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Synthesis and characterization of BSA nanoparticles loaded with antidiabetic compounds from *Alpinia calcarata* extract

B. M. Jayawardena[1*] and B. S. Wanniarachchi[1]

[1]Department of Chemistry, University of Kelaniya, Sri Lanka
bimali@kln.ac.lk*

Diabetes is the ninth leading cause of death in the world is also the no.1 cause of kidney failure, adult blindness, and lower-limb amputations. Due to this reason, the necessity for the use of antidiabetic drugs has arisen across the globe. But due to the high cost and side effects of oral antidiabetic drugs, scientists have started focusing their attention on natural products as safer and more potent alternatives for the treatment of diabetes. The rhizome of *Alpinia calcarata* Roscoe (Heen araththa) is known to exert its antidiabetic activity through the inhibition of intestinal glucose absorption by inhibiting the activity of pancreatic α-amylase and α-glucosidase enzymes. Therefore, once its antidiabetic compounds are extracted using the pressurised water extraction method, which has proven to be one of the promising techniques, an anti-diabetic nutraceutical can be produced for the treatment of diabetes. Bovine Serum Albumin (BSA) nanoparticles loaded with the bioactive compounds of *A. calcarata* are a good form of an anti-diabetic nutraceutical as they result in protection of active compounds from environmental agents, specific delivery to target sites, reduced side effects, and prolonged shelf-life. The objective of the present study was to synthesize and characterize *A. calcarata* loaded BSA nanoparticles to be used as a powder form nutraceutical with higher antidiabetic activity. In this study, an aqueous *A. calcarata* extract (4.00 mL) was added to BSA (20 mg/mL, 4.00 mL, pH 9) in the presence of citric acid as the crosslinking agent. The synthesized nanoparticles were tested for antidiabetic activity using α-amylase inhibition assay and yeast glucose uptake assay and characterized using parameters such as particle size, surface charge, morphology, and particle structure using FTIR. The IC_{50} value calculated using the GraphPad Prism 9.2.0 software for the nanoparticles was 147.00±0.97 µg/mL. The glucose uptake percentage at 5 mM glucose concentration for the 0.5 mg/mL nanoparticle sample was 73.09 ±0.06% and that obtained under the same conditions for an aqueous *A. calcarata* extract was 45.30 ±0.97%. The synthesized nanoparticles were 1030.70±75.3 nm in size, with a polydispersity index of 0.199± 0.003, zeta potential value of 2.57±0.32 mV, spherical morphology, and uniform size. The FT-IR results showed that citric acid had caused conformational changes in the protein structure of BSA and that the active compounds were successfully loaded into the synthesized nanoparticles which interacted with the protein matrix via covalent bonds. Therefore, it can be concluded that the synthesized nanoparticles have an anti-diabetic effect and the antidiabetic activity of bioactive compounds of the aqueous *A. calcarata* extract is enhanced when loaded onto the nanocarriers. The nanoparticles have also been synthesized effectively and therefore, can be used as a powder form anti-diabetic nutraceutical for the treatment of diabetes.

Keywords: *A. calcarata,* BSA nanoparticles, Citric acid, Diabetes, Nutraceutical

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