The harvesting process of medicinal raw materials.

1. Rational methods of collection of medicinal raw materials of different morphological groups. Primary processing of raw materials.
2. Drying of different types of raw materials.
3. Bringing medicinal raw materials to a standard state.
4. Packaging, labelling and transport of raw materials.
5. Storage of herbal medicinal raw materials.

The raw material base is composed of :

- harvesting from wild medicinal plants;
- harvesting of medicinal plants from cultivated plants;
- raw materials imported from abroad;
- raw materials obtained by cell and tissue culture of medicinal plants.

Harvesting herbal medicinal material includes several stages :

- preparation;

- organisational and methodological;

- collecting raw materials;

- primary processing;

- drying;

- bringing raw materials to standard condition;

- packaging, labelling, transport of raw materials

- storage.

Preparation stage.

- The best time to collect medicinal plants is when the plant is at its highest content of biologically active substances.

Proper determination of the vegetative phase and the timing of harvesting are important, as premature or late harvesting reduces the quality of the raw material and sometimes makes it unusable at all.

Organisational and methodological stage.

A lot of collectors are involved in the collection of medicinal plants. Collectors must follow instructions for collecting and drying medicinal raw materials, measures for the protection and rational use of herbs, and the ability to distinguish medicinal plants from other plants.

- For this purpose, training seminars are held with collectors , a contract is drawn up and collection certificates are issued.
- In the case of collection of rare and other protected species, a partial and limited collection licence is issued.

Raw material harvesting.

The raw material is collected only from healthy, well-developed plants that have not been damaged by insects or microorganisms.

The aerial parts of plants (leaves, flowers, herbs, fruits) are collected in dry weather after the dew has dried (from 8 to 10 a.m.) and before the evening dew (before 5 p.m.); the underground organs (roots, rhizomes, etc.) are collected throughout the day.

Purity of collection is one of the basic requirements of harvesting. Raw materials should not be collected near large industrial plants and on roadsides with heavy traffic, as well as within the territory of large cities, along polluted ditches, etc. Plants growing along roads or near industrial plants can accumulate significant quantities of various toxicants (heavy metals, benzopyrene, etc.).

Primary processing involves the removal of substandard harvested plants and foreign impurities immediately before drying the raw material to be harvested.

General rules for harvesting individual morphological groups.

Buds – Gemmae. In pharmaceutical practice, the buds are the whole buds that are collected during the corresponding growing season and dried lateral (axillary) and apical (terminal) buds.

The buds are collected in late winter or early spring, when they are swollen but not budding (i.e. when their leaflets have not begun to spread).

Two types of buds are officially registered: birch and pine.

Pine buds

drooping birch:
1 - branch with buds; 2 - branch with male and female earrings during flowering; 3 - shortened shoot with immature female earring; 4 - branch with female earrings during full fruit ripening; 5 - bract scales; 6 - fruit - winged nut; 7 - bud; 8 - bud in longitudinal section

Before drying, remove any impurities and buds that have begun to grow. Transport to the drying spot in bags.

Dry on the day of harvesting. To prevent the buds from starting to grow, the room with the harvested material is not heated.

Bark - Cortices. Bark in pharmaceutical practice is the external part of the trunks, branches and roots of trees and shrubs, located to the periphery from the cambium. There are 3 types of bark: **oak bark, buckthorn bark, and cranberry bark**. Bark is collected during the sap movement, before leaves open. At this time, it is easily separated from the wood. Bark is usually harvested in conjunction with forest clearings.

alder buckthorn - Frangula alnus (hamnus frangula).

For medicinal purposes, the bark is only harvested from young branches when they are no more than 2-3 mm thick. The bark of old branches and trunks is covered with a thick corky layer that does not contain any active substances.

Before drying, remove impurities, discard thicker pieces of bark and remove lichen. Place the bark in sacks, not stacking it too tightly and making sure that the grooved pieces do not get into each other, as they can darken, get mouldy and deteriorate.

Dry on the day of collection, spreading out in an even layer several pieces of bark thick.

Leaves - Folia. In pharmacy practice, leaves are medicinal plant material, which are dried or fresh leaves or individual leaves of a compound leaf.

Leaves are harvested when they are fully developed, usually during the budding and flowering phase, unless specifically stated in the ND, and if consistent with the biology of the plant.

Common coltsfoot

Tussilago farfara

Common bearberry

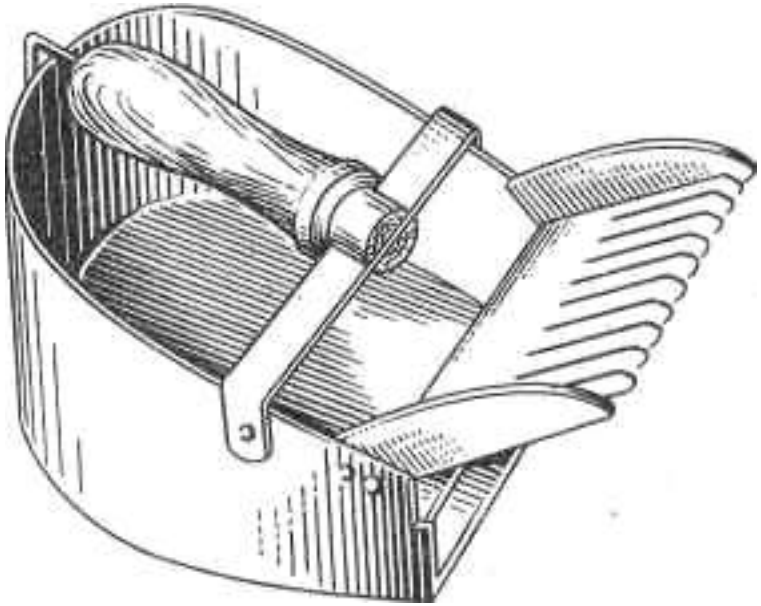
Leaves are cut with a knife, scissors, sickles or carefully removed by hand with the petiole, without the petiole or with part of the petiole.

- The leaves are placed loosely in low baskets and taken immediately to the drying area. Succulent leaves are easily self-heated, yellowing and browning. Before drying, remove foreign impurities, leaves damaged by pests, and blackened leaves. Dry in a thin layer in the shade or in a heat dryer, stirring occasionally.

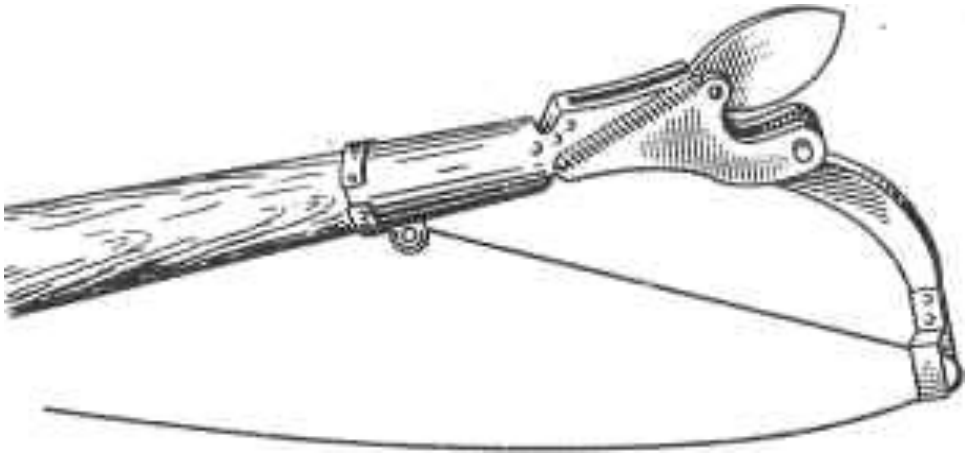
- **Flower - Flores.** In pharmaceutical practice, florets are medicinal raw materials consisting of dried individual flowers or inflorescences as well as their parts.

- Flowers are usually picked at the beginning of flowering (as they are less likely to fall off and retain their colour better).

- The flowers are removed by hand (calendula), cut off with scissors, sickles, pruners, pruning shears (hawthorn, linden) or scraped off with a special scoop (camomile), and plantations use special harvesting machines.



Scoop for collecting flowers



Wind pruner

The flowers are the most delicate parts of the plant; they are collected in baskets, placed in a loose, thin layer, taking care not to crush them, and kept out of direct sunlight when they are brought to the drying place.
They are placed in thin layers and dried out of direct sunlight.

