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

**30.03 - 03.04 – Topic:** Calculation of the plant material biological and operational reserves

**CLASS**

**Theoretical material**

**Aim**: learn to calculate the operational reserve and possible volume of annual medicinal plant material collection, compose inventory sheet of medicinal plant brushwood and recommendation projects on rational collection of certain medicinal plant species.

**Actuality**: Resource assessment is an evaluation of some aspect of the resource based on information from a variety of sources. It can include socio-economic issues, market issues, or the quantity and quality of the resource.

***Theoretical part:***

**Calculation of the plant material biological reserve**

**Biological reserve** – the size of raw material (phytomass) formed by all (commercial and non-commercial) specimens of a certain species on any plots – whether suitable or not for collection – low-productive, difficult of access or of a small area.

The process of biological reserve calculation involves several steps: calculation of the mean productivity, projecting cover, sizes of certain brushwood areas.

**Calculation of medicinal plants operational reserve and possible volume of annual collection**

When calculating the productivity, the plant material of all commercial specimens is taken into account but at collection some part of them is left for the brushwood renewal. That is why the operational reserve is calculated using the lower productivity limit. In some cases, (for plants which raw material are fruits, e.g. hawthorn, wild rose, buckthorn etc.) the operational reserve is equal to the biological reserve.

The value of operational reserve indicates the amount of plant material which is possible to collect at one-time usage of the brushwood. It has been proven that annual collection of plant material from the same brushwood is possible only in cases when the plant material is fruits. In such cases the total value of operational reserve of fruits in all brushwood is equal to the possible volume of annual collection (PVAC). In other cases it is necessary to know how many years are needed for the population to be restored.

There is the data of restoration periods only for some species of plants. For the rest of the species the duration of such periods is not determined and thus there are general terms of collection periodicity:

* for inflorescences and aerial parts of annual plants – once in two years;
* for aerial parts of perennial plants – once in 4 – 6 years;
* for underground parts of the majority of perennial plants – once in 15 – 20 years.

In Northern regions and at unfavourable growth conditions upper limits of the recovery periodicity are used. Thus, the amount of plant material which is allowed to collect from certain territory is the possible volume of annual collection which is calculated by division of the operational reserve (OR) on the collection turnover which includes the year of collection and the length of brushwood recovery period (RP):

|  |  |
| --- | --- |
| PVAC =  | OR |
| 1 + RP |

According to the Ukrainian Forest Code it is allowed to collect plant materials in the forests within the following limits (percent from the general biological reserve of the territory):

* underground parts (roots, rhizomes, bulbs) – up to 10 %;
* herbs, leaves, flowers and inflorescences of herbaceous, shrubby plants and trees – up to 40 %.

The collection of plant material from the same territory is carried out periodically, in particular:

* inflorescences, fruits and other aerial parts of annual plants – once in two years;
* aerial parts of perennial plants (leaves, flowers, herb, buds) – once in 5 years;
* underground parts of all plants – once in 10 years.

According to the recommendations of the Ministry of Environment and Natural Resources the collection of yarrow herb and flowers and St. John's wort herb are conducted at intervals of at least 3 years. It is not allowed to use 1/3 of the brushwood every year. Only the alternation of brushwood from year to year with necessary intervals can provide the recovery of each collected plant and save its primary resources.

**Examples of calculation of the plant material operational reserve and the possible volume of annual collection on certain brushwood**

**Example № 1.**

The method of productivity determination – **method of registration plots**.

Brushwood of lily-of-the-valley occupies the area of 0,5 hectares. During the resource investigation 15 registration plots were laid 1 m2 each. Mass of newly-collected raw material – lily-of-the-valley herb – from each ground was correspondingly: 201 g, 187 g, 199 g, 231 g, 62 g, 267 g, 228 g, 203 g, 179 g, 237 g, 162 g, 78 g, 129 g, 177 g, 195 g. Calculate the productivity, biological and operational reserve of the brushwood and possible volume of annual collection.

