ECONOMIC EVALUATION OF MEDICINAL PLANT RAW MATERIAL

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One of the principal means of raising the economic efficiency of the pharmaceutical chemistry industry is the use of more economical types of initial raw material.

A technical-economic comparison of different production variants must not be limited to a comparison of indices for efficiency of the output of the product itself. Expenses in related areas must also be considered, i.e., not departmental or factory efficiency but the national economic effectiveness of any variant.

This method of analysis of economic efficiency has a special importance in the production of preparations from plant raw material where the capital investment in production organization, the preparation, drying, and primary treatment of raw material, can substantially exceed the expenses in the output of the preparation itself. Here, it must be kept in mind that about 40% of the remedies used in medicine are obtained from plant raw material.

In the economic evaluation of different types of plant raw material, the following model scheme is recommended as worked out by the authors with reference to lobed nightshade, source material for derivation of steroid hormones (Table 1).

With no possibility of fully clarifying all indices, we shall concentrate on the principal ones—capital expenditures and production cost with the use of different types of raw material, index of reported expenditures, and labor productivity. These indices should be examined in all their connections and interrelationships. The final rating in the choice of a certain raw material should be based on a calculation of both current and capital investments.

Capital Investments. In the composition of an index of capital investment for the production of medicines from plants, a large proportion is assigned to investments in related areas connected with the cultivation, harvest, drying, primary treatment, and storage of the plant raw material. As an illustration we shall present a model consolidated estimate of proportionate capital investments in the production of methyltestosterone from two species of plant stock. At the same time, comparison is made with a production variant of the preparation from β-sitosterol, a by-product of the cellulose sulfate industry (70-90 kg obtained from 1 ton of cellulose) (Table 2).

From Table 2 it follows that the production of hormones from β-sitosterol requires less capital. But if one is limited to a calculation of capital expenditures solely in the final output of the finished article, then the erroneous conclusion could be drawn that only half the capital expenditure is required for the organization of production of methyltestosterone from plant raw material as compared with a similar production based on the use of byproducts of the cellulose sulfate industry. This is explained by the fact that, with the use of plant medicinal raw material, the share of capital expenditure for the final output consists of a little over 30%. The remaining 70% is necessary for related areas connected with organization for obtaining the primary raw material and intermediate products. Of course, these ratios will change with improvement in production of the primary and intermediate types of raw material.

Production Cost. We shall demonstrate the importance of the cost index for production from different types of raw material with the data in Table 3 as an example, showing current expenses in the production of methyltestosterone from the same two species of plant stock and from β-sitosterol.

From Table 3 it is seen that the cost of hormones from by-products of the cellulose sulfate industry is lower. As for the distribution of current expenses, final output makes up 90% and related areas only ~10%.
TABLE 2. Proportionate Capital Expenditures in Methyltestosterone* Production (in thousand rubles for 1 ton of preparation)

<table>
<thead>
<tr>
<th>Area of capital investment</th>
<th>From plant raw material</th>
<th>From ( \beta )-sitosterol (product of soap sulfate reprocessing)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>lobed night-shade</td>
<td>multi-racemed Dioscorea</td>
</tr>
<tr>
<td>Derivation of original raw material</td>
<td>686</td>
<td>555</td>
</tr>
<tr>
<td>Production of intermediate product for hormones (solasodin, diosgenin, ( \beta )-sitosterol)</td>
<td>66</td>
<td>50</td>
</tr>
<tr>
<td>Final hormone production (derivation of methyltestosterone)</td>
<td>350</td>
<td>320</td>
</tr>
<tr>
<td>Total</td>
<td>1,102</td>
<td>925</td>
</tr>
</tbody>
</table>

*Here and subsequently all absolute figures are approximations and have a methodological character.

TABLE 3. Current Expenses in Methyltestosterone Production (in thousand rubles for 1 ton of preparation)

<table>
<thead>
<tr>
<th>Area of expenditure</th>
<th>From plant raw material</th>
<th>From ( \beta )-sitosterol</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>lobed night-shade</td>
<td>multi-racemed Dioscorea</td>
</tr>
<tr>
<td>Derivation of original raw material</td>
<td>760</td>
<td>150</td>
</tr>
<tr>
<td>Production of intermediate product for hormones (solasodin, diosgenin, ( \beta )-sitosterol)</td>
<td>2,775</td>
<td>462</td>
</tr>
<tr>
<td>Final hormone production (derivation of methyltestosterone)</td>
<td>22,331</td>
<td>3,645</td>
</tr>
<tr>
<td>Total</td>
<td>25,866</td>
<td>4,257</td>
</tr>
</tbody>
</table>

Considering the sharp divergence in the level of proportional capital investment and current expenses in the production, the selection of an economical variant must be based on a comparison of the so-called reported annual expenses with a consideration of both the production cost and determined deductions from capital investment in relation to the normative coefficient of relative economic efficiency in a computation on the annual production volume.

That variant proves to be the most remunerative which ensures a minimal value for the reported annual expenditures as estimated according to the formula:

\[ N_i + E_nC_i = \min, \]

where \( N_i \) is the net cost of annual production output with the use of raw material type i; \( C_i \), the capital investments with the i variant (calculating also the investment in related areas); and \( E_n \), coefficient of normative relative economic efficiency of the capital investment.

Using the index of the reported annual expenditures for the examined production variants for hormonal preparations from different raw material, we shall establish their minimal value in the variant from byproducts of the cellulose sulfate industry (reprocessing of \( \beta \)-sitosterol) (Table 4).