Graduate Program in Molecular Biosciences and Bioengineering

History

The Department of Molecular Biosciences and Bioengineering (MBBE) was established in 1999 as a result of a reorganization within the College of Tropical Agriculture and Human Resources (CTAHR). Most faculty in MBBE came from three original CTAHR departments, Plant Molecular Physiology (PMP), Environmental Biochemistry, and Biosystems Engineering. Among these three departments, only PMP had a graduate program that offered both PhD and MS degrees. The PMP Graduate Program started in 1985 and focused primarily on plant biology and biotechnology.

After the formation of the MBBE department, the PMP Graduate Program was reorganized, expanded, and renamed as the Graduate Program in Molecular Biosciences and Bioengineering in 2000. The scope of the MBBE Graduate Program was widened to include molecular biology, biochemistry, bioinformatics, cell biology, biotechnology, and bioengineering aspects of plant science, tropical agriculture, aquaculture, environmental bioremediation, bioengineering, and biomedical sciences.

With the expansion of the scope of the graduate program, many other faculty from other UHM departments and scientists from other scientific institutes in Hawaii joined the MBBE Graduate Program as co-operating and affiliate graduate faculty. The number of students also started to increase over the years. A new set of guidelines and requirements has been developed to maintain a high standard of the program. Currently, many MBBE graduate students are supervised by faculty from John A. Burns School of Medicine, Cancer Research Center, Pacific Biomedical Research Center, Queens Medical Center, Hawaii Agricultural Research Center, Oceanic Institute, Sea Grant College Program, School of Ocean and Earth Science and Technology, College of Engineering and several departments including Microbiology, Zoology, Human nutrition, Food and Animal Sciences, and Plant and Environmental Protection Sciences. Thus, MBBE became an interdisciplinary graduate program involving tropical agriculture, natural sciences, engineering, and biomedical sciences.
Graduate Program in Molecular Biosciences & Bioengineering (MBBE)

The Molecular Biosciences and Bioengineering (MBBE) graduate program offers both MS and PhD degrees. The MBBE research and graduate training center around understanding the biochemical, nutritional and molecular-biological processes that underlie growth, development, photosynthesis, and stress, especially as related to tropical agriculture, aquaculture, plant and environmental biotechnology, biomedical science and bioengineering. Many MBBE graduate students are supervised and supported by cooperating and affiliate graduate faculty from John A. Burns School of Medicine, Cancer Research Center, Pacific Biomedical Research Center, Hawaii Agricultural Research Center, Sea Grant College Program, School of Ocean and Earth Science and Technology, College of Engineering and several departments including Microbiology, Zoology, Human nutrition, Food and Animal Sciences, and Plant and Environmental Protection Sciences.

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School of Ocean and Earth Science and Technology, College of Engineering and several departments including Microbiology, Zoology, Human nutrition, Food and Animal Sciences, and Plant and Environmental Protection Sciences. Thus, MBBE became an interdisciplinary graduate program involving tropical agriculture, natural sciences, engineering and biomedical sciences.

Entrance Requirements

- