

CURRICULUM VITAE
and List of Publications
 Aug. 2006

PERSONAL DETAILS

Name: **ZVI COHEN**
 Date of Birth: November 27, 1947
 Place of Birth: Cluj, Rumania
 Date of Immigration: 1950
 Marital status: Married, 2 children
 Regular military service: 1965-6
 Address at work: Microalgal Biotechnology Laboratory, Albert Katz Dept. of Desert Biotechnologies, Jacob Blaustein Institutes for Desert Research (BIDR), Ben-Gurion University of the Negev, Sde-Boker Campus, 84990, Israel
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EDUCATION

B.Sc. 1966-70 Bar-Ilan University, Dept. of Chemistry
 M.Sc. 1970-73 Bar-Ilan University, Dept. of Chemistry
 Advisor: Dr. B. Sklarz
 Thesis: The Phosphite Deoxygenation of Bridgehead Nitroso Compounds
 Ph.D. 1974-78 Weizmann Institute of Science, Dept. of Organic Chemistry
 Advisor: Prof. Y. Mazur
 Thesis: Functionalization of Unactivated Carbon Atoms: Selective Hydroxylation and Halogenation in Steroids

EMPLOYMENT HISTORY

2002 Professor, Albert Katz Dep. of Drylands Biotechnologies, Jacob Blaustein Institutes for Desert Research (BIDR), Ben-Gurion University of the Negev (BGU), Sde Boker, Israel
 1996-02 Associate Professor, BIDR, BGU, Sde Boker, Israel
 1991-96 Researcher Grade A, BIDR, BGU, Sde Boker, Israel
 1989-90 Visiting Scientist, Weed Science Lab., Plant Science Inst., USDA, Beltsville, MD
 1987-91 Researcher Grade B, BIDR, BGU (tenured)
 1982-87 Lecturer, BIDR, BGU
 1981 Lecturer, University of Massachusetts, Worcester, MA
 1978-81 Research Fellow, Harvard Medical School, Boston, MA
 1970-73 Teaching assistant, Department of Chemistry, Bar-Ilan University, Ramat Gan, Israel

PROFESSIONAL ACTIVITIES

(a) Position in academic administration

2005- Chairman, Coordinating council of Israel's faculty associations
 2004- Member, Promotions subcommittee, BIDR, BGU
 2004- Member, Promotions higher committee for research rank, BGU

- 2003- Member, Intellectual property committee, BGU
 2002-5 Member, Promotions subcommittee, humanities and social sciences faculty, BGU
 1998-01 Director, European Union Large Scale facility for desert studies, BIDR, BGU
 1997-01 Director, the Blaustein International Center for Desert Studies, BIDR, BGU
 1996- Chairman, BGU Faculty Association
 1996-04 Member, research studies committee, the Kreitman School for Advanced Research Studies
 1992-7 Member, Steering committee of the Jacob Blaustein International Center for Desert Studies, BGU
 1992-4 Ombudsman for BGU students at the BIDR, BGU

(b) Professional functions outside university

- 2006- Director, Bashan Foundation
 2000-3 Director, Makefet pension fund

(c) Professional consulting

- 1986 Ramat Hovav, Analysis of industrial sewage effluents
 1984-85 Agis Pharmaceutical, Analysis and quality control of active drug ingredients

(d) Editor or member of editorial board of scientific or professional journal

- 1994- Member of the editorial board of Annals of Microbiology

(e) Membership in professional/scientific societies

Member of the international advisory committee, The XVth International Symposium on Plant Lipids, 5/2002, Okazaki, Japan. American Oil Chemists Society, International Phycological Society

(f) Review of manuscripts/research proposals

Aquaculture, Ann. Microbiol., Appl. Biochem. Biotechnol., Aquaculture, Biotechnol. Bioeng., Bot. Mar., Chemosphere, Comp. Biochem. Physiol., Europ. J. Phycol., FEMS Microbiol. Lett, Food Tech. Biotech Lett., J. Agric. Food Chem., J. Amer. Oil Chem. Soc., J. Appl. Phycol., J. Phycol., Lipids, Micron, Phytochemistry
 US-Israel Binational Agricultural Research Foundation (BARD), US-Israel Binational Science Foundation (BSF), The Israel Science Foundation (ISF)

EDUCATIONAL ACTIVITIES

(a) Courses taught

- 2000- Analytical methods, Albert Katz International School for Desert Studies, BIDR, BGU
 1995- Organic chemistry lab course, Dept. of Chemistry
 1994-02 General and inorganic chemistry lab course, Dept. of Chemistry, BGU
 1993 Organic chemistry, Dept. of Chemistry
 1993 3rd International Advanced Training Course on Algal Biotechnology for graduate students, BIDR
 1991 2nd International Advanced Training Course on Algal Biotechnology for graduate students, BIDR
 1988 1st International Advanced Training Course on Algal Biotechnology for graduate students, BIDR

- 1982-93 Establishment, direction and teaching of chemistry courses for gifted children, Dept. of Chemistry, BGU
- 1975-7 Chemistry for gifted children, Weizmann Inst. for Science
- 1971-4 Chemistry for gifted children, Dept. of Chemistry, Bar Ilan University
- 1970-4 Organic chemistry lab course, Dept. of Chemistry, Bar Ilan University
- (b) Research students and post doctoral fellows
- 2006- U. Iskandarov, Ph.D. student, A. Katz International School for Desert Studies, BIDR, BGU (with Dr. I. Khozin-Goldberg).
- 2005- S. Abu Ghosh, M.Sc student, A. Katz International School for Desert Studies, BIDR, BGU (with Dr. I. Khozin-Goldberg).
- 2004- A. Dagar, M. Sc. Student, A. Katz International School for Desert Studies, BIDR, BGU (with Dr. I. Khozin-Goldberg and Dr. D. Zilberg).
- 2004-5 Dr. N. Jain, Post doctoral fellow, isolation and cloning of TAG biosynthesis genes in *Parietochloris incisa*.
- 2003-6 M. Cohen, M.Sc. Student, A. Katz International School for Desert Studies, BIDR, BGU (with Dr. I. Khozin-Goldberg).
- 2003-6 G. Darmoni, M. Sc. Student, A. Katz International School for Desert Studies, BIDR, BGU (with Dr. I. Khozin-Goldberg).
- 2002-4 M. Zhekisheva, Ph.D. student. Correlation of lipids and Astaxanthin production in *Haematococcus pluvialis* (with Prof. S. Boussiba).
- 2002-4 Dr. I. Khalilov, Post doctorate fellow, Triacylglycerols accumulation in *P. incisa*.
- 2001- International Mentor to Dr. Saymarat Panpoom, Lecturer, Mae Fah Luang University, Chiangrai, Thailand.
- 2001-4 D. Cohen, M.Sc. Student, Dep. of Chemistry, BGU, Biosynthesis and role of triacylglycerols in *P. incisa* (with Dr. I. Khozin-Goldberg).
- 2001-4 P. Shrestha, Ph.D. student, BGU, Production of arachidonic acid by *P. incisa*.
- 2001-3 T. Castillo, M.Sc. student, Biotechnological Engineering, Polytechnic Institute, Mexico City, Mexico, Selection of EPA-overproducing clones of *Phaeodactylum tricornutum*.
- 2000-2 Q. Gao, M.Sc., Albert Katz Int. School for Desert Studies, BGU. Response to environmental stresses and accumulation of arachidonic acid in two green algae *Parietochloris incisa* and *Neochloris cohaerens* (with Prof. A. Vonshak & S. Boussiba).
- 2000-2 M. Zhekisheva, M.Sc., Albert Katz Int. School for Desert Studies, BGU. Correlation of lipids and Astaxanthin production in *Haematococcus pluvialis*, (with Prof. S. Boussiba).
- 1994-9 D. Adlerstein, Ph.D. student. Dept. of Chemistry, BGU. EPA biosynthesis in algae.
- 1994-9 C. Bigogno, Ph.D. student. Dept. of Chemistry, BGU. Elucidation of arachidonic acid production in *Parietochloris incisa*.
- 1994-6 C. Segura, Ph.D. student, Dept. of Genetics, Univ. of Almeria, Spain (with Dr. D. Lopez).
- 1993-5 Dr. Z. Y. Hu, Post-doctoral fellow. Selection of *Porphyridium* mutants deficient in lipid biosynthesis.
- 1992-5 D. Shiran, M.Sc. Student, Department of Biology, BGU. EPA biosynthesis in algae (with Prof. Y.M. Heimer).
- 1992-4 Dr. I. Khozin, Post-doctoral fellow. Enhancement of oil production in algae and plants.
- 1991-2 W. Siangdung, M.Sc. Student, Department of materials and energy, King Mongkut's Institute of Technology, Thailand. Selection of herbicide-resistant GLA-overproducing strains of *Spirulina* (with Prof. M. Tanticharoen).

- 1989-90 S. Cohen, B.Sc., Liverpool Polytechnic. Development of methods for EPA purification from *Porphyridium* biomass.
- 1985-90 J. Morton, Ph.D. student, Department of Life Sciences, BGU. Cell membranes function in the control of the balance of K⁺ and Na⁺ in the roots of the wilted mutant *Scabrous diminutive* of pepper (with Prof. M. Tal).

AWARDS, HONORS AND RESEARCH FELLOWSHIPS

(a) Awards and Honors

- 2005- Incumbent of the Maks and Rochelle Etingin Professorial Chair in Desert Research
- 1998 Recipient of the Pasternak prize for Agricultural research
- 1986-97 Incumbent of the Sonnenfeldt Career Development Chair in Desert Research

(b) Fellowships

- 2005 Visiting fellowship to the U. of Wageningen, the Netherlands, granted by the ministry of Agriculture, Israel
- 1999 Visiting fellowship to U. of Almeria, Spain, granted by the Ministry of Science, Israel
- 1994 Visiting fellowship, Wuhan, China, granted by the Chinese Academy of Science
- 1993 Visiting fellowship, National Research Council, Florence, Italy, granted by the Israeli Academy for Sciences and Humanities and the Italian National Research Council
- 1989-90 Research fellowship, US Dept. of Agriculture, Beltsville, MD

SCIENTIFIC PUBLICATIONS

A. Chapters in Books

1. Z. Cohen (1985) Products from microalgae. In: *Handbook for Algal Mass Culture*, A. Richmond ed. (1985) CRC Press, Boca Raton, FL. p. 421-54.
2. Z. Cohen, A. Vonshak & A. Richmond (1986) Light and temperature effects on the fatty acids of *Porphyridium cruentum*. In: *The metabolism, Structure and Function of plant lipids*, P.K. Stumpf, J.B. Mudd & W.D. Ness, Eds, Plenum press, NY, p. 641-643.
3. Z. Cohen (1988) Production of eicosapentaenoic and arachidonic acid by the red alga *Porphyridium cruentum*. In: *Proceedings of the World Conference on Biotechnology for the Fats and Oils Industry*, T.H. Applewhite ed., American Oil Chemists' Society, Champaign IL, p. 285-7.
4. A. Golan-Goldhirsh, Y. M. Heimer, Z. Cohen. & S.H. Lips. (1988) Pistachio nut production in the Negev. In: *Advances in Desert Arid Land Technology and Development*, Vol. 5, Harwood Academic Publishers, New York.
5. Z. Cohen & Y.M. Heimer (1990) Linoleic acid desaturase inhibitors as tools for selection of GLA over-producing cell lines. In: *Plant Lipid Biochemistry, Structure and Utilization*. P.J. Quinn & J.L. Harwood Eds, Portland Press Limited London, p. 414-7.
6. Z. Cohen & Y. M. Heimer (1992) Production of polyunsaturated fatty acids (EPA, ARA and GLA) by the microalgae *Porphyridium* and *Spirulina*. In: *Industrial application of single cell oil*. D. J. Kyle & C. Ratledge Eds, American Oil Chemists' Society, Champaign IL, pp 243-73.
7. Z. Cohen, I. Khozin, D. Shiran, H.A. Norman & P. Pillai (1995) *In vivo* and *in vitro* inhibition of fatty acid desaturation by the antibiotic cerulenin. In: *Plant*

- Lipid Metabolism*. J-C. Kader & P. Mazliak Eds., Kluwer Academic Publishers, p. 462-4.
8. Z. Cohen (1996) The chemicals of *Spirulina*. In: *Spirulina platensis* (Arthrospira), Physiology, Cell biology and Biotechnology, A. Vonshak Ed. Taylor and Francis, London, pp. 175-204.
 9. I. Khozin, H. Zheng Yu, D. Adlerstein, C. Bigogno & Z. Cohen (1997) Triacylglycerols participate in the eukaryotic pathway of PUFAs biosynthesis in the red microalga *Porphyridium cruentum*. In: *Biochemistry and Molecular Biology of Plant Lipids*. J.P. Williams, U.K. Mobashsher, and W.L. Nora Eds., Kluwer Academic Publishers, Dordrecht, pp. 90-2.
 10. I. Khozin, D. Adlerstein, C. Bigogno & Z. Cohen (1997) Elucidation of the biosynthesis of eicosapentaenoic acid (EPA) in the microalga *Porphyridium cruentum*. In: J.P. Williams, U.K. Mobashsher, and W.L. Nora, Eds., Physiology, Biochemistry and Molecular Biology of Plant Lipids. Kluwer Academic Publishers, Dordrecht, pp. 93-5.
 11. D. Adlerstein, I. Khozin, C. Bigogno & Z. Cohen (1997) Effect of environmental conditions on the molecular species composition of galactolipids in the alga *Porphyridium cruentum*. In: J.P. Williams, U.K. Mobashsher, and W.L. Nora, Eds, Physiology, Biochemistry and Molecular Biology of Plant Lipids. Kluwer Academic Publishers, Dordrecht, pp. 218-20.
 12. Z. Cohen (1999) Production of polyunsaturated fatty acids by the microalga *Porphyridium cruentum*. In: Z. Cohen Ed., Production of chemicals by microalgae. Taylor and Francis, London, pp. 1-24.
 13. Z. Cohen (1999) EPA production potential of *Monodus*. In: Z. Cohen Ed., Production of chemicals by microalgae. Taylor and Francis, London, pp. 25-40.
 14. P. Shrestha, I. Khozin-Goldberg & Z. Cohen (2003) Reutilization of arachidonyl moieties of triacylglycerols in the microalga *Parietochloris incisa* following recovery from nitrogen starvation. In: N. Murata, M. Yamada, I. Nishida, H. Okuyama, J. Sekya and H. Wada (eds.) Advanced Research on Plant Lipids. Kluwer Academic Publishers, Dordrecht, pp.159-62.
 15. C. Ratledge, H. Streekstra, Z. Cohen & J. Fichtali (2004) Processing aspects of single cell oils. In: N.T. Dunford and H.B. Dunford, (eds.) Nutritionally enhanced edible oil processing', American Oil Chemists' Society, Champaign IL , pp. 279-98.
 16. Z. Cohen & I. Khozin-Goldberg (2005) Searching for PUFA-rich microalgae. In: Z. Cohen & C. Ratledge (eds.) Single Cell Oils, American Oil Chemists' Society, Champaign IL pp. 53-72.
 17. C. Ratledge, H. Streekstra, Z. Cohen & J. Fichtali (2005) Down-stream processing, extraction and purification of single cell oils. In: Z. Cohen & C. Ratledge (eds.) Single Cell Oils, American Oil Chemists' Society, Champaign IL pp. 202-19.

