Estimation of time spent on studies of toxic elements in food in an accredited laboratory testing center

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Abstract. Reducing the time spent on preparing a sample for analysis by 19.5 times, as well as cost items for raw materials and basic materials by 2.6 times, is a weighty argument in favor of introducing the PLP-01M microwave laboratory system. When the estimated price for a unit of research is established, the competitiveness in the market for the services provided significantly increases, the setting of the market price allows increasing revenue by 1.2 times, which will amount to 883 thousand rubles. additional income. Upgrading the equipment used from Kvant-AFA to Kvant-2AT with the simultaneous implementation of the PLP-01M microwave laboratory system will not only improve the used measuring instrument, but also the entire sample preparation system as a whole. The optimal choice of measuring instruments for updating the laboratory base is carried out based on the volume of analyzed samples, the productivity of existing and considered for implementation instruments, the cost of equipment and the solvency of the TLC, as well as the possibility of implementing a new method in the laboratory.

1. Introduction

Improving the quality of services provided by updating the laboratory base is considered as one of the most important ways to increase competitiveness, achieve competitive advantages, which, in turn, contributes to increasing the economic efficiency of the testing laboratory center (hereinafter referred to as the TLC).

Ensuring food safety remains an urgent and priority task [1-6]. Assessment of the quality and safety of the developed food products is a prerequisite [7-18]. In the conditions of market relations at any enterprise, including testing laboratories, the relevance of quality management is determined by its focus on ensuring such a level of quality of services that can fully satisfy all consumer needs. The lack of updating of measuring instruments, test and auxiliary equipment makes it difficult to ensure a stable quality of services. The processes of updating the laboratory base in modern conditions of the development of scientific and technological progress are objectively necessary [16-24].

2. Materials and methods

The determination of the time spent was established by standard methods, according to the Quality Manual of the TLC.

Equipment:

- atomic absorption spectrometer "Kvant-2AT" (hereinafter referred to as "Kvant-2AT");
• voltammetric analyzer "TA-4" (hereinafter referred to as "TA-4");
• analyzer "Pan-arsenic" (hereinafter referred to as "Pan-arsenic");
• photoelectric concentration colorimeter "KFK-2MP" (hereinafter referred to as "KFK-2MP");
• atomic absorption spectrometer "Kvant-AFA" (hereinafter referred to as "Kvant-AFA");
• microwave laboratory system PLP-01M (hereinafter referred to as PLP-01M);

3. Results and discussions
Calculations for price formation depending on the time spent on research for each of the above measuring instruments are summarized in tables 1-10.

Table 1. Time spent on the determination of lead and cadmium on the Kvant-2AT/Kvant-AFA spectrometer.

| Job title                                      | Position                      | Time standard, h |
|-----------------------------------------------|-------------------------------|------------------|
| Sample collection and registration, sample identification, log entries | laboratory assistant          | 0.1              |
| Taking a sample                               | clerk                          | 0.2              |
| Preparation of reagents                       | laboratory assistant of the highest category | 0.1              |
| Sample mineralization                         | laboratory assistant          | 0.2              |
| Preparation of the device for operation, construction/refinement of the calibration graph | engineer                       | 0.4              |
| Analysis of a sample on an atomic absorption spectrometer "Kvant-2AT" | engineer                       | 0.11             |
| Carrying out internal laboratory control, making calculations, registering results | engineer                       | 0.3              |
| Preparing dishes                              | laboratory assistant          | 0.3              |
| Paperwork                                     | head of TLC                   | 0.3              |

Table 2. Determination of lead and cadmium on the "Kvant-2AT" / "Kvant-AFA" spectrometer.

| Cost item                  | Amount, rub. |
|----------------------------|--------------|
| Basic and additional wages | 64.80        |
| Material costs             | 9.72         |
| Overheads                  | 125.72       |
| TOTAL cost                 | 200.24       |
| Profitability              | 50.06        |
| TOTAL including VAT        | 315.38       |
| Price in the price list    | 315.00       |

The price for carrying out one study of food products and food raw materials as determined by the atomic absorption spectrometer "Kvant-2AT" / "Kvant-AFA" for both lead and cadmium is 315 rubles.

Table 3. Time spent on the determination of lead and cadmium on the analyzer "TA-4".

| Job title                                    | Position                           | Time standard, h |
|----------------------------------------------|------------------------------------|------------------|
| Acceptance and registration of samples, specimen identification, log entries | laboratory assistant             | 0.1              |
| Taking a sample                              | clerk                              | 0.2              |
|                                              | laboratory assistant of the highest category | 0.1              |
Table 4. Determination of lead and cadmium on the analyzer "TA-4".

| Cost item                        | Amount, rub. |
|----------------------------------|--------------|
| Basic and additional wages       | 71.88        |
| Material costs                   | 10.78        |
| Overheads                        | 139.44       |
| TOTAL cost                       | 222.09       |
| Profitability                    | 55.52        |
| TOTAL including VAT              | 349.80       |
| Price in the price list          | 350.00       |

The price for one study of food products and food raw materials, as determined by the voltammetric analyzer "TA-4", for both lead and cadmium is 350 rubles.

