MEDICINAL PLANTS RESOURCE SCIENCE

for 5th year students 22 Public health 226 «Pharmacy, industrial pharmacy», educational program «Pharmacy»

Фс15(5,0д)English 1-5 groups

16.03 - 20.03**– Topic: A choice of objects (medicinal plants) for resource study Working out a calendar plan of region’s resource study**

**CLASS**

**Theoretical material**

**Aim**: learn to characterize collection practices; select objects for immediate resource study; characterizepost-harvest processing; work out a calendar plan of region’s resource study taking into account periods of the MPM collection.

**Actuality**: Collection practices should ensure the long term survival of wild populations and their associated habitats. Management plans for collection should provide a framework for setting sustainable harvest levels and describe appropriate collection practices that are suitable for each medicinal plant species and plant part used (roots, leaves, fruits, etc.).

***Theoretical part:***

Collection of medicinal plants raises a number of complex environmental and social issues that must be addressed locally on a case-bycase basis.

More guidance can be found in the *WHO/IUCN/WWF Guidelines on the conservation of medicinal plants*.

In some countries, collection permits and other documents from government authorities and landowners must be obtained prior to collecting any plants from the wild. Sufficient time for the processing and issuance of these permits must be allocated at the planning stage. National legislation, such as national “red” lists, should be consulted and respected.

For medicinal plant materials intended for export from the country of collection, export permits, phytosanitary certificates, Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) permit(s) (for export and import), CITES certificates (for re-export), and other permits must be obtained, when required.

**Selection of medicinal plants for collection**

Where applicable, the species or botanical variety selected for collection should be the same as that specified in the national pharmacopoeia or recommended by other authoritative national documents of the end-user's country, as the source for the herbal medicines concerned. In the absence of such national documents, the selection of species or botanical varieties specified in the pharmacopoeia or other authoritative documents of other countries should be considered. In the case of newly introduced medicinal plants, the species or botanical variety selected for collection should be identified and documented as the source material used or described in traditional medicine in original countries.

Collectors of medicinal plants and producers of medicinal plant materials and herbal medicines should prepare botanical specimens for submission to regional or national herbaria for authentication. The voucher specimens should be retained for a sufficient period of time, and should be preserved under proper conditions. The name of the botanist or other experts who provided the botanical identification or authentication should be recorded. If the medicinal plant is not well known to the community, then documentation of the botanical identity should be recorded and maintained.

**Collection**

Collection practices should ensure the long-term survival of wild populations and their associated habitats. The population density of the target species at the collection site(s) should be determined and species that are rare or scarce should not be collected. To encourage the regeneration of source medicinal plant materials, a sound demographic structure of the population has to be ensured. Management plans should refer to the species and the plant parts (roots, leaves, fruits, etc.) to be collected and should specify collection levels and collection practices. It is incumbent on the government or environmental authority to ensure that buyers of collected plant material do not place the collected species at risk.

Medicinal plant materials should be collected during the appropriate season or time period to ensure the best possible quality of both source materials and finished products. It is well known that the quantitative concentration of biologically active constituents varies with the stage of plant growth and development. This also applies to non-targeted toxic or poisonous indigenous plant ingredients. The best time for collection (quality peak season or time of day) should be determined according to the quality and quantity of biologically active constituents rather than the total vegetative yield of the targeted medicinal plant parts.

Only ecologically non-destructive systems of collection should be employed. These will vary widely from species to species. For example, when collecting roots of trees and bushes, the main roots should not be cut or dug up, and severing the taproot of trees and bushes should be avoided. Only some of the lateral roots should be located and collected.

When collecting species whose bark is the primary material to be used, the tree should not be girdled or completely stripped of its bark; longitudinal strips of bark along one side of the tree should be cut and collected.

Medicinal plants should not be collected in or near areas where high levels of pesticides or other possible contaminants are used or found, such as roadsides, drainage ditches, mine tailings, garbage dumps and industrial facilities which may produce toxic emissions. In addition, the collection of medicinal plants in and around active pastures, including riverbanks downstream from pastures, should be avoided in order to avoid microbial contamination from animal waste.

In the course of collection, efforts should be made to remove parts of the plant that are not required and foreign matter, in particular toxic weeds. Decomposed medicinal plant materials should be discarded. In general, the collected raw medicinal plant materials should not come into direct contact with the soil. If underground parts (such as the roots) are used, any adhering soil should be removed from the plants as soon as they are collected. Collected material should be placed in clean baskets, mesh bags, other well aerated containers or drop cloths that are free from foreign matter, including plant remnants from previous collecting activities.

