

REFERENCES

- Abdel-Hamid, M.I. (1991): A practical method for immobilization and de-immobilization of freshwater algae for toxicity screening and water quality studies. Environ. Toxicol-Norwegian Institute for water Research NIVA, E-88427, Q-470.
- Abdel-Hamid, M.I.; Olav, M.S. and Shaaban-Dessouki, S.A. (1991): Phytoplankton and water quality of the river Nile in Egypt. Ph.D. Mansoura University, Egypt.
- Abdel-Hamid, M.I.; Azab, Y.A.; Rashid, IG.A.; El-Komy, M.A. and Al-Sarwy, A.A (1994): The use of algal bioassays for the assessment of toxicity reduction by soot. Proceedings of the Fourth International Conference on “Environmental Protection is a Must”. National Institute of Oceanography and Fisheries, Alexandria, Egypt (10-12 May). pp 137-153.
- Abdel-Migid, H.M.; Azab, Y.A. and Ibrahim, W.M. (2004): Use of plant genotoxicity bioassay for the evaluation of efficiency of algal biofilters in bioremediation of toxic industrial effluents. *Egypt. J. Biotechnology*, **17**: 235-256.
- Aderhold, D.; Williams, C. J. and Edyvean, R.G.J. (1996): The removal of heavy metal ions by seaweeds and their derivatives. *Biores. Technol.*, **58**: 1-6.

- Ahner, B.A. and Morel, F.M.M. (1995): Phytochelatin production in marine algae. Induction by various metals. *Limnology and Oceanography*, **40 (4)**: 658–665.
- Ahuja, P.; Gupta, R. and Saxena, R.K. (1997): *Oscillatoria anguistissima*: a promising Cu biosorbent. *Curr Microbiol.*, **35(3)**: 151-154.
- Ahuja, P.; Gupta, R. and Saxena, R.K. (1999): Sorption and desorption of cobalt by *Oscillatoria anguistissima*. *Curr Microbiol.* **39(1)**:49-52.
- Akhtar, N. ; Iqbal, J. and Iqbal, M. (2003a): Microalgal-luffa sponge immobilized disc: a new efficient biosorbent for the removal of Ni(II) from aqueous solution. *Letters in Applied Microbiology*, **37**: 149-153.
- Akhtar, N.; Saeed, A. and Iqbal M. (2003b): *Chlorella sorokiniana* immobilized on the biomatrix of vegetable sponge of *Luffa cylindrica*: a new system to remove cadmium from contaminated aqueous medium. *Bioresour Technol.*, **88(2)**:163-165.
- Akhtar, N.; Iqbal, J. and Iqbal, M. (2004): Enhancement of lead (II) biosorption by microalgal biomass immobilized onto loofa (*Luffa cylindrica*) sponge. *Engineering in Life Sciences*, **4(2)**: 171-178.
- Albertano, P. (1989): The tolerance towards mercury of *Chlorella* strains determined by algal plating. *Arch. Hydrobiol.*, **82(4)**: 461- 468.
- Aldor, I.; Fourest, E. and Volesky, B. (1995): Desorption of cadmium from algal biosorbent. *Can. J. Chem. Engin.*, **73**: 516-522.

- Alia, S.; Saradhi, P.P. and Mohanty, P. (1997): Involvement of proline in protecting thylakoid membranes against free radical-induced photodamage. *J. Photochem. Photobiol.*, **38**: 253–257.
- Alloway, B.J. (1995): Cadmium heavy metals in soils, 2nd ed, B.J. Alloway, ed, Chapman and Hall, London pp. 122–151.
- Amemiya, Y. and Nakayama, O. (1984): The chemical composition and metal adsorption capacity of the sheath materials isolated from *Microcystis*, Cyanobacteria. *Jpn J Limnol.*, **45**: 187-193.
- Andersen, H. B. and Buckley, J. A. (1998): Acute toxicity of ammonia to *Ceriodaphnia dubia* and a procedure to improve control survival. *Bull. Environ. Contam. Toxicol.*, **61**: 116–122.
- APHA (1985): Standard methods for the examination of water and waste water, 16th edition.-New York, American Public Health Association.
- Audholia, S.; Goyal, D. and Saxena, R.K. (1993): Zinc tolerance in *Phormidium uncinatum*. *Folia Micrbiol.*, **38**: 341–344.
- Azab, Y.A.; Kenawy, I.; Mohamedin, A. and Ibrahim, W.M. (2004): Bioremoval of cadmium, cobalt and copper from laboratory cultures by cyanobacteria and green microalgae. *Algological Studies*, **111**: 159-171.

- Babich, H. and Stotzky, G. (1983): Physicochemical factors of natural reservoirs affect the transformation and exchange of heavy metals toxic to microbes. *Ecol. Bull.*, **35**: 315-323.
- Bakkaloglu, I.; Butter, T.J.; Evison, L.M.; Hollan, F.S. and Hancock, I.C. (1998): Screening of various types biomass for removal and recovery of heavy metals (Zn, Cu, Ni) by biosorption, sedimentation and desorption. *Water Sci Technol.*, **38**: 269-277.
- Banks, E.C.; Ferretti, L.E. and Shucard, D.W. (1997): Effects of low-level lead exposure on cognitive function in children: A review of behavioral, neuropsychological and biological evidence. *Neurotoxicology*, **18**: 237-81.
- Bariaud, M.; Burg, M. and Mestre, J.C. (1985): Mechanisms of Cd resistance in *Euglena gracillis*. *Physiol. Biol. Ecol.*, **3**: 191-198.
- Barteltt, L.; Rabe, F.W. and Funk, W.H. (1974): Effects of copper, zinc and cadmium on *Selenastrum capricornatum*. *Water Res.*, **8**: 179-185.
- Bartless, P.D. ;Craig, P.J. and Morton, S.F. (1977): Behaviour of mercury species in isolated estuarine sediments. *Nature*, **267**: 606-609.
- Becker, E.W. and Venkatarman, L.V. (1982): Biotechnology and exploitation of algae. The Indian approach. German Agency for Technical Cooperation (GTZ), Eschborn, FRG.

- Bender, J.; Lee, R.F. and Phillips, P. (1995): Uptake and transformation of metals and metalloids by microalgal mats and their use in bioremediations. *J. Indus. Microbiol.*, **14**: 113–118.
- Benjamin, M.M.; Sletten, R.S.; Bailey, R.P. and Bennett, T. (1996): Sorption and filtration of metals using iron-oxide-coated sand, *Water Research*, **30**: 2609-2620.
- Benoff, S.; Jacob, A. and Hurley, I.R. (2000): Male infertility and environmental exposure to lead and cadmium. *Hum Reprod Update*, **6**:107-121.
- Benson, J.M.; Burt, R.L.; Carpenter, R.L.; Eideson, A.F.; Hahn, F.F.; Haley, P.J.; Hanson, R.L.; Hobbs, C.H.; Pickrell, J.A. and Dunnick, J.K. (1988): Comparative inhalation toxicity of nickel sulfate in F344/N rats and B6C3F1 mice exposed for 12 days. *Fundam. Appl. Toxicol.*, **9**: 252-265.
- Bentley-Mowat, J. A. and Reid, S. M. (1977): Survival of marine phytoplankton in high concentrations of heavy metals, and uptake of copper. *J. exp. mar. Biol. Ecol.*, **26**: 249-264.
- Bittell, J.E. and Koeppe, D.E. (1973): The effect of cadmium on electron and energy transfer reaction in corn mitochondria. *Physiol. Plant*, **28**:166-171.
- Bittner, A.C.; Echeverria, D.; Woods, J.S.; Aposhian, H.V.; Naleway, C. and Martin, M.D. (1998): Behavioral effects of low-level exposure to

- HgO among dental professionals: A cross study evaluation of psychomotor effects. *Neurotoxicol Teratol.*, **20**: 429-439.
- Blaise, C.; Legault, R.; Bermingham, N.; Van Coillie, R. and Vasseur, P. (1986): A simple microplate algal assay technique for aquatic toxicity. *Tox. Assess.*, **1**: 261-281.
- Bonilla, I.; Bolanos, L. and Mateo, P. (1995): Interaction of boron and calcium in the cyanobacteria *Anabaena* and *Synechococcus*. *Physiol. Plant.*, **94**: 31-36.
- Brady, J.M.; Tobin, J.M. and Roux, J.C. (1999): Continuous fixed bed biosorption of Cu ions; application of a simple two parameter mathematical model. *J. Chem. Tech. Biotech.*, **74**: 71-77.
- Brennan, R.J. and Schiestl, R.H. (1996): Cadmium is an inducer of oxidative stress in yeast. *Mutat. Res.*, **356**: 171-178.
- Buchet, J.P.; Roels, H.; Bernard, A. and Lauwerys, R. (1980): Assessment of renal-function of workers exposed to inorganic lead, cadmium, or mercury-vapor. *J. Occup. Environ. Med.*, **22**: 741-750.
- Burdin, K.S. and Bird, K.T. (1994): Heavy metal accumulation by carrageenan and agar producing algae. *Botanica. Marina*, **37**: 467-470.
- Burrows, D.; Creswell, S. and Merrett, J.D. (1981): Nickel, hands and hip prostheses. *British Journal of Dermatology*, **105**: 437-442.