Flower-Buds - Alabastra, collected unopened dried flowers (santonica wormwood, Sophora japonica). Harvested before the flowers bloom (during the budding phase). Santonica wormwood buds are harvested by mowing the above ground parts and then grinding them. Remove extraneous parts of the plant, flowers, diseased buds. In baskets are taken to the drying place. Dry in a thin layer in direct sunlight.

Herb - Herba is the dried or fresh above-ground parts of herbaceous plants.

- Herbs are collected during the flowering phase, some at the beginning of flowering (bur beggar-ticks, bitter wormwood, lily of the valley), others at the end of flowering and before the fruit sets (spring adonis) or during the fruiting period (marsh marigold).

- Cut the shoots with knives, scissors, sickles, with scythes or haymakers, having first removed any foreign plants from the thicket.

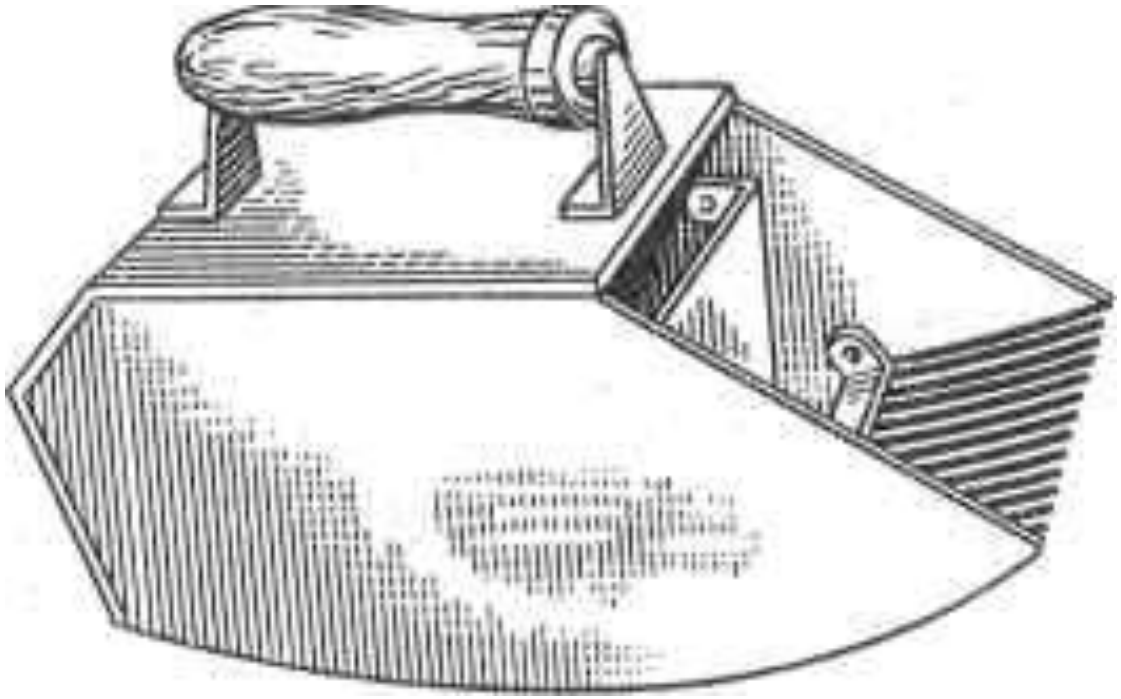
- Do not pull a plant with underground parts if it is perennial.

Fruit - Fructus. Fruits in pharmaceutical practice are simple and compound fruits as well as false fruits, copulas and their parts. Fruits are harvested when mature and dried. Some fleshy fruits (sea buckthorn, raspberries) are processed fresh.

- **Seeds - Semina.** Seeds in pharmaceutical practice are whole seeds or individual seedpods.

- Fruits and seeds are usually harvested when mature, less often when 60-70% of the fruit is ripe (Apiaceae, castor beans, flax).

The fleshy fruit is collected by hand, without the peduncles, and if possible without damaging the integrity of the fruit shells, as crushed fruit can easily go mouldy. Sometimes the fruits are gently scraped off with special scoops. But their use causes noticeable damage to the bush and requires a more thorough primary processing.



Scoop for collecting cranberries

- **Do not cut or break** branches with sea buckthorn, hawthorn or rose hips.

