

8. REFERENCES

About O.A.S.A., 2010. Impact of pollution with lead, mercury and cadmium on the immune response of *Oreochromis niloticus*. New York. Sci. J. 3(9): 12-16.

[ATSDR] Agency for toxic Substance and Disease Registry. 1992. Toxicological profile for lead draft. Atlanta: U.S. Department of Health and Human Services, public Health Service.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2007. Toxicological profile for arsenic, draft for public comment. Retrieved from <http://www.atsdr.cdc.gov/toxprofiles/tp2.html>.

[IARC] International Agency for Research on Cancer. 2004. IARC monograph on the evaluation of carcinogenic risk to humans. Some drinking water disinfectant and contaminants, including arsenic. Vol. 84. Lyon, FR.

[NRC] National Research Council. 2000. Arsenic in drinking water. Washington, DC: National Academy Press.

Abernathy C.O., Ohanian, E.V., 1993. Health effects of inorganic arsenic in drinking water. Proc. AWWA WQTC, Miami, Fla., Nov. 7-11.

Adams S.M., Greesly M.S., 1999. Establishing possible links between aquatic ecosystem health and human health: an integrated approach. In: Interconnections between human and ecosystem health. Di Giulio R.T., Monosson E. (ed.). Chapman and Hall, London p. 91-102.

Adeniyi A.A., Yusuf K.A., 2007. Assessment of the exposure of two fish species to metals pollution in the Ogun river catchments, Ketu, Lagos, Nigeria. Environ. Monit. Assess. 37: 451-458.

Aderem A., Underhill D.M., 1999. Mechanisms of phagocytosis in macrophages. Annu. Rev. Immunol. 17:593-623.

Akter M.S., Ahmed M.K., Akhand M.A.A., Islam M.A., 2008. Acute toxicity of arsenic and mercury to fresh water climbing perch, *Anabas testudineus* (Bloch.). World. J. Zool. 3(1): 13-18.

Alain G., Tousignant, J., Rozenfarb, E., 1993. Chronic arsenic toxicity. Int. J. Dermatol. 32: 899-901.

Alexander J.B., Ingram G.A., 1992. Noncellular non-specific defence mechanisms in fish. Ann. Rev. Fish. Dis. 2: 249-279.

Almroth B.C., 2008. Oxidative Damage in Fish used as Biomarkers in Field and Laboratory Studies. Department of Zoology/Zoophysiology Goteborg University Sweden. 1:74.

- Anderem A., Underhill D.M., 1999. Mechanisms of phagocytosis in macrophages. *Annu. Rev. Immunol.* 17: 593-623.
- Anjem A., Varghese S., Imlay J.A., 2009. Manganese import is a key element of the OxyR response to hydrogen peroxide in *Escherichia coli*. *Mol. Microbiol.* 72:844–858.
- Aposhian H.V., 1989. Biochemical toxicology of arsenic. *Rev. Biochem. Toxicol.* New York, NY: Elsevier/North Holland. 10:265–299.
- Aranyi C., Bradof J.N., O’Shea W.J., Graham J.A., Miller F.J., 1985. Effects of arsenic trioxide inhalation exposure on pulmonary antibacterial defenses in mice. *J. Toxicol. Environ. Health.* 15:163–72.
- Babior B.M., 1999. NADPH oxidase: an update. *Blood.* 93: 1464 –1476.
- Barchowsky A., Dudek E.J., Treadwell M.D., Wetterhahn K.E., 1996. Arsenic induces oxidant stress and NF kappa B activation in cultured aortic endothelial cells. *Free. Radic. Biol. Med.* 21: 783-790.
- Barth D.A., Berlin R., Engel P.R., Smeets J. (ed.). 1973. Proceedings international symposium. Environmental health aspects of lead. *Comis. European Commun., Luxembourg.* p. 1168.
- Birdsall C.W., Grue C.E., Anderson, A., 1986. Lead concentrations in bullfrog *Rana catesbeiana* and green frog *R. clamitans* tadpoles inhabiting highway drainages. *Environ. Pollut.* 40A:233-247.
- Birge W.J., Roberts O.W., 1976. Toxicity of metals to chick embryos. *Bull. Environ. Contam. Toxicol.* 16: 319-324.
- Bishayi B., Sengupta M., 2003. Intracellular survival of *Staphylococcus aureus* due to alteration of cellular activity in arsenic and lead intoxicated mature Swiss albino mice. *Toxicol.* 184:31–9.
- Bogges W.R. (ed.). 1977. Lead in the environment. *Natl. Sci. Found. Rep. NSF/RA-770214.* p. 272. Avail. from U.S. Gov. Printing Office, Washington, D.C. 20402.
- Bols N.C., Brubacher J.L., Ganassin, R.C., Lee L.E.J., 2001. Ecotoxicology and innate immunity in fish. *Dev. Comp. Immunol.* 25:853-873.
- Bondy S.C. Oxygen generation as a basis for neurotoxicity by metals. In: *Toxicology of Metals.* Chang, L.W.; Eds.; CRC Press, Boca Raton, 1996, p. 699-706.

- Borenfreund E., Babich H., Martin-Alguacil N., 1988. Comparison of two in vitro cytotoxicity assays: The neutral red (NR) and tetrazolium (MTT) tests. *Toxicol.in vitro.* 2: 1–6.
- Bos A.R., Weaver R., Roos D.,1990. Characterization and qualification of peroxidase in human neutrophils.*Biochem..Biophys..Acta.*525: 4133- 4141.
- Bustamante J., Dock L., Vahter M., Fowler B., Orrenius S., 1997. The semiconductor elements arsenic and indium induce apoptosis in rat thymocytes. *Toxicol.* 118:129–36.
- Camardese M.B., Hoffman D.J., LeCaptain L.J., Pendleton G.W., 1990. Effects of arsenate on growth and physiology in mallard ducklings.*Environ. Toxicol. Chem.* 9: 785-795.
- Carlberg I., Mannervik B.,1975. Purification and characterization of the flavoenzyme glutathione reductase from rat liver.*J. Biol. Chem.*250: 5475-5480.
- Censi P., Spoto S.E., SaianoF., SprovieriM., MazzolaS., NardoneG., GeronimoS.I.D., Punturo R., OttonelloD., 2006. Heavy metals in coastal water systems.A case study from the northwestern Gulf of Thailand.*Chemosphere.* 64: 1167-1176.
- Chakraborti D., Hussam A., Alauddin M., 2003b. Arsenic: Environmental health aspects with special reference to ground water in South Asia. *J. Environ. Sci. Health. Part A* 38(1):xi–xv.
- Chakraborti D., Mukherjee S.C., Saha K.C., Chowdhury U.K., Rahman M.M., Sengupta M.K., 2003a. Arsenic toxicity from homeopathic treatment. *J. Toxicol. Clin.Toxicol.* 41(7): 963– 967.
- Chavez E., Holguin J.A.,1988. Mitochondrial calcium release as induced by Hg²⁺. *J.Biol. Chem.* 263: 3582-3587.
- Chen Y.C., Lin-Shiau S.Y., Lin J.K.,1998. Involvement of reactive oxygen species and caspase 3 activation in arsenite-induced apoptosis. *J. Cell. Physiol.*177:324–333.
- Chiesa S., Scalici M., Gibertini G., 2006. Occurrence of allochthonous freshwater crayfishes in Latium (Central Italy). *Bull. Fr Pêche. Piscic.* 380-381: 883-902.
- Chowdhury U.A., Biswas B.K., Chowdhury T.R., Samanta G., Mandal B.K., Basu G.C., Chanda C.R., Lodh D., Saha K.C., Mukherjee S., Roy S., Kabir S., Quamruzzaman Q., Chakraborti D., 2000. Ground water arsenic contamination in Bangladesh and West Bengal, India. *Environ Health Persp.* 108(5): 393-7.
- Chung, S., Secombes, C.J., 1998. Analysis of the events occurring within teleost macrophages during the respiratory burst. *Comp. Biochem. Physiol.* 89:539-544.
- Claiborne, A., 1985. ‘Catalase activity’. In: ‘CRC Handbook of Methods for Oxygen Radical Research’ Ed: Greenwald, R.A.) CRC Press, Boca Raton, FL, p. 283–284.

Cohen D., Moore M., 2007. Occupational Skin Disease. In: Rom W and Markowitz S eds. Environmental and Occupational Medicine, 4th ed. Hagerstown, MD: Lippincott Williams & Wilkins. p. 635.

Cuzick J., Evans S., Gillman M., Prince Evans D.A., 1982. Medicinal arsenic and internal malignancies. Br. J. Cancer. 45: 904-11.

Czuprynski C.J., Henson P.M., Campbell P.A., 1984. Killing of *Listeria monocytogenes* by inflammatory neutrophils and mononuclear phagocytes from immune and non immune mice. J. Leuk. Biol. 35: 193-208.

Datta D.V., 1976. Arsenic and non-cirrhotic portal hypertension. Lancet. 1: 433.

Datta S., Ghosh D., Saha D.R., Bhattacharaya S., Mazumder S., 2009. Chronic exposure to low concentration of arsenic is immunotoxic to fish: Role of head kidney macrophages as biomarkers of arsenic toxicity to *Clarias batrachus*. Aq. Toxicol. 92(2): 86-94.

Davies M.J., Hawkins C.L., Pattison D.I., Rees M.D., 2008. Mammalian heme peroxidases: from molecular mechanisms to health implications. Antioxid. Redox. Signal. 10: 1199–1234.

de la Fuente H., Portales-Perez D., Baranda L., Diaz-Barriga F., Saavedre-Alanis V., 2002. Effect of arsenic, cadmium and lead on the induction of apoptosis of normal human mononuclear cells. Clin. Exp. Immunol. 129:69–77.

De Michele S.J., 1984. Nutrition of lead. Comp. Biochem. Physiol. 78A: 401-408.

De Vos., C.H.R., Schat H., 1991. Free radical and heavy metal tolerance. In: Rozema, J., Verkleji, J.A.C. (ed.), Ecological Response to Environmental Stress. Kluwer, Dordrecht, p. 22–30.

DeLeo F.R., Quinn, M.T., 1996. Assembly of the phagocyte NADPH oxidase: molecular interaction of oxidase proteins. J. Leuk. Biol. 60: 677- 691.

Devi R., Bannerjee T.K., 2007. Toxicopathological impact of sub-lethal concentration of lead nitrate on the aerial respiratory organs of 'murrel' *Channa striata* (Bloch, Pisces). Iran. J. Environ. Health. Sci. Eng. 4(4):249-256.

Di Giulio R.T., Washburn P.C., Wenning R.J., Winston G.W., Jewell C.S., 1989. Biochemical responses in aquatic animals: a review of determinants of oxidative stress. Environ. Toxicol. Chem. 8: 1103-1123.

Diefenbach A., Schindler H., Röllinghoff M., Yokoyama W. M., Bogdan C., 1999. Science. 284:951–955.

Dietert R.R., Piepenbrink M.S., 2006. Lead and immune function. Crit. Rev. Toxicol. 36(4): 359-85.

