H-25)	50.10 (C-l), 57.67 (C-5), 47.33 (C-9)
1.22 (H-23)	216.41 (C-3), 48.10 (C-4), 57.67 (C-5)
1.42 (H-29)	54.56 (C-18), 72.67 (C-19), 42.35 (C-20)
1.64 (H-27)	40.37 (C-8), 140.07 (C-13), 42.16 (C-14),29.26 (C-15)
1.87 (H-9)	50.10 (C-1), 40.37 (C-8), 37.90 (C-10), 17.30 (C-25), 16.77 (C-26)
2.48 (H-1)	69.73 (C-2), 216.41 (C-3), 37.90 (C-10), 17.30 (C-25)
3.03 (H-18)	127.55 (C-12), 140.07 (C-13), 42.16 (C-14), 26.31 (C-16), 48.25 (C-17), 72.67 (C-l9), 42.35 (C-20), 180.65 (C-28)
4.80 (H-2)	50.10 (C-1)
5.55 (H-12)	47.33 (C-9), 42.16 (C-14), 54.56 (C-18)

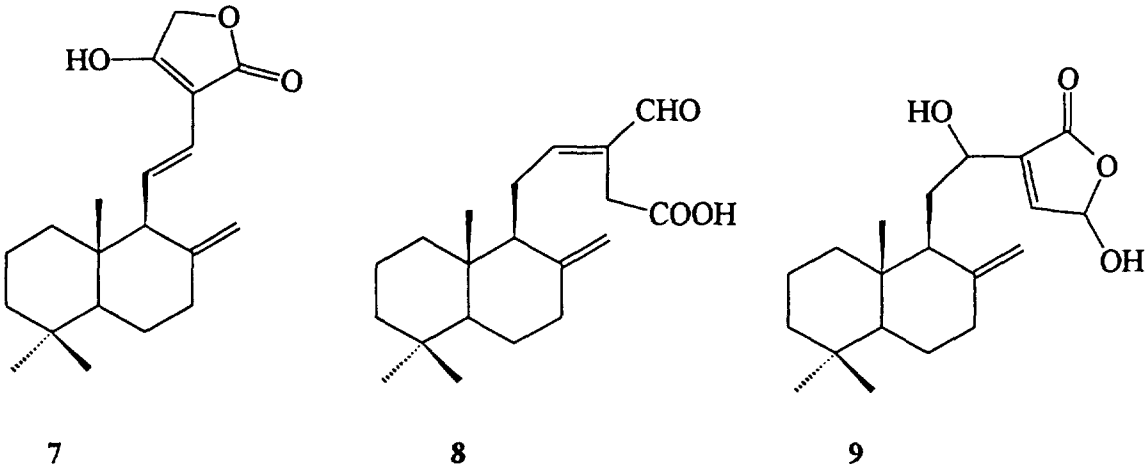
All the compounds isolated from the EtOAc soluble fraction were tested for their anti-HIV- 1 activity by hplc assay. As shown in Table 3, 2α, l9α-dihydroxy-3-oxo-12-ursen-28-oic acid (**1**), ursolic acid (**2**) and maslinic acid (**4**) exhibited stronger activity than the others at the concentration of 17.9 μg/ml. Maslinic acid (**4**) showed the strongest activity, while euscaphic acid (**5**) did not show any activity at the tested concentration. G. *japonicum* has been used as a diuretic and astringent in Chinese and Japanese traditional medicine. This is the first report of anti-HIV-1 activity of this drug. Further studies of structure-activity relationships are currently in progress in our laboratory, but the results of the experiments obtained in the present study indicate that compounds **1, 2** and **4** may contribute towards the anti-HIV-1 protease activity of the EtOAc soluble fraction of *G. japonicum.*

Table 3. Inhibitory Activity of Compounds 1-6 Against HIV- 1.

Compound	Inhibition %
1	72.19
2	85.07
3	42.18
4	100.00
5	0.00
6	49.47

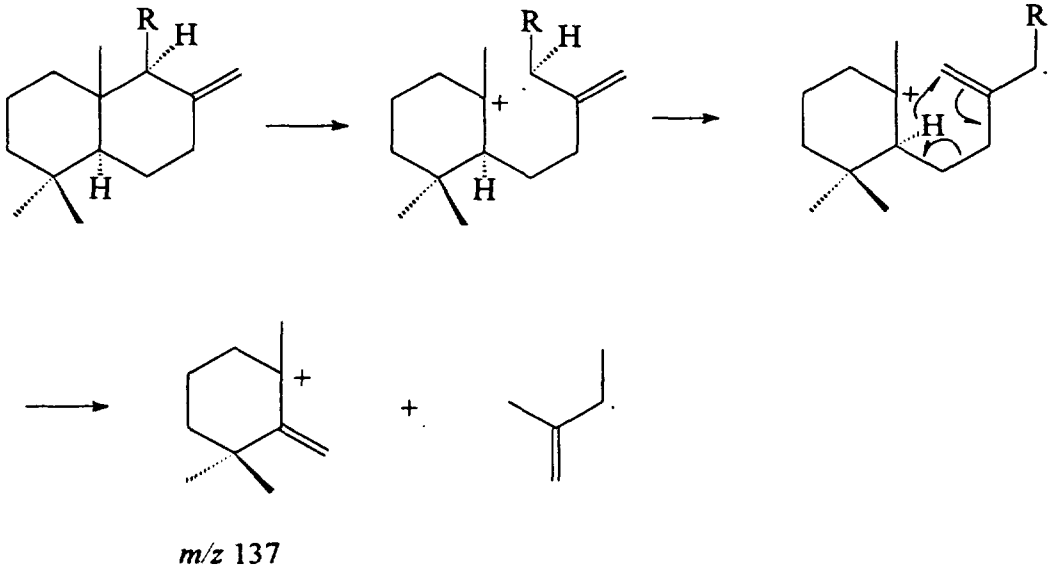
(2) Labdane diterpenes from the seeds of A. *zerumbet*.

An aqueous methanol extract of the dried seeds of A. zerumbet was partitioned into hexane and $CHCl_3$ fractions. Column chromatography on silica gel of the $CHCl_3$ soluble fraction furnished three new labdane-type diterpenes, named zerumin (7) zerumin A (**8**) and zerumin B (**9**), along with two known compounds, (E)-15,16-bisnorlabda-8,11-diene-13-one (**10**) and coronarin E (**11**). Their structures were established by various spectroscopic methods including 2D NMR techniques.



7 **8** **9**

Figure 2. Structures of Labdane-Type Diterpenes (7-9) from A. zerumbet.



m/z 137

Scheme 2. The Characteristic Mass Spectral Fragment of Compounds 7-9.

Table 4. ^{13}C NMR Spectral Data of Labdane-Type Diterpenes **7**-**9**.

C	7	8	9
1	40.9 *t*	39.2 *t*	39.5 *t*
2	19.1 *t*	19.3 *t*	19.9 *t*
3	42.2 *t*	42.0 *t*	42.7 *t*
4	33.5 *s*	33.6 *s*	34.0 *s*
5	54.6 *d*	55.4 *d*	52.5 *d*
6	23.3 *t*	24.1 *t*	25.0 *t*
7	36.7 *t*	37.9 *t*	38.9 *t*
8	149.3 *s*	148.0 *s*	148.0 *s*
9	61.9 *d*	56.4 *d*	56.1 *d*
10	39.4 *s*	39.6 *s*	39.5 *s*
11	135.0 *d*	24.6 *t*	31.7 *t*
12	120.9 *d*	159.4 *d*	65.2 *d*
13	128.2*s*	135.7s	142.8*s*
14	136.0 *s*	29.6 *t*	145.0 *d*
15	68.2 *t*	175.3 *s*	98.1 *d*
16	171.6	sl93.6 *d*	171.0 *s*
17	108.3 *t*	107.9 *t*	107.9 *t*
18	33.5 *q*	33.6 *q*	34.0 *q*
19	21.9 *q*	21.7 *q*	22.0 *q*
20	15.1 *q*	14.4 *q*	15.0 *q*

THE CHEMISTRY AND TECHNOLOGY OF MONGOLIAN MEDICINAL PLANTS

Prof. D. Badgaa.

Director of the Chemistry Institute of Mongolian Academy of Sciences

Mongolian flora accounts 2700 species of high vascular plants among which about 700 species are registered as medicinal. More than 200 species are commonly used in medicine. Research activities are directed to create new medicals according to traditional prescriptions. More than 60 kinds of traditional drugs of plant, animal or mineral origin have been screened. 30 of them are produced as domestic medical preparations at about 30 pharmaceutical factories of Mongolia.

By studying the medical manuscripts about 4000 prescriptions of traditional medicine have been found by our scientists.

The traditional Mongolian medicines have unique feature that they consist of multiorigin compounds. For instance, according to manuscripts there are some drugs composed of thirty plant species.

Botanists have demonstrated that 90 plant species are most frequently involved in traditional prescriptions as important components. Among them I would like to mention the following species:

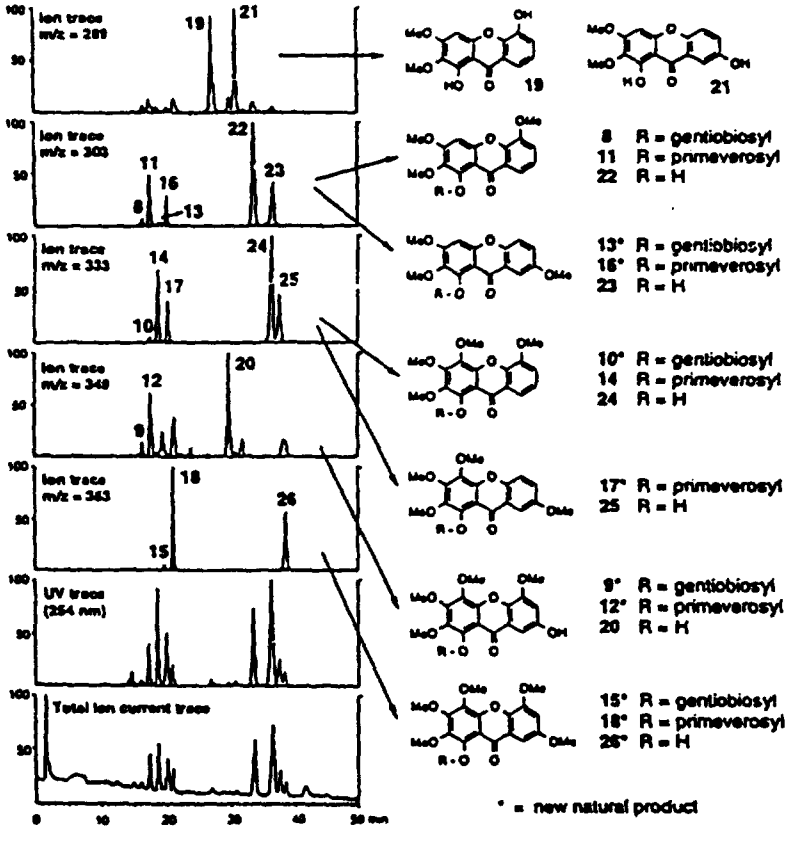
- -Hyppophae
- -Glyzerrhiza
- -Adonis
- -Sophora
- -Aconitum
- -Cistanche
- -Gentiana
- -Achillea
- -Ammopiptanthus
- -Stellera
- -Thalictrum etc.

During the last 20 years phytochemical investigation of more than 130 plants have been carried out at the laboratories of Chemistry Institute, Institute of Botany of Mongolian Academy of Sciences and Institute of traditional medicine of Mongolian Ministry of Health. Around 3000 natural compounds have been isolated individually, purified, identified, and about 120 newly found plant bioactive compounds as alkaloids, flavonoids, coumarins, iridoids, xanthones and lignans were structurally characterized. The results of these investigations are summarized in various international scientific journals (List of main publications is available).

Now let me present some results of chemical study of *Halenia corniculata* and *Thalictrum simplex*:

16 compounds have been isolated from *Halenia corniculata* and 9 of them were new.
Thalictrum simplex was found as a source of 10 alkaloids and 4 of them were new. The most interesting one was thalimonin. The preliminary pharmacological screening of the alkaloid has shown its antiviral activity against *Herpes simplex*.

The chemical study on isolation and characterization of bioactive compounds from endemic medicinal plants as well as pharmacological studies of them are being promising scientific and commercial areas in the world. So I'm sincerely inviting advanced scientists and representatives of business to visit Mongolia for joint conferences and other kind of collaborations in this field.



9 New xanthones and their glycosides have been isolated from aerial part of Halenia corniculata and investigation of biological activity of them is in progress.

Flora and medicinal plants of Mongolia:

1. Number of all species: 2700
2. Number of medicinal plants: 700
3. Species exploited in medicine: 200
4. Number of species determined systematically: 100
5. Number of species determined in resource: over 20
6. Number of species cultivated in Mongolia: 15 Hippophae rhamnoides

   Glyzerrhiza uralensis
   Adonis mongolica
   Sophora alopecuroides
7. Number of species chemically investigated: 135
8. Number of chemical bioactive compounds isolated from plants and structurally characterized: 3000

LIST OF PUBLICATIONS OF THE CHEMISTRY INSTITUTE MONGOLIAN ACAIDEMY OF SCIENCES, RELATED TO THE CHEMISTRY OF PLANT BIOACTIVE COMPOUND

1. Naran R.,Ebringerova A., and Alfoeldi J.
   The cell wall material of the wood root parasite Cistanche deserticola Y C Ma. Holzforschung 49 (1995), pp.293-299,
2. Naran R. ,Ebringerova A. ,Hromadkova Z. , and Patoprstry V.
   Carbohydrate polymers from the underground part of Cistanche deserticola Y C Ma. Phytochemistry 1995, vol.40, N3, pp.709-715,
3. Naran R.,Ebringerova A., and Badgaa D.
   Carbohydrate components of the holoparasite Cistanche deserticola Y C Ma. General characteristics of the underground part. Chem.papers 49 (1), pp.35-38 (1995),
4. Bankova V. , Dyulgerov A.,Popov S. , Purev O. , and Jamyansan Ya. ,
   Propolis produced in Bulgaria and Mongolia: Phenolic compounds and plany origin Apidologie 1992,23,pp.79-83.
5. Khandjieva N.,Spassov S.,Purev O.,Jamyansan Ya. et al,
   Majoriside, an iridoid glucoside from Plantago major Phytochemistry, 1991, vol.30.N 4, pp.1317-1318.
6. Purev O and Pospisil F.
   Metebolism of quercetin in cell suspension culture of Nicotiana Tabacum.L., Biologia plantarum (Praha),1989,31(3),pp.182-187.
7. Purev O., Pospisil F., and Motl O.

Flavanoids from Ephedra sinica.Stapf. Collection of Czechoslovac chem.comm. 1988,vol.53,pp.3139-3196.

8. Khandjieva N.,Ivanova A.,Purev O., and Jamyansan Ya. Iridoid glucosides from Plantago Komarovi., Phytochemistry 1994.
9. Purev O., Jamyansan Ya., and Oyun H.
   Xanthones and flavanoids from Gentiana barbata. Chimia prirodnych soedinenii, 1990, N4,pp.284-285 (in russian).
10. Purev O., and Jamyansan Ya.
    Flavanoids from Hippophae rhamnoides. L. Chim.prir.soed.1978,N3,pp.403 (in russian).
11. Purev O.,Jamyansan Ya.,Popov S. et al
    Antibacterial activity and chemical composition of Bulgarian and Mongolian propolis and poplar buds 7th Intl. conference on chemistry and biotechnology of biologically active natural products,1989,Varna,Bulgaria.
12. Purev O., Odontuya G.,and Zhong-Ze Ma.
    A method of isolation of lutedin-7-0-4b1-D-glucopyranoside (cynarozid) from Halenia corniculata and its quantitative determinationChinese Journal of medicinal chemistry, 1994, vol.4, N2, pp.118-121.
13. Purev O., Odontuya G., Khishge D., Oyun H., Tanchaeva L M., Nikolaeva G G. and Komissarenko N F.
    Flavonoids from Halenia corniculata (I) cornaz. and Lomatogonium rotatum (L) fries ex fern. (Mongolia), Rastitelnye resursy 1994, vol.30, N1-2,pp.148-151.
14. Purev O., Odontuya G., Oyun H., Tanchaeva L M.,Nasreen A., and Atta-ur-Rahman Xanthones H.corniculata. Part 1. Nat.Prod.Letters 1995, vol.5, pp.261 - 268
15. 0dontuya G., Purev O., Davaasambuu G., Nasreen A., and Atta-ur-Rahman Xanthones H.corniculata. Part 2. Nat. Prod. Letters 1995,vol.5,pp.269-273
16. Rodriguez S., Jean-Luc-Wolfender, Odontuya G., Purev O. and Hostettmann K. Xanthones, secoiridoids and flavonoids from H.corniculata Phytochem.,1995, vol.40, N4, pp.1265-1272.
17. Tanchaeva L. M., Purev O., Komissarenko N.F., Nicolaeva G G., and Odontuya G. Xanthones of H.corniculata (L) cornaz Mongolia Rastiteinye resursy 1995, vol.31, N1, pp.57-60.
18. Batsuren D., Cecegma S., Batbayar N., Dungerdorj D., Ahmetjanova V I., Milgrom Yu M.,Rashkes Ya V. and Ibragimov A A., Alkaloids of Oxytropis DC Chim.Prir.Soed.1992, N3-4, pp.388-393.
19. Batbayar N. , Batsuren D., Tashhodjaev B., Achmedjanova V I., Bessonova I A., and Yagudaev N R., Structure of kalidine Chim.Prir.Soed. 1987,N4,pp.558-561.
20. .Bessonova I A., Batsuren D., Abdulaev N D., and Yunusov S Yu., Daurine- a new alkaloid from Haplophyllum dauricum Chim.Prir.Soed.1983,N1,p.116.
21. Bessonova I A., Batsuren D., and Yunusov S Yu., Alkaloids from Haplophyllum dauricum Chim.Prir.Soed. 1984, N1, pp.73-75.

22. Batbayar N., Batsuren D., Sultanchodjaev M N., and Yunusov M S., Alkaloids of Aconitum barbatum and structure of bataconine Chim. Prir. Soed .1988, N2, pp .237-239.
23. Batbayar N., Batsuren D., and Sultanchodjaev M N., Alkaloids of 3 Aconitum species grown in Mongolia, Chim.Prir.Soed.1990, N4, pp. 559-560
24. Batbayar N., Batsuren D., and Sultanchodjaev M N.,Alkaloids of Aconitum Turczaninowii Worosch., Chim.Prir.Soed.1992,N5, pp. 594-595.
25. Batbayar N., Batsuren D., and Sultanchodjaev M N., Turcosine - a new alkaloid from Aconitum Turczaninowii Worosch, Chim.Prir.Soed.1993,N1,pp.60-62.
26. Batbayar N., Batsuren D., Tashhodjaev B.,Yusupova I N., and Sultanchodjaev M N., Altaconitine, a new alkaloid from Aconitum Altaicum, Chim.Prir.Soed.1993, N1, pp. 62-64.
27. Irgashev T., Israilov I A., Batsuren D., Yunusov M S., Alkaloids of Corydalis stricta, Chim.Prir.Soed. 1983, N4, pp.490-493.
28. Batsuren D., Telezheneckaya M V., Yunusov S U., Baldan T., Alkaloids of Peganum nigellastrum Bge., Chim.Prir.Soed. 1978, N3, p.418.
29. Batsuren D., Telezheneckaya M V., Yunusov S Yu., Alkaloids of Peganum nigellastrum Bge. and Peganum harmala, Chim.Prir.Soed.1980,N5,pp.736-787
30. Batirov E H., Batsuren D., Malikov V M., Compounds from Haplophyllum dauricum, Chim. Prir. Soed. 1984, N2, pp. 244-245.
31. Jamyansuren D., Batsuren D., Burgedbazar B., Nyamaa D., Spectroscopic study of dauroside, Journal prikladnoy spectroscopii 1986,vol.45,N2,p.316-320,
32. Narantuya S., Batsuren D., Batirov E H.,Malikov V M., Coumarins of Salsola laricifolia, Chim.Prir.Soed.1986,N2,pp.243-244,
33. Narantuya S., Batsuren D., Batirov E H.,Malikov V M. Lariside-a new scopoletine glucoside from Salsola laricifolia, Chim.Prir.Soed.1986,N3,pp.288-291
34. Batsuren D ., Batirov E H . ,Malikov V M. Aryinapthaline lignans from Haplophyllum dauricum and structure of daurinol, Chim.Prir.Soed.1981,N3,pp.295-297
35. Batsuren D ., Batirov E H . ,Malikov V M. Aryinapthaline lignans from Haplophyllum dauricum. Structure of daurinol, Chim.Prir.Soed.1981,N3,pp.295-297,
36. Batsuren D ., Batirov E H . ,Malikov V M. Coumarinsfrom Haplophyllumdauricum. 5,7-dioxycoumarin and its C-glycoside. Chim.Prir.Soed.1982,N5,pp.650-651,
37. 37.Proksa B., Uhrin D., Batsuren D.,Batbayar N., and Selenge D., 11-acetyl-1,19-epoxydenudatine: a new alkaloid from Aconitum barbatum., Plant medica 1990,vol.56,N5,pp.461-463,
38. Batsuren D., Yagudaev M P., Batirov E H.,Malikov V M., Application of double proton resonance for the structure elucidation of aryinaphtaline lignans. Structure of daurinol., Chim. Prir. Soed.1983, N3,pp.19-23,

39. Batsuren D., Yagudaev M P., Batirov E H.,Malikov V M., Structure of daurosides A and B-the new acylcoumarin glycosides from Haplophyllum dauricum., Chim. Prir. Soed. 1983, N2, pp.142-147.
40. Vdovin A D., Batsuren D., Batirov E H., Malikov V M., ^{1}H, ^{13}C spectra and structure of new coumarin-C-glycoside -dauroside from Haplophyllum dauricum., Chim. Prir. Soed. 1983, N4, pp.441 -445
41. Cecegma S.,Batsuren D.,Dungerdory D.,Batirov E H.,MalikovVM. Flavonoids of 2 species Oxytropis DC grown in Mongolia Chim.Prbr.Soed.1992,N6,pp.722-723.
42. Selenge D., Batsuren D., Batirov E H.,Malikov V M. Isoflavones from Ammopiptanthus mongolicus Chim.Prir.Soed.1986,N2,pp.242-243,
43. Saidhodjaev A l.,Batsuren D.,Malikov V M., Esters from Ferula akitschkensis, Chim.Prir.Soed.1985,N5,pp.709-710,
44. Jonhojaeva F B.,Shamianov I D.,Batsuren D et al Components of Artemisia santanifolia, Chim.Prir.Soed.1990,N5,pp.697-698,
45. Batbayar N.,Batsuren D.,Sultanhodjaev M N. Alkaloids from the aerial part of Aconitum Turczaninowii, Chim. Prir. Soed.1992, N3, pp.444445\,
46. Batbayar N.,Batsuren D.,Semenov A A.,Sultanhodjaev M N., Turpelline- a new alkaloid from Aconitum Turczaninowii Chim.Prir.Soed.1993
47. Ahmetjanova V l.,Batsuren D.,Shakirov R Sh., Structure of oxytrifine from Oxytropis DC, Chim.Prir.Soed.1993,
48. Narantuya S.,Batsuren D.,Milgrom Yu M.,Rashkes Ya V. Bicoumarins from Stellera chamajasmae, structure of chamajasmoside, Chim.Prir.Soed.1993
49. Ripperger ,Shatar S., Phytochemische Untersuchungen an pflanzen der Mongolischen Flora, Farmazie 36,H.9,1981,pp.642-644,
50. Shatar S., Monosesquiterpene im aetherischen Oel Mongolischer Juniperus Arten, Farmazie 39, H .1,1984, pp.66-67.
51. Shatar S. Anaiyse der aetherischen Oel aus drei Rhododendron Arten der Mongolischen Volks Republik, Farmazie 40,H.6.1985,pp.432-433,
52. Shatar S. Analyse der aetherischen Oel aus den Naden einiger Konferen aus der Mongolischen Volks Republik Farmazie 41,H.2,1986,pp.155-156,
53. Shatar S. Chemische charakterisierung aetherischer Oele aus Mongolischen Arten der Gattung Artemisia.L Farmazie 41,H.11,1986,pp.819,
54. Shatar S. Untersuchungen der chemischen Zusammensetzung des aetherischen Oels von Ledum palustre L aus der Mongolischen Flora, Farmazie 43,H.4,1988,p.293.
55. Shatar S.,Ognianov I., Sesquiterpene lactones in Mongolian Saussuria Lipshitzii, Collect.Czech.Chem.Commun.56,1991,pp.1106-1110.
56. Adams R.,Shatar S., Comparison of the volatile leaf oils of Juniperus daurica Pal. from Mongolia, with plants cultivated in Kazachstan, Russia and Scotland, J.Essential Oil Res.6,1994,pp.217-221.
57. Shimizu S., Karasawa D., Shatar S., Study of Mongolian mints., J. Essential Oil Res. 7, 1995, pp.255-260.