After collection, the raw medicinal plant materials may be subjected to appropriate preliminary processing, including elimination of undesirable materials and contaminants, washing (to remove excess soil), sorting and cutting. The collected medicinal plant materials should be protected from insects, rodents, birds and other pests, and from livestock and domestic animals.

If the collection site is located some distance from processing facilities, it may be necessary to air or sun-dry the raw medicinal plant materials prior to transport. If more than one medicinal plant part is to be collected, the different plant species or plant materials should be gathered separately and transported in separate containers. Cross-contamination should be avoided at all times.

Collecting implements, such as machetes, shears, saws and mechanical tools, should be kept clean and maintained in proper condition. Those parts that come into direct contact with the collected medicinal plant materials should be free from excess oil and other contamination.

**Post-harvest processing**

Inspection and sorting. Raw medicinal plant materials should be inspected and sorted prior to primary processing. The inspection may include:

\_ visual inspection for cross-contamination by untargeted medicinal plants and/or plant parts;

\_ visual inspection for foreign matter;

\_ organoleptic evaluation, such as: appearance, damage, size, colour, odour, and possibly taste.

Primary processing. Appropriate measures of primary processing are dependent on the individual materials. These processes should be carried out in conformity with national and/or regional quality standards, regulations and norms. In some cases, purchasers may request that specific protocols are followed. These protocols should also comply with national and/or regional regulatory requirements that apply in the producer and the purchaser countries.

As far as possible, standard operating procedures should be followed. If modifications are made, they should be justified by adequate test data demonstrating that the quality of the medicinal plant material is not diminished. Harvested or collected raw medicinal plant materials should be promptly unloaded and unpacked upon arrival at the processing facility. Prior to processing, the medicinal plant materials should be protected from rain, moisture and any other conditions that might cause deterioration. Medicinal plant materials should be exposed to direct sunlight only where there is a specific need for this mode of drying.

Medicinal plant materials that are to be used in the fresh state should be harvested/collected and delivered as quickly as possible to the processing facility in order to prevent microbial fermentation and thermal degradation. The materials may be stored under refrigeration, in jars, in sandboxes, or using enzymatic and other appropriate conservation measures immediately following harvest/collection and during transit to the end-user. The use of preservatives should be avoided. If used, they should conform to national and/or regional regulations for growers/collectors and end-users.

Medicinal plant materials that are to be employed fresh should be stored under refrigeration, in jars, in sandboxes, or using enzymatic or other appropriate conservation measures, and transported to the end-user in the most expeditious manner possible. The use of preservatives should be avoided. If used, this should be documented and they should conform to national and/or regional regulatory requirements in both the source country and the end-user country.

All medicinal plant materials should be inspected during the primary-processing stages of production, and any substandard products or foreign matter should be eliminated mechanically or by hand. For example, dried medicinal plant materials should be inspected, sieved or winnowed to remove discoloured, mouldy or damaged materials, as well as soil, stones and other foreign matter. Mechanical devices such as sieves should be regularly cleaned and maintained.

All processed medicinal plant materials should be protected from contamination and decomposition as well as from insects, rodents, birds and other pests, and from livestock and domestic animals.

Drying. When medicinal plant materials are prepared for use in dry form, the moisture content of the material should be kept as low as possible in order to reduce damage from mould and other microbial infestation. Information on the appropriate moisture content for particular medicinal plant materials may be available from pharmacopoeias or other authoritative monographs.

Medicinal plants can be dried in a number of ways: in the open air (shaded from direct sunlight); placed in thin layers on drying frames, wire-screened rooms or buildings; by direct sunlight, if appropriate; in drying ovens/rooms and solar dryers; by indirect fire; baking; lyophilization; microwave; or infrared devices. When possible, temperature and humidity should be controlled to avoid damage to the active chemical constituents. The method and temperature used for drying may have a considerable impact on the quality of the resulting medicinal plant materials. For example, shade drying is preferred to maintain or minimize loss of colour of leaves and flowers; and lower temperatures should be employed in the case of medicinal plant materials containing volatile substances. The drying conditions should be recorded.

