Dr. Freya Q. Schafer, Ph.D.

(CV 1987 – 2006)

Education Ph.D (Human Biology) 1993 University of Ulm, Germany
M.S. (Chemistry) 1988 University of Ulm, Germany

Assistant Research Scientist (1999- 2006)
in the Laboratory of Dr. Garry R. Buettner, Free Radical Research Institute & ESR Facility, The University of Iowa.

Field of research:
1. The redox environment of the cell during proliferation, differentiation and cell death.
2. The influence of antioxidants in photodynamic therapy.

Postdoctoral Research Associate (1997- 1999)
in the Laboratory of Dr. Garry R. Buettner, Free Radical Research Institute & ESR Facility, The University of Iowa.

Field of research: The mechanism of oxidative stress in tumor cells exposed to Photofrin photosensitization.

Postdoctoral Research Associate (1994- 1996)
in the Laboratory of Dr. J. Malcolm Shick, Department of Zoology, University of Maine.

Field of research: Protection of sea urchin DNA against UV damage by mycosporine-like amino acids (MAAs).

Postdoctoral fellow (1993-1994)
in the laboratory of Dr. Gisela Witz, University of Medicine and Dentistry of New Jersey, Environmental and Occupational Health Science Institute.

Field of research: 8-Hydroxy-2'-deoxyguanosine (8OHdG) as a bioindicator for oxidative DNA damage.

Ph.D Thesis (1988-1993)
in the laboratory of Dr. Hans J. Seidel, University of Ulm, Institute of Occupational and Social Medicine, Germany.

Thesis: Determination of benzene metabolites and modification of benzene metabolism in BDF-1 mice.

Master Thesis (1987-1988)
in the laboratory of Dr. Vladimir Krivan, University of Ulm, Department of Analytical Chemistry, Germany.

Thesis: Spruce needles as bioindicator for heavy metals.

Awards

• Travel Award from the American Society for Photobiology (2000)

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• Travel Award from the American Society for Photobiology (1998)

• Travel Award from the Oxygen/Free Radical Research Society (1999)

• Travel Award from the American Society for Photobiology (1997)

Papers published

Krivan V, Schafer F. (1989) Surface deposits on spruce needles as a possible indicator for the degree of heavy metal pollution of the atmosphere. *Fresenius Z Anal Chem.* **333:** 726.

Seidel HJ, Barthel E, Schafer F, Schad H, Weber L. (1991) Actions of Benzene Metabolites on Murine Hemapoietic Stem Cells in vitro. *Toxicol Appl Pharmacol.* **111:** 128-131.

Schad H, Schafer F, Weber L, Seidel HJ. (1992) Determination of Benzene with Solid Phase Extraction and HPLC in Urine of Mice. *J Chrom.* **593:** 147-151.

Schafer F, Schad H, Weber L. (1993) Determination of phenylmercapturic acid in urine of benzene-exposed BDF-1 mice. *J Chrom.* **620:** 239-242.

Zhang Z, Schafer F, Schoenfeld H, Cooper KR, Snyder R, Goldstein BD, Witz G. (1995) The Hematotoxic Effects of 6-Hydroxy-trans, trans-2,4-hexadienal a Reactive Metabolite of trans, trans-Muconaldehyde, in CD-1 Mice. *Toxicol Appl Pharmacol.* **132:** 213-219.

Mason DS, Schafer F, Shick JM, Dunlap WC. (1998) Ultraviolet radiation-absorbing mycosporine-like amino acids (MAAs) are acquired from their diet by medaka fish (Oryzias latipes) but not by SKH-1 hairless mice. *Comparative Biochemistry & Physiology. Part A, Molecular & Integrative Physiology.* **120:** 587-598.

Schafer FQ, Buettner GR. (1999) Singlet oxygen toxicity is cell line-dependent: a study of lipid peroxidation in nine leukemia cell lines. *Photochem Photobiol* **70:** 858-867.

