

Bibliography

- Abrams, J. J., Webster, D. A., 1990. Purification, partial characterization, and possible role of catalase in the bacterium *Vitreoscilla*. Arch. Biochem. Biophys. **279**: 54–59
- Abril, A., Zurdo-Pineiro, J.L., Peis, A., Rivas, R., Velazquez, E., 2007. Solubilization of phosphate by a strain of *Rhizobium leguminosarium* bv *trifolii* isolated from *Phaseolus vulgaris* in EI Chaco Arido soil (Argentina). In Velazquez, E., Rodriguez-Berruenco, C.,(Eds) Book Series: Developments in Plant and Soil Sciences. Springer, The Netherlands. pp:135-138
- Ae, N., Arihara, J., Okada, K., 1991. Phosphorus response of chick pea and evaluation of phosphorus availability in Indian alfisols and vertisols. In: Johansen, C., Lee, K. K., Sharawat K. L., (Eds.) Phosphorus nutrition of grain legumes. ICRISAT, India. pp: 33-41
- Ahmed, S., 1995. Agriculture–Fertilizer interface in Asia issues of growth and sustainability. Oxford and IBH publishing Co, New Delhi.
- Alikhani, H.A., Saleh-Rastin, N., Antoun, H., 2007. Phosphate solubilization activity of rhizobia native to Iranian soils. In Velazquez, E., Rodriguez-Berruenco, C.,(Eds) Book Series: Developments in Plant and Soil Sciences. Springer, The Netherlands. pp:135-138
- Ames, B.N., 1964. Assay of inorganic phosphate, total phosphate and phosphatases. Methods Enzymol. **8**: 115-118.
- Ames, F.L.G., Prody, C., Kutsu, S., 1984. Simple rapid and quantitative release of periplasmic proteins by chloroform. J. Bacteriol. **160**: 1181-1183.
- Anand, A., Duk, B.T., Singh, S., Akbas, M.Y., Webster, D.A., Stark, B.C., Dikshit, K.L., 2010. Redox-mediated interactions of VHb (*Vitreoscilla* haemoglobin) with OxyR: novel regulation of VHb biosynthesis under oxidative stress. Biochem. J. **426**: 271-280
- Anderson, G., Arlidge, E.Z., 1962. The adsorption of inositol phosphates and glycerophosphate by soil clays, clay minerals, and hydrated sesquioxides in acid media. Euro. J. Soil Sci. **13** (2): 216-224
- Anderson, G., Malcolm, R.E., 1974. The nature of alkali-soluble soil organic phosphates. J. soil Sci. **25**(3): 282-297
- Archana, G., Buch, A., Naresh Kumar, G., 2012. Pivotal role of organic acid secretion by rhizobacteria in plant growth promotion. In: Satyanarayana, T., Johri, B.N., Prakash, A., (Eds.) Microorganisms in Sustainable Agriculture and Biotechnology. Springer, pp: 35-53

- Asea, P.E.A., Kucey, R.M.N., Stewart, J.W.B., 1988. Inorganic phosphate solubilization by two *Penicillium* species in solution culture and soil. *Soil Biol. Biochem.* **20**: 459- 464
- Ausubel, F.M., Brent, R., Kingston, R.E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K., 1992. *Current protocols in molecular biology*. Greene Publishing, New York, N.Y.
- Aydin, S., Webster, D.A., Stark, B.C., 2000. Nitrite inhibition of *Vitreoscilla* hemoglobin (VHb) in recombinant *E. coli*: direct evidence that VHb enhances recombinant protein production. *Biotechnol. Prog.* **16**: 917–21
- Babu-Khan, S., Yeo, C., Martin, W.L., Duron, M. R., Rogers, R. D., Goldstein, A. H., 1995. Cloning of a mineral phosphate-solubilizing gene from *Pseudomonas cepacia*. *Appl. Environ. Microbiol.* **61**: 972-978
- Bacilio-Jimenez, M., Aguilar-Flores, S., Ventura-Zapata, E., Perez-Campos, E., Bouquelet, S., Zenteno, E., 2003. Chemical characterization of root exudates from rice (*Oryza sativa*) and their effects on the chemotactic response of endophytic bacteria. *Plant Soil* **249**: 271-277
- Bais, H.P., Weir, T.L. Perry, L.G., Gilroy, S., Vivanco, J.M., 2006. The role of root exudates in rhizosphere interactions with plants and other organisms. *Annu. Rev. Plant Biol.* **57**: 233-266
- Banik, S., Dey, B.K., 1982. Available phosphate content of an alluvial soil as influenced by inoculation of some isolated phosphate solubilizing microorganisms. *Plant Soil* **69**: 353–364
- Bar-Yosef, B., Rogers, R.D., Wolfram, J.H., Richman, E., 1999. *Pseudomonas cepacia* mediated rock phosphate solubilization in kaolinite and montmorillonite suspensions. *Soil Sci Soc. Am. J.* **63**:1703–1708
- Bashan, Y., Puente, M.E., Rodriquez, M.N., Toledo, G., Holguin, G., Ferrera-Cerrato, R., Pedrin, S., 1995. Survival of *Azorhizobium brasilense* in the bulk soil and rhizosphere of 23 soil types. *Appl. Environ. Microbiol.* **61**: 1938-1945
- Baya, A.M., Robert, S.B., Ramos, C.A., 1981. Vitamin production in relation to phosphate solubilization by soil bacteria. *Soil Biol. Biochem.* **13**: 527-532
- Beever, R.E., Burns, D.J.W., 1980. Phosphorus uptake storage and utilization by fungi. *Adv. Bot. Res.* **8**: 127- 219

- Berg, G., Smalla, K., 2009. Plant species versus soil type: which factors influence the structure and function of the microbial communities in the rhizosphere? *FEMS Microbiol. Ecol.* **68**: 1–13
- Bieleski, R.L., 1973. Phosphate pools, phosphate transport, and phosphate availability. *Annu. Rev. Plant Physiol.* **24**: 225-252
- Bremer, E., Kuikman, P., 1994. Microbial utilization of ^{14}C [U] glucose in soil is affected by the amount and timing of glucose additions. *Soil Biol. Biochem.* **26**: 511-517
- Bremer, E., van Kessel, C., 1990. Extractability of microbial ^{14}C and ^{15}N following addition of variable rates of labeled glucose and $(\text{NH}_4)_2\text{SO}_4$ to soil. *Soil Biol. Biochem.* **22**: 707-713
- Brimecombe, M.J., De, Lelj, F.A., Lynch, J.M., 2001. The rhizosphere. The effect of root exudates on rhizosphere microbial populations. In: Pinton, R., Varanini, Z., Nannipieri, P., (Eds.). *The rhizosphere, biochemistry and organic substances at the soil-plant interface*. Marcel Dekker, New York, pp: 95-140
- Brunker, P., Minas, W., Kallio, P.T., Bailey, J.E., 1998. Genetic engineering of an industrial strain of *Saccharopolyspora erythraea* for stable expression of the *Vitreoscilla* haemoglobin gene (vhb). *Microbiology* **144**:2441–8
- Buch, A.D., Archana, G., Naresh Kumar, G., 2009. Enhance citric acid biosynthesis in *Pseudomonas fluorescence* ATCC 13525 by overexpression of the *Escherichia coli* citrate synthase gene. *Microbiol.* **155**: 2620-2629
- Bunemann, E.K., 2008. Enzyme additions as a tool to assess the potential bioavailability of organically bound nutrients. *Soil Biol. Biochem.* **40**:2116-2129
- Celi, L., Lamacchia, S., Barberis, E., 2000. Interaction of inositol with calcite. *Nutr. Cycling Agroecosyst.* **57**: 271–277
- Celi, L., Lamacchia, S., Marsan, F.A., Barberis, E., 1999. Interaction of inositol hexaphosphate on clays: adsorption and charging phenomena. *Soil Sci.* **164**: 574585
- Celi, L., Presta, M., Ajmore-Marsan, F., Barberis, E., 2001. Effects of soil pH and electrolytes on inositol hexaphosphate interaction with goethite. *Soil Sci. Soc. Am. J.* **65**: 753-760

