

CURRICULUM VITAE

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NAME: Aaron J. Ciechanover

DATE OF BIRTH: October 1, 1947

PLACE OF BIRTH: Haifa, Israel

ADDRESS: Vascular and Cancer Biology Research Center
The Rappaport Faculty of Medicine and Research Institute,
Technion-Israel Institute of Technology,
P.O. Box 9649,
Haifa 31096, ISRAEL

Telephone: +972-4-829-5356 (office)
+972-4-829-5379; +972-4-829-5399 (laboratory)
+972-4-829-5427 (coordinator; Mrs. Meirav
Franks)

Fax: +972-4-851-3922 (laboratory);
+972-4-852-1193 (coordinator; Mrs. Meirav
Franks);
e-Fax: +972-3-725-5981

E-mail: c_tzachy@netvision.net.il (preferred) OR
mdaaron@tx.technion.ac.il

meiravf@tx.technion.ac.il (Mrs. Meirav Franks,
coordinator)

EDUCATION:

DEGREES:

1970	M.Sc.:	Medical Sciences. Summa Cum Laude. Faculty of Life Sciences and the Department of Biochemistry, "Hadassah" and the Hebrew University School of Medicine, Jerusalem, Israel.
1974	M.D.:	"Hadassah" and the Hebrew University School of Medicine, Jerusalem, Israel.
1981	D.Sc.:	Faculty of Medicine, Technion-Israel Institute of Technology, Haifa, Israel.

CLINICAL TRAINING:

1973-1974	Internship. "Rambam" University Medical Center, and the Faculty of Medicine, Technion-Israel Institute of Technology, Haifa, Israel.
1974-1979	Partial training. Department of Surgery "B", "Rambam" University Medical Center and the Faculty of Medicine, Technion-Israel Institute of Technology, Haifa, Israel.

ACADEMIC APPOINTMENTS:

- 1977-1979 **Research Fellow.** Department of Biochemistry, Faculty of Medicine, Technion-Israel Institute of Technology, Haifa, Israel.
- 1979-1981 **Lecturer.** Department of Biochemistry, Faculty of Medicine, Technion-Israel Institute of Technology, Haifa, Israel.
- 1984-1987 **Senior Lecturer (with tenure).** Department of Biochemistry, Faculty of Medicine, Technion-Israel Institute of Technology, Haifa, Israel.
- 1987-1992 **Associate Professor.** Department of Biochemistry, Faculty of Medicine, Technion-Israel Institute of Technology, Haifa, Israel.
- 1992- **Full Professor.** Department of Biochemistry, Faculty of Medicine, Technion-Israel Institute of Technology, Haifa, Israel.
- 2002- **Distinguished Research Professor.** Technion-Israel Institute of Technology, Haifa, Israel.

ADMINISTRATIVE APPOINTMENTS:

- 1993-2000 **Director.** The Rappaport Family Institute for Research in the Medical Sciences. Technion-Israel Institute of technology, Haifa, Israel.

VISITING APPOINTMENTS:

- 1978, 1979 **Visiting Scientist.** The Institute for Cancer Research,
1980, 1981 The Fox Chase Cancer Center, Philadelphia, Pennsylvania, USA
(Dr. Irwin A. Rose's laboratory).
- 1981-1984 **Postdoctoral Fellow.** Department of Biology, Massachusetts Institute of
Technology (M.I.T.) and The Whitehead Institute for
Biomedical Research, Cambridge, Massachusetts,
USA (Dr. Harvey F. Lodish's laboratory).
- 1985, 1986 **Visiting Professor.** The Dana Farber Cancer Institute
and Harvard Medical School, Boston, Massachusetts,
USA (Dr. Alan L. Schwartz's laboratory).
- 1987, **Visiting Professor.** Division of Hematology-Oncology,
1988-1989 Department of Pediatrics, Children's Hospital,
1990, 1991 Washington University School of Medicine,
1992, 1993 St. Louis, Missouri, USA. (Dr. Alan L. Schwartz's laboratory).
1994, 1995
1996, 1997
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2001
- 1988-1989 **American Cancer Society Eleanor Roosevelt
Memorial Fellow.**
Visiting Professor. Division of Hematology-Oncology, Department of
Pediatrics, Children's Hospital, Washington University School of
Medicine, St. Louis, Missouri, USA. (Dr. Alan L. Schwartz's laboratory).
- 2000 **Visiting Professor.** University of Kyoto School of Medicine
(Dr. Kazuhiro Iwai's Laboratory).
- 2002, 2003 **Visiting Adjunct Professor.** Northwestern University School of
Medicine, Chicago, Illinois, USA. (Department of Medicine and Division
of Pulmonary Critical care: Dr. Jacob J. Sznajder's Laboratory).