In the case of natural drying in the open air, medicinal plant materials should be spread out in thin layers on drying frames and stirred or turned frequently. In order to secure adequate air circulation, the drying frames should be located at a sufficient height above the ground. Efforts should be made to achieve uniform drying of medicinal plant materials and so avoid mould formation.

Drying medicinal plant material directly on bare ground should be avoided. If a concrete or cement surface is used, medicinal plant materials should be laid on a tarpaulin or other appropriate cloth or sheeting. Insects, rodents, birds and other pests, and livestock and domestic animals should be kept away from drying sites.

For indoor drying, the duration of drying, drying temperature, humidity and other conditions should be determined on the basis of the plant part concerned (root, leaf, stem, bark, flower, etc.) and any volatile natural constituents, such as essential oils.

If possible, the source of heat for direct drying (fire) should be limited to butane, propane or natural gas, and temperatures should be kept below 60 °C. If other sources of fire are used, contact between those materials, smoke and medicinal plant material should be avoided.

Specific processing. Some medicinal plant materials require specific processing to: improve the purity of the plant part being employed; reduce drying time; prevent damage from mould, other microorganisms and insects; detoxify indigenous toxic ingredients; and enhance therapeutic efficacy. Common specific processing practices include pre-selection, peeling the skins of roots and rhizomes, boiling in water, steaming, soaking, pickling, distillation, fumigation, roasting, natural fermentation, treatment with lime and chopping. Processing procedures involving the formation of certain shapes, bundling and special drying may also have an impact on the quality of the medicinal plant materials.

Antimicrobial treatments of medicinal plant materials (raw or processed) by various methods, including irradiation, must be declared and the materials must be labelled as required. Only suitably trained staff using approved equipment should carry out such applications, and they should be conducted in accordance with standard operating procedures and national and/or regional regulations in both the grower/collector country and the end-user country. Maximum residue limits, as stipulated by national and/or regional authorities, should be respected.

Bulk packaging and labeling. Processed medicinal plant materials should be packaged as quickly as possible to prevent deterioration of the product and to protect against unnecessary exposure to potential pest attacks and other sources of contamination.

Continuous in-process quality control measures should be implemented to eliminate substandard materials, contaminants and foreign matter prior to and during the final stages of packaging. Processed medicinal plant materials should be packaged in clean, dry boxes, sacks, bags or other containers in accordance with standard operating procedures and national and/or regional regulations of the producer and the end-user countries. Materials used for packaging should be non-polluting, clean, dry and in undamaged condition and should conform to the quality requirements for the medicinal plant materials concerned. Fragile medicinal plant materials should be packaged in rigid containers. Whenever possible, the packaging used should be agreed upon between supplier and buyer.

Reusable packaging material such as jute sacks and mesh bags should be well cleaned (disinfected) and thoroughly dried prior to reuse, so as to avoid contamination by previous contents. All packaging materials should be stored in a clean and dry place that is free from pests and inaccessible to livestock, domestic animals and other sources of contamination.

A label affixed to the packaging should clearly indicate the scientific name of the medicinal plant, the plant part, the place of origin (cultivation or collection site), the cultivation or collection date and the names of the grower/collector and the processor, and quantitative information. The label should also contain information indicating quality approval and comply with other national and/or regional labelling requirements.

The label should bear a number that clearly identifies the production batch. Additional information about the production and quality parameters of the medicinal plant materials may be added in a separate certificate, which is clearly linked to the package carrying the same batch number.

Records should be kept of batch packaging, and should include the product name, place of origin, batch number, weight, assignment number and date. The records should be retained for a period of three years or as required by national and/or regional authorities.

Storage and transportation. Conveyances used for transporting bulk medicinal plant materials from the place of production to storage for processing should be cleaned between loads. Bulk transport, such as ship or rail cars, should be cleaned and, where appropriate, well ventilated to remove moisture from medicinal plant materials and to prevent condensation. Organically grown medicinal plant materials should be stored and transported separately or in a manner that ensures their integrity.

Appropriate security measures should be applied to the storage and transport of medicinal plant materials that are potentially toxic or poisonous. Whenever required and when possible, fresh medicinal plant materials should be stored at appropriate low temperatures, ideally at 2−8°C; frozen products should be stored at less than −20° C.