B. Refereed Articles in Scientific Journals

1. Z. Cohen, E. Keinan, Y. Mazur, & T. H. Varkony (1975) Dry ozonation, a method for stereoselective hydroxylation of saturated compounds on silica gel. *J. Org. Chem.*, 40, 2141-2.
2. Z. Cohen, E. Keinan, Y. Mazur, & A. Ullman (1976) Hydroxylation with ozone on silica gel. The synthesis of 1,25-dihydroxyvitamin D₃. *Org. Chem.*, 41, 2651-2.
3. Y. Mazur, D. Freeman & Z. Cohen (1976) Synthetic approaches to hydroxylated vitamin D derivatives. *Israel J. Med. Soc.*, 12, 1488-9.

4. Y. Mazur, & Z. Cohen (1978) N,N,-dichlorourethane - a selective chlorination reagent: synthesis of corticoids. *Angew. Chem. Int. Ed.*, 17, 281-.
5. Z. Cohen & Y. Mazur (1979) Tertiary alcohols from hydrocarbons by ozonation on silica gel: 1-adamantanol. *Org. Syn.*, 59, 196-200.
6. Z. Cohen & Y. Mazur (1979) Dry ozonation of steroids. C-25 Functionalization of cholestane derivatives. *J. Org. Chem.*, 44, 2318-20.
7. Z. Cohen, E. Berman, & Y. Mazur (1979) A convenient method for the synthesis of hydroxyvitamin D₃ analogues. Structure determination of tertiary alcohols by carbon-13 nuclear magnetic resonance spectroscopy. *J. Org. Chem.*, 44, 3077-80.
8. R. N. Hanson, M. A. Davis & Z. Cohen (1980) Cardioselective radiolabeled beta andrenergic antagonists as potential myocardial imaging agents. *J. Nucl. Med.*, 21, 55-8.
9. Z. Cohen, S. E. Seltzer & M. A. Davis (1981) Iodinated starch particles: New contrast material for computed tomography of the liver. *J. Assisted Tomography*, 5, 843-6.
10. A. Vonshak, Z. Cohen & A. Richmond (1985) The feasibility of mass cultivation of *Porphyridium*. *Biomass*, 8, 13-25.
11. D. Kaplan, Z. Cohen & A. Abeliovich (1985) Optimal growth conditions for *Isochrysis galbana*. *Biomass*, 9, 37-48.
12. A. Vonshak, Z. Cohen & A. Richmond (1986) The potential use of *Porphyridium* biomass for valuable natural products. *Beihefte Nova Hedwigia*, 83, 136-.
13. S. Boussiba, A. Vonshak, Z. Cohen, Y. Avissar & A. Richmond (1987) Lipid and biomass production by the halotolerant microalga *Nannochloropsis salina*. *Biomass*, 12, 37-47.
14. Z. Cohen, A. Vonshak & A. Richmond (1987) Fatty acid composition in different *Spirulina* strains and under various environmental conditions. *Phytochemistry*, 26, 2255-8.
15. Z. Cohen (1987) Production of eicosapentaenoic acid and arachidonic acid by the alga *Porphyridium cruentum*. *J. Am. Oil Chem. Soc.* 64, 1261-2.
16. S. Boussiba, E. Sandbak, Z. Cohen, A. Vonshak, A. Ben Amotz, G. Shelef & A. Richmond (1988) Outdoor cultivation of the marine microalga *Isochrysis galbana* in open Reactors. *Aquaculture*, 72, 244-53.
17. Z. Cohen, A. Vonshak, S. Boussiba & A. Richmond (1988) The effect of temperature and cell concentration on fatty acid composition of outdoor cultures of *Porphyridium cruentum*. in *Algal biotechnology*. T. Stadler, J. Mollion, M-C. Verdus, Y. Karamanos, H. Morvan & D. Christiaen, Eds. Elsevier Applied Science, London, pp. 421-9.
18. Z. Cohen, A. Vonshak & A. Richmond (1988) Effect of environmental conditions on fatty acid composition of the red alga *Porphyridium cruentum*: correlation to growth rate. *J. Phyc.*, 24, 328-32.
19. Z. Cohen & Y. M. Heimer (1990) $\Delta 6$ desaturase inhibition: A novel mode of action of Norflurazon. *Plant Phys.*, 93, 347-9.
20. Z. Cohen (1990) The production potential of eicosapentaenoic acid and arachidonic acid of the red alga *Porphyridium cruentum*. *J. Am. Oil Chem. Soc.*, 67, 916-20.
21. Z. Cohen & S. Cohen (1991) Preparation of eicosapentaenoic acid concentrate from *Porphyridium cruentum*. *J. Am. Oil Chem. Soc.*, 68, 16-9.
22. Z. Cohen & A. Vonshak (1991) The fatty acid composition of *Spirulina*-like cyanobacteria as a tool for chemotaxonomy. *Phytochemistry*, 30, 205-6.
23. Z. Cohen, S. Didi & Y. M. Heimer (1992) Over-production of γ -linolenic and eicosapentaenoic acids by algae. *Plant Phys.*, 98, 569-72.

24. Z. Cohen, H. A. Norman & Y.M. Heimer (1993) Potential use of substituted pyridazinones for selecting polyunsaturated fatty acid overproducing lines of algae. *Phytochemistry*, 32, 259-64.
25. Z. Cohen, M. Reungjitchachawali, W. Siangdung, & M. Tanticharoen (1993) Production and partial purification of γ -linolenic acid and some pigments from *Spirulina platensis*. *J. Appl. Phyc.*, 5, 109-15.
26. E. Shochat, I. Hermoni, S. Belkin, Z. Cohen & A. Abeliovich (1993) Bromoalkane-degrading *Pseudomonas* species. *App. and Env. Microbiol.* 59, 1403-9.
27. Z. Cohen, M. Reungjitchachawali, W. Siangdung, M. Tanticharoen & Y. M. Heimer (1993) Herbicide resistant lines of microalgae: Growth and fatty acid composition. *Phytochemistry* 34, 973-8.
28. M. Tanticharoen, M. Reungjitchachawali, B. Bunnag, A. Vonshak & Z. Cohen (1994) Optimization of γ -linolenic acid (GLA) production in *Spirulina platensis*. *J. Appl. Phyc.*, 6, 295-300.
29. Z. Cohen (1994) Production of eicosapentaenoic acid by the alga *Monodus subterraneus*. *J. Am. Oil Chem. Soc.*, 71, 941-5.
30. Z. Cohen, H. A. Norman & Y. M. Heimer (1995) Microalgae as a source of omega-3 fatty acids. *World Rev. Nutr. Dietetics*, 77, 1-31.
31. Z. Cohen, M. C. Margheri & L. Tomaselli (1995) Chemotaxonomy of cyanobacteria. *Phytochemistry* 40, 1155-8.
32. L. Fan, A. Vonshak, R. Gabbay, J. Hirshberg, Z. Cohen & S. Boussiba (1995) The biosynthetic pathway of astaxanthin in *Haematococcus pluvialis* as indicated by diphenylamine. *Plant Cell Physiol.* 36, 1519-24.
33. D.L. Alonso, C. I. Segura del Castillo, E.M. Grima & Z. Cohen (1996) First insights into improvement of eicosapentaenoic acid content in *Phaeodactylum tricornutum* (Bacillariophyceae) by induced mutagenesis. *J. Phycol.* 32, 339-45.
34. M.N. Merzlyak, I. Khozin & Z. Cohen (1996) Spectrophotometric analysis of carotenoids in plant extracts based on elimination of chlorophyll absorption. *Phytochem. Anal.* 7, 294-9.
35. M.N. Merzlyak, S. I. Pogosyan, L. Lehimena, T. V. Zhigalova, I.F. Khozin & Z. Cohen (1996) Characterization of chlorophyll photooxidation products generated *in vitro* and during photodamage to the cyanobacterium *Anabaena variabilis*. *Russ. J. Plant Physiol.* 43, 186-.
36. I. Khozin & Z. Cohen (1996) Differential response of microalgae to the substituted pyridazinone Sandoz 9785, reveals different pathways in the biosynthesis of eicosapentaenoic acid (EPA). *Phytochemistry* 42, 1025-9.
37. S. Watanabe, S. Hirabayashi, Z. Cohen, A. Vonshak & A. Richmond (1996) *Parietochloris incisa* comb. nov. (Trebouxiophyceae, Chlorophyta) *Phycol. Res.* 44, 107-8.
38. D. Shiran, I. Khozin, Y.M. Heimer & Z. Cohen (1996) Biosynthesis of eicosapentaenoic acid in *Porphyridium cruentum*. I: The use of externally supplied fatty acids. *Lipids* 31, 1277-82.
39. H. Qiang, H. Zhengyu, Z. Cohen & A. Richmond (1997) Enhancement of eicosapentaenoic acid (EPA) and γ -linolenic acid (GLA) production by manipulating cell density in outdoor cultures of *Monodus subterraneus* (Eustigmatophyte) and *Spirulina platensis* (Cyanobacterium). *Europ. J. Phycol.* 32, 81-6.
40. Z. Cohen, D. Shiran, I. Khozin & Y.M. Heimer (1997) Fatty acid unsaturation in the red alga *Porphyridium cruentum*. Is the methylene interrupted nature of

