

Microbiological studies at the stages of development of magnetic medications

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A wide variety of magnetic pharmaceutical preparations has been developed, incorporating highly dispersed particles of magnetic materials. These materials are typically ferrites of different chemical compositions, which act as the core magnetic filler and provide the desired magnetic properties for therapeutic or diagnostic applications. These magnetic medications are often ferrites of various compositions that serve as the magnetic filler. However, the absence of standardized protocols and universally accepted methods for evaluating their potential risks and long-term effects on human health remains a significant barrier to widespread clinical adoption. Comprehensive safety assessments, including toxicity studies and biocompatibility evaluations, ensure magnetic medication is safe and effectively integrated into routine medical practice.

Cytotoxicity tests are a primary in vitro microbiological analysis method for new drugs within preclinical trials. The widespread adoption of alternative research methods, including cell cultures, allows for more ethical and cost-effective use of animals in modern biological studies. Cell cultures are highly sensitive to the effects of small amounts of test substances, whose impact on the whole organism may only become apparent at high doses or after a significant amount of time.

The aim of the study was to develop a method for determining the cytotoxic effect of magnetic medications. A modified Shrek method was chosen as the primary approach to achieve this goal. The modification involved subjecting the test sample of the magnetic medications to an external static magnetic field for 2 to 20 minutes after adding a suspension of rat red bone marrow cells until the transparent and opaque phases separated.

The phase separation of magnetic medication samples and the rat red bone marrow cell suspension under the influence of a permanent magnet is based on the unique magnetic properties of the preparations. The time required for the separation process is determined experimentally and depends on the magnetic characteristics of both the permanent magnet and the magnetic pharmaceutical preparation.

The developed method was used to determine the cytotoxic effect of an X-ray contrast magnetically controlled agent in the Problem Laboratory of Morphofunctional Research using in vitro cell culture biotests. The study used rat red bone marrow cells obtained by flushing with a cold saline solution. Considering the samples had a dense black consistency and were insoluble in saline, the red bone marrow cell suspension was layered onto the samples. The plates were placed on a prism-shaped permanent magnet after 15, 30, 60, and 90 minutes.

Under the external magnetic field's influence, the test substance and the red bone marrow cell suspension separated. The cytotoxic effect was monitored by light microscopy. The experimental results were statistically processed using the variation statistics method with the Student's t-test. The magnetically controlled X-ray contrast agent did not exhibit cytotoxic effects in in vitro experiments.

Thus, the developed method for determining the cytotoxic effect of magnetic medications, which involves using a permanent magnet to separate black-colored magnetic medication samples with inherent magnetic properties from a suspension of rat red bone marrow cells, provides a straightforward and effective tool for cytotoxicity assessment. Utilizing light microscopy makes it possible to detect and quantify changes in the ratio of «live» to «dead» cells, offering valuable insights into the cellular response to magnetic materials. This approach ensures reliable and reproducible cytotoxicity monitoring and represents a practical, cost-effective, and accessible option for early-stage in vitro microbiological analysis. As a result, it can serve as one of the primary screening methods during preclinical trials, helping researchers identify potential safety concerns and optimize the composition of new magnetic pharmaceuticals before advancing to in vivo studies.

A Ukrainian patent for invention has been obtained for the developed method using a permanent magnet to assess the cytotoxic effect of magnetic medications.