Lao People's Democratic Republic
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MAJOR ROLE OF THE RESEARCH INSTITUTE OF MEDICINAL PLANTS OF THE LAO PEOPLE'S DEMOCRATIC REPUBLIC

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Reference Nr. RIMP

I-Introduction:

Lao People's Democratic Republic is a landlocked country, covers 236,800 sq. km. Laos shares borders 492 km of the South with the Kingdom of Cambodia, 416 km of the North with the People's Republic of China, 230 On of the .Northwest with Myanmar, 1,730 km of the West with the Kingdom of Thailand and 1,957 km of the East with the Socialist Republic of Vietnam. Lao population is approximately 4,3 million, composed 3 major categories: Lao Lum or low Lao, Lao Theung or Approaching-the-top-Lao and Lao Sung or the H'mong (high Lao). Laos is covered by 47.2% forest area (official statistic data in 1989). Lao people have long term tradition in using their own traditional medication. The Lao country is also endowed with wealthy natural resources, medicinal plants are included. In order to meet the people's health need, the Government of Laos encourage the health facility system applying the traditional as well as herbal medicine which our ancestor handed down to our generation.

II- The Research Institute of Medicinal Plants its major tasks and achievements:

Recognizing the important role of Traditional as well as Herbal Medicine, the abundance of medicinal plants of the country, the Government of Laos decided to established The Research Institute of Medicinal Plants or RIMP in 27 April 976.

The main tasks of RIMP are as follow

1. Studies on the utilization of medicinal plants and traditional medicine within the Country, . These studies aim at proving the efficacy of the traditional remedies

collected from different regions. In the studies, clinical trials are taken into account.

2. Preservation of precious traditional remedies of famous Traditional Healers by publishing the booklets. Furthermore creating Herbarium and Herbal Drug Specimen Office for multipurpose.
3. Qualitative and quantitative survey of medicinal plants in all provinces of the country and then carry out the classification of species into right families.
4. Transfer of the production technology of traditional medicine to Pharmaceutical factories for the industrial scale production.
5. Offer of Technical assistance to provincial traditional medicine stations under the form of technical seminars, Short term training and providing basic material for the production of TRM such as grinding, sieving, compressing machines etc.
6. Contributing to the formation specialty staff in term of TRM, herbal medicine as well as pharmacognosia in medical sciences institutions, supervising them during the practicing period in RIMP.

Recent achievement

- Isolation and purification of Umbelliferine from the vine of *Coscinium usitatum* Pierre
- Isolation and purification of l-Tetrahydro Palmatine from the tuber of *Stephania glabra* Roxb.
- Precipitation of Artocarpine from the fluid extract of *Artocarpus lakoocha* Roxb. (tapeworm killer)
- Finding out the parameters for spraying dried extracts of some fluid extracts to promote the galenical form of plant-based-medicine. For instance, fluid extracts of *Leonurus artemisia, Adenosma capitatum* Benth., *Curcuma longa* L., *Curcuma* sp., *Eleutherine subaphylla* Gagnep., etc..have been sprayed.

The Institute has also great deal of successes in medicinal plants survey. From the beginning of its foundation. more than 400 species belong to 80 botanical families have been found, some of these are precious plants and may be exploited for industrial scale production. Some traditional remedies had been produced in pilot scale and distributed to consumer. The galenical form of TRM produced by RIMP is gradually improved and make them better looking.

Current problems:

As RIMP was newly founded, that's why it is facing many difficulties:

- It's still poor of experience in scientific research as well as management.
- Because we have lacked of funds, RIMP's progress has been slow

- RIMP lacks also qualified professional staff who have ability in conducting the scientific research on TRM.
- As a result of having few scientific research to prove the efficacy of TRM, most of medical doctors in the health facility system do not perceive the important role of TRM and we are facing difficulties in convincing them to support our activities in rural areas.

III- Recommendations:

In order to shift the current state of the RIMP to the desired state, the Research Institute of Medicinal Plants strongly wishes to have closed cooperation with the relevant Institutes of neighboring countries, International organizations as well as NGO's. In the cooperation, we has some recommendations as follow:

- Support our institute in domestic training or providing fellowship to train abroad. The field of training are: medicinal plants survey, extraction and separation method of active ingredients in medicinal plants.
- Providing some necessary equipment for scientific research on TRM as well as herbal medicines and medicinal plants.
- Based on the mutual interest, studying together the feasibility in producing Traditional Medicine in Industrial scale.
- Providing some necessary equipment for the production in pilot scale.
- Exchange information concerning the scientific research results and the marketing of plant-based-medicinal products.

Annex I

Some Exploitable Medicinal Plants for Industrial scale Production

Nr	Local name	Scientific name	Family	Observation
1	Kheua haem	*Coscinium usitatum* Piere	*MENISPERMACEAE*	Grow wild
2	Som Mo	*Terminalia chebula* Retz	*COMBRETACEAE*	-
3	Saengkhamton	*Terminalia nigrovenulosa* P.	-	-
4	Dook deua	*Amorphophallus* sp.	*ARACEAE*	-
5	Cheellai kom	*Adenosma capitatum* Benth.	*LABIATAE*	-
6	Nat sov	*Leonurus heterophyllus* Sw.	-	-
7	Nja kee on	*Xanthium strumarium* L.	*COMPOSITAE*	-
8	Tom ngeun	*Stephania rotunda* Lour.	*MENISPERMACEAE*	-
9	Euang bon	*Costus speciosus* Smith	*LILIACEAE*	-
10	Khae	*Cinnamomum* spp.	*LAURACEAE*	-

List of Indigenous Medicines produced in Lao PDR

Nr	Items	Indications
1	Aromax	Leukorrhea
2	Berberine Chloride	Dysentery
3	Berberine hydrochloride	-
4	Bertanine	-
5	Tanine	Dysentery - Diarrhea
6	Eomesal	Tapeworm killer
7	Stilben	-
8	Eleutherini	Gastrointestinal Ulcer
9	Gastra	-
10	Curcumae sp.	Prolapsus
11	Vano 500	-
12	Adenosyl	Hepatitis
13	Leonuryl	Menstrual disorder
14	Artocarpine	Tapeworm killer
15	Tanidan	Dysentery-Diarrhea
6	Elisir-T	-
17	Curacid	Gastrite, Hyperacidity
18	Murryl	Cough relief
19	Mulberryl	Arthritis-Rheumatism
20	Homalomen	-
21	Kidneys washer	Kidneys washer
22	Galactogogue	Galactogogue
23	Amoquine 500	Antimalaria
24	Leonurus sibiricus	Menstrual disorder

HERBAL/TRADITIONAL MEDICINE IN BHUTAN

Paolo Morisco

I. Introduction

This paper has been prepared for the Expert Group Meeting for the Industrial Exploitation of Indigenous Medicinal Plants, Jakarta, 1995.
It describes the traditional medicinal practices present in Bhutan and depicts their status of development at the time the paper has been written (December 1995}.

II. The country

Bhutan, a monarchy of southern Central Asia, in the eastern Himalaya, is bounded on the north and northwest by the Tibet Autonomous Region of China and on the east, south, and southwest by India. It has a total area of 47,000 sq km (18,147 sq mi).

Bhutan is almost entirely mountainous. A narrow strip along the southern border, the Duars Plain, is the country's only area of flat land. Ranges of the Himalaya rise abruptly from the plain and generally increase in elevation to the north, rising to maximum elevation of Jumolhari (7800 m circa) on the Chinese border. Bhutan's rivers, none of which is navigable, flow south to the Brahmaputra River in India.

Climate varies from subtropical on the Duars Plain to a temperate climate, with cool winter and warm summers, in the mountain valeys. It becomes increasingly harsh at higher elevations. Average annual precipitation is generally heavy, ranging from about 1520 mm (about 60 in) in the mountain valleys to more than 5080 mm (about 200 in) in the Duars Plain. More than two-thirds of the country is forested Wildlife is diverse and includes elephants, tigers, leopards, deer, and bear. Known mineral resources include copper, gypsum, iron ore, limestone, lead, coal, and dolomite; commercial exploitation is minimal.

The largest ethnic group in Bhutan, constituting more than 60% of the population, is the Drugpa, who live mostly in the north. A Nepalese minority is present in the south. The total population (1993) estimated was 600,000. Thimphu (1993, 27,000) is the capital and largest town. The official language is Dzongkha, which derives from classic Tibetan. The official religion is a Lamaistic form of Mahayana Buddhism; monasteries are numerous in Bhutan, and monks number some 6000.

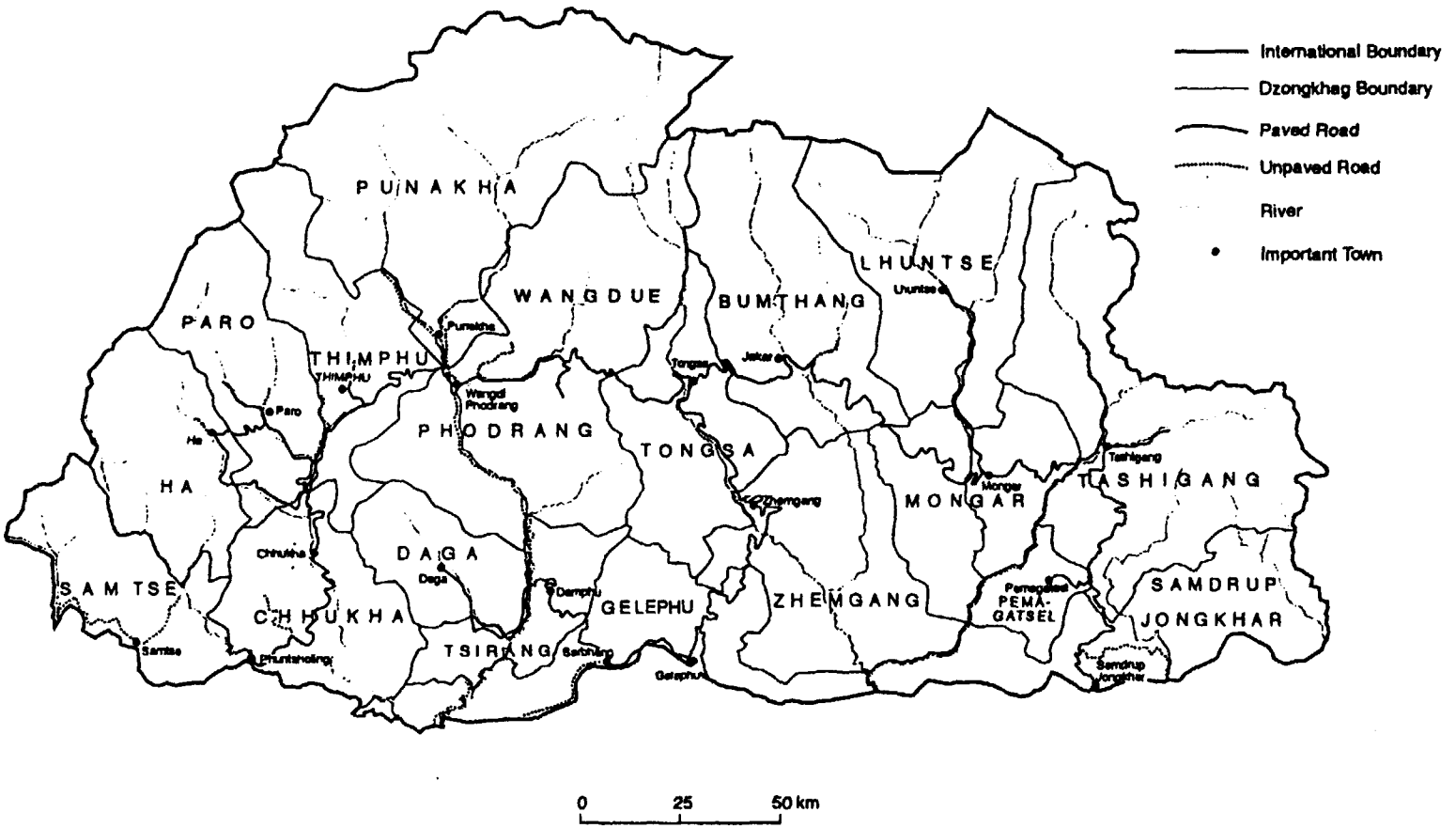
Health statistics are rapidly improving thanks to the efforts of an attentive and dedicated health sector. Universal Immunization has been reached in 1992 and the

infant mortality rate has fallen drastically {70 per thousand), raising life expectancy to 66 years.

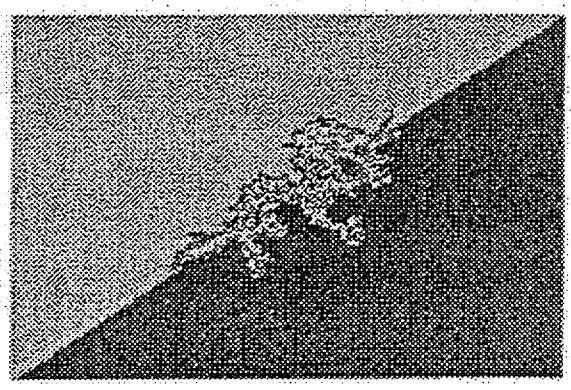
Although all children are entitled to 11 years of primary and secondary education, literacy rate has been low until late in the eighties, because of poor accessibility to public schools, until the nineties when 54% literacy rate has been reached.

The economy of Bhutan is overwhelming agricultural. Much of the cultivated hand is terraced and irrigated. The principal crops are rice, wheat, corn, and potatoes. Cardamom and fruit, including apples, tangerine, pears, and plums, are grown for export. Livestock such as cattle, yaks, and sheep are raised. Light and heavy industry has been established, producing textiles, cement, matches, calcium carbide, particle boards, ferrous silicone and alcoholic beverages. Hydroelectric power is the fastest growing source of revenue for the Government of Bhutan.

MAP OF BHUTAN



According to a survey carried out in 1995, Bhutan has 72.5% of its total area under forest cover (including 9% circa of scrap forest areas) and only 7.8% of the land has been developed for agriculture. This presents good conditions for the growth of indigenous flora, as the natural ecosystems seem relatively untouched. The flora is very rich; reflected not only by the number, but more significantly by the heterogeneity of species. Many species are unique to the Kingdom. 300-400 plant species are used in Bhutanese traditional medicine. Many of these plants are also part of the pharmacopoeia of traditional medical systems of neighboring countries. In the past, Bhutan was known as The Land of Medicinal Plants and exports to Tibet and India were frequently recorded. More recently however, the herbs of Bhutan have been less exploited and, after a ban of exports in 1968, only two species {Swertia Chirata and Piper Longum) is collected for export. All other plants are collected only for the preparation of traditional medicines for local demand. Many species, especially of the high altitude plants, are unknown to science in the sense that no classification and research into the active chemical ingredients and other properties has so far been done.



The Bhutanese National flag

III. Traditional Medicine History

Traditional medicine, in its present form, was introduced into Bhutan around the 16th century with the arrival of the Shabrung Ngawang Namgyal, the prince who unified Bhutan and who had a prominent physician among his ministers. Physicians all over the Himalayas had always used Bhutan as a major source of medicinal plants because of the fertility of its mountains, but also because of the variety of species that are found at different altitudes ranging from 200 to 7800 meters above sea level.

After the Sixteenth Century, Tibetans provided schools for training Bhutanese doctors and, in exchange, Bhutanese would transport medicinal plants as far as Lhasa or Kham. Most of the trained Bhutanese doctors would return to Bhutan and set up

their own practices in monasteries or dzongs. However, from the coming to power of the Wangchuk dynasty in 1885, the regime has supported traditional medicine and always kept one or two physicians at court.

A. Official Government Involvement

The traditional medicine services network, as an offshoot of the Division of Health (DOH) of the Ministry of Health and Education, has been established as part of the delivery of health care to the people of Bhutan for the past 25 years. The principal initiative and main financial brunt has been borne by the Royal Government; but with some outside assistance - mainly from the EU (European union), Disarmo e Sviluppo (DISVI, an Italian NGO) and, sporadically, from the World Health Organization (WHO) and the United Nations Children Fund (UNICEF).

In 1967 the Royal Government (RGOB), recognising the importance, both scientific and cultural, of traditional medicine, decided to include it in the National Health System and to provide free care to the people of Bhutan giving them the choice of being treated either with modern or traditional medicine.

After Bhutan became a member of the United Nations in the early 1970s, its Health Services began to be shaped around the then newly-formulated and internationally recognized principles of Primary Health Care. Organizations such as WHO and UNICEF commenced funding programmes that greatly expanded the modern system of medicine. By 1979, RGOB had established two traditional dispensaries and a school for traditional physicians in the Thimphu valley, but which however worked with few facilities and in very basic conditions. In 1982, WHO donated some pharmaceutical machines. This possibility of increasing the output of medicines allowed RGOB to start planning the expansion of traditional dispensaries in other districts such as Punakha, Tashigang, Tongsa, Bumthang and, later, Haa. The budget allocations for traditional medicine nevertheless remained very limited, and there was little planning or training in the traditional medicine sector until well into the 1980s.

B. DISVI Assistance

There can be little doubt that, given time and a greater availability of resources, RGOB on its own would have been fully capable of developing traditional medicine in Bhutan. Fortunately however, it has been possible to speed the process with outside assistance. Between 1988 and 1993, considerable attention and funds - mainly from DISVI (which has worked in health-related fields in many Asian countries) - have made it possible to establish in Thimphu a National Institute of Traditional Medicine (NITM) which provides a solid base for future development in the sector; since NITM's activities range from training to research, production of medicines and treatment of patients.

In 1988 RGOB, with DISVI involvement, established a Coordination Centre at the Indigenous Dispensary in Thimphu. Facilities include an outpatients department, hostels and a library for training. There was also a laboratory which allowed, for the first time ever, the introduction of modern scientific methods into the practice of traditional medicine. Plants and other materials used in medicinal formulas are identified and tested in the laboratory for their chemical contents and pharmacological characteristics.

DISVI contributed around US$. 1,000,000 over the four-year period, during which it has been possible for RGOB to establish NITM as the centre for development of traditional medicine. This success fed on itself, so much so that, in the current Five-Year Development Plan, funds have been included to open traditional dispensaries in all districts of the country.

Because of its small size and the difficulty it had in obtaining further funds Prom its usual sponsors, DISVI could not assist RGOB to address an area of traditional medicine in Bhutan which has now become the priority - the procurement of sufficient quantities of raw materials to meet even present levels of demand; let alone those anticipated for future years.

The major areas which remained to be addressed when DISVI's involvement ceased, concerned the collection of raw materials consisting of plants, minerals and animal maker, post-harvest treatment, testing, cultivation of plants and, finally, manufacture and distribution of traditional medicines in Bhutan and abroad. In the longer term, there was an overriding need to render the whole system of traditional medicine in the country self-sufficient and financially viable. An immediate priority was the necessity of protecting and preserving the resource base in an unique natural environment.