- Chen, C.R., Condron, L.M., Davis, M.R., Sherlock, R.R., 2002. Phosphorus 360 dynamics in the rhizosphere of perennial ryegrass (*Lolium perenne* L.) and radiata pine (*Pinus radiata* D. Don.). *Soil Biol. Biochem.* **34**: 487-499
- Chen, H., Chu, J., Zhang, S., Zhuang, Y., Qian, J., Wang, Y., Hu, X., 2007. Intracellular expression of *Vitreoscilla* hemoglobin improves S-adenosylmethionine production in a recombinant *Pichia pastoris*. *Appl. Microbiol. Biotechnol.* **74**:1205–1212
- Chen, R., Xue, G., Chen, P., Yao, B., Yang, W., Ma, Q., Fan, Y., Zhao, Z., Trezynski, M.C., Shi, J., 2008. Transgenic maize plants expressing a fungal phytase gene. *Transgenic Res.* **17**: 633-643
- Chen, W., Hughes, D.E., Bailey, J.E., 1994. Intracellular expression of *Vitreoscilla* hemoglobin alters the aerobic metabolism of *Saccharomyces cerevisiae*. *Biotechnol. Prog.* **10**: 308–313
- Chen, W., Hughes, D.E., Bailey, J.E., 1994. Intracellular expression of *Vitreoscilla* hemoglobin alters the aerobic metabolism of *Saccharomyces cerevisiae*. *Biotechnol. Prog.* **10**: 308–13.
- Chen, Y.P., Rekha, P.D., Arun, A.B., Shen, F.T., Lai, W.A., Young, C.C., 2006. Phosphate solubilizing bacteria from subtropical soil and their tricalcium phosphate solubilizing abilities. *Appl. Soil Ecol.* **34**:33–41
- Chi, P.Y., Webster, D.A., Stark, B.C., 2009. *Vitreoscilla* hemoglobin aids respiration under hypoxic conditions in its native host. *Microbiol. Res.* **164**: 267-275
- Chien, L.J., Lee, C.K., 2005. Expression of bacterial hemoglobin in the yeast, *Pichia pastoris*, with a low O₂-induced promoter. *Biotechnol. Lett.* **27**: 1491–7
- Cho, J., Lee, C., Kang, S., Lee, J., Lee, H., Bok, J., Woo, J., Moon, Y., Choi Y., 2005. Molecular cloning of a phytase gene (phy M) from *Pseudomonas syringae* MOK1. *Curr. Microbiol.* **51**: 11-15
- Choi, K.H., Schweizer, H.P., 2006. Mini-Tn7 insertion in bacteria with single *attTn7* sites: example *Pseudomonas aeruginosa*. *Nat Protoc.* **1**: 153–161
- Chuang, C.C., Kuo, Y.L., Chao, C.C., Chao, W.L. 2007. Solubilization of inorganic phosphates and plant growth promotion by *Aspergillus niger*. *Biol Fertil Soils* **43**:575–584
- Chung, H., Park, M., Madhaiyan, M., Seshadri, S., Song, J., Cho, H., Sa, T., 2005. Isolation and characterization of phosphate solubilizing bacteria from the rhizosphere of crop plants of Korea. *Soil Biol. Biochem.* **37**:1970-1974.

- Cohen, S., Chang, A.C.Y., Leslie, H.S.U., 1972. Nonchromosomal antibiotic resistance in bacteria: Genetic transformation of *Escherichia coli* by R-factor DNA (CaCl_2 /extrachromosomal DNA/plasmid). *Proc. Nat. Acad. Sci. USA* **69**(8): 2110-2114
- Cunningham, J.E., Kuiack, C., 1992. Production of citric and oxalic acids and solubilization of calcium phosphate by *Penicillium bilaji*. *Appl. Environ. Microbiol.* **58**: 1451-1458
- Curl, E.A., Truelove, B., 1986. The Rhizosphere. p. 1-8, Introduction; p. 140- 166, Microbial Interactions; p. 167-190, Rhizosphere in Relation to Plant Nutrition and Growth. Springer-Verlag, New York.
- Dao, T.H., 2003. Polyvalent cation effects on myo-inositol hexakis dihydrogenphosphate enzymatic dephosphorylation in dairy wastewater. *J. Environ. Qual.* **32**: 694-701.
- De Freitas, J.R., Banerjee, M.R., Germida, J.J., 1997. Phosphate-solubilizing rhizobacteria enhance the growth and yield but not phosphorus uptake of canola (*Brassica napus* L.). *Biol. Fertil. Soils* **24**: 358-364
- DeModena, J.A., Gutierrez, S., Velasco, J., Fernandez, F.J., Fachini, R.A., Galazzo, J.L., 1993. The production of cephalosporin C by *Acremonium chrysogenum* is improved by the intracellular expression of a bacterial hemoglobin. *Biotechnol.* **11**: 926-9
- Dikshit, R.P., Dikshit, K.L., Liu, Y., Webster, D.A., 1992. The bacterial hemoglobin from *Vitreoscilla* can support the aerobic growth of *E. coli* lacking terminal oxidases. *Arch. Biochem. Biophys.* **293**: 241-245
- Dogan, I., Pagilla, K.R., Webster, D.A., Stark, B.C., 2006. Expression of *Vitreoscilla* hemoglobin in *Gordonia amarae* enhances biosurfactant production. *J. Ind. Microbiol. Biotechnol.* **33**: 693-700.
- Elias, M.D., Nakamura, S., Migita, C.T., Miyoshi, H., Toyama, H., Matsushita, K., Adachi, O., Yamada, M., 2004. Occurrence of a bound ubiquinone and its function in *Escherichia coli* membrane-bound quinoprotein glucose dehydrogenase. *J. Biol. Chem.* **279**: 3078-3083
- Elizabeth, P., Miguel, S., Ball, Maria, M., Andre's, Y.L., 2007. Isolation and characterization of mineral phosphate-solubilizing bacteria naturally colonizing a limonitic crust in the south-eastern Venezuelan region. *Soil. Biol. Biochem.* **39**: 2905-2914

- Emsley, J., Niazi, S., 1981. The structure of *myo*-inositol hexaphosphate in solution: ^{31}P NMR investigation. *Phosphorus and Sulfur* 10: 401–408
- Erenler, S.O., Gencer, S., Geckil, H., Stark, B.C., Webster, D.A., 2004. Cloning and expression of the *Vitreoscilla* hemoglobin gene in *Enterobacter aerogenes*: effect on cell growth and oxygen uptake. *Appl. Biochem. Microbiol.* 40: 241–8.
- Esler, J. and Bennett, E., 2011. A broken geochemical cycle. *Nature*. 478: 29-31
- Feng, L., Chen, S., Sun, M., Yu, Z., 2007. Expression of *Vitreoscilla* hemoglobin in *Bacillus thuringiensis* improves the cell density and crystal proteins yield. *Appl. Microbiol. Biotechnol.* 74: 390–397
- Fenice, M., Selbman, L., Federici, F., Vassilev, N., 2000. Application of encapsulated *Penicillium variable* P16 in solubilization of rock phosphate. *Biores. Technol.* 73:157–162.
- Frey, A.D., Farres, J., Bollinger, C.J., Kallio, P.T., 2002. Bacterial hemoglobins and flavohemoglobins for alleviation of nitrosative stress in *Escherichia coli*. *Appl. Environ. Microbiol.* 68: 4835–40
- Frey, A.D., Kallio, P.T., 2003. Bacterial hemoglobins and flavohemoglobins: versatile proteins and their impact on microbiology and biotechnology. *FEMS Microbiol. Rev.* 27: 525–545
- Fuentes, B., Mora, D.L., Bolan, N.A., Naidu R., 2008. Assessment of phosphorus bioavailability from organic wastes in soil. In: Naidu R (Eds.) *Chemical bioavailability in terrestrial environments*. *Developments in soil science*. 32: 363-411
- Geckil, H., Gencer, S., Kahraman, H., Erenler, S.O., 2003. Genetic engineering of *Enterobacter aerogenes* with the *Vitreoscilla* hemoglobin gene: cell growth, survival, and antioxidant enzyme status under oxidative stress. *Res. Microbiol.* 154: 425–431
- Geckil, H., Arman, A., Gencer, S., Ates, B., Yilmaz, H.R., 2004a. *Vitreoscilla* hemoglobin renders *Enterobacter aerogenes* highly susceptible to heavy metals. *Biometals* 17: 715–23
- Geckil, H., Barak, Z., Chipman, D.M., Erenler, S.O., Webster, D.A., Stark, B.C., 2004b. Enhanced production of acetoin and butanediol in recombinant *Enterobacter aerogenes* carrying *Vitreoscilla* hemoglobin gene. *Bioprocess Biosyst. Eng.* 26: 325–30

