**ABSTRACT**

Although chemotherapeutics plays a pivotal role in the therapy of many aggressive cancers, there are many pitfalls including multidrug resistance and lack of selectivity which result in progression of the cancer. Triple negative breast cancer (TNBC) is one such aggressive type of breast cancer with minimal therapeutic approaches. As TNBC is associated with high risk of metastasis and low survival percentage, an immense requisite to expand the therapeutic strategy is needed. In support of this quest, an attempt was made to exploit the anticancer efficacy of fabatin, a phytodefensin peptide obtained from the seeds of Vicia faba, along with the biocompatible nanocarrier silica as a therapeutic strategy against TNBC. The current work was intended to isolate the plant defensin cationic antimicrobial peptide fabatin from the seeds of Vicia faba and also to load it in mesoporous silica nanoparticles (F-SNP) to increase its efficiency in the TNBC system, both in vitro using MDA-MB-231 cells and in vivo in a xenograft mice model. In vitro studies demonstrated the efficient role of F-SNP against MDA-MB-231 cells with inhibitory concentration (IC50) of 7.8 ± 0.9 μg mL−1 while showing least significant effect on normal breast MCF-10A cells. The appearance of apoptotic bodies specifies the cell death promoted by isolated cationic defensin peptide fabatin. Moreover, expression studies evinced the downregulation of PI3K which further resulted in the upregulation of pro-apoptotic proteins and downregulation of anti-apoptotic proteins. Further in vivo studies supported our in vitro findings by confirming a significant reduction in tumor volume. Histopathological observations confirm the absence of noteworthy effect in F-SNP treated mice model. Our findings altogether indicated F-SNP to be a most promising drug with significant pharmaceutical potential in the treatment of TNBC cells.