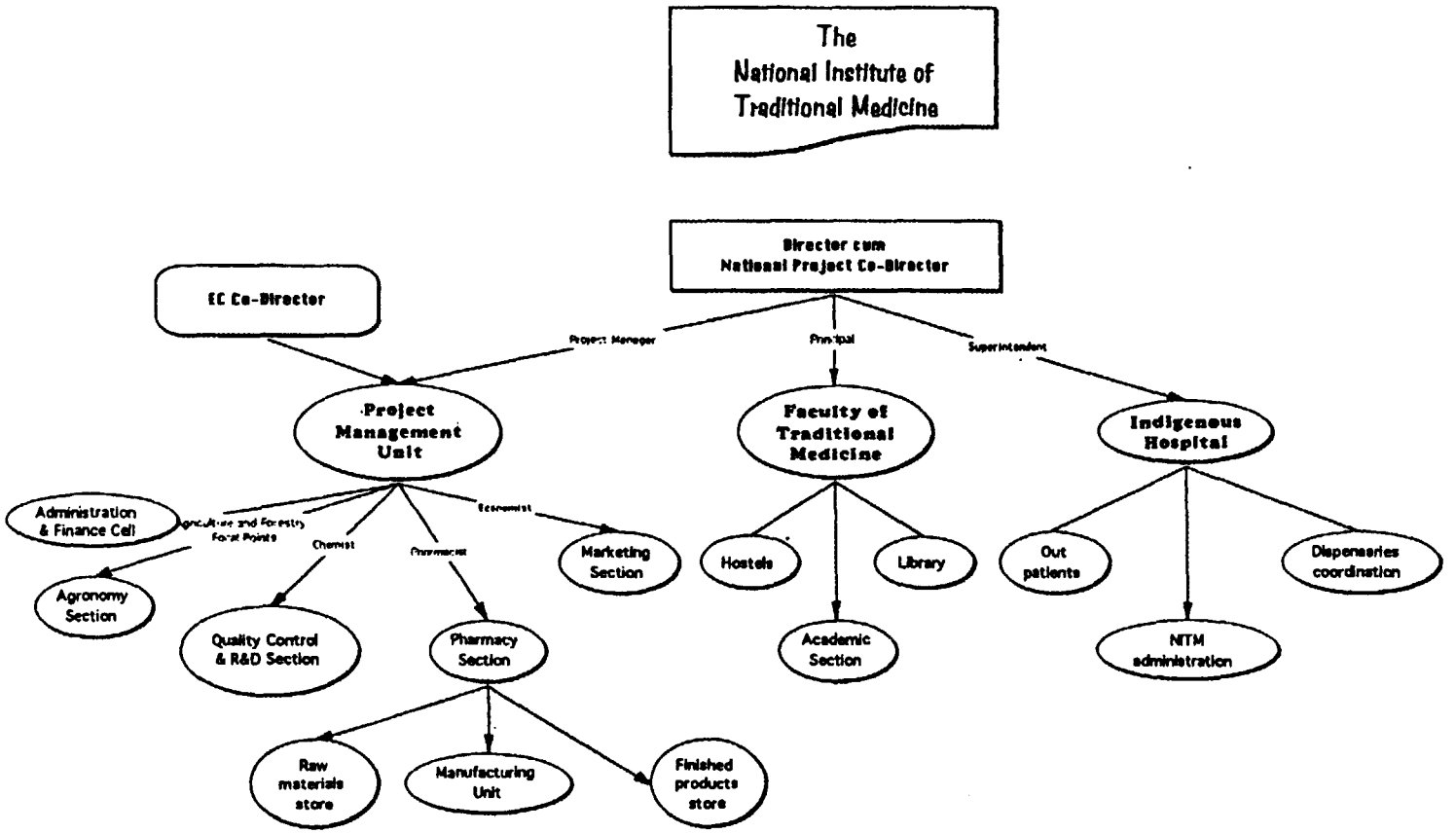
It was these considerations which led RGOB to approach the EU for the support which was agreed to in principle October 1990, but that became effective only in 1994.

C. The EU Project

The overall objective of the project the EU took up in 1994, was therefore to improve the health of the population of Bhutan and raise standards of living - particularly within those communities living at higher altitudes which are most involved in the collection and cultivation of medicinal plants.

This, by identifying three project objectives, of which:

1. the first, to promote traditional medicine and increase the availability of traditional drugs by augmenting the supply of raw materials.
2. secondly, to preserve the environment - mainly in this context by ensuring that there is no overexploitation of plants and other raw materials.
3. and thirdly to improve the incomes of the inhabitants of rural areas by introducing medicinal crops from collection and cultivation activities.


The
National Institute of
Traditional Medicine
Director cum
National Project Co-Director
EC Co-Director
Project Manager
Principal
Superintendent
Project
Management
Unit
Faculty of
Traditional
Medicine
Indigenous
Hospital
Administration
& Finance Cell
Economist
Chemist
Pharmacist
Marketing
Section
Agronomy
Section
Quality Control
& R&D Section
Pharmacy
Section
Hostels
Library
Academic
Section
Out
patients
Dispensaries
coordination
NITM
administration
Raw
materials
store
Manufacturing
Unit
Finished
products
store

Objectively verifiable indicators of the attainment of the first project objective included an increase in production of raw materials from both high and low elevations (whether by collection or cultivation); improved processing and quality control methods - thereby increasing the output value from a given quantity of raw materials, and research findings which had the same effect. The maintenance of stocks of traditional herbs in the wild would be an indicator of the second objective. As regards the third, evidence of higher cash incomes by rural communities involved in the project would suffice.

IV. The Presents

Two years into She EU project, giants steps have been taken, and a concerted effort of different Ministries of RGOB have ensured that the major goals of the project are pursued in the most effective way. As seen in the attached chart, new sections have been opened under the project, which specialise in one of She major areas connected with the fulfillment of the project objectives; those are:

A. The Agronomy section

More than three centres for cultivation trials have been established so far, including a major area at 4000 meters above sea level, where a collection and drying centre has been constructed to function as a focus for high altitude areas.

In all centres, work is carried out in both the major areas of collection from the wild and cultivation. Different techniques and approaches are used, including rotational wild crazing, biological fertilisation and mixed cropping.

Many farmers show a keen interest in becoming involved with medicinal crops and have, right from the very first season of collection sold around Nu. 1,000,000 to NITM.

B. The Research and Quality Control section

Catalogation and study on raw ingredients have been ongoing since the beginning of the nineties, in areas that include Botanical and Pharmacognostic identification, Chemical fingerprinting and extraction and Biological screening. Quality control standards are now being developed for the same.

1. The resource base

Seven different categories of raw materials are used in traditional medicine, they are:

a) Of Veg etable Origin (approx. 300-400 species)

(1) Sgno-sman, or high altitude plants
(2) Khrog-sman, or plants at altitudes below 2300 meters
(3) rTsi-sman, or resins

(4) bZang-drug, or plants from the plains

b) Of Mineral Origin (approx. 30 varieties)

(1) J rDo-sman, or base minerals
(2) Sa-sman, or soils
(3) Rin-po-chei-sman, or precious stones

c) Of Animal Origin (about 50 types)

(1) Srog-chags-sman, or parts of animals

2. The medicinal use

All ingredients are mixed in different combinations that amount to around 200 commonly used drugs, although the traditional text records many more possibilities. The Q.C. has now started standardising drugs as well, to form as a base for the newly introduced Quality Assurance and Good Manufacturing Practices for drug manufacturing

C. The Industrial Production section

Since no proper system was in place for the production of drugs, the project has had to start from scratch, building a proper industrial manufacturing facility and equipping it with GMP machinery and services.

Here an interesting combination of modern technology with long lived traditional practices come together inasmuch as the project is trying to produce with modern machinery and methods, traditional drugs, while maintaining all the traditional criteria for processing, together with the ancient formulas used for more than a thousand years.

This is rendered possible by the fact that traditional drugs were prepared in the post only by hend, catering therefore for a relatively small number of patients, whereas the present demand has grown nation-wide and requires, therefore, an industrial approach which is obviously lacking in the traditional system and for which the traditional doctors realise they have to turn to modern science for.

This new unit, which will soon have to adapt its production to cultivation surplus from the rural production areas, is therefore geared also to produce export products which will be from time to time steered by the Marketing and Procurement section, in strict collaboration with the Agronomy section.

D. The Marketing and Procurement section

This new addition to NITM has been designed to absorb the brunt of the major changes that are expected springing from the present project; i.e. the increase in production of raw ingredient and of drugs to quantities not yet quantifiable.

Marketing contacts have already been established with different companies and new contacts are constantly sought to place products that range:

1. Raw ingredients surplus

   To sustain local farmers in taking up medicinal crops, no limit are imposed on production, and NITM expects to find itself in the position of having much more raw ingredients than in requires. Neighbouring countries are the immediate market for these products.

2. Traditional drugs

   Traditional drugs are distributed freely to the different dispensaries of the country. A surplus is not expected immediately, since demand is still much higher than production, but possible outlets in the west have already been identified.

3. New herbal medicinal or cosmetic products

   This is a very promising area of development based especially on the fact that Bhutan has so many unique different medicinal plants thot could be used for different purposes and investigated for cosmetic use. The fact that Bhutan offers unpolluted and organically grown products, should act as an extra incentive for buyers who are interested in the Bhutanese line of production.

V. References

A. Encarta Encyclopedia 1994□ Microsoft Corporation

B. Inception Report, Cultivation of Medicinal Plants for Traditional Medicine Project, EC, 1 90A

C. Gso-ba Rig-pa, Le Systeme Medical Tibetain, Femand Meyer, CNRS, 1988

D. Health Bulletin 1993, Division of Health, Royal Government of Bhutan

E. Land Cover figures for Bhutan, Land Use Planning Project, Thimphu, 1995

THE USE OF MEDICINAL PLANTS IN BANGLADESH AND INVESTIGATIONS ON *BRUGMANSIA SUAVEOLENS*, *CASSIA FISTULA* L, *CURCUMA ZEDOARIS* ROSC AND *AEGLE MARMELOS* (L) CORR.

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Abstract

546 medicinal plants have been recorded to be present in Bangladesh. In Ayurvedic and Unani system of medicines nearly 120 plants are used. The remaining plants have got traditional application by individuals. Among the total plants a few likely 15 including *Brugmansia suaveolens*, *Cassia fistula* L and *Curcuma zedoaria* Rosc have got active principles related to modern allopathic medicines. *Aegle marmelos* fruits have been re-examined for antidiarrhoeal preparations

Introduction

Bangladesh is a densely populated country with a small area. The plain lands are mainly and extensively used for the production of crops like paddy, Jute, sugarcane and vegetables. Medicinal plants are generally found in the forest and high land. Only a few plants which are used both in medicine and food in the form of spices, fruits and vegetables are cultivated. Most other plants are collected from wild growth or imported from neighboring country.

Allopathic system of medicine uses synthetic as well as plant based pure compounds but no extract as per prevailing drug policy. At present all these pharmaceuticals are imported. Plant based pure compounds used in modern medicine are not yet isolated in Bangladesh. Probably the followings are the reasons:

(i) appropriate technology for isolation of pure compound from plant source 18 yet to be developed.

(ii) medicinal plants are not yet cultivated and hence may not be available to such extent as to feed any chemical industry

(iii) economic viability or return is another vital factor for setting up such industry.

Among the plants which have got active principles related to modern allopathic medicine the followings may be mentioned

Active principles	Sources
Tropane alkaloids- Hyoscine Hyoscyamine	1. *Datura metal* L. 2. *Brugnansia suaveolens*
Reserpine Ajmalin	1. *Rauvolfia serpentina* (L) Benth. ex kurz 2. *Rauvolfia tetraphylla* L 3. *Rauvolfia vomitoria* L
Vincristine Vinblastine Ajmalicine	1. *Catharenthus roseus*(L).G.Don
Senna glycosides	1. *Cassia fistula* L
Strychnine Brucine	1. *Strychnos nux-vomica* L.
Diosgenin	1. *Costus speciosus* (koenig) sm
Papain	1. *Caria papaya* L
Aloin, Emodin	1. *Aloe barbadensis* Mill
Caffeine	1. *Camellia sinensis* (L) O kuntze
Ephedrine ?	1. *Sida cordifolia* L
Colchicine	1. *Gloriosa superba* L
Starch/Starch derivatives	1. *Curcuma zedoaria* Rosc

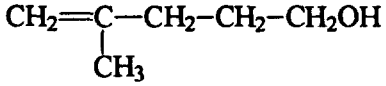
Recently some investigations were done on *Brugmansia suaveolens, Cassia fistula* L, *Curcuma zedoaria* Rosc to ascertain their active principles and on *Aegle marmelos* (L) Corr. to assess its anti diarrhoeal property.

Brugmansia suaveolena: Total alkaloids were estimated in the leaves and stem and the results were found as given below:

Leaves → 0.6% tropane alkaloids
Stem → 0.051% " "

Leaves were also found to contain some irritant principles volatile in nature and GC-MS studies indicated the following components:

Major component:

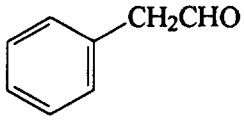


4-Pentel-1-ol-4-methyl

M.F. $C_6H_{11}OH$

M.W. 100

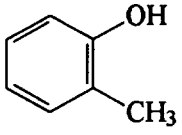
Mass spectrum: m/e 100 (M^+, 3.96), 82 (38.66), 69(27.27), 67(74.97), 57(12.35), 55(39.29), 42(20.20) and 41(100).
Minor components:¶



M.F. C_8H_8O
M.W. 120

Phenyl acetaldehyde

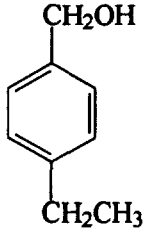
Mass spectrum: m/e 120 (M^+ 23.92), 94(12.41), 92(25.43), 91(100), 65(33.98) and 63(18.81).



M.F. C_7H_8O
M.W. 108

o-Cresol

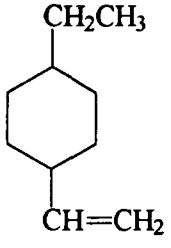
Mass spectrum: m/e 108(M^+ 48.43), 107(67.97), 94(23.92), 93(54.47), 83(30.91), 80(48.12), 79(91.04), 77(48.93), 71(100), 55(48.03) and 41(72.10).



M.F. $C_8H_{12}O$
M.W. 136

p-Ethyl benzylalcohol

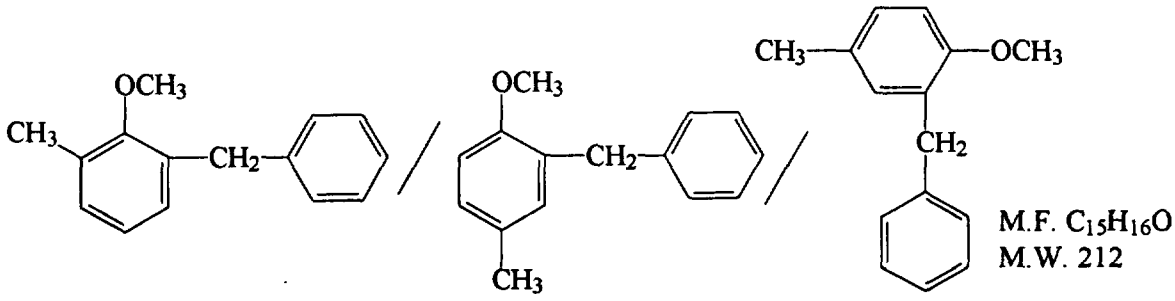
Mass spectrum: m/e 136 (M^+ 21.90), 135(100), 134(11.99), 119(10.96), 107(19.29), 91(11.91), 77(5.66), 69(3.96), 65(13.65) and 41 (26.60).



M.F. $C_{10}H_{18}$
M.W. 138

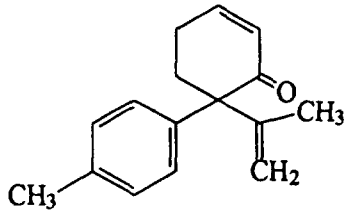
4-Ethyl-1-vinyl-cyclohexane

Mass spectrum: m/e 123(M-15,59.54),119(11.19), 115(22.72), 111(61.72), 97(18.65), 93(52.33), 91(23.50), 84(60.76), 68(41.33), 56(23.79), 44(79.84) and 41(100).



2-Benzyl-6-methylanisole 2-Benzyl-4-methylanisole 2-Methyl-4-benzylanisole

Mass spectrum: m/e 212(M^+,37.59), 197(100), 192(13,94), 165(9.88), 149(22.36), 135(3.84), 128(7.69), 115(10.82), 105(6.62), 91(10.58), 77(6.24) and 65(9.69).



M.F. $C_{16}H_{18}O$
M.W. 226

2-Cyclohexene-1-one-6-(isopropyl)-6-(4-methyl)-phenyl

Mass spectrum: m/e 226(M,31.91), 211(100), 186(17.66), 153(21.93), 133(20.92), 103(34.05), 98(19.20), 79(24.19), 78(30.08) and 68(19.21).

Cassia fistula L:- Senna glycosides and the total ash estimated in the whole fruits, total pulp extracted with the help of water and the dilute alcohol extract were found to be present as given below:

Fruits/extract	Senna glycosides calculated as sennoside B (%)	Total ash (%)
Whole fruits	1.14	3.3
↓ water		
Total pulp	4.55	8.2
↓ 70 ±5 alcohol		
Alcohol extract	4.23	3.26

The laxative action of the alcoholic extract and the standard sennoside B were compared on rat stools and the results found are given below:

Name of drugs and groups	Doses/os mg/kg	Mean no offecal pellets in first 6 hrs after dosing	Percentage of soft pellets in 6 hrs	Mean no offecal pellets in 18 hrs after 6 hrs observation		% of soft pellets in 18 hrs
Control (10)	5ml/kg (water)	2.0 1	Nil	30.00	2	Nil
Sennoside B(10)	10 mg/kg	7.9 1	63.29	19.7	1	45.68
Alcohol ext. of Cassia fistula (10)	Concentrate containing10 mg/kg (Sennoside B.)	7.7 1	60.54	22.6	1	42.00

Curcuma zedoaria Rosc:¶

Starch was isolated from the rhizomes of *Curcuma zedoaria* Rosc and it was found to be about 10%.

Steps:

$$\text{Rhizomes} \xrightarrow[\text{2. Crushing with water}]{\text{1. Washing with water}} \text{Pulp} \xrightarrow[\text{through cloth}]{\text{Squeezing}} \text{slurry} \xrightarrow{\text{Settling}} \text{Starch}$$ ¶

Aegle marmelos (L) Corr. -Antidiarrhoeal properties of half-ripe fruits.

Preparation of *Aegle marmelos* (bael) powder: Half ripe fruits were processed to obtain the total pulp including seeds and ground to powder after proper drying. The proximate composition of bael powder (Table 1) and the elements in acid soluble part of the ash (Table 2) were determined. The toxicity level of bael powder (Table 3) and the antibacterial properties of its oil fraction (Table 4) were also determined.

Table 1. Percentage composition of bael powder.

Moisture	3.38	Ether extract (other than fatty oil)	0.10
Sucrose	49.00	Sulfate	1.50
Fructose	26.00	Phosphate	0.60
Ash	1.66	Other matters insoluble in water (mainly)polysacharide)	8.30
Fatty oil (Petroleum ether extract)	0.63		
Tannin	0.49		
Crude fibre	7.12		
Protein	1.13		

Table 2. Percentage of elements estimated in acid soluble part of the ash

sodium	7 23
Potassium	18.37
Calcium	22.65
Iron	0.84
Magnesium	3.67

Table 3. Acute toxicity of bael powder on rats

	4 weeks	
200g/kg feed supplement	———	no visible change
400g/kg " " "		" "
600g/kg " " "		lost body weight from 3rd day

Affected groups regained normal weight within 2 weeks when given normal diet again

Table 4. Antibacterial activity of the oil of bael powder

Bacteria	Diameter of zone of inhibition mm
Escherichia coli	-
Staphylococcus aureus	17
Shigella dysentriae	19
Vibrio cholerae	19
Salmonella typhi	24

Considering all these properties and requirements for controlling diarrhoea the following formulation was proposed as a single dose for adults with 250 ml water after each loose motion.

Aegle marmelos powder - 4g
Sodium chloride - 1.25g

Acknowledgment:

The author thanks the Director, BCSIR Laboratories, Chittagong for his help in carrying out this research. The author also thanks Mr. Ms. Yusuf, S.S.O., and mrs. Jaripa Begum, S.S.O., for help to prepare this paper

References:

1. Md. Yusuf, Jasim Uddin Chowdhury, Abdul Wahab and Jaripa Begum--Medicinal Plants of Bangladesh. 1994.

2. Shamsul Alam Chowdhury, K. Jahan, T. Ferdows Begum and A.K. Chowdhury-- GC-MS Studies on Volatile Constituents of *Brugmansia suaveolens* leaves (under publication).
3. Shamsul Alam Chowdhury, Mustafa Kamal,M.N.Alam, M.A.Gafur, B.K.Ray, K.Ahmed and Omar Faruq-- Sennoside B rich Active Concentrate from *Cassia fistula* (under publication).
4. Shamsul Alam Chowdhury, A.K.M.Mustafa Kamal, Jarifa Begum, M.A. Gafur and M.N.Alam- Properties of Half-Ripe Aegle marmelos Corr. Fruits (under publication).
5. Mann,W.N- Conybeare's Text book of Medicine. Churcehill Livingstone Edinburgh, P. 100-101, 1975.

STANDARDIZATION OF QUALITY CONTROL OF MEDICINAL PLANT PRODUCTS (TRADITIONAL DRUGS)

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Directorate of Traditional Drugs Control, Ministry of Health

INTRODUCTION

As the integral part of the National Development Program, the ultimate goal of the Health Development Program Stated in National Health System is the achievement of every individual ability to live healthily in order to create the optimum health of the whole society, as one aspect of the general welfare stated in the National objective. The Health development objective as stated in the National Health System is the source of objectives and targets stated in the long term health development program and has been formulated further into "Five objectives for Health (Panca Karsa Husada) namely :

1. the improvement of the peoples capability to help themselves in the field of health.
2. the improvement of life environment, which can guarantee health.
3. the improvement of the community's nutritional status.
4. the decrease of morbidity and mortality.
5. the development of healthy and prosperous family by the wider acceptance of the norm of happy and prosperous small family.

The National Drugs Policy is derived from National Health System and becomes the guidance for all activities in the field of drugs.

In realizing drug development, especially traditional medicines, the situation and the problem mentioned below should be noticed :

1. Total of the population is more than 180 million, scattered in many big and small islands, either in towns, village etc.
2. Although health efforts have been conducted through Community Health Centers, Sub community Health centers and Mobile Community Health Centers, but those activities have not reached the whole population yet. The poverty of the people which is illustrated by the low education, income and consumption per capita-constitute the inhibiting factors for the endeavor to develop the people's capability to participate in health development.

