[Effects of integrin beta1 on phycocyanin inhibiting proliferation of K562 cells].

[Article in Chinese]
Niu ZY, Pan L, Liu YJ, Zhang XJ, Suo XH.

Source
Department of Hematology, The Second Hospital, Hebei Medical Univercity, Shijiazhuang 050000, China.

Abstract
This study was purposed to investigate the effect of phycocyanin at different concentration on proliferation of K562 cells, to detect the changes of integrin beta1 expression and intracellular focal adhesion kinase (FAK) gene expression on the surface K562 cells treated with phycocyanin, and to explore the possible mechanism of integrin beta1 effect on phycocyanin inhibiting proliferation of K562 cells. The expression level of integrin beta1 on the surface of K562 cells was evaluated by flow cytometry (FCM); the growth of K562 cells treated with phycocyanin was measured by MTT assay; the expression level of FAK mRNA was analyzed by relatively quantitative RT-PCR after four-day culture of K562 cells with phycocyanin of 40 microg/ml, 80 microg/ml and 160 microg/ml, respectively. The results showed that integrin beta1 expression on the surface of K562 cells was significantly higher than that in bone marrow mononuclear cells (BMMNC) from normal subjects. Phycocyanin could not change the level of integrin beta1 expression. Phycocyanin could increase the expression of FAK gene on K562 cells and inhibit the proliferation of K562 cells. It is concluded that phycocyanin can inhibit the proliferation of K562 cells through enhancing the conjunction of cell stroma with integrin beta1 on K562 cell surface, up-regulating the expression level of FAK gene in K562 cells, restoring the signaling pathway of proliferation inhibition mediated by integrin beta1. The possible mechanism of phycocyanin in the proliferation inhibition of K562 cells is to increase the expression of FAK gene. The phycocyanin may be considered as a potential agent for inhibition of cancer cell proliferation.

PMID: 16928294
[PubMed - indexed for MEDLINE]


Phycocyanin-mediated apoptosis in AK-5 tumor cells involves down-regulation of Bcl-2 and generation of ROS.

Pardhasaradhi BV, Ali AM, Kumari AL, Reddanna P, Khar A.

Source
Centre for Cellular and Molecular Biology, Hyderabad 500 007, India.

Abstract
C-phycocyanin, which is a major biliprotein of the blue-green algae, has been shown to possess cyclooxygenase-2 inhibitory activity. We have studied the effect of phycocyanin on a rat histiocytic tumor line. AK-5 cells are induced into apoptotic death program when treated with phycocyanin, which involves the activation of caspase-3. Phycocyanin-mediated apoptotic death is induced through the generation of reactive oxygen radicals. Free radical scavengers inhibited phycocyanin-induced apoptotic death in AK-5 cells. Bcl-2, an inhibitor of apoptosis, is shown to regulate ROS generation. Bel-2 gene-transfected AK-5 cells are resistant to phycocyanin-induced death. Overexpression of Bel-2 inhibited the production of ROS in phycocyanin-treated AK-5 cells. Thus, our observations demonstrate phycocyanin-induced apoptotic death in AK-5 cells, which is inhibited by Bcl-2 expression through the regulation of free radical generation. Phycocyanin, a natural product, could therefore be a possible chemotherapeutic agent through its apoptotic activity against tumor cells.

PMID: 14617790
[PubMed - indexed for MEDLINE]


The recombinant beta subunit of C-phycocyanin inhibits cell proliferation and induces apoptosis.


Source
Department of Biology, Georgia Cancer Center, Georgia State University, University Plaza, Atlanta,
GA 30303, USA.

Abstract
C-Phycocyanin (C-PC) from blue-green algae has been reported to have various pharmacological characteristics, including anti-inflammatory and anti-tumor activities. In this study, we expressed the beta-subunit of C-PC (ref to as C-PC/beta) in Escherichia coli. We found that the recombinant C-PC/beta has anti-cancer properties. Under the treatment of 5 microM of the recombinant C-PC/beta, four different cancer cell lines accrued high proliferation inhibition and apoptotic induction. Substantially, a lower response occurred in non-cancer cells. We investigated the mechanism by which C-PC/beta inhibits cancer cell proliferation and induces apoptosis. We found that the C-PC/beta interacts with membrane-associated beta-tubulin and glyceraldehyde-3-phosphate dehydrogenase (GAPDH). Under the treatment of the C-PC/beta, depolymerization of microtubules and actin-filaments were observed. The cells underwent apoptosis with an increase in caspase-3, and caspase-8 activities. The cell cycle was arrested at the G0/G1 phase under the treatment of C-PC/beta. In addition, the nuclear level of GAPDH decreased significantly. Decrease in the nuclear level of GAPDH prevents the cell cycle from entering into the S phase. Inhibition of cancer cell proliferation and induction of apoptosis may potentate the C-PC/beta as a promising cancer prevention or therapy agent.

