OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

Distr.
LIMITED

ID/WG.466/18(SPEC.)
22 May 1987

ENGLISH

United Nations Industrial Development Organization

Third Consultation on the
Pharmaceutical Industry

Madrid, Spain, 5-9 October 1987

GUIDELINES FOR THE SUPPLY OF MEDICINAL PLANTS AS RAW MATERIALS OR PROCESSED PRODUCTS*

Background Paper

Prepared by

UNIDO Secretariat

* This document has been reproduced without formal editing.

V.87-85455

553

CONTENTS

Preface

The Second Consultation on the Pharmaceutical Industry held in Budapest, Hungary, 21-25 November 1983, discussed the issue of development of drugs based on medicinal plants. A recommendation was made at the Consultation meeting to UNIDO to develop guidelines to assist developing countries to accomplish the improved supply of medicinal plants as raw materials or processed products.

This document has been prepared in pursuance of this recommendation.

1. Introduction

Herbal medicines have been used for healing and as an aid to healthy living, in man's fight against disease throughout the ages.

The last four decades have seen the development of a wide variety of antibiotics - new therapeutic substances. The research and modifications made necessary by bacteria becoming resistant to the ones in use has meant that newer and more effective substances have to be found. Many of the new therapeutic agents now available to modern medicine have been the result of pure chemical research, but some of them still result from modern isolation techniques and pharmacological testing procedures, applied to plant material. By this means new plant drugs usually find their way into modern medicine as purified substances rather than in the form of older galenical preparations. These new plant drugs and other raw materials of botanic origin have recently given rise to development projects which are mainly centred in developing countries where social as well as climatic conditions appear to be most favourable for their use and for the cultivation of selected species. In fact, within the developing countries one finds a variety of climatic conditions that have enabled spontaneous growth of indigenous plants and herbs used as food or for medicinal preparations over the centuries.

The isolation or near isolation of the habitats of indigenous plants and herbs has meant that for centuries methods of cultivation and indeed plant selection have depended on local conditions and on local requirements either in terms of food or as herbal medicines. With the renewed interest in the raw materials of botanic origin certain requirements have been laid down by the consumers and in many cases, these requirements concern not only products extracted from botanicals but the botanicals themselves.

These guidelines are designed to assist developing countries to accomplish the improved supply of medicinal herbs and plants either as raw materials or as partly or fully processed products. Since a large part of these products is destined for export, the main emphasis in the guidelines are laid on points which would help producers/traders to maximize benefits through the application of appropriate practices along the chain starting from cultivation/harvesting up to the point of delivery to purchaser.

These guidelines therefore represent a simplified version of the descriptions of products and the standards that apply to them in international trade. For more specific or detailed information, literature cited in the bibliography should be consulted and for more details the assistance of a Research Institution dealing with Natural Products of this nature may be sought.

2. Medicinal Plants as Raw Materials

2.1 Authenticity

The rapid development of plant chemistry and methods of analysis over the last hundred years has shown in increasing detail the differences that can

exist between herbs and plants of apparently similar origin and structure but growing in different parts of the world.

The investigations are now so detailed that further development calls for raw materials of known specification and content.

These raw materials include all parts of plants i.e. whole plants or parts separated from the main plant, parts cut up into coarse medium or fine portions, or powdered. Unless otherwise specified, they are shipped in the dried form.

Furthermore, these raw materials can only be provided if concerted efforts are made to define accurately the morphology and anatomy of the plants in order to make sure that the proper species is being considered.

Herbarium and Voucher Specimens

In some developing countries, economic mapping has been carried out by botanists who have identified and quantified the aromatic and medicinal plants and herbs being sought. This has led to the possibility of carrying out preliminary analyses in the field to evaluate the content of "active" principles.

However, this practice cannot be applied when topographical, physical and economic constraints make it difficult if not impossible to establish such a practice.

Many tools are available even in several developing countries to assure correct identification. Modern floras, provide keys and descriptions to enable accurate identification. Generic taxonomic monographs define morphologic limits of species and also provide keys and descriptions to aid identification.

However, the knowledge of the world's flora, particularly in the developing parts of the world is incomplete. Many specimens of the flora are classified in the major herbaria of the world. In general, these institutions specialize in the flora of specific regions of the world and represent a vast reservoir of botanical information useful for resolving difficult identification problems.

The developing countries which often do not enjoy proximity to an internationally reputed herbarium must rely on information gathered by others and stored either in recognized Research Centres with laboratories and Herbariae or in Botanical Gardens with adequate recording and storage facilities.

Most developing countries enjoy the beauty and attraction of Botanical Gardens wherein are grown plants that are either of spontaneous growth in the area or have been introduced at some stage for research or commercial reasons.

Whatever the reasons for deciding upon the selection and cultivation of plants or herbs and these can go from simple commercial reasons to those of Government policy on agrarian and agricultural development, the species must be identified and selected according to established practice.

