

Immunotropic Effects of Gelling Polysaccharide from Red Alga *Tichocarpus crinitus*

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Abstract: *It was shown that gelling polysaccharide from Pacific red alga Tichocarpus crinitus under oral administration have immunomodulatory effect, in particular it influences on cellular activity and cytokines production in mice immune cells. Carrageenan also possesses a protective effect in in LPS-induced endotoxemia model in mice due to reducing an intensity of inflammatory response induced by LPS probably through its modulating effect on cellular activity of peritoneal leukocytes and on cytokine production in blood cells.*

Keywords: *κ/β -carrageenan, cytokines, LPS-induced endotoxemia, murine peritoneal macrophages, cellular activity.*

1. Introduction

Sulfated polysaccharides of red algae – carrageenans consisting of D-galactose residues linked by alternating regularly β -(1-4) and α -(1-3) glycosidic bonds refer to soluble dietary fibers and relate in the list of foodstuffs (Food and Drugs, 2008). Variation of the basic structure are determined by the content of 3,6-anhydrogalactose, by the location and number of sulfate groups [1]. The three most industrially exploited types namely κ -, ι - and λ -carrageenans are distinguished by the presence of one, two and three ester-sulfate groups per repeating disaccharide unit, respectively. Native carrageenans always represent complex hybrid structures or are generally a mixture of galactans composed of different carrabiose types [2]. Also carrageenans are known as nontoxic biopolymers with different biological activity. In particular, carrageenans possess a number of immunotropic effects and have an ability to stimulate of immune mediators biosynthesis including different cytokines, pro-inflammatory as well as anti-inflammatory.

2. Results and Discussion

2.1 Sample of Carrageenan

The gelling fraction of polysaccharide isolated from sterile form of red algae *Tichocarpus crinitus* (*T. crinitus*) was used during the present study. According to data obtained previously gelling sulfated galactan from vegetative form *T. crinitus* have hybrid structure κ/β -carrageenan [3]. The average molecular weight of studied carrageenan was measured by viscosimetric method and calculated using the Mark-Houwink equation and was 400 g/mol. The κ/β -structure [3] of studied carrageenan was confirmed by IR-spectroscopy method [4].

2.2 Influence of Carrageenan on Cytokine Production

Earlier, we have shown that carrageenans with different chemical structure induce *ex vivo* synthesis of cytokines in human blood immune cells in dose-dependent manner [5]. In addition, we have shown the κ/β -carrageenan which in contrast with other carrageenan types characterized by the least sulfate content possesses the greatest capacity to induce the synthesis of anti-inflammatory cytokine IL-10 in human blood cells, and besides independently on its concentration. However, κ/β -carrageenan capacity to induce the synthesis of pro-inflammatory cytokines such as IL-6 and TNF is remained low [1]. We also have revealed the ability of κ/β -carrageenan and also their oligosaccharides to induce *in vivo* the IL-10 production in mouse blood cells under orally pretreatment animals with polysaccharide during 8 days [6]. Moreover, the influence of κ/β -carrageenan on *in vivo* production on some immune mediators and also its effect on bacterial induced endotoxemia was studied.

We have shown recently that κ/β -carrageenan under oral administration once at dose of 100 mg/kg stimulates the induction of anti-inflammatory cytokines (IL-10) in mice blood cells by more than 2.5 times compared with control exerting no effect on pro-inflammatory cytokines (TNF- α) production. The application of κ/β -carrageenan one day before endotoxemia induction promotes to reduce of TNF- α production in mouse blood cells in 2 times and at the same time significantly to increase (more than 2.5 times) induction of anti-inflammatory cytokine IL-10 compared with group animals which did not get of polysaccharide before injection of LPS. Also, it was shown the carrageenan moderately stimulates of IL-1 β production, so, it levels in mice sera from mice group pretreated orally with carrageenan was 40% higher than in control group, but 2 times less than after single intraperitoneal injection of LPS. In addition, oral application of carrageenan before LPS injection promoted to reduce the production of IL-1 β by more than 2 times compared with the group of mice injected of LPS only.

2.3 Influence of Carrageenan on Macrophage Cell Activity

We also have studied the influence of κ/β -carrageenan on murine peritoneal macrophages activity. The cellular activity was comparatively estimated using a number of linear and non-linear morphological parameters which describes the cell morphology changing during different activation processes [7, 8]. A total of 5 parameters (including 3 linear and 2 nonlinear) were used to describe the cell shape. Linear parameters were as follows: Area of cell (Area), the ratio of foreground pixels to all pixels of Hull Area (Density), the ratio of major to minor axes of the convex hull (Span Ratio). Nonlinear parameters includes box counting fractal dimension (D_B) and lacunarity calculated based on differences in the number of foreground pixels in different boxes of the grid superimposed image for all orientations of grid (LF) [9, 10, 11]. According our results κ/β -carrageenan introduced orally once at dose 100 mg kg⁻¹, alone and in combination with LPS promotes to stimulating the macrophage adhesion and spreading steps that's on the one side confirmed by higher Area and lacunarity and on the other – low Density in all experimental groups compared with control that correlates with general non-specific complication of cells shape, their activation and also changing cells behavior. However the macrophage Area was significantly higher in groups injected LPS only and in group treated with carrageenan before injection LPS compared with control group and group getting carrageenan alone. So, carrageenan alone activates cells in less degree compared with LPS. It is necessary to note that the both substances are also contribute to reduce of Density values, however, LPS reduces of it more than carrageenan, at the same time the combined effect of LPS and carrageenan gives the average value between LPS and carrageenan. This fact could be explained by that carrageenan in some extent promotes to reducing of intensive activation of macrophages by such stronger inflammatory agents as LPS, thus exhibiting some protective effect.

3. Acknowledgements

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4. References

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