- 2003 **Visiting Professor.** STINT Fellow. Microbiology and Tumor Biology Center. The Karolinska Institute, Stockholm, Sweden. (Laboratory of Dr. Maria Masucci).
- 2002, 2003-2004, **Visiting Professor** (within the frame of the JSPS – Japan Society for Promotion of Science – Eminent Scientist Award). City University of 2005 Osaka School of Medicine (Dr. Kazuhiro Iwai's Laboratory).
- 2004 **Visiting Professor.** Rockefeller University, New York, NY, USA (Dr. Hermann Steller's laboratory).
- 2007- **Distinguished Visiting Research Professor.** National Cheng Kung University (NCKU), Tainan, Taiwan.

BOARDS (academic):

- 2006 - Institute of Advanced Studies, Hong Kong University of Science and Technology
- 2006 - Scientific Advisory Board. Britton Chance Center for BioMedical Photonics. Huazhong University of Science and Technology, Wuhan, China
- 2008 - President's council, NY Academy of Sciences

MILITARY SERVICE:

- 1974-1977 National Compulsory Service, Israel Defense Forces. Military Physician, Israeli Navy and the Unit for Research and Development, Surgeon General Headquarters.

FELLOWSHIPS:

- 1981-1984 Fulbright Fellow. Massachusetts Institute of Technology (M.I.T.) Cambridge, Massachusetts, USA (Dr. Harvey Lodish's Laboratory).
- 1981-1983 Leukemia Society of America Fellow. M.I.T.
- 1981-1984 Israel Cancer Research Fund (ICRF), USA Fellow. M.I.T.
- 1983-1984 Medical Foundation and Charles A. King Trust Fellow. M.I.T. Research Career Development Award, Israel Cancer Research Fund (ICRF), USA.
- 1988-1989 American Cancer Society Eleanor Roosevelt Memorial Fellow.

EDITORIAL BOARDS:

- 1999- Israel Medical Association Journal (IMAJ)
- 2006- Experimental Biology and Medicine
- 2007- Cell Death and Differentiation (CDD; Nature Group)

AWARDS (academic):

- 1999 The Austria Ilse and Helmut Wachter Prize, University of Innsbruck (along with Dr. Avram Hershko).
- 2000 The Jewish National Fund Alkales Award for Distinguished Scientific Achievements.
- 2000 The Albert and Mary Lasker Award for Basic Medical Research (along with Drs. Avram Hershko and Alexander Varshavsky)
- 2001 The Michael Landau (Mifa'al Ha'Peis) Award in Medical Sciences (along with Dr. Avram Hershko).

- 2002 EMET (Truth) Prize (Israeli Prime Minister Prize), for Arts, Sciences and Culture (in Life Sciences and Medicine along with Drs. Avram Hershko and Leo Sachs). Awarded by the AMAN Foundation.
- 2003 The Israel Prize for Biology
- 2003-2006 Japan Society for Promotion of Science (JSPS) Eminent Scientist Award
- 2004 Nobel Prize in Chemistry (shared with Drs. Avram Hershko and Irwin A. Rose)

HONORS (academic):

- 1996- Janet and David Polak Professor of Life Sciences. Technion-Israel Institute of Technology, Haifa, Israel
- 2002- University Distinguished Research Professor. Technion-Israel Institute of Technology, Haifa, Israel.
- 2003- Professor. Israel Cancer Research Fund (ICRF), USA.
- 2005 Cell Stress Society international (CSSi) Medal and Distinguished Life Member.
- 2006 Sir Hans Krebs Medal. Federation of the European Biochemical Societies (FEBS).
- 2007 Medical Magnus Medal. Polish Academy of Medicine.

