

## Biomarkers: The Role of Medicinal Chemistry in Early Detection of Diseases

Mualliflar: **Shukurullayeva Dilnoz Inom qizi,**  
**Yuldosheva Ra`no Daminovna,**  
**Salimov Xusen Abdurafikovich,**

Biznes va fan universiteti Tabiiy fanlar kafedrası o`qituvchilari  
E-mail: [shukurullayevadilnoz@gmail.com](mailto:shukurullayevadilnoz@gmail.com), [diyarovarano@gmail.com](mailto:diyarovarano@gmail.com),  
[xusenjon4243@gmail.com](mailto:xusenjon4243@gmail.com),

Article History	Abstract
Received: 20 <sup>th</sup> March,, 2026  Accepted: 14 <sup>th</sup> April, 2026	Biomarkers are biological indicators that allow objective assessment of physiological and pathological processes in the body or response to treatment. This article reviews the types of biomarkers, the role of medicinal chemistry in their detection, their importance in diagnosis and prognosis, and the main biomarkers used in oncology based on a scientific approach. It also covers advanced analytical methods and their application in clinical practice. identification,
<b>Keywords:</b> biomarker, medicinal chemistry, early diagnosis, spectroscopy, disease Alpha-fetoprotein, carcinoma, tumor antigen	

**Introduction:** Oncology, hepatocellular In modern medicine, early detection of diseases is the most important condition for effective treatment. Biomarkers play a central role in this. They not only indicate the presence of the disease, but also allow assessing its stage, rate of development, and response to individual therapy. Medicinal chemistry serves as the main science in the identification, analysis and interpretation of these biomarkers. Biomarkers can be used to identify the initial stages of diseases, assess the severity of the disease and monitor the treatment process. A biomarker is an indicator of biological processes in the body, pathological changes or response to treatment. Biomarkers are widely used in the fields of oncology, cardiology, endocrinology, immunology. In oncology, biomarkers play an important role in the early detection of various types of tumors, assessment of the course of the disease and monitoring the response to

treatment. Among them, one of the most studied and widely used in practice is Alpha-fetoprotein (AFP). AFP is mainly synthesized during the embryonic development of liver cells and is almost not found in healthy adults. Therefore, an increase in AFP levels may be associated with liver cell cancer (hepatocellular carcinoma), embryonal tumors (teratoma, biliary tract tumors) and sometimes metastatic liver lesions. Main part Biomarkers can be various molecules such as proteins, hormones, genetic material, metabolites. Biomarkers are usually detected in blood, urine, feces, saliva or tissues. Biomarkers can be divided into the following types: Diagnostic biomarkers- confirm the presence of a disease (for example, troponin- for heart attack). Prognostic biomarkers- assess the future course of the disease. Biomarkers and medicinal chemistry: A comprehensive approach: Biomarkers are molecules produced by biological systems and provide information about a disease or physiological state. They play a key role in modern medicine in early diagnosis, treatment monitoring and determining the prognosis of the disease. Medicinal chemistry acts as a basic science in the identification of these biomarkers. Through immunochemical analyses: biochemical Metabolites (e.g. glucose, creatinine), Enzymes (e.g. AST, ALT), Hormones (e.g. TSH, insulin), tests, Nucleic acids and genetic markers are determined. enzymatic reactions, For example, in heart attacks, early diagnosis is made based on troponin I and T indicators. This significantly increases the chance of saving lives. The following modern technologies are widely used in the field of biomarkers: Proteomics: identification of biomarkers through a complete analysis of proteins. Genomics: identification of genetic mutations based on DNA and RNA (for example, BRCA1- risk of breast cancer). Metabolomics: early diagnosis by identifying changes in metabolites. Materials and methods Methods used to identify biomarkers include: - Enzyme-linked immunosorbent assay (ELISA): proteins that are detected based on antigen-antibody interactions (for example, C-reactive protein, troponin).- Mass spectrometry: analysis of particles according to their mass/particle charges.- Spectrophotometry and colorimetric analyses: used to determine the level of enzymes and metabolites (for example, glucose, creatinine).- PCR (polymerase chain reaction): for biomarkers at the genetic level (oncogenes, viral DNA/RNA). Table 1. Classification of biomarkers by medical field