- Dimitrova M.S.T., Tsinova V., Velcheva V., 1994. Combined effect of zinc and lead on the hepatic superoxide dismutase-catalase system in carp (*Cyprinus carpio*). *Comp. Biochem. Physiol. Part C*, 108: 43-46.
- Duce J.A., Bush A.I., 2010. Biological metals and Alzheimer's disease: Implications for therapeutics and diagnostics. *Prog. Neurobiol.* 92: 1-18.
- Eisler R., 1988. Arsenic hazards to fish, wildlife, and invertebrates: a synoptic review. U.S. Fish and Wildlife Service Biological Report 85 (1.12), Contaminant Hazard Reviews Report 12. p. 92.
- El Benna J., Dang P. M., Gaudry M., Fay M., Morel F., Hakim J., Gougerot-Pocidallo M. A., 1997. Phosphorylation of the respiratory burst oxidase subunit p67 (phox) during human neutrophil activation: Regulation by protein kinase C-dependent and independent pathways. *J. Biol. Chem.* 272: 17204-1728.
- Ellis A.E., 2001. Innate host defense mechanisms of fish against viruses and bacteria. *Dev. Comp. Immunol.* 25:827-39.
- Ellman G.L., 1959. Tissue sulfhydryl groups. *Arch. Biochem. Biophys.* 82: 70-77.
- English J., Pearson G., Wilsbacher J., Swantek J., Karandikar M., Xu S., 1999. New insights into the control of MAP kinase pathways. *Exp. Cell. Res.* 233: 255-270.
- Englyst V., Lundstrom N.G., Gerhandsson L., Rylander L., Nordberg G., 2001. Lung cancer risks among lead smelter workers also exposed to arsenic. *Sci. Total. Environ.* 273(1-3): 77-82.
- EPA. 1980. Ambient water quality criteria for lead. U.S. Environ. Protection Agency Rep. 440/5-80-057. p. 151. Avail. from Natl. Tech. Infor. Serv., 5285 Port Royal Road, Springfield, Virginia 22161.
- Ercal N., Gurer-Orhan H., Aykin-Burns N., 2001. Toxic metals and oxidative stress part I: mechanisms involved in metal-induced oxidative damage. *Curr. Top. Med. Chem.* 1(6): 529-39.
- Espinoza E., Mann M.J., 1995. Arsenic and mercury in traditional chinese herbal balls. *N. Engl. J. Med.* 333: 803-804.
- Ezemonye L., Enuneku A., 2005. Evaluation of acute toxicity of cadmium and lead to amphibian tadpoles (Toad: *Bufo maculatus* and frog: *Ptychadena bibroni*). *J. Aq. Sci.* 20(1): 33-38.

- Fairbrother A., Fix M., O'Hara T., Ribic C.A., 1994. Impairment of growth and immune function of avocet chicks from sites with elevated selenium, arsenic, and boron. *J. Wildl. Dis.* 30: 222-33.
- Fang F.C., 2004. Antimicrobial reactive oxygen and nitrogen species: concepts and controversies. *Nat. Rev. Microbiol.* 2: 820–832.
- Finkel T., 2003. Oxidant signals and oxidative stress. *Curr. Op. Cell. Biol.* 15:247–254.
- Forman H.J., Torres M., 2002. Reactive oxygen species and cell signaling. *Am. J. Resp. Critic. Care. Med.* 166: 24-28.
- Frei B., 1999. Molecular and biological mechanisms of antioxidant action. *FASEB J.* 13: 963-964.
- Fruman D.A., Cantley L.C., 2002. Phosphoinositide 3-kinase in immunological systems. *Immunol.* 14: 7-18.
- Fujiki K., Yano T., 1997. Effect of sodium alginate on the non-specific defense system of the common carp. *Fish. Shellfish. Immunol.* 7: 417-427.
- Garbarino J.R., Bednar A.J., Rutherford D.W., Beyer R.S., Wershaw R.L., 2003. Environmental fate of roxarsone in poultry litter. I. Degradation of roxarsone during composting. *Environ. Sci. Technol.* 37:1509–14.
- Gayathri M., Rao B., Shetty V., Sudha K., 2007. Evaluation of lead toxicity and antioxidants in battery workers. *Biomed. Res.* 19(1): 1-4.
- Ghezzi P., Bonetto V., 2003. Redox proteomics: Identification of oxidatively modified proteins. *Proteomics.* 3: 1145-1153.
- Giberson A., Vaziri N.D., Mirahadi K., Rosen S.M., 1976. Haemodialysis of acute arsenic intoxication with transient renal failure. *Arch. Intern. Med.* 136: 1303–1304.
- Gilani S.H., Alibhai Y., 1990. Teratogenicity of metals to chick embryos. *J. Toxicol. Environ. Health.* 30: 23-31.
- Goldstein B. J., Mahadev K., Wu X., Zhu L., Motoshima H., 2005. Role of insulin induced reactive oxygen species in the insulin signaling pathway. *Antioxid. Redox. Signal.* 7: 1021-1031.
- Gonzales-Rangel Y., Portales-Perez D.P., Galicia-Cruz O., Escudero-Lourdes C., 2005. Chronic exposure to arsenic sensitizes CD3 β and CD56 β human cells to sodium arsenite-mediated apoptosis. *Proc. West. Pharmacol. Soc.* 48: 89–91.

- Gunasegaran K.Q., Xie W., Buller R.M., Nathan C., Duarte C., MacMicking, J.D., 1993. Inhibition of viral replication by interferon- γ -induced nitric oxide synthase. *Science*.261:1445-1447.
- Gurr J.R., Liu F., Lynn S., Jan K.Y., 1998. Calcium dependent nitric oxide production is involved in arsenite induced micronuclei. *Mutat. Res.* 416: 137-48.
- Gwinn M.R., Vallyathan V., 2006. Nanoparticles: Health effects - Pros and cons. *Environ. Health.Persp.* 114(12):1818-1825.
- Gyorgyey F., 1987. Arsenic and no lace. *Caduceus*.3: 40-65.
- Halliwell B., Gutteridge J.M.C., 1999. Free radicals in biology and medicine. Oxford University Press, Oxford.
- Haribabu B., Zhelev D.V., Pridgen B.C., Richardson R.M, Ali H., Snyderman R.,1999.Chemoattractant receptors activate distinct pathways for chemotaxis and secretion. Role of G-protein usage. *J. Biol. Chem.* 274:37087–37092.
- Harrison M.T., McCoy K.L., 2001. Immunosuppression by arsenic: a comparison of cathepsin L inhibition and apoptosis. *Int. Immunopharmacol.* 1:647–56.
- Harrison R.M., Laxen D.P.H., 1981. Lead pollution. Causes and control. Chapman and Hall, New York. p. 168.
- Hatch G.E., Boykin E., Graham J.A., Lewtas J., Pott F., Loud K., Mumford J.L., 1985. Inhalable particles and pulmonary host defense: in vivo and in vitro effects of ambient air and combustion particles. *Environ. Res.* 36:67–80.
- Hoffmann J.A., Kafatos F.C., Janeway C.A., Ezekowitz R.A., 1999. Phylogenetic perspectives in innate immunity.*Science.* 284: 1313-1318.
- Howard J.K.,1974. Human erythrocyte glutathione reductase and glucose 6- phosphate dehydrogenase activities in normal subjects and in persons exposed to lead. *Clin. Sci. Molec. Med.* 47: 515-520.
- Hultberg B., Anderson A., Isaksson A.,2001.interaction of metals and thiols in cell damage and glutathione distribution: potentiation of mercury toxicity by dithiothreitol. *Toxicol.*156:93-100.
- Humphries K.M., Juliano C., Taylor S.S.,2002. Regulation of cAMPdependent protein kinase activity by glutathionylation.*J. Biol. Chem.*.277: 43505-43511.
- Imlay JA. Oxidative stress. In: Böck A, Curtis R3, Kaper J, Karp PD, Neidhardt FC, Nystrom T., 2009. (ed.). *EcoSal- Escherichia coli and Salmonella: Cellular and Molecular Biology*.Washington, DC: ASM Press.