The consultation of a local or regional, even national Herbarium provides valuable information on plant identity, any work done in the past and can also supply local names of plants and establish the state of the plant at the moment it was gathered. These institutions are the recognized reposities for Herbarium voucher specimens of the flora and could be consulted for authentication of any dubious species, and for the preparation of voucher specimens.

These facilities are either supported by a direct link with an Herbarium or by an academic link with established Research Centres.

2.2 Precautionary Measures

During the last three decades renewed interest in so-called natural medication and medicines of botanical origin has led to cultivation of selected species on a wide scale, and the gathering and collecting of wild or spontaneous flora from regions which can vary greatly due to micro-climate conditions.

Cultivation has brought the advantages of proper site selection, concentration of growth areas, meachanization in gathering and even an increase in plant yield per hectare by the studied and balanced use of authorized fertilizers.

However, although the advantages have been considerable in obtaining a greater volume of products relative to that obtained from wild flora, some disadvantages have given rise to further control.

Large scale production and an increase in wild flora by means of fertilizers has also meant the creation of conditions favourable to the development of diseases and the spread of insect infestation. This has led to higher costs. These disadvantages can be off-set by the judicious use of insecticides and pesticides but these must be used with great care and must conform to those recommended either by legislation or by accepted practice and under controlled conditions.

Residual chemicals can be hazardous in themselves and on occasions give rise to changes in the active principles in the plants, so proper care of the flora, spontaneous or cultivated must be given a priority. This activity must be controlled by those in charge of cultivation and be subject to regular checking according to operational standards laid down to avoid the dangers due to a partial or total phytotoxicity of the crop. Of late the under mentioned maximum tolerance of residues for various insecticides/herbicides have been put into practice by number of concerned quarters for the guidance of producers:

	max.tolerance mg/kg		max.tolerance mg/kg
- HCH + ...	0,2	op - DDE ++	-
- HCH + ...	-	Dieldrin +++	0,1
Hexachlorobenzene (HCB) ..	0,1	pp - DDE ++	-
Lindane	0,5	op - DDD ++	-
Aldrin +++	0,1	op - DDT ++	-
Heptachlor	0,1	pp - DDD ++	-
Heptachlorepoxide	0,1	pp - DDT ++	-
Endosulfan	30,0	Total - DDT	1,0
Pentachlorophenol	0,01	Chlorpyrifos-methyl	0,1
Propargit	5,0	Piperonylbutoxide	3,0
Chlordan	0,05	Endrin	0,1

+ HCH-Isomere: +++ Aldrin or Dieldrin: single or both;
++ calculated as total DDT.

Introduction of strict legislation by consumers on the quality requirements based on stringent parameters is in the offing for the extracts/concentrates, hence restrictive measures and precautions about the use of herbicide/pesticides warrants check.

2.2.1 Harvesting techniques for cultivated flora

In regions of spontaneous growth, or in those of cultivation, the harvesting techniques will depend largely on the assessments made of the crop yield.

Under well controlled conditions such as those that can be achieved for cultivated flora, the harvesting techniques are sometimes simpler in that the spread of the crop over the ground can enable mobility of the crop gathering team. This is most noticeable in areas where mechanization can be introduced because the mechanization will vary according to the part of the plant being harvested. All parts of mechanical cutters/harvesters contacting the crop, i.e. blades, collector chute, hoppers must be regularly cleaned and regularly kept free from plant material and debris.

Climatic conditions, i.e. the dry season or rainy season affects the gathering technique for rhizomes and root material due to the condition of the soil and they affect the gathering of stems and leaf material as much as the flowers and floral tips.

The roots and rhizomes are drawn from the soil either by manual labour or by mechanization; the floral tips and flowers are often hand-picked as automatic cutting or stripping may mean the presence of unwanted stem material.

As far as the stem and leaf material is concerned, the above-ground cutting takes place before the digging or pulling up of the roots.

In the case of the cultivated flora, and before the post harvest preparation, it is possible to ensure more easily that the proper material is harvested and that extraneous vegetation can be removed.

It is important that the gathered material is assembled in one or more areas where the post harvest preparation or treatment can be carried out under controlled conditions. Harvested material should not be collected on the ground but either in clean dry sacks or baskets or in clean dry hoppers. Sacks should not be filled tightly, nor compacted. Sacks should be hung and moved to dry locations. Save the harvest from contamination of all type soil, fertilizer, bacteria, fungi etc.

2.2.2 Collection techniques for wild flora

Where plants are collected from the natural habitat only, it is important to determine the optimum level of collection to ensure constant natural regermination and therefore the total collected should never exceed a level which could endanger replacement or lead to extinction. In this context attention should be paid to the following recommendation of Plenary Session of 5th ISHS International Symposium on Medicinal Plants, Darjeeling, February 23-25 1985":

"According to the Washington-Convention of 1973 (Protection against extinction), efforts are necessary to domisticate the large number of wild collected medicinal and aromatic plants. A special attention may be given to the outstanding but deminishing flora of India and the Himalaya regions. Concurrently with replacing the wild collection by systematic cultivation laws/orders may be established to restrict the commercial use of wild plants."