- Bux, F.; Naidoo, D. and Kasan, H.C. (1996): Laboratory-scale biosorption and desorption of metal ions using waste sludges and selected acids. *S. A. J. Sci.*, **92**: 527-529.
- Canizares-Villanueva, R.O. and Travieso, L. (1990): Mischievous, Microalgae immobilization in different means support for the wastes purification, Report CONACYT, Project 8.14/90, Program Cuba, Mexico.
- Canizares-Villanueva, R.O. and Travieso, L. (1991): Microalgae immobilization for the treatment of wastewaters, Report CONACYT, Project .07/91, Program Cuba, Mexico.
- Canizares-Villanueva, R.O. and Travieso, L. (1992): Microalgae immobilization for the heavy metals removal, Report CONACYT, Project . 18/92, Program Cuba, Mexico.
- Carrilho, E.N.; Nobrega, J.A. and Gilbert, T.R. (2003): The use of silica-immobilized brown alga (*Pilayella littoralis*) for metal preconcentration and determination by inductively coupled plasma optical emission spectrometry. *Talanta*, **60**: 1131-1140.
- Casas, J.M.; Rosas, H.; Sole, M. and Lao, C. (2003): Heavy metals and metalloids in sediments from the Llobregat basin, Spain. *Environmental Geology*, **44**: 325–332.
- Chaoui, A.; Mazhoudi, S.; Ghorbal, M.H. and Ferjani, E.E. (1997): Cadmium and zinc induction of lipid peroxidation and effects on

- antioxidant enzyme activities in bean (*Phaseolus vulgaris* L.).
Plant Sci., **127**: 139-147.
- Cheng, Y.; Schwartz, J.; Sparrow, D.; Aro, A.; Weiss, S.T. and Hu, H.
(2001): A prospective study of bone lead level and hypertension:
The normative aging study. *Am. J. Epidemiol.*, **153**: 164-171.
- Chiaaudani, G. and Vighi, M. (1978): The use of *Selenastrum
capricornatum* batch cultures in toxicity studies. *Mitt. Internat.
Verein. Limnol.*, **21**: 316-329.
- Chmielewská, E. and Medved, J. (2001): Bioaccumulation of heavy metals
by green algae *Cladophora glomerata* in a refinery sewage lagoon.
Crotica Chemica Acta., **74 (1)**: 135-145.
- Chojnacka, K. (2003): Heavy metal ions removal by microalgae *Spirulina* sp.
in the processes of biosorption and bioaccumulation. Ph.D.
Dissertation, Wroclaw University of Technology, Poland.
- Chojnackaa, K.; Chojnacki, A. and Goreckab, H. (2004): Trace element
removal by *Spirulina* sp. from copper smelter and refinery
effluents, *Hydrometallurgy*, **45**: 521-529
- Chong, A.M.Y.; Wong, Y.S. and Tam, N.F.Y. (2000): Performance of
different microalgal species in removing nickel and zinc from
industrial wastewater. *Chemosphere*, **41**: 251-257.

- Cohen, C.K.; Fox, T.C.; Garvin, D.F. and Kochian, L.V. (1998): The role of iron-deficiency stress responses in stimulating heavy metal transport in plants. *Plant Physiol.*, **116**: 1063-1072.
- Cossich, E.S.; Tavares, C.R.G. and Ravagnani, T.M.K. (2002): Biosorption of chromium(III) by *Sargassum* sp. biomass. *EJB Electronic Journal of Biotechnology*, **5(2)**: 133-140.
- Costa, A.C. and Franca, F.P. (1998): Cadmium uptake by *Spirulina maxima*: toxicity and mechanism. *World Journal of Microbiology & Biotechnology*, **14 (4)**: 579-581.
- Cotoras, D.; Viedma, P. and Pimentel, J. (1993): In; Biohydrometallurgical Technologies (eds Torma, A. E., Apel, M. L. and Brierley, C.), The Minerals, Metals and Materials Society, TMS Publication, Wyoming, USA. **2**: 103-109.
- Courchene, J.E. and Chapman, J.D. (1975): Algae control in Northwest reservoirs. *J. Am. Water Works Ass.*, **67(3)**: 127-130.
- Crist, R.H. ;Oberholser, K.; Shank, N. and Nguyen, N. (1981): Nature of bonding between metallic ions and algal cell walls. *Environ. Sci. Technol.*, **15**: 1212-1218.
- Cronberg, G. (1982): Phytoplankton changes in Lake Trumen induced by restoration: Long-term whole-lake studies and food-web experiments. *Folia Limnologica Scandinavica*, **18**: 1-119.

- Das, A.K. (1990): A textbook on medicinal aspects of bio-inorganic chemistry. CBS, Delhi, India.
- Davies J.E. (1986): Occupational asthma caused by nickel salts. *J. Soc. Occup. Med.*, **36**: 29-31.
- Davis, T. A.; Volesky, B. and Mucci, A. (2003): A review of the biochemistry of heavy metal biosorption by brown algae. *Water Research.*, **37**: 4311-4330.
- Decho, A.W. and Herndl, G.J. (1995): Microbial activities and the transformation of organic matter within mucilaginous material. *Sci Total Environ.*, **165**: 33-42.
- De Filippis, L.F. and Pallaghy, C.K. (1976): The effect of sublethal concentrations of mercury and zinc on *Chlorella*. Development and possible mechanism of resistance to metals. *Z.Pflanzenphysiol*, **79**: 323-332.
- De Filippis, L. F. (1978): The effect of sublethal concentrations of mercury and zinc on *Chlorella*. Characteristics of general reducing enzyme system for metallic ions. *Z.Pflanzenphysiol.*, **86**: 339-348.
- De Filippis, L.; Hampp, R. and Ziegler, H. (1981): The effects of sub-lethal concentrations of zinc, cadmium and mercury on *Euglena* Growth and pigments. *Pflanzen Physiology*, **101**: 37-47.

- De Filippis, L.F. and Ziegler, H., (1993): Effect of sublethal concentrations of zinc, cadmium and mercury on the photosynthetic carbon reduction cycle of *Euglena*. *J. Plant Physiol.*, **142**: 167-172.
- Delauney, A.J. and Verma, D.P.S. (1993): Proline biosynthesis and osmoregulation in plants. *Plant J.* **4**: 215–223.
- Delmotte, A. (1980): Influence of cadmium on growth and nitrogen metabolism of *Anabaena cylindrica*. *J. Exp. Bot.* **31(123)**: 1107-1118.
- Desi, I.; Nagymajtenyi, L. and Schulz, H. (1998): Behavioural and neurotoxicological changes caused by cadmium treatment of rats during development. *J. Appl. Toxicol.*, **18**: 63-70.
- Dickman, M. D. (1998): Benthic marine diatom deformities associated with contaminated sediments in Hong Kong. *Environment International*, **24(7)**: 749-759.
- Dietz, K.J.; Baier, M. and Kramer, U. (1999): Free radicals and reactive oxygen species as mediators of heavy metal toxicity in plants. In: Heavy metal stress in plants: from molecules to ecosystems. Prasad, M. N. V. and Hagemeyer, J., eds. Berlin: Springer-Verlag. 73-97.
- Disyawongs, G. (2002): Accumulation of Copper, Mercury and Lead in *Spirulina platensis* studied in Zarrouk's medium. *The Journal of KMITNB*, **12(4)**: 33-35.

- Donghua, L. and J. Wusheng. (1997): Effects of nickel sulfate on root growth. In: Ecological issues and environmental impact assessment. Cheremisinoff, P.N. (editor). Gulf Publishing Company, Houston, Texas. 315-318
- Dudka, S. and Adriano, D.C. (1997): Environmental impacts of metal ore mining and processing: A review. *J. Environ. Qual.*, **26**: 590– 602.
- Dunnick, J.K.; Benson, J.M.; Hobbs, C.H.; Hahn, F.F.; Cheng, Y.S. and Eidson, A.F. (1988): Comparative toxicity of nickel oxide, nickel sulfate hexahydrate, and nickel subsulfide after 12 days of inhalation exposure to F344/N rats and B6C3F1 mice. *Toxicol.*, **50**: 145-156.
- Dziwulska, U. ; Bajguz, A. and Beata, G. (2004): The use of algae *Chlorella vulgaris* immobilized on cellex-T support for separation/preconcentration of trace amounts of Platinum and Palladium before GFAAS determination, *Analytical letters*, **37**: 2189 – 2203.
- Eccles, H. (1999): Treatment of metal-contaminated wastes: why select a biological process? *Trends Biotechnol.*, **17**: 462-465.
- Ehrlich, H.L. and Brierley, C. L. (1990): Microbial mineral recovery. *McGraw-Hill Publishing Company.*, USA. pp 227-302.