IPCS 1995. Inorganic lead - Environmental Health Criteria 165. International Programme on Chemical Safety. World Health Organisation, Geneva, Switzerland.

Jacobs A.A., Huber J.L., Ward R.A., Klein J.B., Mcleish K.R., 1995. Chemoattractant receptor-specific differences in G protein activation rates regulate effector enzyme and functional responses. *J. Leuko. Biol.* 57: 679-686.

Janeway C.A. Jr., Medzhitov R., 1998. Introduction: the role of innate immunity in the adaptive immune response. *Semin. Immunol.* 10:349-350.

Jeziarska B., Witeska M., 2006. The metal uptake and accumulation in fish living in polluted waters. *Soil. Water. Poll. Monit. Prot. Remed.* 3-23.

Jozefczak M., Remans T., Vangronsveld J., Cuypers A., 2012. Glutathione is a key player in metal-induced oxidative stress defenses. *Int. J. Mol. Sci.* 13: 3145-3175.

Huang J., DeGraves F.J., Lenz S.D., Gao D., Feng P., Li D., Schlapp T., Kaltenboeck B., 2002. The quantity of nitric oxide released by macrophages regulates Chlamydia-induced disease. *PNAS* 99 (6):3914–3919.

Johri N., Jacquillet G., Unwin R., 2010. Heavy metal poisoning: the effects of cadmium on the kidney. *Biometals.* 23: 783-792.

Kaltreider R.C., Davis A.M., Lariviere J.P., Hamilton J.W., 2001. Arsenic alters the function of glucocorticoid receptor as a transcription factor. *Environ. Health. Perspect.* 109:245 – 51.

Kettle A.J., Winterbourn C.C., 1997. Myeloperoxidase: a key regulator of neutrophil oxidant production. *Redox. Rep.* 3: 3–15.

Khangarot B.S., Sehgal A., Bhasin M.K., 1985. Man and biosphere- Studies on the Sikkim Himalayas. Part 5: Acute toxicity of elected heavy metals on the tadpoles of *Rana hexadactyla*. *Acta. Hydrochim. et Hydrobiol.* 13: 259-263.

Khojasteh S.M.B., 2012. The morphology of the post-gastric alimentary canal in teleost fishes: a brief review. *Int. J. Aq. Sci.* 3 (2): 71-88.

Klebanoff S.J., 2005. Myeloperoxidase: friend and foe. *J. Leuk. Biol.* 77: 598–625.

Kohn H.W., 1983. The significance of DNA damage assays in toxicity and carcinogenicity assessment. *Ann. N.Y. Acad. Sci.* 407:106-118.

Kwon J., Lee S.R., Yang K.S., Ahn Y., Kim Y.J., Stadtman, E.R. Rhee, S G., 2004. Reversible oxidation and inactivation of the tumor suppressor PTEN in cells stimulated with peptide growth factors. *Proc. Natl. Acad. Sci. USA* 101: 16419-16424.

- Landrigan P.J., Silbergeld E.K., Froines J.R., Pfeffer R.M., 1990. Lead in the modern workplace. *Am. J. Public. Health.* 80(8): 907–908.
- Leigh P.C.J., Van F.R., Zwet T.L., 1986. In vitro determination of phagocytosis and intracellular killing of polymorphonuclear neutrophils and mononuclear phagocytes. In: Weir DM, (ed.). *Handbook of experimental immunology.* Oxford: Blackwell Scientific Publications. p. 1-19.
- Levine R.L., Williams J.A., Stadtman E.R., Shacter E., 1994. Carbonyl assays for determination of oxidatively modified proteins. *Methods. Enzymol.* 233: 346–357.
- Liew F.Y., Li Y., Millot S., 1990. Tumor necrosis factor- α synergies with INF- γ in mediating killing of *Leishmania major* through the induction of nitric oxide. *J. Immunol.* 145: 4306-4310.
- Lin Y.L., Huang Y.L., Ma SH Yeh Chiou C.T.S.Y., Chen L.K., Liao C.L., 1997. Inhibition of Japanese encephalitis virus infection by nitric oxide: antiviral effect of nitric oxide on RNA virus replication. *J. Virol.* 71: 5227–5235.
- Livingstone D.R., 2001. Contaminant-stimulated reactive oxygen species production and oxidative damage in aquatic organisms. *Mar. Pollut. Bull.* 42: 656-666.
- Livingstone D.R., 2003. Oxidative stress in aquatic organism in relation to pollution and agriculture. *Revue.de Med. Vet.* 154: 427–430.
- Loewe S., 1953. The problem of synergism and antagonism of combined drugs. *Arzneimittelforschung.* 3: 285–290.
- Lorentzen M.A., Maage K.J., 1994. Effects of dietary selenite or selenomethionine on tissue selenium levels of Atlantic salmon (*Salmo salar*). *Aquaculture.* 121: 359–367.
- Luna C.M., Gonzalez V.S., Trippi V.S., 1994. Oxidative damage caused by excess copper in oat leaves. *Plant.Cell. Physiol.* 35: 11–15.
- Lund B.O., Miler D.M., Woods J.S., 1991. Mercury induced H₂O₂ formation and lipid peroxidation in vitro in rat kidney mitochondria. *Biochem.Pharmacol.* 42:S181-S187.
- Luoma S.N., Rainbow P.S., 2008. Sources and cycles of trace metals. In: *Metal Contamination in Aquatic Environments: Science and Lateral Management.* Cambridge University Press, Cambridge. p. 47–66.
- Lynn S., Gurr J.R., Lai H.T., Jan K.Y., 2000. NADH oxidase activation is involved in arsenite-induced oxidative DNA damage in human vascular smooth muscle cells. *Circ. Res.* 86: 514-519.

