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NEUTRON ACTIVATION ANALYSIS FOR MEDICINAL PLANTS

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Statement of the Problem: Traditional systems of medicine continue to be widely practiced for many reasons. Population growth, inadequate supply of drugs, side effects of most synthetic drugs and development of resistance to currently used drugs for infectious diseases have led to increased emphasis on the use of plant materials as a source of medicines for a wide variety of human ailments. Recently, WHO estimated that 80 per cent of people worldwide rely on herbal medicines for their primary health care needs. According to WHO, around 21,000 plant species have the potential for being used as medicinal plants. Over the past few decades, there has been a tremendous increase in the use of herbal medicine. However, there is still a significant lack of research data in this field. The purpose of our studies is to establish a direct correlation between the elemental content of medicinal plants and their curative ability which is not yet understood in terms of modern pharmacological concept. The quantitative estimation of various trace element concentrations is important for determining the effectiveness of the medicinal plants in treating various diseases and also to understand their pharmacological action. Moreover, trace elemental analysis of medicinal plants can be used to decide the dosage of the herbal drugs prepared from these plant materials.

Methodology & Theoretical Orientation: Neutron activation analysis (NAA) is a sensitive technique useful for quantitative multi-element analysis of major, minor, and trace elements present in various matrices. NAA offers sensitivities that are superior to those possible by all other analytical methods. Moreover, the accuracy and precision of the technique are such that NAA in 2007 has become one of the primary methods employed to certify the concentrations of elements in standard reference materials. The NAA technique involves the irradiation of a sample by neutrons to make the sample radioactive. After irradiation, the gamma rays emitted from the radioactive sample are measured to determine the amounts of different elements present in the sample. As a result, NAA has a number of advantages over most other analytical methods when investigating biological specimens. First, it is nearly free of any matrix interference effects because the vast majority of biological samples are transparent to the probe, the neutron, and the emitted analytical signal, the gamma ray. Second, because NAA can be applied instrumentally (without sample digestion or dissolution), there is little opportunity for reagent or laboratory contamination. Third, the preparation of samples from most matrices (especially biological sample types) for analysis by NAA is extremely easy: in most instances a portion of the sample need only be weighed and place in an appropriate container. The method is based on a relative standardization using high quality certified reference materials (CRMs).

Findings: NAA of different plants (herbs and woods) from Mongolia, India, Vietnam, Poland, Bulgaria, Portugal and Iran allowed determination of about of 41 elements: Na, Mg, Al, Cl, K, Ca, Sc, V, Cr, Mn, Fe, Co, Ni, Zn, As, Se, Br, Rb, Sr, Zr, Mo, Cd, Cs, Ba, La, Hf, Ta, W, Sb, Au, Hg, Ce, Nd, Sm, Eu, Tb, Dy, Yb, Lu, Th, U. Such a large group of elements, for the best of our knowledge, was determined in the medicinal plants for the first time. The results were interpreted in terms of excess, for example, of such elements as Se, Cr, Ca, Fe, Ni, Mo, and rare earth elements.

Conclusion & Significance: Among those elements thirteen dietary minerals (Ca, Cl, Co, Fe, K, Mg, Mn, Mo, Na, Ni, S, V, Zn) and toxic elements (As, Ba, Cd, Sb) were detected. Possible connection between the medicinal properties and elemental content of the plants was established.

Biography

Marina Frontasyeva, Associate Professor in Physics and Mathematical Sciences, is an internationally recognized specialist in neutron activation analysis applied in the Life Sciences and Material Science carried out at the reactor IBR-2 of the Joint Institute for Nuclear Research. She is the head of the Sector of NAA and Applied Research at the FLNP JINR combining her activities with lecturing on nuclear methods for studying the environment at the Department of Chemistry of the International University of Nature, Society and Man of Dubna. She is a member of the International Committee on Activation Analysis (ICAA) and a Coordinator of the UNECE International Cooperative Program Vegetation (Moss Surveys) the framework of the Convention of the Long-Range Transboundary Air Pollution (CLRTAP). She is leader of numerous international projects coordinated by the International Atomic Energy Agency (IAEA) and the EU Programs. She is the author and co-author of more than 390 scientific publications.

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