Berries are collected in the early morning or evening; berries collected during the day, in extreme heat, soon spoil. Dirty berries must not be washed before delivery (washed berries soon spoil). Dirty berries should be picked in advance of drying.

Under the name "berries" the following berries are usually collected as medicinal raw materials: berries (blueberries, cranberries, currants); stonefruits (bird cherry, joester); compound and false fruits (raspberries, hawthorn, rosehips, juniper, strawberries).

The berries are collected in shallow, wide baskets lined with cloth on the inside.

Dry the fleshy raw material without delay in a thin layer.

The fruits of species of Apiaceae family do not ripen at the same time, so they can fall off. It is advisable to stack the fruit-bearing tops in mounds until they are fully ripe, then thresh and peel them.

The seeds are transported to the drying place by placing them in bags, or delivered in bulk. Dry in a relatively thick layer by stirring with a wooden shovel.

Underground organs (roots, rhizomes, tubers, bulbs, corms). In pharmaceutical practice, dried, less frequently fresh underground organs of perennial plants, collected more often in autumn (when all the above-ground parts of the plant begin to wither) or early spring (before growth starts), cleaned or washed from the soil, free from dead parts, stem and leaf residues.

Rhizomes and roots of peony – *Paeonia anomala rhizomata et radices*

Valerian medicinal rhizomes with roots – *Valerianae officinalis rhizomata cum radicibus*

After collecting the underground organs of dug up plants for regrowth, it is advisable to shake off the seeds or put pieces of rhizome into the resulting hole. The raised turf should be placed back in its original location and the area should be tamped down and, if possible, watered. Do not dig up more than one third of the plants to maintain the thicket.

The method of collecting any type of raw material should always be gentle and in accordance with the ND in terms of size, development phase and purity. The best containers for carrying the raw material to the drying area are wicker baskets, wooden crates and cloth sacks. The raw material should be loose in the container. Leaves, herbs and flowers should not be placed in polyethylene bags as they quickly become self-heating, which leads to the destruction of the active ingredients.

The collected raw material should be taken quickly (2-3 hours) to the drying place or placed in the shade on a cloth, tarpaulin, etc.

Collection of poisonous plants and precautions when working with them.

Poisonous medicinal plants include belladonna, datura, hellebore, agave, lily of the valley, oleander, foxglove, celandine, etc.
They contain poisonous and potent substances - alkaloids, cardiac glycosides, etc.

When collecting and working with poisonous plants, certain precautions must be observed.

Only adult harvesters, after careful instruction, may be involved in collecting raw materials from belladonna, hemlock, datura and hellebore. Pregnant women and nursing mothers are not allowed.

Stand with your back to the wind when collecting raw materials, so that poisonous fumes can escape. Do not touch the mucous membranes of the eyes, nose or mouth, eat, smoke or use cosmetics while working. After work you should wash your hands and face thoroughly with soap and water and clean or wash your clothes. When handling poisonous raw materials, wear protective respirators or moistened multi-layer gauze bandages.

Poisonings are always the result of improper safety measures when collecting poisonous plants.

Do not harvest other plant species together with poisonous raw materials.

- **Drying medicinal plants** is a specific method of conservation by optimal dehydration (evaporation of moisture).

- Medicinal raw materials harvested usually contain 70-90 % moisture and dried raw materials contain 10-15(20)% moisture.