- El-Enany, A.E. and Issa, A.A. (2000): Cyanobacteria as a biosorbent of heavy metals in sewage water. *Environmental Toxicology and Pharmacology*, **8**: 95-101.
- Emani, P.; Teresa, C.S.; Maria, A.S.; Oswaldo, K. and David, M. (2003): Review heavy metal-induced oxidative stress in algae. *Journal of Phycology*, **39(6)**: 1008-1011.
- Errecalde, O. and Campbell, P.G.C. (2000): Cadmium and zinc bioremoval ability to *Selenastrum capricornatum* (Chlorophyceae): accidental metal uptake and toxicity in the presence of citrate. *J. Phycol.*, **36**: 473-483.
- Fehrmann, C. and Pohl, P. (1993): Cadmium adsorption by the non-living biomass of microalgae grown in axenic mass culture. *J. Appl. Phycol.*, **5**: 555-562.
- Fennikof, K.B.; Hirschfield, H.I. and Kneip, T.J. (1978): Cadmium toxicity in planktonic organisms of a freshwater food web. *Environ. Res.*, **15**: 357-367.
- Fodor, E.; Szabo-Nagy, A. and Erdei, L. (1995): The effects of cadmium on the fluidity and H⁺-ATPase activity of plasma membrane from sunflower and wheat roots. *J. Plant Physiology*, **147**: 87-92.
- Forstner, U. and Wittmann, G.T.W. (1981): Metal pollution in the aquatic environment. Springer-Verlag, New York.

References

- Foulkes, E.C. (2000): Transport of toxic heavy metals across cell membranes. *Proc. Soc. Exp. Biol. Med.*, **159**: 321-323.
- Fujita, M.; Takabatake, E. and Lwaski, R. (1978): Effects of light, magnesium and cyanide on accumulation of mercury by a fresh water diatom, *Synedra*. *Bull. Environ. Contam. Toxicol.*, **16(2)**: 164-172.
- Gardea-Torresdey, J. L. (1988): Metal ion adsorption by algae and its novel electroanalytical applications, Ph.D. Dissertation, New Mexico State University.
- Gardea-Torresdey, J.L.; Becker-Hapak, M.K.; Hosea, J.M. and Darnell, D.W. (1990): Effect of chemical modification of algal carboxyl groups on metal ion binding. *Environ. Sci. Technol.*, **19**: 1372-1379.
- Gardea-Torresdey, J.L.; Arenas, J.L.; Webb, R.; Tiemann, K. and Gonzalez, J. (1996a): Uptake of metal ions from solution by inactivated cells of cyanobacteria. *J. of Hazardous Materials*, **48** :191-200.
- Gardea-Torresdey, J.L. ; Tiemann, K.J. ; Gonzalez, J. A. ; Henning, J. H. and Townsend, M.S. (1996b): Uptake of copper ions from solution by different populations of *Medicago Sativa* (Alfalfa). *Solvent Extraction and Ion-exchange*, **14**: 119-140.
- Gardea-Torresdey, J.L.; Tiemanna, K.J.; Gameza, G.; Dokkena, K. and Yacamanb, M.J. (1998): Innovative technology to recover gold

(III) from aqueous solutions by using *Medicago sativa* (alfalfa), *Proceedings of the 12th Annual Conference on Hazardous Waste Research*. Edited by Erickson, L.E.; Tillison, D.L.; Grant, S.C. and McDonald, J.P., Kansas State University, Manhattan, KS, 209-214.

Garnham, G.; Codd, G. and Gadd, G. (1992): Kinetics of uptake and intracellular location of cobalt, manganese and zinc in the estuarine green alga *Chlorella salina*. *Applied Microbiology and Biotechnology*, **37**: 270-276.

Garrido, M.I.; Blasco, J.; Delvalle, G.M. and Lubian, L.M. (1998): Differences in copper accumulation by the marine microalga *Nannochloropsis gaditana*, submitted to two different thermal treatments. *Ecotoxicology and Environmental Restoration*, **1(1)**: 43-47.

Gawkrodger, D.J.; Cook, S.W.; Fell, G.S. and Huner, J.A.A. (1986): Nickel dermatitis: the reaction to oral nickel challenge. *British Journal of Dermatology*, **115**: 33-38.

Geesey, G.G. and Jang, L. (1989) In: Metal ions and bacteria, Beveridge, T.J. and Doyle, R.J. (eds.), Wiley, New York, pp. 325-357.

Gekeler, W.; Grill, E.; Winnacker, E. L. and Zenk, M.H. (1998): Algae sequester heavy metals via synthesis of phytochelatin complexes. *Archives of Microbiology*, **150**: 197-202.

- Geyer, H.; Scheunert, I. and Korte, F. (1985): The effects of organic environmental chemicals on the growth of the alga *Scenedesmus subspicatus*: a contribution to environmental biology. *Chemosphere*, **14**: 1355-1369.
- Goering, J.J.; Biosseau, D. and Hottori, A. (1979): Effect of copper on silicic acid uptake by a marine phytoplankton populations: controlled ecosystem pollution experiment. *Bull. Mar. Sci.*, **27(1)**: 58-65.
- Gonzalez-Davila, M.; Santana-Casiano, J.M.; Perez-Pena, J. and Millero, F.J. (1995): Binding of Cu (II) to the surface and exudates of the alga *Dunaliella teriolecta* in seawater. *Environmental Science and Technology*, **29(2)**: 289-301.
- Gonzalez-Cossio, T.; Peterson, K.E.; Sanin, L.; Fishbein, S.E.; Palazuelos, E.; Aro, A.; Hernández-Avila, M. and Hu, H. (1997): Decrease in birth weight in relation to maternal bone-lead burden. *Pediatrics*, **100**: 856-62.
- Grandjean, P.; Guldager, B.; Larsen, I.B.; Jorgensen, P.J and Homstrup, P. (1997): Placebo response in environmental disease. Chelation therapy of patients with symptoms attributed to amalgam fillings. *J Occup Environ Med.*, **39**:707-714.
- Grandjean, P.; Weihe, P.; White, R. F. and Debes, F. (1998): Cognitive performance of children prenatally exposed to "safe" levels of methylmercury. *Environ Res.*, **77**: 165-172.

- Greene, B.; Hosea, J.M.; McPherson, R.; Henzl, M.; Alexanzder, M.D. and Darnall, D.W. (1986): Interaction of gold I and gold III complexes with algal biomass. *Environ. Sci. Technol.*, **20**: 627-632.
- Greene, B.; Gardea-Torresdey, J.L.; Hosea, J.M.; McPherson, R.A. and Darnell D.W. (1987): Algal ion exchangers for waste metal reclamation. *Am. Chem. Soc. Nat. Meeting Preprint Extend Abstract*. **272(2)**: 800-804.
- Greene, J.C.; Bartles, C.I.; Warren-Hicks, W.J.; Parkhurst, B.R. ; Linder, G.L.; Peterson, S.A. and Miller, W.E. (1989): Protocols for short term toxicity screening of hazardous waste sites.-EPA/600/3-88/029, U.S. Environmental Protection Agency, Corvallis, Oregon.
- Greene, B. and Darnell, D.W. (1990): Microbial oxygenic photoautotrophs (Cyanobacteria and Algae) for metal-ion binding. In: Microbial mineral recovery. Ehrlich, H.L. and Brierley, C.L. (editors). McGraw-Hill, USA. 277-302.
- Greene, B. and Bedell, G.W. (1990): Algal gels or immobilized algae for metal recovery. In: Introduction to applied phycology. Akatsuka, I. (Ed.), The Hage, The Netherlands. 109-136.
- Guerinot, M.L. (2000): The ZIP family of metal transporters. *Biochim. Biophys. Acta*, **14 (65)**: 190–198.
- Gulriz, B. (2002): Phytochelation biosynthesis and cadmium detoxification. *Journal of Cell and Molecular Biology.*, **1(2)** :45-56.