Schafer FQ, Buettner GR. (2000) Acidic pH amplifies iron-mediated lipid peroxidation in cells. *Free Rad Biol Med.* **28:** 1175-1181.

Qian SY, Wang HP, Schafer FQ, Buettner GR. (2000) EPR detection of lipid-derived radicals from PUFA, LDL, and cell oxidations. *Free Rad Biol Med.* **29:**568-579.

Schafer FQ, Qian SY, Buettner GR. (2000) Iron and free radical oxidations in cell membranes. *Cellular and Molecular Biology.* **46:** 657-662.

Buettner GR, Schafer FQ. (2000) Free radicals, oxidants and antioxidants. *Teratology.* **62:** 234.

Venkataraman S, Martin SM, Schafer FQ, Buettner GR. (2000) Detailed methods for the quantification of nitric oxide in aqueous solutions using either an oxygen monitor or EPR. *Free Radic Biol Med.* **29:**580-585.

Wang HP, Qian SY, Schafer FQ, Domann FE, Oberley LW, Buettner GR (2001) Phospholipid Hydroperoxide Glutathione Peroxidase Protects against Singlet Oxygen-Induced Cell Damage. *Free Radic Biol Med.* **30:**.825-835.

Schafer FQ, Buettner GR. (2001) Redox environment of the cell as viewed through the redox state of the glutathione disulfide/glutathione couple. *Free Radic Biol Med.* **30:**1191-1212.

Schafer FQ, Wang HP, Kelley EE, Cueno KL, Martin SM, Buettner GR (2002) Comparing β-carotene, vitamin E and nitric oxide as membrane antioxidants. *Biol Chem.* **283:** 671-681.

Wang HP, Schafer FQ, GoswamiPC, Oberley LW, Buettner GR (2003) Phospholipid hydroperoxide glutathione peroxidase induces a delay in G_1 of the cell cycle. *Free Rad Res.* **37:** 621-630.

Schafer FQ, Buettner GR. (2003) Targets of photosensitzation: Lipids, proteins and nucleic acids. In electronic press as part of *The Digital Photobiology Compendium*

Schafer FQ, Buettner GR. (2003) Redox state and redox environment in Biology. In *Signal Transduction by Reactive Oxygen and Nitrogen Species: Pathways and Chemical Principles*. Eds Forman HJ, Torres M, Fukuto J. Kluwer academic Publishers, Dordrecht, Netherlands, Chapter 1, pp. 1-14.

Venkataraman S, Schafer FQ, Buettner GR. (2004) Detection of lipid radicals using EPR. *Antioxidants and Redox Signaling*. **6**: 631-638.

Venkataraman S, Wagner BA, Jiang X, Wang HP, Schafer FQ, Ritchie JM, Burns CP, Oberley LW, Buettner GR. (2004) Overexpression of manganese superoxide dismutase promotes the survival of prostate cancer cells exposed to hyperthermia. *Free Radic Res.* **38:** 1119-1132.

Wang M, Kirk JS, Domann FE, Zhang HJ, Schafer FQ, Weydert CJ, Spitz DR, Buettner GR, Oberley LW. (2005) Manganese superoxide dismutase suppresses hypoxic induction of hypoxia inducible factor-1a and vascular endothelial growth factor. *Oncogene* **24:** 8154-8166.

Hummel SG, Fischer AJ, Martin SM, Schafer FQ, Buettner GR. (2006) Nitric oxide as a cellular antioxidant: a little goes a long way. *FRBM.* **40:** 501-506.

Kramarenko GG, Wilke WW, Dayal D, Buettner GR, Schafer FQ. (2006) Ascorbate Enhances the Toxicity of the Photodynamic Action of Verteporfin in HL-60 Cells. *Photochem Photobiol.* 40: 1615-1627.

Buettner GR, Schafer FQ. (2006) Classic Papers by Albert Szent-Györgyi from the Biochemical Journal: Dr. Albert Szent-Györgyi and the Identification of Vitamin C. *The Biochemist.* 28: 31-33.