3. Traditional medicines have been widely used by the public since ancient time, and there has been tendency of increasing.
4. The raw materials of traditional medicines are derived from plant, animals and minerals, which can generally be found in Indonesia. The National Health System stated that health development should be based on the belief in our own capability and potential. So the potential of flora, fauna and minerals which can be used for drugs and developed for promoting the public's capability to participate in health development efforts. National Drug Policy stated that traditional medicines which can be proved efficacious should be developed and utilized in social health care. The development of traditional medicines should be conducted properly, especially the curative ones.
5. The supply of traditional medicines for social health cares should be realized through :
   - spreading, promoting and developing Family Medicinal Garden.
   - regulating, promoting and controlling the production and distribution of traditional medicines conducted by traditional medicines industries and trades.

   Most of the validity of the traditional medicines efficacy have not been proved scientifically yet, because the utilization of traditional medicines is mostly based on tradition. In this case it should be endeavored to keep the use of traditional medicines safe by the public. In relation to the effectiveness and efficiency of traditional medicines used, research efforts should be realized, either on their safety, efficiency and quality.
6. The greater part of domestic crude drugs are derived from plants. Those crude drugs are generally derived in : wild plant, catch crops and cultivated plants.

THE IMPROVEMENT AND CONTROL EFFORTS IN THE FIELD OF TRADITIONAL DRUG.

The improvement and control efforts should be carried out in order that the safe, useful and quality traditional drugs can be provided. This task is not only the responsibility of the government but also the responsibility of the manufactures. In this regard the government carries out improvement and control efforts through the activities mention bellow :

1. Regulation

   To improve the production, distribution (marketing) and utilization of traditional drugs that in compliance with the stipulated requirements, the government should implant regulation to traditional drugs production,

distribution and utilization efforts. This regulation activities can be realized through provisions in regulations and their guidelines. Therefor the government should issue regulations and guidelines. In this regard the Ministry of Health has issued regulations on :

a. The production and distribution of traditional drugs;
b. The compulsory registration of traditional drugs;
c. The Labeling of traditional drugs; and others.

2. Standardization

This activity is carried out by the Ministry of Health for encouraging and directing all production and distribution activities to provide traditional drugs that are in compliance with the safety, usefulness and quality requirements. This activity among other are :

a. The establishment of crude drug standards (Materia Medika Indonesia).
b. The establishment of galenical preparation standards.
c. The establishment of traditional drug dosage form standards.
d. The establishment of phytopharmaca standards (phytopharmaca is a development result of traditional medicine).
e. The establishment of Good Manufacturing Practices Guidelines.
f. The establishment of Good Distributing Practices Guidelines.

3. Licensing

The licensing system is implemented to encourage either the manufacturers, wholesalers or retailers of traditional drugs to improve their facilities and also their technology of traditional drugs production and distribution needed, in order to be able to implement the principles of Good Manufacturing Practices (GMP) and Good Distributing Practices (GDP). This activity among other are :

a. The implementation of licensing system of traditional drugs manufacturers.
b. The implementation of licensing system of phytopharmaca manufacturers.
c. The implementation of licensing system of galenical preparation manufacturers.
d. The implementation of licensing system of crude drugs manufacturers
e. The implementation of licensing system of crude drugs importation.

4. Registration

The registration system is one of the control mechanisms, particularly for traditional drugs before their productions. In this regard there is a provision in

article 3, of the Minister of Health Regulation No.246/Me.Kes/Per/V/90 on The License of Traditional Drugs, which states that traditional drugs (including crude drugs and galenical preparations) should prior approved and registered at the Ministry of Health before that production, market and export.

Exception to this provision are :

a. Traditional drugs in the form of coarse cuttings, "pilis", "tapel", and "parem" produced by small scale traditional drugs manufacturer from crude drugs and with the claims that are in compliance with the decree of Director General of Drugs and food control, can be exempted from the compulsory registrations.
b. Traditional drugs produced by Jamu Dispensaries.
c. Traditional drugs produced by Jamu Peddlers.

Note : The requirements implemented for traditional drugs produced by small scale traditional drug manufacturers in the forms of outings, "pilis", "tape", and "parem" are also implemented for traditional drugs produced by "jamu" dispensary and "jamu" peddlers.

Traditional drug candidates that their registration applications have been submitted are evaluated their compositions, preparation methods, quality control methods, labeling, evaluation methods of the duration of life, usefulness and so on.

Traditional drug candidates should comply with the requirements mentioned bellow :

a. Empirically they are proven safe and useful for human utilization;
b. Their principal ingredients and production processes used are in compliance with the stipulated requirements;
c. They do not contain synthetic or isolated drug chemical substances;
d. They do not contain materials belong to dangerous drugs or narcotics.

If their registration applications have already been approved, their registration numbers will be issued by the Director General of drugs and Food Control. The registration numbers should be put by printing them in their labels, containers or wrappers and their brochures.

Those registration numbers can be revoked if one of the matters mentioned bellow happens :

a. The registered traditional drugs are proven not to be in compliance with the valid requirements any more;
b. Their labeling derivate from the approved ones;

c. The registered traditional drugs are proven to break the provisions in the valid regulations.

5. Control

Control activities are carried out to encourage either traditional drug (also crude drug or galenical preparation) produces, wholesalers or retailers to implement all provisions in the valid regulation. As mentioned before that conducting control activities is not only the responsibility of the government, but the responsibility of traditional drug producers, wholesalers and retailers as well.

Control effort is a serial of activities which covers each stage of all sectors of the implementations of quality control of traditional drugs provision effort.

Government i.e. Ministry of Health conducts the quality control of traditional drugs by organizing inspections to traditional drug producers, wholesalers or retailers to know whether they really carry out internal control activities or not.

In addition to those inspection activities, sampling activities are carried out as well sampling are organized by taking samples from the manufactories or buying samples from the markets.

If a manufacturer is proven to be guilty, because he breaks the valid provisions or requirements, Ministry of Health will give him warning up to thrice, and if after the last warning he still breaks the valid provisions or requirement, the Ministry of Health will revoke his license and all registration numbers. In addition if he as a breaks the provisions in the valid criminals law, he will be punished in accordance with the provision in it.

QUALITY CONTROL ACTIVITIES

As informed before that based on the valid laws, acts and regulations in Indonesia control activities should be carried out in order that traditional remedies produced distributed and utilized in Indonesia comply with the valid requirements. Those requirements either stated in Farmakope Indonesia, Ekstra Farmakope Indonesia, Materia Medika Indonesia or other decrees and regulations.

Based on those requirements quality control laboratories in Indonesia have carried out control activities against pharmaceuticals, including traditional remedies. Control activities on traditional remedies carried out by the government began in 1976 after the establishment of the Directorate of Traditional Remedies Control.

Up to now Indonesia has 27 provincial Quality Control Laboratories, each of them situated in the Capital City of the Province. Among those 27 laboratories seven of which to be referral laboratories, and in addition there is a National Drugs and Food Quality Control laboratory in Jakarta.

In this regard, if there is a problem can not be solved by a provincial laboratory in the same group with that provincial laboratory. Later if the same problem can not also be solved by the referral laboratory, it should be transferred to the National Drugs and Food Quality Control Laboratory as top referral laboratory. In addition to those laboratory quality examinations, the inspections of traditional remedy industries, wholesalers and retails should also be carried out, to encourage them to implement the Good Manufacturing Practices Guidelines in Traditional Remedy Manufactories and Good Distributing Practices in Wholesalers and Retailers.

By the realization of both laboratory examinations and inspection activities, traditional remedies provided to the population can comply with the valid quality requirements, so that they can be utilized safely and efficiently.

The inspections are carried out by inspecting all conditions of the premises and process of production distribution of traditional remedies, the quality of materials used, the quality control activities in manufactories, wholesalers and retailers and so on.

SAFETY AND EFFICACY TESTING

Up to now only a few natural remedies that mostly herbal remedies have reached formal health cares and used as drug according to scientific concept, because most of natural remedies as traditional ones used by the population empirically. So the development efforts should be realized in order that their utilization in formal health cares can be improved. In this regard safety (toxicity) testand efficacy test up to clinical trial are necessarily to be done.

For this purpose in the first step the government issues a decree in which there is a prevision that all curative traditional remedies, such as antidiabetic, antihypertension, anticholesterol etc. should have safety, pharmacological and clinical data. In this regard the manufactures have to submit application to research institutes to carry out testing and trials of their curative products.

In addition, the government also establishes a guidelines for traditional drugs development, including its steps, i.e. :

1. The step of selection
2. The step of biological screening, based on :
   a. Its pharmacological effects
   b. Its acute toxicity
3. The step of pharmacodynamic test

4. The step of further toxicity, i.e. subacute, chronic and specific toxicity tests.
5. The step of preparation development (formulation)
6. The step of clinical trial.

If such traditional remedies really have significant clinical efficacy and comply with the safety requirements, then further research and development should be carried out. In this case it consist of more thorough pharmaconamic tests, phytochemical research and so on.

STANDARD OF ASEAN HERBAL MEDICINE

WHO and ASEAN deeply realized that the use of Herbal Medicine is increasing in all countries, stimulated by the need to utilized local natural resources and in some cases, a rebound effect from report of various adverse reactions with the use of drugs made from pure chemical substances. In order to active the aims of "HEALTH FOR ALL BY THE YEAR 2000", traditional remedies, including medicinal plants should be utilized properly, hand in hand with the are chemical drugs.

Due to the entice diversity among the population in ASEAN countries, the are also variations in the systems of traditional healing. In some countries patient view the various medicinal system, including modern medicine, as complementary rather than antagonists, and move freely from one and the other in search for relief and cure, mostly those suffering from severe r chronic illness regardless of ethnic origin.

There is considerable trade in herbal medicine among ASEAN countries, some ASEAN countries have initiated programs to promote the use of herbal medicine validated by scientific investigation in primary health care, either through FAME garden or by other means.

Effort to increase the utilization of herbal medicine are hampered due to lack of safety and efficacy studies and because or deficiencies of standardization and identification of their preparation. Identification and study of pharmacological active components of each medicine is on going in some countries at different investigative levels.

Some countries have individually established official standard requirements for the most widely utilized crude drugs; such standard can be adopted and developed as ASEAN standard, the Book of ASEAN standard name is "STANDARD OF ASEAN HERBAL MEDICINE" consist of 36 monographs.

CONCLUSION

The objective of the improvement and control efforts carried out by the Director General of Drugs and Food Control to traditional drug producers,

wholesalers and retailers is to make sure that the marketed traditional drugs are always safe, useful and quality.

This program has been implemented as the realization of the message in the Broad Lines of States Policies 1993, that is "Traditional medicines that medically can be justified should always be improved for broadening and distributing health care deliveries evenly. The care and development of traditional medicines as the national cultural irrigate should always be improved and its development efforts should be encourage through the explorations, researchers, examination, developments and discoveries of drugs, including the cultivation of medicinal plants that medically can be justified". The implementation of this program is aimed to reach the health and economic development goal.

RESEARCH AND DEVELOPMENT ON MEDICINAL PLANTS AND THEIR PRODUCTS IN INDONESIA

Djoko Hargono

INTRODUCTION

Traditional drugs have been widely utilized by the people since long-long ago in Indonesia and there have been a tendency of increasing. Generally the utilization of traditional drugs just based on the experiences, either of the Indonesian inheritance, other people or their own.

The validity of the most traditional drug efficacies have not yet been proved scientifically, therefore up to now only a few traditional drugs have been utilized in formal health cares. That is why the usefulness of traditional drugs should be proved by basing to the scientific principles to improve their status, in order that they can be utilized in formal health cares, to improve health care deliveries to the peoples widely and equally.

THE IDEA OF TRADITIONAL DRUG RESEARCH AND DEVELOPMENT

The idea of Indonesian people to conduct traditional drug research and development have already begun since 1960. It can be seen from a provision in the article 11 of Basic Health Law No. 9, 1960, particularly paragraph (4), which stated :

> *Drugs of Indonesian origin should be studied and utilized as good as possible.*

At that time this provision gave legal basis to the efforts of conducting researches, developments and utilization of drugs of Indonesian origin (Indonesian traditional drugs). In addition the research and development activities and also the utilization of Indonesian traditional drugs should be carried out as good as possible. It means that the government should regulate, give guidance and counseling, as well as control the efforts of the research, development, production, distribution (marketing) and utilization of Indonesian traditional drugs. This was stated in paragraph (1) of the same article. This effort indeed should be conducted, to that they meet the requirements stated in Farmakope Indonesia (Indonesian Pharmacopeia) or other

regulations, as required in paragraph (3) of the same article. In such condition it can be expected that their utilization are safe, usefulness, effective and efficient.

Based on these provisions the government establishes other provisions in Pharmacy Law No. 7, 1963, which states that firstly, the government gives guidelines on the development as well as the control of the efforts of utilizing Indonesian traditional drugs or jamus; secondly, the Minister of Health makes efforts on the researches of the production, utilization and usefulness of jamus, their standardization, and the efforts of searching the new resources of jamu and others.

Though there were provisions in Basic Health Law No. 9, 1960 and Pharmacy Law No. 7, 1963 on the research and development of traditional drugs at that time, but it still could not yet enough encourage the experts of university research institutes or others in Indonesia to begin those activities, therefore only a few research results could be met until the Seminar on the Exploration of Natural Drugs, which was held in 1964 by Gajah Mada University in Yogyakarta. Since that time the experts of several universities began to move to conduct research activities on medicinal plants and traditional drugs.

For implementing all provisions stated in Basic Health Law No. 9, 1960 and Pharmacy Law No. 7, 1963, in 1975 based on the Minister of Health Decree No. 125/IV/Kab/BU/75 on the Organization and Job Description of the Ministry of Health, the Directorate of Traditional Drugs Control in the area of Directorate General of Drugs and Food Control, and Pharmaceutical Research and Development Institute in the area of Health Research and Development Institute, based on the Minister of Health Decree No. 114/Men.Kes/XII/75 on the Organization and Job Description of Health Research and Development Institute. The task of Directorate of Traditional Drugs Control is regulating, developing and controlling the production, development, control and utilization of traditional drugs, while the Pharmaceutical Research and Development is conducting and coordinating research activities of pharmaceuticals, including traditional drugs. Further both decrees have been renewed by the minister with the Minister of Health Decree No. 558/Men.Kes/SK/1984 on the Organization and Job Description of the Ministry of Health.

To fulfill the desire of medicinal plant experts to establish an organization, as a forum in which they can put forward their research results and meet together for exchanging experiences an organization, which is named PERHIBPA (the association of natural material researchers) has already been established in November 18, 1978. Through this organization research results on medicinal plants have already begun to be accelerated.

Then the General Assembly of the Peoples Representatives in 1983 has issued several notes which consists of 9 statements. One of them is a statement, which stressed the need of traditional drug development efforts. This statement gave more and more encouragement to experts in Indonesia to do much on the research activities of traditional drugs.

Further next five years, that was in 1988, the General Assembly of the Peoples Representatives has issued Broad Lines of State Policies (GBHN) 1988 which stated as follows :

> *For promoting health care deliveries widely and evenly, simultaneously for preserving and developing national cultural heritage, the inventory, research, examination, and development efforts of traditional drugs and healing should be continued. In addition the development efforts of medicinal plants cultivation that medically can be justified should be encouraged.*

Based on the statement exist in this Broad Lines of State Policies as well as all provisions in the valid laws and acts, Minister of Health has issued Ministerial Regulation No. 760/Men.Kes/Per/IX/1992 on Phytopharmaca and Ministerial Decree No. 761/Menkes/SK/ IX/1992 on the Guidelines of Phytopharmaca. The consideration of issuing those Ministerial Based on its level those educational (university) research institutes can be divided into three categories :

a. Faculty level ..... 32 institutions
b. Department level ..... 19 institutions
c. Division level ..... 5 institutions

If we differentiate further into government and private institution, the data can be shown in table 2

Table 2. Education Research Institutions Based on Their Levels

No.	Level	Government	Private	Total
1.	Faculty	29	4	33
2.	Department	19	-	19
3.	Division	4	1	5
	T o t a l	**52**	**5**	**57**

Resource: B.Dzulkarnain, Drs., et.al., Pharmaceutical Research and Development Institute, Ministry of Health.

The names of those institutions are explained in the List 1

List 1. The List of Research Institutions

NO	NAME INSTITUTION	GOVERNMENT	PRIVATE
1.	Pharmaceutical Research and Development Institute Ministry of Health, Jakarta	Government	
2.	Faculty of Pharmacy, Airlangga University, Surabaya	Government	
3.	Center of Traditional Drugs Research and Development, Airlangga University, Surabaya	Government	
4.	Department of Pharmacy, Faculty of Mathematics and Natural Sciences, Indonesia University, Jakarta	Government	
5.	Spice and Medicinal Plant Research Institute, Ministry of Agriculture, Bogor	Government	
6.	Center of Biological Research and Development, Indonesian Science Institute, Jakarta	Government	
7.	Daya Varia Laboratory, Jakarta		Private
8.	Department of Biological Resources Conservation, Faculty of Forestry, Institute Pertanian Bogor	Government	
9.	Department of Biology, Faculty of Mathematics and Natural Sciences, Institute Pertanian Bogor	Government	
10.	Faculty of Veterinair Medicine, Institute Pertanian Bogor	Government	
11.	Department of Cultivations, Faculty of Agriculture, Institute Pertanian Bogor	Government	
12.	Faculty of Post Graduate Study, Institute Pertanian Bogor	Government	
13.	Faculty of Agricultural Technic, Institute Pertanian Bogor	Government	
14.	Department of Biology, Faculty of Mathematics and Natural Sciences, Institute Teknologi Bandung	Government	
15.	Department of Pharmacy, Faculty of Mathematics and	Government	

	Natural Sciences, Institute Teknologi Bandung		
16.	Department of Chemistry, Faculty of Mathematics and Natural Sciences, Institute Teknologi Bandung	Government	
17.	Study of Chemistry, Faculty of Doctorate, Institute Teknologi Bandung	Government	
18.	Faculty of Biology, Gajah Mada University, Yogyakarta	Government	
19.	Faculty of Medicine, Gajah Mada University, Yogyakarta	Government	
20.	Faculty of Dental Health, Gajah Mada Univ. Yogyakarta	Government	
21.	Faculty of Veterinair Medicine, Gajah Mada Univ. Yogya.	Government	
22.	Faculty of Agricultural Technic, Gajah Mada Univ. Yogya.	Government	
23.	Faculty of Medicine, Indonesia University, Jakarta	Government	
24.	Division of Biology, Faculty of Medicine, Indonesia Univ. Jakarta	Government	
25.	Division of Biochemistry, Faculty of Medicine, Indonesia University, Jakarta	Government	
26.	Division of Pharmacology, Faculty of epicene, Indonesia University, Jakarta	Government	
27.	Department of Biology, Faculty of Mathematics and Natural Sciences, Indonesia University, Jakarta	Government	
28.	Department of Chemistry, Faculty of Mathematics and Natural Sciences, Indonesia University, Jakarta	Government	
29.	Faculty of Post Graduate Study, Indonesia University, Jkt.	Government	
30.	Division of Pharmacology, Faculty of Medicine, Airlangga University, Surabaya	Government	
31.	Faculty of Dentistry, Airlangga University,	Government	

	Surabaya		
32.	Center of Traditional Drugs Research, Gajah Mada University, Yogyakarta	Government	
33.	Department of Biology, Faculty of Mathematics and Natural Sciences, Andalas University, Padang	Government	
34.	Department of Pharmacy, Faculty of Mathematics and Natural Sciences, Andalas University, Padang	Government	
35.	Faculty of Biology, National University, Jakarta	Government	
36.	Faculty of Medicine, Brawijaya University, Malang	Government	
37.	Faculty of Agriculture, Brawijaya University, Malang	Government	
38.	Research Institute, Diponegoro University, Semarang	Government	
39.	Mathematic and Natural Science Management Institute, Diponegoro University, Semarang	Government	
40.	Department of Pharmacy, Faculty of Mathematics and Natural Sciences, Hassanudin University, Ujung Pandang	Government	
41.	Faculty of Agriculture, Hassanudin University, Ujung Pandang	Government	
42.	Faculty of Medicine, Padjadjaran University, Bandung	Government	
43.	Department of Biology, Facult of Mathematic and Natural Sciences, Padjadjaran University, Bandung	Government	
44.	Department of Pharmacy, Faculty of Mathematic and Natural Sciences, Padjadaran University, Bandung	Government	
45.	Department of Chemistry, Faculty of Mathematics and Natural Sciences, Padjadjaran University, Bandung	Government	
46.	Faculty of Agriculture, Padjadjaran University Bandung	Government	
47.	Faculty of Medicne, Sebelas Maret University,	Government	

	Surakarta		
48.	Faculty of Biology, Jend.Sudirman University, Purwokerto	Government	
49.	Faculty of Medicine, Sriwijaya University, Palembang	Government	
50.	Faculty of Pharmacy, Tujuh Belas Agustus University, Jkt.		Private
51.	Faculty of Medicine, Udayana University, Denpasar	Government	
52.	Faculty of Pharmacy, Pancasila University, Jakarta		Private
53.	Faculty of Medicine, Sam Ratu Langi University, Menado	Government	
54.	Department of Pharmacy, Sumatera Utara University, Medan	Government	
55.	Faculty of Agriculture, Sumatera Utara University, Medan	Government	
56.	Faculty of Pharmacy, Widya Mandala University,Surabaya		Private
57.	Centre of Traditional Drugs Research and Development, Widya Mandala University, Surabaya		Private
58.	Faculty of Pharmacy, Surabaya University, Surabaya		Private
59.	Faculty of Pharmacy, Gajah Mada University, Yogyakarta	Government	
60.	Department of Biology, Faculty of Mathematics and Natural Sciences, Airlangga University, Surabaya	Government	
61.	Faculty of Post Graduate Study, Airlangga University, Surabaya	Government	

Resource: B.Dzulkarnain, Drs. et.al., Pharamceutical Research and Development Institute, Ministry of Health (with small correction).