- plant polyunsaturated fatty acids an intrinsic property of the desaturases. *Biochim. Biophys. Acta* 1344, 59-64.
41. I. Khozin, D. Adlerstein, C. Bigogno, Y. M. Heimer & Z. Cohen (1997) Elucidation of the biosynthesis of EPA in the microalga *Porphyridium cruentum* II: Radiolabeling studies. *Plant Physiol.* 114, 223-30.
 42. D. Adlerstein, I. Khozin & Z. Cohen (1997) Effect of environmental conditions on the molecular species composition of galactolipids in the alga *Porphyridium cruentum*. *J. Phycol.* 33, 975-9.
 43. I. Khozin, C. Bigogno & Z. Cohen (1999) Salicylhydroxamic acid inhibits $\Delta 6$ desaturation in the microalga *Porphyridium cruentum*. *Biochim. Biophys. Acta* 1439, 384-94.
 44. N. Zou, C. Zhang, Z. Cohen & A. Richmond (2000) Production of cell mass and eicosapentaenoic acid (EPA) in ultrahigh cell density cultures of *Nannochloropsis* sp. (Eustigmatophyceae). *Europ. J. Phycol.* 35, 127-33.
 45. I. Khozin-Goldberg, Hu Z. Y., D. Adlerstein, S. Didi Cohen, Y. M. Heimer & Z. Cohen (2000) Triacylglycerols of the red microalga *Porphyridium cruentum* participate in the biosynthesis of eukaryotic galactolipids. *Lipids* 5, 881-9.
 46. Z. Cohen, I. Khozin-Goldberg, D. Adlerstein & C. Bigogno (2000) The role of triacylglycerols as a reservoir of polyunsaturated fatty acids for the rapid production of chloroplastic lipids in certain microalgae. *Biochem. Soc. Trans.* 28, 740-3.
 47. Z. Cheng-Wu, Z. Cohen, I. Khozin-Goldberg & A. Richmond (2002) Characterization of growth and arachidonic acid production of *Parietochloris incisa* comb. nov (Trebouxiophyceae, Chlorophyta). *J. Appl. Phycol.* 14, 453-60.
 48. M. Zhekisheva, S. Boussiba, I. Khozin-Goldberg, A. Zarka & Z. Cohen (2002) Accumulation of oleic acid in *Haematococcus pluvialis* (chlorophyceae) under nitrogen starvation or high light, is correlated with that of astaxanthin esters. *J. Phycol.* 38, 325-31.
 49. C. Bigogno, I. Khozin-Goldberg, D. Adlerstein & Z. Cohen (2002) Biosynthesis of arachidonic acid in the oleaginous microalga *Parietochloris incisa* (Chlorophyceae): Radiolabeling studies. *Lipids* 37, 209-16.
 50. C. Bigogno, I. Khozin-Goldberg & Z. Cohen (2002) Accumulation of arachidonic acid and triacylglycerols in the microalga *Parietochloris incisa* (Chlorophyceae). *Phytochemistry* 60, 135-43.
 51. C. Bigogno, I. Khozin-Goldberg, S. Boussiba, A. Vonshak & Z. Cohen (2002) Lipid and fatty acid composition of the green alga *Parietochloris incisa*. *Phytochemistry* 60, 497-503.
 52. I. Khozin-Goldberg, S. Didi-Cohen & Z. Cohen (2002) Biosynthesis of eicosapentaenoic acid (EPA) in the fresh water eustigmatophyte *Monodus subterraneus*. *J. Phycol.* 38, 745-56.
 53. J.G. Liu, Z. Cohen & A. Richmond (2002) Fatty acid profile in a high cell density culture of arachidonic acid-rich *Parietochloris incisa* (Trebouxiophyceae, Chlorophyta) exposed to high PFD. *Chi. J. Oceanol. Limnol.* 20, 149-56.
 54. I. Khozin-Goldberg, C. Bigogno, & Z. Cohen (2002) Nitrogen starvation induced accumulation of arachidonic acid in the freshwater green alga *Parietochloris incisa*. *J. Phycol.* 38, 991-4.
 55. S. Rozner, J. Eichler, S. Kolusheva, Z. Cohen, W. Dowhan & R. Jelinek (2003) Detection and analysis of membrane interactions by a biomimetic colorimetric lipid/polydiacetylene assay. *Anal. Biochem.* 319, 96-104.
 56. A. Ivanova, I. Khozin-Goldberg, Z. Kamenarska, J. Nechev, Z. Cohen, S. Popov, & K. Stefanov (2003) Lipophilic compounds from *Euphorbia peplis* L. -

- a halophytic plant from the Bulgarian Black Sea coast. *Z. Naturforsch.* 58c: 783-8.
57. B. Aricha, Z. Cohen, I. Khozin-Goldberg, I. Fishov, R. Dagan & N. Porat (2004) Differences in membrane fluidity between phenotypic variants of *Streptococcus pneumoniae*. *J. Bacteriol.* 186, 4638-44.
 58. M. Zhekisheva, A. Zarka, I. Khozin-Goldberg, Z. Cohen & S. Boussiba (2005) Astaxanthin accumulation in the green alga *Haematococcus pluvialis* (Chlorophyceae) under high light irradiance depends on *de novo* synthesis of fatty acids. *J. Phycol.* 41, 819-26
 59. I. Khozin-Goldberg, P. Shrestha & Z. Cohen (2005) Mobilization of arachidonyl moieties from triacylglycerols into chloroplastic lipids following recovery from nitrogen starvation of the microalga *Parietochloris incisa*. *Biochim. Biophys. Acta* 1738, 63-71.
 60. I. Khozin-Goldberg, & Z. Cohen (2006) Effect of phosphate starvation on the lipid and fatty acid composition of the eustigmatophyte *Monodus subterraneus* and its implication on the biosynthesis of "eukaryotic-like" and "prokaryotic-like" molecular species of galactolipids. *Phytochemistry* 67, 696-701.
 61. I. Khozin-Goldberg, Z. Cohen, M. Pimenta-Leibowitz, J. Nechev, & D. Zilberg (2006) Feeding with arachidonic acid-rich triacylglycerols from the microalga *Parietochloris incisa* increased recovery of guppies from infection with *Tetrahymena* sp. *Aquaculture* 255, 142-50.