Buettner GR, Ng CN, Wang M, Rodgers GJ, Schafer FQ. (2006) A new Paradigm: Manganese Superoxide dismutase influences the production of H_2O_2 in cells and their biological state. *Free Radic Biol Med.* 41: 1338-1350.

Vislisel JM, Schafer FQ, Buettner GR. (2007) A simple and sensitive assay for ascorbate using a plate reader. *Analytical Biochem.* 365: 31-39.

Ng CF, Schafer FQ, Buettner GR, Rodgers VGJ. (2008) The rate of cellular hydrogen peroxide removal shows dependency on GSH: Mathematical insight into in vivo H_2O_2 and GPx

concentrations. *Free Rad Res.* 41: 1201–1211.

Book Chapters

Schafer FQ, Kelley EE, Buettner GR (2003) *Oxidative stress and antioxidant intervention.* In Oxidative Stress and Aging, eds. Cuttler RG, Rodriguez H. Chapter 49. pp. 849-869; World Scientific Publishing, Riveredge, NJ.

Schafer FQ, Buettner GR. (2003) *Redox state and redox environment in Biology.* In Signal Transduction by Reactive Oxygen and Nitrogen Species: Pathways and Chemical Principles. Eds Forman HJ, Torres M, Fukuto J. Chapter 1, pp. 1-14; Kluwer Academic Publishers, Norwell MA, USA.

Buettner GR, Schafer FQ. (2003) Ascorbate (Vitamin C) as an Antioxidant in *Vitamin C:its Functions and Biochemistry in Animals and Plants.* Ed May JM, Asard H, Smirnoff N. BIOS Scientific Publishers. pp 173-188..

Buettner GR, Samson FE, Schafer FQ. (2004) Free radicals in brain, functions and failures. *Encyclopedia of Neuroscience* Ed. Adelman G, Snith BH. 3rd ed. CD-ROM.

Electronic Publications

1. Schafer FQ (1997) DNA damage: Hot spots for free radical attack[PDF] Virtual Free Radical School for Oxygen Society

2. Buettner GR, Schafer FQ. (2002) Free Radical Nomenclature: A beginning [PDF] Virtual Free Radical School for Oxygen Society.

3. Buettner GR, Schafer FQ. (2002) SI Units [PDF] Virtual Free Radical School for Oxygen Society.

4. Buettner GR, Schafer FQ. (2002) Ascorbate (Vitamin C), its Antioxidant Chemistry [PDF | Powerpoint] Virtual Free Radical School for Oxygen Society.

5. Schafer FQ, Buettner GR. (2002) Redox State and Redox Environment [PDF | Powerpoint] Virtual Free Radical School for Oxygen Society

6. Schafer FQ (2002) Pointers for PowerPoint Presentations [PDF | Powerpoint] Virtual Free Radical School for Oxygen Society.

7. Schafer FQ, Buettner GR. (2003) Targets of photosensitzation: Lipids, proteins and nucleic acids. In electronic press as part of *The Digital Photobiology Compendium*

Presentations at National and International Conferences

Weber L, Schad H, Schafer F.(1989) Trennung der Benzolmetaboliten mit HPTLC-Materialien. (Separation of Benzene Metabolites with HPTLC-materials). Berichte ueber die 29. Jahres-tagung der Deutschen Gesellschaft fuer Arbeitsmedizin e. V., Gentner Verlag, Stuttgart.

Schafer F, Weber L, Schad H. (1989) Trennung von t,t-Muconsaeure und t,t-Muconaldehyd auf selectiven HPLC-Materialien. (Separation of t,t-Muconic acid and t,t-Muconaldehyde with selective HPLC-materials). Ultro Chrom '89, 4. Wuerzburger Chromatographie Gespraeche.

