УДК 371.3

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ТЕСТ ЭЙМСА

Аннотация: *В статье рассматривается подробная характеристика генетического теста с использованием бактерий вида Salmonella Typhimurium в качестве тест-объекта. Определены преимущества и недостатки данного метода. Рассмотрены практика применения и значение.*

Ключевые слова: *тест Эймса, мутагенная активность, генотоксичность, генетический тест, канцерогенность, пестициды, Salmonella Typhimurium.*

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AMES TEST

Annotation: *The article provides a detailed description of the genetic test using the bacteria Salmonella Typhimurium as the test object. The advantages and disadvantages of this method are identified. The practical application and significance are discussed.*

Keywords: *Ames test, mutagenic activity, genotoxicity, genetic test, carcinogenicity, pesticides, Salmonella Typhimurium.*

The Ames test is a genetic test for the mutagenicity of chemical substances, a method for analyzing DNA damage based on changes in mutation in bacterial test strains. The test is based on GIS bacteria with mutations that either lack the ability to synthesize histidine or have a mutation that confers histidine ability. Through this transformation of bacteria, clear information about the level of genotoxicity of a chemical component, which is presumed to have mutagenic effects, can be obtained «Цитата» [1, с. 832].

The relevance of studying the mutagenic and carcinogenic properties of pesticides and their possible conjugates with other inorganic and organic pollutants in the environment remains a significant issue, as the widespread use of genetically hazardous substances poses a real threat not only to ecosystems but also directly to humans«Цитата» [2, с. 15].

The Ames test was developed in a series of studies in the early 1970s by Bruce Ames and his group at the University of California, Berkeley. It is a biological assay designed to evaluate the mutagenic potential of various chemical substances, drugs,

or implants. This test specifically assesses the ability of these substances to cause mutations in the DNA of the test organism, predominantly using histidine auxotrophs of Salmonella typhimurium or tryptophan auxotrophs of Escherichia coli. The microorganisms of this strain do not grow in a medium lacking histidine, but under the influence of mutagens, they regain this ability, characteristic of the original Salmonella strain (reverse mutation).

The characteristics of the indicator strains Salmonella typhimurium are presented in Table 1. All strains are derivatives of the laboratory strain Salmonella typhimurium LT-2, from which histidine auxotrophic mutants G-46, C-207, C-3076, and D-3052 were obtained under the action of various mutagenic agents «Цитама» [3, с. 31].

Table 1

Characteristics of test strains of Salmonella typhimurium

Strains	Mutations			Plasmid pKM 101	Type of regulated mutations
	Auxotrophy for histidine	rfa	uvrB		
G-45	G-46	-	-	-	Replacement of bases
TA 1950	G-46	-	+	-	-»-
TA 1534	D-3052	-	+	-	Read offset
TA 1535	G-46	+	+	-	Replacement of bases
TA 1536	C-207	+	+	-	Read offset
TA 1537	C-3076	+	+	-	-»-
TA 1538	D-3052	+	+	-	-»-
TA 100	G-46	+	+	+	Replacement of bases
TA 98	D-3552	+	+	+	Read offset

Special strains have been created that allow for the detection of "base-pair substitution" mutations (strain TA-1531) and "frameshift" mutations (strains TA-1537, TA-1538).

In the Ames test, the suspected mutagen is introduced into the medium. If the reversion rate, indicated by the appearance of a greater number of colonies, increases in the presence of the suspected mutagen, this indicates the mutagenic potential of the chemical substance. The higher the number of colonies formed, the higher the mutagenicity of the tested substance.

The main advantages of this method are:

- simplicity and speed of execution;

- high sensitivity;

- the ability to differentiate both types of gene mutations due to the use of different indicator strains of S. Typhimurium;

- high (around 90%) correlation between mutagenic and carcinogenic activities of substances.

These advantages have made the Ames test the main method for primary screening of chemical substances for genotoxicity.

Bacteria as test objects have a significant drawback, namely the lack of the monooxygenase oxidation system characteristic of multicellular organisms, which occurs in the endoplasmic reticulum. These membrane structures are isolated from cell homogenates as microsomes (S9 fraction), so the process is called microsomal oxidation.

A drawback of the method is the complexity of obtaining quantitative characteristics of the mutagenic activity of the substances being studied for mammals and humans.

The main application of the Ames test is screening and detection of chemical mutagens that can cause mutations. These mutations can be carcinogenic and pose a danger to both humans and animals. For example, some chemical substances, such

as the food additive AF-2 and the flavoring agent safrole, have been found to be both mutagenic and carcinogenic.

Identification of drug mutagenicity: Some drugs, such as isoniazid, which is used to treat tuberculosis, have been found to be mutagenic. Therefore, the Ames test plays a crucial role in the pharmaceutical industry, ensuring the safety of drugs when used.

Adaptation of eukaryotic cells: although the Ames test mainly uses the bacterium Salmonella typhimurium, it has been adapted to test mutagens using eukaryotic cell cultures, yeast cells, and even animal models. This adaptation is necessary because Salmonella may not always be the most suitable organism for testing human mutagens. Some chemical substances, such as sodium nitrate (NaNO3), are not inherently mutagenic, but can be converted into mutagens during metabolism in the body. For example, sodium nitrate becomes a potent mutagen, nitrous acid (HNO2), in the stomach under the action of HCl.

The Ames test is highly sensitive and can detect potential mutants even in a huge population of bacteria. This sensitivity ensures the detection of even minimal amounts of mutagens, providing a comprehensive safety assessment.

Focus on mutagenicity, not carcinogenicity: It is important to note that this method primarily tests for mutagenicity, not carcinogenicity. However, there is a significant correlation, as over 90% of mutagens detected by the Ames test are known to cause cancer.

The Ames test operates on the principle of reverse mutation in bacteria. This means that a defective gene in bacteria can be mutated back into a functional gene, allowing for the identification of mutagenic substances

Ecological screening: The Ames test is of invaluable importance in detecting and verifying potentially hazardous chemicals present in the environment, food products, or medications. This ensures the identification and control of harmful substances, protecting the health of the population.

The pharmaceutical industry heavily relies on the Ames test. Before the start of clinical trials, various drugs and chemical substances are tested using the Ames test to ensure their safety and non-mutagenic nature.

The Ames test is one of the main methods in screening programs of various countries when it is necessary to comparatively quickly analyze a large number of compounds and select among them those that potentially could be mutagens for humans. Such widespread use of this method is associated with a high correlation between carcinogenic and mutagenic activities of chemical substances «Цитата» [4, с. 250].

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