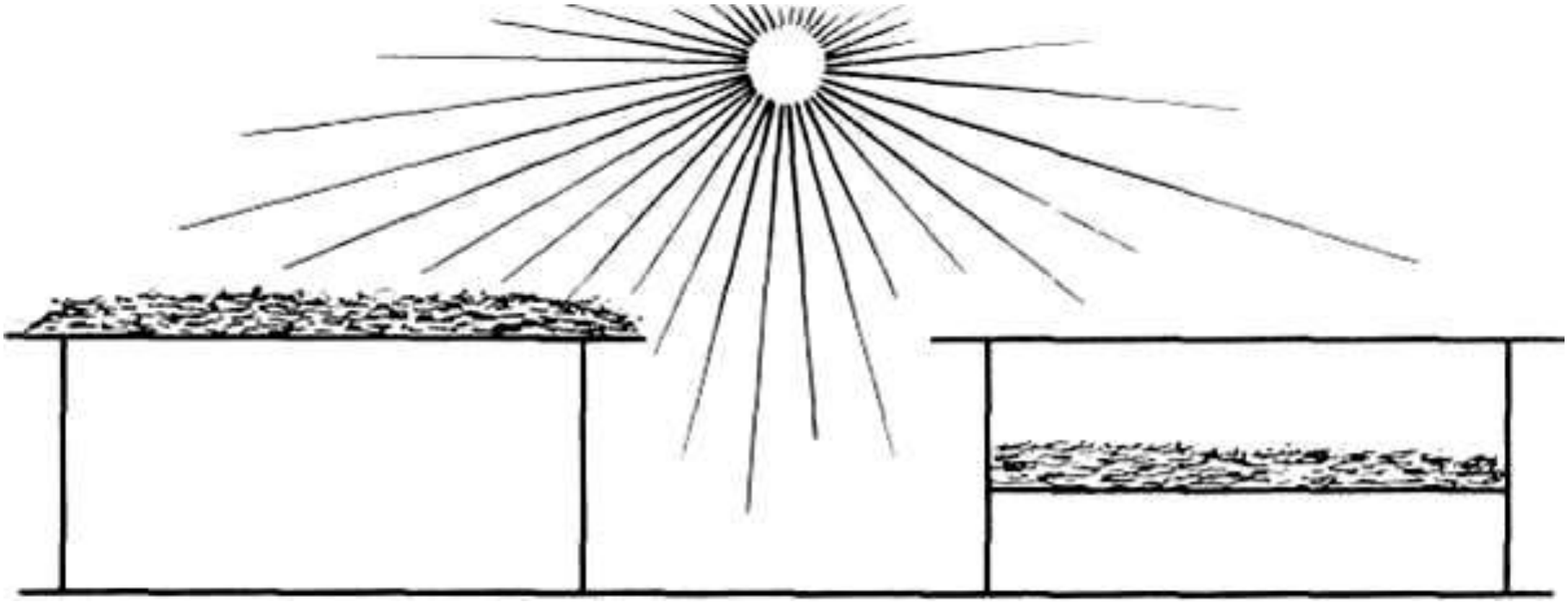
Untimely drying can reduce or even destroy the active ingredients in the plant. Drying should therefore be carried out as soon as possible after harvesting. The period between collection and drying should not exceed a few hours.

The drying methods currently in use for medicinal raw material can be divided into two groups: natural and artificially heated.

Natural (without artificial heating).

a) air-shadowing, carried out outdoors but in the shade, under sheds, in attics, in special drying sheds and air dryers.

b) solar drying, in the open air or in solar dryers. It is used in areas with hot, dry climates, mainly for bark, roots, rhizomes and other underground organs, which are usually hardly damaged by solar radiation.



Solar and shadow drying.

Artificially heated, or thermally heated.

Heat drying is used to dry different morphological groups of raw materials. It ensures fast dehydration and can be used in all weather conditions and in all harvesting areas. A distinction is made between convection drying and thermo-radiation drying depending on the heat input.

Convection drying is carried out in batch or continuous dryers.

Stationary dryers are usually installed in farms where medicinal plants are cultivated, or at large collection points. They consist of a drying chamber equipped with racking with frames on which cloth or metal mesh is stretched, and a boiler system isolated from the drying chamber. The dryers are heated by water, steam or flue gas.

- Portable dryers are mainly designed for drying "wild-growing" medicinal raw materials.

Portable dryers are easy to transport and allow the drying of raw materials directly in the harvesting area.

Individual collectors use ovens and heated plates for heat drying.

Radiation drying is carried out by means of infrared rays, which have a high penetrating power and allow a significant reduction in the dehydration process. This method is used in the laboratory.

The optimal drying conditions can be found in the instructions for harvesting and drying specific medicinal herbs.

For all drying methods, except for the essential-oil raw materials, the medicinal raw materials are spread out in a thin layer and turned over regularly, but avoid increasing the degree of crushing.

Putting raw material into the electric dryer.

Drying is finished when the roots, rhizomes, bark and stems do not bend when bent but break; the leaves and flowers are crushed into powder; the fleshy fruits do not stick together into clumps but disperse when pressed.

Bringing raw materials to a standard condition.

The following operations are carried out to bring the raw material to a standard condition: drying, sorting and, if necessary, cutting (grinding or crushing) of the raw material.