Weber L, Schafer F, Schad H. (1989) Trennung der Benzolmetabolite Phenol, Brenzkatechin Hydrochinon und t,t-Muconsaeure mit HPLC-Verfahren. (Separation of the Benzene Metabolites Phenol, Catechol, Hydroquinone and t,t-Muconic acid with HPLC). Ultro Chrom '89, 4. Wuerzburger Chromatographie Gespraeche.

Schad H, Schafer F, Weber L. (1990) Trennung von Benzolmetaboliten aus Urin. (Separation of Benzene Metabolites from urine). Bericht ueber die 30. Jahrestagung der Deutschen Gesellschaft fuer Arbeitsmedizin e.V.

Schafer F, Harvey J, Zhang Z, Kline SA, Witz G, Cooper KR, Goldstein BD. (1994) Toxicity and urinary metabolites of benzene in glucuronidation deficient Gunn rats and their normal congeners. Poster at the SOT-Meeting, Dallas,Texas; March.

Luber T, Schafer F, Schoenfeld HA, Goldstein BD, Witz G. (1996) DNA-Protein Crosslink formation by benzene metabolites in a chemical model system. Poster at the SOT-Meeting, Annaheim, California; March.

Schafer F, Kelley EE, Buettner GR. (1997) Does vitamin E influence lipid derived radical formation and viability in L1210 cells exposed to Photofrin® and light? Poster at the College of Medicine Research Week, Iowa City, Iowa; April.

Schafer F , Kelley EE, Buettner GR.(1997) Influence of vitamin E on Photofrin® photosensitization in L1210 murine leukemia cells. Poster at the ASAP-Meeting, St. Louis, Missouri; July.

Wang H, Schafer F, Kelley EE, Wagner BA, Buettner GR. (1997) β-carotene rescues L1210 cells from photodynamic therapy with Photofrin®. Poster at the ASP-Meeting, St. Louis, MO; July.

Schafer F. (1997) Oxidative DNA Damage: A Radical Primer. Invited Sunrise Free Radical School presentation at the Oxygen Society-Meeting, San Francisco, California; November.

Schafer F, Wagner BA, Buettner GR. (1997) Influence of vitamin E on Photofrin® photosensitization in HL60, K562 and L1210 cells. Poster at the Oxygen Society-Meeting, San Francisco, California; November 1997.

Wang H, Schafer F, Kelley EE, Wagner BA, Buettner GR. (1997) Problems in the delivery of β-carotene to cultured cells: THF enhances Photofrin® toxicity. Poster at the Oxygen Society-Meeting, San Francisco, California; November.

Schafer F, Wagner BA, Buettner GR (1998) HL60 and K562 cells respond differently to Photofrin® photosensitization. Poster at the Radiation Research Society-Meeting, Louisville, Kentucky; April.

Wang H, Schafer F, Kelley EE, Wagner BA, Buettner GR. (1998) The role of β-carotene in Photofrin® photodynamic therapy (PDT). Poster at the Radiation Research Society-Meeting, Louisville, Kentucky; April.

Schafer F, Buettner GR. (1998) Photofrin® photosensitization in HL-60 & K562 cells is [PUFA] & pH dependent. Poster at the ASP-Meeting, Snowbird, Utah; July.

Wang H, Schafer F, Kelley EE, Wagner BA, Buettner GR. (1998) The effect of. β-carotene on lipid peroxidation induced by Photofrin® photosensitization. Poster at the ASP-Meeting, Snowbird, Utah; July.

Schafer F. (1998) Photofrin® and light, a deadly combination: what is the mechanism behind its action? Oral presentation at the 50th Anniversary of the Radiation Research Laboratory, Iowa City, Iowa; October.

Schafer F, Buettner GR. (1998) Small pH changes affect iron-mediated lipid peroxidation in cells. *Free Radic. Biol. Med.* **25:** S19.

Schafer F, Buettner GR. (1998) Singlet oxygen toxicity is cell line-dependent: A study of lipid peroxidation in leukemia cell lines. *Free Radic. Biol. Med.* **25:** S79.

