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

**06.04 - 10.04 – Topic:** Phytocenoses of Ukraine. Green and Red Books. Preparation of crude drug

**CLASS**

**Theoretical material**

**Aim**: to acquaint students with the classification of endangered species; the Red Book of Ukraine as a national conservation document and international IUCN Red List; the Green Book of Ukraine and its importance for conservation of plant associations.

**Actuality**: Plants are a fundamental part of ecosystems, forming their physical structure, and are of essential importance to the functioning of the planet’s atmosphere. The majority of plants conduct photosynthesis, a process that by using sunlight energy, converts carbon dioxide and water into organic compounds (such as sugar), water and most importantly into oxygen. Plant species provide habitat, enable the life of animal species and are primary producers for the food web.

***Theoretical part:***

**Green Book of Ukraine** is a public document that summarized information about the current status of rare, endangered and common natural plant groupings in Ukraine that need protection and are important as part of biodiversity. This document is the basis for developing measures to protect or unsustainable use of natural plant groupings, defines the categories of rare, endangered and common natural plant groupings listed in the Green Book of Ukraine.

The protection of plant communities listed in the Green Book of Ukraine is provided by:

* establishment of their special legal status, taking into consideration the requirements for the protection of these communities during the development of regulations;
* creation of biosphere reserves, other territories and objects of the nature reserve fund, including transboundary, in the places of these communities’ existence;
* carrying out ongoing monitoring of their condition and necessary research;
* introduction of special saving modes;
* the establishment of administrative, civil and criminal liability for destruction or damage to the communities and their places of growth.

The Green Book of Ukraine contains the following information: binomial scientific name of the plant community, its synphytososological index, class, category, distribution in Ukraine, physico-geographical conditions, biotope, phytocoenotic, autphytososological and botanical-geographical importance, coenotic structure and floristic core, renewal potential, type of preservation regime, necessity of protection implementation, biotechnical and sosotechnical recommendations, information sources, map of the group distribution.

Vegetation of Ukraine is characterized by a significant syntaxonomic diversity due to its geographical position. There are four geobotanical regions at the territory of Ukraine – European broadleaf, Euro-Siberian forest-steppe, European-Asian steppe and Pre-mediterranian regions. The western part of Ukraine covers an original in phytocoenotic terms Carpathian mountain subprovince, and in the southern part of Ukraine the Mountain-Crimean subprovince. Peculiarities of the geographical location, topography and climate led to the formation in Ukraine's rich natural vegetation, represented by forest, shrub, steppe, meadow, marsh, water, halophytic, psamophytic, lithophytic, calciphytic vegetation types whose communities are grouped together into almost 3800 associations of 348 formations.

The Green Book of Ukraine includes 160 articles, which give relevant information about the 800 vegetation associations of Ukraine, among them are rare (347), endangered (354) and typical (99). Articles are grouped according to the vegetation types: forest (72 articles, 308 associations), bushes and semi-shrub Carpathians and Crimean vegetation (9 articles, 32 associations), grass and shrub steppe vegetation (25 articles, 222 associations), grass and semi-shrub vegetation of xerophytic type on outcrops and sand (8 articles, 32 associations), meadow (6 articles, 20 associations), marsh (11 articles, 39 associations), halophytic (3 articles, 10 associations), water (26 articles, 137 associations).

The translation of an article for a plant association from the Green Book of Ukraine is shown below (Beech forests grouping as an example).

**The beech forests grouping** (*Fagetа sylvaticae)* with dominating lesser periwinkle *(Vinca minor)*

**Association**. Beech periwinkle forest (*Fagetum (sylvaticae) vincosum*

*(minoris))*

**Synphytosozological index, class, category, status of groupings**: 11,1; І; 2; “endangered”

**Distribution in Ukraine**. Lviv region (Roztochya, Gologory), Ternopil region (Kremenetsky mountains), Bukovina (Khotyn height).

**Physico-geographical conditions.** Upper parts of Northerngentle slopes in temperate climatic zone with light-brown soils or soils formed on carbonate rocks.

**Biotope.** Western Ukrainianbeech forests

**Phytocoenotic and outphytososologic importance.** Rare type of dominating species association, where in grassland dominate a relict species – lesser periwinkle *(Vinca minor).*

**Botanical-geographical importance.**  Edificator – European beech *(Fagus sylvatica)* is situated on the plain at North-Eastern distribution boundary.