MEMBERSHIPS (academies, etc.):

- 1996- Member, Council of the European Molecular Biology Organization (EMBO).
- 1999- Member. Asia-Pacific IMBN (International Molecular Biology Network)
- 2004- Member. European Academy of Sciences and Arts.
- 2004- Member. European Academy of Sciences.
- 2004- Fellow. European Academy of Sciences.
- 2004- Member. Israeli National Academy of Sciences and Humanities.
- 2004- Member (Hon.). American Chemical Society (ACS)
- 2005 Fellow (Hon.). Royal Society of Chemistry RCS, (UK). HonFRSC.
- 2005- Member (Foreign). American Philosophical Society
- 2006- Honorary Member. Society for Experimental Biology and Medicine.
- 2006- Fellow. Federation of Asian Chemical Societies (FACS).
- 2007- Member. Pontifical Academy of Sciences, The Vatican.
- 2007- Member. Polish Academy of Medicine.
- 2007- Member. Albert Schweitzer World Academy of Medicine.
- 2007- Member. National Academy of Science and Technology of South Korea
- 2007- Associate (Foreign). National Academy of Sciences of the USA (NAS USA).
- 2008- Member (Honorary; Foreign). American Academy of Arts and Sciences (AAAS).
- 2008- Associate (Foreign). Institute of Medicine of the National Academies of the USA (IOM).
- 2009- Member (Foreign), Ukrainian Academy of Sciences

MEMBERSHIPS (professional organizations):

- 1984 - American Association for Advancement of Science (AAAS)

HONORARY DEGREES (academic institutions):

2001	Honorary Doctor (Doctor Philosophiae Honoris Causa; Ph.D. Hon.), Tel Aviv University, Tel Aviv, Israel.
2004	Honorary Doctor (Doctor Philosophiae Honoris Causa; Ph.D. Hon.), Ben-Gurion University, Beer Sheba, Israel.
2005	Honorary Doctor (Doctor Philosophiae Honoris Causa; Ph.D. Hon.), City University of Osaka, Osaka, Japan.
2005	Honorary Doctor (Doctor Philosophiae Honoris Causa; Ph.D. Hon.), University of Athens, Greece.
2005	Honorary Doctor (Doctor Philosophiae Honoris Causa; Ph.D. Hon.), National University of Uruguay, Montevideo, Uruguay.
2006	Honorary Doctor (Doctor Philosophiae Honoris Causa; Ph.D. Hon.), Washington University, St. Louis, Missouri, USA
2006	Honorary Doctor (Doctor Philosophiae Honoris Causa; Ph.D. Hon.), Cayetano Heredia University, Lima, Peru.
2006	Honorary Professor. Capital University of Medical Sciences (CPUMS), Beijing, China.
2006	Honorary Professor. Peking Union Medical College (PUMC). Beijing, China.
2006	Honorary Professor. Chinese Academy of Medical Sciences (CAMS), China.
2007	Honorary Doctor (Doctor Philosophiae Honoris Causa; Ph.D. Hon.), Hebrew University, Jerusalem, Israel.
2007	Honorary Doctor (Doctor Philosophiae Honoris Causa; Ph.D. Hon.), Bar-Ilan University, Ramat Gan, Israel.
2007	Honorary Professor. Henan University, Keifang, China.
2007	Honorary Professor. Nankai University, Tianjin, China.
2007	Honorary Professor. 1 st . Teaching Hospital Medical School, XinJiang University, Urumqi, China.
2007	Honorary Professor. 4 th Military Medical University, Xi'an, China.
2007	Honorary Professor. Shihezi University, Shihezi, China.
2007	Honorary Doctor (Doctor Honoris Causa of Science; D.Sc. Hon.), Albert Schweitzer World Academy of Science.
2007	Honorary Professor. Jiaotong University, Xi'an, China.
2007	Honorary Professor. Northwest University, Xi'an, China.
2008	Honorary Doctor (Doctor Philosophiae Honoris Causa; Ph.D. Hon.), Weizmann Institute of Science, Rehovot, Israel.
2008	Honorary Doctor (Doctor Honoris Causa), Universidad San Francisco, Quito, Ecuador.
2008	Honorary Doctor (Doctor Philosophiae Honoris Causa; Ph.D. Hon.), Universidad del Norte, Asuncion, Paraguay.
2008	Honorary Doctor (Doctor Philosophiae Honoris Causa; Ph.D. Hon.), Angeles University, Angeles City, The Philippines.
2008	Honorary Doctor (Doctor Philosophiae Honoris Causa; Ph.D. Hon.), University of New South Wales (NSW), Sydney, Australia
2008	Honorary Professor. Nanjing University, Nanjing, China.
2009	Honorary Causa. The Academic College, Netanya, Israel.

