

## **The Role of Analytical Chemistry in Ensuring Food Safety and Methodological Bases of its Teaching**

***Mirzayev D.M., Abdisamatov E.D.***  
*Fergana State Technical University*

**Abstract.** *This article highlights the important role of analytical chemistry in the development of the chemical industry, and presents practical work carried out independently with students on quantitative and qualitative analysis of nutrients in food products, and the average values of the results obtained are presented in tables.*

**Key words:** *Protein, carbohydrate, fat, mineral substances, qualitative and quantitative analysis, analytical chemistry, substance.*

### **Introduction.**

Analytical chemistry is of incomparable importance for the rapidly developing chemical industry, food technology, pharmaceuticals, oil and gas processing, and environmental monitoring processes today. This science is used to study the composition of raw materials, semi-finished products, and finished products in depth, and to accurately determine their quality indicators, purity, beneficial components, and harmful impurities. In particular, the quantitative and qualitative assessment of organic and inorganic substances in food plays an important role in human health and the standardization of industrial products[1-2].

In today's modern society, analytical chemistry laboratories are being equipped with the latest equipment - spectrophotometers, chromatographs, mass spectrometers, atomic absorption analyzers, pH meters, and other precise measuring devices. These technologies allow the composition of a product to be determined quickly, accurately, and reliably. Analytical chemistry is divided into two main areas: qualitative analysis shows which element or compound is present in a substance, and quantitative analysis determines how much of it is present. Thus, analytical chemistry is a fundamental scientific discipline that serves to obtain safe, high-quality, and standardized products in all production sectors[3-4].

*Qualitative analysis* – this is the determination of the substances, elements and ions that make up a substance and its mixtures. In qualitative analysis, an arbitrary (dimensionless) amount of the substance being examined is taken and a suitable reagent is exposed to a reaction that indicates the presence of the substance, ion or element being determined. As a result, a conclusion is drawn about the presence or absence of the substance and the corresponding substance, ion or element in it[5-6].

*Quantitative analysis* – This is the process of obtaining information about the amount of a substance, ion, or element present in a substance or mixture based on the results of qualitative analysis. The result is obtained by determining the amount of the substance, ion, or element in the substance or mixture under investigation [7-8].

Analytical chemistry is the science that determines the composition and suitability of all food products consumed by humans. Every industrial technologist is required to study this science in depth.

The neglect of analytical chemistry in higher education institutions does not mean that future engineering technologists will become qualified specialists. It is no secret to any of us that the developing industry today needs new ideas and projects. Therefore, paying attention to the teaching of this subject in higher and professional education institutions will greatly help in achieving all the goals set[9-10].

### Scientificity

Analytical chemistry has played a role in the development of every industry, and many examples can be given. In agriculture, it performs tasks such as classifying plant varieties based on the amount of gossypol in cotton plants, determining soil fertility based on the amount of minerals in the soil, determining the fertility of black cattle based on the amount of fat in their milk, or determining the quality of feed based on the amount of nutrients in plants. The table below (Table 1) shows the composition, quality, and quantity of nutrients in some plants, determined by analytical methods[11].

The analysis process took the average value of several experiments. However, it was not possible to determine the amount of harmful substances in the feed. Only the amount of gossypol in the cotton was obtained from the literature analysis. Experiments were conducted on quantitative and qualitative analysis of the nutritional content of meat, milk, and eggs from food products using laboratory equipment. The average values of the experimental results (no harmful substances were detected during the experiment) are shown in Table 2. The experiments were conducted with the participation of students of the food technology department. Students learned how important analytical chemistry is in future professional activities by understanding the essence of the content in independent lessons. However, the experiments conducted may differ from the values of nutrients in standard conditions. Because the experiments conducted were carried out in independent lessons in educational laboratory processes. If they are carried out in modern scientific laboratories, they correspond to standard conditions. Our main goal was to develop skills in students [12].

**Table 1. Average values of nutrients in forage plants**

Nº	Products	Carbohydrate content (%)	Oil quantity (%)	Protein	Minerals matter	Harmful substances gossypol (%)
1	Wheat	70	2	12	2,3	0
2	Sunflower	12%	63-67	3,5	3,5	0
3	Cotton	13	76	4,2	4,1	1-2
4	Corn	71	9-9,5	4,8	3,6	0
5	Beans	11	11,5	76,5	4,4	0
6	Peas	12	4-7	35	4,2	0
7	Rice	76	10	17-24	3,5	0
8	Barley	65	2,8	2	2,8	0

**Table 2. Nutrient content of animal products.**

Nº	Products	Carbohydrate content (%)	Oil quantity (%)	Protein	Minerals matter	Harmful substances
1	Milk	6,5-7,5	1,6-2	1,5-2,5	10-12	0
2	Meat	1-1,5	4,2	18-25	2	0
3	Egg	13	12,5	12-15	1,5	0

### Conclusion

The incomparable role of analytical chemistry in the development of industry, science, and technology has been confirmed once again through these studies and analyses. In the chemical industry, proper organization of quality and quantity control in all processes, from raw materials to

finished products, ensures production efficiency, safety, and product compliance with international standards. Accurate information obtained using analytical chemistry methods forms the foundation for processes such as controlling technological processes, creating new products, eliminating environmental problems, and reducing waste.

Therefore, it is important to teach this subject in depth in higher education institutions and to strengthen students' practical skills along with their theoretical knowledge. Equipped with modern laboratories, innovative teaching methods, and involved in research activities, students will become mature, responsible, and competitive specialists in the future. Such personnel will be able to make a worthy contribution to the sustainable development of the chemical industry and economy of our country.

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