- George, T.S., Richardson, A.E., Hadobas, P.A., Simpson, R.J., 2004. Characterization of transgenic *Trifolium subterraneum* L. which expresses phyA and releases extracellular phytase:
- George, T.S., Richardson, A.E., Smith, J.B., Hadobas, P.A., Simpson, R.J., 2005a. Limitations to the potential of transgenic *Trifolium subterraneum* L. plants that exude phytase when grown in soils with a range of organic P content. *Plant Soil* **258**: 263–274
- George, T.S., Simpson, R.J., Hadobas, P.A., Richardson, A.E., 2005b. Expression of a fungal growth and P nutrition in laboratory media and soil. *Plant Cell Environ.* **27**: 1351-1361
- phytase gene in *Nicotiana tabacum* improves phosphorus nutrition of plants grown in amended soils. *Plant Biotechnol. J.* **3**: 129-140
- Giddens, J.E., Dunigan, E.P., Weaver, R.W., 1982. Legume inoculation in the southeastern USA. *South Coop. Ser. Bull.* **283**: 1-38
- Gulati, A., Sharma, N., Vyas, P., Sood, S., Rahi, P., Pathania, V. and Prasad, R., 2010. Organic acid production and plant growth promotion as a function of phosphate solubilization by *Acinetobacter rhizosphaerae* strain BIHB 723 isolated from the cold deserts of the trans-Himalayas. *Arch. Microbiol.* **192**: 975-983.
- Guo, L., Zhao, Y., Zhang, S., Zhang, H., Xiao, K., 2009. Improvement of organic phosphate acquisition in transgenic tobacco plants by overexpression of a soybean phytase gene *Sphy1*. *Front. Agric. China.* **3**: 256-265
- Gupta, R.R., Singal, R., Shanker, A., Kuhad, R.C., Saxena, R.K., 1994. A modified plate assay for screening phosphate solubilizing microorganisms. *Gen. Appl. Microbiol.* **40**: 255–260
- Goldstein, A.H., Liu, S. T., 1987. Molecular cloning and regulation of a mineral phosphate solubilizing (*mps*) gene from *Erwinia herbicola*. *Nature Biotechnol.* **5**: 72-74
- Goldstein, A.H., Rogers, R.D., Mead, G., 1993. Separating phosphate from ores via bioprocessing. *Biotechnol.* **11**:1250-1254.
- Goldstein, A.H., 1995. Recent progress in understanding the molecular genetics and biochemistry of calcium phosphate solubilization by gram negative bacteria. *Biol. Agric. Hor.* **12**: 185–193
- Goodwin, P.M., Anthony, C., 1998. The biochemistry, physiology and genetics of PQQ and PQQ containing enzymes. *Adv. Microb. Physiol.* **40**: 1-80

- Gottschal, J.C., 1992. Substrate capturing and growth in various ecosystems. J. Appl. Bacteriol. Symp. Suppl. 73: 39-48
- Greaves, M. P., Webley, D. M., 1965. A study of the breakdown of organic phosphates by microorganisms from the root region of certain pasture grasses. J. Appl. Biotechnol. 28: 454-465
- Greiner, R., Konietzny, U., 2006. Phytase for food application. Food Technol. Biotechnol. 44: 125-140
- Greiner, R. 2007. Phytate-degrading enzymes: regulation of synthesis in microorganisms and plants. In: Inositol Phosphates: Linking Agriculture and the Environment. Turner, B.L., Richardson, A.E., Mullaney, R., (Eds.) CAB International, Wallingford, Oxfordshire, UK. pp:78-97
- Griffiths, B.S., Kuan, H.L., Ritz, K., Glover, L.A., McCaig, A.E., Fenwick, C., 2004. The relationship between microbial community structure and functional stability, tested experimentally in an upland pasture soil. Microb. Ecol. 47: 104- 113
- Grynspan, F., Cheryan, M., 1983. Calcium phytate: Effect of ph and molar ratio on *in vitro* solubility. J. Am. Oil Chem. Soc. 63: 1761-1764
- Gyaneshwar, P., Naresh Kumar, G., Parekh, L.J., 1998a. Cloning of mineral phosphate solubilizing genes from *Synechocystis* PCC6803. Curr. Science 74: 1097-1099.
- Gyaneshwar, P., Naresh Kumar, G., Parekh, L.J., 1998b. Effect of buffering on the phosphate solubilizing ability of microorganisms. World J. Microbiol. Biotechnol. 14: 669-673
- Gyaneshwar, P., Parekh, L.J., Archana, G., Poole, P.S., Collins, M.D., Hutson, R.A., Naresh Kumar, G., 1999. Involvement of a phosphate starvation inducible glucose dehydrogenase in soil phosphate solubilization by *Enterobacter asburiae*. FEMS Microbiol. Lett. 171: 223-229
- Gyaneshwar, P., Naresh Kumar, G., Parekh, L.J., Poole, P.S., 2002. Role of soil microorganisms in improving P nutrition of plants. Plant Soil 245: 83-93
- Hadacek, F., Kraus, G.F., 2002. Plant root carbohydrates affect growth behaviour of endophytic microfungi. FEMS Microbiol. Ecol. 41: 161-170
- Haefner, S., Knietzsch, A., Scholten, E., Braun, J., Lohscheidt, M., Zelder, O., 2005. Biotechnological production and applications of phytases. Appl. Microbiol. Biotechnol. 68: 588-97

- Halder, A. K., Chakrabartty, P. K. 1993. Solubilization of inorganic phosphate by *Rhizobium*. Folia Microbiol. 38: 325-330.
- Harrison, A.F., 1987. Soil organic phosphorus: a world literature review. Wallingford: Commonwealth Agricultural Bureaux International.
- Hawkes, G.E., Powlson, D.S., Randall, E.W., Tate, K.R. 1984. A ^{31}P nuclear magnetic resonance study of the phosphorus species in soils from long continued field experiments. J. Soil Sci. 35: 35-45
- Hayes, J. E., Simpson, R. J., Richardson, A. E., 2000. The growth and phosphorus utilization of plants in sterile media when supplied with inositol hexaphosphate, glucose 1-phosphate or inorganic phosphate. Plant Soil 220:165–174
- Hayes, J.E., Richardson, A.E., Simpson, R. J., 1999. Phytase and acid phosphatase activities in extracts from roots of temperate pasture grass and legume seedlings. Aus. J. Plant Phys. 26: 801-809
- He, J., Lu, D.J., Wang, H.Q., 2001. Cloning and expression of VHB gene in D-arabitol producing yeast. Wei Sheng Wu Xue Bao 41: 315–9 [in Chinese].
- Heijnen, C. E., Chenu, C., Robert, M., 1993. Micro-morphological studies on clay-amended and unamended loamy sand, relating survival of introduced bacteria and soil structure. Geoderma 56: 195-207
- Heijnen, C. E., Page, S., van Elsas, J. D., 1995. Metabolic activity of *Flavobacterium* strain P25 during starvation and after introduction into bulk soil and the rhizosphere of wheat. FEMS Microbiol. Ecol. 18: 129-138
- Heijnen, C. E., van Veen, J. A., 1991. A determination of protective microhabitats for bacteria introduced into soil. FEMS Microbiol. Ecol. 85: 73-80
- Heijnen, C.E., van Elsas, J.D., Kuikman, P.J., van Veen, J.A., 1988. Dynamics of *Rhizobium leguminosarum* biovar *trifolii* introduced in soil: the effect of bentonite clay on predation by protozoa. Soil Biol. Biochem. 20: 483-488
- Ho, W. C., Ko, W. H., 1985. Soil microbiostasis: effects of environmental and edaphic factors. Soil Biol. Biochem. 17: 167-170

- Huang, H., Shao, N., Wang, Y., Luo, H., Yang, P., Zhou, Z., Zhan, Z., Yao B., 2009a. A novel beta propeller phytase from *Pedobacter nyackensis* MJ11 CGMCC 2503 with potential as an aquatic feed additive. *Appl. Microbiol. Biotechnol.* **83**: 249-259
- Huang, H., Shi, P., Wang, Y., Luo, H., Shao, N., Wang, G., Yang, P., Yao, B., 2009b. Diversity of beta-propeller phytase genes in the intestinal contents of grass carp provides insight into the release of major phosphorus from phytate in nature. *Appl. Environ. Microbiol.* **75**:1508–1516.
- Hwangbo, H., Park, R.D., Kim, Y.W., Rim, Y.S., Park, K.H., Kim, T.H., Such, J.S., Kim, K.Y., 2003. 2-ketogluconic acid production and phosphate solubilization by *Enterobacter intermedium*. *Curr. Microbiol.* **47**: 87–92
- Idriss, E.E., Makarewicz, O., Farouk, A., Rosner, K., Greiner, R., Bochow, H., Richter, T., Borriss, R., 2002. Extracellular phytase activity of *Bacillus amyloliquefaciens* FZB45 contributes to its plant-growth-promoting effect. *Microbiol.* **148**: 2097-2109
- Iijima, M., Griffiths, B., Bengough, A. G., 2000. Sloughing of cap cells and carbon exudation from maize seedling roots in compacted sand. *New Phytol.* **145**: 477-482
- Illmer, P., Schinner, E., 1992. Solubilization of inorganic phosphates by microorganisms isolated from forest soils. *Soil Biol. Biochem.* **24**: 389-395
- Illmer, P., Schinner, E., 1995. Solubilization of inorganic calcium phosphates solubilization mechanisms. *Soil Biol. Biochem.* **27**: 257-263
- Jackman, R.H., Black, C.A., 1951. Solubility of iron, aluminium, calcium, and magnesium inositol phosphates at different pH values. *Soil Sci.* **72**: 179-186
- Jaeger III, C.H., Lindow, S.E., Miller, W., Clark, E., Firestone, M.K., 1999. Mapping of sugar and amino acid availability in soil around roots with bacterial sensors of sucrose and tryptophan. *Appl. Environ. Microbiol.* **65**: 2685–2690
- Jones, D.L., 1998. Organic acids in the rhizosphere - a critical review. *Plant Soil* **205**: 25-44
- Jones, D.L., Nguyen, C., Finlay, R.D., 2009. Carbon flow in the rhizosphere: carbon trading at the soil root interface. *Plant Soil* **321**: 5-33.