- Maddison J.E., Hawk C.G., 1993. Lead toxicity in dogs and cats. *Lead Action News* 1(4): 234-38.
- Mahadev K., Wu X., Zilbering A., Zhu L., Lawrence J.T.R., Goldstein B.J., 2001. Hydrogen peroxide generated during cellular insulin stimulation is integral to activation of the distal insulin signaling cascade in 3T3-L1 adipocytes. *J. Biol. Chem.* 276:48662-48669.
- Mannervik B., Gutenber C., 1981. Glutathione transferase (human placenta). *Methods Enzymol.* 77: 231-235.
- Mantovani A.P., Reis.E.L., Gacek F., Bó G.A., Binelli M., Baruselli P.S., 2005. Prolonged use of a progesterone releasing intravaginal device (CIDR) for induction of persistent follicles in bovine embryo recipients. *Anim. Reprod.* 2:272-277.
- Marklund S., Marklund G., 1974. Involvement of the superoxide anion radical in the autoxidation of pyrogallol and a convenient assay for superoxide dismutase. *Eur. J. Biochem.* 47: 469-474.
- Marimuthu K., Arokiaraj A.J., Haniffa M.A., 2009. Effect of diet quality on seed production of the spotted snakehead *Channa punctatus* (Bloch). *Int. J. Sustain. Agric.* 1:6-9.
- McGowan C., Donaldson W.E., 1986. Changes in organ nonprotein sulfhydryl and glutathione concentrations during acute and chronic administration of inorganic lead to chicks. *Biol. Trace Elem. Res.* 10: 37-46.
- Mehta R.A., Fawcett T.W., Porath D., Matto A.R., 1992. Oxidative stress causes lipid membrane translocation and in vivo degradation of ribulose 1,5 bisphosphate carboxylase/oxygenase. *J. Biol. Chem.* 267: 2810-2816.
- Mertz W., 1981. The Essential Trace Element, *Science.* 213: 1332-1338.
- Mohammad I.K., Mahdi A.A., Raviraja A., 2008. Oxidative stress in painters exposed to low lead levels. *Arh. Hig. Rada. Toksikol.* 59: 161-169.
- Myroie A.A., Umbles C., Kyle J., 1984. Effects of dietary copper supplementation on erythrocyte superoxide dismutase activity, ceruloplasmin and related parameters in rats ingesting lead acetate. In: *Trace Substances in Environmental Health.* Hemphill Ed.: 18 Univ. of Missouri Press, Columbia. p. 497-504.
- NAS. 1977. Medical and biological effects of environmental pollutants: Arsenic Washington, D. C. National Academic of Science.
- Nath K.A., Croatt A.J., Likely S., Behrens T.W., Warden D., 1996. Renal oxidant injury and oxidant response induced by mercury. *Kidney. Int.* 50:1032-1043.

- Nathan C., Shiloh M.U., 2000. Reactive oxygen and nitrogen intermediates in the relationship between mammalian hosts and microbial pathogens. *Proc. Natl. Acad. Sci. USA.* 97:8841–8848.
- Nathan C.F., 1987. Secretory products of macrophages. *J. Clin. Invest.* 79: 319-326.
- NRCC. 1973. Lead in the Canadian environment. *Natl. Res. Coun. Canada Publ. BY73-7 (ES).* 116 pp. Avail. from Publications, NRCC/CNRC, Ottawa, Canada K1A 0R6.
- Nriagu J.O., Pacyna J., 1988. Quantitative Assessment of Worldwide Contamination of Air, Water and Soil by Trace Metals. *Nature.* 333: 134 – 139.
- Nriagu, J.O., 1978a. The biogeochemistry of lead in the environment. Part A. (ed.). *Ecological cycles.* Elsevier/North Holland Biomedical Press, Amsterdam. p. 422.
- Nriagu, J.O., 1978b. The biogeochemistry of lead in the environment. Part B. (ed.). *Biological effects.* Elsevier/North Holland Biomedical Press, Amsterdam. p. 397.
- Nussey G., Vuren J.H.J.V., Preez H.H.D., 2000. Bioaccumulation of chromium, manganese, nickel and lead in the tissues of the Moggel, *Labeo umbratus* (Cyprinidae), from Witbank Dam, Mpumalanga. *Water S.A.*, 26: 269-269.
- Oguzie F.A., 2003. Heavy metals in Fish, water and effluents of lower ikpoba river in benin City, Nigeria. *Pakistan. J. Sci. Indust. Res.* 46: 156-160.
- Onishi H., 1969. Arsenic. In: Wedepohl KH ed. *Handbook of Geochemistry*, Vol. II-2. New York, Springer.
- Ou Y., Ruan Y., Cheng M., Moser J.J, Rattner J.B., Van Der Hoorn F.A., 2009. Adenylate cyclase regulates elongation of mammalian primary cilia. *Exp. Cell. Res.* 315:2802–2817.
- Pandey S., Parvez S., Sayeed I., 2003. Biomarkers of oxidative stress: a comparative study of river Yamuna fish *Wallago attu*. *Sci. Total. Environ.* 20: 105-115.
- Paskerová H., Hilscherová K., Bláha L., 2012. Oxidative stress and detoxification biomarker responses in aquatic freshwater vertebrates exposed to microcystins and cyanobacterial biomass. *Environ. Sci. Poll. Res.* 19: 2024-2037.
- Patocka J., Cerny K., 2003. Inorganic lead toxicology. *Acta. Medica.* 46(2): 65-72.
- Patterson R., Vega L., Trouba K., Bortner C., Germolec D., 2004. Arsenic-induced alterations in the contact hypersensitivity response in Balb/c mice. *Toxicol. Appl. Pharmacol.* 198: 434–43.
- Pernadones C.E., Illera V.A., Robert F.A., 1993. Regulation of apoptosis in vitro in mature murine spleen T-cells. *J. Immunol.* 151(7): 3521.