- Gulson, B.L.; Jameson, C.W.; Mahaffey, K.R.; Mizon, K.J.; Korsch, M.J. and Vimpani, G. (1997): Pregnancy increases mobilization of lead from maternal skeleton. *J Lab Clin Med.*, **30**: 51-62.
- Gupta, R.; Ahuja, P.; Khan, S.; Saxena, R. K. and Mohapatra, H. (2000): Microbial biosorbents: Meeting challenges of heavy metal pollution in aqueous solutions. *Current Science*, **78(8)**: 967-972.
- Hall, J.L. (2002): Cellular mechanisms for heavy metal detoxification and tolerance. *J. Exp. Botany*, **53(366)**: 1-11.
- Hammouda, O.; Gaber, A. and Abdel-Raouf, N. (1995): Microalgae and wastewater treatment. *Ecotoxicol-Environ.Saf.*, **31(3)**: 205-210.
- Hashim, M.A. and. Chu, K.H. (2004): Biosorption of cadmium by brown, green, and red seaweeds. *Journal of Chemical Engineering*, **97**: 249-255
- Hellstrom, L.; Elinder, C.G.; Dahlberg, B.; Lundberg, M.; Jarup, L.; Persson, B. and Axelson, O. (2001): Cadmium exposure and end-stage renal disease. *Am. J. Kidney Dis.*, **38**: 1001-1008.
- Hessler, A. (1974): The effects of lead on algae. Effects of Pb on viability and motility of *Platymonas subcordiformis*. *Water Air and Soil Pollut.*, **3**: 371-384.
- Holan, Z.R. and Volesky, B. (1994): Biosorption of lead and nickel by biomass of marine algae. *Biotech. Bioeng.*, **43**: 1001-1009.

- Holan, Z.; Volesky, B. and Prasetyo, I. (1998): Biosorption of cadmium by biomass of marine algae. *Biotechnology and Bioengineering*, **41(8)**: 819-825.
- Holderness, J.; Fenwick, M. G. and Lynch, D.L. (1975): The effect of methyl mercury on the growth of the green alga *Coelastrum microporum* Naeg, strain 280. *Bull. Environ. Contam. Toxicol.*, **13(3)**: 348-350.
- Holl, W.H. (2001): Separation of mixtures of heavy metals by parametric pumping with variation of pH, 6th World Congress of Chemical Engineering, 23-27 September, Melbourne, Australia.
- Höröcsik, Z.T. and Balogh, Á. (2002): Intracellular distribution of chromium and toxicity on growth in *Chlorella pyrenoidosa*. *Acta Biol Szeged.*, **46(4)**: 57-58.
- Horikoshi, T.; Nakajima, A. and Sakaguchi, T. (1979): Uptake of uranium by *Chlorella regularis*. *Agricultural and Biological Chemistry*, **43**: 617-623.
- Howard, H.M.D. (2002): Human health and heavy metals exposure. In: Life support: The environment and human health. McCally, M. (ed.), MIT press. Chapter 4: 85-98.
- Howe, G. and Merchant, S. (1992): Heavy metal-activated synthesis of peptides in *Chlamydomonas reinhardtii*. *Plant Physiol.*, **98**: 127-136.

- Hu, H.; Rabinowitz, M. and Smith, D. (1998): Bone lead as a biological marker in epidemiologic studies of chronic toxicity: Conceptual paradigms. *Environ Health Perspect.*, **106**: 1-7.
- Hu, S.; Lau, K.W.K. and Wu, M. (2001): Cadmium sequestration in *Chlamydomonas reinhardtii*. *Plant Sci.*, **161**: 987-996.
- Hunt, S. (1986): Diversity of biopolymer structure and its potential for ion-binding applications, In: Immobilization of ions biosorption. Eccles, H. and Hunt, S. (eds.), Ellis Harwood Limited, Chichester, England.
- Ibrahim, W.M.; Azab, Y.A.; Kenawy, I. and Mohamedin, A. (2000): Bioremoval of heavy metals from industrial wastewater by free and immobilized microalgae. M.Sc, Mansoura University, Egypt.
- Inthorn, D.; Nagase, H.; Isaji, Y.; Hirata, K. and Miyamoto, K. (1996): Removal of cadmium from aqueous solution by the filamentous cyanobacterium *Tolypothrix tenuis*. *J. Ferment. Bioeng.*, **82(6)**: 580-584.
- Inthorn, D.; Sidtitoon, N.; Silapanuntakul, S. and Incharoensakdi, A. (2002) : Sorption of mercury, cadmium and lead by microalgae. *Science Asia.*, **28**: 253-261.
- Issa, A.(1995): Aspects of growth and nitrogenase activity of the photosynthetic cyanobacterium *Nostoc muscorum* in continuous culture. *Crypt. Algal.*, **10**: 247-253.

- Issa, A.A.; Adam, M.S. and Abdel-Basset, R. (1998): Effect of Ca^{2+} on the detoxification of Cd^{2+} by *Scenedesmus obliquus* cells at low or high temperature. *Folia Microbiol.*, **43**: 645-648.
- Jalali, R.; Ghafourian, H.; Asef, Y.; Davarpanah, S.J. and Sepehr, S. (2002): Removal and recovery of lead using nonliving biomass of marine algae. *Journal of Hazardous Materials*, **92**: 253–262.
- Jensen, T.; Baxter, M.; Rachlin, J. and Jani, V. (1982): Uptake of heavy metals by *Plectonema boryanum* (Cyanophyceae) into cellular components, especially polyphosphate bodies: an X-ray energy dispersive study. *Environmental Pollution*, **27**: 119- 127.
- Kaewsarn P. and Yu Q. (2001): Cadmium(II) removal from aqueous solutions by pre-treated biomass of marine alga *Padina* sp., *Environ Pollut.*, **112(2)**: 209-213.
- Kahle, H. (1993): Response of roots of trees to heavy metals. *Environ. Exp. Bot.*, **33**: 99-119.
- Kaim, W. and Schwederski, B. (1994): Bioinorganic chemistry: Inorganic elements in the chemistry of life. John Wiley and Sons, New York p. 330-348.
- Kaplan, D.; Christiaen, D. and Arad, S. M. (1987): Chelating Properties of Extracellular Polysaccharides from *Chlorella* sp. *Appl. Environ. Microbiology*, **53(12)**: 2953-2956.

- Kaplan, D.; Heimer, Y.M.; Abeliovich, A. and Goldsbrough, P.B. (1995): Cadmium toxicity and resistance in *Chlorella* sp. *Plant Sci.*, **109**: 129–137.
- Kaya, V.M.; Nouee, J.D. and Picard, G. (1994): A comparative study of four systems for tertiary wastewater treatment by *Scenedesmus bicellularis* : New technology for immobilization. *J. Appl. Phycol.*, **7**: 1-2.
- Kayser, H. (1976): Waste water assay using continuous algal cultures: The effect of mercuric acetate on the growth of some marine dinoflagellates. *Mar. Boil.*, **36**: 61-72.
- Khattar, J.I.S.; Sarma, T.A. and Singh, D.P. (1999): Removal of chromium ions by agar immobilized cells of the cyanobacterium *Anacystis nidulans* in a continuous flow bioreactor. *Enzyme and Microbial Technology*, **25**: 564-568.
- Khummongkol, D.; Canterford, G.S. and Fryer, C. (1982): Accumulation of heavy metals in unicellular algae. *Biotechnol. Bioeng.*, **24**: 2643-2660.
- Kirchman, R. and Bonott, S. (1971): Acetabularia, a useful tool for research in pollution Rev. *Internat. Oceanorg. Med.*, **24**: 138- 139.
- Klimmek S.; Stan H.J.; Wilke A.; Bunke G. and Buchholz R. (2001): Comparative analysis of the biosorption of cadmium, lead, nickel, and zinc by algae. *Environ Sci Technol.*, **35(21)**: 4283-4288.

- Koeppel, D.E. and Miller, R.J. (1970): Lead effects on corn mitochondrial respiration. *Science*, **167**: 1376-1378.
- Korrick, S.A.; Hunter, D.J.; Rotnitzky, A.; Hu, H. and Speizer, F.E. (1999): Lead and hypertension in a sample of middle-aged women. *Am. J. Public Health*, **89**: 330-345.
- Kratochvil, D.; Volesky, B. and Demopoulos, G.(1997): Optimizing Cu removal/recovery in a biosorption column. *Wat. Res.*, **31(9)**: 2327-2339.
- Kropfl, K.; Zaray, G. and Acs, E. (2003): Investigation of lead and nickel contaminated natural biofilms. *Spectrochimica Acta*, **58**: 2177-2181.
- Kuwabara, J.S. (1985): Phosphorus-zinc interactive effects on growth by *Selenastrum capricornatum* (Chlorophyta). *Environ. Sci. Technol.*, **19(5)**: 417-421.
- Kuyucak, N. and Volesky, B. (1989a): Accumulation of cobalt by marine algae. *Biotechnology and Bioengineering*, **33**: 809-814.
- Kuyucak, N. and Volesky, B. (1989b): The mechanism of cobalt biosorption. *Biotechnology and Bioengineering*, **33**: 823-831.
- Labyntseva, R.; Ulianenko, T. and Kosterin, S. (1998): Effect of heavy metal ion on super precipitation and ATPase activity of uterine smooth muscle actomyosin activity. *Ukrainskii Biokhimicheskii Zhurnal.*, **70**: 271-277.