The techniques used will depend on the spread of the natural habitat, the topography and the ease or difficulty of access. The collection is carried out manually and as it often depends on unskilled labour, care must be taken by means of local superintendents to ensure that harvesting of the right material takes place and that all unwanted herbs, grasses or plants are separated from the bulking.

This is to facilitate the next operation of post harvest preparation.

The natural habitat may be widely spread, so the collection areas must be planned to enable a further grouping at the most appropriate point for further treatment.

It is most important, in the absence of cultivation planning to ensure that the flowers and floral tips, the stems and leaf material as well as the rhizomes and root material are not only well selected but carefully handled.

Transport of the raw material will be organized in such a way that all collected material will be assembled at the selected spot without a large time difference.

2.3 Post Harvest Preparation

In many ways this is the most critical part of the gathering cycle, as on its proper handling depends the success of the raw material as a product suitable for sale as such or for sale for further processing.

At the time of gathering, the plants are placed in baskets or sacs made of cloth (the use of non-porous plastic material will be avoided as it causes rapid degradation of the plant material) and are brought from the field to the main collection depot. Crops should not be allowed to stand for extended period in sacks and in direct sun. Must be protected from rain.

It is then that the initial stages of preparation are carried out.

The operations are the following:

1. For flowers: one removes by hand the flowers that are brown or discoloured, the remains of flowers, twigs, branches or other growths. For large quantities sorting equipment is available.

2. For the leaves: one removes the brown or damaged leaves and remains of branches.

3. For the aerial parts: unwanted leaves are removed as are the fruit, twigs without leaves and extraneous vegetation.

4. For the roots and rhizomes: these must be washed immediately under running water to remove the earth. The neck is then separated and the dried or damaged roots are removed.

5. For the fruit and seeds: all damaged specimen are removed, also any unripe fruit, leaves and remains of branches or twigs.

6. For the bark: old and cracked parts are removed; any wood or cork fragments are detached.

The next stage in post harvest preparation is drying which should finally lead to a water content of 10 to less than 15 %, which inhibits the development (growth) of mould and micro-organisms and enables conservation of the product. A properly dried product can be recognized quite easily, without the use of laboratory equipment, by examining the material, which since it has lost its elasticity, and by becoming brittle, breaks with a sharp snap. This is particularly noticeable for the aerial parts of plants, roots and barks.

Drying must take place as quickly as possible after gathering. Drying can be "natural" or "artificial" the latter method only being justified for products which may lose active substances through slow drying.

Natural drying practices usually follow basic rules:

a) only white flowers and non-succulent roots are exposed to direct sunlight whereas coloured flowers, leaves and aerial parts must be dried in the shade so as not to lose their colour.

b) the products are spread thinly, usually without stacking so that on $1m^2$ there are 0.3 to 0.5 kg of flowers; 0.5 to 1 kg of leaves or aerial parts of plants and 1 to 2 kg of bark or roots.

c) the products are turned over every day at the commencement of the process and less frequently as they begin to dry, to avoid fragmentation.

d) the products are to be covered on particularly humid days.

e) to avoid soil and microorganism contamination, no floor drying is recommended.

Drying can take place in the open (with some precautions for covering when required) or in well aired rooms or hangars (warehouses) free from foreign odours which might impregnate the plants and free from insects, worm or plant infestation and birds. The roofing can be galvanized sheet metal which heats easily and spreads the accumulated heat.

Natural drying can be carried out in several ways:

1. The plants can be laid out in thin layers over the whole available surface of the room or shed provided it is clean and covered with paper. Drying on direct floor is not recommended. It must be damp proof, scrupulously clean and dry. Polythene sheeting may be used. Quantities may be small but the method is the simplest.

2. The plants can be laid on special frames of 1m x 0.70m (to make handling easy) with edges that are raised at the corners to enable stacking with a 10 cm to 15 cm head space between each frame. The frames can be made of stainless steel, of wicker, or fine branches or other material inter-twined as in lattice work. The height of the stacking is determined on the basis of manoeuvrability. Such stacking can increase the drying area by 10 to 15 times.

3. Large leaves, roots and bark can be suspended on ropes or string to dry.

Artificial drying requires special equipment using mostly liquid fuel, natural gas or electricity. These use of artificial drying can be costly and is only justified if required on technical grounds or when the cost can be borne by the value of the products.

To diminish energy costs the use of solar energy collectors should be preferred wherever possible.

