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Summary

I am an innovative, enthusiastic, result oriented and pragmatic biochemical engineer with a strong background in microbiology. I have 30-year experience in the field of biochemical engineering as a researcher, guide and lecturer, and contributed significantly to the biotechnology field related to production and/or purification. During these years, I have acquired experience in project management and supervision in an R&D environment. I have worked in multidisciplinary biotechnology laboratories using different types of bioreactors for microbial and mammalian cell cultivation but for the last 13 years have been using different purification units for the large-scale purification of proteins and viruses.

Research Goal

My research goal is to use my project management and purification skills in a challenging environment to manufacture large-scale biological materials from cell cultures.

Work Experience

5/2002 - Present **Biotechnology Research Institute**, Montreal, Québec
Research Officer (Advisor: Dr. A. Kamen)

- Supervisory Role:
  - Supervisory function of two employees.
- Project Manager:
  - Since 2011, intensively doing Project Management for clients' work by preparing Gantt Chart using MS Project to follow the tasks and resources to make sure the work is completed as scheduled; arranging meetings; and routinely updating the status and preparing reports.
  - Currently, one of the key team players acting as a Project Manager to Manage NRC contracts on SAP-Project System.
- Purification:
  - Purification of Gutless-Adenovirus Particles from the cell culture containing both Adenovirus and gutless-Adenovirus particles using ultracentrifugation.
  - Developed two-step chromatography method for the purification of nine (9) different serotypes of AAV (AAV1-9) based on ion exchange and hydrophobic interactions chromatography techniques.
  - Purification of six (6) different AAV constructs produced by Baculovirus/insect cell system.
  - Developed purification process for adeno-associated virus like particles (AAV-VLPs) produced by Baculovirus/insect cell system.
  - Developed primary separation protocol for the release of AAV from the cell cultures of transfection/mammalian cells and Baculovirus/insect cell systems.
  - HIC was developed to replace iodixanol density gradient centrifugation method as it is not a scaleable process.
  - Applied Adeno-associated virus (AAV) Purification Methodology to Baculovirus/insect cell system at high cell density (10 million cells/mL) culture infected at low MOI of 0.1.
  - Scale-up of AAV purification from mammalian and insect cells by Transfection Technology and by Baculovirus System, respectively.
  - Scaled-up the plasmid purification process produced by *Escherichia coli* to be used for transient transfection. A mixing chamber was designed to handle highly viscous liquid without damaging the genomic DNA. Demonstrated the process at a scale of 100 mg purified plasmid.
- Analytical:
  - Characterization of AAV-VLPs by Particle size and stability by Zeta

Potential measurements.
- Designed primers and TaqMan probes to quantify DNAse resistant AAV particle concentration.
- Validation of reovirus particle quantification by HPLC method.
- Explored HPLC to determine AAV concentration by using fluorescence dye and Fluorescence detector.

- Production:
  - Production of nine (9) different serotypes of AAV (AAV1-9) by transfection technology using HEK293 cells in serum-free suspension cell cultures.
- Design of Experiment (DoE):
  - Guided NRC personnel to optimize cummate switch inducible system using DoE approach.
- Service to Clients:
  - As a team member, have completed several contract works on time that had purification steps. The tasks included writing integrated process design proposals, statement of work, deliverables, Gantt chart, and technical reports.
  - The project included purification of: AAV, MAb, rProteins, AdV (Adenovirus), gutless AdV, Virus-Like-Particles (VLPs of enveloped and non-enveloped viruses).
- As a Reviewer:
  - Regular reviewer of papers for *Biotechnology and Bioengineering*, *Journal of Biotechnology*, *Journal of Chromatography*, *Cytotechnology*; and *NSERC Grants*.
- Self-Training on Skill Improvement:
  - Currently Learning Quality by Design (QbD) and Process Analytical Technology (PAT) to implement acquired knowledge to future service to clients as well as NRC's Vaccine Program.
  - Self-Learned MS-Project Software as well Task Management and Scheduling to build Project Manager competency. Also joined a two-day course in Project Management
  - Self-Learned TaqMan technique for Real-Time PCR and guidelines to design TaqMan probes. Ordered the probes and verified the functionality of the Probes and Primers. Also joined a three-day course in polymerase chain reaction (PCR).
  - Learned French to obtain level of BBB.
- Training Others:
  - Trained PhD student for various aspects of lab techniques to produce AAV / VLPs using Baculovirus system.
  - Trained Master's Student to purify Gutless-Adenovirus by Iodixanol ultra centrifugation method.
  - Trained Master's Student in several techniques used in transfection technology from plasmid production, plasmid purification, shake flask and bioreactor runs, and analytical techniques for AAV quantification.
- Volunteer Work:
  - Constructed and maintained a web site for the 6th Conference on Protein Expression in Animal Cells to be held on September 2003.