- 2009 Honorary Doctor (Doctor Philosophiae Honoris Causa; Ph.D. Hon.),
The National University of Cambodia, Phnom Pen, Cambodia
- 2010 Honorary Doctor (Doctor Philosophiae Honoris Causa; Ph.D. Hon.).
The Government of the People’s Republic of China via Huazhong
University of Science and Technology (HUST), Wuhan, China.

HONORS (non-academic):

- 2005 Honorary Citizenship, City of Haifa, Israel
- 2005 Sakura Award, the City of Osaka, Japan.
- 2005 Special Award, the Mayor of Osaka, Japan.
- 2006 Honorary Citizenship, City of Montevideo, Uruguay.
- 2006 Honorary Citizenship, City of Lima, Peru
- 2008 Honorary Citizenship, City of Quito, Ecuador
- 2008 Special Distinction for Contribution to Education, Minister of Education,
Government of Ecuador
- 2008 Honorary Citizenship, City of Manila, The Philippines

HONORARY MEMBERSHIPS (non-academic):

- 2004 The Roule Wallenberg Foundation
- 2005 The World Innovation Foundation, WIF
- 2005 Academy of Achievement, USA.

PUBLICATIONS:

Original Papers:

1. **Ciechanover, A.** and Hershko, A. (1976). Early Effects of Serum on Phospholipid Metabolism in Untransformed and Oncogenic Virus Transformed Cultured Fibroblasts. *Biochem. Biophys. Res. Commun.* **73**, 85-91.
2. **Ciechanover, A.,** Hod, Y. and Hershko, A. (1978). A Heat-stable Polypeptide Component of an ATP-dependent Proteolytic System from Reticulocytes. *Biochem. Biophys. Res. Commun.* **81**, 1100-1105.
3. Hershko, A., **Ciechanover, A.** and Rose, I.A. (1979). Resolution of the ATP-dependent Proteolytic System from Reticulocytes: A Component that Interacts with ATP. *Proc. Natl. Acad. Sci. USA* **76**, 3107-3110.
4. **Ciechanover, A.,** Heller, H., Elias, S., Haas, A.L. and Hershko, A. (1980). ATP-dependent Conjugation of Reticulocyte Proteins with the Polypeptide Required for Protein Degradation. *Proc. Natl. Acad. Sci. USA* **77**, 1365-1368.
5. Hershko, A., **Ciechanover, A.,** Heller, H., Haas, A.L. and Rose, I.A. (1980). Proposed Role of ATP in Protein Breakdown: Conjugation of Proteins with Multiple Chains of the Polypeptide of ATP-dependent Proteolysis. *Proc. Natl. Acad. Sci. USA* **77**, 1783-1786.