Wang H, Schafer F, Kelley EE, Wagner BA, Buettner GR. (1998) β-carotene reduces membrane damage from singlet oxygen in murine 308 epidermal cells. *Free Radic. Biol. Med.* **25:** S102.

Schafer FQ, Aminzay A, Cueno KL, Buettner GR. (1999) Photofrin photosensitization is cell line dependent: a study of nine leukemia cell lines. *Photochem Photobiol.* **69:** 37S.

Wang H, Qian SY, Schafer F, Buettner GR. (1999) Phospholipid hydroperoxide glutathione peroxidase (PhGPx) uniquely protects cell membranes from photo-oxidation. *Free Radic. Biol. Med.* **27:** S46.

Venkataraman S, Martin SM, Schafer F, Buettner GR. (1999) A new method for quantification of nitric oxide in solution using a standard oxygen monitor. *Free Radic. Biol. Med.* **27:** S88.

Schafer F, Wagner BA, Wang H, Buettner GR. (1999) Does peroxide toxicity correlate with antioxidant enzyme activity or oxidizability of cells? *Free Radic. Biol. Med.* **27:** S115.

Qian SY, Wang H, Schafer F, Buettner GR. (1999) EPR detection of lipid-derived radicals from peroxidations of PUFA, LDL, and cells. *Free Radic. Biol. Med.* **27:** S133.

Schafer FQ, Buettner GR. (2000) Nitric oxide protects cell-membranes from free radical-mediated lipid peroxidation. Invited presentation at the 13th International Photobiology-Meeting, San Francisco, California; July.

Buettner GR, Schafer FQ, Wang HP, Kelley EE, Qian SY. (2000) Antioxidants and their networks of protection. Invited presentation at the 13th International Photobiology-Meeting, San Francisco, California; July.

Schafer FQ, Wang HP, Cueno KL, Buettner GR. (2000) Protecton of different antioxidants against singlet oxygen-induced cell damage. Poster at the 13th International Photobiology-Meeting, San Francisco, California; July.

Wang HP, Qian SY, Schafer FQ, Domann FE, Oberley LW, Buettner GR. (2000) MCF-7 cells stably transfected with phospholipid hydroperoxide glutathione peroxidase are resistant to photo-oxidative stress. Poster at the 13th International Photobiology-Meeting, San Francisco, California; July.

Schafer FQ, Cueno KL, Venkataraman S, Wang H, Buettner GR. (2000) Nitric oxide as an antioxidant: *Free Radic. Biol. Med.* **29:** S76.

Schafer FQ, Wang HP, Venkataraman S, Goswami PC, Buettner GR. (2001) PhGPx inhibits cell growth in MCF-7 cells. *Free Radic. Biol. Med.* **31:** S106.

Venkataraman S, Jang X, Wang HP, Schafer FQ, Oberley LW, Buettner GR. (2001) Oxidative stress during hyperthermia: the role of MnSOD on a human prostatic carcinoma cell line. *Free Radic. Biol. Med.* **31:** S141.

Fischer AJ, Martin SM, Schafer FQ, Buettner GR. (2002) A new method to examine the antioxidant function of nitric oxide. *Free Radic. Biol. Med.* **33:** S375.

Martin SM, Holland CL, Schafer FQ, Buettner GR. (2002) Redox chemistry of motexafin gadolinium with ascorbate and GSH. *Free Radic. Biol. Med.* **33:** S442.

Kramarenko GG, Dunkle AJ, Buettner GR, Schafer FQ. (2003) Vitamin E protects cells against mitochondrial induced singlet oxygen damage. *Free Radic Biol Med.* **35**: S328.

Schafer FQ, Martin SM, Holland CL, BuettnerGR. (2003) A new method to determine cellular protein hydroperoxides. *Free Radic Biol Med.* **35:** S349.