The main types of equipment are:

a) air heated in a special boiler and circulated by a ventilator.

b) a heating system using pipes in which circulates steam.

c) solar collectors on the roof or outdoor for air heating

c) a drying tunnel where the material is stacked. With the doors closed, hot air is injected into the tunnel.

d) band dryers which convey the material through a drying chamber.

e) mechanical rotating dryer.

Special care also needs to be taken to maintain microbiological cleanliness.

2.4 Storage

Drying enables plant material to be stored in good conditions. The following rules will have to be applied.

1. The store-rooms or warehouses must be kept clean, well aired and without infiltrations of humidity. Temperature must be kept low and constant.

2. Adequate measures must be taken to combat insect/rodent infestation. With this in view, the warehouse will have an annexe where the plants can be treated with recognized chemical substances before being stored. The annexe can also be used for storage whilst the main warehouse is being cleared of infestation.

3. Toxic plants will be stored separately in special compartments.

4. Every precaution will be taken to prevent fire, as medicinal plants can be extremely flammable.

5. Plant samples stored must at the outset be fully and adequately labelled. In general, the label must be securely afixed to the containers. The containers must be such that they must secure the plant material from damage, deterioration and pest infestation during storage.

   Planned cultivation, organized collection and distribution through established centres are features of this industry and development of such infrastructure for the supplies pays well.

The label must bear the following information:

0 Batch Reference No.

1 Name of Plant: local _____ Latin binomial _____

2 Plant part:

3 Date collected:

4 Conditions of drying:

5 Locality from which plant was collected:

6 Reference to herbarium voucher:

7 Any other relevant information:

The following generally accepted short forms enable the distinct labelling and swift identification of the stored plant material:

AE	=	Aerial parts	RB	=	Root bark
BD	=	Buds	RH	=	Rhizome
BU	=	Bulk	RT	=	Root
BN	=	Bean	SB	=	Skin-bark
CO	=	Corim	SD	=	Seed
EX	=	Exudate	ST	=	Stem
FL	=	Flowers	TU	=	Tuber
FR	=	Fruit	TW	=	Twig
IF	=	Inflorescence	WR	=	Root wood
LF	=	Leaf	WS	=	stem wood
			TH	=	Thallus

2.5 Physical Characteristics

The identification and characterization of a raw material of botanical origin calls for examinations that are macroscopic, microscopic, histo-chemical and chemical.

The first examination is macroscopic and establishes the characteristics that are visible to the eye or through a magnifying glass, or detectable by odour and taste. The examination specifies the appearance, the size, the colour, the odour and the taste.

The appearance will refer to the general shape of the product, to the way it has been gathered and prepared, throwing light on the cleanliness (or otherwise) and on any physical defects or spoilation.

The examination of the aerial parts of the plants will consider the appearance, the shape, the nature of the surfaces (rough or smooth), the size of the stems, the interior and exterior colour of the dried material, the odour and even the taste (determined on a fragment of the product or by means of a decoction).

The examination of the bark tends to determine the external and internal surfaces, to note the presence or absence of striations, lenticelles or lichens, the type of transversal fracture, the size, colour and the odour of a scraping of the dry material. As the term bark applies not only to the cortex above ground but also to underground material, it should be noted that roots are free of lenticelles and lichens.

The macroscopic examination of the leaves and folia requires no special preparation and concerns the dry or partially moist material. Size, thickness, colour, shape and state of growth are determined by examination of the moist material spread on a glass plate.

The examination of the flowers will determine their state of growth, their number, whether they grow singly or in clusters and can be carried out on dry or moist material.

Examination of the fruit defines the type, the degree of maturity at time to picking, its shape (either whole or fragmented) as well as its size and the condition of the outer surface.

The seeds represent the vegetable products used either as such or as part of the fruit. Examination establishes the shape, size and general appearance as well as any peculiarities.

The botanicals usually referred to as herbs (meaning the parts above ground) will be described in detail.

For botanicals that are either cut or fragmented the procedure remains the same. For those that are pulverized, the organoleptic tests will help to define the particle size, the colour, odour and taste.

The microscopic examination of raw materials of botanic origin is much more detailed than the macroscopic first phase and requires proper laboratory equipment and specially trained personnel. This is best done by the local Research Centres or by approved analytical laboratories.

The same comments apply to the histo-chemical examination which enables the localization of a specific active principle.

The chemical examination is qualitative and must be carried out by laboratories or Research Centres, well equipped and where modern analytical instrumentation helps identification.

It may be necessary to carry out very detailed examinations when identifying and characterizing materials of botanic origin, in which case, recognized analytical and pharmacognostic tests and criteria must be applied.

2.6 Packing

All products, whether prepared or not, which are destined to go for sale, are packed as follows:

a) In bales: all products (with the exception of seeds, buds and powdered plants). The plants are compressed either manually or mechanically and covered with cloth. The bales are generally of 50 kg.

b) In cloth sacs: fruits and seeds.

c) In paper bags: flowers, buds, fruit and powders.

d) In boxes: flowers and leaves which have to be delivered intact or in the best possible condition.