RESEARCH ACTIVITIES

Research activities that have been conducted by research and development institutions their report that have been able to be collected by Pharmaceutical Research and Development Institute, Ministry of Health total 2536 research topics on traditional drugs or medicinal plants. Those reports consist of their in the form of

Strata 1 scriptions, Strata 2 thesises, Strata 3 desertations and research reports. All of them are shown in table 3. The kind of report and the total of them can be seen in table 4. Table 5 showed that recently in the period of 15 years there have many research activities been done. It means that the research interests on traditional drugs and medicinal plants have increased.

The reasons among others are :

1. The increase of researcher attentions in conducting researches of traditional drugs and medicinal plants.
2. The economic condition of the country is better than before, so that it can provide more budget for research activities.
3. There are more facility can be provided, particularly the instruments, including foreign aids.
4. There are more opportunities to improve the human resources by studying in this country or abroad.
5. The statement in Broad Lines of State Policies on traditional medicine, which should be used as the basis and guidance for the development efforts of traditional drugs, have encouraged the acceleration of the research efforts on traditional drugs.

All of those have increased the attentions of the experts to conduct researches on traditional drugs and medicinal plants.

Table 3. Scriptions, Thesises, Desertations, Research Reports.

NO	SCRIPTION, THESISES, DESERTATION, RESEARCH REPORT	TOTAL
1.	Scription	2.102
2.	Thesis	74
3.	Desertation	15
4.	Research report	345
	T o t a l	2.536

Resurce : B. Dzulkarnain, Drs.et.al., Pharmaceutical Research and Development Institute, Ministry of Health.

All research data mentioned above can be grouped into six periods, based on the year in which the research activities have been done, beginning with 1965. Each period is five years period. Those six periods are :

I. 1965 - 1969
II. 1970 - 1974
III. 1975 - 1979
IV. 1980 - 1984
V. 1985 - 1989

VI. 1990 - 1994

Then the kind and the total of data mentioned above are grouped in table 4.

Table 4. The Kinds and The Total of Research Reports in Five Year Period

No	Kinds	I	II	III	IV	V	VI	Total
1.	S1	31	29	107	408	925	591	2.102
2.	S2	-	-	1	15	37	21	74
3.	S3	-	-	1	12	2	-	15
4.	R	4	3	51	121	97	69	351
	Total	35	32	162	564	1.061	682	2.536

Resource : B. Dzulkarnain, Drs. et. al., Pharmaceutical Research and Development Institute, Ministry of Health.

THE FIELDS OF RESEARCH THAT HAVE BEEN DONE

The researches that have been carried out can be divided into 10 groups based on the field of them. The 10 groups are :

1. **Survey**
   This field covers all activities for collecting informations on medicinal plants, traditional drugs, ethnobotany, ethnopharmacology and so on.

2. **Pharmacognosy and Phytochemistry**
   The purpose of the research in this field is to find the characteristic features of traditional drugs, including crude drugs, that are very important for carrying out the control activities. In this regard the researches can either be morphological, histological and chemical researches.

3. **Pharmacology**
   This field consist of toxicity test and efficacy test. Toxicity test can either be acute, subacute, chronic and specific toxicity test, in vitro or in vivo.

4. **Cultivation**
   This field covers the preparation of growing media, preparation of seed or seedling, preparation of land, preparation of seedbed, fertilizing, harvest, post harvest process etc.

5. **Formulation**
   This field covers the researches on the formula (composition) of traditional drugs, the dosage forms of traditional drugs and so on.

6. **Dosage form quality**
   It covers the laboratory testing on the dosage forms of traditional drugs that have been marketed.

7. **Chemical method development**
   It is conducted for developing the chemical method used for analyzing crude drugs or traditional drugs.

8. **Post harvest**
   This field covers all researches on harvest methods, the crops and the process of the crops into crude drugs.

9. **Efficacy testing**
   It has the same meaning with clinical trial. For this purpose the volunteers as well as patients are used to justify the efficacy of crude drugs or traditional drugs.

10. **General**
    It covers research activities that are difficult to be grouped into all fields mentioned above.

The total of researches based on those field shown in table 6 :

Table 6. The Total Researches That Belong To Each Field Mentioned Above During 1965 - 1993

No.	Research Field	Total
1.	Pharmacognosy / Phytochemistry	1.043
2.	Pharmacology	1.047
3.	Cultivation	300
4.	Survey	48
5.	Formulation	29
6.	Dosage form quality	16
7.	Chemical method development	13
8.	Post harvest	9
9.	Efficacy testing	10
10.	General	39

Resource : 1. B. Dzulkarnain, Drs., et. al., Pharmaceutical Research and Development Institute, Ministry of Health.
2. Directorate of Traditional Drugs Control, Ministry of Health.

The fields that has frequently got attention from the experts are pharmacognosy/phytochemistry, pharmacology and cultivation. Those fields can be seen in table 6 and their details in table 7.

Table 7. The Total of Three Fields That Frequently Got Attention From The Experts In Each Five Year Period.

No.	Research Field	I	II	III	IV	V	VI	Total
1.	Pharmacognosy/ Phytochemistry	27	25	65	223	451	251	1049
2.	Pharmacology	8	5	71	200	418	342	1047
3.	Cultivation	-	1	8	1154	122	55	300

Note : I, II, III, IV, V and VI are five year period as mentioned in table 4.

THE RESEARCHES OF MEDICINAL PLANTS

1. The kinds of medicinal plant

The total medicinal plants that have already been studied in Indonesia are 616 species. This number is rather a lot, because the research activities are carried out by many institutions scattered in numerous regions. It also shows our wealth in medicinal plants, that a few of them are potential enough to be developed further. Out of that number 20 species are selected, based on the fact that they are more generally utilized by the people and more frequently by the experts. These species are mentioned bellow :

Table 8. The Frequent Medicinal Plants That Are Studied Based On The Research Field.

No	Plant name	a	b	c	d	e	f	g	h	i	j	Total
1	Curcuma xantho-rrhizha Roxb.	20	39	1	-	1	-	-	1	-	-	62
2.	Zea mays L.	3	2	54	-	2	-	-	-	-	-	61
3.	Allium savinum L.	5	27	2	-	-	-	-	-	-	-	34
4.	Curcuma longa L.	12	18	1	1	-	-	-	1	-	-	33
5.	Momordica charantia L.	7	25	-	-	-	-	-	-	-	-	32
6.	Psidium guaiva L.	9	14	3	-	3	-	-	-	-	-	29
7.	Morinda citrifolia L.	11	17	-	-	-	-	-	-	-	-	28
8.	Phyllanthus niruri L.	9	18	-	-	-	-	-	-	-	-	27
9.	Carica papaya L.	3	15	2	-	1	-	-	2	1	-	24
10.	Averrhoa bilimbi L.	8	13	-	-	-	-	-	-	-	-	21
11.	Stevia rebaudiana Bertoni	7	4	9	-	-	-	-	-	-	1	21
12.	Pluchea indica Nees	13	7	-	-	-	-	-	-	-	-	20
13.	Aviennia officinale L.	3	16	-	-	-	-	-	-	-	-	19
14.	Centella asiatica Urban	8	10	-	-	-	-	-	1	-	-	19
15.	Manihot utillissima Pohl.	10	3	3	2	-	-	-	-	-	1	19
16.	Vitex trifolia L.	12	6	-	-	-	-	-	-	-	-	18
17.	Costus speciosus Smith.	7	4	6	-	-	-	-	-	-	-	17
18.	Sonchus arvensis L.	8	6	2	-	-	-	-	-	-	-	16
19.	Graptophyllum pictum Griff.	9	4	1	2	-	-	-	-	-	-	16
20.	Phaseolus vulgaris L.	4	4	5	-	-	-	-	-	-	-	13

Resource : B. Dzulkarnain, Drs., et.al., Pharmaceutical Research and Development Institute, Ministry of Health.

Note : a. Pharmacognosy/Phytochemistry
b. Pharmacology
c. Cultivation
d. Survey
e. Formulation
f. Quality
g. Chemical method development
h. Post harvest
i. Efficacy testing
j. General

2. The number of researches on those 20 medicinal plants.

The number of research activities on those 20 medicinal plants in each five year period since 1965 up to 1994 are shown in table 9.

Table 9. The Number of Research Activities On Those 20 Medicinal Plants In Each Five Year Period.

No.	Plants Name	I	II	III	IV	V	VI	Total
1	Curcuma xanthorrhizha Roxb.	-	-	1	5	40	16	67
2.	Zea mays L.	-	1	-	36	20	2	61
3.	Allium sativum L.	-	-	-	2	19	12	33
4.	Curcuma longa L.	-	-	-	2	21	10	33
5.	Momordica charantia L.	-	-	-	2	19	11	32
6.	Psidium guaiava L.	1	-	-	11	11	6	29
7.	Morinda citrifolia L.	-	1	4	6	8	9	28
8.	Phyllanthus niruri L.	-	-	1	12	3	10	27
9.	Carica papaya L.	-	-	-	4	13	7	24
10.	Averrhoa bilimbi L.	-	-	1	8	8	4	21
11.	Stevia rebaudiana Bertoni	-	-	-	6	13	2	21
12.	Pluchea indica Nees	-	-	1	2	11	6	20
13.	Avicenna officinale L.	-	-	-	1	11	6	18
14.	Centella asiatica Urban	-	-	-	6	8	5	19
15.	Manihot utilissima Pohl	-	-	-	6	9	4	19
16.	Vitex trifolia L.	-	5	-	2	-	10	18
17.	Costus speciosus smith.	-	-	1	10	2	4	17
18.	Sonchus arvensis L.	1	1	-	2	8	4	16
19.	Graptophyllum pictum Griff.	-	-	-	8	7	1	16
20.	Phaseolus vulgaris L.	-	-	1	1	10	1	13

From table 9 it can be seen that the attention of experts are around the researches on the field of phytochemistry, pharmacology and cultivation. Those activities are grouped into five year period activities and carried out by institutions mentioned in table 10.

Table 10. The Number of Institutions That Carried Out Researches on 20 Kinds of Medicinal Plant

No.	Plants Name	Number of Institution
1.	Curcuma xanthorrhizha Roxb.	19
2.	Zea mays L.	1
3.	Allium sativum L.	15
4.	Curcuma longa L.	21
5.	Momordica charantia L.	13
6.	Psidium guaiava L.	14
7.	Morinda citrifolia L.	8
8.	Phyllanthus niruri L.	13
9.	Carica papaya L.	17
10.	Averrhoa bilimbi L.	13
11.	Stevia rebaudiana Bertoni	10
12.	Pluchea indica Nees	10
13.	Avicenna officinale L.	3
14.	Centella asiatica Urban	8
15.	Manihot utilissima Pohl	10
16.	Vitex trifolia L.	7
17.	Costus speciosus smith.	11
18.	Sonchus arvensis L.	8
19.	Graptophyllum pictum Griff.	9
20.	Phaseolus vulgaris L.	9

Resource : B. Dzulkarnain, Drs., et. Al., Pharmaceutical Research and Development Institute, Ministry of Health.

CONCLUSION

The researches on traditional drugs and drugs have begun to develop since 1965. The rapid development happened in 15 years recently. The reasons are :

1. This country has developed, so that its condition has become better than before.
2. More research budget available, so that more research apparatus and instruments can be provided.
3. The statement which has existed in Broad Lines of State Policies (GBHN) since 1988, concerning to traditional drugs and healings, becomes the basis and guidance of all development efforts on traditional drugs and

healings. Therefore inevitably, that statement has encouraged all experts in the field of traditional drugs and healings to carry out researches in such field.

4. By the way the developments in this field abroad, particularly the situation of research activities following "back to nature" movement in western countries, that improves very much the research activities on herbal medicines there tends to influence research activities in this country.
5. The cooperation with other countries gives this country possibilities to improve the capability of its human resources in the field of research and development on traditional drugs.
6. Last but not least the improvement of capability in collecting and managing data has improved all information prepared, so that the implementation of research and development of traditional drugs can be more developed as well.

For improving and increasing research and development efforts of traditional drugs, firstly the development of human resources should be continued and improved In this regards, the men power education and training are needed Secondly the availability of apparatus and instruments of traditional drugs research and development should be increased either its kinds or its numbers. Thirdly the availability of reliable information is very important. Therefore the exiting data collection, its management and its dissemination (the information system) should be improved and developed, so that the data collected and managed as well as the information prepared and disseminated can be used effectively and efficiently. If all of them can be realized, the acceleration of research and development efforts on traditional drugs, including crude drugs and medicinal plants as their resource, can be realized as well.

REFERENCES

1. **Anonym** : Suntingan Naskah Populer Obat Tradisional, Departement Kesehatan RI, 1986.
2. **Anonym** : Garis-Garis Besar Haluan Negara, Republik Indonesia, 1988
3. **Anonym** : Garis-Garis Besar Haluan Negara, Republik Indonesia, 1993
4. **Anonym** : Undang-Undang No. 23 Tahun 1992 tentang Kesehatan
5. **Anonym** : Peraturan Menteri Kesehatan RI No.246/Menkes

/Per/V/ '90 tentang Izin Usaha Industri Obat Tradisional dan Pendaftaran Obat Tradisional.

6. **Anonym** : Peraturan Meneteri Kesehatan RI No. 760/ Menkes/Per/IX/92 tentang Fitokimia.

7. **Anonym** : Keputusan Menteri Kesehatan RI No.761/Menkes/ SK/X/92 tentang Pedoman Fitofarma.

8. **Dzulkarnain, Drs.et.al.** : Penelitian Tanaman Obat ndonesia 1965-1995 (are being printed in 1995).

R & D & P ON MEDICINAL PLANT PRODUCTS AND THEIR PRODUCTS IN THE INSTITUTE OF MATERIA MEDICA IN VIETNAM

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I. INTRODUCTION

Vietnam is a tropical country with different climatic and geographical features in its various regions. It has an abundance of diverse natural resources, in which medicinal plants and herbal drugs have made a tremendous contribution to national health and development from the very beginning. When Vietnam wrested back its independence, the government has paid great attention to the health care. One factor of primary importance is provision of drugs. For a country that soon after its liberation from colonialism had to face with an atrocious war throughout 30 years, the only right way is to mobilize its own potentiality to produce medicines from indigenous raw materials-medicinal plants.

For materializing this task, in 1961, the Institute of Materia medica (IMM) was established in Hanoi as a top branch institution researching on medicinal plants for comprehensive study on medicinal materials throughout the country, to supply raw materials for the pharmaceutical industry, for the traditional medicine, and for the production of new-drugs from medicinal plants.

II. INSTITUTE OF MATERIA MEDICA

Function : IMM has 7 function :

1. To carry out the exploration of medicinal resource, especially medicinal plants to execute the inventory in the whole country.
2. To carry out the research on the acclimatization and the technology of cultivation of medicinal plants, the technology of strain selection, strain multiplication, revitalization, hybridization and preservation of medicinal plant gene source.
3. To carry out chemical, pharmacological and clinical studies aiming at confirming the therapeutic value of local medicinal plant to inherit and improve the national traditional medicine, to create new drugs from medicinal plants.
4. To train post-graduate specialists on medicinal materials, Master and PhD degree on pharmacognosy and pharmacology of medicinal plants.

5. To carry out the information and propagation for the development and usage of medicinal plants and traditional medicine.
6. To endorse research contracts and scientific services in the field of strain study, technology of medicinal plant cultivation, analysis of the chemical components of medicinal plants, extraction of active constituents, pharmacological and toxicological assays, elaboration of medicine and medicinal materials standards.
7. To produce certain medicines with high therapeutic value and complicated technology.

Organization :

IMM consists of 6 department (Botany and medicinal resources, Phytochemistry, Chemical analysis and standarization, Pharmacology and Biochemistry, Galenic pharmacy, Tissue culture and Callus culture), one pilot plants for extraction and formulation, and 3 stations at different altitudes for the research on Agronomy.

Main research subjects in 5 years program (1991-1995)

1. 28 research subjects at different levels have been carried out, as followings :
   + 11 research subjects at state level
   + 7 research subjects at ministry level
   + 10 research subjects at institute level

2. 7 kinds of medicines and pure compounds from medicinal plants have been produced in large scale :
   + Artemisinin (antimalarial drug) from *Artemisia annua* L.
   + Bidentin (antihypercholesterolaemic drug) from *Achyranthes bidentata.*
   + Raucaxin (antihypertensive drug) from *Rauwaulfia canescens.*
   + D-Strophantin (carditonic drug) from *Strophantus divaricatus*
   + Rutin from *Sophora japonica*
   + Abilin (for hepatopathy) from *Adenosma indianum*
   + Diosgenin (chemical for synthesis of steroid) from *Dioscorea* species.

3. 3 books on medicinal plants in Vietnam have been published.

The research on Artemisinin production from Artemisia annua L. could be taken as a typical example (see part II).

RESEARCH ON THE PRODUCTION OF ARTEMISININ FROM ARTEMISIA ANNUAL.

IMM has implemented the resent subject since 1987, and the following results have been s far reached.

I. Research on Raw-material

1. Research on ecology and resource of *Artemisia annua* L.

Its presence in Vietnam was confirmed, their resevior being located in the north Vietnam. The Artemisinin content dynamics was determined as well as the ecological conditions to serve the research on the cultivation process of the plant.

A plan for the preservation of the gene source of this plant was available.

2. Research on technical processes for the cultivation of *Artemisia annua* L.

From the seeds gathered from the wild plants, researches were carried out aiming at knowing the technical processes for the cultivation of *Artemisia annua* at IMM's station for 3 years, the a process for intensive cultivation was studied and applied for trial 3 regions with different ecological conditions.

For the improvement of the agro-technology, the artemisinin content of 573 individuals selected from the wild population of *Artemsia annua* was determined and the results are very various from 0.27% to 1.6%.

These results suggest the possibility for the selection of high quality seed. We chose 1000 strong individuals from cultivated population, and continued the selection on the basis of examination of exterior form and the Artemisinin content.

After two years, 20 better lines were selected and applied for development in 3 different regions. Finally, a new strain with high quality was selected. With the improvement of the technical process and the selection of high quality seed, the yield and the quality of cultivated Artemisia annua had been increased step by step.

In 1989, the first experiment of cultivation was carried out.

In 1991, the average yield increased to 200% of dried leaves/ha, the average Artemisinin content increased to 110%.

In 1993, the average yield increased to 300% of dried leaves/ha, the average Artemisinin content increased to 120%. In some locations the yield reached more than 400% and the Artemisinin content reached more than 130%.

Three different 50 ha regions for cultivation were created to supply raw material for the IMM's worksop for artemisinin production.

A process for production of high quality Artemisia annua strains was eloborated with an annual production of 150-200 kg of seeds. The researches on the

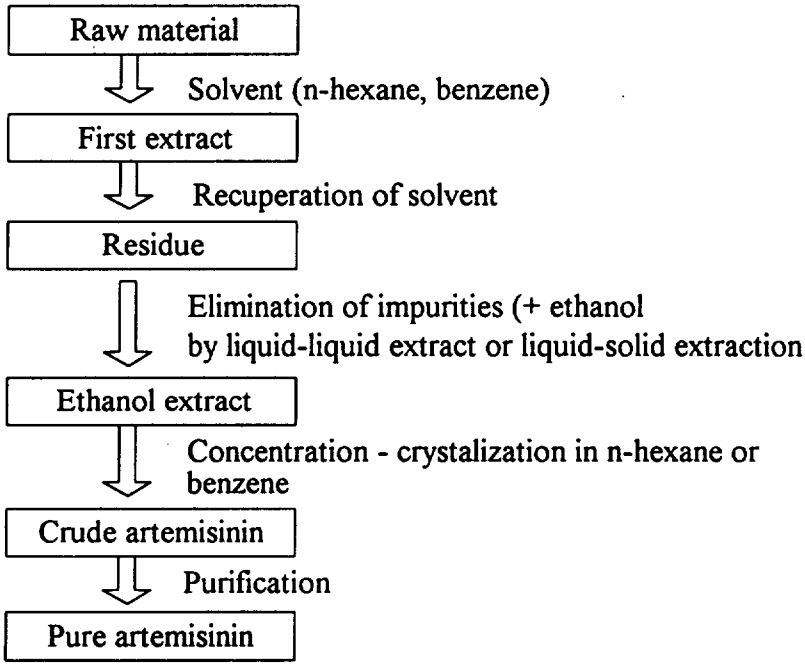
after - harvesting drying process and the conditions of storage of raw material were carried out.

II. Research on the technology of Artemisinin extraction.

In 1989, the process for artemisinin extraction was studied at laboratory scale. After only 4 months, with the pilot plant's modern equipment supported by UNIDO, the extraction trial was carried out at IMM's pilot plant, with daily extraction capability of 80 kg raw material (40 kg x 2 times).

In 1991, the production was carried out at industrial scale with daily extraction of 300 kg raw material per day, and 1000 kg in 1993.

The schema of Artemisinin extraction process :



The outputs in the following years are as follow :

1989	(last 3 months)	12.5 Kg
1990		20.0 Kg
1991		62.0 Kg
1992		247.0 Kg
1993		475.0 Kg

From 1994, the production capability of IMM can reach 1000 kg/year.

III. Research on the artemisinin dosage forms.

Research and production at pilot scale were carried out since 1990 for the 0.25 g artemisinin tablets and capsules dosage forms, in 10 units blister foil with high quality. Validity monitoring of the tablets/capsules was performed, and checking was done once every 6 months, the results showed that tablets/capsules produced since 1990 have got negligible decrease in artemisinin content.

In order to ensure the quality, from 1990 to 1992, the Ministry of Health has assigned the IMM to play the role of unique unit having the authorization for the production of arteisinin tablets and capsules for clinical trial. Up to now IMM produced more than 3,000,000 tablets/capsules of Artemisinin.

