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Proteoglycan isolated from *Phellinus linteus* inhibits tumor growth through mechanisms leading to an activation of D11c$^+$ CD8$^+$ DC and type I helper T cell-dominant immune state

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Dendritic cells (DC) are known to not only induce the activation of T cells, but are also associated with the polarization of T cells. This study investigated whether or not proteoglycan (PG) isolated from *Phellinus linteus* induces the phenotypic and functional maturation of CD11c$^+$ DC *in vitro* and *in vivo*. PG was found to induce the phenotypic and functional maturation of bone marrow-derived DC via Toll-like receptors (TLR) 2 and 4 *in vitro*. Administration of PG *in vivo* strongly inhibited the MCA-102 tumor growth and increase *in vivo*. The ratio of CD8$^+$DC to CD8$^-$ DC increased, and PG enhanced IL-12 and IFN-γ production, and expression of surface molecules including major histocompatibility complexes (MHC) classes I, MHC II, CD80, and CD86 in MCA-102-challenged mice. PG also caused a marked increase in the production of Th (helper T cells)-1 cytokine (IFN-γ) and a decrease in the production of Th-2 cytokine (IL-4) by splenic cells and inguinal lymph node cells in MCA-102 tumor-bearing mice. Furthermore, PG stimulated the proliferation of CD4$^+$ and CD8$^+$ T cells. In addition, a combination of PG and tumor lysate-pulsed DC inhibited completely the growth of MCA-102 cells in tumor-bearing mice. These results indicate that the administration of PG inhibited the tumor growth through a mechanism leading to a Th-1 dominant immune state and the activation of CD11cCD8$^+$ DC.