1/1999 – 4/2002 **Biotechnology Research Institute**, Montreal, Québec
Project Leader – Interim, Downstream Processing Team
(Advisor: Dr. A. Kamen)

- Supervisory Role:
  - Supervisory function of Downstream Processing Team.
  - Guided a Master's student from Ecole Polytechnique on the modeling of the hydrodynamics of Expanded-Bed Chromatography.
- Purification:
  - Contributed to the development of a large-scale adenovirus purification procedure.
  - Developed a procedure to concentrate budded Baculovirus particles.
  - Scaled-up issues related to protein refolding and expanded-bed

chromatography technology.

- Analytical:
  - Developed and Validated HPLC method for the detection of Adenovirus concentration.
  - A reverse phase HPLC method was developed to differentiate SEAP from BSA.
- Proposals:
  - Proposal entitled, "Setting up a Pilot-Scale Downstream Processing unit to purify large quantities of recombinant proteins" for $500 000 was prepared, presented and accepted by NRC, Major Initiative Committee.
- Volunteer Work:
  - Updated and modified the BRI's web site for the Animal Cell Technology and Downstream Processing Group of Bioprocess Sector.

1/1998 – 4/1999 **Biotechnology Research Institute**, Montreal, Québec
Assistant Research Officer (Advisor: Dr. A. Kamen)

- Teaching:
  - Trained Technical Officer of BRI from another Group by exposing him to the lipase production, Baculovirus production and Baculovirus concentration
  - Training Course: *"Large Scale Fermentation and Primary Separation Process Course"* was given twice. The topics included Mixing, Mass Transfer and Scale-up.
- Volunteer Work:
  - Established a Biosafety Level-2 facility for animal cell cultivation and viral purification.
  - Designed a walk-in biological hood for the purification of viruses under BSL2 environment.

Biotechnology Research Institute, Montreal, Québec
3/1997 – 1/1998 Project Leader, Large Scale Bioprocesses (Advisor: Dr. A. Kamen)

- Production:
  - Developed methanol fed-batch strategies to grow cells in high-cell-density to produce recombinant proteins in 20-L bioreactor.
  - Grew *Pichia pastoris* in 20-L bioreactor and obtained a maximum of 550 Optical Density that corresponded to 150 g/L dry weight.
  - Developed an expression system of *Pichia pastoris* to produce recombinant protein with high purity (700 mg/L, which was more than 98% of the total secreted proteins).
- Process Control:
  - In collaboration with Computer Programmer, modified software to control two feeds (glycerol and methanol) independently for the production of lipase by *Pichia pastoris.*
- Proposals:
  - Proposal entitled, "Upgrading of existing facility and acquisition of equipment to implement Biosafety Level 2 pilot plant for the production and purification of gene therapy vectors and recombinant proteins for pre-clinical experiments" for $680 000 was prepared, presented and accepted by NRC, Major Initiative Committee.