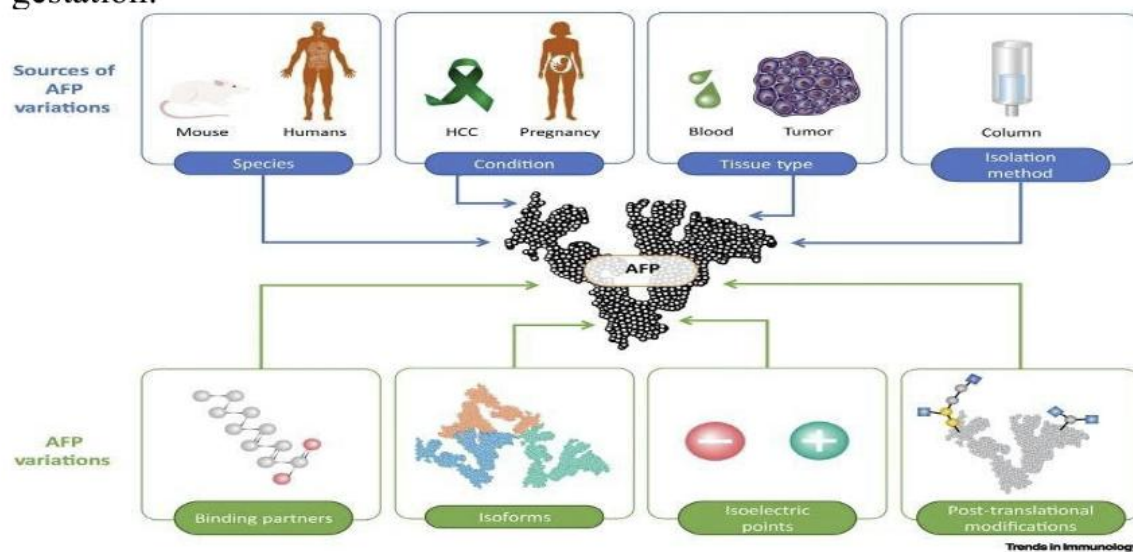
Table 1. Classification of biomarkers by medical field

Field	Biomarker	Field	Biomarker	Field	Biomarker
Importance		Importance		Importance	
Oncology	CA-125, PSA, HER2	Oncology	CA-125, PSA, HER2	Oncology	CA-125, PSA, HER2
Early detection of cancer		Early detection of cancer		Early detection of cancer	
Cardiology	Troponin I, BNP	Cardiology	Troponin I, BNP	Cardiology	Troponin I, BNP
Diagnosis of heart attacks		Diagnosis of heart attacks		Diagnosis of heart attacks	
Endocrinology	HbA1c, Insulin	Endocrinology	HbA1c, Insulin	Endocrinology	HbA1c, Insulin
Monitoring of diabetes		Monitoring of diabetes		Monitoring of diabetes	
Immunology	Interleukin-6, TNF- $\alpha$	Immunology	Interleukin-6, TNF- $\alpha$	Immunology	Interleukin-6, TNF- $\alpha$
Assessment of the level of inflammation		Assessment of the level of inflammation		Assessment of the level of inflammation	

Many biomarkers have been introduced into clinical practice in modern oncology. For example, markers such as AFP, CEA, CA-125, PSA, HER2 and BRCA1/2 help in early detection, monitoring and assessment of treatment efficacy in various tumor types. Alpha-Fetoprotein (AFP) is the most common serum biomarker used in the treatment of hepatocellular carcinoma (HCC). Hepatocellular carcinoma (HCC), a major malignant liver disease, is one of the most common cancers globally, causing significant health problems and is the third most common cause of cancer-related death. HCC is difficult to treat and manage due to late detection, high tumor recurrence rate, resistance to classical chemotherapy and radiotherapy, and significant molecular heterogeneity. Despite recent advances in understanding the molecular pathogenesis of HCC, which have led to the development of new approved therapies, treatment options for advanced disease are limited. Until recently, sorafenib, an oral, systemic, multikinase inhibitor, was the only approved treatment for advanced HCC, and showed modest improvement in survival with an increase in adverse events compared with placebo. Although several phase 3 studies of targeted therapies have not shown improvement over sorafenib in the first-line setting, several targeted therapies have recently been approved in a variety of settings, including lenvatinib in the first-line setting and regorafenib and cabozantinib after progression on first-line therapy. Despite these advances, the current prognosis

for advanced disease remains poor, with a median OS ranging from 7.3 to 13.6 months, a median progression-free survival (PFS) ranging from 3.1 to 7.4 months, and an objective response rate ranging from 2% to 24%. Although the search for other diagnostic, prognostic, or predictive biomarkers for HCC is extensive, AFP remains the most commonly used biomarker in HCC. AFP ( $\alpha$ -Fetoprotein) is a 591-amino acid glycoprotein that is structurally related to the serpin (serine protease inhibitor) family. Its molecular weight is approximately 69–70 kDa. The AFP molecule has a three-domain helical structure, with each domain folded predominantly into an alpha-helix. They are linked together in a twisted manner, providing a stable 3D structure for the protein. AFP is also an N-glycosylated protein, containing a single N-glycan-linked residue. This glycosylation affects its stability in plasma, its interaction with cells, and its immunological properties. Figure 1. The spatial structure of AFP. Biochemically, the general chemical formula of AFP is as follows:  $C_{3081}H_{4806}N_{842}O_{903}S_3$ . This formula represents the average elemental composition of the protein, but each amino acid residue and glycosyl chain are located in a specific configuration. This complex structure allows AFP to be used as a biomarker with a high degree of specificity and sensitivity, especially in the detection of liver tumors and embryonal tumors. Over the past 30 years, about 11,000 articles have been published on AFP, which is more than the average publication per day since 1969. Most of the publications are about the diagnostic use of the protein or other applications of AFP in biomedicine; although some of them describe the biochemical and functional properties of AFP, two aspects have been extensively reviewed. Conformational stability of AFP It is known that, despite their wide configurational space, proteins have a remarkable ability to adopt a strictly defined conformation. Different stable ordered forms can exist in solution, and under certain conditions the polypeptide chain can switch from an ordered to a disordered conformation and vice versa. Such conformational transitions are in response to changes in external conditions (e.g., temperature, pH, or solvent composition). AFP samples isolated by different methods are usually immunologically identical. However, they always show a significant degree of charge heterogeneity. The spatial structure and stability of AFP are very sensitive to the presence of natural ligands. Due to the strict relationship between structure and function, the function of this protein can also be modulated by the ligand composition. At least two functions, transport and immunoregulation, have been attributed to AFP. Significant variations and contradictions in the composition of the main AFP ligands, polyene fatty acids,