Drying. Special dryers are available in well-equipped warehouses. Drying is carried out to an air-dry condition as determined by the ND of each type. If dried, the raw material becomes brittle. In such case, the raw material is left in the normally dry room for 1-2 days. If the raw material has a musty smell due to high moisture, spread it in a thin layer in the air or in a well ventilated room until the smell of stale odour has gone. Raw materials with a musty odour are not suitable for use.

- **Removing impurities** from raw materials is performed by removing from raw materials any parts of the plant that were not collected by mistake, removing defective parts of the raw material (such as those that have changed their natural colour, moldy, hard stems, root parts that have become woody, marshmallow shoots, sifting any extra crushed parts, removing extraneous organic and mineral impurities). All operations are carried out manually or by various means of mechanisation.

- When sorting herbs, remove the rough parts of the stems and the parts that have lost their natural colouring; from thyme, clover, and daisy, sift out the excessively crushed raw material and remove the stem parts of the plants.
- The sorting of the flowers consists of sifting out the excess crushed raw material when required by the ND, or removing the raw material that has changed colour during drying.

- Berries are sorted on sorters of various designs . The light impurities are separated by a fan-driven air jet, while the other impurities are separated by sieves according to particle size.

- Seeds are purified using special separators with the appropriate set of sieves. The impurities are separated from the raw material by centrifugal force and air flow.

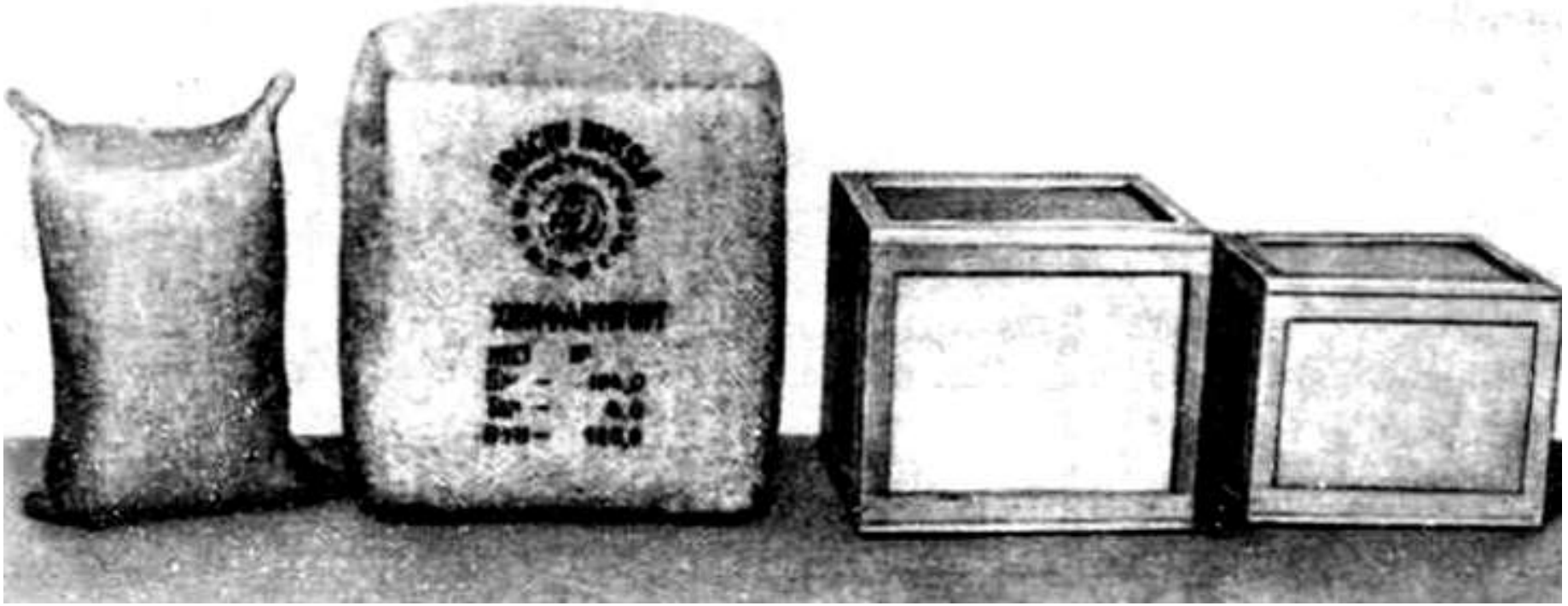
- Roots, rhizomes, bark are sorted by sorting belts - conveyor belts.