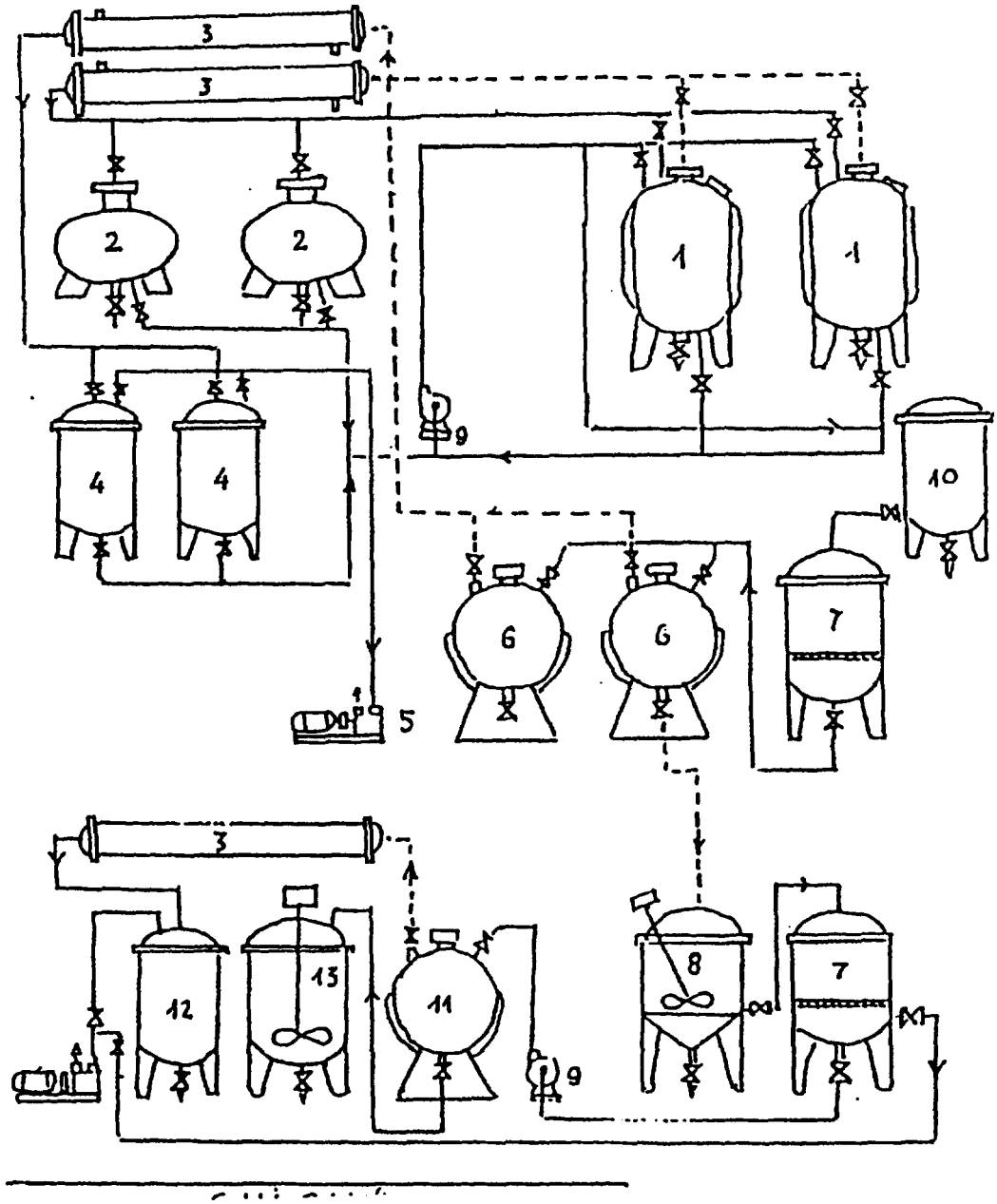
The artemisinin substance and the artemisinin tablet, capsule forms produced by IMM were analysed by several foreign laboratories (The Netherlands, Switzerland, Japan, French, Sweden, ...) and their high purity as adequate content were confirmed.

IV. Conclusions

1. After six years - research on the production of artemisinin from *Artemisia annua* L.,
   we have got successful results :
   - To confirm the presence and the reservoir of *Artemisia annua* L. in Vietnam.
   - To establish a technical process for the cultivation f *Artemisia annua* L. in large scale and select a high quality new strain which increases the yield and the quality of cultivated *Artemisia annua* L., to supply good raw material for the production of artemisinin.
   - To establish the technology for the industrial production of artemisinin. The production capability can supply the inland need and export.
   - The products reaching national norms and have good quality.

2. Besides artemisinin, we have implemented the development at pilot scale of the semi-synthesis of artesunat, artemether, arteether and Dihydro-artemisinin.

The Flow of Technology for Extraction of Artemicinin



STANDARIZATION OF QUALITY CONTROL OF MEDICINAL PRODUCTS

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1. Introduction

Jamu or the Indonesian traditional drugs have been used by the community since ancient time. The main ingredients of jamu are plant materials (whole plant, plant organs, cell inclusions, plant exudates, and plant extracts). The main three dispensing forms are (1) Jamu godog, consisting of whole or coarse out simplisia (simplisia are plant materials used for the production of jamu), (2) Powdered Jamu, consisting of powdered simplisia, and (3) Jamu Instant, consisting of galenical preparation of jamu.

The marketed jamu consists of those above mentioned three main dispensing forms and their two modifications, namely :

a. Plain Jamu Godog
b. Mixture of Jamu Godog and powdered jamu
c. Powdered jamu
d. Mixture of powdered jamu and jamu instant
e. Jamu Instant

2. Analytical methods

Three analytical methods can be applied on the 5 jamu dispensing forms : Macroscopic analysis, microscopic analysis, and physicochemical or TLC (Thin-Layer Chromatography) analysis.

Correlation between the jamu dispensing forms and the analytical methods are as follows :

No	Dispensing form	Macroscopic analysis	Microscopic analysis	Physicochemical-TLC analysis
1	Jamu Godog	+	(+)	(+)
2	Mixture of Jamu Godog and powdered Jamu	+	+	(+)
3	Powdered Jamu	-	+	(+)
4	Mixture of powdered jamu and jamu instant	-	+	+
5	Jamu Instant	-	-	+

Table 1. + = Main applicable analytical method
(+) = Applicable, but not necessarily performed
- = Not applicable

3. Macroscopic analysis

a. Qualitative analysis

This method require a skilled analyst, who has the ability to select and separate the individual simplisia organoleptically. This ability is taught/trained at the Faculty of Pharmacy. The most skilled analyst is the person who everyday purchases simplisia for the jamu manufacturer.

b. Quantitative analysis

Gravimetric method is applied; this is the standard method. The selected and separated simplisia is weighed. The individual weight is then converted to percentage.

4. Microscopic analysis

a. Qualitative analysis

Data on microscopic analysis of simplisia is admitted in the Indonesian Pharmacopeia (Farmakope Indonesia, FI), the Extra Indonesia Pharmacopeia (Ekstra Indonesia, EFI), and the Indonesia Materia Medica (Materia Medica Indonesia, MMI). Only the MMI is provided with drawings of the plant fragments and the plant inclusions.

The best ability in microscopic qualitative analysis is obtained after intensive training and daily practice. Microscopic analysis is the standard method in the identification of simplisia in powdered jamu; this method ca be applied on Jamu Godog if necessary.

b. Quantitative analysis

The method is still unknown. Preliminary research works on this method show that characteristic plants fragmented can become uncharacteristic if the jamu powder is very fine. Furthermore, simplisia from different source may have different amount of characteristic fragment per mg simplisia.

5. Physicochemical-TLC analysis

a. Qualitative analysis

No official method is known about the qualitative physicochemical analysis of simplisia as component of jamu. Due to this condition, the Faculty of Pharmacy, Pancasila University, formulates itself the needed technique.

The technique is designated as the "Reverse Approach" work design. The RA work design consists of four steps :

- Step 1 : Qualitative analysis
- Step 2 : Isolation of the identity substance
- Step 3 : Elucidation of the molecular structure of the identity substance
- Step 4 : Quantitative analysis.

- Step 1.

  Three kind of extracts are applied on the TLC plate; these are :
  A = extract of the simplisia to be identified
  B = extract of the blank (jamu without simplisia A)
  C = extract of the jamu

  A dye is used as reference substance (to calculate the hR_x values).

  The chromatograms of A, B and C must comply with the A + B = C Equation, meaning that all spots of chromatogram A and B must appear in chromatogram C (some spots may overlap with each other) and at least one spot of A is not covered by B; this spot is designated as the characteristic spot A. The substance that causes the characteristic or specific spot is designated as the identity substance.

  The identity substance is not necessarily the active principle of the simplisia. Any secondary metabolit can become an identity substance, for example

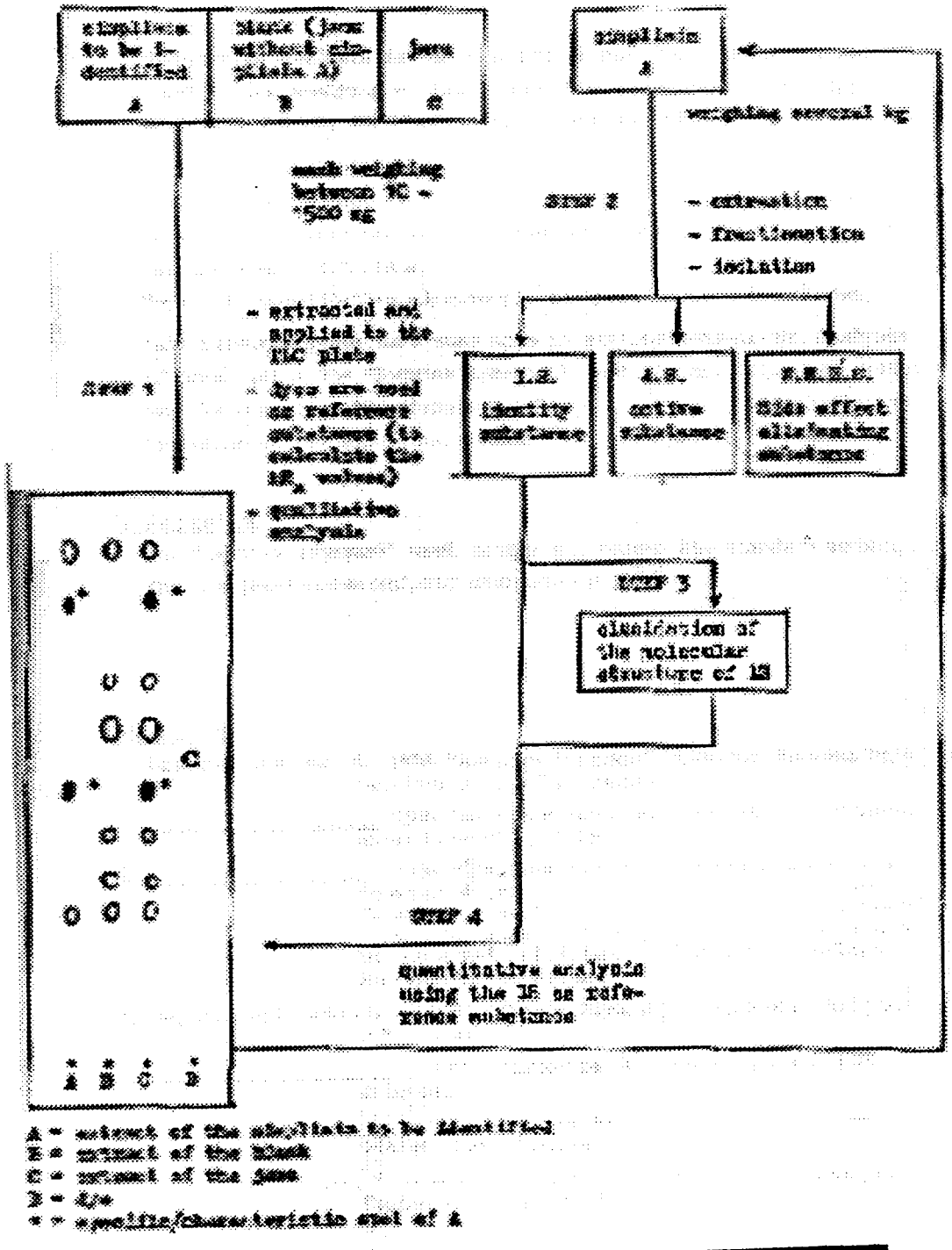
alkaloid, flavonoid, coumarin derivates, constituents of volatile oil, and steroid.

The identity substance of the certain simplisia is not necessarily the same chemical substance, because different jamu composition will give different composition of the blank, and hence that chromatogram will also be different.

Papers based on the "Reverse Approach" work design have been presented in international forums, such as the FAPA Congress (FAPA = Federation of Asian Pharmaceutical Association), ICTAM (International Conference on Traditional Asian Medicine), and ASOMPS (Asian Symposium on Medicinal Plants & Spices). The book "Reverse Approach" (written in the Indonesian language) has been published on 1986; an English edition of this book will be published in 1996.

b. Quantitative analysis

Research works, based on the "Reverse Approach" work design will be performed after the identity substance has been isolated; densitometry is the method of choice. An example in this case is the utilization of sinensitin as the identity substance of the leaf of *Orthosiphon aristatus*.



6. Discussion

Macroscopic analysis is the standard method for qualitative and quantitative analysis of Jamu Godog. The simplisia is identified through its form, texture, colour, taste and odour. Microscopic analysis is the standard method for the identification of simplisia in powdered jamu. Essential is the knowledge about the form, size, colour and minute characteristics of the fragments of the individual simplisia. Method in quantitative microscopic analysis of jamu is unknown. Many research works have been done in physicochemical-TLC analysis of jam, using the "Reverse Approach" work design. This work design must be supported by extensive phytochemical works, especially the isolation of the main constituents of the simplisia.

7. Suggestion

The "Reverse Approach" work design can become the standard method for the physicochemical-TLC analysis of jamu.

References

1. Bambang-Sutrisno, R. 1986 "Reverse Approach" Fakultas Farmasi Universitas Pancasila, Jakarta.
2. _____ 1986 "Analisis Jamu" Fakultas Farmasi Universitas Pancasila, Jakarta.
3. _____ 1994 "The development of phytopharmaca in Indonesia" Paper presented at the Joint Workshop "Plants in Medicine : Validation and Development" at the Department of Pharmacy, Faculty of Mathematics & Natural Sciences, Institut Teknologi Bandung, 24-26 Januari 1994.
4. Departemen Kesehatan RI 1981 Ekstra Farmakope Indonesia" Ditjen. POM, Jakarta.
5. _____ 1989 "Farmakope Indonesia" Ditjen. POM, Jakarta.
6. _____ 1977 "Materia Medika Indonesia" Volume I, Ditjen. POM, Jakarta.
7. Wagner, H., Bladt, S. & Zgainsky, E.M. 1984 "Plant Drug Analysis" Springer-Verlag, Berlin, Heidelberg.

ACTIVITIES STUDIES OF MEDICINAL PLANTS WITH SPECIAL REFERENCE ON *Sauropus Androgynus* Merr

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ABSTRACT

Physiological effects of *Sauropus androgynus* Merr (SA) was studied using laboratory animals as models for the experiments. The animals organs studied were conducted in viva as well as in vitro. The experimental animals were created humanly in accordance to the Indonesian Veterinary Medical Association Oath. Deep general anesthesia was applied during surgical performance to conduct in viva studies while for the studies of isolated organs the animals were put into sleep using the accepted euthanasia procedures.

From the animals-experiments it was found that SA decease blood-pressure from 120 mm Hg to 60-80 mm Hg; has a negative chrono and ionotropic effect on heart in Vivo as well as on heart in vitro; decrease peristaltic movement of intestine in Vivo as well as in vitro; caused contraction of uterus in vitro; act as abortivum, and as antipyretica.

Using small ruminant (goat) as experimental model shows that SA increase milk production by 21.03%; increase blood glucose and increase the supply of blood glucose to mammary gland by 52.66% in comparison with the control-group. SA did not effect the milk composition of the goat milk.

Feed digestibility were increased in rabbits when the animals were given SA or papaverine (PPV). The absorption of glucose from the intestine into the portal vein was increased in are animal given SA while no effect was shown in the group of animals given PPV. Comparing the animals given SA with control group and the PPV group at the end of the experiment shows that SA cause the process of glycogenesis in the liver to increase. PPV to a lesser extent also increase are glycogenesis in the liver in comparison with the control group.

Hundred thirty one species medicinal plants were collected from West Java, Middle Java, East Java provincies, identified, verified and stored in herbarium for further studies

Key words: blood pressure, negative chrono- ionotropic, isolated organs, milk production, feed digestibility, blood glucose, milk composition, glycogenesis.

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INTRODUCTION

The Indonesian flora offers a variety of plants with curative properties which are well known in the traditional medicine. One of these plants which is frequently used as a remedy is *Suropus androgynus*. Many people believe that this plant supports a woman's lactation and mothers eat or drink preparations of its leaves in order to increase their breast milk production. In animal husbandry farmes occasionally use *Sauropus androgynus* and other leaves as a feed additive for dairy cows with the purpose of increasing milk yield.

One of the active compounds of *Sauropus androgynus* was identified as papaverine. This alkaloid is known as a vasodilator, relaxant, and spasmolyticum for various smooth muscles and cardiac tissue. Consequently it has some general l effects on the physiological functions, particularly on the function of the gastrointestinal tract, the cardiovascular system and on the metabolism.

This experiment investigates the effect of *Sauropus androgynus* leaves on cardiovascular system, digestive tract, uterus, milk production, feed digestibility, glucose absorption and glucose metabolism in the liver.

MATERIALS AND METHODS

I. S. Djojosoebagio : national seminar on exploration of Indonesian natural resources for pharmaceutical use. Yogyakarta nov. 30 dec. 5, 1964. Financial support : Dept. of National Research, RI Phyto Medica, vol. 1; Nr.l; p70; 1989.

A. Material

SA was dried, ground and made 20% infusum of it. The infusum was subjected to distillation and the *extract* obtained was dried in an oven with the highest temperature of 90°c for a period of 24-36 hours. The sauropus extract (se) was dissolved with water for oral (per OS) administration and dissolved in NaCl 0.9% for parentral (injection) administration.
Proximate analysis was performed on the dried SA

B. Methods

(1) Blood pressure
determination of blood pressure was performed on 12 experimental animals (dogs and cats) using the direct method (bloedige methode) by inserting a canule in the *A. caroticus* containing physiological sodium chloride and heparin and connected to manometer. Two of the experimentalanimals was used to determine the effect of SE on blood pressure, heart rate and intestine simultaneously. For the observation of heart rate in *in vivo*, a thorax surgery was performed and artificial

respiration was applied to the subject. The heart was connected kymograph for registration of the heart activities. The movement of the intestine was recorded by inserting a baloon containing water in tha intestine (after the intestine was exposed by *laparotomi* and connected a plastic tube to a tambour of Marey and kymograph. Ten percent of SE solution physiological sodium chloride was injected to the experimental animal through the *V. saphena.*

(2) Heart in vivo

Four animals (cats and rabbits) were used for this experiment. Thorax surgery with artificial respiration was subjected to the animals and the heart activities were recorded by connecting the heart to a kymograph. Ten percent of SE solution was injected to the animals through the *V. saphena*

Five frog (*Rana cancrinifora*) were also used to determine the effect of SE on their hearts activities *in vivo*. The hearts of the animals were exposed and connected to a kymograph. Ten percent of SE solution was applied in loco and the hearts were kept fresh by periodically dripping ringer-solution locally.

(3) Heart in vitro

Cats and Rabbits (four in number) were employed for this experiment. The hearts of the experimental animals were removed from the bodies and assembled on a manual Langendorf equipment. The hearts were perfused with 37 °C. Tyrode solution and the beat of the hearts were recorded by connecting the heart with kymograph Application of 10% SE solution was conducted by injection of the solution in the rubber tube that connected the source of the tyrode solution and the heart.

(5) Uterus in vitro

Nine guinea pigs (virgin, not-virgin and one was pregnant), 3 rabbits and 2 cats uterus were used in this experiment. After the uterus were exposed, the uterus were cut around 2.0 - 3.0 cm long and were handled as described in the experiment (4) (intestine in vitro)

(6) SE as abortivum

Three pregnant animals (rabbit, cat and guinea pig) were injected with 10 ml - 10% SE solution intra peritoneally once a day for 3 consecutive days. Daily observation were conducted on the experimental animals.

(7) SE as anti pyretica

Fourteen male rabbits were used to investigate the effect of SE on body temperature. Twelve rabbits were injected with 3.0 ml "anti-rabbit serum"

intravenously. Two animals were served as controls. The body temperature of the animals were recorded every hour for a period of 8 hours. The injected animals were treated as follows: 5 animals were given 25 ml 10% SE solution orally, 4 animals were given 25 ml water also orally and three animals did not receive either SE solution nor water.

(8) Inducing lactation

As preliminary study for lactation observation two female rabbits were used for this purposes. Pseudo pregnancy in the experimental animals were developed by parenteral administration of 100 i.u/day gonadotrophinum chorionicum (chorionic gonadotrophin hormone) for a period of 4 days. After the pseudo-pregnancy symptoms were observed (between 12-14 days after the administration of the hormone) the animals were injected intra peritoneally with 10 ml 10% SE daily for a period of 10 days. Three days before the experiment was terminated blood samples were collected from the animals. The serum of these animals were used to detect the "lactation-inducing-activities" of the serum by using the pigeons crop development as indicator (the serum was injected subcutaneously in the crop of pigeons). At the end of the experiment the animals were put to sleep by euthanasia procedures, the crops as well as mammary glands were dissected for histopathological studies, stained with hematoxylin-eosin.

II. A. Suprayogi : Research report, Bogor Agricultural University, 1992. Financial support : Ministry of Education and Cultural RI. Agrotech. vol.1; Nr.2; p.61; 1993.

A. Material

SA was treated as described in the previous protocol (I.A).

B. Methods

(1) Blood glucose

Six lactating goats (one month post partum and first time lactating) were: use in this experiment. The animals were randomly devided into 2 groups of 3 animals per group and served as control and treated groups. The treated group was given 20% SE dissolved in water by means of a plastic tube through an abdomen fistule directly into the abomasum. The total SE administered to the animals was 500 mg/kg. b.w./day and given twice in the morning and in the evening for a period of 12 days. In the same way water was administered to the control group. At day 15 after the administration of the SE blood samples were collected from the *A. Caroticus communis* and *V. mammaria* of both groups for blood glucose determination

(2) Milk production
Milking of the goats mere conducted twice daily (in the morning and the evening) after each milking, the amount of milk was directly measured using a measuring glass.