C. Editorship of collective volumes and scientific journals

- Z. Cohen (Ed.) (1999) Chemicals from microalgae. Taylor and Francis, London, 450 pp.
- Z. Cohen & C. Ratledge (2005) Single Cell oils, American Oil Chemists' Society, Champaign IL, 257 pp.

D. Published scientific reports and technical papers

1. S. Boussiba, A. Vonshak, Z. Cohen, A. Abeliovich, D. Kaplan & A. Richmond (1985) Development of an outdoor system for production of lipid-rich halotolerant microalgae. SERI *Aquatic Species Review*, SERI/CP-231-2700, pp. 271-88.

E. Scientific Reports

1. Literature Survey and species recommendation on halotolerant lipid-producing algae (1983). Submitted to SERI (Solar Energy Research Institute), Dept. of Energy, USA.
2. Studying the feasibility of developing an algal marine culture system for the production of valuable chemicals (1984). Final report, submitted to BARD.
3. Development of an outdoor system for production of lipid-rich halotolerant microalgae (1984). Annual report, submitted to SERI.
4. The effect of light on the mass production in two halotolerant microalgae *Nannochloropsis salina* and *Isochrysis galbana* (1985). Submitted to SERI.
5. Extraction of chemicals from the alga *Porphyridium* (1986). Annual report, submitted to the National Council for Research and Development.
6. Production of eicosapentaenoic acid by the alga *Porphyridium* (1987). Annual report, submitted to the National Council for Research and Development.
7. Separation and purification of eicosapentaenoic acid from *Porphyridium* (1988). Annual report, submitted to the National Council for Research and Development.

8. Effect of environmental conditions on outdoor production of EPA in *Porphyridium* (1989). Annual report, submitted to the Agency for International Development, USA.
9. The production potential of EPA and AA of the red alga *Porphyridium* (1989). Submitted to the Agency for International Development, USA (AID).
10. Effect of environmental and nutritional conditions on GLA production in *Spirulina*. (1989). Annual report, submitted to the Agency for International Development, USA
11. Effects of substituted pyridazinons on fatty acid desaturation in *Spirulina* (1990). Annual report, submitted to the Agency for International Development, USA.
12. Linoleic acid desaturase inhibitors as tools for selection of EPA over-producing lines in *Porphyridium* (1990). Annual report, submitted to the Agency for International Development, USA.
13. Overproduction of GLA in *Spirulina* (1993). Final report, submitted to the Agency for International Development, USA.
14. Enhanced oil production in plants (1993). Final report, submitted to the PEF foundation.
15. Chemical composition of snow algae (1993). Annual report, submitted to the System Research Institute, Japan.
16. Production of arachidonic acid by snow algae (1994). Annual report, submitted to the System Research Institute, Japan.
17. Production of eicosapentaenoic acid (EPA) by microalgae (1994). Final report, submitted to the Agency for International Development, USA.
18. Enhancement of the arachidonic acid content of a snow alga (1995) Annual report, submitted to the System Research Institute, Japan.
19. Elucidation of eicosapentaenoic acid (EPA) biosynthesis in *Porphyridium cruentum* (1995). Annual report, submitted to the Ministry of Science.
20. Elucidation of eicosapentaenoic acid (EPA) biosynthesis in *Porphyridium cruentum* (1996). Annual report, submitted to the Ministry of Science.
21. Inducing oil production in plants (1996). Final report, submitted to the RASHI foundation.
22. Elucidation of eicosapentaenoic acid (EPA) biosynthesis in *Porphyridium cruentum* (1997). Final report, submitted to the Ministry of Science.
23. Production of EPA from *Monodus* (1998). Annual report, submitted to BRITE (EU).
24. Biosynthesis of EPA in *Monodus* (1999). Annual report, submitted to BRITE (EU).
25. Production of EPA from microalgae (2000). Final report, submitted to BRITE (EU).
26. Production of AA in *Parietochloris incisa* (2003). Annual report, submitted to AID.

INVITED LECTURES

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| 1990 | Enhancement of oil production in algae and higher plants, E. I. Dupont Research Institute, Wilmington DE. |
| 1990 | Production of polyunsaturated fatty acids by microalgae, Workshop on AID/SCI Funded Research in Agricultural Biotechnology, Kasetsart University, Bangkok Thailand. |
| 1991 | Production of EPA and AA by the red alga <i>Porphyridium cruentum</i> , Single Cell Oils Symposium, 81 st Meeting of the American Oil Chemists' Society, Chicago IL. |

- 1993 Fatty acid overproduction in algae, 6th International Meeting of the SAA Recent Progress in Algal Biotechnology, Trebon, Czech Republic.
- 1993 Polyunsaturated fatty acid biosynthesis in *Porphyridium cruentum*. CNR Florence, Italy.
- 1994 Biosynthesis of EPA in microalgae. The institute for applied algology, University of Las Palmas, Gran Canaria, Canary Islands, Spain.
- 1994 Microalgal production of PUFA. University of Seville, Seville, Spain.
- 1995 Physiological, biochemical and genetic means for enhancing EPA content in *Porphyridium cruentum*. University of Madrid summer course, Aguadulce, Spain.
- 1996 Biosynthesis of EPA in *Porphyridium cruentum*. University of Almeria, Almeria, Spain.
- 1996 Biosynthesis of PUFA in microalgae. King Mongkut Institute of Technology, Bangkok, Thailand.
- 1999 PUFAs in microalgae. Session chairman, 8th International Conference on Applied Algology, Montecatini Terme, Italy (invitation declined).
- 2002 Production of arachidonic acid by microalgae. 9th International Conference on Applied Algology, Almeria, Spain (invitation declined).
- 2002 Biotechnological applications of PUFAs and pigments from microalgae. Center for Biotechnological Investigations of the North-West (CIBNOR), La Paz, Mexico.
- 2002 Production of AA in microalgae: Center for Biotechnological Investigations of the North-West (CIBNOR), La Paz, Mexico.
- 2002 Production and biosynthesis of arachidonic acid in microalgae. Dept. of Biotechnological Engineering, Polytechnic Institute (CINVESTAV), Mexico City, Mexico.
- 2002 The Potential of Biotechnology for alternative crops in desert areas. Universidad Autonoma De Hidalgo, Pachuca, Mexico.
- 2002 Biotechnological production of algae. Universidad Nacional Autónoma de México (UNAM), Mexico city, Mexico.
- 2003 Accumulation of PUFA-rich triacylglycerols in microalgae. Single Cell Oils Symposium, 93rd Meeting of the American Oil Chemists' Society, Kansas city.
- 2003 Why bother with microalgae? Center for Biotechnological Investigations of the North-West (CIBNOR), La Paz, Mexico.
- 2003 Biosynthesis of EPA in microalgae. Dept. of Biotechnological Engineering, Polytechnic Institute (CINVESTAV), Mexico City, Mexico. Dept. of Biotechnological Engineering, Polytechnic Institute (CINVESTAV), Mexico City, Mexico.
- 2003 Production of arachidonic acid in microalgae. Institute of Chemistry and Institute of Marine studies, Universidad Nacional Autónoma de México (UNAM), Mexico city, Mexico.
- 2004 How to find PUFA-rich microalgae? Center for Biotechnological Investigations of the North-West (CIBNOR), La Paz, Mexico.
- 2004 Why bother with microalgae? University of Namibia, Windhoek, Namibia.
- 2005