References

- Lau, T.C. ; Ang, P.O. and Wong, P.K. (2003): Development of seaweed biomass as a biosorbent for metal ions . *Water Sci Technol.*, **47(10)**: 49-54.
- Leborans, G.F. and Novillo, A. (1996): Toxicity and bioaccumulation of cadmium in *Olithodiscus luteus*. *Water Resources*. **30(1)**: 57-62.
- Lee, L. H. and Lustigman, B. (1996): Effect of barium and nickel on the growth of *Anacystis nidulans*. *Bulletin of Environmental Contamination and Toxicology*, **56**: 985-992.
- Lee, J.G.; Ahner, B.A. and Morel, F.M.M. (1996): Export of cadmium and phytochelatin by the marine diatom *Thalassiosira weissflogii*. *Environ. Sci. Technol.*, **30**: 1814–1821.
- Lee, R.E. (1997): Phycology, 2nd ed.. Cambridge: Cambridge University Press. pp. 10-57.
- Les, A. and Walker, W.R. (1984): Toxicity and binding of copper, zinc, and cadmium by blue-green alga, *Chroococcus paris*. *Water, Air, and Soil Pollution.*, **23**: 129-139.
- Leusch, A.; Holan, Z.R. and Volesky, B. (1995): Biosorption of heavy metals (Cd, Cu, Ni, Pb, Zn) by chemically-reinforced biomass of marine algae. *Journal of Chemical Technology and Biotechnology*. **62**: 279-288.
- Lucido, S.P. and Iwasaki, I. (1991): The removal of Cu from mine effluents using a fresh water green alga, *Cyanidium caldarium*.

- Environmental management for the 1990's: Proceedings of the Symposium on Environmental Management for the 1990's*, Denver, Colorado, February, **143**: 25-28.
- Maclean, F.L.; Lucis, O.J.; Shaikh, Z.A. and Mansz, E.R. (1972): The uptake and subcellular distribution of Cd and Zn in microorganisms. *Fed. Proc.*, **31**: 669-674.
- Madrid, Y.; Barrio-Cordoba, E. and Camara, C. (1998): Biosorption of antimony and chromium species by *Spirulina platensis* and *Phaseolus*. Applications to bioextract antimony and chromium from natural and industrial waters. *Analyst.*, **123**: 1593-1598.
- Maeda, S. and Sakaguchi, T.(1990): Accumulation and detoxification of toxic metal elements by algae. In: Introduction to applied phycology. Akatsuka, I. (ed.) The Hage, The Netherlands. 137-149.
- Malanchuk, J.L. and Gruending, K.G. (1973): Toxicity of nitrate to algae. *Water Air and Soil Pollut.*, **2**: 181-190.
- Mallich, N. and Rai, L.C. (1998): Characterization of Cd-induced low molecular weight protein in a N₂-fixing cyanobacterium *Anabena doliolum* to Co-multiple tolerance. *Biometals*, **11**: 55-61.
- Mallicka, N. and Mohn, F.H. (2003): Use of chlorophyll fluorescence in metal-stress research: a case study with the green microalga *Scenedesmus*. *Ecotoxicology and Environmental Safety*, **55** : 64–69.

- Mang, S. and Broda, E. (1976): Influence of cadmium on the growth of *Chlorella*. *Naturwissenschaften* (Australasia), **63**: 259-301.
- Mangas-Ramirez, E.; Sarma, S.S.S. and Nandini, S. (2002): Combined effects of algal (*Chlorella vulgaris*) density and ammonia concentration on the population dynamics of *Ceriodaphnia dubia* and *Moina macrocopa* (Cladocera). *Ecotoxicology and Environmental Safety*, **51**: 216-222.
- Manning, T.M.; Wilson, S.P. and Chapman, J.C. (1996): Toxicity of chlorine and other chlorinated compounds to some Australian aquatic organisms. *Bull. Environ. Contam. Toxicol.*, **56**: 971-976.
- Matagi, S.V.; Swai, D. and Mugabe, R. (1998): A review of heavy metal removal mechanisms in Wetlands. *Afr. J. Trop. Hydrobiol. Fish.*, **8**: 23-35.
- Matheickal, J.T. and Yu, Q. (1996): Biosorption of lead from aqueous Solutions by marine alga *Ecklonia radita*. *Water Sci. Technol.*, **34**: 1-7.
- Matheickal, J.T.; Feltham, J. and Yu, Q. (1997) : Cu(II) binding by marine alga *Ecklonia radita* biomaterial. *Environ. Technol.*, **18**: 25-34.
- Matheickal, J.T.; Yu, Q. and Woodburn, G. M. (1998): Biosorption of cadmium(II) from aqueous solutions by pre-treated biomass of marine algae *Durvillaea potatoru*. *Wat. Res.*, **32**: 1896-1912.

- McConnell, L.H.; Fink, J.N.; Schlueter, D.P. and Schmidt M.G. (1973): Asthma caused by nickel sensitivity. *Ann. Int. Med.*, **78**: 888-890.
- McHale, A.P. and McHale, S. (1994): Microbial biosorption of metals: Potential in the treatment of metal pollution. *Biotech. Adv.*, **12**: 647-652.
- Mehta, S.K.; and Gaur, J.P. (1999): Heavy metal induced proline accumulation and its role in ameliorating metal toxicity in *Chlorella vulgaris*. *New Phytol.*, **143**: 253–259.
- Miller, R.J. and Koeppe, D.E. (1970): Accumulation and physiological effects of lead in corn. In: Trace substances in environmental health, Hemphil, D.D. (ed.). Univ. Missouri, Columbia, Missouri., 186-193.
- Miller, W.W.; Greene, J.C. and Shiroyama, T. (1978): The *Selenastrum capricornatum* algal assay bottle test: Experimental design, application and data interpretation protocol. APA-600/9-78-018, U.S. Environmental Protection Agency, Corvallis, OR.
- Muraleedharan, T.R.; Iyengar, L. and Venkobachar, C.(1991): Biosorption: an attractive alternative for metal removal and recovery. *Current Science*, **61**: 379-385.
- Muramoto, S. and Ohi, Y. (1983): Removal of some heavy metals from polluted water by water hyacinth. *Bulletin of Environmental Contamination and Toxicology*, **30**: 170-177.

- Murata, K.; Weihe, P.; Araki, S.; Budtz-Jorgensen, E. and Grandjean P. (1999): Evoked potentials in faroese children prenatally exposed to methylmercury. *Neurotoxicol Teratol.*, **21**: 471-475.
- Nakajima, A. (2003): Accumulation of gold by microorganisms. *World Journal of Microbiology and Biotechnology*, **19** (4): 369-374.
- Navarro, R. R.; Sumi, K.; Fujii, N. and Matsumura, M. (1996): Mercury removal from wastewater using porous cellulose carrier modified with polyethyleneimine. *Water Research*, **30**: 2488-2494.
- Neyens, E.; Juliastuti, S.R. and Hulpiau, H. (2001): Reverse osmosis, nanofiltration and enhanced ultrafiltration of wastewaters, 6th World Congress of Chemical Engineering, 23-27 September, Melbourne, Australia.
- Nichols, H.W. (1973): Freshwater growth media. In: Handbook of Phycological methods, culture methods and growth measurements. Stein, J.R. (ed) Cambridge Univ. Press.
- Nielsen, G.D.; Jepsen, L.V.; Jorgensen, P.J.; Grandjean, P. and Brandrup, F. (1990): Nickel-sensitive patients with vesicular hand eczema: oral challenge with a diet naturally high in nickel. *British Journal of Dermatology*, **122**: 299-308.
- Nierenberg, D.W.; Nordgren, R.E.; Change, M.B.; Siegler, R.W.; Blayney, M.B. and Hochberg, F. (1998): Delayed cerebella disease and

- death after accidental exposure to dimethylmercury. *New Engl J Med.*, **338**: 1672-1676.
- Nies, D.H. (1999): Microbial heavy-metal resistance. *Appl. Microbiol. Biotechnol.*, **51**: 730-750.
- Nogawa, K. and Kido, T. (1993): Biological monitoring of cadmium exposure in Itai-Itai disease epidemiology. *Int. Arch. Occup. Environ. Healt.*, **65**: 43–46.
- Noraho, N. and Gaur, J.P. (1996): Cadmium adsorption and intercellular uptake by two macrophytes, *Azolla Pinnata* and *Spirodcla polrhiza*. *Arch. Hydrobiol.*, **136**: 135–144.
- Nosier, S.A. (2003): Removal of cadmium ions from industrial wastewater by cementation. *Chem. Biochem. Eng. Q.*, **17 (3)**: 219–224.
- Nourbakhsh, M.; Sag, Y.; Ozer, D.; Aksu, Z.; Kutsal, T. and Caglar, A. (1994) : A comparative study of various biosorbent for removal of chromium (VI) ions from industrial waste-water. *Process Biochemistry*, **29**: 1-5.
- Novoy, H.S.; Habib, M. and Wells, I.D. (1983): Asthma and IGE antibodies induced by chromium and nickel salts. *J. Allergy*, **72(4)**: 407-412.
- Nriagu, J.O. and Pacyna, J.M. (1988): Quantitative assessment of worldwide contamination of air, water and soils by trace-metals. *Nature*, **333**: 134-139.

