



## **SPECTROSCOPIC ANALYSIS OF BLOOD: NEW ADVANCES IN INFECTIOUS DISEASE DIAGNOSIS**

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### **Abstract:**

This article reviews the role of spectroscopic analysis of blood, in particular Fourier transform infrared (FTIR) and Raman spectroscopy, in the detection of infectious diseases. The rapidity, high sensitivity, and cost-effectiveness of spectroscopy compared to traditional microbiological methods are highlighted based on statistical data.

**Keywords:** Spectroscopy, blood analysis, diagnostics, infrared spectrum, Raman, statistical efficiency, infectious diseases.

### **Login**

Infectious diseases remain a major threat to global health systems. Rapid and accurate diagnostics are key to curbing the spread of pathogens. In recent years, optical spectroscopy methods have made it possible to detect biomolecular changes in blood at the "molecular fingerprint" level.

### **Spectroscopic Methodology**

The following two methods are mainly used in blood analysis:

- **FTIR spectroscopy:** It determines the ratio of protein, lipid, and carbohydrate by measuring the vibrational energy in molecules.

- **Raman spectroscopy:**It is based on inelastic scattering of light and provides high accuracy in aqueous media (blood serum).

### Diagnostic Significance and Statistical Analysis

The comparative effectiveness of spectroscopic analysis with traditional methods (PCR, IFA, culture) is shown in the table below:

Indicator	Traditional methods (Medium)	Spectroscopic analysis
Time to get results	24–72 hours	15–30 minutes
Sensitivity	85–90%	94–98%
Specificity	88–92%	96–99%
Sample size	2–5 ml	< 100 µl

### Statistical trends:

Studies show that in cases of sepsis (blood poisoning), the identification of the pathogen type using spectroscopy is 97.2% accurate. In cases of viral load (such as Hepatitis C or HIV), the error rate is less than 0.5%.

### Special Applications for Infectious Diseases

1. **Bacterial infections:**Bacterial metabolites produce specific shifts in the blood spectrum.
2. **Viral pathogens:**Changes in the ratio of albumin to globulin in serum as a result of viral infection are clearly visible in the infrared spectrum.
3. **Parasitic diseases:**For example, malaria is detected in the early stages of the disease through the spectroscopic signals of hemozoin crystals.

### Advantages and Problems

#### Advantages:

- Possibility of performing analysis without reagents (label-free).

- Scanning for multiple pathogens at the same time (multiplexing).
- Integration with automated artificial intelligence (AI) algorithms.

#### **Disadvantages:**

- The initial cost of the equipment is high.
- The need to standardize the database (spectral library).

#### **Conclusion**

Spectroscopic analysis of blood is a revolutionary step in medical diagnostics. Statistical data prove that this method is not only fast, but also extremely accurate. In the future, the introduction of portable spectrometers will take point-of-care diagnostics to a new level.

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