PROCEEDINGS OF MEETINGS

1. Z. Cohen & Y. Mazur, (1978) Chromic anhydride on silica gel. A useful specific oxidation reagent. Annual Meeting of the Israel Chemical Society, Haifa.
2. R. N. Hanson, J. Blumberg, Z. Cohen, B. L. Holman & M. A. Davis, (1979) Synthesis and biologic evaluation of ¹²⁵I-cardioselective beta-antagonists as

- myocardial imaging agents. 178th American Chemical Society National Meeting, Washington D.C.
3. R. N. Hanson, B. L. Holman, Z. Cohen & M. A. Davis, (1979) Myocardial imaging agents: Comparison of ²⁰¹Tl and radio-iodinated beta adrenoceptor antagonists in a damaged rat heart model. Society of Nuclear Medicine Annual Meeting, Atlanta, GA.
 4. Z. Cohen, (1984) Rapid analysis of fatty acids in lipids. Annual Meeting of the Israel Chemical Society, Jerusalem.
 5. A. Vonshak, Z. Cohen & A. Richmond, (1984) The potential use of *Porphyridium* biomass for valuable natural products. Algal Biomass Workshop, Golden, CO.
 6. Z. Cohen, (1984) Quick and efficient GC and HPLC lipid analysis: Lipid hydrolysis and conversion to fatty acids methyl esters utilizing solid supported reagents. 2nd International Symposium on Polymer-supported reactions in Organic Chemistry, Lancaster, UK.
 7. Z. Cohen, A. Vonshak & A. Richmond, (1986) The effect of environmental conditions on fatty acid composition of *Porphyridium cruentum*. International Symposium on Plant Lipids, Davis, CA.
 8. A. Golan-Goldhirsh, Y. M. Heimer, Z. Cohen & S. H. Lips, (1987) Pistachio Nut Production in the Negev. 2nd International Conference on Desert Development, Cairo, Egypt.
 9. Z. Cohen, A. Vonshak, S. Boussiba & A. Richmond, (1987) The effect of temperature and cell concentration on fatty acid composition of outdoor cultures of *Porphyridium cruentum*. 4th International Meeting of the SAA Recent Progress in Algal Biotechnology, Villeneuve D'ascq, France.
 10. Z. Cohen, (1987) Production of eicosapentaenoic and arachidonic acid by the red alga *Porphyridium cruentum*. World Conference in Biotechnology for the fats and oils industry, Hamburg, Germany.
 11. Z. Cohen, (1988) Effect of environmental conditions on fatty acid composition of the red alga *Porphyridium cruentum*: correlation to growth rate. 8th International Symposium on Plant Lipids, Budapest, Hungary.
 12. Z. Cohen & Y. M. Heimer, (1990) Linoleic acid desaturase inhibitors as tools for selection of GLA over-producing lines in *Spirulina*. 9th International Symposium on Plant Lipids, Wye, England.
 13. Z. Cohen, (1990) *Porphyridium cruentum* - an alternative EPA producer. 81st Meeting of the American Oil Chemists' Society, Baltimore, MD.
 14. J.R. Morton, Z. Cohen & M. Tal, (1990) ATPase activity and lipid composition of the microsomal membrane preparation from roots of the wilty mutant of pepper, *Scarbus diminutive*. 7th Congress of the Federation of European Societies of Plant Physiology, Umea, Sweden.
 15. Z. Cohen, (1990) Production of EPA by *Porphyridium cruentum*. Annual Meeting of the Phycological Society of America, College Park, MD.
 16. Z. Cohen & Y. M. Heimer, (1991) Production of polyunsaturated fatty acids (EPA, ARA and GLA) by the microalgae *Porphyridium* and *Spirulina*. 83rd Meeting of the American Oil Chemists' Society, Chicago, IL.
 17. Z. Cohen & D. Shiran, (1993) Biosynthesis and overproduction of EPA in microalgae. 6th International Conference on Applied Algology, Ceske Budgeovice, Czech Republic.
 18. W. Siangdung, M. Tanticharoen, B. Bunaag & Z. Cohen, (1993) Selection of *Spirulina platensis* strains resistant to SAN 9785 for a high α -linolenic acid producer. 6th International Conference on Applied Algology, Ceske Budgeovice, Czech Republic.

19. W. Siangdung, M. Tanticharoen, B. Bunaag & Z. Cohen, (1993) Effect of SAN 9785 on growth, photosynthesis and fatty acid composition in *Spirulina platensis*. 6th International Conference on Applied Algology, Ceske Budejovice, Czech Republic.
20. I. Khozin, H. A. Norman, D. Shiran & Z. Cohen, (1994) The inhibitory effect of cerulenin on linoleic acid desaturation. 11th International Symposium on Plant Lipids, Paris, France.
21. M. Tanticharoen, B. Bunnag, W. Siangdung, W. Chanasattru, P. Tantiwachwuttikul & Z. Cohen, (1994) *Spirulina* as a source of high value chemicals. 2nd Asia-Pacific Conference on Algal Biotechnology, Singapore.
22. L. Fan, S. Boussiba, Y. Hirshberg, R. Gabbay, Z. Cohen & A. Vonshak, (1994) The physiological role of astaxanthin in *Haematococcus pluvialis* (chlorophyceae).
23. Z. Cohen, I. Khozin, D. Adlerstein, C. Bigogno, D. Shiran, Z.-Y. Hu & Y. Heimer, (1996) Biosynthesis of eicosapentaenoic acid (EPA) in the red microalga *Porphyridium cruentum*. 7th International Conference "Opportunities from micro- and macroalgae", Knysna, South Africa.
24. Z. Cohen, (1996) The Potential of microalgae as a source of PUFAs. 7th International Conference "Opportunities from micro- and macroalgae", Knysna, South Africa.
25. I. Khozin, D. Adlerstein, C. Bigogno & Z. Cohen, (1996) Elucidation of the biosynthesis of eicosapentaenoic acid (EPA) in the microalga *Porphyridium cruentum*. 12th International Symposium on Plant Lipids, Toronto, Canada.
26. I. Khozin, H. Zheng Yu, D. Adlerstein, C. Bigogno & Z. Cohen (1996) Triacylglycerols participate in the eukaryotic pathway of PUFAs biosynthesis in the red microalga *Porphyridium cruentum*. 12th International Symposium on Plant Lipids, Toronto, Canada.
27. D. Adlerstein, I. Khozin, C. Bigogno & Z. Cohen (1996) Effect of environmental conditions on the molecular species composition of galactolipids in the alga *Porphyridium cruentum*. 12th International Symposium on Plant Lipids, Toronto, Canada.
28. D. Adlerstein, C. Bigogno, I. Khozin & Z. Cohen (1997) Studies of eicosapentaenoic acid biosynthesis in the microalga *Porphyridium cruentum* 4th International Congress on Essential Fatty Acids, Edinburgh, Scotland.
29. I. Khozin, C. Bigogno, D. Adlerstein & Z. Cohen (1998) Salicylhydroxamic acid inhibits $\Delta 6$ desaturation in the microalga *Porphyridium cruentum*. 13th International Symposium on Plant Lipids, Seville, Spain.
30. C. Bigogno, D. Adlerstein, I. Khozin & Z. Cohen (1998) Biosynthesis of arachidonic acid in the alga T12. 13th International Symposium on Plant Lipids, Seville, Spain.
31. Z. Cohen, C. Bigogno & I. Khozin-Goldberg (1999) Microalgae as a source of the polyunsaturated fatty acid arachidonic acid. 8th International Conference on Applied Algology, Montecatini Terme, Italy.
32. J. Liu, Z. Cohen & A. Richmond (1999) Changes in the fatty acid profile in a high cell density culture of arachidonic acid-rich T12 (a snow alga) exposed to high PFD. 8th International Conference on Applied Algology, Montecatini Terme, Italy.
33. J. Yan, S. Boussiba, Z. Cohen & A. Vonshak (1999) Quantitative studies on the growth and EPA productivity of *Monodus subterraneus*. 8th International Conference on Applied Algology, Montecatini Terme, Italy.
34. Z. Cohen, I. Khozin-Goldberg, D. Adlerstein & C. Bigogno (2000) The role of triacylglycerol as a reservoir of polyunsaturated fatty acids for the rapid