PMID: 16740358
[PubMed - indexed for MEDLINE]


C-Phycocyanin, a selective cyclooxygenase-2 inhibitor, induces apoptosis in lipopolysaccharide-stimulated RAW 264.7 macrophages.

Source
Department of Animal Sciences, School of Life Sciences, University of Hyderabad, Hyderabad 500 046, India.

Abstract
C-Phycocyanin (C-PC) is one of the major biliproteins of Spirulina platensis, a blue green algae,
with antioxidant and radical scavenging properties. It is also known to exhibit anti-inflammatory and anti-cancer properties. However, the mechanism of action of C-PC is not clearly understood. Previously, we have shown that C-PC selectively inhibits cyclooxygenase-2 (COX-2), an inducible isoform that is upregulated during inflammation and cancer. In view of the reported induction of apoptosis in cancer cells by cyclooxygenase-2 inhibitors, the present study is undertaken to test the effect of C-PC on LPS stimulated RAW 264.7 mouse macrophage cell line. These studies have shown a dose dependent reduction in the growth and multiplication of macrophage cell line by C-PC. This decrease in cell number appears to be mediated by C-PC induced apoptosis as evidenced by flow cytometric and confocal microscopic studies. Cells treated with 20 micro M C-PC showed typical nuclear condensation and 16.6% of cells in sub-G(0)/G(1) phase. These cells also showed DNA fragmentation in a dose dependent manner. The studies on poly(ADP ribose) polymerase (PARP) cleavage showed typical fragmentation pattern in C-PC treated cells. This C-PC induced apoptosis in RAW 264.7 cells appears to be mediated by the release of cytochrome c from mitochondria and independent of Bcl-2 expression. These effects of C-PC on RAW 264.7 cells may be due to reduced PGE(2) levels as a result of COX-2 inhibition.

PMID: 12711327
[PubMed - indexed for MEDLINE]


**Molecular mechanisms in C-Phycocyanin induced apoptosis in human chronic myeloid leukemia cell line-K562.**

Subhashini J, Mahipal SV, Reddy MC, Mallikarjuna Reddy M, Rachamallu A, Reddanna P.

Source
Department of Animal Sciences, School of Life Sciences, University of Hyderabad, Hyderabad 500046, India.

Abstract
C-Phycocyanin (C-PC), the major light harvesting biliprotein from Spirulina platensis is of greater importance because of its various biological and pharmacological properties. It is a water soluble, non-toxic fluorescent protein pigment with potent anti-oxidant, anti-inflammatory and anti-cancer properties. In the present study the effect of highly purified C-PC was tested on growth and multiplication of human chronic myeloid leukemia cell line (K562). The results indicate significant
decrease (49%) in the proliferation of K562 cells treated with 50 microM C-PC up to 48 h. Further studies involving fluorescence and electron microscope revealed characteristic apoptotic features like cell shrinkage, membrane blebbing and nuclear condensation. Agarose electrophoresis of genomic DNA of cells treated with C-PC showed fragmentation pattern typical for apoptotic cells. Flow cytometric analysis of cells treated with 25 and 50 microM C-PC for 48 h showed 14.11 and 20.93% cells in sub-G0/G1 phase, respectively. C-PC treatment of K562 cells also resulted in release of cytochrome c into the cytosol and poly(ADP) ribose polymerase (PARP) cleavage. These studies also showed down regulation of anti-apoptotic Bcl-2 but without any changes in pro-apoptotic Bax and thereby tilting the Bcl-2/Bax ratio towards apoptosis. The present study thus demonstrates that C-PC induces apoptosis in K562 cells by cytochrome c release from mitochondria into the cytosol, PARP cleavage and down regulation of Bcl-2.

PMID:
15242812
[PubMed - indexed for MEDLINE]


[Inhibition activity of spirulina platensis proteins photo-immobilization biomaterial on proliferation of cancer cells].
[Article in Chinese]
Guan Y, Guo B.