2.6.1 Samples

The packing used for the samples will largely depend on the size of sample requested by the buyer.

The labelling is most important because it indicates to the buyer not only the nature of the product but its origin. The label must carry the latin or local name, or the accepted commercial and trade definition; the origin; the name of the supplier; the weight and any other information requested by the buyer. The label must mention the date of preparation (Vide also 2.4.5).

The documentation such as despatch notes, invoice with a "No Commercial Value" must accompany the sample and bear the same identification as that of the sample itself.

2.6.2 Packaging Recommendations

Although the size of the packaging may be dependant upon the specific requirements of the purchaser, it is important, wherever possible to adhere to the sizes determined by trading practice.

The materials to be used range from jute bags to paper bags, wooden or metal boxes, large and small bales but whatever the packaging, it is most important and that the containers carry clear labels giving the name of the product, its origin, the lot or batch number, the name of the supplier. When these labels are stuck to the outside of the packaging, a copy must be included in the package itself.

Containers of any kind which hold toxic plants must carry a special warning, that is, the word "Danger - Toxic" or the conventional design of a "skull and crossbones". These containers will not be used for any other material. This constraint also applies to packaging used for the shipment of plants with heavy penetrating odours which could impregnate other botanicals.

2.7 Commercial Practice

Purchasers are becoming more aware of the need to ensure that the product purchased conforms to the sample on which the order is based and therefore try to obtain confirmation of this before shipment. Final payment is usually subject to satisfactory goods being shipped to and received by the purchaser.

Development of organized suppliers is necessary for healthy trade. Reliability in terms of quality of material, fulfilment of commitments and financial transaction is of great importance.

2.7.1 Purchasing Agreement

This takes the form of an exchange of letters (offer and acceptance) or telex messages duly confirmed by the issuing of an order by the purchaser. The order specifies the goods' description, confirms the price agreed and the quantity purchased. Whatever terms are applicable by law or custom will be mentioned.

2.7.2 Sample specifications

When an order is placed subject to acceptance of sample, this means that any sample submitted must conform to the goods that will be delivered following the order. It is also possible that the purchaser will specify certain requirements of the sample and it is important the the supplier or shipper agree to these specifications with the purchaser before sampling.

2.7.3 Terms

The terms under which botanicals are sold and bought depend largely on the technical requirements laid down by the purchaser, or by accepted practice and the ability of the supplier or shipper to provide products of the required quality.

The terms governing a purchasing agreement will include a precise definition of quality (usually based on its major constituent) because many countries are continually tightening the regulatory controls with respect to percentage of active constituents and purity.

The terms will also state the quantity required, the type of packing preferred, the means of shipment, any special requirements which the purchaser may stipulate concerning storage aboard ship and care of the material during shipment. Special precautions as to storage may also be stated. Delivery time will be specified.

Terms should be agreed quite clearly between supplier and purchaser prior to shipment.

2.7.4 Weights and measures

Medicinal plants are used in the following manner:

- As raw materials for extraction of their active constituents.
- As sources of crude extracts.
- As products for direct sale.

The end use will very often influence the scale of the order and the size and type of packaging.

The purchasing agreement will state the quantity or amount ordered, either by weight or by volume.

The weight will be stated in tonnes, kilos or pounds (lbs.) according to the weights and measures applied in the country of end-use.

2.7.5 Certification

The standards of quality are determined by the ultimate use or destination of the end product.

However, complaints concerning the quality of botanicals received from developing countries are frequent and refer specifically to the difference between the goods received and the samples on the basis of which the purchase contract was made.

To avoid these problems, it is important that the exporting country have the means and the technical competence to certify the quality of the goods exported.

A government chemist or analyst or a recognized scientific authority is empowered to issue a Certificate upon which is clearly stated the name and origin of the drug and the fact that it complies with the standards of quality laid down either by the purchaser or by recognized authorities such as the pharmacopoeiae or the national formularies used in the country of destination.

2.7.6 Bills of lading and tariffs

Bills of lading are documentary evidence of the nature and quantity of goods embarked for shipment. The documents may vary according to the mode of transport used, by sea, by road or by air.

The Bills of Lading specify quantity, packaging and identification and may carry "special instructions" such as "STOW AWAY FROM HEAT", etc.

These instructions must be complied with to avoid any misunderstanding and a possible refusal of acceptance by the purchaser if they are not complied with.

The Bills of Lading may be accompanied by Certified Documents and by Invoices which may indicate the Tariff conditions under which the goods may be imported.

In general medicinal plants are traded without any tariff restrictions as most plants and crude drugs are exempt from duty.

However, tariffs are levied on many of the derivatives and on the advanced forms of the plants or their extracts. Most developing countries are able to benefit under the Generalized System of Preferences, which often exempt even the derivatives supplied by developing countries.