(3) Milk composition
Milk samples from the animals before and after the administration of SE or water were collected for the determination of their composition. Alternately every two days the mile of the experimental animals were collected for this purpose.

III. A. Suprayogi : Master thesis Georg-August University, Gottingen, Germany, 1995. Supervisor ; Prof. Dr. Udo Ter Meulen; Prof. Dr. Bohnel; Prof. Dr. Soewondo Djojosoebagio. Financial support : Gtz, Germany.

A. Material
SA was dried in an automatic oven at 60°c overnight and ground and suspended in distilled water (ss) to form a 14.17% concentration. Papaverine PPV used in the experiment was in the form of 5% solution of papaverine-hydrochloride.

B. Methods
(1) blood glucose
Thirty six male rabbits were employed to conduct this investigation and housed in an individual cages and fed with rabbit feed (pellet) and *water ad libitum*. The animals were divided into 3 groups of 12 animals per group and served as control group (CG), as PPV treated group and as SS-group. The CG was given 0.87 ml distilled water/twice a day, the ppv-group was given 2 mg ppv/kg.bw/twice a day. and the SS-group was given 0.95 ml. SS of 14.17% suspension twice a day (equal to 2 mg ppv/kg.bw). The materials were administered to the animals orally by means of plastic stomach catheter for a period of 15 days, at days 5, 10 and 15, four rabbits of each group were subjected to abdominal surgery under general anaesthesia to collect blood sampels from the *V. portalis* and from the *V. hepaticus* for the blood glucose determination.

(2) Feed digestibility
Four rabbits of each group that will stay alive until the termination of the experiment were used for the feed digistibility study. The feed intake of each animal was calculated from the amount of feed given in the morning (200 grams) minus the amount if feed not consumed by each animal. The feces of each animal were collected daily and stored in a refrigerator. At the end of the experiment the feces were subjected to proximate analysis.

IV. Surgical procedures

All animal used in these investigations were treated humanly in accordance to the Indonesian veterinary medical association oath. Animal used for *in vivo* organs activities observation were always under deep general anaesthesia. If the organ must be removed from the body for *in vitro* observation, the animal must be put into sleep under the accepted euthanasia procedures.

V. A. Hartana and M. Rifai : Research Report Life Sciences, Inter-University Center, Bogor Agriculture University, 1990. Financial support: World Bank 17 (soft loan).

Primary data collection of indigenous medicinal plants used for the treatment of domestic animal diseases by way of interviews with local farmers was conducted in places in West Java, Middle Java and East Java to include the island of Madura. The medicinal plants collected were identified and verified and later made as herbarium by Herbarium Bogoriense, Bogor.Materia Medika Indonesia published by the ministry of health, RI. was used as reference for the activities verification of the collected plants.

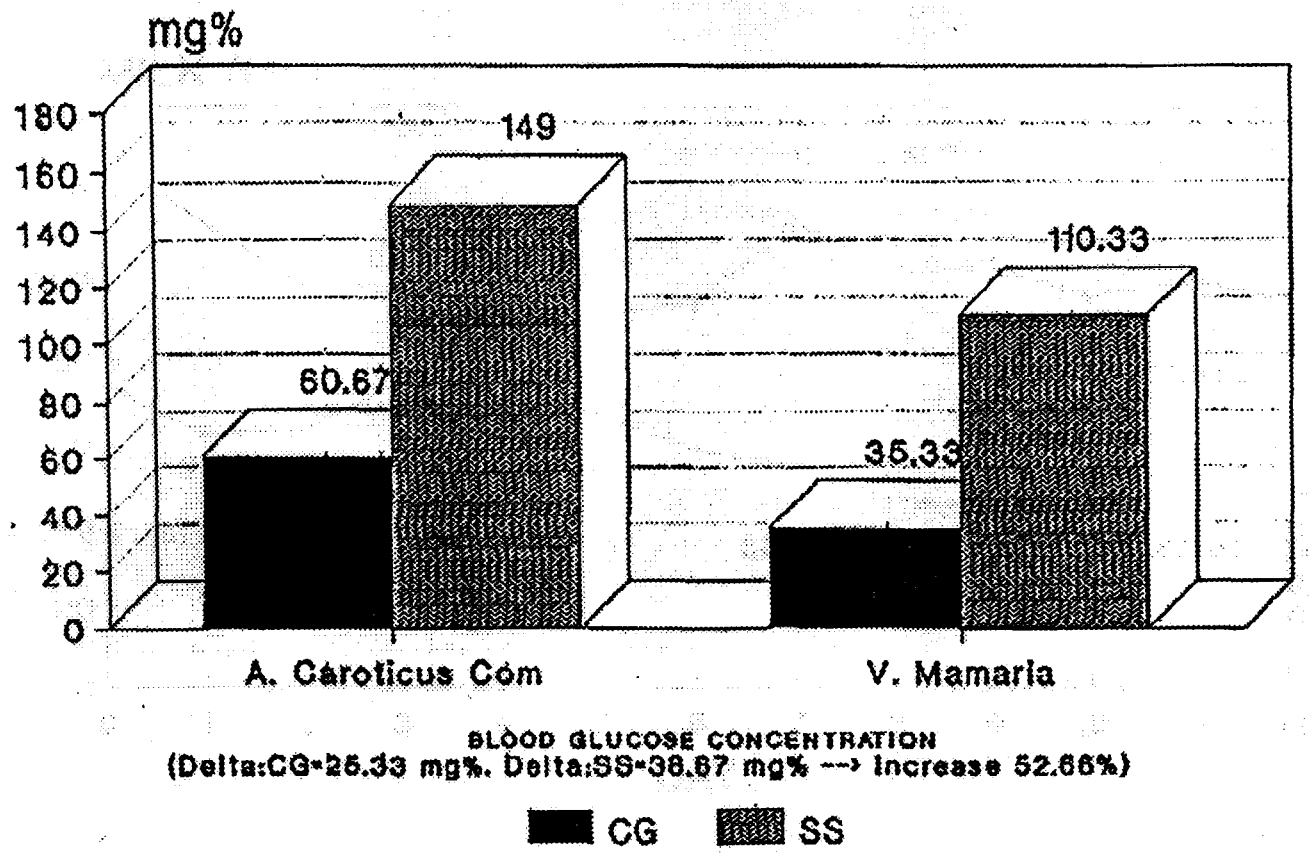
RESULTS

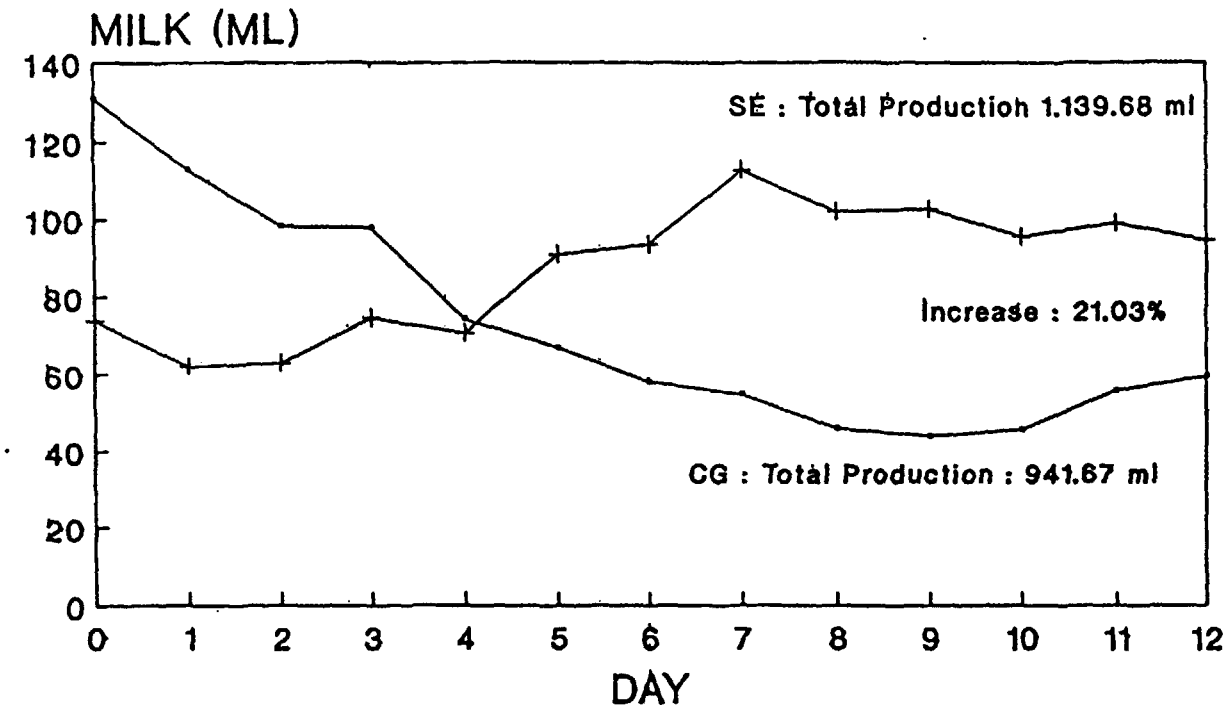
NUTRITION COMPOSITION OF SA

NUTRIENT	MIN. OF HEALTH, REPUBLIC OF INDONESIA (1972)	DJOJOSOEBAGIO (1964)
Carbohydrate	11.00 %	*
Starch	*	2.76 %
C. Protein	4.80 %	6.45 %
C. Fat	1.00 %	1.76 %
C. Fiber	*	2.18 %
Ash	*	2.04 %
Water	81.00 %	78.21 %
Calcium	2.04 mg/g	*
Phosphor	0.83mg/g	*
Iron	0.03 mg/g	*
Vitamin A	103.70 UI/g	*
Vitamin B1	10^{-3} mg/g	*
Vitamin C	2.39 mg/g	*
G. Energy	0.59 cal./g	*

I. THE PHYSIOLOGICAL EFFECTS OF SA.

PARAMETERS	EXPT. ANIMALS (N)	TREATMENT SE-10%	ACTIVITIES
Blood Pressure	Dogs (6) Cats (6)	I.V. I.V.	Decrease from 120 mm Hg to 60 - 80 mm Hg
Heart in vivo (in situ)	Cats (2) Rabbits (2) Dogs (2)	I.V. I.V. I.V.	Negative chrono and ionotropic (decrease in the amplitudo and fruquency of the contraction)
Heart in vitro (isolated)	Cats (2) Rabbits (2)	I.T.	Chrono and ionotropic
Intestine in vivo	Dogs (2)	I.V.	Decrease of peristaltic movement
Intestine in vitro	Rabbits (13) Guinea pigs (3) Chickens (3) Dog (1)	In loco (in the glass tube)	Contraction followed by relaxation and decrease in frequency
Uterus in vitro	Guinea pigs (9) Rabbits (3)	In loco	Contraction
Pregnant animals	Rabbit (1) Cat (1) Guinea pig (1)	I.P.	Abortus
Body temperature	Rabbits (14)	Per OS (oral)	Decrease body temperature > 1 °C
Inducing lactation	Rabbits (2) Pigeons (4)	IP SC	Not conclusive


mg%
180
160
140
120
100
80
60
40
20
0
149
60.67
110.33
35.33
A. Caroticus Com
V. Mamaria
BLOOD GLUCOSE CONCENTRATION
(Delta:CG=26.33 mg%. Delta:SS=36.67 mg% --> Increase 52.66%)
CG
SS

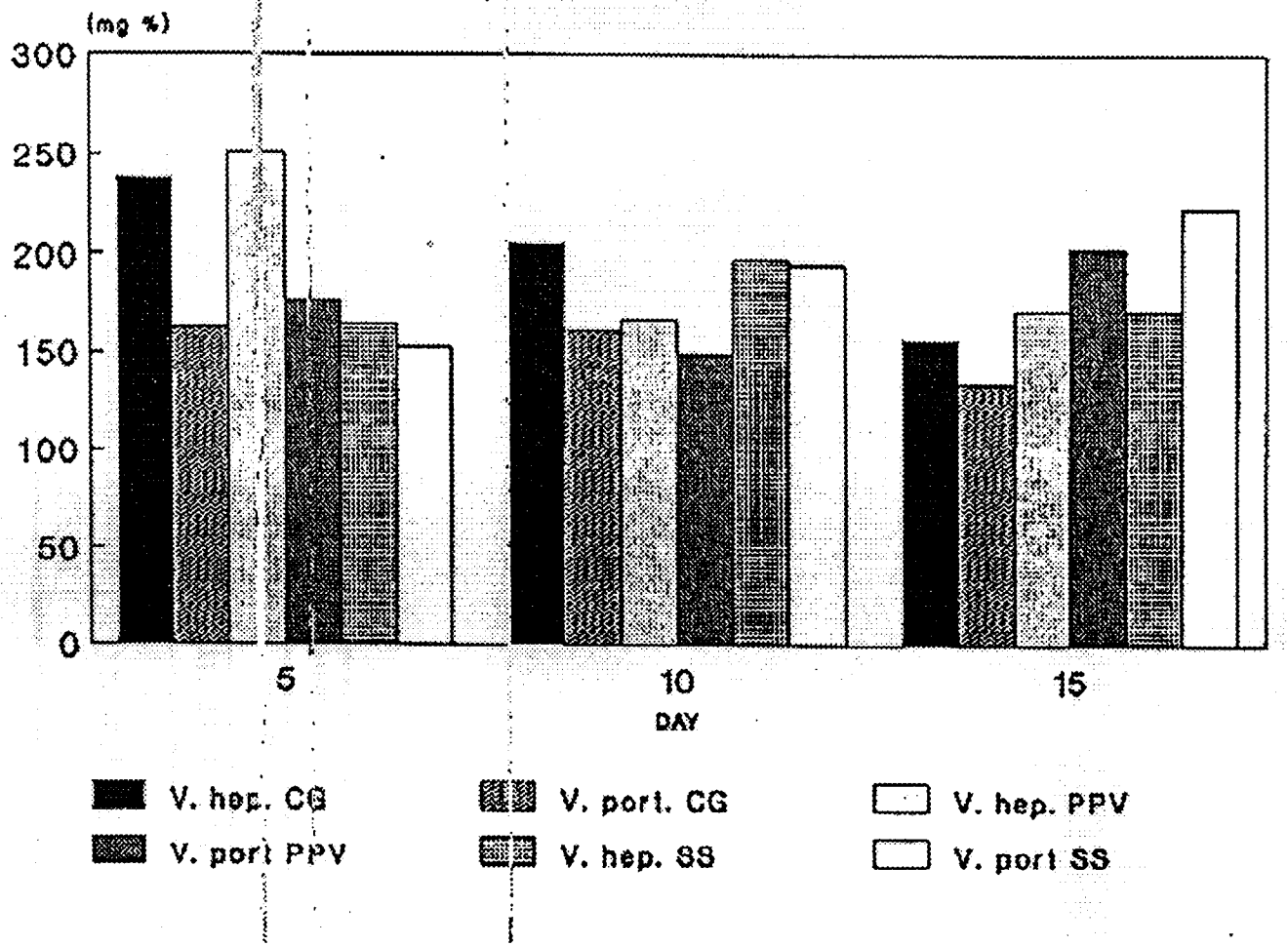


MILK PRODUCTION

MILK COMPOSITION

DAY	CONTROL GROUP			SE-GROUP		
	FAT	FFDM	PROTEIN	FAT	FFDM	PROTEIN
0	7.90 ± 0,78	19.06 ± 3.68	6.46 ± 0.51	11.80 ± 0.92	21.67 ± 0.82	7.31 ± 0.58
2	9.20 ± 1.73	19.99 ± 3.31	7.08 ± 0.92	9.60 ± 2.36	18.04 ± 1.93	5.60 ± 0.09
4	8.80 ± 2.55	17.08 ± 6.30	6.17 ± 2.92	9.33 ± 3.33	26.33 ± 15.39	5.81 ± 1.34
6	10.60 ± 4.69	19.75 ± 2.96	6.14 ± 2.13	9.37 ± 2.94	19.53 ± 2.96	5.22 ± 0.09
8	8.20 ± 1.78	17.26 ± 4.68	4.42 ± 2.29	10.30 ± 0.70	19.33 ± 2.93	5.00 ± 0.58
10	7.27 ± 1.45	19.62 ± 2.78	2.27 ± 0.21	8.33 ± 2.12	16.40 ± 3.17	6.48 ± 1.01
12	7.80 ± 2.88	21.17 ± 5.64	2.02 ± 0.11	10.20 ± 2.11	19.11 ± 2.13	6.33 ± 0.58

GLUCOSE FLUX IN THE LIVER



AVERAGE DAILY FEED INTAKE (DRY MATTER)

TREAMENT	FEED INTAKE (DM in grams)
	MEANS ± SD
Control group	122.95 ± 16.09
PPV group	108.25 ± 2.20
SA leaves group	87.68 ± 4.37

AVERAGE DIGESTIBILITY OF DM, CP, CL, CF, NFE, ASH, and GE

DIGESTIBILITY OF	CONTROL GROUP	PPV GROUP	SA GROUP
	MEANS ± SD	MEANS ± SD	MEANS ± SD
Dry matter (%)	62.62 ± 3.87	65.91 ± 0.74	69.07 ± 1.66
C. protein (%)	60.77 ± 2.61	62.11 ± 2.73	69.89 ± 1.63
C. lipid (%)	79.65 ± 6.63	76.95 ± 12.81	87.67 ± 2.77
C. fiber (%)	2.12 ± 1.40	7.34 ± 5.65	9.26 ± 5.74
NFE (%)	75.77 ± 2.01	75.15 ± 0.76	78.61 ± 1.43
Ash (%)	31.48 ± 4.50	37.64 ± 4.31	45.90 ± 1.15
G. energy	67.44 ± 1.07	63.22 ± 2.67	70.53 ± 1.14

MEDICINAL PLANT

Hundred and thirty one plants that have been used as traditional medicines by local farmers were collected, identified, verified, made herbarium and stored in the Herbarium Bogoriense in Bogor. Interviewing the local farmers, it was found that the indigenous medicinal plants have been used to cure diseases in domestic animals, e.g. stomachache, increase feed consumption increase libido sexual, open wound, increase energy, eye diseases, skin diseases, diarrhea, worm infestation, toxicity, high body temperature (as antipyretica) ectoparasites, post partus, etc.

CONCLUSION

Sauropus androgynus in its crude form exerts several physiological processes, namely decrease blood pressure, decrease the amplitudo as well as the frequencies of heart contraction, decrease peristaltic movement of the intestine, decrease body temperature and can also act as abortivum.

Milk production and feed digestibility are increased by administration of *Sauropus androgynus* to experimental animals. Feed conversion and glycogenesis in liver might be increased by using Sauropus androgynus as feed additive.

The mechanism of its effect, however, are needed to be elucidated by further investigation.

FURTHER RESEARCH ACTIVITIES

Theme : Coservation of Biodiversity Utilization

1. Plant conservation and genetic improvement (9 sub-project).
2. Animal conservation and genetic improvement (14 sub-project).
3. Identification and genetic improvementof microbes for sustainable utilization of natural resources (14 sub-project).
4. Development and utilization of biopharmaca (6 sub-project).
5. Enhancing the sustainable use Indonesian non-human primates through appropriate conservation and breeding techniques and biotechnology (10 sub-project).
6. Forest product and forest protection (9 sub-project).

Table 1 . Some Pharmaceuticals of Plants Origin

Pharmaceuticals	**Sources**
Steroids from diosgenin	*Dioscorea detoides*
Codeine	*Papavewr somniferum*
Atropine/hyoscyamine	*Hyoscyamus niger*
Reserpine	*Rauwolfia serpentina*
Digoxin	*Digitalis lanata*
Digitoxin	*Digitalis purprea*
Scopolamine	*Datura metel*
Pilocarpine	*Pilocarpus jabonandi*
Vincristine and vinblastine	*Catharanthus roseus*
Ephedrine	*Ephedra sinica*
Colchicine	*Colchicum autumnale*
Artemisinin	*Artemisia annua*
Taxol	*Taxus brefolia*
Yuehchukene	*Muraya paniculata*
Callonolide A	*Callophylum lenigerum*
Michelamine-B	*Ancistrocladus abbreviatus*
Camptothecin	*Camptotheca acuminata*
Swainsonine	*Swainsonia spp.*
Prostratin	*Homalanthus rutans*
Phyllanthoside	*Phyllanthus aciminatus*
Pancrastatin	*Pancratiumlittorale*
4-Ipomeanol	*Ipomea batatas*
Halichondrin B	*Axinnella spp.*
Sulpholipids	*Lyngbiua lagerheimii*

The earliest discovery of modern drugs from marine organisms may be traced back to the isolation of cephalosporin-C from *Chepalosporium acrimonium*[4]. Several algal toxin sch as Gonyaulux toxin, saxitoxin and mytilotoxin have also been isolated from marine algae. These are among the most toxic compounds known to man which has pharmacological potency of more than 10^5 times than local anaesthetics such as procaine[5]. The active principle of the red algae Dignea simplex was isolated and identified as kainic acid (2-carboxy-3-carboxymethyl-4-isopropenylpyrrolidone) and now is being widely used clinically as a ermifuge and anthelmintic. It is interesting to note that this discovery was also based on the knowledge in folk medicine[2]. The interest in marine chemistry is currently extended further into the study of marine bacterial metabolites. Many interesting compounds from the standpoint of chemistry and bioactivity have been discovered and their potential uses in chemotherapy should not be overlooked[6].

The progress made in biotechnology has unveiled yet another potential exploitation of natural products in pharmaceutical industry. A multidisciplinary approach incorporating chemistry, pharmacy and biochemistry has allowed the enhancement of products yield through tissue culture and genetic manipulation of cell[7]. Further progress in biotechnology however will require genetic materials which are only available from nature.

Biodiversity in drug discovery

Diversity of genetic resources means a wider spectrum of compounds are available in the nature which can be subjected to biological tests in order to evaluate its potential activities. The wider spectrum of compounds will provide a better chance of discovering new compounds having the desired activities. The cost of biodiversity conservation however is high. In preserving permanently pristine areas biodiverse forest or coral reef, the country will not only forego the commercial returns from its exploitation whether it is for logging, fisheries or felling for agriculture, but it also incurs additional and substantial long-term costs for the maintenance of boundary demarcation and park rangers it ensure that it remains in a pristine condition. The efforts to raise the standard of living of ever growing population has resulted in the conversion of forests land into developed areas for commercials purpose Economic pressure among the people also contributes to the difficulties in enforcing the existing laws in most developing countries.