- Nuhoglu, Y.; Malkoc, E.; Gurses , A. and Canpolat, N. (2002): The removal of Cu(II) from aqueous solutions by *Ulothrix zonata*. *Bioresource Technology*, **85**: 331–333.
- Nygaard, G.; Komarek, T.; Kristiansen, J. and Skullberg, O.M. (1986): Taxonomic designation of the bioassay alga NIVA-Chl 1 (*Selenastrum capricornatum*) and some related strains. *Opera Botancia*, **90**: 1-46.
- OECD (2002): Guidelines for the testing of chemicals: Draft revised guideline 201 (freshwater algae and cyanobacteria, growth inhibition test), Organization for Economic Cooperation and Development, Paris; 21pp.
- Omar, H.H. (2002): Bioremoval of zinc ions by *Scenedesmus obliquus* and *Scenedesmus quadricauda* and its effect on growth and metabolism. *International Biodeterioration & Biodegradation*, **50**: 95-100.
- Ouariti, O.; Boussama, N.; Zarrouk, M.; Cherif, A. and Ghorbal, M.H. (1997): Cadmium and copper induced changes in tomato membrane lipids. *Phytochemistry*, **45**: 1343-1350.
- Outridge, P. M. and Scheuhammer A. M. (1993): Bioaccumulation and toxicology of nickel: implications for wild mammals and birds. *Environmental Reviews*, **1**: 172-197.

- Pappas, C.; Randall, S. and Sneddon, J. (1990): An atomic emission study of the removal and recovery of chromium from solution by an algae biomass. *Talanta*, **37**: 707-712.
- Pardos, P.; Benninghoff, C. and Thomas, R.L. (1998): Photosynthetic and population growth response of the test alga *Selenastrum capricornutum* Printz to zinc, cadmium and suspended sediment elutriates. *Journal of Applied Phycology*, **10(2)**: 145-151.
- Park, Y.H.; Lim, J.M. and Park, C.R. (1997): New modified poly(ethylene terephthalate) based adsorbent for heavy metal ions. *J. Appl. Pol. Sci.*, **63**: 773-778.
- Parry, G.D. and Hayward, J. (1973): The uptake of zinc by *Dunaliella tertiolecta*. *J.Mar. Biol. Assoc. U.K.*, **53**: 915-922.
- Parsons, J.G.; Peralta-Videa, J.R.; Tiemann, K.J.; Saupe, G.B. and Gardea-Torresdey, J.L. (2005): Use of chemical modification and spectroscopic techniques to determine the binding and coordination of gadolinium (III) and neodymium (III) ions by alfalfa biomass. *Talanta*, **2**: 8-15.
- Peltier, W.H. and Weber, C.I. (1985): Methods for measuring the acute toxicity of effluents to freshwater and marine organisms. 3rd edition- EPA/600/4-85/013. EMSL, ORD, U.S. Environmental Protection Agency, Cincinnati, OH.

- Perez-Rama, M.; Alonso, J.A.; Lopez, C.H. and Vaamonde, E.T. (2002): Cadmium removal by living cells of the marine microalga *Tetraselmis suecica*. *Bioresour. Technol.*, **84(3)**: 265-270.
- Pickett-Heaps, J.S. and Staehelin, L.A. (1975): The ultrastructure of *Scenedesmus* (Chlorophyceae). II. Cell division and colony formation. *J. Phycol.*, **11**: 186-202.
- Pinto, E.; Sigaud-Kutner, T.C.S.; Leitao, M.A.S.; Okamoto, O.K.; Morse, D. and Colepicolo, P. (2003): Heavy metal induced oxidative stress in algae. *J. Phycol.*, **39**: 1008–1018
- Porcella, D.B. (1983): Protocol for bioassessment of hazardous waste sites. EWPA/600/2-83-054. U.S. Environmental Protection Agency, Corvallis, OR.
- Pradhan, S. and Rai, L.C. (2001): Copper removal by immobilized *Microcystis aurignosa* in continuous flow columns at different bed heights: study of the adsorption/desorption cycle. *World Journal of Microbiology and Biotechnology*, **17(9)**: 829-832.
- Prescott, G.W. (1978): How to know the fresh water algae. Third edition. The pictured key nature series. W.M.C. Brown Company Publishers. Dubuque, Iowa.
- Rai, L.C.; Gaur, J.P. and Kumar, H.D. (1981a): Phycology and heavy metal pollution. *Biol. Rev.*, **56**: 99-103.

- Rai, L.; Gaur, J. and Kumar, H. (1981b): Protective effects of certain environmental factors on the toxicity of zinc, mercury and methyl mercury to *Chlorella vulgaris*. *Environmental Research*, **25**: 250-259.
- Rai, L.C. and Mallick, N. (1992): Removal and assessment of toxicity of Cu and Fe to *Anabaena doliolum* and *Chlorella vulgaris* using free and immobilized cells. *World J. Microbiol. Biotechnol.*, **8(2)**: 110-114.
- Rangsayatorn, N.; Upatham, E.S.; Kruatrachue, M.; Pokethitiyook, P. and Lanza, G.R. (2002): Phytoremediation potential of *Spirulina (Arthrospira) platensis*: biosorption and toxicity studies of cadmium. *Environ Pollut.*, **119(1)**: 45-53.
- Rangsayatorn, N.; Pokethitiyook, P.; Upatham, E.S. and Lanza G.R. (2004): Cadmium biosorption by cells of *Spirulina platensis* TISTR 8217 immobilized in alginate and silica gel. *Environment International*, **30**: 57- 63.
- Rao, V.N.R.; Kashyap, A.K. and Kumar, H.D. (1994): Adaptation of algae to heavy metal toxicity. *Recent-advances-in-physiology*, **21**: 261-264.
- Regine, H.S.F. and Volesky, B. (2000): Biosorption: A solution to pollution? *Internatl Microbiol.*, **3**: 17–24.

- Reid, R.J.; Brookes, K.J.D.; Tester, M.A. and Smith, F.A. (1996): The mechanism of zinc uptake in plants; characterisation of the low-affinity system. *Planta*, **198**: 39-45.
- Revis, N.J.P.; Merks, A.G.A.; Valenta, P. and Rutzel, H.(1989): Heavy metal uptake by phytoplankton and other seston particles. *Chemical Speciation and Bioavailability*, **1 (1)**: 31-37.
- Robinson, N. (1988): Algal methallothioneins: Secondary metabolites and protein. *Journal of Applied Phycology*, **1**: 5-18.
- Ross, I.S. and Townsley, C.C. (1986): In: Immobilization of ions by biosorption (eds. Eccles, H. and Hunt, S.), IRL Press, Chichester, pp. 49-58.
- Roy, D.; Greenlaw, P.N. and Shane, B.S. (1993): Adsorption of heavy metals by green algae and ground rice hulls. *J. Environ. Sci. Health*, **28**: 37-50.
- Rucinska, R.; Sobkowiak, R. and Gwozdz, E. A. (2004): Genotoxicity of lead in lupin (*Lupinus luteus*) root cells as evaluated by the comet assay, *Cellular & Molecular Biology Letters*, **9**: 519- 528.
- Sabater, S.; Buchac, T.; Cambra, J.; Catalan, J.; Guasch, H. and Ivorra, N. (2003): Structure and function of benthic algal communities in an extremely acid river. *J. Phycol.*, **39**: 481– 489.

- Sakaguchi ,T.; Tsuji, T.; Nakajima , A. and Horikoshi, T. (1979): Accumulation of cadmium by green microalgae. *European J. Appl. Microbiol. Biotechnol.*, **8**: 207-215.
- Sanchez, A.; Ballester, A.; Blazquez, M.L.; Gonzalez, F.; Munoz, J. and Hammami, A. (1999): Biosorption of copper and zinc by *Cymodocea nodosa*. *FEMS Microbiol Rev.*, **23(5)**: 527-536.
- Sandalio, L.M.; Dalurzo, H.C.; Gómez, M.; Romero-Puertas, M.C. and Río, L.A. (2001): Cadmium-induced changes in the growth and oxidative metabolism of pea plants. *J. Exp. Bot.*, **52**: 2115–2126.
- Sandau, E.; Sandau, L.P.; Pulz, O. and Zimmermann, M. (1996a): Heavy metal sorption by marine algae and algal by-product. *Acta Biotechnol.*, **16**: 103-119.
- Sandau, E.; Sandau, L.P. and Pulz, O. (1996b): Heavy metal sorption by algae. *Acta Biotechnol.*, **16**: 227–235.
- Satarug, S.; Haswell-Elkins, M.R. and Moore, M.R. (2000): Safe levels of cadmium intake to prevent renal toxicity in human subjects. *Br J Nutr.*, **84**:791-802.
- Schat, H.; Sharma, S.S. and Vooijs, R. (1997): Heavy metal induced accumulation of free proline in a metal-tolerant and a non tolerant ecotype of *Silene vulgaris*. *Physiol. Plant.*, **101**: 477-482.
- Schneegurt, M.A.; Jain, J.C.; Menicucci, J.A.; Brown, S.A.; Kemner, K.M.; Garofalo, D.F.; Quallick, M.R.; Neal, C.R. and Kulpa, C.F. (2001):

Biomass byproducts for the remediation of wastewaters contaminated with toxic metals. *Environ Sci Technol.*, **35(18)**: 3786-3791.

