Synthesis and characterization of silver nanoparticles with sulfated polysaccharide and their immunomodulatory activities

Negreiros, M. M. F. \(^1\); Machado, R. I. A \(^1\); Bezerra, F. L. \(^2\); Albuquerque, I. R. L. \(^1\); Brito, T. K. \(^1\); Rocha, H. A. O. \(^1\)

\(^1\)Departamento de Bioquímica, Centro de Biociências, Universidade Federal do Rio Grande do Norte, Natal, Brazil. 
\(\text{(hugo@cb.ufrn.br)}\)

\(^2\)Deptamento de Microbiologia e parasitologia, Universidade Federal do Rio Grande do Norte, Natal, Brazil.

Introduction and objectives: Several algal sulfated polysaccharide-rich extracts (ASP) from seaweeds showed antioxidant, antiproliferative and immunomodulatory activities. On the other hand, silver nanoparticles has shown antiproliferative and bactericidal effect but is not clear how they influence on immune response. Our goal was to synthesize silver nanoparticles using ASP and verify their immunomodulatory activities.

Materials and Methods: The seaweeds \textit{Spatoglossum schröederi}, \textit{Dictyopteris justii}, \textit{Sargassum filipendula} e \textit{Dictyota mertensii} were collected in Pirangi beach, Parnamirim, RN, washed and submitted to proteolysis for 18 h. After, two volumes of methanol was added to solution in order to obtain SPE. Sulfated polysaccharide silver nanoparticles (SPN) were synthesized using ASP as reducing agent. Chemical and infrared analysis were used to characterize the ASP and the silver nanoparticles. Furthermore, SPN were analyzed on Dynamic light scattering (DLS), Zeta potential and Scanning electron microscope (SEV). Nitric oxide (NO), TNF\(\alpha\) and IL-6 secreted from macrophage in the presence of samples were quantified in order to determinate their immunomodulatory activity.

Results and conclusions: The chemical and infrared analysis showed silver nanoparticles containing high amount of sulfated polysaccharides and low protein contamination. The nanoparticles average diameters obtained in DLS was 108 ± 2 nm; 82 ± 1nm; 288 ± 52 nm; 104 ± 2 nm for \textit{S. schröederi}; \textit{D. justii}; \textit{S. filipendula}; \textit{D. mertensii}, respectively. They were stable for nine months. Polysaccharides and nanoparticles from \textit{S. filipendula} and \textit{D. mertensii} increased production of NO in macrophages in the absence of LPS but not in the presence. All the ASP and SPN were able to increase TNF production in absence of LPS, whereas only ASP and SPN from \textit{S. schröederi} and \textit{D. mertensii} were able to increase IL-6 amount in absence of LPS. Therefore, ASP was able to stimulate the immune response in different way and ASP had similar immunomodulatory effects compared to SPN.

Keywords: Seaweed, nitric oxid, cytokines.