**Coenotic structure and floristic core.** Forest stand of different agesof crown closure 0,9 – 1,0 and productivity I-II bonitets is formed by European beech of 27 – 28 m high. The second layer is often formed by common hornbeam (*Carpinus betulus)*. The understorey is formed by common hazel (*Corylus avellana),* wayfaring tree *(Viburnum lantana),* European elder(*Sambucus nigra),*European spindle *(Euonymus europaea)* and silver birch *(Betula verrucosa)*. Lesser periwinkle (60%) dominates in the herbage. Such species as European Wild Ginger (*Asarum europaeum),* male fern *(Dryopteris filix-mas),* greater stitchwort (*Stellaria holostea),* wood sanicle(*Sanicula europaea)* are also common. Moss cover is not expressed, juniper haircap moss (*Polytrichum juniperinum)* may sometimes be found.

**Renovation potential.** Good.

**Type of preservation regime**. Nature Reserve (Ia).

**Protection implementation**. Preserved at the National Preserve “Roztochya”.

**Biotechnical and sosotechical recommendations.** Forest management measures, aimed at protecting and restoring of the communities.

**Information sources.** Стойко, 1977, 1977а; Солодкова та ін., 1980; Стойко и др., 1980; Зеленая книга ..., 1987; Стойко, Вантух, 1988; Шеляг-Сосонко та ін., 2002.

IUCN was founded in October 1948 as the International Union for the Protection of Nature (or IUPN) following an international conference in Fontainebleau, France.

The organization changed its name to the International Union for Conservation of Nature and Natural Resources in 1956 with the acronym IUCN (or UICN in French and Spanish).

The mission of IUCN is to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable.

The six IUCN Commissions unite 10,000 volunteer experts from a range of disciplines:

* Commission on Education and Communication (CEC);
* Commission on Environmental, Economic and Social Policy (CEESP);
* Commission on Environmental Law (CEL);
* Commission on Ecosystem Management (CEM);
* Species Survival Commission (SSC);
* World Commission on Protected Areas (WCPA).

IUCN protected area management categories classify protected areas according to their management objectives. The categories are recognized by international bodies such as the United Nations and by many national governments as the global standard for defining and recording protected areas and as such are increasingly being incorporated into government legislation.

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| **IUCN**  **category** | **Description of the category** |
| **Ia**  Strict Nature Reserve | Category Ia are strictly protected areas set aside to protect biodiversity and also possibly geological/geomorphological features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values. Such protected areas can serve as indispensable reference areas for scientific research and monitoring. |
| **Ib**  Wilderness Area | Category Ib protected areas are usually large unmodified or slightly modified areas, retaining their natural character and influence, without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition. |
| **II**  National Park | Category II protected areas are large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities. |
| **III**  Natural Monument or Feature | Category III protected areas are set aside to protect a specific natural monument, which can be a landform, sea mount, submarine cavern, geological feature such as a cave or even a living feature such as an ancient grove. They are generally quite small protected areas and often have high visitor value. Category III protected areas could include:  **- Natural geological and geomorphological features**: such as waterfalls, cliffs, craters, caves, fossil beds, sand dunes, rock forms, valleys and marine features such as sea mounts or coral formations;  **- Culturally-influenced natural features**: such as cave dwellings and ancient tracks;  **- Natural-cultural sites**: such as the many forms of sacred natural sites (sacred groves, springs, waterfalls, mountains, sea coves etc.) of importance to one or more faith groups;  **- Cultural sites with associated ecology**: where protection of a cultural site also protects significant and important biodiversity, such as archaeological/historical sites that are inextricably linked to a natural area. |
| **IV**  Habitat/Species Management Area | Category IV protected areas aim to protect particular species or habitats and management reflects this priority. Many category IV protected areas will need regular, active interventions to address the requirements of particular species or to maintain habitats, but this is not a requirement of the category. Category IV protected areas usually help to protect, or restore: 1) **flora species** of international, national or local importance; 2) **fauna species** of international, national or local importance including resident or migratory fauna; and/or 3) **habitats**. |
| **V**  Protected Landscape/ Seascape | A protected area where the interaction of people and nature over time has produced an area of distinct character with significant ecological, biological, cultural and scenic value: and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values. |
| **VI**  Protected area with sustainable use of natural resources | Category VI protected areas conserve ecosystems and habitats, together with associated cultural values and traditional natural resource management systems. They are generally large, with most of the area in a natural condition, where a proportion is under sustainable natural resource management and where low-level non-industrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area. |