Schneider, I.A.H.; Smith, R.W. and Rubio, J. (1999): Effect of some mining chemicals on biosorption of Cu II by the non living biomass of the freshwater macrophyte *potomogenten lucens*. *Miner. Eng.*, **12**: 255–260.

Schneider, I.A.H.; Rubio , J. and Smith, R. W. (2001): Biosorption of metals onto plant biomass: exchange adsorption or surface precipitation? *Int. J. Miner. Process.*, **62**: 111-120.

Schützendübel, A.; Schwanz, P.; Teichmann, T.; Gross, K.; Langenfeld-Heyser, R.; Godbold, D.L. and Polle, A. (2001): Cadmium-induced changes in antioxidative systems, hydrogen peroxide content, and differentiation in Scots pine roots. *Plant Physiol.*, **127**: 887–898.

Scott, J. and Palmer, S. (1990): Sites of cadmium uptake in bacteria used for biosorption. *Applied Microbiology and Biotechnology*, **33**: 221-225.

Segel, I.E. (1976): Biochemical calculations, 2nd Edition, John Wiley and Sons Inc., New York.

Shah, K. and Dubey, R.S. (1998): Effect of cadmium on praline accumulation and ribonuclease activity in rice seedlings: Role of proline as a possible enzyme protectant. *Biol. Plant.*, **40**: 121–130.

- Shieh, Y.J. and Barber, J. (1973): Uptake of mercury by *Chlorella* and its effect on potassium regulation. *Planta*, **109**: 49-60.
- Shukla, S.R. and Sakhardande, V.D. (1991): Metal ion removal by dyed cellulosic materials. *J. Appl. Polym. Sci.*, **42**: 829-835.
- Sies, H. (1999): Glutathione and its role in cellular functions. *Free Radic. Biol. Med.*, **27**: 916–921.
- Silverberg, B.A. (1975): Ultrastructural localization of lead in *Stigeoclonium tenue* (Chlorophyceae, Ulotrichales) as demonstrated by cytochemical and X-ray microanalysis. *Phycologia*, **14**: 265–274.
- Singh, A.L.; Asthana, R.K.; Srivastava, S.C. and Singh, S.P. (1992): Nickel uptake and its localization in a cyanobacterium. *FEMS Microbiol Lett.*, **99**: 165–168.
- Singh, D.P.; Khare, P. and Bisen, P.S. (1989): Effect of Ni, Hg and Cu on growth, oxygen evolution and photosynthetic electron transport in *Cylindrospermam* IU 942. *J. Plant Physiol.*, **134**: 406–412.
- Singh, R. and Prasad, B.B. (2000): Trace metal analysis: selective sample (copper II) enrichment on an Alga SORB column. *Process Biochem.*, **35**: 897– 905.
- Skowronska, T.; De Knecht, J.A.; Simons, J. and Verkleij, J.A.C. (1998): Phytochelatin synthesis in response to cadmium uptake in

Vaucheria (Xanthophyceae). *European Journal of Phycology*, **33**: 87–91.

Skowronska, B.P. (2000): Relationships between acid-soluble thiol peptides and accumulated Pb in the green alga *Stichococcus bacillaris*. *Aquatic Toxicology*, **50**: 221–230.

Skowronska, B.P. (2002): Correlations between toxic Pb effects and production of Pb-induced thiol peptides in the microalga *Stichococcus bacillaris*. *Environmental Pollution.*, **119**: 119-127.

Skowronska, B.P. (2003): Resistance, accumulation and allocation of zinc in two ecotypes of the green alga *Stigeoclonium tenue* Kütz. coming from habitats of different heavy metal concentrations. *Aquatic Botany*, **75**: 189–198.

Sobhan, R. and Sternberg, S.P.K. (1999): Cadmium removal using *Cladophora*. *J. Environ. Sci. Health. Part A. Toxic/Hazardous Substances & Environ. Engineering*, **34(1)**: 53-72

Sponza, D. T. (2002): Necessity of toxicity assessment in Turkish discharges (examples from metal and textile industry effluents). *Environmental Monitoring and Assessment*, **73**: 41-66.

Staessen, J.A.; Roels, H.A.; Emelianov, D.; Kuznetsova, T.; Thijs, L. and Vangronsveld, J. (1999): Environmental exposure to cadmium, forearm bone density, and risk of fractures: Prospective

population study. Public Health and Environmental Exposure to Cadmium Study Group. *Lancet*, **353**: 1140-1144.

Stauber, J.L. and Florence, T.M. (1989): The effect of culture medium on metal toxicity to the marine diatom *Nitzschia closterium* and the freshwater green alga *Chlorella pyrenoidosa*. *Wat. Res.*, **23(7)**: 907- 911

Sternberg S.P. and Dorn R.W. (2002): Cadmium removal using *Cladophora parriaudii* in batch, semi-batch and flow reactors. *Bioresour Technol.*, **81(3)**: 249-255.

Stirk, W.A. and Van Staden, J. (2002): Desorption of cadmium and the reuse of brown seaweed derived products as biosorbents. *Botanica Marina*, **45**: 9-16.

Stohs, S.J.; Bagchi, D.; Hassoun, E.; and Bagchi, M. (2000): Oxidative mechanisms in the toxicity of chromium and cadmium ions. *J. Environ. Pathol. Toxicol. Oncol.*, **19**: 201–213.

Stratton, G.W. and Croke, C.T. (1979): The effect of cadmium ions on the growth, photosynthesis and nitrogenase activity of *Anabeana inaequalis*. *Chemosphere*, **5** :277-282.

Stratton, G.W.; Huber, A.L. and Croke, C.T. (1979): Effect of mercuric ion on the growth, photosynthesis and nitrogenase activity of *Anabeana inaequalis*. *Appl. Environ. Microbiol.*, **38(3)**: 537-543.

- Sunda, W.G. and Lewis, J.A.M. (1978): Effect of complexation by natural organic ligands on the toxicity of copper to a unicellular alga, *Monochrysis lutheri*. *Limnol. Oceanogr.*, **23(5)**: 870-876.
- Sutherland, I.W. (1990): Biotechnology of microbial exopolysaccharides, University Press, Cambridge, USA. p. 163-172.
- Takamura, N.; Kasai, F. and Watanabe, M.M. (1989): Effect of Cu, Cd and Zn on photosynthesis of freshwater benthic algae. *J. Appl. Phycol.*, **1**: 39–52.
- Tam, N.F.Y.; Wong, J.P.K. and Wong, Y.S. (2001): Repeated use of two *Chlorella* species for cyclic nickel biosorption. *Environ. Pollut.*, **114**: 85-92.
- Terry, P.A. and Stone, W. (2002): Biosorption of cadmium and copper contaminated water by *Scenedesmus abundans*. *Chemosphere*, **47**: 249–255.
- Tien, C.J. (2002): Biosorption of metal ions by freshwater algae with different surface characteristics. *Process Biochemistry*, **38**: 605-613.
- Ting, Y.P.; Lawson, F. and Prince, I.G. (1991): Uptake of cadmium and zinc by the alga *Chlorella vulgaris*: part II. Multi-ion situation. *Biotechnology and Bioengineering*, **37**: 445–455.
- Thomas, W.H. and Seibert, D.L.K. (1977): Effect of copper on the dominance and the diversity of algae. *Bull. Mar.Sci.*, **27(1)**: 34-43.

- Toppi, L.S. and Gabbrielli, R. (1999): Response to cadmium in higher plants. *Environ. Exp. Bot.*, **41**: 105-130.
- Torresdey, J.L.; Arenas, J.L.; Francisco, N.M.C.; Tiemann, K.J. and Webb, R. (1998): Ability of immobilized cyanobacteria to remove metal ions from solution and demonstration of the presence of metallothionein genes in various strains. *Journal of Hazardous Substance Research*, **1**: 1-18
- Travieso, L. ; Canizares-Villanueva, R.O.; Borja, R.; Benitez, F.; Dominguez, A.R.; Dupeyron, R. and Valiente, V. (1999): Heavy metal removal by microalgae. *Bull. Environ. Contam. Toxicol.*, **62**: 144–151.
- Travieso, L.; Pellón , A.; Benitez, F.; Sánchez, E.; Borja, R.; Farrill, N. O. and Weiland, P. (2002): Bioalga reactor: preliminary studies for heavy metals removal. *Biochemical Engineering Journal*, **12**: 87-91.
- Trevors, J.T.; Stratton, G.W. and Gadd, G.M. (1986): Cadmium transport, resistance, and toxicity in bacteria, algae, and fungi. *Canadian Journal of Microbiology*, **32**: 464–474.
- Tsuritani, I.; Honda, R.; Ishizaki, M.; Yamada, Y. and Nishijo, M. (1996): Ultrasonic assessment of calcaneus in inhabitants in a cadmium-polluted area. *J. Toxicol. Environ. Health*, **48**: 131–140.