The current estimated cost for developing a single drugs runs between 50 to 200 million USD and can take up between 5 to 12 years t develop. These figures seems to be very large, but pharmaceutical firms are still very much into this approach of drug development indicating the potential returns if one big discovery is made. Fellow gave a rough indication of the value of a species of medicinal plant once it "hit the big time" at USD 4 billion per year[8]. One study estimates that tropical medicines, developed t their full potential could add 900 billion USD a year to Third World Economic (Newsweek, February 9, 1992). As for Malaysia which is endowed with about 15,000 species of flowering plants and with roughly I out of 2,000 species producing successful prescription, we can expect about 7 species to finally become the big time[9].

Recently, a number of encouraging new discoveries of new natural products for various potential medicines have been reported. The case of *Calophyllum lanigerum*, a tree found in Sarawak which initial test on the extracts gave negative results for cancer cure but gave positive on HIV-virus, was rather an exciting discovery which can help build the confidence of the people and policy makers that biodiversity can indeed become a tangible asset to this country. Unfortunately, this Case of potential long term value of bioactive compounds from indigenous species received a hard blow in Malaysia since the research work carried out overseas resulted in a foreign patent. Recently, it was reported that the Serawak Government

EXPLOITATION OF INDIGENEOUS MEDICINAL PLANTS FROM THE MALAYSIAN PERSECTIVE

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Introduction

Malaysia along with many other developing countries are rich with flora and fauna of diverse nature. This not at all surprising since many of these countries are situated in a tropical belt and thus endowed with thick rain forests. Diversity in the ecology of tropical rain forests made them suitable for prolific growth of flora from diverse species and genetic make-ups. From the chemistry point of view, each of these species may be equated to plant consistently producing a unique pool of chemical compounds which may have potential value to mankind. Although many of the specific functions of these chemicals to the producing organism itself may not be very well understood, some of their roles in maintaining ecological balance have been well documented.

The concern over the loss of biodiversity due to human activities has been one of the major global issues of the 90's. Several resolutions and declarations pertaining to this issue have been documented resulting from the flora held at various conventions and seminars. This global concern has finally reached the summit in 1992 when the Convention on Biological Diversity (Agenda 21) was formulated at the UNCED, World Summit in Rio, and eventually ratified by most countries around the globe the following year. This is only the beginning of a path towards addressing the worries of the world community and that some concrete and acceptable measures be taken by all people to alleviate the grave potential consequences. The document itself will not contribute to anything unless it is translated into actions. The major task of the parties concerned is to cultivate the awareness among the general public on the importance of conserving the biological diversity and develop it sustainably. But as for the time being the question that comes to mind is what is the use of conservation if it does not contribute to their economic well-being and livelihood of the people conserving it.

In this paper the author wishes to discuss and as aspect of biodiversity utilization for economic development with particular reference to Malaysia.

Pharmaceuticals of biological origin.

Use of drugs is one of the important human defence strategies in maintaining god well being. At present there are approximately 15,000 prescription containing one or more ingredients available in the market and the estimate on the number of non-prescription products varies from 100,000 to 1.5 million. Such enormous number unfortunately are still insufficient for consumers and physicians. The first reason was that there has not a single perfect drug been developed-the drug that has absolute specificity in its action, helps all person with disease, has no side effects, and is completely non-toxic. Some good drugs such as penicillin super from being considered perfect drugs because certain resistant bacterial strains have progressively developed and about 10 per cent of a total population is allergic to it[1]. Discovery of new diseases such as AIDS and cancers add to the demand for new drugs.

Although the majority of drugs prescribed today are of synthetic origin, some 25 percent of them are derived from higher plant while further 12 percent are from microbial sources. Some of these pharmaceuticals are of complex molecules and would therefore be almost impossible t replace synthetically due to various factors. These include low yield, high cost, complexity in chemical conversion and the need to obtain the compound in high purity.

plant derived products contribute multimillion dollar profit to international pharmaceutical industries [1,2,3]. The annual sale of vincristine and vinblastine alone runs to about 100 million USD world wide. Some of the most common pharmaceuticals derived from plants and micro-organisms, as well as some newly discovered potential drugs are listed in table 1.

Ethnic folklore or empirical therapeutic uses of plant parts have often provided the early indication of the possibility in discovering some pharmacologically active substance from it. Extraction followed by bioassay guided isolation and purification using available separation techniques may, with some luck lead to purified substance which maintains its biological activity. Spectral studies allow the molecular structure of the active compounds be characterized. Ordinarily a series of compounds having closely related structure are at the same time isolated, thus allowing the researcher to carry out structure-activity relationship investigation. For the same purpose chemical transformation from the isolated product or total synthesis from remote chemical origin may have to be undertaken in order to have adequate representative of the series. In several instances it has been shown that the parent compounds or the so-called lead compounds are sometime not satisfactory as it stand and the studies on structure activity relationship allow the best selection of candidates to be developed. In some cases plant isolated substances may be used as precursor for the synthesis of the selected drug.

has embarked on sylviculture of this plants which is too rare in the wild to be harvested on a sustainable basis. However, the prospect of commercial returns on such a venture is clouded by the threat of the possibility of chemical synthesis or cell culture as some contracts use these approaches as a means of slipping out of paying royalties. In the case Calonolide A, the active compound isolated from *Calophyllum lanigerum* its total synthesis has been reported[10].

Similar cases have also occurred in several other countries including the Philippines (*Pandanus spp.*), Australia (*Conospermum spp.*), and Cameroon (*Ancistrocladus korupensis*) leading to similar apprehensive responses from local scientists who, given the chance, wish to be able to participate in the discovery processes. As a result of this there has been a shift in public's perception regarding the potential value of biological resources to a countries. Back in the mind 80's when we raised our concern regarding exploitation of our plant resources by foreign collectors, many felt that there was not any need to worry about this minor issues since we ourselves were carrying out its exploitation. The view that biological resources is global commons was still a universally accepted consensus during those time. Today many believe that if proper treatment is given to our biological resources, some benefits might be gained by the country where the resources originate.

Science in Developing Countries and Biodiversity Prospecting

It is well acknowledged that the culture of science in developing countries is way behind the developed countries. In often cases, after independence, which in Malaysia was in 1959, the science has had to struggle for funding against other vital areas as the building up of education and health infrastructure. It is not at all surprising that science has lagged behind and to some extent this has been encouraged by traditional colonial systems where the colony was the producer of raw materials while the research, development and manufacturing were carried out in the industrialized countries. This has led to a scenario where most developing countries, compared with industrialized ones, are weak in scientific capability in term of facilities, trained personal and and research culture. A research or science culture in this context means the appreciation particularly by decision makers and politicians of the why's and how's to carry out research. For example, the need for well qualified technicians and adequate maintenance grants to keep sophisticated machines running has not been appreciated, and it is not generally understood that without a sound knowledge of the flora and fauna it is not possible to exploit the riches of biodiversity and develop it sustainably. The scientists in this region have not been discouraged by the difficulties in doing research due to lack of funds, facilities and general infrastructure for research. Various activities for promoting research and training in science and technology have been carried out through the support of agencies And programs such as UNESCO through the Regional Network for the Chemistry of

Natural Products Australia International Development Program through the Network for the Chemistry of Biologically Important Natural Products, the International Foundation for Science and Japan Society for the Promotion of Science.

The interest in research on natural products in Malaysia as been very significant in the last ten years. This is true since the government has provided substantial research funds for research in the Fifth and Sixth Malaysia plants under the Intensified Research in Priority Areas Programme. Currently there are several research groups located in nine universities and research institutions who are actively involved in research on our biological resources. Their field of studies include the Chemistry, Pharmacology, Ethnobotany, Biochemistry, Microbiology, Cell-culture Technology and Biotechnology, Entomology, Phamacognosy and other related areas. Collaboration with foreign scientists in their specific areas has contributed greatly to the progress of these researches. One lacking element in term of bioactivity prospecting however has been the coordination of the research activities by different researcher in order to direct the research into some common goals. As such, many of the research findings are fragmented and independent of one another. This is not surprising since majority of the scientists are still rather young and at almost the same age bracket while the nature of the institutional organizations encourage independent research undertakings. An effort to streamline research is currently being attempted through one massive evaluation exercise in the Intensified Research in Priority Area Programme to be implemented in the Seventh Malaysia Plan (1996-2000). Other factors which may still be required to assist the enhancement of research in Malaysia is the creation of critical mass of scientists who are actively involved in research, improvement of basic infrastructure and management of research, and participation of private sector.

Bioactive natural product discovery program requires integration between various disciplines and involve some fundamental steps including, (i) the selection collection and unambiguous identification of the organisms, (ii) reparation and evaluation of an appropriate array of in vitro test systems, (iii) prioritization of the plants/organisms to be further studied, (iv) bioactivity-directed fractionation, and (v) structure determination of the active isolate(s). Subsequent steps may include addition biological, toxicological and pharmacological evaluations. Bio-optimization and other alternative approaches to the desired compounds such as through synthesis, cell or organ culture and genetic engineering are normally pursued for optimum economic feasibility. Many of the technologies and funds required to carry out these investigations are not yet available in developing countries.

Pharmaceutical industry which has been the major driving force in drug discovery researches in industrialized countries does not exist in Malaysia as well as in most other developing countries, Although a number of industries producing toiletories, cosmetics or other health products for external use have been established their sizes are relatively very small. These industries at their present states are not capable in dealing with research and development programmes in fundamental areas

such as drugs discovery programmes. In most cases they only deal with formulation of products for external uses. Their markets are normally very limited in term of distribution and product lines. A similar situation is also shared by traditional medicine industry in Malaysia. These industries which generally deal with herbal based products are actually even smaller in size as compared to the former. Although some multinational pharmaceutical firms have established their offices in our country, their activities are mainly in marketing and promotion of their products. Other than these they may be involved in repackaging and to some extent, a limited research in products reformulation to suit the local market. The major fundamental research and development activities are still carried out at their main headquarters in the industrialized countries.

With such scenario, even if a breakthrough in the discovery of new drug is accomplished developing countries are still faced with several issues such as securing FDA's approval for its use in human, marketing and promotion of products. This issues is even more prominent when they have to compete with the big-boys in the arena who have established their names in the market. The research on bioresources in developing countries will not reactive its due recognition with the present economic and scientific conditions of these developing countries unless efforts are made to improve its future potentials.

Collaboration in Biodiversity Prospecting

With the background presented above the scientists participating in the Seventh Asian Symposium on Medicinal Plants, Species and Other Natural Products held in Manila in 1992 (ASOMPS VII) endorsed the recommendations concerning ethical utilization of Asian biological resources, which include; the call development of adequate legislation by each national Government; putting high priority on the development of a code of ethics by professional societies that facilitate formation of equitable partnership in the development of new products from biological resources; inclusion in any collecting agreement the provision for any commercial development that may eventually arise; establishment of mandatory royalty to ensure fair and equitable distribution of benefits t the region of origin and the establishment of specific regulations which ensure the collection and export of biological material adequately monitored and controlled in the interest of the supplier country. These recommendations are recorded in a document called the Manila Declaration. These recommendations do not at all exclude investigation of biological resources by foreign organizations or scientists but rather they promote sharing of tasks in discovery and development of potential products and all benefits derived from exploitation of these biological resources between those having the capabilities and those having the biological resources but lacking in capabilities. There are still plenty of biological resources and excitements in discovering new knowledge and products to be shared since only less than 10% of about 250,000 world's species have been investigated for more than one therapeutic activities[6]. It is also interesting to note that the desires

expressed in the Manila Declaration are generally accepted and supported by scientific communities elsewhere as is clearly shown by the Williamsburg Declaration (developed by the American Pharmacognosy Society) and by the Bukit Tinggi Declaration (developed at the UNESCO Seminar on the Chemistry of Rainforest Plants and Their Utilization for Development). The sovereign right of a country over its biological resources was ultimately recognized as recorded in The Convention on Biological Diversity developed at the United Nation Conference on Environmental Development (UNCED), in 1992. The Convention also recognized the need to conserve biological diversity and value of indigenous knowledge on the utilization of their biological resources.

Although there was widespread agreement with the desires expressed in the Manila Declaration, in some cases there was not a corresponding change in the attitude of foreign collectors. Therefore scientists in this region felt that proactive steps have to be taken by all developing countries which generally are rich in biological diversity to ensure that future exploitation of their biological resources should also benefit them. Thus, the scientists participating at the Eight Asian Symposium on Medicinal Plants and Other Natural Products (ASOMPS VIII), held in June 1994 agreed on a number of recommendations as documented in the Melaka Accord (appendix 1). These include: the need to urge for national governments to developed straight-forward legislation to control the collection and conservation of biota through a number of number of appropriate steps at regional and international levels; urges journal editors, per reviewers and professional societies t ensure that host country collaborators receive appropriate recognition; ensure that acknowledgement of permit approval be made in manuscripts, technical reports and conference papers and; urges nations within the region to develop cooperative screening facilities as the first step towards the formation of regional drugs discovery and development consortia.

International Cooperative Programmes in Bioprospecting in Malaysia

The move towards implementation of Agenda 21 of the Convention on Biological Diversity in Malaysia has been handled by the Ministry of Science, Technology and the Environments. For the purpose of drawing up the Nation Policy on Biological Diversity and Plan of Actions for its implementation, the Ministry has set up a National Committee on Biological Diversity. The Committee is chaired by the Secretary General of the Ministry and represented by other relevant Ministries, non-governmental organizations, and experts in relevant fields. In addition to providing views and inputs to the Ministry on the National Policy pertaining to Agenda 21, the committee has recently been involved with the review and revision of the existing particular those related to Article 15 of the convention to ensure the protection of national interest on the access of our biological resources. From its initial meetings the committee has proposed that the requirements under Article 15 be incorporated in the currently existing legal framework, ie, Forestry, Fisheries, Protection of wildlife

and the Animal Ordinance Acts. The Committee also felt that a separate law be drawn up in respect of access to microorganisms based on the requirements of Article 15. In order to formulate strict legal mechanism for protection of access to genetic resources fund in Malaysia the committee proposed the imposition of a mandatory statutory requirement on persons who are gaining access to genetic resources in Malaysia to obtain a prescribed form on licence under the Act, whether or not such access relates to collection, use, exports or research of genetic resources in question.

The committee also proposed the imposition of separate contractual mechanism whereby any persons intending to gain access to genetic resources in Malaysia must enter in to an Agreement with the Government of Malaysia in respect of the collection, use, export etc. of the genetic resources. Although this mechanism will have to be incorporated into the various laws, whether new or the existing ones, the committee views that there should be uniformity in its format to ensure basic principles and requirement like prior informed consent, equitable sharing of benefits arising from commercial use and utilization, and results of research and development of genetic resources and participation in research and development are embodied. However the provision should be flexible enough to allow differentiated and ad hoc concerns pertaining to the various components of biodiversity to taken into account.

A set of contract guidelines encompassing the minimum standards for equity and partnership in research of natural products has been published as an appendix to the Manila Declaration. These guidelines are general in this nature but the elements included can be modified as necessary to suit a specific situation. For example, in the case where the contractors may want to execute their collaboration in phase by phase manner whereby a more specific set of agreement can be entered to as new results appear, the parties can set new terms incorporating the new or the same elements but may be at different quantum or level of participation of the parties. Other specific manner of execution of the research and findings, obligations of each contractor can also be formulated based on the outlines depending on the capacity of the contractors.

It is also worth noting that Economic Planing Unit of the Malaysia Government is currently formulating a new set of Guidelines in respect of foreign collaborative research which is to be adopted as temporary measure before the completion of revision and amendment of laws.

Recommendations

In conclusion, in the commercial exploitation of biodiversity as seen from a Malaysia perspective, several lines of action urgently need to be taken :

(1) We need to coordinate research under a national policy for research on indigenous natural products.

This is presently underway, both in the of them launching of the Malaysia Natural Products Society and the current development by the Ministry of Science,

Technology and the Environment of a National Policy for Priority Areas for Research, which includes natural products as one of the priority areas.

(2) Emphasis on research in field, which

a) are currently neglected, such as ethnobotany (where we have only one or two local ethnobotanists compared with the number of foreign ethnobotanists who carry out research in Malaysia), and the sylviculture of commercially valuable plants (as we cannot continue to rely on wild-stocks, Kiew, 1992), or

b) have yet to reach world-class standard, such as a capability to carry out bioassays and to developed and test drugs.

(3) There is an urgent need for satisfactory legal contracts for foreign collectors, which in Malaysia should be administrated by a single national agency

There should also be agreement on the form of contracts on a regional basis to ensure that all countries are equally protected, i.e. no country that is without legally binding contracts becomes a focus for foreign exploitation.

(4) Encourage multinational pharmaceutical firms to establish their industrial research and development activities in developing countries where the source material originates.

Establishment of such activities will act as a nucleus for more active research in the country, improve the research standards and eventually increase the awareness on the value of their biological resources.

(5) Revision of patent laws.

The current patent laws only protect the interest of developed countries where infrastructure for research and critical mass of scientists and inventors are already existing. As such scientists from developing countries are able to compete with their counterparts in industrialized countries. Many of the discoveries made in biodiversity prospecting are repeated synthetically either for the same compounds or the modified analogues. Some modification of the laws such as protection of general structure of active compounds are necessary if country of origin of the resources is to benefit from the discovery.

(6) There should adequate long-term funding for research to carry out phytochemical prospecting.

The current national spending for R&D in most developing countries including Malaysia is still very low as compared to the most developed countries.

(7) There is need to strengthen national, regional and international network to build up research capability within the region and to establish links between scientists and institutions.

(8) Last but not least, we must get back the spirit of collaboration between scientists from different countries. Legislative should not prevent the commercial development of the organisms for the benefit of mankind; but it should ensure an equitable sharing of benefits, not only of commercial benefits but also the benefits of collaborating in research, which can help build up expertise and research capability so that scientists in biodiverse countries can share the excitement of scientific discovery.

References

1. Gerald, M.C. (1981) *Pharmacology : Introduction to Drugs*, 2nd. Ed., Prentice Hall, N. Jersey.
2. Brown E.G. (1985) *Ann.Proc.Phytochem.Soc.Eur.*, 26, 1-10.
3. Eisner, T. (1990) *Chemecology*, 1. 38-40; Mann J. (1989) *Chemistry in Britian*, 478-482.
4. Abraham, G.G.F. and Abraham E.P. (1956) *Biochem. J.*, 62, 651-658
5. Fenicle, W. (1987) *J. Natural Prod.*, 50, 1001-1008
6. Walton, N.J. (1992) *Chemistry in Britain*, June, 525-529
7. Kutney J.P. (1995) *Trends in Traditional Medicine Research*, 52-71
8. Fellows, L.E. (1992) *New Drugs from Natural Sources*. IBC Technical Services Ltd., Lndon. Pp. 93-100.
9. Kiew, R. (1992) *Proceedings of ASOMPS VII*, Manila. Pp. 174-183
10. Chenera, B., West, M.L., Finkelstein, J.A. and Dreyer G.B. (1993) *J. Org. Chem.*, 58, 5605-5606.

THE MELAKA ACCORD

adopted at

The Eight Asian Symposium on Medicinal Plants,
Species and Other Natural Products
12-16 June 1994, Melaka, Malaysia

Given that :

* *the region represented by ASOMPS has high terrestrial and marine biological diversity.*
* *the region has a significant human resource and skills base to conserve and use its biological resources,*
* *many biological species are not confined in their occurrence to political boundaries,*

ASOMPS VIII has considered the benefits to be accrued by adopting consistent regional approaches to :

* *establishing national legislation, policies, and procedures relevant to accessing and conserving biological diversity,*
* *involving scientists of the different nations of the region in raining, research and development related to the sustainable use of biological diversity,*
* *ensuring the fair equitable sharing of the knowledge and financial benefits arising from the utilisation of these biological resources.*

ASOMPS VIII therefore adopted the following resolutions :

1. As a matter of urgency all nations should developed straight-forward legislation to control the collection and conservation of the biota under their jurisdicition, which will be used for bioprospecting.

   As part of this regional approach to conservation of biodiversity, within the overall concept of ecologically sustainable development, within 1994 each national group of scientists and technologists should :

   (a) submit copies of the Manila Declaration and the Melaka Accord to their relevant government noting that their objectives are consistent with those of the UNCED Convention on Biodiersity.

   (b) encourage their incorporation in relevant national strategies on conservation of diodiversity, and

(c) request that they be brought to the attention of appropriate regional bodies, such as ASEAN (Association of Southeast Asian Nations), for adoption on a regional basis.

2. To achieve this aim :

2.1 The scientists of each country represented at ASOMPS VIII, in conjunction with the appropriate government agencies in their country and with appropriate legal advisors should within six (6) months of this Symposium prepare and submit to UNESCO-ROSTSEA a draft version of their country's proposed legislation and their guidelines on access to, research on, and use of the biological resources of their country in order to ensure equitable and sustainable development.

2.2. UNESCO shall be requested to organise, within eight (8) months this Symposium, a meeting of a working group to :

(a) consider the proposed legislation and guidelines,

(b) formulate an agreed set of minimum regulations and guidelines concerning these biological resources which might be applicable to all countries involved.

The working group should consist of 20-25 scientists, government and legal representatives from each of the countries involved so that definitive and authoritative proposals can be formulated during the meeting.

2.3. UNESCO shall be requested to distribute this agreed set of minimum legislation and guidelines together with the various drafts and relevant comments from the working group, to all countries involved in ASOMPS VIII so that these countries can optimise can optimise their own legislation and ensure compatibility with those of other countries in the region.

3. Journal editors, peer reviewers and professional societies when reviewing manuscripts, grant applications or conference papers should attempt to ensure that host country collaborators receive appropriate recognition for their contribution.

4. In countries where permit infrastructure exists all researchers and particularly collectors should formally acknowledge permit approval (by citation of permit number or equivalent) in manuscripts, technical report and conference papers, and copies of such papers should be provided annually to the permit authorities.

In countries where no such permit legislation exists, the national government should be encouraged to develop such legislation.

5. Nations within the region should establish a working party to develop cooperative screening facilities as the first step towards the formation of regional drug discovery and development consortia.