- All sorting operations must be carried out in a ventilated room, as the dust generated during the processing of dried raw materials can irritate the upper respiratory tract.
- Particular care should be taken when working with poisonous and potent raw materials (protect your eyes with goggles, nose and mouth from dust with a respirator or gauze mask).

- Crushing (grinding) the raw material. Raw materials are usually kept in one piece in the warehouses. Whole raw materials retain their qualities better, as their tissues are less exposed to the external environment. Medicinal herbal raw materials that come to pharmacies have to be shredded or powdered. The degree of shredding is determined by the standard. Cutting is carried out by machines, the most commonly used being straw cutters.

Packaging, labelling and transport of medicinal raw materials.

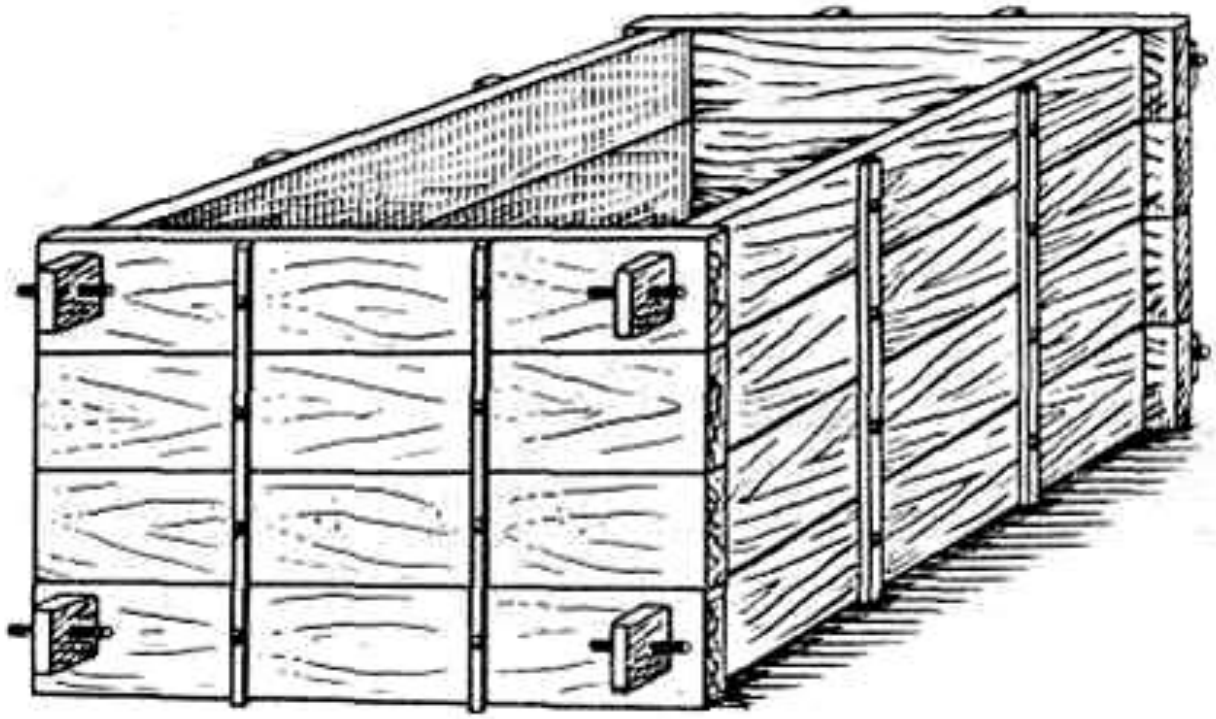
- Packaging must protect the medicinal plant material from damage and loss during transport and storage. For each type of raw material a specific type of packaging and packaging is stipulated in the normative documentation.



