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Development of Inhalable Nano-lipid Carriers for the Treatment of Pulmonary Aspergillosis using Hot Melt Extrusion Technology

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Project Summary

Overview: I am Gauri Shadambikar, second year PhD. student in department of Pharmaceutics and Drug Delivery. Pulmonary Aspergillosis is an infection caused by a type of mold and can have serious effects on patients with a weak immune system or with underlying lung disease[1]. Itraconazole, a triazole is a compound with a broad antifungal spectrum[2]. An inhalation-based drug delivery system has the advantage of rapid onset of action directly at the site of infection along with controlled and prolonged delivery[3]. Hence the aim of my project was to prepare inhalable nano-lipid carriers (NLC) which would be a viable and efficient alternative to traditional routes such as oral administration.

Intellectual Merit: Pulmonary Aspergillosis, is a mycotic disease caused by Aspergillus fumigatus, a saprophytic and ubiquitous airborne fungus. Fungal infections such as Aspergillosis can be life threatening for immunocompromised patients[4]. The lung as a major port of entry into the body and site of infection plays an important role in this disease. Itraconazole, a broad-spectrum antifungal compound helps in inhibiting the fungal cell membrane[5]. The treatment for pulmonary aspergillosis includes several weeks of administration of antifungal medicines given orally. The above-mentioned delivery mode for treatment depends on systemic absorption resulting in undesirable side effects of itraconazole such as nausea, abdominal pain and hepatotoxicity. To overcome aforementioned issues, there is a need to have products that are able to achieve an instant therapeutic level and able to maintain its level in the body for longer periods of time. Inhalation drug delivery represents a potential delivery route for the treatment of pulmonary diseases. It has several advantages as it can directly reach the lung epithelium resulting in faster onset of action[6]. Also, the dosing and dose can be reduced compared to the traditional oral route as it can avoid first pass metabolism and systemic toxicity. Biodegradable nano-lipid carriers (NLC) of lipophilic compounds have the potential advantage in protecting the compound from degradation and releasing the drug in a controlled manner for a prolonged period. These NLCs can be immediately released into the pulmonary epithelium by nebulization and control the release of itraconazole for prolonged periods. Utilizing hot melt extrusion technology for preparation of nanoparticles over the conventional method will be energy efficient, as well as environmentally and industry friendly[7].

External Opportunity: We will use the preliminary data to write a pre-doctoral grant proposal to FDA, Broad Agency Announcement of 2020 (FDABAA-20-00123). New delivery systems for mycotic diseases is applicable to this announcement. The potential funding amount, in a collaboration could be $250K/year which is due in April of 2020. This accomplishment would propel my academic career and will provide a promising job offer.