PMF, Cesium and Rubidium Nanoparticles Induce Apoptosis in A549 Cells

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***Abstract*—**Cancer becomes one of the leading cause of death in many countries over the world. Fourier-transform infrared (FTIR) spectra of human lung cancer cells (A549) treated with PMF (natural product extracted from PM 701) for different time intervals were examined. Second derivative and difference method were taken in comparison studies. Cesium (Cs) and Rubidium (Rb) nanoparticles in PMF were detected by Energy Dispersive X-ray attached to Scanning Electron Microscope SEM-EDX. Characteristic changes in protein secondary structure, lipid profile and changes in the intensities of DNA bands were identified in treated A549 cells spectra. A characteristic internucleosomal ladder of DNA fragmentation was also observed after 30 min of treatment. Moreover, the pH values were significantly increases upon treatment due to the presence of Cs and Rb nanoparticles in the PMF fraction. These results support the previous findings that PMF is selective anticancer agent and can produce apoptosis to A549 cells.

***Keywords*—**Apoptosis, FTIR spectroscopy, pH therapy, Scanning Electron Microscope- Energy Dispersive X-ray (SEM-EDX).

I. Introduction

NANOTECHNOLOGY has considerable promise for the detection, staging and treatment of cancer [1]. The past two decades have witnessed rapid advances in the ability to structure matter at the nanoscale with sufficient degree of control over the material size, shape, composition, and morphology [2]. The combination of the unique properties with the appropriate size has motivated the introduction of nanostructure into biology [3]-[6] Cells and their constituent organelles lie on the sub-micron to micron size scale. Further, proteins and macromolecules found throughout the cell are on the nanometer size scale. [7]. Thus nanoparticles ranging from a few to a hundred nanometers in size become ideal as labels and probes for incorporation into biological systems[5],[6]. Despite significant investment and research, cancer is still responsible for 25% of all deaths in developed countries[8]. There is a pressing need for more sensitive, selective and cost-effective methods for detecting and treating cancer.

The presence of natural occurring nanoparticles that can produce apoptosis in cancer cells would be of great help. PMF, the active fraction separated from PM 701 [(natural product previously proved to be selective anticancer agent) [9]-[15] would give a promising therapeutic criterion in treating cancer. The effect of PMF on lung cancer cells A549 will be monitored by Fourier-transform infrared (FTIR) spectroscopy.

FTIR spectroscopy has become a useful analytical tool in biomedical science in the past decade, e.g., for the characterization of microorganisms[16], isolated cells or cell lines[17-20], body fluids and tissues [21]-[26] The ability to detect drug action, disease or dysfunction rapidly has obvious benefits, including early intervention of therapeutic strategies, hopefully in a prognostic fashion, significant reduction in mortality and morbidity, and the freeing up of much needed economic resources within health care systems [27]. With these highly sensitive techniques, the frequency and the intensity of light in the resulting spectrum provides biochemical information regarding the molecular composition, structure and interaction in cells and tissues.

Apoptosis, as a pre-programmed physiological mode of cell death, plays an important role in the pathogenesis and progression of cancer. Understanding of the basic mechanisms that underlie apoptosis will point to potentially new targets of therapeutic treatment of diseases that show an imbalance between cell proliferation and cell loss. As an active process, apoptosis involves biochemical changes on three essential cellular components, DNA, protein and lipid. There are three steps in apoptosis, the initiation phase triggered by a stimulus received by the cell, the decision phase during which the cell commits itself to live or to die, and the degradation phase

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