Fumigation against pest infestation should be carried out only when necessary, and should be carried out by licensed or trained personnel. Only registered chemical agents authorized by the regulatory authorities of the source country and the countries of intended end-use should be used. All fumigation, fumigation agents, and dates of application should be documented. When freezing or saturated steam is used for pest control, the humidity of the materials should be checked after treatment.

Documentation. Standard operating procedures should be adopted and documented. All processes and procedures involved in the production of medicinal plant materials and the dates on which they are carried out should be documented.

Multiple sets of good herbarium specimens should be prepared and preserved for confirmation of plant identity and reference use. A photographic record (including film, video, or digital images) of the collection site and the medicinal plants under collection should be made, whenever possible.

All agreements between the collector, processor and purchaser, and intellectual property and benefit-sharing agreements should be recorded.

Batch numbers should unambiguously and clearly identify all batches from each cultivation or collection area. Assignment of batch numbers should take place at an early stage of production. Collected and cultivated medicinal plant materials should carry different batch numbers. Where applicable, the results of audits should be documented in an audit report which contains copies of all documents, analysis reports, and local, national and/or regional regulations, and which are stored according to their requirements.

All production of medicinal plant materials by agriculture and collection should conform to national and/or regional regulations on safety, materials handling, sanitation and hygiene. All those involved in the handling and processing of cultivated or collected medicinal plants should in all processing procedures comply with national and/or regional regulations on hygiene.

All personnel should be protected from contact with toxic or potentially allergenic herbs by means of adequate protective clothing, including gloves. Smoking and eating should not be permitted in medicinal plant processing areas.

Personnel who handle medicinal plant materials should refrain from behaviours that could result in contamination of the materials, for example, spitting, sneezing or coughing over unprotected materials.

**Ethical and legal considerations**

The cultivation, collection and harvesting of medicinal plants, as well as the post-harvest processing of medicinal plant materials, must be carried out in accordance with legal and environmental requirements and with the ethical codes or norms of the community and country in which the activities take place. The provisions of the Convention on Biological Diversity must be respected.

**Threatened and endangered species**

Medicinal plants that are protected by national and international laws, such as those listed in national “red” lists, may be collected only by relevant permission according to national and/or international laws. The provisions of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) must be complied with. Endangered medicinal plant species must be sourced only in accordance with national and/or regional legislation.

When medicinal plant materials from threatened, endangered or protected medicinal plant species are obtained through cultivation, they should be accompanied by appropriate documentation in accordance with national and/or regional regulations, to certify that no such medicinal plant materials collected from the wild are included.

**Research of medicinal plant resources**

A national and/or regional inventory of medicinal plants may facilitate the identification of medicinal plants used by communities (including endangered species), outline their distribution and assess their abundance. It can also be used as a tool in tackling questions concerning intellectual property rights issues.

Research is greatly needed to improve the agronomy of cultivated medicinal plants, promote the exchange of information on agricultural production and investigate the social and environmental impact of medicinal plant cultivation and collection.

Data sheets and monographs should be developed on medicinal plants that take into account the particular situation of regions and countries. Such information materials can be useful instruments for promoting technical advancement. General as well as specific education and training materials should be developed for local growers and collectors of medicinal plants.

**Selecting objects of resource study in Ukraine**

There are 5000 species of vascular plants in Ukrainian flora, only about 250 species of which are officially recognized as medical in Ukraine, although nearly 1100 species of Ukrainian flora have medicinal properties, and raw material of some of these plants is used for the drugs manufacturing in the world.

Nowadays in Ukraine, raw materials of nearly 60 species of wild medicinal plants are gathered, which can be objects of resource study.

At the regional resource surveys, the first task of the preparatory period is the choice of medicinal plants, as object of resource studyin this area.

The list of objects of study includes the most valuable medicinal plants whose harvest is planned and also rare species of the "Red Book of Ukraine" in this area.

Expedition may be entrusted the study of introduced woody plants raw materials, such as horse chestnut, Japanese pagoda tree**,** black chokeberryet al. In addition, in the objectives of the study species with export value may be included (angelica, white dead-nettle, mullein), and prospective plants being tested in clinical studies.

In remote areas it is impractical to conduct resource surveys of species that are sufficiently large number of available growing areas. No need to study the resources of plants, which are widely cultivated.

Woody plants resources research are not relevant, if their resource is well known and many times exceeding the needs of their raw materials.

Typically, the employer must provide to the Contractor a list of herbs that are subject to resource assessment.

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