- production of chloroplastic lipids in certain algae. 14th International Symposium on Plant Lipids, Cardiff, UK.
35. M. Zhekisheva, S. Boussiba, I. Khozin-Goldberg, I. Zarka & Z. Cohen (2001) Accumulation of triacylglycerols in *Haematococcus pluvialis* is correlated with that of astaxanthin esters. 7th International Congress of Phycology, Thessaloniki, Greece.
 36. P. Shrestha, I. Khozin-Goldberg & Z. Cohen (2002) Reutilization of arachidonyl moieties of triacylglycerols in the microalga *Parietochloris incisa* following recovery from nitrogen starvation. 15th International Symposium on Plant Lipids, Okazaki, Japan.
 37. T. Castillo, F.X. Arredondo-Vega, N.Y. Hernandez-Saavedra, Z. Cohen & B.O. Arredondo-Vega (2002) Molecular biology studies of the *Phaeodactylum tricornutum* $\Delta 5$ desaturase. 9th International Conference on Applied Algae, Almeria, Spain.
 38. Z. Cohen & I. Khozin-Goldberg (2003) Role and production of arachidonic acid in the microalga *Parietochloris incisa*. 1st European Symposium on Plant Lipids, Aachen, Germany.
 39. D. Cohen, P. Shrestha, I. Khozin-Goldberg, M. N. Merzlyak & Z. Cohen (2003) Purification and characterization of oil-bodies from the cells of the arachidonic acid-producing alga *Parietochloris incisa*. 1st European Symposium on Plant Lipids, Aachen, Germany.
 40. P. Shrestha, D. Cohen, I. Khozin-Goldberg & Z. Cohen (2003) Triacylglycerol biosynthesis in microsomes of the oleaginous green alga *Parietochloris incisa*. 1st European Symposium on Plant Lipids, Aachen, Germany.
 41. M. Zhekisheva, A. Zarka, I. Khozin-Goldberg, S. Boussiba & Z. Cohen (2003) Astaxanthin accumulation in *Haematococcus pluvialis* depends on the *de novo* fatty acid synthesis. 1st European Symposium on Plant Lipids, Aachen, Germany.
 42. P. Shrestha, I. Khozin-Goldberg and Z. Cohen (2002) Reutilization of arachidonyl moieties of triacylglycerols in the microalga *Parietochloris incisa* following recovery from nitrogen starvation, 15th International Symposium on Plant Lipids, Okazaki, Japan.
 43. P. Shrestha, D. Cohen, I. Khalilov, I. Khozin-Goldberg and Z. Cohen (2004) Triacylglycerol biosynthesis in microsomes and oil bodies of the oleaginous green alga *Parietochloris incisa*. 16th International Symposium on Plant Lipids, Budapest, Hungary.
 44. I. Khalilov, I. Khozin-Goldberg & Z. Cohen (2004) Initial studies on the fatty acid desaturase genes in the unicellular green algae *Parietochloris incisa*. 16th International Symposium on Plant Lipids, Budapest, Hungary.

PATENTS

- 1975 Y. Mazur, Z. Cohen, E. Keinan & T. H. Varkony. Production of saturated tertiary alcohols and ketones. Israel Patent No. 47,344.
- 1978 Z. Cohen & Y. Mazur. A Process for the Production of 25-Hydroxy Cholesterol. Israel Patent No. 54,463.
- 1978 Y. Mazur, Z. Cohen & E. Keinan. Processes and novel intermediates for the production of 1,25-dihydroxy vitamin D₃, Israel Patent No. 49,287.
- 1996 S. Boussiba, A. Vonshak, Z. Cohen & A. Richmond. A process for large-scale production of astaxanthin from *Haematococcus pluvialis*, Israel Patent App. No. 116,995.

- 1997 H. Itokawa, H. Seishiro, A. Richmond, Z. Cohen, S. Boussiba & A. Vonshak. Production of arachidonic acid from microalgae. Japanese Patent No. 9098794A2.
- 1997 S. Boussiba, A. Vonshak, Z. Cohen & A. Richmond. A procedure for large-scale production of astaxanthin from *Haematococcus pluvialis*. World Patent Appl. No. PCT/IL97/00042.
- 2006

RESEARCH GRANTS

- 1981 Ministry of Absorption: Z. Cohen. Chemicals from Algae, 1982. Total amount - \$5,000.
- 1982 Koor-Chemicals: A. Richmond, S. Boussiba & Z. Cohen. Extraction of chemicals from Spirulina, 1982-83. Annual amount - \$20,000, Total amount - \$40,000.
- 1983 Solar Energy Research Institute (SERI): A. Richmond, A. Vonshak, S. Boussiba & Z. Cohen. Development of an outdoor system for production of lipid-rich halotolerant microalgae, 1983-86. Annual amount - \$60,000, Total amount - \$180,000.
- 1983 Ein-Yahav Algae - A. Richmond, A. Vonshak, S. Boussiba & Z. Cohen. Establishing a large production site for *Spirulina* biomass, 1983-86. Total amount \$140,000.
- 1984 Binational Agricultural Research and Development Fund (BARD): A. Richmond, Z. Cohen & A. Vonshak. Studying the feasibility of developing an algal marine culture system for the production of valuable chemicals, 1984. Annual and total amount - \$15,000.
- 1985 The National Council for Research and Development: Z. Cohen & A. Richmond. Extraction of chemicals from the alga *Porphyridium*, 1985-88. Annual amount - \$20,500, Total amount - \$61,500.
- 1986 Agency for International Development (AID): B. Kessler, Y. Eshdat & Z. Cohen. Epicuticular plant surface agglutinins, 1987-90. Annual amount - \$50,000, Total amount - \$150,000.
- 1986 AID: Z. Cohen & A. Richmond. The alga *Spirulina* as a source of γ -linolenic acid and other valuable chemicals, 1987-91. Annual amount - \$50,000, Total amount - \$150,000.
- 1987 AID: Z. Cohen & A. Richmond. Production of Eicosapentaenoic acid (EPA) by microalgae, 1988-93. Annual amount - \$50,000, Total amount - \$250,000.
- 1992 BARD: E. Gantt, A. Vonshak, S. Boussiba, Z. Cohen & A. Richmond. Carotenoid-rich algal biomass for aquaculture: astaxanthin production by *Haematococcus pluvialis*, 1992-95. Total amount - \$220,000.
- 1992 PEF-MORIA foundation: Z. Cohen & Y.M. Heimer. Enhancing oil production in plants. Annual amount - \$10,000.
- 1992 System Research Institute, Japan: S. Boussiba, Z. Cohen, A. Richmond & A. Vonshak. Characterization of snow algae, 1992-94. Total amount - \$300,000.
- 1993 PEF-MORIA foundation: Z. Cohen & Y.M. Heimer. Enhancing oil production in plants. Annual amount - \$25,000.
- 1994 RASHI foundation: Z. Cohen & Y. M. Heimer. Enhancing oil production in plants. 1994-96. Total amount - \$113,000.
- 1994 RASHI foundation: S. Boussiba, Z. Cohen, A. Richmond & A. Vonshak. Astaxanthin production by *Haematococcus pluvialis*, 1994-96. Total amount - \$340,000.
- 1995 Ministry of science: Z. Cohen & Y.M. Heimer. Elucidation of EPA biosynthesis in algae, 1995-7. Total amount - NIS100,000.