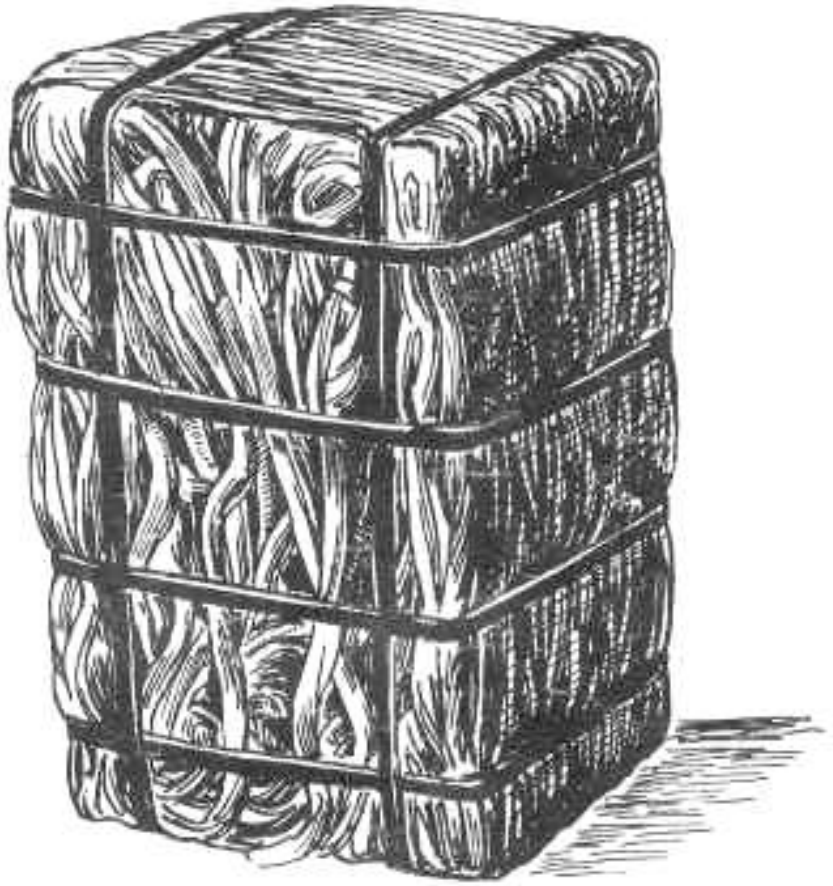
Types of packages.

1 - bag; 2 - bale; 3 - box.

- Bags are used to pack fruit, seeds, buds, crushed bark and roots.
- Double bags are used for packing heavy, hygroscopic, loose raw materials (althea root, licorice root, alder's copulas, pickings, powdered raw materials).
- The weight of raw material in cloth bags should not exceed 50 kg, in paper bags - 15 kg, in paper packets - 5 kg net.



Collapsible bale box.



Bale of roots.

LABELLING OF CONTAINERS OF MEDICINAL RAW MATERIALS

- **Labelling** is the writing on the packaging, on 20x10 cm labels or directly on the container with indelible paint.

The marking shall indicate:

- - the name of the ministry;
- - the sender;
- - the quantity of raw materials (net weight and gross weight);
- - year and month of harvesting;
- - number of the batch;
- - The normative documents for this type of raw material.

- Each package is accompanied by a packing packing slip:
- - the name of the sender;
- - name of the raw material;
- - number of the batch;
- - name and number of the packer.

TRANSPORTATION OF MEDICINAL RAW MATERIALS

- Raw materials may be transported by any type of transport, provided they are covered, dry, clean and free from extraneous odours. Raw materials are transported by rail in wagons or containers.

- The raw materials are to be loaded by type. Poisonous, strong-acting and essential-oil raw materials are loaded separately. Do not put heavy weights or dampening products on the packaged product. It is not allowed to transport the raw materials together with people.
- Raw materials must be transported with transport documents.

STORAGE OF MEDICINAL RAW MATERIALS

- Storage conditions for medicinal raw materials should ensure their conservation both in terms of external view and content of active substances.
- The raw materials should be stored in isolation from other raw materials:

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- **Poisonous and highly potent** (leaves belladonna, scopolia rhizomes, hellebore rhizomes with roots, seeds of chilibukha, etc.) in a separate room or in a separate cupboard under lock and key.

- **Essential oil raw materials with odour** (chamomile flowers, anise fruits, peppermint leaves and sage leaves), in well-closed containers (including tightly closed bags, bales).

- **Fruits and seeds** (hawthorn, raspberry, elderberry, rosehip, etc.). Store them in a draught or ventilate the room often and protect them from pests.

- **Raw materials for general storage** (leaves of plantain, nettle, bark of oak etc.).

Thank you for your attention