Modification of chitosan by using samarium for potential use in drug delivery system

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Highlights
- Chitosan–Sm complexes were synthesized by the impregnation method.
- Chitosan combined with Sm³⁺ ions produced a drug carrier material with fluorescence properties.
- The addition of Sm³⁺ ions into chitosan affects its physical and chemical properties.
- The Sm³⁺ ion is used as an indicator of drug release with ibuprofen as a model drug.
- Chitosan–Sm 25 wt.% showed the highest efficiency of ibuprofen adsorption (33.04%).

Abstract
In the presence of hydroxyl and amine groups, chitosan is highly reactive; therefore, it could be used as a carrier in drug delivery. For this study, chitosan–Sm complexes with different concentrations of samarium from 2.5 to 25 wt.% have been successfully synthesized by the impregnation method. Chitosan combined with Sm³⁺ ions produced a drug carrier material with fluorescence properties; thus, it could also be used as an indicator of drug release with ibuprofen (IBU) as a model drug. We evaluated the spectroscopic and interaction properties of chitosan and Sm³⁺ ions, the interaction of chitosan–Sm matrices with IBU as a model drug, and the effect of Sm³⁺ ions addition on the chitosan ability to adsorb the drug. The result showed that the hypersensitive fluorescence intensity of chitosan–Sm (2.5 wt.% is higher than the others, even though the adsorption efficiency of chitosan–Sm 2.5 wt.% is lower (29.75%) than that of chitosan–Sm 25 wt.% (33.04%). Chitosan–Sm 25 wt.% showed the highest efficiency of adsorption of ibuprofen (33.04%). In the release process of ibuprofen from the chitosan–Sm–IBU matrix, the intensity of orange fluorescent properties in the hypersensitive peak of ⁴G₅/₂ → ⁴H₇/₂ transition at 590 nm was observed. Fluorescent intensity increased with the cumulative amount of IBU released; therefore, the release of IBU from the Sm-modified chitosan complex can be monitored by the changes in fluorescent intensity.

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Introduction
Indonesia produces large amount of biological wastes, including shrimp waste, crab shells, and ox bones. Shrimp waste is promising material having a high sales value because it contains protein, carotenoids, and chitin [1]. Chitin compounds in biological waste are part of a class of polysaccharides that can be converted to chitosan by deacetylation. Chitosan shows excellent potential as a biomaterial because of its biocompatibility in the mammalian body; it is a polymer biomaterial that is biodegradable and non-toxic to mammalian cells [2]. Due to these properties, therefore,