1. Lily-of-the-valley – a perennial herbaceous plant, 15 - 25 cm high, which is often found in coniferous and mixed forests in Ukraine. It forms uniform brushwood under the trees. Separate specimens are easily determined in the brushwood. Leaves, flowers and herb are collected as the plant material from this plant.

Regarding the peculiarities of the plant development and the types of plant material, the method of registration plots was chosen for the determination of lily-of-the-valley resources.

2. The productivity is determined as arithmetical mean using the formula:



Thus, the average productivity is 182,3 g/m2.

3. The operational reserve (OR) is calculated by multiplying the lily-of-the-valley brushwood area to the lower productivity limit.

OR = S × M= 5000 × 182,3 = 911500 g = 911,5 kg.

The operational reserve of the lily-of-the-valley herb is calculated regarding the yield of dry plant material from the freshly collected one. The percentage of dry plant material yield is determined experimentally or the literature data is used. According to the literature data the yield of the dry lily-of-the-valley herb is 20 %. Thus:

OR dry. = 911,5 х 0,20 = 182,3 kg.

4. The possible volume of annual collection is calculated by division of the operational reserve (OR) on the collection turnover which includes the year of collection and the length of brushwood recovery period (RP). It is allowed to collect lily-of-the-valley herb once in 5 years. Thus:

PVAC = OR dry : (1 + 5) = 182,3 kg : 6 = 30,3 kg.

**Example № 2.**

The method of productivity determination – **method of model specimens.**

Calculate the operational reserve and possible volume of annual collection for greater burnet rhizomes and roots which occupy the area of 5 hectares. The number of specimens was determined on sections of route motion 20 steps in 2 m wide line each. An average step length is 65 cm. Thus the number of specimens was determined on the area of 25 m2 at each route section. The average number of specimens (М1±m1) showed to be 20,3 ± 1,16 at each route section. 60 specimens were taken, rhizomes and roots of each one were weighed and the mean weight of each specimen (М2±m2) was 210,9 ± 18,86 g.

1. Greater burnet is a perennial herbaceous plant which grows in flood-meadows, forest margins, along the riversides all over Ukraine. Rhizomes and roots are the plant material used in medicine.

According to the development and growing features of the plant and the type of plant material the most appropriate method of resource determination is the method of model specimens.

2. The average productivity on the route sections is calculated by multiplying (М1±m1) × (М2±m2):

М1 × М2 = 20,3 × 210,9 =4281,3 г.



Thus, the average amount of the plant material collected from 25 m2 is 4281,3 ± 459,6 g, and average productivity is 171,3 ± 18,4 g/m2.

3. Calculate the operational reserve (OR), multiplying the greater burnet brushwood area to the lower productivity limit.

OR = S × (М – 2m) = 50000 × (171,3 - 2×18,4) = 6725000 g = 6725 kg.

The operational reserve of the greater burnet rhizomes and roots is calculated regarding the yield of dry plant material from the freshly collected one. According to the literature data the yield of dry greater burnet plant material is 25 %. Thus:

OR dry. = 6725 × 0,25 = 1681,3 kg.

4. The possible volume of annual collection is calculated by division of the operational reserve (OR) on the collection turnover which includes the year of collection and the length of brushwood recovery period (RP). The greater burnet underground organs are allowed to collect once in 15 years. Thus:

PVAC = ORdry : (1 + 15) = 1681,3 kg : 16 = 105,1 kg.

**Example № 3.**

The method of productivity determination – **method of projecting cover**.

Calculate the operational reserve and possible volume of annual collection of the thyme herb which grows on the area of 0,5 hectares. It was determined during the resource study that the average percentage of the projecting cover (М1±m1) was 75,3 ± 6,8%, and the average productivity of the thyme herb (М2±m2) was 20,9 ± 1,2 g/m2.