- Persad S., Elimban V., Kaila J., Dhalla N.S., 1997. Biphasic alterations in cardiac beta-adrenoceptor signal transduction mechanism due to oxyradicals. *J. Pharmacol. Exp. Ther.* 282: 1623-1631.
- Persad S., Panagia V., Dhalla N.S., 1998. Role of H₂O₂ in changing adrenoceptor and adenylyl cyclase in ischemia-reperfused hearts. *Mol. Cell. Biochem.* 186: 99-106.
- Popper H., Thomas L.B., Telles N.C., Falk H., Selikoff I.J., 1978. Development of hepatic angiosarcoma in man induced by vinyl chloride, thorotrast and arsenic. *Am. J. Pathol.* 92: 349- 376.
- Quig D., 1998. Cysteine metabolism and metal toxicity. *Alter. Med. Rev.* 3:262-270.
- Ramos O., Carrizales L., Yanez L., 1995. Arsenic increased lipid peroxidation in rat tissues by a mechanism independent of glutathione levels. *Environ. Health. Perspect.* 103: 85-88.
- Reid T.J., Murthy M.R.N., Sicignano A., Tanaka, N., Musick W.D.L., Rossman M.G., 1981. *Proc. Acad. Sci. U. S. A.* 78: 4767-4771.
- Reyes J.L., Molina-Jijón E., Rodríguez-Muñoz E., Bautista-García P., Debray-García Y., Namorado Mdel.C., 2013. Tight Junction Proteins and Oxidative Stress in Heavy Metals-Induced Nephrotoxicity. *Biomed. Res. Int.* 2013: 730789.
- Reynolds E.S., 1901. An account of the epidemic outbreak of arsenical poisoning occurring in beer drinkers in the north of England and midland countries in 1900. *Lancet.* 1: 166-170.
- Robinson G.R. Jr., Ayotte J.D., 2006. The Influence of Geology and Land Use on Arsenic in Stream Sediments and Ground Waters in New England, USA. *Appl. Geochem.* 21: 1482-1497.
- Rodrigney V.M., Dufour L., Carrizales L., Diaz-Barriga F., Jimenez-Capdeville M.E., 1998. Effects of oral exposure to mining waste on *in vitro* dopamine release from rat striatum. *Environ. Health. Perspect.* 106 (8): 487-91.
- Rooney J.P.K., 2007. The role of thiols, dithiols, nutritional factors and interacting ligands in the toxicology of mercury. *Toxicol.* 234: 145-156.
- Rosenman K., 2007. Occupational heart disease. In: Rom W and Markowitz S (ed.) *Environmental and occupational medicine*, 4th ed. Hagerstown, MD: Lippincott Williams & Wilkins. p. 688.
- Rudneva I.I., 1997. Blood antioxidant system of Black Sea elasmobranch and teleost. *Comp. Biochem. Physiol.* 118C: 255-260.

- Rusakov N.V., Mukhambetova L.K., Pirtakhiia N.V., Koganova Z.I., 1998. The assessment of the hazard of industrial waters containing heavy metals. [Russian] *Gigiena Sanitariia*. 4: 27-9.
- Saggers B.A., Gould M.L., 1989. The attachment of microorganisms to macrophages isolated from the tilapia *Oreochromis spilurus* Gunther. *J. Fish. Biol.* 35: 287–294.
- Saliu J.K., Bawa-Allah K.A., 2012. Toxicological effects of lead and zinc on the antioxidant enzyme activities of post juvenile *Clarias gariepinus*. *Resources. Environ.* 2(1): 21-26.
- Sancho E., Cerón J.J., Ferrando, M.D., 2000. Cholinesterase activity and hematological parameters as biomarkers of sublethal molinate exposure in *Anguilla Anguilla*. *Ecotoxicol. Environ. Saf.* 46: 81–86.
- Sandhir R., Julka D., Gill K.D., 1994. Lipoperoxidative damage on lead exposure in rat brain and its implications on membrane bound enzymes. *Pharmacol. Toxicol.* 74: 66-71.
- Santos M.A., Pacheco M., Ahmad I., 2004. *Anguilla anguilla* L. antioxidants responses to in situ bleached kraft pulp mill effluent outlet exposure. *Environ. Int.* 30: 301–308.
- Scalon M.C.S., Rechenmacher C., Siebel A.M., Kayser M.L., Rodrigues M.T., Maluf S.W., Rodrigues M.A.S., Silva L.B., 2010. Evaluation of Sinos River water genotoxicity using the comet assay in fish. *Braz. J. Biol.* 70(4):1217-1222.
- Scoullou M.J., 1986. Lead in coastal sediments: the case of the Elefsis Gulf, Greece. *Sci. Total. Environ.* 49:199-219.
- Secombes C.J., 1994. Enhancement of fish phagocyte activity. *Fish. Shellfish. Immunol.* 4: 421-436.
- Secombes C.J., Fletcher T.C., 1992. The role of phagocytes in the protective mechanisms of fish. *Ann. Rev. Fish. Dis.* 2: 51–71.
- Secombes C.J., 1990. Isolation of salmonid macrophages and analysis of their killing activity, *Tech. Fish Immunol.* 1: 137-155.
- Secombes C.J., 1996. The nonspecific immune system: cellular defences. In: Iwama G Nakashini T (ed.). *The fish immune system: organism, pathogen and environment*. Academic Press, San Diego. p. 63-103.
- Sengupta M, Bishayi B. 2002. Effect of lead and arsenic on murine macrophage response. *Drug. Chem. Toxicol.* 25:459–72.
- Senthil S., Murugan R., Karuppasamy K., Poongodi S., Puvaneswari R., 2008. Bioaccumulation pattern of zinc in freshwater fish *Channa punctatus* (Bloch.) after chronic exposure. *Turk. J. Fish. Aq. Sci.* 8: 55-59.

