The Effect of Graphene Nanoplatelets on MRC-5 and MFC-7

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Introduction

Graphene is a novel material with potential beneficial use in many areas of science, ranging from electronics to medicine. It is a two-dimensional material which demonstrates surprisingly high malleability and conductivity at room temperature. Even though it has been recently rediscovered the abundance of special qualities of this material are staggering. Although commercial production is not possible at this time, its potential is evident enough for further studies. The testing of graphene has proved that it has potential to become prevalent in future technology and in the medical field. Yet the question has risen as to whether graphene is safe enough to be used in live animals for medical purposes. Many studies have been made testing its beneficial abilities yet very few have tested for side effects. **Even though it may be extremely beneficial, side effects might prevent it from possibly becoming one of the greatness advancements of the decade. Its toxicity and side effects must be tested out before major research into its prospects continue.** This experiment pursues to find a safe concentration in which the side effects are kept to a minimum so that it should be used in vivo for medical purposes.

Background

The Huntington Breast Cancer Action Coalition ,inc. is a community based organization full of bright individuals devoted to the cause of preventing breast cancer. While scientists work on ways to treat it, the goal is to keep it from happening all together. Through educating the community with specific carcinogens, it is expected for people to become not only more environmentally aware, but to spread the word to family and friends so that no one has to deal with the tragedy of becoming a cancer patient. Graphene, a two dimensional crystalline materials compromising a single layer of carbon atoms tightly packed into a honeycomb lattice, has become the very popular among the scientific community recently. If an individual were to be treated with a high concentration of graphene then the individual would be at high risk of getting cancer, the windows of susceptibility are time periods in a persons life when their biological immunology experience fluctuation. The "windows" being weakest as a newborn and towards the end of one's life (65+) and are at their peak at around mid-age. The "susceptibility" is the weakening of the immune system due to external factors. This has been known to occur from stress and toxic chemicals. Some of these toxins are put into products with the knowledge of the manufacturer, and without the knowledge of the public. By educating the public we can close the window of susceptibility and reduce cancer occurrences significantly. Due to the inevitable widespread use of graphene oxide, toxicity levels must be measured in vivo. a protocol must be developed to ensure safety when injected into humans.

Purpose

Through the *in vitro* experimentation of graphene nanoplatelets on breast cancer and lung cancer cells, the safe concentration of graphene nanoplatelets within humans was to be determined.

Materials and Methods

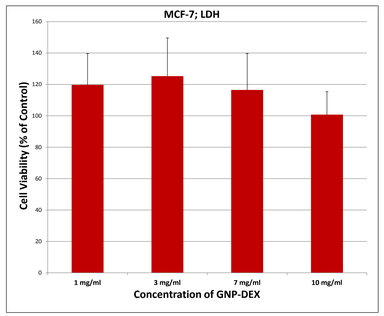
The experiment started by synthesizing the graphene nanoplatelets, with a series of potent acids and bases in order to properly oxidize the nanoplatelets. The oxidation of the nanoplatelets would allowed for the carbon nanotubes to attach to the cells. The graphene oxide nanoplatelets were then coated with dextran to ensure high dispensability among these particles in solution. The solutions consisted of concentrations of 1, 3, 7, and 10 mg/ml. The dextran coated particles were exposed to two cell lines (MCF7 and MRC5) in a solution consisting of Fetal Bovine Serum(to simulate human growth), the specified media (dependent upon the cell line), and Penicillin streptomycin(to deter infection). The experiment was conducted with wells consisting of a control, dextran, Mannitol, 1mg/ml, 3 mg/ml, 7 mg/ml and 10 mg/ml. They were then tested with the LDH release assay and Presto Blue assay. The LDH assay works through quantitatively measuring energy released from the mitochondria. Presto blue works through a process of quantitatively of measuring cell proliferation. The reason MRC5 cells(lung fibroblast cells) were used was due to the fact that the respiratory system is the first system that is exposed if the particles are inhaled accidentally. MCF7 cells are cells derived from the carcinoma of breast tissue. These particles are being explored as possible drug delivery agents in breast cancer and thus breast tissue would be exposed to these particles. We measured the results with a fluorescence and absorbance machine.