4/1996 – 2/1997 **Biotechnology Research Institute**, Montreal, Québec
Post-Doctoral Fellow (Advisor: Dr. A. Kamen)

- Bioreactor Characterization:
  - Investigated the mixing time characteristics in small- and large-scale bioreactors, ranging in size from 150-L to 1500-L.
  - Investigated various methods to determine the Oxygen Transfer Coefficient in bioreactors (ranging in size from 20-L to 1500-L) and then recommended the best, reliable, and economical method.
- Proposals:
  - Proposal entitled, "Development of methanol fed-batch strategies to grow cells in high-cell density to produce recombinant proteins in 20-L bioreactor"

for $30 000 was prepared, presented and accepted by BRI's Research Advisory Committee.

8/1993 – 3/1996 **University of Québec**, Institut Armand-Frappier, Laval, Québec
Post-Doctoral Fellow (Advisor: Prof. D.S. Chahal)

- Purification:
  - Used chromatography system to isolate by-products of lignin degradation by the enzyme.
- Enzyme Production by Fungus:
  - Optimized the medium and culture conditions of fungus, *Trichoderma reesei*, to get a complete cellulose system having β-glucosidase to filter paper activity ratio around one.
  - Optimized the conditions for the hydrolysis of cellulose with such cellulase system and ethanol production from its hydrolysate.
  - Production of ligninolytic enzymes with *Phenerochaete chrysosporium*

9/1991 – 7/1993 **University of British Columbia**, Biotechnology Laboratory, Vancouver, BC
Post-Doctoral Fellow (Advisor: Prof. J.M. Piret)

- Supervisory Role:
  - Supervised, guided and taught laboratory techniques to two BSc students on projects related to oxygen volumetric mass transfer coefficient (k_La) in spinner flasks used for animal cell cultivation.
- Protein Production by Anchorage Dependent Mammalian Cells:
  - Worked on the development of polystyrene macroporous bead system for large-scale production of recombinant proteins by anchorage dependent mammalian cells.
- Method Development:
  - Developed a methodology to observe pH gradient in cell culture medium by employing confocal scanning laser microscope and a fluorescent dye.
  - Developed a method to measure live cell concentration in polystyrene macroporous beads.

9/1986 – 8/1991 **University of Western Ontario**, London, Ontario
PhD Student (Advisor: Prof. A. Margaritis)

- Drug Production by Fungus:
  - Developed medium and culture conditions for fungus *Beauveria nivea* to increase the production of an immunosuppressant drug, Cyclosporin-A, used by organ transplant patients to avoid immune-rejection of transplanted organs.
- Method Development:
  - Developed a substrate-feeding strategy to increase the Cyclosporin-A production in the bioreactor using in-situ NADH fluorescence signal. By this method, Cyclosporin-A concentration was increased 10 times.
- Patent:
  - A patent application was filed for this procedure.
- Lecturer (9/1990 – 4/1991):
  - Taught two courses of 4th year BSc in Department of Chemical and Biochemical Engineering, entitled, "*Biochemical Separation Processes"* and *"Biochemical Process Technology"*.
- Teaching Assistant (9/1986 – 12/1990)
  - Second and third year courses in Chemical Engineering and fourth year courses in Biochemical Engineering with following duties: helping students in solving problems, assisting in laboratory set-up and marking assignments and laboratory reports.
  - Supervised, guided and taught laboratory techniques to one BSc student and two high school students on three different projects.

9/1983 – 8/1986 **University of Ottawa**, Ottawa, Ontario
MASc Student (9/1984 – 8/1986) (Advisor: G. André)
University of Québec, Institut Armand-Frappier, Laval, Québec

- Cellulase Production by Fungus:
    - Developed culture conditions and fermentation strategies to increase the production of cellulose enzyme from *Trichoderma reesei* using wood as a substrate.
- Technician (9/1983 – 8/1984):
    - Worked on optimal removal of lignin and hemicelluloses from wood by sodium hydroxide treatment to expose cellulose to the given organism for cellulose production.