Shalat S.L., Walker D.B., Finnell R.H., 1996. Role of arsenic as a reproductive toxin with particular attention to neural tube defects. *J. Toxicol. Environ. Health.* 48(3):253–72.

Sharma S., Sharma V., Pracheta, Sharma S.H., 2011a. Therapeutic potential of hydromethanolic root extract of *Withania somnifera* on neurological parameters in Swiss albino mice Subjected to lead nitrate. *Int. J. Curr. Pharmaceu. Res.* 3: 52-56.

Sharma V., Sharma S., Pracheta, Paliwal R., Sharma S.H., 2011b. Therapeutic efficacy of *Withania somnifera* root extract in the regulation of lead nitrate induced nephrotoxicity in Swiss albino mice. *J. Pharm. Res.* 4: 755-758.

Sharma V., Sharma S., Pracheta, Sharma S.H., 2011c. Lead induced hepatotoxicity in male Swiss albino mice: The protective potential of the hydromethanolic extract of *Withania somnifera*. *Int. J. Pharmaceu. Sci. Rev. Res.* 7: 116-121.

Sikorski E.E., Burns L.A., Stern M.L., Luster M.I., Munson A.E., 1991. Splenic cell targets in gallium arsenide-induced suppression of the primary antibody response. *Toxicol. Appl. Pharmacol.* 110:129–42.

Simeonova P.P., Luster M.I., 2004. Arsenic and atherosclerosis. *Toxicol. Appl. Pharmacol.* 198: 444–449.

Soignet S.L., Maslak P., Wang Z.G., Jhanwar S., Calleja E., Dardashti L.J., Corso D., DeBlasio A., Gabrilove J.L., Scheinberg D.A., Pandolfi P.P., Warrell R.P., 1998. Complete remission after treatment of acute promyelocytic leukemia with arsenic trioxide. *N. Engl. J. Med.* 339: 1341-1348.

Solliway B.M., Schaffer A., Pratt H., 1996. Effects of exposure to lead on selected biochemical and haematological variables. *Pharmacol. Toxicol.*, 78: 18-22.

Soltanianejad K., Kebriaeezadeh A., Minaiee B., 2003. Biochemical and ultrastructural evidences for toxicity of lead through free radicals in rat brain. *Hum. Exp. Toxicol.*, 22: 417-433.

Sqibb K.S., Fowler B.A., 1983. The toxicity of arsenic and its compound. In: *Biological and Environmental Effects of Arsenic*. Fowler B.A. (ed.). Elsevier, New York. p. 233-69.

Sreejai R., Jaya D.S., 2010. Studies on the changes in lipid peroxidation and antioxidants in fishes exposed to hydrogen sulfide. *Toxicol. Int.* 17(2): 71-77.

Stegeman J.J., Brouwer M., Digiulio R.T., Forlin L., Fowler B.A., Sanders B.M., Vanveld P.A., 1992. Molecular responses to environmental contamination— enzyme and protein systems as indicators of chemical exposure and effect. In: Huggett, R.J., Kimerle, R.A., Mehrle, P.M. and Bergman, H.L., (ed.). *Biomarkers Bio- chemical, Physiological, and Histological Markers of Anthropogenic Stress*, Lewis Publishers, Inc., Boca Raton, 235-335.

Stephens L., Ellson C., Hawkins P., 2002. Roles of PI3K in leukocyte chemotaxis and phagocytosis. *Curr. Opin. Cell. Biol.* 14: 203-213.

Stohs S.J., Bagchi D., 1995. Oxidative mechanisms in the toxicity of metal ions. *Free. Radic. Biol. Med.* 18(2): 321-36.

Storey K.B., 1996. Oxidative stress: animal adaptations in nature. *Braz. J. Med. Biol. Res.* 29: 1715-1733.

Styblo M., Delnomdedieu M., Thomas D.J., 1995. Biological mechanisms and toxicological consequences of the methylation of arsenic. In: Goyer RA & Cherian MG (ed.). *Toxicology of metals – biochemical aspects*. Berlin, Springer. p. 407–433.

Sugawara E., Nakamura K., Miyake T., Fukumura A., Seki Y., 1991. Lipid peroxidation and concentration of glutathione in erythrocytes from workers exposed to lead. *Br. J. Ind. Med.* 48: 239-242.

Suhnel J., 1992. Zero-interaction response surfaces, interaction functions and difference response surfaces for combinations of biologically active agents. *Arzneimittelforschung-Drug. Res.* 42: 1251-8.

Tan C.M., Kelvin D.J., Litchfield D.W., Ferguson, S.S.G., Feldman R.D., 2001. Tyrosine kinase-mediated serine phosphorylation of adenylyl cyclase. *Biochemistry*. 40: 1702-1709.

Tan C.M., Xenoyannis S., Feldman R.D., 1995. Oxidant stress enhances adenylyl cyclase activation. *Circ. Res.* 77: 710-717.

Tejeda-Vera R., Lopez-Lopez E., Sedeno-Diaz J.E., 2007. Biomarkers and bioindicators of the health condition of *Ameioba splendens* and *Goodea atripinnis* (Pisces: Goodeidae) in the Ameioba River, Mexico. *Environ. Int.* 33: 521-531.

Theron A.J., Tintinger G.R., Anderson R., 2012. Harmful Interactions of Non-Essential Heavy Metals with Cells of the Innate Immune System. *J. Clin. Toxicol.* S3:005. doi:10.4172/2161-0495.S3-005.

