MEDICINES FOR MOON OUTPOST: COSMIC RAY STABILITY OF SPACE-DEVELOPED OF IBUPROFEN FORMULATIONS ON EARTH AND THE INTERNATIONAL SPACE STATION.

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Abstract: This is a study in stability of medicines for future space missions. Space medicine and space health is a prerequisite for human space exploration. In space, drug properties are different compared to Earth. Drugs being carried on space missions have been noticed to have a shorter shelf life relatively compared to Earth counterpart [1]. Cosmic radiation is one of the underlying causes of the pharmaceutical instability of space medicine. In this research, we are studying the impact of Earth-simulated 'space radiation' on medicines, which are formulated to have higher stability under cosmic radiation. We study the stability of Ibuprofen tablet as a function of its formulation environment, i.e., the pharmaceutical excipients which form a tablet. Ibuprofen is probably the best-studied medicine for its decomposition by irradiation; mostly concerning UV [2].

In the space-developed ibuprofen tablets, ibuprofen was dissolved in a mix of six 'moon simulants', which are inorganic substances known to be abundant on the moon lunar-simulating materials. The purpose of this study is to explore the effects of cosmic radiation on the API and countermeasures. We applied three shielding concepts against cosmic radiation (i) dilution of the API in the excipient matrix, (ii) coating the tablet with a material assumed to shield cosmic radiation, (iii) using specific API-excipient interaction as countermeasures.

The research was carried out by using on-Earth radiation to simulate space-like conditions, i.e., Americium-241 and Strontium-90 sources for alpha and beta (particle) irradiation and linear accelerators for high energy photons irradiation, which can penetrate solid formulation. For particle irradiation, results show that the ibuprofen content was not harmed inside the formulation, which acts as proof of the first concept. The second concept was justified by showing that the tablets without the shielding coating (iron oxide and titania) have a greater degree of ibuprofen reduction.

Our research is complemented by two International Space Station (ISS) experiments. 60 and 6 tablet samples with 19 different compositions were sent to the ISS to experience real space conditions inside and outside of the station, respectively (for about one year). A ten times lower ibuprofen content in low iron oxide tablets was found as compared to the control sample, showing a shielding was not effective and thus confirming the Earth simulation experiment. On the contrary, the in-flight tablet samples with high iron oxide content (high shield) have a similar ibuprofen content as the control samples.

References:

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