- Turner, J.S. and Robinson, N.J. (1995): Cyanobacterial metallothioneins: biochemistry and molecular genetics. *J. of Industrial Microbiology*, **14**: 119-125.
- US Environmental Protection Agency. (1986): Air quality criteria for lead. Research Triangle Park (NC): Environmental Criteria and Assessment Office; EPA-600/8-83-028.
- USPHS; (U. S. Public Health Service) (1993): Toxicological profile for nickel. U.S. Public Health Service, Agency for Toxic Substances and Disease Registry, Atlanta, Georgia. 158 - 283.
- Van Assche, F. and Clijsters, H. (1990): Effects of metals on enzyme activity in plants. *Plant, Cell and Environment*, **13**: 195-206.
- Van Eykelenburg, C. (1978): A glucan from the cell wall of the Cyanobacterium. *Antonie van Leeuwenhoek*, **44**: 321-327.
- Vasseur, P. ; Bios, F.; Ferard, J.F.; Rast, C. and Larbaigt, G. (1986): Influence of physio-chemical parameters on the microtox test response. *Tox. Assess.*, **1**: 283-300.
- Venkataraman, L.V. and Becker, E.W. (1986): In: Biotechnology and utilization of algae: The Indian Experience Pub. Department of Science and Technology, New Delhi, India.
- Venkatarataman, L.V.; Suvarnalatha, G. and Manaj, G. (1992): Uptake, accumulation and toxicity of heavy metals in algae. *Phykos*, **31(1,2)** : 173-195.

- Verma, D.P.S. (1999): Osmotic stress tolerance in plants: Role of proline and sulfur metabolisms. In *Molecular Responses to Cold, Drought, Heat and Salt Stress in Higher Plants*, K. Shinozaki and K. Yamaguchi-Shinozaki, eds (Austin, TX: R.G. Landers). pp. 153–168.
- Volesky, B. (1990): *Biosorption of Heavy Metals*. CRC Press, Boston, USA. 408 -414.
- Volesky, B. (1994): Advances in biosorption of metals: selection of biomass type. *FEMS Microbiol Rev.*, **14**: 291–302.
- Walsh, G.E.; Deans, C.H. and Mclaughlin, L.L. (1987): Comparison of four methods for calculating the EC₅₀ from algal population growth. *Environ. Toxicol. Chem.*, **6**: 767-770.
- Wang, T.; Weissman, J.; Ramesh, G.; Varadarajan, E. and Benemann, J. (1998): Heavy metal binding and removal by *Phormidium*. *Bulletin of Environmental Contamination and Toxicology*, **60**: 739–744.
- Weckesser, J.; Hofmann, K.; Jurgens, U.J.; Whitton, B.A. and Raffelsberger, B. (1988): Isolation and chemical analysis of the sheaths of the filamentous Cyanobacteria *Calothrix parietina* and *C. scopulorum*. *J Gen Microbiol.*, **134**: 629-634.
- Wehrheim, B. and Wetter, M. (1994): Biosorption of cadmium, copper and lead by isolated mother cell walls and whole cells of *Chlorella fusca*. *Appl. Microbiol. Biotech.*, **41**: 725-728.

- Weissenhorn, I.; Mench, M. and Leyval, C. (1995): Bioavailability of heavy metals in a sewage-sludge-amended sandy soil. *Soil Biology and Biochemistry*, **27**: 287-296.
- Whitton, B.A. ; Say, P.J. and Wehr, J.D. (1981): Use of plants to monitor heavy metals in rivers. In: Heavy metals in northern England: environmental and biological aspects, Say, P.J. and Whitton, B.A. (eds.), pp: 135–145.
- Wierzbicka, M. (1995): How lead loses its toxicity to plants. *Acta Soc. Bot. Pol.*, **64**: 81-90.
- Wilde, E.W. and Benemann, J.R. (1993): Bioremoval of heavy metals by use of micro-algae. *Biotechnol. Advances*, **11**: 781– 812.
- Wilkinson, S.C.; Goulding, K.H. and Robinson, P.K. (1990): Mercury removal by immobilized algae in batch culture systems. *Journal of Applied Phycology*, **2**: 223-230.
- Winterbourn, C.C. (1982): Superoxide-dependent formation of hydroxyl radicals in the presence of iron salts is a feasible source of hydroxyl radicals in vivo. *Biochem. J. Lett.*, **205**: 461-463.
- Wong, P.K. and Change, L. (1991): Effect of copper, chromium and nickel on growth, photosynthesis and chlorophyll-a synthesis of *Chlorella pyrenoidosa*. *Environ. Pollut.*, **72**: 127-139.

- Wong, P.K. and Kwok, S.C. (1992): Accumulation of nickel ion by immobilized cells of *Enterobacter* species. *Biotechnol Lett.*, **14**: 629–634.
- Wong, M.H. and Pak, D.C.H. (1992): Removal of copper and nickel by free and immobilized microalgae. *Biomedical and Environmental Sciences*, **5**: 99-108.
- Wong, M.Y.; Sauser, K.R.; Chung, K.T.; Wong, T.Y. and Liu, J.K. (2001): Response of the ascorbate-peroxidase of *Selenastrum capricornutum* to copper and lead in stormwaters. *Environmental Monitoring and Assessment*, **67**: 361-378.
- Wood, J.M. and Wang, H.K. (1983): Microbial resistance to heavy metals. *Environ. Science Technol.*, **17**: 582-590.
- Xia, H. and Rayson, G.D. (2002): Cd-NMR spectrometry of Cd binding sites on algae and higher plant tissues. *Advances in Environmental Research*, **7**: 157-167.
- Xue, H.B.; Stumm, W. and Sigg, L. (1988): The binding of heavy metals to algal surfaces. *Water Res.*, **22**: 917-926.
- Ye, J.; Wang, S.; Barger, M.; Castranova, V. and Shi, X. (2000): Activation of androgen response element by cadmium: a potential mechanism for a carcinogenic effect of cadmium in the prostate. *J Environ Pathol Toxicol Oncol.*, **19**: 275-280.

- Yin, P.; Yu, Q.; Lin, Z. and Kaewsarn, P. (2001): Biosorption and desorption of cadmium(II) by biomass of *Laminaria japonica*. *Environ Technol.*, **22(5)**: 509-514.
- Yu, Q. and Kaewsarn, P. (1999): Fixed-Bed study for copper (II) removal from aqueous solutions by marine algae *Durvillaea potatorum*. *Environm. Technol.*, **20**: 1005-1008.
- Yu, Q.; Matheickal, J. T.; Yin, P. and Kaewsarn, P. (1999): Heavy metal uptake capacities of common marine macroalgal biomass. *Wat. Res.*, **33(6)**: 1534-1537.
- Zarrouk, C. (1966): Contribution a l'étude d'une cyanophycee. Influence de divers facteurs physiques et chimiques sur la croissance et la photosynthese de *Spirulina maxima*. Thesis, University of Paris.
- Zavodnik, N. (1977): Note on the effects of lead on oxygen production of several littoral seaweeds of the Adriatic Sea. *Botanica Marina*, **20**: 107-170.
- Zhang, W. and Majidi, V. (1994): Monitoring the cellular response of *Stichococcus bacillaris* to exposure of several different metals using in vivo ³¹P NMR and other spectroscopic techniques. *Environ. Sci. Technol.*, **28**: 1577-1581.
- Zhang, Q.; Kusaka, Y.; Zhu, X.; Sato, K.; Mo, Y.; Kluz, T. and Donaldson, K. (2003): Comparative toxicity of standard nickel and ultrafine

nickel in lung after intratracheal instillation. *J.Occup.Health*, **45**: 23-30.

Zhao, M.; Duncan, J.R. and Van Hille, R.P. (1999): Removal and recovery of zinc from solution and electroplating effluent using *Azolla filiculoides*. *Wat. Res.*, **33**: 1516-1522.

Zhao, L.; Yin, P.; Yu, Q. and Qi, Y. (2001): Bioaccumulation mechanism of red tide alga *Prorocentrum micans* for heavy metal ions. *Huan Jing Ke Xue*, **22(4)**: 42-45.

Zhou, J.L.; Huang, P.L. and Lin, R.G. (1998): Sorption and desorption of Cu and Cd by macroalgae and microalgae. *Environ. Pollut.*, **101**: 67-75.