- Jorquera, M.A., Hernandez, M.T., Rengel, Z., Marschner, P., Mora, M.L., 2008a. Isolation of culturable phosphobacteria with both phytate-mineralization and phosphatesolubilization activity from the rhizosphere of plants grown in a volcanic soil. *Biol. Fertil. Soils* **44**: 1025–1034.
- Jorquera, M.A., Martinez, O., Maruyama, F., Marshner, P., Mora, M.L., 2008b. Current and future biotechnology applications of bacterial phytases and phytase-producing bacteria. *Microbes Environ.* **23**: 182–191
- Kallio, P.T., Bailey, J.E., 1996. Intracellular expression of *Vitreoscilla* hemoglobin (VHb) enhances total protein secretion and improves the production of alpha-amylase and neutral protease in *Bacillus subtilis*. *Biotechnol Prog* **12**: 31–9
- Kallio, P.T., Kim, D.J., Tsai, P.S., Bailey, J.E., 1994. Intracellular expression of *Vitreoscilla* hemoglobin alters *Escherichia coli* energy metabolism under oxygen-limited conditions. *Eur. J. Biochem.* **219**:201–8
- Kamilova, F., Kravchenko, L.V., Shaposhnikov, A.I., Azarova, T., Makarova, N., Lugtenberg, B. J., 2006. Organic acids, sugars, and L-tryptophane in exudates of vegetables growing on stonewool and their effects on activities of rhizosphere bacteria. *Mol. Plant-Microbe Interact.* **19**: 250-256
- Kang, S.H., Cho, K.K., Bok, J.D., Kim, S.C., Cho, J.S., Lee, P.C., Kang, S.K., Lee, H.G., Woo, J.H., H Lee, H.J., Lee, S.C., Choi, Y.J., 2006. Cloning, sequencing and characterization of a novel phosphatase gene, *phoI*, from soil bacterium *Enterobacter* sp. 4. *Curr. Microbiol.* **52**: 243-248
- Katznelson, H. and Bose, B., 1959. Metabolic activity and phosphate dissolving capability of bacterial isolates from wheat roots in the rhizosphere and non rhizosphere soil. *Can. J. Microbiol.* **5**: 79-85
- Kaur, R., Pathania, R., Sharma, V., Mande, S., Dikshit, K. L., 2002. Chimeric *Vitreoscilla* hemoglobin (VHb) carrying a flavoreductase domain relieves nitrosative stress in *Escherichia coli*: new insight into the functional role of VHb. *Appl. Environ. Microbiol.* **68**: 152–160
- Kerovuo, J., Tynkkynen, T., 2000. Expression of *Bacillus subtilis* phytase in *Lactobacillus plantarum* 755. *Lett. Appl. Microbiol.* **30**: 325-329
- Khan, M. S., Zaidi, A., Wani P. A., 2006. Role of phosphate-solubilizing microorganisms in sustainable agriculture – A review. *Agron. Sustain. Dev.* **26**: 1-15

- Khleifat, K.M., 2006. Correlation between bacterial hemoglobin and carbon sources: their effect on copper uptake by transformed *E. coli* strain DH5 α . *Curr Microbiol* **52**. 64–8
- Khosla, C., Bailey, J.E., 1988. Heterologous expression of a bacterial hemoglobin improves the growth properties of recombinant *Escherichia coli*. *Nature* **331**:633–635
- Khosla, C., Bailey, J.E., 1988. The *Vitreoscilla* hemoglobin gene: molecular cloning, nucleotide sequence and genetic expression in *Escherichia coli* *Mol. Gen. Genet.* **214**:158–61
- Khosla, C., Curtis, J.E., DeModena, J., Rinas, U., Bailey, J.E., 1990. Expression of intracellular hemoglobin improves protein synthesis in oxygen limited *Escherichia coli*. *Biotechnol.* **8**: 849–53
- Kim, C.H., Han, S.H., Kim, K.Y., Cho, B.H., Kim, Y.H., Koo, B.S., Kim, Y.C., 2003. Cloning and expression of pyrroloquinoline quinine (PQQ) genes from a phosphate-solubilizing bacterium *Enterobacter intermedium*. *Curr. Microbiol.* **47**: 457–461
- Kim, D., Hwang, D.S., Kang, D.G., Kim, J.Y., Cha, H.J., 2008. Enhancement of mussel adhesive protein production in *Escherichia coli* by co-expression of bacterial hemoglobin. *Biotechnol. Prog.* **24**: 663–666
- Kim, H.W., Kim, Y.O., Lee, J.H., Kim, K.K., Kim, Y.J., 2003. Isolation and characterization of a phytase with improved properties from *Citrobacter braakii*. *Biotechnol. Lett.* **25**:1231-1234
- Kim, K.Y., Jordan, D., Krishnan, H.B., 1998a. Expression of genes from *Rahnella aquatilis* that are necessary for mineral phosphate solubilization in *Escherichia coli*. *FEMS Microbiol. Lett.* **159**, 121–127
- Kim, K.Y., McDonald, G.A., Jordan, D., 1997. Solubilization of hydroxypatite by *Enterobacter agglomerans* and cloned *Escherichia coli* in culture medium. *Biol. Fertil. Soils* **24**, 347–352
- Kim, Y.J., Sa, S.O., Chang, Y.K., Hong, S.K., Hong, Y.S., 2007. Overexpression of *Shinorhizobium meliloti* hemoprotein in *Streptomyces lividans* to enhance secondary metabolite production. *J. Microbiol. Biotechnol.* **12**: 2066–2070
- Kim, Y.O., Kim, H.W., Lee, J.H., Kim, K.K., Lee, S.J., 2006. Molecular cloning of the phytase gene from *Citrobacter braakii* and its expression in *Saccharomyces cerevisiae*. *Biotechnol. Lett.* **28**: 33-38

- Kim, Y.O., Lee, J.K., Kim, H.K., Yu, J.H., Oh, T.L., 1998. Cloning of the thermostable phytase gene (*phy*) from *Bacillus* sp. DS11 and its overexpression in *Escherichia coli*. FEMS Microbiol. Lett. **162**: 185-191
- Kim, Y., Webster, D.A., Stark, B.C., 2005. Improvement of bioremediation by *Pseudomonas* and *Burkholderia* by mutants of the *Vitreoscilla* hemoglobin gene (*vhb*) integrated into their chromosomes. J. Ind. Microbiol. Biotechnol. **32**:148-54
- Koch, B., Worm, J., Jensen, L. E., Hojberg, O., Nybroe, O., 2001. Carbon limitation induces σ^S -dependent gene expression in *Pseudomonas fluorescens* in soil. Appl. Environ. Microbiol. **67**: 3363-3370
- Konietzny, U., Greiner R., 2002. Bacterial phytase: Potential application, *in vivo* function and regulation of its synthesis. Brazil J. Microbiol. **35**: 11-18
- Konietzny, U., Greiner R., 2002. Molecular and catalytic properties of phytate-degrading enzymes (phytases). Int. J. Food Sci. Technol. **37**: 791-812
- Kozdrój, J., van Elsas, J. D., 2001. Structural diversity of microorganisms in chemically perturbed soil assessed by molecular and cytochemical approaches. J. Microbiol. Methods **43**: 197-212
- Kpomblekou, A. K., Tabatabai, M. A., 1994. Effect of organic acids on release of phosphorus from phosphate rocks. Soil Sci. **158**: 442-452
- Krishnaraj, P.U., Goldstein, A.H., 2001. Cloning of a *Serratia marcescens* DNA fragment that induces quinoprotein glucose dehydrogenase-mediated gluconic acid production in *Escherichia coli* in the presence of stationary phase *Serratia marcescens*. FEMS Microbiol. Lett. **205**: 215-220.
- Kucey, R.M.N. 1983. Phosphate solubilizing bacteria and fungi in various cultivated and virgin Alberta soils. Can. J. Soil Sci. **63**: 671-678
- Kucey, R.M.N., Jenzen, H.H., Leggett, M.E., 1989. Microbially mediated increases in plant available phosphorus. Adv. Agron. **42**: 199-228
- Kuiper, I., Kravchenko, L., Bloemberg, G. V., Lugtenberg, B. J. J., 2002. *Pseudomonas putida* strain PCL1444, selected for efficient root colonization and naphthalene degradation, effectively utilizes root exudate components. Mol. Plant-Microbe Interact. **15**:734-741