Schafer FQ, Cueno KL, Venkataraman S, Martin SM, Buettner GR. (2004) Nitric oxide is a cellular chain-breaking antioxidant via its reaction with peroxyl radicals: Lipid alkoxyl radicals are minor propagating species. *Free Radic Biol Med* **36:** S51

Hummel S, Martin SM, Schafer FQ, Buettner GR. (2005) Ascorbater reacts with singlet oxygen to produce hydrogen peroxide. *Free Radic Biol Med.* **39:** S23

Hummel S, Fischer A, Martin SM, Schafer FQ, Buettner GR. (2005) Nitric oxide as a cellular antioxidant: A little goes a long way.. *Free Radic Biol Med.* **39:** S98

Kramarenko GG, Wilke WW, Dayal D, Buettner GR, Schafer FQ. (2005) Vitamin C enhances verteporfin-induced phototoxicity in HL-60 cells but protects U937 cells. *Free Radic Biol Med.* **39:** S35

Teaching Activities and Invited oral presentations

- Invited speaker at the Career Workshop of the American Radiation Research Society meeting. (November 2006)
  Topic: Career planning and academic ladder transitions

- Invited speaker in the Summer Research Opportunity Program, The University of Iowa. (July 2006)
  Topic: Career planning

- Invited speaker in the Summer Program of the College of Medicine, The University of Iowa. (July 2006)
  Topics: How to prepare poster abstracts
  How to give a scientific oral and poster presentation

- Workshop on scientific communication at the College of Medicine, The University of Iowa, (June 2006)
  Topics: How I write a scientific paper, pointers for posters and tips for oral presentations.

- Invited speaker in the Bioscience Program of the College of Medicine, The University of Iowa. (June 2006)

Topic: How to give a scientific oral and poster presentation

- Invited speaker in the Seminar Series at the Institute of Environment Health, The University of Pittsburgh (Sep 2005)
  Topic: Quantitative redox biology: Antioxidant enzymes and peroxide Tone.

- Invited speaker in the Seminar Series at the Institute of Environment Health, The University of Pittsburgh (Sep 2005)
  Topic: How I write a scientific paper: Selling your data with power writing.

- Workshop on "How to land the job you want" at the Annual Meeting of the Society for Free Radicals in Biology and Medicine (Nov 2005).

- Invited speaker at the Second Workshop on Comparative Aspects of Oxidative Stress in Biological Systems, La Paz, Mexico (Feb 2005).
  Topic: The Challenge of Detecting Protein Hydroperoxides

- Guest lecturer at The University of Iowa in the course of Dr. G. R. Buettner (1997, 1999, 2001, 2003, 2005)
  Topic: Cellular redox environment; Free radicals and DNA; Protein oxidation.

- Workshop on "Scientific Communication", Annual Meeting of the The Society for Free Radical Biology and Medicine, Seattle, WA (2003).

- Seminar at the Radiation Research Seminar, The University of Iowa.
  Topic: Pointers for posters and tips for talks (2001).

- Seminar at the Radiation Research Seminar, The University of Iowa.
  Topic: Photofrin phototoxicity in leukemia cells (1998).

- Schafer F. (1997) Oxidative DNA Damage: A Radical Primer. Invited Sunrise Free Radical School presentation at the Oxygen Society-Meeting, San Francisco, California; November.

- Seminar at the Radiation Research Seminar, The University of Iowa.
  Topic: HPLC (1997).

- Seminar at the Zoology Forum, University of Maine
  Topic: Oxidative Stress (1995), HPLC (1996).

- Guest lecturer at the University of Maine in the course of Dr. Rebecca van Beneden (1995)
  Topic: Oxidative stress and disease.

- Seminar at Mount Desert Island Biological Laboratories (MDIBL, 1995)
  Topic: Practical approach to detect 8-hydroxy-2'-deoxyguanosine in sea urchin eggs.

- Seminars at the University of Ulm, Germany (1992)
  Topics: Introduction to HPLC and isolation of benzene metabolites from urine of mice.

- Prepared medical students for their chemistry exams (1988-1992).

- Tutor in analytical chemistry lab (1987).