6. **Ciechanover, A.,** Elias, S., Heller, H., Ferber, S. and Hershko, A. (1980). Characterization of the Heat-stable Polypeptide of the ATP-dependent Proteolytic System from Reticulocytes. *J. Biol. Chem.* **255**, 7525-7528.
7. **Ciechanover, A.,** Heller, H., Etzion-Katz, R. and Hershko, A. (1981). Activation of the Heat-stable Polypeptide of the ATP- dependent Proteolytic System. *Proc. Natl. Acad. Sci. USA* **78**, 761-765.
8. Hershko, A., **Ciechanover, A.** and Rose, I.A. (1981). Identification of the Active Amino Acid Residue of the Polypeptide of ATP-dependent Protein Breakdown. *J. Biol. Chem.* **256**, 1525-1528.
9. **Ciechanover, A.,** Elias, S., Heller, H. and Hershko, A. (1982). "Covalent Affinity" Purification of Ubiquitin Activating Enzyme. *J. Biol. Chem.* **257**, 2537-2542.
10. Hershko, A., Eytan, E., **Ciechanover, A.** and Haas, A.L. (1982). Immunochemical Analysis of the Turnover of Ubiquitin-protein Conjugates in Intact Cells: Relationship to the Breakdown of Abnormal Proteins. *J. Biol. Chem.* **257**, 13964-13970.
11. **Ciechanover, A.,** Schwartz, A.L. and Lodish, H.F. (1982). The Asialoglycoprotein Receptor Internalizes and Recycles Independently of the Transferrin and Insulin Receptors. *Cell* **32**, 267-275.
12. Dautry-Varsat, A., **Ciechanover, A.** and Lodish, H.F. (1983). pH and the Recycling of Transferrin During Receptor Mediated Endocytosis. *Proc. Natl. Acad. Sci. USA* **80**, 2258-2262.
13. Hershko, A., Heller, H., Elias, S. and **Ciechanover, A.** (1983). Components of Ubiquitin-protein Ligase System: Resolution, Affinity Purification and Role in Protein Breakdown. *J. Biol. Chem.* **258**, 8206-8214.
14. **Ciechanover, A.,** Schwartz, A.L., Dautry-Varsat, A. and Lodish, H.F. (1983). Kinetics of Internalization and Recycling of Transferrin and the Transferrin Receptor in a Human Hepatoma Line: Effect of Lysosomotropic Agents. *J. Biol. Chem.* **258**, 9681-9689.