1. Thyme is a semi-shrub, with creeping stems up to 10 cm long, which form integral brushwood where it is hard to determine separate specimens. Thyme herb is collected as the plant material.

According to the development and growing features of the plant and the type of plant material the most appropriate method of resource determination is the method of projecting cover.

2. The average productivity is calculated by multiplying (М1±m1) × (М2±m2):

М1 × М2 = 75,3 × 20,9 =1573,8 g.



The average productivity is 1573,8 ± 168,4 g/m2.

The operational reserve is calculated regarding the yield of dry plant material from the freshly collected one. According to the literature data the yield of the dry thyme herb is 30 %. Thus:

ORdry = 1573,8 × 0,3 = 472,1 kg of the dry plant material.

3. The possible volume of annual collection which is calculated by division of the operational reserve (OR) on the collection turnover which includes the year of collection and the length of brushwood recovery period (RP). The thyme herb is allowed to collect once in 5 years. Thus:

PVAC = OR dry.: (1 + 5) = 472,1: 6 = 78,7 kg.

**The yield of the dry plant material from the freshly collected one**

|  |  |  |
| --- | --- | --- |
| **№** | **Name of the plant material** | **The yield of dry plant material according to the literature data, %** |
| **1** | **2** | **3** |
| 1. | Birch buds | 40 |
| 2. | Pine buds | 40 |
| 3. | Arnica flowers | 20-22 |
| 4. | Chamomile flowers | 25 |
| 5. | Cornflower flowers | 20 |
| 6. | Elder flowers | 18-20 |
| 7. | Hawthorn flowers | 18-20 |
| 8. | Immortelle flowers | 25-30 |
| 9. | Lily-of-the-valley flowers | 14 |
| 10. | Lime flowers | 25 |
| 11. | Alder buckthorn bark | 40 |
| 12. | High-cranberry bark | 40 |
| 13. | Oak bark | 40 |
| 14. | Bistort rhizome | 25 |
| 15. | Calamus rhizome  | 30 |
| 16. | Fern rhizome | 30 |
| 17. | Tormentil rhizome | 28-32 |
| 18. | Burnet rhizomes with roots | 25 |
| 19. | Elecampane rhizomes with roots | 30 |
| 20. | Valerian rhizomes with roots | 25 |
| 21. | Veratrum rhizomes with roots | 25 |
| 22. | Dandelion roots | 33-35 |
| 23. | Marshmallow roots | 22 |
| 24. | Restharrow roots | 30-32 |
| 25. | Bearberry leaves | 50 |
| 26. | Coltsfoot leaves | 15 |
| 27. | Cowberry leaves | 45 |
| 28. | Henbane leaves | 16-18 |
| 29. | Jimson weed leaves  | 12-14 |
| 30. | Lily-of-the-valley leaves | 20 |
| 31. | Nettle leaves | 22 |
| 32. | Wormwood leaves | 24-25 |
| 33. | Labrador tea shoots | 32-36 |
| 34. | Bilberry fruits | 13 |
| 35. | Bird cherry fruits | 42-45 |
| 36. | Blackcurrant fruits | 18-20 |
| 37. | Common buckthorn fruits | 17 |
| 38. | Dog rose fruits | 32-35 |
| 39. | Hawthorn fruits | 25 |
| 40. | Raspberry fruits | 16-18 |
| 41. | Celadine herb | 23-25 |
| 42. | Centaury herb | 25 |
| 43. | Horsetail herb | 25 |
| 44. | Lily-of-the-valley herb | 20 |
| 45. | Motherwort herb | 25 |
| 46. | Pansy herb | 20 |
| 47. | Pot marjoram herb | 25 |
| 48. | Redshank herb | 20-22 |
| 49. | Shepherd’s purse herb | 26-28 |
| 50. | St. John’s wort herb | 30 |
| 51. | Thyme herb | 25-30 |
| 52. | Water pepper herb | 20-22 |
| 53. | Wormwood herb | 22 |
| 54. | Yarrow herb | 22 |

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

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