Source
Biotechnology Research Institute, South China Normal University, Guangzhou 510631.

Abstract
The bioactive protein-phycocyanin and all the proteins of Spirulina Platensis were isolated and purified. Photo-reactive proteins were synthesized by coupling the proteins with (N-(4-azidobenzoyloxy)succinimide) and were spread onto the 24-well cell culture polystyrene plate. Then the coated surface was exposed to ultraviolet irradiation for chemical fixation of proteins via the conversion of the phenylazido group to the highly reactive phenyl-nitrene which spontaneously formed covalent bonds with neighboring hydrocarbons. On these proteins-immobilized polystyrene plates, the liver cancer cells 7402 were cultured under the serum-free conditions, and the inhibition activity on proliferation of liver cancer cells was investigated and analyzed.

PMID:
11951491
Protective effect of Spirulina against doxorubicin-induced cardiotoxicity.

Khan M, Shobha JC, Mohan IK, Naidu MU, Sundaram C, Singh S, Kuppusamy P, Kutala VK.

Source
Department of Clinical Pharmacology and Therapeutics, Nizam's Institute of Medical Sciences, Hyderabad, India.

Abstract
The generation of reactive oxygen species and mitochondrial dysfunction has been implicated in doxorubicin (DOX)-induced cardiotoxicity. The aim of the present study was to determine whether Spirulina, a blue-green algae, could serve as a cardioprotective agent during DOX treatment in a mouse model. Mice were treated with DOX (4 mg/kg bw, intraperitoneally), weekly, for 4 weeks. Spirulina was administered orally for 3 days twice daily, then for 7 weeks along with the four equal injections of DOX. Cardiotoxicity was assessed, at 3 weeks after the end of the DOX-treatment period, by mortality, volume of ascites, liver congestion, oxidative stress and ultrastructural changes of heart tissue. The DOX-treated animals showed higher mortality (53%) and more ascites. Myocardial damage, as assessed by ultrastructural changes, showed loss of myofibrils, cytoplasmic vacuolization and mitochondrial swelling. Myocardial superoxide dismutase and glutathione peroxidase activities were decreased and lipid peroxidation was increased. Pretreatment with Spirulina significantly protected the mice from DOX-induced cardiotoxic effects as evidenced from lower mortality (26%), less ascites, lower levels of lipid peroxidation, normalization of antioxidant enzymes and ultrastructural studies showing minimal damage to the heart. In vitro cytotoxic studies using ovarian cancer cells demonstrated that Spirulina did not compromise the anti-tumor activity of doxorubicin. These results suggest that Spirulina has a protective effect against cardiotoxicity induced by DOX and it may, therefore, improve the therapeutic index of DOX.

Copyright 2005 John Wiley & Sons, Ltd.

PMID: 16372368
[PubMed - indexed for MEDLINE]
[Update on the pharmacology of Spirulina (Arthrospira), an unconventional food].

[Article in Spanish]
Chamorro G, Salazar M, Araújo KG, dos Santos CP, Ceballos G, Castillo LF.

Source
Escuela Nacional de Ciencias Biológicas, Instituto Politécnico Nacional, M.A.D. México
Universidade Federal Fluminense, Niteroi, Brasil.

Abstract
Spirulina (Arthrospira), a filamentous, unicellular alga, is a cyanobacterium grown in certain countries as food for human and animal consumption. It is also used to derive additives in pharmaceuticals and foods. This alga is a rich source of proteins, vitamins, amino acids, minerals, and other nutrients. Its main use, therefore, is as a food supplement. Over the last few years, however, it has been found to have many additional pharmacological properties. Thus, it has been experimentally proven, in vivo and in vitro that it is effective to treat certain allergies, anemia, cancer, hepatotoxicity, viral and cardiovascular diseases, hyperglycemia, hyperlipidemia, immunodeficiency, and inflammatory processes, among others. Several of these activities are attributed to Spirulina itself or to some of its components including fatty acids omega-3 or omega-6, beta-carotene, alpha-tocopherol, phycocyanin, phenol compounds, and a recently isolated complex, Ca-Spirulan (Ca-SP). This paper aims to update and critically review the results published over the last few years with regards to these properties. The conclusion is that even if this cyanobacterium has been one of the most extensively studied from the chemical, pharmacological and toxicological points of view, it is still necessary to expand the research in order to have more consistent data for its possible use in human beings.

PMID: 12448336
[PubMed - indexed for MEDLINE]