15. **Ciechanover, A.**, Schwartz, A.L. and Lodish, H.F. (1983). Sorting and Recycling of Cell Surface Receptors and Endocytosed Ligands: The Asialoglycoprotein and the Transferrin Receptors. *J. Cell. Biochem.* **23**, 107-130.
16. **Ciechanover, A.**, Finley, D. and Varshavsky, A. (1984). The Ubiquitin Mediated Proteolytic Pathway and Mechanisms of Energy Dependent Intracellular Protein Degradation. *J. Cell. Biochem.* **24**, 27-53.
17. Finley, D., **Ciechanover, A.** and Varshavsky, A. (1984). Thermolability of Ubiquitin Activating Enzyme from the Mammalian Cell Cycle Mutant ts85. *Cell* **37**, 43-55.
18. **Ciechanover, A.**, Finley D. and Varshavsky, A. (1984). Ubiquitin Dependence of Selective Protein Degradation Demonstrated in the Mammalian Cell Cycle Mutant ts85. *Cell* **37**, 57-66.
19. Patel, V.P., **Ciechanover, A.**, Platt, O. and Lodish, H.F. (1985). Mammalian Reticulocytes Lose Adhesion to Fibronectin During Differentiation to Erythrocytes. *Proc. Natl. Acad. Sci. USA* **82**, 440-444.
20. **Ciechanover, A.**, Wolin, S.L., Steitz, J.A. and Lodish, H.F. (1985). Transfer RNA is an Essential Component of the Ubiquitin and ATP-dependent Proteolytic System. *Proc. Natl. Acad. Sci. USA* **82**, 1341-1345.
21. **Ciechanover, A.**, Finley, D. and Varshavsky, A. (1985). Mammalian Cell Cycle Mutant Defective in Intracellular Protein Degradation and Ubiquitin Protein Conjugation. *Prog. Clin. Biol. Res.* **180**, 17-31.
22. Neutra, M.R., **Ciechanover, A.**, Owen, S.L. and Lodish, H.F. (1986). Intracellular Transport of Transferrin- and Asialoorosomuroid- colloidal Gold Conjugates to Lysosomes after Receptor Mediated Endocytosis. *J. Histochem. Cytochem.* **33**, 1134-1144.
23. Ferber, S. and **Ciechanover, A.** (1986). Transfer RNA is Required for Conjugation of Ubiquitin to Selective Substrates of the Ubiquitin- and ATP-dependent Proteolytic System. *J. Biol. Chem.* **261**, 3128-3134.
24. Jahngen, J.H., Haas, A.L., **Ciechanover, A.**, Blondin, J., Eisenhauer, D. and Taylor, A. (1986). The Eye Lens has an Active Ubiquitin-lens Protein Conjugation System. *J. Biol. Chem.* **261**, 13760-13767.
25. Teeters, C.L., Lodish, H.F., **Ciechanover, A.** and Wallace, B.A. (1986). Transferrin and Apotransferrin: pH-dependent Conformational Changes Associated with Receptor-mediated Uptake. *Ann. N.Y. Acad. Sci.* **463**, 403-407.
26. Schwartz, A.L., **Ciechanover, A.**, Merritt, S. and Turkewitz, A. (1987). Antibody-induced Receptor Loss: Different Fates for Asialoglycoproteins and the Asialoglycoprotein Receptor in HepG2 Cells. *J. Biol. Chem.* **261**, 15225-15232.
27. **Ciechanover, A.** (1987). Regulation of the Ubiquitin Mediated Proteolytic Pathway: Role of the Substrate γ -NH₂ Group and of Transfer RNA. *J. Cell. Biochem.* **34**, 81-100.
28. Ferber, S. and **Ciechanover, A.** (1987). Role of Arginine-tRNA in Protein Degradation by the Ubiquitin Pathway. *Nature* **326**, 808-811.
29. **Ciechanover, A.**, Ferber, S., Ganoth, D., Elias, S., Hershko, A. and Arfin, S. (1988). Purification and Characterization of Arginyl-tRNA-Protein Transferase from Rabbit Reticulocytes: Its Involvement in Posttranslational Modification and Degradation of Acidic N-Termini Substrates of the Ubiquitin Pathway. *J. Biol. Chem.* **263**, 11155-11167.