2.8 Provisions in case of litigation

Most of the cases of litigation that arise are due to the differences in quality between the approved sample and the goods delivered.

It is, therefore, most important that goods shipped be from the same lot from which the sample was taken.

Proper quality control at the time of shipment and proper certification minimizes the risk of litigation.

Should the threat arise, batch samples must be submitted immediately to the Government analyst or to whichever Organization is recognized as competent in order to obtain an independent assessment as to quality.

Most purchase agreements contain a litigation clause setting out the conditions under which and under whose authority and independent assessment is to be made.

These stipulations must be agreed between supplier/shipper and purchaser prior to shipment.

3. Medicinal Plants - Processed

3.1 Authenticity

Herbarium and voucher specimens

Herbarium voucher specimens should be prepared if possible in the field or soon after gathering for each batch of plant species to be processed or shipped abroad. The vouchers which should contain the essential parts of the plant, may be pressed down between newsprint placed between hard board and dried on site. Later they may be suitably mounted (see also p. 2).

3.2 Processed products

Those parts of medicinal plants that are called "drugs" are the raw material for the production of different types of processed products. The methodology of processing depends on the ultimate use of the medicinal plant and will vary from the simple process of pulverization of dried crude drug to the more complex process of isolation of pure substances leading to involved chemical modifications.

3.2.1 Types of processed products

Processing results in the following types of processed products:

(i) Decoctions and infusions
(ii) Total extracts and tinctures
(iii) Purified extracts
(iv) Chemically pure active compounds
(v) Volatile constituents.

Each of these products represents a step in the passage from traditional to modern medicine. Yet each of them has its own value and function and it is incorrect to assume that purified chemicals are the most active or desirable products. In certain cases extracts are endowed with grater activity than a single chemical constituent.

The most usual reason for preference of extracts is when they contain a group of compounds of related chemical structure and when separation and isolation of a single constituent is difficult and thereapeutically as well as economically unreasonable, e.g. mixtures of anthraquinones, saponins, or polyphenols. Equally often it is desirable for extracts to contain constituents which are inactive by themselves, but which improves the solubility or bioavailability of the active constituent.

3.2.2 Processes used

Decoctions and infusions are the classical forms in which traditional remedies are prepared. Extracts arise from the needs of the pharmaceutical industry, and are more concentrated than decoctions and infusions. They can be standardized accurately to be produced in modern dosage forms such as tablets, syrups, capsules etc.

Total extracts are obtained by hot or cold extraction or percolation of the plant raw material with either water or organic solvent, followed by removal of the extracting or percolating agent.

Purified extracts are when certain extractives that are not necessary are removed, to retain only a group of desired constituents. This purification is done by precipitation, crystallisation, or by use of separation techniques such as dialysis, counter-current extraction, or chematography.

Purified extracts are standardized in terms of the content of desired constituents. Example:

- Ginseng dry extract containing 14% sponins calculated as Ginsenoside Rg
- Cinchona extract containing 20% alkaloids calculated as quinine
- Centelle extract containing 70% triterperic acids

The preparation of a standardized extract is a relatively sophisticated operation and requires a knowledge of the active ingredients and their properties. These factors dictate the choice of solvent, the temperatures and duration of extraction.

In general, the pharmaceutical formulations have to be adjusted to suit the characteristics of extracts. For example:

The active ingredienst of Valeriana contain valepotriates which belong to the class of substances called IRIDOIDS and are most soluble in concentrated alcohol and in chlorinated solvents. Their stability in water or aqueous alcohol is poor. Accordingly, Valepotriates are extracted with strong alcohol and used as tinctures or dry extracts.

The routine quality control of extracts is difficult and again involve the use of modern analytical techniques such as thin layer chromatography, high performance liquid chromatography coupled with UV and IR spectroscopy.

Analyses have to be conducted by a well accepted laboratory in order to be reliable and acceptable to the industry.

Pure products and selected principles

These are the pure chemical compounds isolated by a sequence of carefully worked out separation techniques. They are rigorously characterized by use of sophisticated analytical methods such as UV, IR, NMR and mass spectrometry. Selected principles result then sometimes it is not worthwhile isolating the purified chemicals singly, as in the case for example of Sennosides A and B isolated together from Senna.

Volatile constituents

These are obtained by the technique of steam-distillation. Examples are the essential oils from plants such as Mentha piperita, Cinnamomum camphora and Coriandrum sativum. These are analysed and characterized almost invariably by the use of Gas Liquid Chromatography.

3.2.3 Predetermined standards

The authenticity of a crude drug is established by reference to the descriptions of it given in the pharmacopoeia or other official publications (B.P.C., K.S.D., J.P.) of the country concerned.

The quality and purity required is achieved by standards (numerical values) also given in the official work of reference. There exist in several national pharmacopoeiae monographs on certain drugs, e.g. ipecacuanha in the European Pharmacopoeia; tragacanth, fully described in the B.P., and so on.