The protected areas of the highest rank, the objects of which are the communities included in the Green Book of Ukraine, are listed below:

* Biosphere preserves: “Askania-Nova”, Danube, Black sea and Carpathian biosphere preserve – Category Ia of the IUCN classification;
* Nature preserve: “Horhanes”, Dnieper-Oril, “Yelanetsky steppe”, Kazantyp, Kaniv, Kara Dag, Crimean, Lugansk, “Medobory”, “Cape Martyan”, Opuk, Polissia, Rivne, “Roztochya”, Ukrainian steppe, Cheremsky, Yalta mountain-forest nature preserves – Category Ib of the IUCN classification;
* National nature parks “Sacred Mountains”, Azov-Syvash, Vyzhnytsky, Desna-Starogutsky, Carpathian, "Podilski Tovtry", “Prypyat-Stohid”, "Synevyr", “Skolivski Beskydy”, “Shatskiy”, “Uzhansky” – Category II of the IUCN classification.

Biodiversity loss is one of the world's most pressing crises and there is growing global concern about the status of the biological resources on which so much of human life depends. It has been estimated that the current species extinction rate is between 1,000 and 10,000 times higher than it would naturally be.

Many species are declining to critical population levels, important habitats are being destroyed, fragmented, and degraded, and ecosystems are being destabilised through climate change, pollution, invasive species, and direct human impacts. At the same time, there is also growing awareness of how biodiversity supports livelihoods, allows sustainable development and fosters co-operation between nations. This awareness is generated through products such as the IUCN Red List of Threatened Species™.

**The IUCN Red List System** was first conceived in 1963 and set a standard for species listing and conservation assessment efforts. For more than 30 years the Species Survival Commission has been evaluating the conservation status of species and subspecies on a global scale - highlighting those threatened with extinction and promoting their conservation.

The Red List is used by government agencies, wildlife departments, conservation-related non-governmental organizations (NGOs), natural resource planners, educational organizations, and many others interested in reversing, or at least halting the decline in biodiversity.

Uses of the **IUCN Red List:**

* Draws attention to the magnitude and importance of threatened biodiversity
* Identifies and documents those species most in need of conservation action
* Provides a global index of the decline of biodiversity
* Establishes a baseline from which to monitor the future status of species
* Provides information to help establish conservation priorities at the local level and guide conservation action
* Helps influence national and international policy, and provides information to international agreements such as the Convention on Biological Diversity (CBD) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

The **European Red List** is a review of the conservation status of c. 6,000 European species (mammals, reptiles, amphibians, dragonflies, butterflies, freshwater fishes, and selected groups of beetles, molluscs, and vascular plants) according to IUCN regional Red Listing guidelines. It identifies those species that are threatened with extinction at the regional level – in order that appropriate conservation action can be taken to improve their status.

In Europe, there are more than 20,000 species of vascular plants. The **European Red List of Vascular Plants** includes 1,826 selected species of vascular plants native to Europe or naturalised before AD 1500. The species selected belong to one or more of three groups:

* Plants listed under European or global policy instruments such as the Habitats Directive, Bern Convention, Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the EU Wildlife Trade Regulation;
* Crop wild relatives (CWR) of priority crops;
* Aquatic plant species.

Geographical scope is continent-wide, extending from Iceland in the west to the Urals in the east, and from Franz Josef Land in the north to the Canary Islands in the south. The Caucasus region is not included. Red List assessments were made at two regional levels: for geographical Europe, and for the 27 current Member States of the European Union.

In the above-mentioned Red List three groups of vascular plants have been assessed, totalling 1,826 species among which 467 have been identified as threatened with extinction. Species listed in policy instruments have a high number of threatened species with at least 44.9% at European and 47.3% at EU 27 level. A further 9.5% are classed as Near Threatened. This high percentage can be explained with the fact that this group of species had already been identified as being of conservation concern. Of the CWR species assessed, at least 11.5% are threatened at European level and 10.5% in the EU 27 member states, with another 4.5% that are Near Threatened. The group of aquatic plants shows that at least 6.6% of the species in Europe and 7.2% in the EU 27 are threatened with extinction. Moreover, 7.4% are Near Threatened.