30. Kulka, R.G., Raboy, B., Schuster, R., Parag, H.A., Diamond, G., **Ciechanover, A.**, and Marcus, M. (1988). A Chinese Hamster cell Cycle Mutant Arrested at G2 Phase Has a Temperature-Sensitive Ubiquitin-Activating Enzyme, E1. *J. Biol. Chem.* **263**, 15726-15731.
31. Schwartz, A.L., **Ciechanover, A.**, Brandt, R.A. and Geuze, H.J. (1988). Immunoelectron Microscopic Localization of Ubiquitin in Hepatoma Cells. *EMBO J.* **10**, 2961-2966.
32. Mayer, A., Gropper, R., Schwartz, A.L. and **Ciechanover, A.** (1989). Purification, Characterization and Rapid Inactivation of Ubiquitin Activating Enzyme from the Mammalian Cell Cycle Mutant ts85. *J. Biol. Chem.* **264**, 2060-2068.
33. Mayer, A. Siegel, N.R., Schwartz, A.L. and **Ciechanover, A.** (1989). Degradation of Proteins with Acetylated Amino Termini by the Ubiquitin System. *Science* **244**, 1480-1483.
34. Bercovich, Z., Rosenberg-Hasson, Y., **Ciechanover, A.** and Kahana, C. (1989). Degradation of Ornithine Decarboxylase in Reticulocyte Lysate is ATP-Dependent but Ubiquitin-Independent. *J. Biol. Chem.* **264**, 15949-15952.
35. **Ciechanover, A.**, Gonen, H., Elias, S. and Mayer, A. (1990). Degradation of Proteins by the Ubiquitin-Mediated Proteolytic Pathway. *The New Biologist* **2**, 227-234.
36. Rosenberg-Hasson, Y., Bercovich, Z., **Ciechanover, A.** and Kahana, C. (1990). Degradation of Ornithine Decarboxylase in Mammalian Cells is ATP-Dependent but Ubiquitin-Independent. *Eur. J. Biochem.* **185**, 469-474.
37. Elias, S. and **Ciechanover, A.** (1990). Post-Translational Addition of an Arginine Moiety to Acidic NH₂-Termini of Proteins is Required for their Recognition by Ubiquitin-Protein Ligase. *J. Biol. Chem.* **265**, 15511-15517.
38. **Ciechanover, A.**, DiGiuseppe, J.A., Bercovich, B., Orian, A., Richter, J.D., Schwartz, A.L. and Brodeur, G.M. (1991). Degradation of Nuclear Oncoproteins by the Ubiquitin System *In Vitro*. *Proc. Natl. Acad. Sci. USA* **88**, 139-143.
39. **Ciechanover, A.**, and Gonen, H. (1990). The Ubiquitin-Mediated Proteolytic Pathway: Enzymology and Mechanisms of Recognition of the Proteolytic Substrates. *Seminars in Cell Biology* **1**, 415-422.
40. Gropper, R., Brandt, R.A., Elias, S., Bearer, C.F., Mayer, A., Schwartz, A.L. and **Ciechanover, A.** (1991). The Ubiquitin-Activating Enzyme, E1, is Required for Stress-Induced Lysosomal Degradation of Cellular Proteins. *J. Biol. Chem.* **266**, 3602-3610.
41. Handley, P.M., Mueckler, M., Siegel, N.R., **Ciechanover, A.** and Schwartz, A.L. (1991). Molecular Cloning, Sequence, and Tissue Distribution of the Human Ubiquitin Activating Enzyme, E1. *Proc. Natl. Acad. Sci. USA* **88**, 258-262.
42. **Ciechanover, A.**, DiGiuseppe, J.A., Schwartz, A.L. and Brodeur, G.M. (1991). Regulation of N-myc Protein Degradation by the Ubiquitin System. *Prog. Clin. Biol. Res.* **366**, 37-43.
43. **Ciechanover, A.** (1991). The Ubiquitin Mediated System for Intracellular Protein Degradation. *J. Basic Clin. Physiol. Pharmacol.* **2**, 141-159.
44. **Ciechanover, A.**, Gropper, R., Schwartz, A.L. (1991). The Ubiquitin-Activating Enzyme is Required for Lysosomal Degradation of Cellular Proteins Under Stress. *Biomedica Biochimica Acta* **50 (4-6)**, 321-332.