have been noted. It is produced by the fetal yolk sac and proximal structures of the liver and gastrointestinal tract. In the human fetus, AFP is the major serum protein, reaching levels of several milligrams per milliliter by the 1 Results Recent studies have shown the following: In oncology: The ability to detect diseases at an early Results Recent studies have shown the following: In oncology: The ability to detect diseases at an early stage has increased with the help of biomarkers such as CA-125, PSA, HER2. In cardiology: Troponin I and T, BNP play an important role in the early detection of heart attacks In infectious diseases: Changes in the level of interleukins and proinflammatory cytokines allow for the early detection of conditions such as sepsis and COVID-19. By determining the level of AFP: oDetect early stages of liver cancer, oPrevent cancer recurrence, oEvaluate the effectiveness of treatment. For example, in many cases of hepatocellular carcinoma (HCC), AFP rises above 200 ng/ml, which serves as an important indicator in clinical decision making. In addition, the accuracy of gestation.



diagnosis is further increased by using AFP in combination with other biomarkers (for example, DCP– Des gamma-carboxy prothrombin). Also, new diagnostic methods are currently being developed based on AFP using nanoparticles, biosensors, and immunoassay technologies. This allows for more accurate and non-invasive approaches to the detection of cancer. Discussion The identification of biomarkers is not possible without the achievements of medicinal chemistry. A new generation of biomarkers, especially indicators detected through omics technologies (genomics, proteomics, metabolomics), is revealing diseases at an earlier stage than was previously considered impossible. However, there are some

problems in the introduction of biomarkers into clinical practice: it is necessary to ensure their high level of specificity and sensitivity, develop technological infrastructure, and comply with bioethical standards. Personal observations and comments According to my personal observations, it is ELISA technology that is easiest for students to master in laboratory classes. This is because in this method, the results can be seen through a color change, and these visual elements arouse interest in students. In addition, spectrophotometry also provides accurate quantitative indicators in real time and helps to understand the analysis in depth. Conclusion Biomarkers play an important role in modern medicine, especially in oncology, in early detection of diseases, assessment of treatment and prognosis. Among them, Alpha-fetoprotein (AFP) is distinguished by its high sensitivity and specificity. Increased AFP levels serve as an important diagnostic criterion, especially in hepatocellular carcinoma and embryonal tumors. The molecular structure of AFP, the degree of glycosylation and the serpin-like domain architecture allow it to be used as an effective biomarker. The fact that new diagnostic technologies based on AFP are currently being developed and it occupies a leading position in combined biomarker systems further increases the importance of this molecule in oncology. With citations As noted by Mayeux (2004), biomarkers do not always have 100% accuracy. In this case, the accuracy of medicinal chemistry laboratories plays an important role. [2] Strimbu and Tavel (2010) noted that biomarkers not only allow for disease detection but also for assessing response to treatment, making them an integral part of not only diagnostics but also the treatment process. [1]

## References:

1. Alimxodjayeva N. T., Tadjiyeva X. S. "Tibbiy kimyo" 2024.
2. [https://medcentr-endomedlab.ru/allergologija/gistamin\\_i\\_allergija.html](https://medcentr-endomedlab.ru/allergologija/gistamin_i_allergija.html)
3. <https://fxmed.com.ua/ru/neperenosimost-gistamina-kak-odna-iz-samyh-rasprostranjonnyh-vidov-pishhevoj-neperenosimosti/> [https://medcentr-endomedlab.ru/allergologija/gistamin\\_i\\_allergija.html](https://medcentr-endomedlab.ru/allergologija/gistamin_i_allergija.html)
4. <https://med360.uz/kasalliklar/allergiya/>
5. <https://medcentr-endomedlab.ru/allergija/gistaminoz.html>
6. Супрастин и Супрастинекс <https://www.suprastin.uz>
7. [uz.healthy-food-near-me.com](https://uz.healthy-food-near-me.com) <https://uz.healthy-food-near-me.com> Antigistaminlar 1, 2 va 3 avlod- Sog'lom oziq-ovqat yaqinimda
8. <https://apps.who.int>
9. <https://www.bioiberica.com>

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10. <https://www.databridgemarketresearch.comf>.