Those documents and any national formularies which exist must be consulted and the prescribed examination carried out.

For extracts and essential oils, there are sometimes available standardization methods in publications such as the Journal of the Association of Analytical Chemists, (USA), Analyst (UK) etc.

3.3 Specifications

Apart from those that might be laid down in official documentation, the large users and buyers often have specifications of their own. These must be obtained as early as possible during any negotiations prior to business being established.

3.3.1 Analytical Data

There are times when drugs which comply with the descriptions given in the pharmacopoeias are nevertheless found to be unsatisfactory due to some deterioration due to faulty harvesting, shipment or storage.

When the sensorial tests have failed to show up any marked deterioration further examination is required.

This will require microscopic examination and detailed analysis of the processed or partially processed medicinal plant.

Special requirements would apply to total extracts or isolates as the buyers may lay down specifications which require analytical quality certificates based on modern instrumental analytical techniques such as has liquid chromatography and high performance liquid chromatography. It is important therefore that suppliers have access to research and development institutions that can advice on such needs.

The guidance of a Government established laboratory or a Research Centre must be sought. The organization must be capable of carrying out chemical, instrumental as well as microbiological tests when necessary, and give the supplier scientific back up in the negotiations leading towards a sale.

3.4 Packaging and Labelling

3.4.1 Samples

The sampling and the labelling of processed or partially processed medicinal plants is frequently more exacting than for the crude drug. The samples submitted must be thoroughly air-dry (if not in liquid or extract form) and care must be taken to limit the drying temperature to 140°F (60°C).

The samples must be labelled with the collectors name or the details of the origin and an abbreviated description of the sample indicating the parts of the plants included. (Vide Table Section 2.4.5)

The information can be written on the outside of the container or placed on a strong label tied to the container with strong string.

Clean glass ampoules, bottles, or other containers must be used. Bark corks are preferred to plastic caps or stoppers as these may sometimes react with extracts or residual solvents etc.

The container used will depend on the nature of the product and the method of shipment selected.

The documentation, including any pro-forma invoices must detail exactly the label information and the kind and size of the container used.

3.4.2 Packaging recommendations

The types and sizes depend on the nature of the product and on the requirements of the purchaser.

Each sample must be in a separate container. Care must be taken to ensure damage does not occurr.

Burlap bags (or similar fabric bags), about 24 x 36 inches in size are usually acceptable.

Cotton (or burlap) bags, 12 x 22 inches in size are recommended for samples required to travel long distances.

For finely chopped samples (or those of coarse powdered material) Kraft paper bags are acceptable especially if the bags are packed in wooden boxes or strong corrugated card-board containers for shipment.

For samples of extracts the type of container would be containers of hard glass, aluminium, or drums lined with tin. Plastics could be used in certain cases but the chemical nature of the extract will dictate the packaging technique and this must be negotiated prior to shipment.

It is important to select packaging that will meet all the climatic conditions likely to be encountered and will ensure that the samples will not be damaged in transit. The size of the sample container will also determine the cost of the freight and it is strongly recommended that excessive freight rates be avoided.

3.5 Commercial Practice

Although the quality specifications for medicinal plants and their derivatives are well defined in the various pharmacopoeias and national formulary standards it is essential to make sure that all the products, samples and bulk consignments conform to the requirements of the country to which they are being delivered. This practice is strictly applicable generally and can carry further requirements when dealing with crude drugs, total extracts and pure therapeutic substances. The requirements for the particular markets must be fully ascertained before packaging is initiated.

3.5.1 Purchasing or Distribution Agreement

These agreements may be concluded directly between a grower and an end user in the same country or overseas, but the practice more often applied is for the exporting country to trade with the importing country through the accepted trade channels.

For the country of origin this means that the producer/grower makes his products available to the exporter who deals directly with the importer or broker overseas dealing for the purchaser. The agreement will specify the origin and nature of the product, the terms upon which trading is to take place, the quality specifications, the packing and finally the penalty clauses if these are to be applied to faulty deliveries.

3.5.2 Terms and Specifications

The terms generally applied refer to goods being transferred from the supplier to the buyer.

The prices are quoted on the basis of any of the following conditions:

Goods for "shipment"
Goods "afloat"
Goods "C and F" (Cost and freights)
Goods "C.I.F." (Cost, insurance, freight)
Goods "Spot" ex Stock
Goods "Duty paid"
Goods "Duty paid delivered)

The exact terms will be agreed between seller and buyer but prices are usually based on the currently applicable practices in terms of convertible currency and duty levies, if any. The specifications are usually laid down by the purchaser and refer to humidity levels and the appearance of the crude drugs but can mention analytical requirements and demand pre-shipment assay of the material concerned. The specifications must be agreed between supplier and purchaser.