- Kumar, V., Behl, R.K., Narula, N., 2001. Establishment of phosphate-solubilizing strains of *Azotobacter chroococcum* in the rhizosphere and their effect on wheat cultivars under greenhouse conditions. *Microbiol. Res.* **156**:87–93
- Kumar, V., Narula, N., 1999. Solubilization of inorganic phosphates and growth emergence of wheat as affected by *Azotobacter chroococcum* mutants. *Biol. Fert. Soils* **28**: 301-305.
- Kurt, A.G., Aytan, E., Ozer, U., Ates, B., Geckil, H., 2009. Production of L-DOPA and dopamine in recombinant bacteria bearing the *Vitreoscilla* hemoglobin gene. *Biotechnol. J.* **4**:1077–1088
- Kvist, M., Ryabova, E. S., Nordlander, E., Bulow, L., 2007. An investigation of the peroxidase activity of *Vitreoscilla* hemoglobin. *J. Biol. Inorg. Chem.* **12**: 324–334
- Laemmli, U.K., 1970. Cleavage of structural proteins during the assembly of the head of bacteriophage T4. *Nature* **227**: 680–685
- Lee, S., Kim, T., Stahl, C.H., Lei, X.G., 2005. Expression of *Escherichia coli* AppA2 phytase in four yeast systems. *Biotechnology. Lett.* **27**: 327-334
- Li, H., Yu, Z., Xiong, X., Li, Y., Wang, H, Li, X., 2009. Expression of *Vitreoscilla* hemoglobin gene in *Pseudomonas delafieldii* R-8 and its application to diesel desulfurization. *Wei Sheng Wu Xue Bao* **49**:1026–1032
- Li, M., Wu, J., Lin, J., Wei, D., 2010. Expression of *Vitreoscilla* hemoglobin enhances cell growth and dihydroxyacetone production in *Gluconobacter oxydans*. *Curr Microbiol* **61**:370–375
- Li, M.Z., Elledge, J., 2008. Harnessing homologous recombination *in vitro* to generate recombinant DNA via SLIC. *Nat. Methods* **4**: 251–256
- Li, X., Wu, Z., Li, W., Yan, R., Li, L., Li, J., Li, Y., Li, M., 2007. Growth promoting effect of a transgenic *Bacillus mucilaginosus* on tobacco planting. *Appl. Microbiol. Biotechnol.* **74**: 1120-1125
- Lin, J.M., Stark, B.C., Webster, D.A., 2003. Effects of *Vitreoscilla* hemoglobin on the 2, 4-dinitrotoluene (2,4-DNT) dioxygenase activity of *Burkholderia* and on 2,4-DNT degradation in two-phase bioreactors. *J. Ind. Microbiol. Biotechnol.* **30**:362–8
- Liu, Q., Zhang, J., Wei, X.X., Ouyang, S.P., Wu, Q., Chen, G.Q., 2008. Microbial production of L-glutamate and L-glutamine by recombinant *Corynebacterium glutamicum* harboring *Vitreoscilla* hemoglobin gene vgb. *Appl. Microbiol. Biotechnol.* **77**: 1297–1304

- Liu, S.C., Liu, Y.X., Webster, D.A., Stark, B.C., 1994. Sequence of the region downstream of the *Vitreoscilla* hemoglobin gene: vgb is not part of a multigene operon. Appl. Microbiol. Biotechnol. 42(2-3): 304-308
- Liu, S.C., Liu, Y.X., Webster, D.A., Wei, M.L., Stark, B.C., 1996. Genetic engineering to contain the *Vitreoscilla* hemoglobin gene enhances degradation of benzoic acid by *Xanthomonas mathophillic*. Biotechnol. Bioeng. 49:101-5
- Lugtenberg, B. J. J., Dekkers, L. C., 1999. What makes *Pseudomonas* bacteria rhizosphere competent? Environ. Microbiol. 1: 9-13
- Lugtenberg, B. J. J., Kamilova, F., 2009. Plant growth promoting rhizobacteria. Ann. Rev. Microbiol. 63: 541-556
- Lugtenberg, B.J., Dekkers, L., Bloemberg, G.V., 2001. Molecular determinants of rhizosphere colonization by *Pseudomonas*. Annu. Rev. Phytopathol. 39: 461-490
- Luis, P., Haiker, M., Wyss, M., Tessier, M., van Loon, A. P. G. M., 1997. Gene cloning, purification, and characterization of a heat-stable phytase from the fungus *Aspergillus fumigates*. 63(5): 1696-1700
- Lung, S.C., Chan, W.L., Yip, W., Wang, L., Yeung, E.C., Lim, B.L., 2005. Secretion of beta-propeller phytase from tobacco and *Arabidopsis* roots enhances phosphorus utilization. Plant Sci. 169: 341-349.
- Lung, S.C., Lim, B.L., 2006. Assimilation of phytate-phosphorus by the extracellular phytase activity of tobacco (*Nicotiana tabacum*) is affected by the availability of soluble sphytate. Plant Soil 258: 1-13
- Ma, X.F., Wright, E., Ge, Y., Bell, J., Yajun, X., Bouton, J.H., Wang, Z.Y., 2009. Improving phosphorus acquisition of white clover (*Trifolium repens* L.) by transgenic expression of plant-derived phytase and acid phosphatase genes. Plant Sci. 176: 479- 488
- Maliha, R., Samina, K., Najma, A., Sadia, A., Farooq, L., 2004. Organic acids production and phosphate solubilization by phosphate solubilizing microorganisms under in vitro conditions. Pak J. Biol. Sci. 7: 187-196
- Martin, C.J., Evans, W.J., 1986. Phytic acid-metal ion interactions. II. The effect of pH on Ca(II) binding. J. Inorg. Biochem. 27:17-30

- Matsushita, K., Ameyama, M., 1982. D-glucose dehydrogenase from *Pseudomonas fluorescens*, membrane bound. *Methods Enzymol.* **89**: 149–154
- Matsushita, K., Shinagawa, E., Ameyama, M., 1982. D-gluconate dehydrogenase from bacteria, 2-keto-D-gluconate yielding, membrane-bound. *Methods Enzymol.* **89**: 187–193
- Meng, C., Ye, Q., Shi, X., Qiu, L., Song, S., Guo, Y., 2002. Cloning and expression of *Vitreoscilla* hemoglobin in *Streptomyces aureofaciens*. *Wei Sheng Wu Xue Bao* **42**:305–10 [in Chinese].
- Metting, F.B. Jr., 1992. Structure and physiological ecology of soil microbial communities. In: FB Metting, Jr., (Eds.) *Soil microbial ecology*. Marcel Dekker, New York, pp: 3–25.
- Miller, G.L., 1959. Use of dinitrosalicylic acid reagent for determination of reducing sugar. *Anal. Chem.* **31**: 426
- Minas, W., Brünker, P., Kallio, P.T., Bailey, J.E., 1998. Improved erythromycin production in a genetically engineered industrial strain of *Saccharopolyspora erythraea*. *Biotechnol Prog* **14**:561–6
- Moghimi, A., and Tate, M.E., 1978. Does 2-ketogluconate chelate calcium in the pH range 2.4 to 6.4? *Soil Biol. Biochem.* **10**: 289-292
- Moghimi, A., Tate M.E., and Oades, J.M., 1978. Characterization of rhizosphere products especially 2-ketogluconic acid. *Soil Biol. Biochem.* **10**: 283–287
- Molla, M.A.Z., Chowdary, A.A., 1984. Microbial mineralization of organic phosphate in soil. *Plant Soil* **78**: 393–399
- Mudge, S.R., Smith, F.W., Richardson, A.E., 2003. Root-specific and phosphate-regulated expression of phytase under the control of a phosphate transporter promoter enables *Arabidopsis* to grow on phytate as a sole P source. *Plant Sci.* **165**: 871-878
- Murphy, J., and Riley J.P., 1962. A modified single solution method for the determination of phosphate in natural waters. *Anal. Chim. Acta* **27**: 31-36
- Muth, G., Nussbaumer, B., Wohlleben, W., Pühler, A., 1989. A vector system with temperature-sensitive replication for gene disruption and mutational cloning in *Streptomyces*. *Mol. Gen. Genet.* **219**: 341-348

- Nasr, M.A., Hwang, K.W., Akbas, M., Webster, D.A., Stark, B.C., 2001. Effects of culture conditions on enhancement of 2,4-dinitrotoluene degradation by *Burkholderia* engineered with the *Vitreoscilla* hemoglobin gene. *Biotechnol. Prog.* **17**: 359–61
- Ognalaga, M., Frossard, E., Thomas, F., 1994. Glucose-1-phosphate and myo-inositol hexaphosphate adsorption mechanisms on goethite. *Soil Sci. Soc. Amer. J.* **58**: 332337
- Ouyang, S.P., Liu, Q., Sun, S.Y., Chen, J.C., Chen, G.Q., 2007. Genetic engineering of *Pseudomonas putida* KY2442 for biotransformation of aromatic compounds to chiral cis-diols. *J. Biotechnol.* **132**: 246–250
- Pandey, A., Das, N., Kumar, B., Rinku, K., Trivedi, P., 2008. Phosphate solubilization by *Penicillium* sps. isolated from soil sample of Indian Himalayan region. *World J. Microbiol. Biotechnol.* **24**: 97-102
- Park, K. W., Kim, K. J., Howard, A. J., Stark, B. C. , Webster, D. A., 2002. *Vitreoscilla* hemoglobin binds to subunit I of cytochrome bo ubiquinol oxidases. *J. Biol. Chem.* **277**: 33334–33337
- Patel, D.K., Archana, G., Naresh Kumar, G., 2008. Variation in the nature of organic acid secretion and mineral phosphate solubilization by *Citrobacter* sp. in the presence of different sugars. *Curr. Microbiol.* **56**: 168–174
- Patel, D.K., Murawala, P., Archana, G., Naresh Kumar, G., 2011. Repression of mineral phosphate solubilizing phenotype in the presence of weak organic acids in plant growth promoting fluorescent pseudomonads. *Biores. Technol.* **102**: 3055-3061
- Patel, K.J., Singh, A. K., Naresh Kumar, G., Archana, G., 2010. Organic-acid-producing, phytate-mineralizing rhizobacteria and their effect on growth of pigeon pea (*Cajanus cajan*). *Appl. Soil Ecol.* **44**: 252-261
- Patel, K.J., Vig, S., Naresh Kumar, G., Archana, G., 2010. Effect of transgenic rhizobacteria overexpressing *Citrobacter braakii appA* on phytate-p availability to mung bean plants. *J. Microbiol. Biotechnol.* **20**(11): 1491–1499
- Patel, S.M., Stark, B.C., Hwang, K.W., Dikshit, K.L., Webster, D.A., 2000. Cloning and expression of *Vitreoscilla* hemoglobin gene in *Burkholderia* sp. strain DNT for enhancement of 2,4-dinitrotoluene degradation. *Biotechnol. Prog.* **16**: 26–30.