- 1995 Ministry of science: Z. Cohen & Y.M. Heimer. Elucidation of EPA biosynthesis in *Porphyridium*. 1995. Total amount - NIS120,000.
- 1997 European commission (BRITE EURAM): Z. Cohen, S. Boussiba, A. Vonshak, D. Hall, E. Molina Grima & M. Tredici. An integrated production system of highly purified EPA from microalgae, 1998-2000, Total amount - €1,008,000.
- 1998 European commission (TMR): Y.M. Heimer & Z. Cohen. Establishment of a large scale facility for desert studies, 1998-9. Total amount - €209,000
- 1999 Algatechnologies: S. Boussiba, Z. Cohen, A. Richmond & A. Vonshak. Astaxanthin production from *Haematococcus*, 1999-2000. Total amount - \$420,000.
- 2000 European commission: Z. Cohen, Support of Access to Research Infrastructure, 2000-2003, Total amount - €300,000.
- 2002 AID: Z. Cohen, S. Boussiba, I. Khozin-Goldberg, A. Vonshak & A. Critchely. Production of arachidonic acid (AA) from the alga *Parietochloris incisa*, 2002-2005. Total amount - \$200,000.
- 2002 Harry Stern Foundation: Z. Cohen & I. Khozin-Goldberg. Enhancing the productivity of the polyunsaturated fatty acid (PUFA), arachidonic acid, in the microalga *Parietochloris incisa*. 2002-2003. Total amount - \$60,000.
- 2003 Ministry of Health: N. Porat & Z. Cohen. Involvement of the cytoplasmic membrane of *Streptococcus pneumoniae* in carriage and disease. Total amount - NIS 80,000.
- 2003 Center for academic and educational relationship with the CIS and the Baltic states: Z. Cohen, I. Khozin-Goldberg, M. Merzlyak, O.B. Chivkunova, A.E. Solovchenko & S.I. Pogosyan. Study of the biochemical and optical properties of algae that can be utilized as a source of pigments and polyunsaturated fatty acids of economical value, Total amount – NIS 50,000.
- 2004 Negev Dev. Res. Authority & Ministry of Absorption: I. Khozin-Goldberg, D. Zilberg & Z. Cohen. Treatment & Prevention of fish diseases by feeding with arachidonic acid-rich microalgae grown on brackish water in the Negev. Total amount – NIS 80,000.
- 2004 Ministry of Health: N. Porat & Z. Cohen. Involvement of the cytoplasmic membrane of *Streptococcus pneumoniae* in carriage and disease. Total amount - NIS 78,000.
- 2005 Ministry of Sciences and Technology: R. Ofir, D. Zilberg, I. Khozin-Goldberg & Z. Cohen. Prevention and treatment of fish diseases by feeding with arachidonic acid-rich microalgae grown on brackish water of the Negev. Total amount – NIS 30,000.
- 2006-9 Binational Scientific Foundation (BSF): B. Pinshow, Z. Cohen, I. Khozin-Goldberg & S. R. McWilliams. How Diet, Body-Composition and Hypothermia affect Fattening in Migrating Birds. Total amount – \$105,000.

PREVIOUS AND CURRENT RESEARCH EXPERIENCES AND INTERESTS

- A) Microalgae as sources for chemicals: polyunsaturated fatty acids and pigments
Effect of environmental conditions and nutritional factors on the content of chemicals in algae
Selection of herbicide-resistant PUFA-overproducing algae
Development of extraction and separation methods
- B) Plant lipid biochemistry
Biosynthesis of polyunsaturated fatty acids (PUFAs)
Enhancement of lipid production in algae and higher plants
- C) Induced pigmentation in fish

- D) Organic reactions in dry media
- E) Design and synthesis of contrast agents for the detection of small lesions in the liver via computed tomography scanning
- F) Synthesis of radioactive cardioselective β -antagonists as myocardial imaging agents

RESEARCH IN PROGRESS

PUFA biosynthesis in microalgae. Although the biosynthesis of polyunsaturated fatty acids (PUFAs) in higher plants was clearly elucidated, very little is known about that of long chain PUFAs (C₂₀₋₂₂) that are common to microalgae. We have utilized several tools such as new inhibitors, incorporation of labelled and unlabeled precursors as well as selection of mutants. These studies resulted in biosynthetic schemes detailing the different pathways that lead to the production of the PUFA eicosapentaenoic acid (EPA) in the rhodophyte *Porphyridium cruentum* and in the xanthophyte *Monodus subterraneus*. Still different pathways were developed for the biosynthesis of arachidonic acid (AA) in the chlorophyte *Parietochloris incisa*. The Δ 12, Δ 6, Δ 5 and Δ 17 desaturases utilize different lipids (PC, PE, DGTS and MGDG) as their substrates in these organisms. Our findings further show that in contrast to higher plants, in *M. subterraneus*, both the eukaryotic-like (20:5/20:5) and the prokaryotic-like (20:5/16:0) molecular species of chloroplastic lipids, originate in the cytoplasm utilizing PC for the early C₁₈ desaturations and PE and DGTS, respectively, for the latter C₂₀ desaturations.

Unique roles of triacylglycerols in microalgae. According to the prevailing dogma, plants accumulate triacylglycerols (TAG) as a store of energy. Various microalgae however accumulate TAG of unique compositions under certain growth conditions. E.g., TAG of the rhodophyte *Porphyridium cruentum* are rich in the PUFAs AA and EPA. Our studies have shown that these PUFAs can be utilized for the rapid biosynthesis of the eukaryotic-like 20/20 molecular species of chloroplastic lipids under low temperatures. Similarly, the alga *Parietochloris incisa*, which can withstand very low temperatures, accumulate AA, especially under nitrogen starvation. It appears that the AA can be deposited in chloroplastic lipids at low temperatures when de novo biosynthesis would be too slow. The alga *Haematococcus pluvialis* is known to accumulate large quantities of astaxanthin under stress conditions. Our findings indicate that the production of astaxanthin requires the biosynthesis of a tailor-made oleate-rich TAG. Interfering with the production of the TAG prevents the accumulation of astaxanthin. These TAG are apparently more suitable to dissolve the large amounts of astaxanthin produced.

Effect of cell concentration on TAG content in PUFA-accumulating algae. Both *Porphyridium cruentum* and *Parietochloris incisa* accumulate large quantities of arachidonic acid (AA)-rich TAG. The accumulation is enhanced when the biomass is kept at relatively high density and therefore, low light per cell. On the other hand, most algae accumulate more TAG under high light per cell. Yet, even in PUFA-rich algae, the TAG is almost entirely made of saturated and monounsaturated fatty acids. We hypothesize that in such algae, excess light is converted to chemical energy in the form of TAG. However, the algae that accumulate PUFA-rich TAG were found in shallow water or snow patches. Such locations are characterized by rapid changes in the environmental conditions. Apparently, a decrease in light per cell which is typical to the stationary phase serves as a signal to accumulate PUFAs in TAG as building blocks for the future construction of chloroplastic membranes. This is necessary since the *de novo* synthesis of PUFAs takes several hours, during which the cell can't grow. Furthermore, the period in which environmental conditions would support exponential growth may not be much longer. Based on this hypothesis we have indeed isolated the AA-rich alga *P. incisa*.

Enhanced production of arachidonic acid (AA). By development of a strategy that includes selection of algal strains and cultivation under special conditions it was possible to obtain an algal strain of *P. incisa* whose AA content is over 20% (of dry weight) and the proportion of AA is up to 60% (of fatty acids). In comparison, the highest published values (also by this investigator) were 2.4 and 40%, respectively. The commercial demand for AA is continuously rising due to recent reports depicting its role in brain development of newborns and its occurrence at relatively high concentration in mother milk.