3.5.3 Certification

In like manner as for medicinal plants, the crude drugs, the total extracts and the pure therapeutic substances benefit greatly from the availability of supporting documentation setting out the standards against which the product is being judged and the details of all tests carried out.

Whenever possible an official Certificate setting out the characteristics of the product should be provided.

3.5.4 Shipping Precautions

Clean and hygienic packaging should be used, whether for medicinal plants, crude drugs or extracts.

If at all possible, shipments should be stored in space free from contamination or infestations.

Most medicinal plants are packed in bags or bales of 30 - 180 kg and the material is often compressed before packaging to reduce bulk.

Moisture content of plants and crude drugs should be kept below 8% to prevent fermentation especially if the transport, shipping and storage time is expected to be prolonged.

3.5.5 Bills of Lading and Tariffs

The "Bills of Lading" being official shipment documents must state any specific instructions relating to the shipment concerned. Warnings as to special conditions to be met, such as "stow away from boilers" or "keep away from heat" or the checking of packaging, should all be mentioned.

A full shipping list must be entered, describing the products included in the shipment. For each product the list must indicate the plant name, the family name and origin as well as the dates of collection.

The invoices which accompany the shipment are copies of the ones sent directly by the supplier to the purchaser and must indicate not only the prices agreed but make some declaration as to the duty liability of the products.

Most medicinal plants carry "no duty" or are "duty zero rated" but this tolerance does not necessarily apply to semi-processed or processed materials which may carry special rates of duty. This must be clarified at the time the purchasing agreement is drawn up.

The Tariffs applied are usually based on the international agreements under the General Agreement on Tariffs and Trade (GATT) but may be modified by conditions prevailing in the country wherein the goods are to be imported.

3.6 Provisions in case of Litigation

Frequently, the agreements entered into by a producer or shipper of medicinal plants and related products and the purchaser or user of such products, are subject to detailed terms and conditions of sale relating specifically to the product or products.

Apart from any specific technical requirements, the agreements usually cover price and price variation, conditions and terms of payment and the right of refusal should the shipment not be up to the agreed standard.

All contracts involving payment for goods supplied should be drawn up so as to mention the legal system under which the contract is drawn up. This facilitates arbitration in case of litigation, that is in case of commercial or technical breaches of contract.

BIBLIOGRAPHY

1.	Plantes medicinales et aromatiques Importance, culture, industrialisation et analyse. Document etabli par le Centre ONUDI/ROUMANIE	14 MARS 1984
2.	Pharmazeutische Biologie, Drogen und ihre Inhaltsstoffe (Prof. Dr. H. Wagner)	G. Fischer Verlag - 1980
3.	Therapie mit Phyto-pharmaka (R. Hansel, H. Haas)	Springer Verlag - 1983
4.	Plantes medicinales de la Cote d'Ivoire (A. Bouquet, M. Debray)	1974
5.	Medicinal Plants of India, Indian Council of Medical Research - New Delhi	1976
6.	Drogen Analyse (H. Wagner, S. Bladt, E.M. Zgainski)	Springer Verlag - 1983
7.	Medicinal Plants of North Africa (Loufty Boulos)	Reference Publications Inc., 1983
8.	Prospects of Indigenous Medicinal Plants in the development of a Pharmaceutical Industry in the developing countries (Sectoral Studies Branch)	UNIDO - August 1983
9.	Medicinal Plants and their derivatives ("Markets for Selected" - International Trade Centre) Geneva	UNCTAD/GATT 1982
10.	British Herbal Pharmacopoeia	
11.	Pharmacopoeia of Japan (English version)	
12.	Practical Manual on the Industrial Utilization of Medicinal, Aromatic Plants. Methodology for Analysis of Vegetable Drugs (Ioan Cuitei)	UNIDO, Vienna, 1982
13.	Cultivation and Utilization of Medicinal Plants (C.K. Atal and B.M. Kapur eds)	CSIR, India, 1982
14.	Cultivation and Utilization of Aromatic Plants (C.K. Atal and B.M. Kapur eds)	CSIR, India, 1982
15.	Flowering Plants of the World (V.H. Heywood Ed.)	Oxford University Press, 1979
16.	Index Plantarum Medicinalum (G. Penso)	O.E.M.F. Milano, 1983
17.	Glossary of Indian Medicinal Plant (R.N. Chopra, S.L. Nayer, I.C. Chopra) and supplement 1974	CSIR, India, 1956
18.	The Quantitative Analysis of Drugs (D.C. Garrat)	Chapman and Hall, UK
19.	Chemotaxonomie der Pflanzen (R. Hegnauer), Vols. I-VI	Birkhauser Verlag
20.	The Essential Oils (E. Geunther), Vols. I-VI	Robert E. Krieger Publishing Co.Inc., New York
21.	European Herbal Infusion Association Guideline to good agricultural practices for herbs	Hamburg, Federal Republic of Germany