- Paul, E.A., Clark, F.E. 1988. Soil microbiology and biochemistry. Academic Press, Inc., San Diego, Calif.
- Peterson, G. L., (1979). Review of the Folin phenol quantitation method of Lowry, Rosenberg, Farr and Randall. Anal. Biochem. 100: 201
- Phillips, D.A., Tama, C., Fox, T.C., King, M.D., Bhuvaneswari, T.V., Teuber, L.R., 2004. Microbial products trigger amino acid exudation from plant roots. Plant Physiol. 136: 2887-2894
- Postma, J., van Elsas, J.D., Govaert, J.M., van Veen, J.A., 1988. The dynamics of *Rhizobium leguminosarum* biovar *trifolii* introduced into soil as determined by immunofluorescence and selecting plating techniques. FEMS Microbiol. Ecol. 53: 251-260
- Quay, S.C., Friedman, S.B., Eisenberg, R.C., 1972. Gluconate regulation of glucose catabolism in *Pseudomonas fluorescens*. J. Bacteriol. 112: 291-298
- Ramakrishna, N., Lacey, J., Smith, J. E., 1991. Effect of surface sterilization, fumigation and gamma irradiation on the microflora and germination of barley seeds. Int. J. Food Microbiol. 13(1): 47-54
- Ramandeep, D., Hwang, K.W., Raje, M., Kim, K.J., Stark, B.C., Dikshit, K.L., Webster, D.A., 2001. Vitreoscilla hemoglobin: intracellular localization and binding to membranes. J Biol Chem 276: 24781-24789.
- Ramírez, M., Valderrama, B., Arredondo-Peter, R., Soberón, M., Mora, M., Hernández, G., 1999. *Rhizobium etli* genetically engineered for the heterologous expression of *Vitreoscilla* sp. Hemoglobin: effects on free-living and symbiosis. Mol Plant Microbe Interact 12: 1008-1015.
- Reyes, I., Baziramakenga, R., Bernier, L., Antoun, H., 2001. Solubilization of phosphate rocks and minerals by a wild type strain and two UV induced mutants of *Penicillium regulosum*. Soil Biol Biochem 33: 1741-1747
- Reyes, I., Bernier, L., Simard, R.R., Antoun, H., 1999b. Effect of nitrogen source on the solubilization of different inorganic phosphates by an isolate of *Penicillium rugulosum* and two UV induced mutants. FEMS Microbiol. Ecol. 28: 281-290

- Reyes, I., Bernier, L., Simard, R.R., Tanguay, P., Antoun, H., 1999a.** Characteristics of phosphate solubilization by an isolate of a tropical *Penicillium rugulosum* and two UV-induced mutants. *FEMS Microbiol. Ecol.* **28**:291–295
- Richardson, A. E., Barea, J. m., McNeill, A.M., Preigent-Combaret, C., 2009.** Acquisition of phosphorus and nitrogen in the rhizosphere and plant growth promotion by microorganisms. *Plant soil* **321**: 305-339
- Richardson, A.E., 2001.** Prospects for using soil microorganisms to improve the acquisition of phosphorus by plants. *Aust. J. Plant Physiol.* **28**:897–906
- Richardson, A.E., 2007.** Making microorganisms mobilize soil phosphorus. In: Valázquez E, Rodríguez-Barrueco C (Eds.) First international meeting on microbial phosphate solubilization. *Developments in Plant and Soil Science*, vol 102. Springer, Dordrecht, pp: 85–90
- Richardson, A.E., Hadobas, P.A., 1997.** Soil isolates of *Pseudomonas* sp. that utilize inositol phosphates. *Can. J. Microbiol.* **43**: 509–516
- Richardson, A.E., Hadobas, P.A., and Hayes, J.E., 2000.** Acid phosphomonoesterase and phytase activities of wheat (*Triticum aestivum* L.) root and utilization of organic phosphorus substrates by seedlings grown in sterile culture. *Plant Cell and Envi.* **23**: 397-405
- Richardson, A.E., Hadobas, P.A., Hayes, J.E., 2001a.** Extracellular secretion of *Aspergillus* phytase from *Arabidopsis* roots enables plants to obtain phosphorus from phytate. *Plant J.* **25**: 641-649
- Richardson, A.E., Hadobas, P.A., Hayes, J.E., Hara, C.P.O., Simpson, R.J., 2001b.** Utilization of phosphorus by pasture plants supplied with *myo*-inositol hexaphosphate is enhanced by the presence of soil micro-organisms. *Plant Soil* **229**: 47-56
- Richardson, A.E., Simpson, R.J., 2011.** Soil microorganism mediating phosphorus availability. *Plant Physiol* **156**: 989-996
- Rinaldi, A.C., Bonamore, A., Macone, A., Boffi, A., Bozzi, A., Di Giulio, A., 2006.** Interaction of *Vitreoscilla* hemoglobin with membrane lipids. *Biochem.* **45**: 4069–4076
- Rodriguez, H., Fraga, R., Gonzalez, T., Bashan. Y., 2006.** Genetics of phosphate solubilization and its potential application for improving plant growth-promoting bacteria. *Plant Soil* **287**: 15-21

- Roitsch, T., Lehle, L., 1988. Post-translational translocation of poly peptides across the mammalian endoplasmic reticulum membrane is size and ribosome dependent. *Eur. J. Biochem.* **174**: 699-705
- Roos, V., Andersson, C.I., Arfvidsson, C., Wahlund, K.G., Bülow, L., 2002. Expression of double *Vitreoscilla* hemoglobin enhances growth and alters ribosome and tRNA levels in *Escherichia coli*. *Biotechnol. Prog.* **18**: 652-656.
- Roos, V., Andersson, C.I., Bülow, L., 2004. Gene expression profiling of *Escherichia coli* expressing double *Vitreoscilla* haemoglobin. *J Biotechnol.* **114**:107-120
- Rothe, C., Lehle, L., 1988. Sorting of invertase signal peptide mutants in yeast dependent and independent on the signal-recognition particle *Eur. J. Biochem.* **252**: 16-24
- Sagoe, C. I., Ando, T., Kouno, K., Nagaoka, T., 1998. Relative importance of protons and solution calcium concentration in phosphate rock dissolution by organic acids. *Soil Sci. Plant Nutr.* **44**: 617-625
- Saichana, I., Moonmangmee, D., Adachi, O., Matsushita, K., Toyama, H., 2008. Screening of thermotolerant *Gluconobacter* strains for production of 5-keto-D-gluconic acid and disruption of flavin adenine dinucleotide-containing D-gluconate dehydrogenase. *Appl. Environ. Microbiol.* **75**: 4240-4247
- Sambrook, J., & Russell, D.W., 2001. *Molecular Cloning: a Laboratory Manual*, Cold Spring Harbor, NY: Cold Spring Harbor Laboratory.
- Sanny, T., Arnaldos, M., Kunkel, S.A., Pagilla, K.R., Stark, B.C., 2010. Engineering of ethanolic *E. coli* with the *Vitreoscilla* hemoglobin gene enhances ethanol production from both glucose and xylose. *Appl. Microbiol. Biotechnol.* **88**:1103-1112
- Schutter, M. E., Dick, R. P., 2001. Shifts in substrate utilization potential and microbial community structure in response to carbon substrates. *Soil Biol. Biochem.* **33**: 1481-1491.
- Shao, N., Huang, H., Meng, K., Luo, H., Wang, Y., Yao, B., 2008. Cloning, expression, and characterization of a new phytase from the phytopathogenic bacterium *Pectobacterium wasabiae* DSMZ 18074. *J. Microbiol. Biotechnol.* **18**: 1221-1226
- Sharma, V., Kumar, V., Archana, G., Naresh Kumar, G., 2005. Substrate specificity of glucose dehydrogenase (GDH) of *Enterobacter asburiae* PSI3 and rock phosphate solubilization with GDH substrates as C sources. *Can. J. Microbiol.* **51**: 477-482.