Tjalkens R.B., Valerio L.G. Jr., Awasthi Y.C., Petersen D.R., 1998. Association of glutathione S-transferase isozyme-specific induction and lipid peroxidation in two inbred strains of mice subjected to chronic dietary iron overload. *Toxicol. Appl. Pharmacol.* 151:174-81.

Tseng W.P., Chu H.M., How S.W., Fong J.M., Lin C.S., Yeh S., 1968. Prevalence of skin cancer in an endemic area of chronic arsenicism in Taiwan. *J. Natl. Cancer. Inst.* 40: 453-463.

- Uede K., Furukawa F., 2003. Skin manifestations in acute arsenic poisoning from the Wakayama curry-poisoning incident. *Brit. J. Dermatol.* 149 (4): 757–762.
- Ulevitch R.J., 2000. Molecular mechanisms of innate immunity. *Immunol. Res.* 21: 49–54.
- Underhill D. M., 1999. The Toll-like receptor 2 is recruited to macrophage phagosomes and discriminates between pathogens. *Nature.* 401:811–815.
- USPHS. 1997. Toxicological profile for lead [on CD-ROM]. *Agency for Toxic Substances and Disease Registry*, U.S. Public Health Service.
- Utley H.C., Bernheim F., Hachslein P., 1967. Effect of sulfhydryl reagent on peroxidation in microsome. *Arch. Biochem. Biophys.* 260: 521–531.
- Vahter M., Concha G., Nermell B., Nilsson R., Dulout F., Natarajan A.T., 1995. A unique metabolism of inorganic arsenic in native Andean women. *Eur. J. Pharmacol. Environ. Toxicol. Pharmacol. Sect.* 293: 455–462.
- Van Alstine W.G., Wickliffe L.W., Everson R.J., DeNicola D.B., 1993. Acute lead toxicosis in a household of cats. *J. Vet. Diagn. Invest.* 5: 496–498.
- Vantroyen B., Heilier J.F., Meulemans A., Michels A., Buchet J.P., Vanderschueren S., 2004. Survival after a lethal dose of arsenic trioxide. *J. Toxicol. Clin. Toxicol.* 42(6): 889–895.
- Viarengo A., Nott, J.A., 1993. Mechanisms of heavy metal cation homeostasis in marine invertebrates. *Comp. Biochem. Physiol.* 104C: 355–372.
- Vodela J.K., Renden J.A., Lenz S.D., McElhenney W.H., Kemppainen B.W., 1997. Drinking water contaminants (arsenic, cadmium, lead, benzene, and trichloroethylene). Interaction of contaminants with nutritional status on general performance and immune function in broiler chickens. *Poult. Sci.* 76: 1474–92.
- Vogiatzis A.K., Loumbourdis, N.S., 1999. Exposure of *Rana ridibunda* to lead: Study of lead accumulation in various tissues and hepatic aminolevulinic acid dehydratase activity. *J. Appl. Toxicol.* 19: 25–29.
- Wang T.S., Kuo C.F., Jan K.Y., Huang H., 1996. Arsenite induces apoptosis in Chinese hamster ovary cells by generation of reactive oxygen species. *J. Cell. Physiol.* 169: 256–268.
- Ward N. E., Stewart J. R., Ioannides C. G. and O'Brian C. A., 2000. Oxidant-induced S-glutathiolation inactivates protein kinase C (PKC): A potential mechanism of PKC isozyme regulation. *Biochemistry.* 39: 10319–10329.
- Whanger P.D., 1992. Selenium in the treatment of heavy metals poisoning and chemical carcinogenesis. *J. Trace Elem. Electrolytes. Health. Dis.* 6:209–221.

Wilkinson P.C., 1986. The locomotor capacity of human lymphocytes and its enhancement by cell growth. *Immunol.* 57: 281–289.

Winterbourn C.C., 1993. Superoxide as an intracellular sink. *Free Rad. Biol. Med.*, 14: 85-90.

Xu J., Ling-jun L., Chen W.U., Xiao-feng W., Wen-yu F.U., Lihong X., 2008. Lead induces oxidative stress, DNA damage and alteration of p53, Bax and Bcl-2 expressions in mice. *Food. Chem. Toxicol.* 46: 1488-1494.

Yamanaka K., Hayashi H., Tachikawa M., Kato K., Hasegawa A., Oku N., Okada S., 1997. Metabolic methylation is a possible genotoxicity-enhancing process of inorganic arsenics. *Mutat. Res.* 394: 95-101.

Yaakob W.A.A., Ali A.B., 1992. Simple method for backyard production of snake head (*Channa striata* Bloch.) fry. *Naga* 15:22–23.

Yamanaka K., Mizol M., Kato K., Hasegawa A., Nakano M., Okada S., 2001. Oral administration of dimethylarsinic acid, a main metabolite of inorganic arsenic, in mice promotes skin tumorigenesis initiated by dimethylbenz (a) anthracene with or without ultraviolet B as a promoter. *Biol. Pharm. Bull.* 5: 510-514.

Yamauchi H., Yamamura Y., 1985. Metabolism and excretion of orally administered arsenic trioxide in the hamster. *Toxicol.* 34: 113-121.

Yang J.M., Lewandrowski K.B., Trace elements, vitamins, and nutrition.2002. In: McClatchey K.D., (ed.). *Clinical Laboratory Medicine.* (2nd ed.). Philadelphia, Pa.: Lippincott Williams and Wilkins. p. 456–460.

Zaldívar R., Prunés L., Ghai G., 1981. Arsenic dose in patients with cutaneous carcinomata and hepatic haemangio- endothelioma after environmental and occupational exposure. *Arch. Toxicol.* 47: 145-154.

Zelikoff J.T., 1998. Biomarkers of immunotoxicity in fish and other non-mammalian sentinel species: predictive value for mammals? *Toxicol.* 129: 63-71.

Zelikoff, J.T., Enane, N.A., Bowser, D., Squibb, K.S., Frenkel, K., 1991, Development of fish peritoneal macrophages as a model for higher vertebrates in immunotoxicological studies, *Fund. Appl.Toxicol.* 16: 576–589.