45. Gonen, H., Schwartz, A.L., and **Ciechanover, A.** (1991). Purification and Characterization of a Novel Protein that is Required for the Degradation of N-alpha-Acetylated Proteins by the Ubiquitin System. *J. Biol. Chem.* **266**, 19221-19231.
46. DeMartino, G.N., McCullough, M.L., Reckelhoff, J.F., Croall, D.E., **Ciechanover, A.**, and McGuire, M.J. (1991). ATP-stimulated Degradation of Endogenous Proteins in Cell-Free Extracts of BHK 21/C13 Fibroblasts: A Key Role for the Proteinase, Macropain, in the Ubiquitin-Dependent Degradation of Short-Lived Proteins. *Biochim. Biophys. Acta* **1073**, 299-308.
47. Schwartz, A.L., Brandt, R.A., Geuze, H., and **Ciechanover, A.** (1992). Stress-Induced Alterations in the Autophagic Pathway: Relationship to the Ubiquitin System. *Am. J. Physiol.* **262**, (*Cell Physiol.* **31**): C1031-C1038.
48. Schwartz, A.L., Trausch, J.S., **Ciechanover, A.**, Slot, J.W., and Geuze, H. (1992). Immunoelectron Microscopic Localization of the Ubiquitin-Activating Enzyme E1 in HepG2 Cells. *Proc. Natl. Acad. Sci. USA* **89**, 5542-5546.
49. Lenk, S.E., Dunn, W.A., Jr., Trausch, J.S., **Ciechanover, A.**, and Schwartz, A.L. (1992). Ubiquitin-Activating Enzyme, E1, is Associated with Maturation of Autophagic Vacuoles. *J. Cell Biol.* **118**, 301-308.
50. Trausch, J.S., Grenfell, S.J., Handley-Gearhart, P.M., **Ciechanover, A.**, and Schwartz, A.L. (1993). Immunofluorescent Localization of the Ubiquitin-Activating Enzyme, E1, to the Nucleus and Cytoskeleton. *Am. J. Physiol.* **264**, (*Cell Physiol.* **33**): C93-C102.
51. Blumenfeld, N., Gonen, H., Mayer, A., Smith, C. E., Siegel, N.R., Schwartz, A. L., and **Ciechanover, A.** (1994). Purification and Characterization of a Novel Species of Ubiquitin-Carrier Protein, E2, That is Involved in Degradation of Non-"N-End Rule" Protein Substrates. *J. Biol. Chem.* **269**, 9574-9581.
52. **Ciechanover, A.**, Shkedy, D., Oren, M., and Bercovich, B. (1994). Degradation of the Tumor Suppressor Protein p53 by the Ubiquitin-Mediated Proteolytic System Requires a Novel Species of Ubiquitin-Carrier Protein, E2. *J. Biol. Chem.* **269**, 9582-9589.
53. Gonen, H., Smith, C. E., Siegel, N. R., Merrick, W. C., Kahana, C., Chakraborty, K., Schwartz, A. L., and **Ciechanover, A.** (1994). Protein Synthesis Elongation Factor EF-1 γ is Essential for Ubiquitin-Dependent Degradation of N- γ -Acetylated Proteins and May be Substituted for by the Bacterial Elongation Factor EF-Tu. *Proc. Natl. Acad. Sci. USA* **91**, 7648-7652.
54. Shkedy, D., Gonen, H., and **Ciechanover, A.** (1994). Complete Reconstitution of Conjugation and Subsequent Degradation of the Tumor Suppressor Protein p53 by Purified Components of the Ubiquitin Proteolytic System. *FEBS Lett.* **348**, 125-130.
55. Grenfell, S.J., Trausch-Azar, J.S., Handley-Gearhart, P.M., **Ciechanover, A.**, and Schwartz, A.L. (1994). Nuclear Localization of the Ubiquitin-Activating Enzyme, E1, is Cell Cycle-Dependent. *Biochem. J.* **300**, 701-708.
56. Handley-Gearhart, P.M., Trausch-Azar, J.S., **Ciechanover, A.**, and Schwartz, A.L. (1994). Rescue of the Complex Temperature-Sensitive Phenotype of Chinese Hamster Ovary E36ts20 Cells by Expression of the Human Ubiquitin-Activating Enzyme cDNA. *Biochem. J.* **304**, 1015-1020.

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 Article Online Posting Date: May 15, 2008

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Patents:

1. Development of an anti-tumor agent from Serum.
Along with Drs. Ofer Binah and Gila Maor, Faculty of Medicine, Technion.
Applied December 2002.
2. Utilization of pro-apoptotic peptides to promote apoptosis in malignant cells.
Along with Dr. Hedva Gonen, Faculty of Medicine, Technion, and
Drs. Hermann Steller and Hyung-Don Ryoo, Rockefeller University, NY, USA.
Applied September 2002.