- Shashidhar, B., Podile, A.R., 2009. Transgenic expression of glucose dehydrogenase in *Azotobacter vinelandii* enhances mineral phosphate solubilization and growth of sorghum seedlings. *Microb. Biotechnol.* 4: 521- 529
- Shengfang, H., Gu, J., Xiao, K., 2007. Improving organic phosphate utilization in transgenic white clover by overexpression of *Aspergillus niger* *PhyA*. *Gene* 1: 265–270
- Shin, W., Ryu, J., Kim, Y., Yang, J., Madhaiyan, M., Sa, T., 2006. Phosphate solubilization and growth promotion of maize (*Zea mays* L.) by the rhizosphere soil fungus *Penicillium oxalicum*. 18th World Congress of Soil Science. July 9–15, Philadelphia, Pennsylvania, USA
- Simon, R., Priefer, U., Puhler, A., 1983. A broad host range mobilization system for *in vivo* genetic engineering: transposon mutagenesis in Gram negative bacteria. *Biotechnol.* 1: 784–791.
- Singal, R., Gupta, R., Saxena, R.K., 1994. Rock phosphate solubilization under alkaline conditions by *Aspergillus japonicus* and *A. foetidus*. *Folia Microbiol.* 39: 33–36
- Singh, B., Satyanarayana, T., 2009. Plant Growth Promotion by an Extracellular HAP-Phytase of a Thermophilic Mold *Sporotrichum thermophile*. *Appl. Biochem. Biotechnol.* 160:1267-1276.
- So, J., Webster, D.A., Stark, B.C., Pagilla, K.R., 2004. Enhancement of 2, 4- dinitrotoluene biodegradation by *Burkholderia* sp. in sand bioreactors using bacterial hemoglobin technology. *Biodegradation* 15: 161–71
- Song, O. R., Lee, S.J., Lee, Y.S., Lee, S.C., Kim, K.K., Choi, Y.L., 2008. Solubilization of insoluble inorganic phosphate by *Burkholderia cepacia* DA23 isolated from cultivated soil. *Brazil J. Microbiol.* 39:151–156
- Sridevi, M., Mallaiah, K.V., Yadav, N.C.S., 2007. Phosphate solubilization by *Rhizobium* isolates from *Crotalaria species*. *J. Plant Sci.* 2: 635-639.
- Srivastava, S., Kausalya, M.T., Archana, G., Rupela, O.P., Naresh Kumar, G., 2007. Efficacy of organic acid secreting bacteria in solubilization of rock phosphate in acidic alfisols. In Velazquez, E.; Rodriguez-Barrueco, C. (Eds.) *Developments in Plant and Soil Sciences*, Springer, 102, pp: 117-124
- Stark, B. C., Dixit, K. L., Pagilla K. R., 2011. Recent advances in understanding the structure, function, and biotechnological usefulness of the hemoglobin from the bacterium *Vitreoscilla*. 33: 1705-1714

- Stark, M.J.R., 1987. Multicopy expression vectors carrying the *lac* repressor gene for regulated high-level expression of genes in *Escherichia coli*. *Gene* **51**: 255-267
- Su, Y., Li, X., Liu, Q., Hou, Z., Zhu, X., Guo, X., Ling, P., 2010. Improved poly-gamma-glutamic acid production by chromosomal integration of the *Vitreoscilla* hemoglobin gene (*vgh*) in *Bacillus subtilis*. *Bioresour Technol* **101**:4733–4736
- Suthar, D.H., Chattoo, B.B., 2006. Expression of *Vitreoscilla* hemoglobin enhances growth and levels of alpha-amylase in *Schwanniomyces occidentalis*. *Appl. Microbiol. Biotechnol.* **72**: 94–102.
- Tang, J., Leung, A., Leung, C., Lim, B.L., 2006. Hydrolysis of precipitated phytate by three distinct families of phytases. *Soil Biol. Biochem.* **38**: 1316–1324
- Tarafdar, J.C., Gharu, A., 2006. Mobilization of organic and poorly soluble phosphates by *Chaetomium globosum*. *Appl. Soil Ecol.* **32**: 273-283
- Theodorou, M.E., Plaxton, W.C., 1993. Metabolic adaptations of plant respiration to nutritional phosphate deprivation. *Plant Physiol.* **101**: 339–344
- Thomas, G.V., 1895. Occurrence and ability of phosphate-solubilizing fungi from coconut plant soils. *Plant Soil* **87**: 357-364
- Tilak, K.V. B. R., Ranganayaki, N., Pal, K.K., De, R., Saxena, A.K., Nautiyal, C.S., Mittal, S., Tripathi, A.K., Johri, B.N., 2005. Diversity of plant growth and soil health supporting bacteria. *Cur. Sci.* **89**(1): 136-150
- Toyama, H., Furuya, N., Saichana, I., Ano, Y., Adachi, O., and Matsushita, K., 2007. Membrane-bound, 2-keto *D*-gluconate-yielding *D*-gluconate dehydrogenase from *Gluconobacter dioxyaceticus* IFO 3271: Molecular properties and gene disruption. *Appl. Environ. Microbiol.* **73**: 6551-6556
- Trivedi, P., Sa, T.M., 2008. *Pseudomonas corrugata* (NRRL B-30409) mutants increased phosphate solubilization, organic acid production, and plant growth at lower temperatures. *Curr Microbiol* **56**:140–144
- Trofymow, J. A., Coleman, D. C., Cambardella, C., 1987. Rates of rhizodeposition and ammonium depletion in the rhizosphere of axenic oat roots. *Plant Soil* **97**: 334-344.

- Tsai, P.S., Nageli, M., Bailey, J.E., 2002. Intracellular expression of *Vitreoscilla* hemoglobin modifies microaerobic *Escherichia coli* metabolism through elevated concentration and specific activity of cytochrome O. *Biotechnol. Bioeng.* **79**: 558–67
- Turner, B.L., 2007. Inositol phosphates in soil: Amounts, forms and significance of the phosphorylated inositol stereoisomers. In: Turner, B.L., Richardson, A.E., Mullaney, E.J., (Eds.), *Inositol Phosphates Linking Agriculture and the Environment*. CABI Publishing, Wallingford, UK. pp: 186–206
- Turner, B.L., 2008. Resource partitioning for soil phosphorus: a hypothesis. *J. Ecol.* **96**: 698–702
- Turner, B.L., Paphazy, M.J., Haygarth, P.M., McKelvie, I.D., 2002. Inositol phosphates in the environment. *Philos. Trans. Roy. Soc. Lond. Ser. B.* **357**: 449–469
- Tye, A., Siu, F., Keung, T., Lim, B., 2002. Molecular cloning and the biochemical characterization of two novel phytases from *B. subtilis* 168 and *B. licheniformis*. *Appl. Microbiol. Biotechnol.* **59**: 190–197
- Unno, Y., Okubo, K., Wasaki, T. S., Osaki, M., 2005. Plant growth promotion abilities and microscale bacterial dynamics in the rhizosphere of lupin analysed by phytate utilization ability. *Environ. Microbiol.* **7** : 396–404
- Urgun-Demirtas, M., Pagilla, K.R., Stark, B.C., 2004. Enhanced kinetics of genetically engineered *Burkholderia cepacia*: the role of vhb in the hypoxic metabolism of 2-CBA. *Biotechnol. Bioeng.* **87**: 110–118
- Urgun-Demirtas, M., Pagilla, K.R., Stark, B.C., Webster, D.A., 2003. Biodegradation of 2-chlorobenzoate by recombinant *Burkholderia cepacia* expressing *Vitreoscilla* hemoglobin under variable levels of oxygen availability. *Biodegradation* **14**: 357–365
- van Elsas, J.D., Dijkstra, A.F., Govaert, J.M., van Veen, J.A., 1986. Survival of *Pseudomonas fluorescens* and *Bacillus subtilis* introduced into two soils of different texture in field microplots. *FEMS Microbiol. Ecol.* **38**: 151–160
- Van Kauwenbergh, S. J., 2010. World phosphate rock reserves and resources technical bulletin IFDC. 75