Table 5. Time spent on the determination of arsenic on the analyzer "Pan-arsenic".

| Job title                                      | Position                        | Time standard, h |
|------------------------------------------------|---------------------------------|------------------|
| Acceptance and registration of samples,        | laboratory assistant           | 0.1              |
| specimen identification, log entries          | clerk                           | 0.2              |
| Taking a sample                                | laboratory assistant of the     | 0.1              |
| highest category                               | highest category                |                  |
| Preparation of reagents                        | engineer                        | 0.45             |
| Sample mineralization                          | laboratory assistant of the     | 1.25             |
| highest category                               | highest category                |                  |
| Preparation of the device and electrodes for   | engineer                        | 1.0              |
| work, construction of a calibration graph      | highest category                |                  |
| Analysis of a sample on a voltammetric         | engine                          | 0.5              |
| analyzer "TA-4"                                | highest category                |                  |
| Carrying out internal laboratory control,      | engine                          | 0.3              |
| making calculations, registering results        | highest category                |                  |
| Preparing dishes                               | laboratory assistant           | 0.3              |
| Paperwork                                       | head of TLC                     | 0.3              |

Table 6. Determination of arsenic on the analyzer "Pan-arsenic".

| Cost item                        | Amount, rub. |
|----------------------------------|--------------|
| Basic and additional wages       | 71.99        |
| Material costs                   | 10.80        |
| Overheads                        | 139.66       |
| TOTAL cost                       | 222.45       |
| Profitability                    | 55.61        |
| TOTAL including VAT              | 350.36       |
| Price in the price list          | 350.00       |
The price for one study of food products and food raw materials for the determination of arsenic on the Pan-arsenic analyzer is 350 rubles.

Table 7. Time spent on determining arsenic on the KFK-2MP colorimeter.

| Job title                                      | Position                        | Time standard, h |
|------------------------------------------------|---------------------------------|------------------|
| Acceptance and registration of samples,        | laboratory assistant clerk      | 0.1              |
| specimen identification, log entries          |                                 | 0.2              |
| Taking a sample                               | laboratory assistant of the highest category | 0.1              |
| Preparation of reagents                        | engineer                         | 0.3              |
| Sample mineralization                          | laboratory assistant of the highest category | 2.2              |
| Preparation of the device and electrodes for work, construction of a calibration graph | engineer                         | 1.1              |
| Analysis of a sample on a voltammetric analyzer "TA-4" | engineer                         | 0.3              |
| Carrying out internal laboratory control, making calculations, registering results | engineer                         | 0.2              |
| Preparing dishes                               | laboratory assistant            | 0.3              |
| Paperwork                                      | head of TLC                     | 0.3              |

Table 8. Determination of arsenic on the KFK-2MP colorimeter.

| Cost item                             | Amount, rub. |
|---------------------------------------|--------------|
| Basic and additional wages            | 80.16        |
| Material costs                        | 12.02        |
| Overheads                             | 155.50       |
| TOTAL cost                            | 247.68       |
| Profitability                         | 61.92        |
| TOTAL including VAT                   | 390.09       |
| Price in the price list               | 390.00       |

The price for one study of food products and food raw materials to determine arsenic on a photoelectric concentration colorimeter "KFK-2MP" is 390 rubles.

Table 9. Time spent on the determination of lead and cadmium at Kvант-2AT/Kvant-AFA, taking into account the use of the PLP-01M system.

| Job title                                      | Position                        | Time standard, h |
|------------------------------------------------|---------------------------------|------------------|
| Acceptance and registration of samples,        | laboratory assistant clerk      | 0.1              |
| specimen identification, log entries          |                                 | 0.2              |
| Taking a sample                               | laboratory assistant of the highest category | 0.1              |
| Preparation of reagents                        | engineer                         | 0.2              |
| Sample mineralization                          | laboratory assistant of the highest category | 1.2              |
| Preparation of the device and electrodes for work, construction of a calibration graph | engineer                         | 0.4              |
| Analysis of a sample on a voltammetric analyzer "TA-4" | engineer                         | 0.11             |
| Carrying out internal laboratory control, making calculations, registering results | engineer                         | 0.3              |
| Preparing dishes                               | laboratory assistant            | 0.3              |
| Paperwork                                      | head of TLC                     | 0.3              |
Table 10. Determination of lead and cadmium on the Kvant-2AT/Kvant-AFA spectrometer taking into account the use of the PLP-01M system.

| Cost item                        | Amount, rub. |
|----------------------------------|--------------|
| Basic and additional wages       | 52.61        |
| Material costs                   | 7.89         |
| Overheads                        | 102.06       |
| TOTAL cost                       | 162.65       |
| Profitability                    | 40.46        |
| TOTAL including VAT              | 256.04       |
| Price in the price list          | 260.00       |

The price for one study of food products and food raw materials, as determined by the atomic absorption spectrometer Kvant-2AT/Kvant-AFA, taking into account the use of the PLP-01M microwave laboratory system of both lead and cadmium is 260 rubles.

The introduction of a microwave laboratory system will reduce the cost of 1 study by 55 rubles.

4. Conclusion
Reducing the time spent on preparing a sample for analysis by 19.5 times, as well as cost items for raw materials and basic materials by 2.6 times, is a weighty argument in favor of introducing the PLP-01M microwave laboratory system.

The use of the PLP-01M microwave laboratory system will make it possible to implement one of two options for the pricing policy of the laboratory management: when the estimated price per unit of research is established, the competitiveness in the market for the services provided significantly increases; additional income.

Upgrading the equipment used from Kvant-AFA to Kvant-2AT with the simultaneous introduction of the PLP-01M microwave laboratory system will not only improve the used measuring instrument, but also the entire sample preparation system as a whole.

The optimal choice of measuring instruments for updating the laboratory base is carried out based on the volume of analyzed samples, the productivity of existing and considered for implementation instruments, the cost of equipment and the solvency of the TLC, as well as the possibility of implementing a new method in the laboratory.

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