The main current threats emerging in the analysis were: Intensified livestock farming, recreational activities, tourism and urban development, wild plant collection, invasive alien species, natural system modifications and pollution.

Extinct (EX)

Extinct in the Wild (EW)

Regionally Extinct (RE)

Critically Endangered (CR)

Endangered (EN)

Vulnerable (VU)

Near Threatened (NT)

Least Concern (LC)

Data Deficient (DD)

Not Applicable (NA)

Not Evaluated (NE)

Adequate data

Evaluated

Eligible for Regional Assessment

All species

Extinction risk

Threatened categories

**The Categories and their application**

***EXTINCT (EX)***

A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

***EXTINCT IN THE WILD (EW)***

A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

***CRITICALLY ENDANGERED (CR)***

A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered and it is therefore considered to be facing an extremely high risk of extinction in the wild.

***ENDANGERED (EN)***

A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.

***VULNERABLE (VU)***

A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild.

***NEAR THREATENED (NT)***

A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for, or is likely to qualify for, a threatened category in the near future.

***LEAST CONCERN (LC)***

A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

***DATA DEFICIENT (DD)***

A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

***NOT EVALUATED (NE)***

A taxon is Not Evaluated when it is has not yet been evaluated against the criteria.

There is increasing demand for training from all regions of the world as countries step up efforts to assess their biodiversity and use the Red List as a basis for conservation action. SSC staff runs workshops around the world on how to apply the criteria at a regional level.

The **Red Book of Ukraine** is an annotated and illustrated list of rare species and subspecies that are endangered in Ukraine, and subject to protection; basic document in which the generalization of the current state of rare and endangered species, under which scientific and practical measures for their protection, restoration and rational use are developed.

The Red Book of Ukraine records the species of animals and plants that permanently or temporarily stay or grow in natural conditions in the territory of Ukraine within its territorial waters, continental shelf and exclusive (maritime) economic zone. The Red Book of Ukraine animal and plant species are under special protection throughout Ukraine.

The first edition of the Red Book of Ukraine (Red Book of the Ukrainian SSR, 1980) included 151 species of plants, the second (Red Book of Ukraine, volume Plantage, 1996) – 541, and the third one (Red Book of Ukraine, volume Plantage, 2009) – 826 species of plants and fungi.

The volume Plantage of the Red Book of Ukraine contains the following chapters: Vascular plants; Algae; Bryophyte; Lichens; Fungi.

In the Red Book of Ukraine for each of the species listed in it the following information is specified: category, distribution, key location, quantity in nature, including outside of Ukrainian territory, its changes, information about reproduction and breeding (introduction into culture), the measures taken and to be taken for their protection, sources of information. The book also contains distribution maps and photos (pictures) of the species included into it.

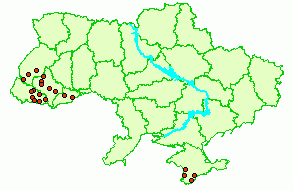
****The translation of an article for a plant from the Red Book of Ukraine is shown below (English Yew as an example).

**Yew**. English yew, European yew34ф

**Taxus baccata L.**

**Vascular** plants.

Division **Pinophyta** (gymnospermae)

Family **Тахасеае**

34ф

**Scientific importance**. Relict (tertiary) species with disjunctive habitat.

**Status**. III category.

**Distribution**. Ukrainian Carpathians, Crimean mountains. The species is also widespread in mountain regions of Western and South-Eastern Europe, Mediterranian region, Middle East, Southern Iran, Caucasus.

**Growing areas**. Hornbeam-beech, beech and beech-coniferous forests. On carbonate rocks, often on calcareous rocks, in ravines.

**Quantity**. There are about 40 places of growing. Populations are local, not numerous, their number is constantly decreasing.

**Reasons of quantity changes**. The mass felling in the past for valuable timber.

**General characteristic**. Coniferous tree or a bush 3 – 16 m high, The bark is thin, scaly brown, coming off in small flakes aligned with the stem. Grows slowly. The life span from 1 to 3 thousands years. The timber is heavy, strong, of red colour. The leaves are lanceolate, flat, dark green, 1–4 cm long and 2–3 mm broad, arranged spirally on the stem, but with the leaf bases twisted to align the leaves in two flat rows either side of the stem, except on erect leading shoots where the spiral arrangement is more obvious. The leaves are highly poisonous (alkaloid taxine). The seed is berry-like, edible. The flowering period – April-May, fruiting – September-October. Propagation – by seeds and vegetative. Shade tolerant.

