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Design of an amorphous solid dispersion of ibuprofen in a biocompatible polymeric matrix obtained by spray drying

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Abstract: Poor aqueous solubility remains one of the main challenges in the development of effective oral dosage forms. Approximately 40% of marketed drugs and nearly 90% of drug candidates exhibit solubility limitations, compromising absorption and bioavailability. Ibuprofen, a widely used non-steroidal anti-inflammatory drug, is a paradigmatic case due to its poor water solubility. This study aimed to design an amorphous solid dispersion (ASD) as a strategy to enhance ibuprofen solubility, employing spray drying as a scalable and versatile formulation technology. Two hydrophilic polymers, polyvinylpyrrolidone K30 (PVP K30) and hydroxypropylcellulose (HPC), were selected for their stabilizing capacity in amorphous systems. A 2⁴ factorial design was applied to evaluate the effect of inlet temperature, feed rate, solid concentration, and drug/polymer ratio. The formulations were processed in a Büchi B-290 mini spray dryer. Critical quality attributes were assessed, including yield, flowability, residual moisture, and drug content. The optimized formulation was encapsulated, and dissolution studies were conducted in phosphate buffer pH 7.2, using USP apparatus II (paddle method) at 100 rpm for 4 h. Formulations with higher solid content and a 1:2 drug/polymer ratio achieved yields above 80% and good flowability, with repose angles between 30° and 35°. Residual moisture remained below 4.5% across all samples. Drug content was within 90–110% of the theoretical value. The optimized ASD achieved ~80% ibuprofen release within 4 h, significantly higher compared to ~30% release from crystalline ibuprofen under the same conditions. Spray drying proved to be an efficient strategy to improve ibuprofen solubility and dissolution profile through the formation of ASDs with PVP K30 and HPC. The optimized formulation demonstrated potential to increase bioavailability and may be applicable to other poorly soluble drugs, representing a promising approach for the pharmaceutical industry.

Keywords: Amorphous solid dispersion; bioavailability; ibuprofen; solubility enhancement; spray drying.