Education

1992 **University of Western Ontario**, London, Ontario, Canada
PhD Chemical and Biochemical Engineering. Advisor: Prof. A. Margaritis
Research Thesis: Fluorosensor controlled fed-batch production of Cyclosporin-A from *Beauveria nivea*.

1987 **University of Ottawa**, Ottawa, Ontario, Canada
MASc Chemical Engineering. Advisor: G. André
Research work was conducted at University of Québec, Institut Armand-Frappier, Applied Microbiology Research Centre, Laval, Québec, Canada
Research Thesis: Cellulase production from lignocellulosic material by *Trichoderma reesei*.

1983 **University of Waterloo**, Waterloo, Ontario, Canada
BASc Chemical Engineering.
Degree obtained through Co-Operative program that combines academic learning and work experience through a series of alternating academic and work terms.
Project Title: Time-temperature history of an injected tube for pyrolysis reactor.

Awards

Following Scholarship was achieved in **Post-Doctoral Program**

- Visiting Fellowship, NSERC, at BRI, Montreal, PQ: 1996

Following Awards and Scholarships were achieved while at **The University of Western Ontario**, London, Ontario

- E.G.D. Murray Biochemical Engineering Research Award: 1991
- Ontario Graduate Scholarship: 1990
- Ivan Malek Biochemical Engineering Research Award: 1990
- Graduate Teaching Assistantship: 1986-1990
- Graduate Research Award: 1989
- Special University Scholarship: 1986, 1988, 1989
- Graduate Entrance Scholarship: 1986

Following Awards and Scholarships were achieved while at **Waterloo Collegiate Institute**, London, Ontario

- Awards of Merit in Mathematics I and II and Electricity: 1978
- Waterloo Collegiate Scholarship: 1978

Invited Speaker

- *"One-Step Protein Refolding"* GBF, Braunschweig, Germany, May 18 (2000)
- *"Cellulase Production in a Solid-State Bioreactor"* Institute's Biotechnology Seminar Series, University of Minnesota, St. Paul, March 7, 1996.

Other Skills

Project Management Skills

Proficient in preparing Gantt Charts and monitoring project tasks and resources to make sure the project is completed as scheduled (using MS Project).

Management Course

2009 *"Mediating Conflict"*.
2001 *"Human Elements in Management"*.
2001 *"Conducting Effective Meetings"*.
1998 *"Management of R&D Projects: Course 508-2E –Project Management"*.

Computer Software and Languages

Able to run most of the software applications and proficient in Web design in HTML and CSS.

Techniques in Molecular Biology

1993 University of British Columbia, Biotechnology Laboratory, Vancouver, BC
Instructor: Dr. L.J. Escote-Carlson
DNA and RNA purification, gel electrophoresis, blotting procedures, cloning of genomic DNA restriction fragments, DNA sequencing by dideoxy chain termination method, immuno-detection of specific proteins by Western blotting, and amplification of specific DNA sequence by polymerase chain reaction (PCR).

Engineering Process Design and Economics

1995 *Economic Analysis for the Production of Cellulase Enzyme in Liquid- and Solid-State Fermentation.* Report prepared for Ministry of Natural Resources, Government of Québec, Canada.
1995 *Preliminary Economic Feasibility Study of Bioprocess for Single-Cell-Protein (SCP) Production from Lignocelluloses.* Report prepared for Institut Armand-Frappier, University of Québec, Laval, Québec.

Work Experience through BASc CO-OP Program

9/1982 - 12/1982 **Bristol-Myers**, Toronto, Ontario.
1/1982 - 4/1982 **Doloro Stellite**, Belleville, Ontario.
5/1981 - 8/1981 **Environment Canada**, Hull, Québec.
9/1980 - 12/1980 **Inco Metal**, Copper Cliff, Ontario.
1/1980 - 4/1980 **Inco Metal**, Copper Cliff, Ontario.
5/1979 - 8/1979 **Chembond**, Toronto, Ontario.