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STUDY REGARDING THE CONDITIONING OPERATION OF MEDICINAL PLANTS AND SPECIFIC SEPARATION EQUIPMENT

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Abstract: *The preparation of herbs according to the use and imposed quality standards is done by a sequence of technological conditioning operations whose complexity and specificity depends on the raw plant material, of the product's destination and the available technical level. Depending on the type of plant material and the available technical equipment, conditioning may be performed manually or mechanically. The equipment used for separating impurities from the product mass may perform a single action or more actions simultaneously and can be performed in different constructive variants, differentiated by the principle of operation.*

Key words: *conditioning, equipment, medicinal plants.*

1. Introduction

A compulsory condition for current herb trades is presenting them on the internal or external market as uniform batches which must meet certain quality requirements. Preparing medicinal plants according to their use and imposed quality standards is done through a sequence of technological conditioning operations whose complexity and specificity depend on the raw plant material, the product's destination and the level of technical equipment.

Generally, conditioning is done differently depending on the location where it is performed and the destination of products and includes the following operations: quantitative reception, qualitative reception, cleaning, sorting, grading, post-harvest chemical treatment and quality control of the conditioned products.

The purpose of the conditioning operation consists of removing the impurities and foreign bodies found in the harvested product. Impurities may be of a mineral or organic nature.

Mineral impurities are pebbles, sand, glass, metal objects etc. Impurities can be found in the plant as independent particles with varying sizes compared to the raw plant material. They can also be found as dust that adheres to the surface of the plant product, along with a specific micro-flora for medicinal plants. Among the mineral impurities only glass shards and metal splinters are harmful, the rest being considered harmless, but with negative influence on quality for the finite product.

Organic impurities are represented by parts of bodies from other cultures found incidentally in the base culture's mass, inadequate quality organs of the base plant product, as well as weeds etc.

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Organic impurities can be divided into two categories, namely: impurities that have an influence on the health of the consumers, named harmful impurities for this reason and also impurities that only influence negatively the qualitative indices of the finite products.

Underground parts of medicinal plants require a special type of conditioning that is achieved through a series of operations: removing roots that are too thick, too thin or attacked by pathogenic agents or pests, shaking the dust or washing usually performed with a fast jet of water in order to not engage a series of easily soluble bio-active substances and longitudinal or transversal segmentation [2].

Depending on the type of plant material and the technical equipment, conditioning may be performed manually or mechanically.

2. Specific Separation Equipment

The conditioning operation can be performed with technical equipment meant for separating one or more components from a solid-solid heterogenous mixture.

Separation by the nature of the constituents can be made based on the differences of physical and chemical constants : density, color, superficial properties of the surface, magnetic susceptibility, solubility, chemical affinities etc.

In terms of the applied principle, the separation operation can be performed based on several physical principles such as:

- separation based on the difference in particle shapes, the operation being called screening;
- separation based on different magnetic susceptibilities, the operation being called magnetic sorting;
- separation based on the difference in particle color, the operation being called color sorting.

Based on the operating principle, impurity separators can be: with air stream, helical, electromagnetic, electrostatic, optical, hydraulic and mechanical [3].

Vibratory separators carry out the impurity separation from the product using inclined plane surfaces in a vibrating motion. Lately these tend to gradually replace those with an alternative oscillating motion. Compared to the oscillating surfaces, this technical equipment has a higher processing capacity and a higher technological efficiency.

In terms of obtaining the vibrations, vibrating separators can be:

- with a shaft mechanism with eccentric masses;
- with an autooscillant mechanism;
- with an eccentric shaft mechanism;
- with a connecting rod mechanism elastically linked to the mobile or resonating frame;
- with an electromagnetic mechanism.

In order to complete the separation, these separators are combined with suction channels through which light impurities are removed. The following parameters can be adjusted: separation surface inclination; the direction of the vibration propagation; the vibration amplitude [1].

The Euro Prima company from Serbia has developed various types of equipment that perform several conditioning operations simultaneously ranging from cutting the herbs into different sized fractions to separating the leaves from the herb, and also separating fruit from the stem and unwanted inorganic impurities.

FS 3004 machine (Figure 1) with wide possibilities and high efficiency is basically a vibration separator, with four sieves placed one above another, which separates material in five fractions.

Fig. 1. *Universal machine FS 3004* [4]

The dimension of each sieve is 1000 x 2800 mm. The capacity of the machine is up to 200 kg/h and depends on the herb type. FS 3004 concept is to allow possibility of upgrading with different parts, resulting in a multifunctional machine which can carry out several tasks in herb processing.