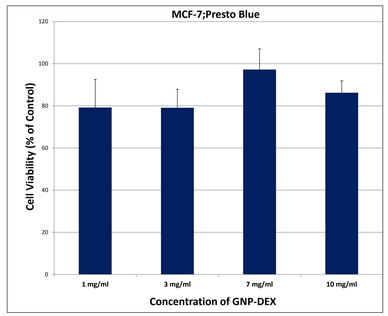
Procedure

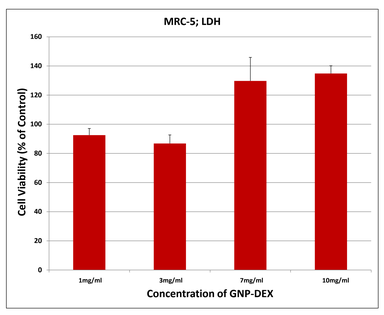
First the synthesizing of the graphene nanoplatelets was done by a series of potent acids and bases in order to produce particles better suited for experimentation. The graphene oxide nanoplatelets were coated with dextran to ensure high dispersibility of these particles in solutions consisting of concentrations of 1, 3, 7, and 10 mg/ml. The dextran coated particles were exposed to two cell lines (MCF7 and MRC5) in a solution consisting of Fetal Bovine Serum(to simulate human growth), the specified media (dependent upon the cell line), and Penicillin streptomycin(to deter infection). The experiment was conducted with wells consisting of a control, dextran, Mannitol, 1mg/ml, 3 mg/ml, 7 mg/ml and 10 mg/ml. The solutions were then combined with the different concentrations in separate wells. They were then tested with the LDH release assay and Presto Blue assay. These particles are being explored as possible drug delivery agents in breast cancer and thus breast tissue would be exposed to these particles. The results were measured with a fluorescence and absorbance machine. The raw data was computed and graphs were made to show trends.

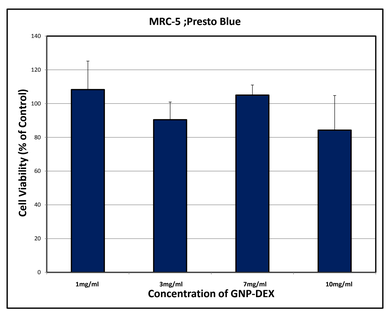
Results

The Graphene Nanoplatelets were tested on both Lung cells (MRC-5) and Breast Cancer cells (MCF7). The alveoli in the lungs contain very small blood vessels in which the graphene nanoplatelets could get stuck, due to their odd shape. This was why it was tested on lung cells, for the high probability that the platelets would get stuck there. Many scientist are looking to use Graphene Nanoplatelets as drug carriers for all types of cancer. Due to the targeting of specific areas the nanoplatelets could get stuck here as well. According to the data gather, the highest concentration for the body to have is 3 mg/ml concentration or less. After this point the cells reach a toxicity level unsafe for the body. It is understood that this concentration is unsafe because of the high number of cell death in the targeted area. The specified safe concentration has been narrowed down to below 3 mg/ml in order to ensure minimum side effects which graphene nanoplatelets can cause to cells.









Discussion

From our perspective many cases of cancers were preventable. Through the unity of the community we can fight businesses that put harmful chemicals in our everyday products. Only when we began educating each other will we move in the direction for a cancer free world. This experiment has paved the way for the future of the graphene nanoplatelets. It has opened doors unimaginable as few of its many possible abilities were caught in action. This experiment will be the precursor to the next experiment, which would most likely be, to find the exact concentration at which the body's toxicity becomes unsafe. It has been proved that there is a safe concentration, and there is only a matter of time before it is discovered. The eventual goal after finding this safe concentration is to use the graphene nanoplatelets as a medical assistance. It will be used to detect cancerous tumors and, if possible, eliminate them through the experimental procedure of heating the nanoplatelets to a temperature that will eliminate a center area of cells. Though many are unsure as to whether graphene nanoplatelets can be properly used one thing is certain, many like minded-individuals at many world-renowned laboratories are working around the clock for the advancement of mankind.

Conclusion

Graphene is a novel material with potential beneficial use in many areas of science, ranging from electronics to medicine. It is a two-dimensional material which demonstrates surprisingly high malleability and conductivity. It is its amazing properties that have made it very popular among all fields of science. Many studies have been done, testing its beneficial abilities yet very few tests for side effects. Especially since many scientists see it as a potential drug carrier, investigating its potential side effects is extremely important. It was found that a concentration of 3 mg/ml was the highest possible concentration that would provide its potential beneficial factors without major damage to the cells. Anything above that would cause cell death and block many of the metabolic processes. This means that graphene nanoplatelets can now potentially be used for medical purposes with the expectation very minimum side effects. However further research needs to be conducted to ensure the safety of human health. As the search for graphene's potential use continues, it can now be tested for in live subjects without the fear of major side effects. Graphene promises to be of great use in future medicine and technology, yet there is still further research that must be completed in order to properly use this magnificent particle.

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