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MINERALOGICAL AND CHEMICAL CHANGES OF BIOTITE MICA DURING ALCHEMICAL PHARMACEUTICAL PREPARATIONS

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Biotite mica enriched with Fe^{2+} ions is used as a therapeutically effective drug material in traditional pharmaceutical science of alchemy (*Rasashastra*). Although many pharmaceutical studies have been carried-out on mineral based preparations, studies on mineralogical and structural changes during specific preparation processes and toxicity studies are limited. Therefore, this study was focused to determine chemical, mineralogical and structural changes occurring in biotite mica during the *Ayurvedic* preparation of *Abhrak Bhasma* (AB). This *Rasashastra* drug was prepared using biotite mica, *Ficus benghalensis* leaves, water extract (10,000 ppm) of *Ricinus communis* leaves and jaggery (each 1:1 by weight with treated mica) as ingredients. Both fresh and weathered biotite samples were used in the study for comparison. Treatment of fresh and weathered mica samples (before the preparation) included repetitive heating (up to 1000 ^{o}C, for 1 hr), quenching (for 10 min) and incineration steps following traditional methods. A muffle furnace was used for heating, and the liquid used for quenching was cow's urine. Changes in mineralogical composition of treated fresh and weathered mica throughout the process of drug preparation were determined using Powder X-ray diffraction (PXRD) analysis and Fourier transform infrared spectroscopy (FTIR). Particle sizes of the products and intermediate steps were measured using particle size analyzer. Na, K, Fe, Mn, Mg, Ca, Zn, Cu, Cr, Pb and Ni concentrations of different stages of treated mica samples and corresponding cow urine samples were measured using Atomic Absorption Spectrophotometer (AAS) after acid digestion. Here the treated mineral samples were totally digested (HNO_3: $HClO_4$: HF in 5:1:1 ratio) while urine samples were acidified with HNO_3. Brine shrimp lethality bioassay was carried out to investigate the cytotoxicity of the AB drug. Mineralogical studies revealed that biotite has been transformed to secondary clay minerals and iron oxides. This suggests structural modifications of the mica during the preparation. Averaged particle sizes of the drugs were in the nanometer range. Chemical analysis revealed clear cation exchanges between K, Fe, Zn and Mn ions among treated fresh mica and Ca ions in cow urine samples. However, such relationship does not exist for treated weathered mica samples. Chemical analyses revealed that AB is relatively rich in Fe and lower in K concentration. Further, the concentrations of trace elements were significantly low. Brine shrimps didn't show any mortality after 24 hr at any of the tested concentrations of AB. Present study revealed that chemical and structural modifications of minerals are taking place during the preparation of mica-drugs for traditional medicines. Further, the ions in cow urine has effectively participated in cation exchange process of mica. Therefore, composition of mica has been vastly altered during the pharmaceutical drug preparation process. This was further proven with the non-cytotoxicity of AB, using brine shrimp lethality assay. Comparative chemical analyses among weathered and fresh mica samples revealed that the artificially (thermally) induced oxidation conditions are more effective in cation exchange processes compared to that occurring during natural weathering.

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