FS 3004 can be delivered with different parts and depending on these parts the machine can be used for: chamomile processing (cutting of stems from dry chamomile flower, flower/pulvis/small cut stems/petals selection or separation of leaves from the flower with air flow and herb processing (mint, melissa, sage etc.), leaf removing from the dry herb, classifying bigger stems from leaves, leaf separation in three fractions, dedusting [4].

Air stream separators. This type of equipment (Figure 2) separates materials by the difference in specific weight and their aerodynamic characteristics. Light materials are carried outwards by the air stream, while the heavier ones remain closer to the falling cascade. There is no precise boundary for separating the materials, but a gradual transition from the heaviest to the lightest material, the useful material also being sorted. Sometimes the passing of a material into a compartment or another is based on chance, not on a precise working criteria. The speed of the air stream can be adjusted, and it generally has values between 4 and 16 m/s for separating seeds from light impurities and 10 to 16 m/s for separating seeds by weight. The classic operating principle is based on Galileo's formula (1), which expresses the velocity v at the end of the fall, depending on the height H:

$$v = \sqrt{2 \cdot g \cdot H} \cong 4.43 \cdot \sqrt{H} \text{ [m/s]}. \quad (1)$$

The flow of the supply cylinder, Q is calculated with the relation (2):

$$Q = 60 \cdot \varphi \cdot \gamma \cdot n \cdot p \cdot l \cdot k \text{ [kg/h]}, \quad (2)$$

where: φ is the coefficient of filling of the channels; γ - volumetric weight of the material to be cleaned, in kg/dm^3; n - supply

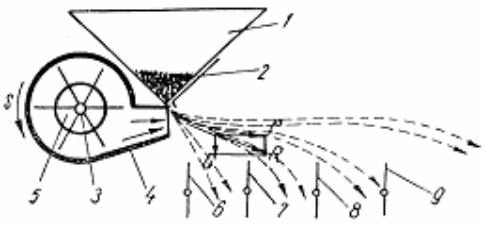

Fig. 2. *Horizontal airflow separator*

shaft rotation speed, în min^{-1}; *p* - number of channels per dm; *l* - length of the supply cylinder, in dm; *k* - theoretical filling of a supply cylinder channel, in dm^3 [6].

An equipment made by the Euro Prima company from Serbia, which works on the principle of air flow separation for light dry plant material is presented in Figure 3.

The F-1000 model is an air separator with vibration dosage and electronic regulation. It is based on the different resistance to air and weight and gives up to two fractions. The electronic flow regulator makes this separator very versatile and easily adjustable for multiple uses (juniper berries, rose hips, mint, melissa, oregano, sage etc.). F-1000 has a strong construction and low power consumption. The machine has a vibration dozer which excludes mass from the hopper, shaking and dosing it into an air cabinet where dust is removed.

The machine is quiet and does not produce vibrations and dust. F-1000 can be easily transported by being placed on wheels.

The equipment is also provided with a cyclone for separating material particles from the air by the effect of the centrifugal force [4].

Fig. 3. *Air separator F-1000* [4]

Separation of impurities from the product mass by color is the most complex method of separating the impurities of different types and also for products with different faults. The latest optical sorting equipment are the SORTEX models made by the Buhler company group.

The premium optical SORTEX A (Figure 4) is designed to offer the highest efficiency and capacity on the market. It is used in the food processing industry to separate input product into two separate output streams on the basis of colour and other optical properties. The main fields of application are rice, grains, seeds and spices, lentils, dehydrated vegetables and grains. Its pioneering custom-designed optical system, background lighting, innovative receptacles and cutting-edge feed system makes it the most consistent sorting machine presently available.

The optional automatic process flow system enables the optical sorter to automatically adjust the capacity to the product flow which ensures easy usage and a consistent performance at highest production standards [5].

Fig. 4. *Optical sorter SORTEX A* [5]

3. Conclusions

- Conditioning operations may be either general or specific for different types of medicinal plants or for different organs of herbs which have an important therapeutic function.
- Depending on the type of impurities and foreign bodies found in the mass of the product, a wide range of equipment and technical installations are used for the cleaning and conditioning process, equipment for separating impurities by shape and size, equipment for separating impurities by aerodynamic properties, equipment for separating impurities by specific mass, equipment for the combined separation of impurities by specific mass and aerodynamic properties, equipment for separating impurities by magnetic properties, equipment for separating impurities and foreign bodies by color.
- Technical equipment used for separating by aerodynamic properties are used for separating light impurities from the product mass subject to the conditioning operation.
- Under current conditions, when it is necessary to ensure food safety for the consumer, having the most modern equipment for conditioning and further processing of medicinal and aromatic plants, will contribute to obtaining competitive products on the foreign market.
- Internationally there is a tendency to use more complex technical equipment for separating impurities, which use combined separation principles and are fitted with programmable systems in order to control work flow and adjust the working parameters.

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