**Conservation measures**. Listed as endangered in the Red Book of Ukraine. Preserved in Yalta mountain-forest nature preserve and Carpathian biosphere preserve, game preserves of national importance (in the Carpathians and Crimea).

It is recommended to create botanical reserves and natural sights in all areas where yew grows and increase the areas of its cultivation (forests, botanical gardens, parks).

**Preparation of crude drug**

***Crude drugs*** are vegetable or animal drugs that consist of natural substances that have undergone only the processes of collection and drying. The term ***natural substances*** refers to those substances found in nature that comprise whole plants and herbs and anatomic parts thereof; vegetable saps, extracts, secretions, and other constituents thereof; whole animals and anatomic parts thereof; glands or other animal organs, extracts, secretions, and other constituents thereof; and substances that have not had changes made in their molecular structure as found in nature. The term ***crude,*** as used in relation to natural products, means any product that has not been advanced in value or improved in condition by shredding, grinding, chipping, crushing, distilling, evaporating, extracting, artificial mixing with other substances or by any other process or treatment beyond what is essential to its proper packing and to the prevention of decay or deterioration pending manufacture.

Crude drugs are used infrequently as therapeutic agents; more often, their chief principles are separated by various means and are employed in a more specific manner. These principles are known as ***derivatives or extractives.*** Regardless of whether the derivative or extractive is a single substance or a mixture of substances, it is considered the ***chief constituent*** of the drug.

In many instances plants have been cultivated in their native habitats, either because of dwindling natural supply or to improve the quality of the drug. Before World War II, the Japanese had established large plantations of camphor trees in Formosa and held a virtual monopoly in natural camphor. Other drugs, such as Ceylon cinnamon and opium, are produced entirely from cultivated plants.

Extensive cultivation of certain drug plants is conducted in specific geographic areas of the United States. Louisiana produces castor oil from cultivated plants. Occasionally, however, some circumstances will completely eliminate a certain section as a drug-producing region. Formerly, mints were extensively cultivated in southwestern Michigan and northern Indiana. Peppermint, spearmint, and other mints were grown in mile-long rows, particularly near Mentha, Michigan. In the early 1950s, a fungus blight invaded the fields of that area, and within a few years it was considered uneconomical to attempt further cultivation. At present, Washington and Oregon have assumed leadership in the production of mints and mint oils, although both Michigan and Indiana have relocated their areas of cultivation.

It is important to ascertain that plants cultivated in a certain geographic area will develop the desired type and amount of constituents. The differences in the relative amounts of volatile constituents often determine the character of the oil and, consequently, the demand for that particular oil. California orange oil is marketed at more than twice the price of Florida oils. The preference for Michigan peppermint oils over Washington and Oregon oils is because of the types of constituents developed—the Michigan oils taste better.

**Preparation of drugs for the commercial market**

**Collection**

Collection of drugs from cultivated plants always ensures a true natural source and a reliable product. This may or may not be the case when drugs are collected from wild plants. Carelessness or ignorance on the part of the collector can result in complete or partial substitution. This is especially true when drugs are difficult to collect or the natural source is scarce. Many drugs are collected from wild plants, sometimes on a fairly extensive scale (tragacanth, senna) when collection is the vocation of the gatherer, and sometimes on a limited scale when collection is an avocation (podophyllum, hydrastis). Because drugs come from all over the world, collection areas are almost universal, and collectors may vary from uneducated natives to highly skilled botanists

Certain areas of the United States are particularly noteworthy as collection areas White pine, podophyllum, ginseng, and many other native American drugs are collected in the Blue Ridge Mountain region, of which Asheville, North Carolina, is one of the important collection areas. Native American drugs are usually collected by individuals, such as farm children and part-time agricultural laborers.

The proper time of harvesting or collecting is particularly important because the nature and quantity of constituents vary greatly in some species according to the season. The most advantageous collection time is when the part of the plant that constitutes the drug is highest in its content of active principles and when the material will dry to give the maximum quality and appearance.

