

ABSTRACT

The stability and release of bioactive compounds are crucial aspects in the development of pharmaceutical and nutraceutical formulations, especially phenolic compounds, which are unstable under extreme environmental conditions. This study aims to develop an encapsulation-based delivery system to enhance the stability and controlled release of fermented *Phyllanthus urinaria* leaf extract. The extract was fermented using *Aspergillus niger* to increase the content and availability of phenolic compounds. The process included fermentation, extraction, characterization of total phenolic and flavonoid content, formulation of encapsulation using sodium alginate through ionic gelation, and evaluation of encapsulation efficiency, loading capacity, and in vitro release profile of phenolic compounds in simulated gastric fluid (SGF, pH 1.2) and intestinal fluid (SIF, pH 6.8). Results showed that total phenolic content increased by 9.26% after fermentation (from 85.38 to 97.56 mg GAE/g), while flavonoid content decreased to 60.06 mg QE/g. Encapsulation efficiency increased with the ratio of coating material, reaching a maximum of 81% at a 1:3 ratio. In vitro release tests indicated that the Alg-FPu formulation released phenolic compounds more rapidly than Alg-NFPU, presumably due to the smaller molecular size of phenolic compounds resulting from fermentation, which diffused more easily from the matrix. These findings suggest that encapsulated fermented *Phyllanthus urinaria* extract has the potential to enhance the stability and bioavailability of active compounds.

Keywords: *Phyllanthus urinaria*, fermentation, phenolic compounds, encapsulation, sodium alginate, in vitro release.