

First case report of anaphylaxis to spirulin: identification of phycocyanin as responsible allergen

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Spirulina (*Arthrospira platensis*) is a cyanobacterium (formerly blue-green algae) used as a human dietary supplement because of its high content in proteins, γ -linoleic acid and vitamins (1). We present the first documented case report identifying the cyanobacterial pigment phycocyanin as a potentially allergenic protein. A 14-year-old adolescent who had previously

experienced urticaria, labial oedema and asthma 6 h after consumption of five spirulin tablets, exhibited positive prick test and oral challenge test to spirulin. Upon oral challenging with increasing spirulin doses corresponding to four spirulin tablets over a 3-h period, he experienced diarrhea 2 h and 5 h after the last challenge, respectively. Moreover, a diffuse erythema occurred 30 min latter the last diarrhea episode, requesting a Xyzall® and Solupred® medication.

The offending spirulina allergen was identified on a cold acetone-precipitated protein extract prepared from spirulin tablets previously homogenized in 20 mM Tris-buffered saline (pH 7.5) and stirred for 4 h at 4°C. Upon transfer of the protein fractions separated by SDS-PAGE (2) on a nitro-cellulose membrane, a Western blotting performed in the presence of 1 : 10 diluted patient serum revealed two main IgE-reacting protein fractions (Fig. 1A,B). A digestion with trypsin of the IgE-reactive fractions in the gel, followed by mass mapping by MALDI-TOF analysis using Protein Prospector for identifying the peptides in the NCBI nonredundant database (3),

unambiguously identified β chain of C-phycocyanin as the responsible allergen. In addition, a faint IgE-binding reaction also occurred with the protein fraction that essentially consists of α chain. C-Phycocyanin consists of α (162 amino acids) and β (172 amino acids) chains associated in a macromolecular assembly, built up from four ($\alpha\beta$)₃ trimers which aggregate face to face to form two superposed ($\alpha\beta$)₆ hexamers (Fig. 1C) (4). The IgE-reactive β chain trimers, which encircle the two central α chain trimers, occupy a nicely exposed position at the surface of C-phycocyanin.

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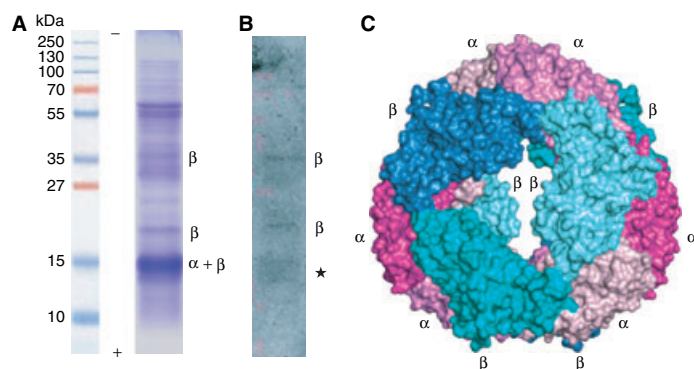


Figure 1. (A) Coomassie-staining of a protein extract of spirulin tablet separated by SDS-PAGE. The main protein fraction ($\alpha + \beta$) essentially consists of α chains associated to a few β chains. Other fractions labelled β consist of aggregated β chains. (B) Western blot showing the IgE-reactive β chain fractions of C-phycocyanin. Note the faint reaction occurring with the ($\alpha + \beta$) protein fraction (★). (C) Ribbon diagram of C-phycocyanin showing the structural organization of α (colored pink) and β (colored blue) chains in the two superposed ($\alpha\beta$)₆ hexamers.