- Van Veen, J. A., Leonard, S., Van Overbeek, L. S., Van Ellsas, J. D., 1997. Fate and activity of microorganisms introduced into soil. *Microbiol. Mol. Biol. Res.* **61**: 121-135
- Vance, C. P., Graham, P. H., and Allan, D. L. 2000. Biological nitrogen fixation: Phosphorus Ba critical future need? p. 509-518. *In*: F.O. Pederosa, M. Hungria, M.G. Yates, and W.E. Newton (ed.), Nitrogen fixation from molecules to crop productivity. Kluwer Academic Publishers, Dordrecht, Netherlands.
- Vassilev, N., Fenice, M., Federici, F., 1996. Rock phosphate solubilisation with gluconic acid produced by immobilized *Penicillium variable* P16. *Biotechnol Tech* **20**: 585–588
- Vats, P., Bhattacharyya, M. S., Banerjee, U., 2005. Use of Use of Phytases (*myo*- Inositol hexakisphosphate Phosphohydrolases) for Combatting Environmental Pollution: A Biological Approach. *Crit. Rev. Environ. Sci. Technol.* **35**: 469-486
- Vazquez, P., Holguin, G., Puente, M., Elopez, C.A., Bashan. Y., 2000. Phosphate solubilizing microorganisms associated with the rhizosphere of mangroves in a semi arid coastal lagoon. *Biol Fertil Soil* **30**: 460–468
- Vikram, A., Algawadi, A.R., Krishnaraj, P.U. and Mahesh, K.K.S., 2007. Transconjugation studies in *Azospirillum* sp. negative to mineral phosphate solubilization *World J. Microbiol. Biotechnol.* **23**, 1333-1337
- Vohra, A., Satyanarayana, T., 2002. Purification and characterization of a thermostable and acid-stable phytase from *Pichia anomala*. *World J. Microbiol. Biotechnol.* **18**: 687- 691.
- Vohra, A., Satyanarayana, T., 2003. Phytases : Microbial sources, production, purification, and potential biotechnological application. *Crit. Rev. Biotechnol.* **23** : 29-60
- Vora, M. S., Shelat, H. N., 1998. Impact of addition of different carbon and nitrogen sources on solubilization of rock phosphate by phosphate-solubilizin micro-organisms. *Ind. J. Agric. Sci.* **68**: 292-294
- Vyas, P., and Gulati, A., 2009. Organic acid production *in vitro* and plant growth promotion in maize under controlled environment by phosphate-solubilizing fluorescent *Pseudomonas*. *BMC Microbiol.* **9**: 174

- Wani, P. A., Khan, M. S. and Zaidi, A., 2007b. Cadmium, chromium and copper in greengram plants. *Agron. Sustain. Dev.* **27**: 14-153
- Wani, P. A., Khan, M. S., Zaidi, A., 2007a. Effect of metal tolerant plant growth promoting *Bradyrhizobium* sp. (vigna) on growth, symbiosis, seed yield and metal uptake by green gram plants. *Chemosphere* **70**: 36-45
- Webley, D.M., and Duff, R.B., 1965. The incidence, in soils and other habitats of micro-organisms producing 2-ketogluconic acid. *Plant Soil* **22**: 307-313
- Webster, D.A., Hackett, D.P., 1966. The purification and properties of cytochrome O from *Vitreoscilla*. *J. Biol. Chem.* **241**: 3308-3315
- Wen, Y., Song, Y., Li, J.L., 2001. The effects of *Vitreoscilla* hemoglobin expression on growth and antibiotic production in *Streptomyces cinnamonensis*. *Sheng Wu Gong Cheng Xue Bao* **17**:24-8 [in Chinese]
- Whipps J.M., 1990. Carbon economy. In: Lynch JM, (Eds). *The rhizosphere*. Chichester: Wiley, 59-97
- Whitelaw, M. A., 2000. Growth promotion of plants inoculated with phosphate solubilizing fungi. *Adv. Agron.* **69**: 100-151
- Whitelaw, M. A., 2000. Growth promotion of plants inoculated with phosphate solubilizing fungi. *Adv. Agron.* **69**: 100-151
- Whitelaw, M. A., Harden, T. J., Helyar, K. R., 1999. Phosphate solubilisation in solution culture by the soil fungus *Penicillium radicum*. *Soil Biol. Biochem.* **31**: 655- 665
- Wodzinski, R.J., Ullah, A.H.J., 1996. Phytase. *Adv. Appl. Microbiol.* **42**: 263-302
- Wu, J.M., Hsu, T.N., Lee, C.K., 2003. Expression of the gene coding for bacterial hemoglobin improves beta-galactosidase production in a recombinant *Pichia pastoris*. *Biotechnol. Lett.* **25**: 1457-62.
- Wu, J.M., Wang, S.Y., Fu, W. C., 2012. Lower Temperature Cultures Enlarge the Effects of *Vitreoscilla* Hemoglobin Expression on Recombinant *Pichia pastoris*. *Int. J. Mol. Sci.* **13**: 13212-13226

- Xiao, K., Harrison, M.J., Wang, Z.Y., 2005. Transgenic expression of a novel *M. truncatula* phytase gene results in improved acquisition of organic phosphorus by *Arabidopsis*. *Planta*. **222**: 27-36
- Xiong, X., Xing, J., Li, X., Bai, X., Li, W., Li, Y., Liu, H., 2007. Enhancement of biodesulfurization in two-liquid systems by heterogeneous expression of *Vitreoscilla* hemoglobin. *Appl. Environ. Microbiol.* **73**: 2394–2397
- Xu, R. K., Zhu, Y.G., Chittleborough, D. 2004. Phosphorus release from phosphate rock and an iron phosphate by low-molecular-weight organic acids. *J. Environ. Sci.* **16**: 5- 8
- Yadav, B. K., Tarafdar, J. C., 2007. Ability of *Emericella rugulosa* to mobilize unavailable P compounds during Pearl millet [*Pennisetum glaucum* (L.) R. Br.] crop under arid condition. *Indian J. Microbiol.* **47**:57–63
- Yadav, J., Verma, J.P., Tiwari, K.N., 2011a. Solubilization of Tricalcium Phosphate by Fungus *Aspergillus niger* at Different Carbon Source and Salinity. *Trends in App. Sci. Res.* **6**: 606-613
- Yadav, J., Verma, J.P., Yadav S.K., Tiwari, K.N., 2011b. Effect of salt concentration and pH on soil inhabiting fungus *Penicillium citrinum* Thom for solubilization of tricalcium phosphate. *Microbiol. J.* **1**: 25-32
- Yanasi, H., Fujimoto, J., Meada, M., Okamoto, K., Kita, K., Tonomura, K., 1998. Expression of the extracellular levansucrase and invertase from *Zymomonas mobilis* in *E. coli* cells. *Biosci. Biotechnol. Biochem.* **62** (9): 1802-1805
- Yanke, L.J., Selinger, L.B., Cheng, K.J., 1999. Phytase activity of *Selenomonas ruminantium*: a preliminary characterization. *Lett. Appl. Microbiol.* **29**: 20-25
- Yip, W., Wang, L., Cheng, C., Wu, W., Lung, S., Lim, B.L., 2003. The introduction of a phytase gene from *Bacillus subtilis* improved the growth performance of transgenic tobacco. *Biochem. Biophys. Res. Commun.* **310**: 1148-1154
- Yu, H., Ma, X., Luo, H., Wen, C., Shen, Z., 2008. Fusion expression of D-amino acid oxidase from *Trigonopsis variabilis* with maltose binding protein and *Vitreoscilla* hemoglobin. *Sheng Wu Gong Cheng Xue Bao* **24**: 1004–1009
- Yu, H.M., Shi, Y., Zhang, Y.P., 2001. Introduction of *Vitreoscilla* hemoglobin gene in a recombinant *E. coli* for PHB production. *Wei Sheng Wu Xue Bao* **41**:548–52 [in Chinese]

- Yum, D.Y., Lee, Y.P., Pan, J.G., 1997.** Cloning and expression of a gene cluster encoding three subunits of membrane-bound gluconate dehydrogenase from *Erwinia cyprripedii* ATCC 29267 in *Escherichia coli*. J Bacteriol. **179(21)**: 6566-6572
- Zaidi, A., Khan, M.S., Ahemad, M., Oves, M., and Wani, P.A., 2009.** Recent advances in plant growth promotion by phosphate-solubilizing microbes. In Khan, M. S., Zaidi, A., and Musarrat, J., (Eds.), Microbial Strategies for Crop Improvement, Springer, Berlin, pp: 23-50
- Zamudio, M., González, A., Bastarrachea, F., 2002.** Regulation of *Raoultella terrigena* comb.nov. phytase expression. Can. J. Microbiol. **48**: 71-81
- Zhang, L., Li, Y., Wang, Z., Xia, Y., Chen, W., Tang, K., 2007.** Recent developments and future prospects of *Vitreoscilla* hemoglobin applications in metabolic engineering. Biotechnol. Adv. **25**:123-136
- Zhu, H., Wang, T.W., Sun, S.J., Shen, Y.L., Wei, D.Z., 2006.** Chromosomal integration of the *Vitreoscilla* hemoglobin gene and its physiological actions in *Tremella fuciformis*. Appl. Microbiol. Biotechnol.
- Zimmermann, P., Zardi, G., Lehmann, M., Zeder, C., Amrhein, N., Frossard, E., Bucher, M., 2003.** Engineering the root-soil interface via targeted expression of a synthetic phytase gene in trichoblasts. Plant Biotechnol. J. **1**: 353-60
- Zinin, N.V., Serkina, A.V., Gelfand, M.S., Shevelev, A.B., Sineoky, S.P., 2004.** Gene cloning, expression and characterization of novel phytase from *Obesumbacterium proteus*. FEMS Microbiol. Lett. **236**: 283-290