**Harvesting**

The mode of harvesting varies with each drug produced and with the pharmaceutic requirements of each drug. Some drugs may be collected by hand labor, however, when the cost of labor is an important factor, the use of mechanical devices is often more successful in economic production of the drug. With some drugs, where the skillful selection of plant parts is an important factor (digitalis), mechanical means cannot replace hand labor

**Drying**

By drying the plant material, one removes sufficient moisture to ensure good keeping qualities and to prevent molding, the action of enzymes, the action of bacteria, and chemical or other possible changes Drying fixes the constituents, facilitates grinding and milling, and converts the drug into a more convenient form for commercial handling. Proper and successful drying involves two main principles:

* control of temperature and regulation of air flow. Control of the drying operation is determined by the nature of the material to be dried and by the desired appearance of the finished product. The plant material can be dried either by the sun (in the shade) or by the use of artificial heat
* With some natural products, such as vanilla, processes of fermentation or sweating are necessary to bring about changes in the constituents. Such drugs require special drying processes, usually called "curing."

**Garbling**

Garbling is the final step in the preparation of a crude drug Garbling consists of the removal of extraneous matter, such as other parts of the plant, dirt, and added adulterants This step is done to some extent during collection, but should be earned out after the drug is dried and before it is baled or packaged Although garbling may be done by mechanical means in some cases, it is usually a semiskilled operation

**Packaging, Storage, and Preservation**

The packaging of drugs depends on their final disposition. In commerce, if transportation, storage, and ultimate use for manufacturing purposes are involved, it is customary to choose the type of packaging that provides ample protection to the drug and gives economy of space. Leaf and herb material is usually baled with power balers into a solid compact mass that is then sewn into a burlap cover. Bales that are shipped overseas weigh from 100 to 250 lb. Senna leaves from India come in bales of 400 lb, stramonium from Argentina m bales of 700 lb. Drugs that are likely to deteriorate from absorbed moisture (digitalis, ergot) are packed in moisture-proof cans. Gums, resins, and extracts are shipped in barrels, boxes, or casks.

Packaging is often characteristic for certain drugs. The standard package for all grades of aloe is a 55-gallon steel drum, and this type of container is also employed for balsam of Peru. Matting-covered packages of cinnamon from the Far East, bales covered with cowhide, containing sarsaparilla from South America, lead flasks with oil of rose from Bulgaria, and many other odd forms of packaging are noted in the drug trade.

Proper storage and preservation are important factors in maintaining a high degree of quality of the drug. Hard-packed bales, barks, and resinous drugs usually reabsorb little moisture. But leaf, herb, and root drugs that are not well packed tend to absorb amounts of moisture that reach 10, 15, or even 30% of the weight of the drug. Excessive moisture not only increases the weight of the drug, thus reducing the percentage of active constituents, but also favors enzymatic activity and facilitates fungal growth.

Light adversely affects drugs that are highly colored, rendering them unattractive and possibly causing undesirable changes in constituents. The oxygen of the air increases oxidation of the constituents of drugs, especially when oxidases are present. Therefore, the warehouse should be cool, dark, and well ventilated with dry air.

The protection of drugs against ***attacks by insects*** must not be overlooked. The insects that infest vegetable drugs belong chiefly to the orders Lepidoptera, Coleoptera, and Diptera.

For destruction of insects and prevention of their attacks, a number of methods have been employed. The simplest method is to expose the drug to a temperature of 65°C. This method is probably the most efficient not only in preventing insect attacks but also in preventing many other forms of deterioration. For the fumigation of large lots of crude drugs, such as those stored in warehouses and manufacturing plants, the use of methyl bromide has met with considerable success.

Small lots of drugs may readily be stored in tight, light-resistant containers. Tin cans, covered metal bins, or amber glass containers are the most satisfactory. Drugs should not be stored in wooden boxes or in drawers and never in paper bags. Not only is deterioration hastened, but odors are communicated from one drug to another, attacks by insects are facilitated, and destruction by mice and rats may occur. If drugs in small quantities are stored in tight containers, insect attack can be controlled by adding to the container a few drops of chloroform or carbon tetrachloride from time to time. In the case of digitalis and ergot, whose low moisture content must be maintained at all times, a suitable cartridge or device containing a nonliquefying, inert, dehydrating substance may be introduced into the tight container.

Because high temperatures accelerate all chemical reactions, including those involved in deterioration, drugs must always be stored at as low a temperature as possible. The ideal temperature is just above freezing, but since this is impractical in most cases, the warehouse or other storage place should be as cool as possible. Certain drugs, such as the biologies, must be stored at a temperature between 2° and 8°C.

***Література для підготовки до занять***:

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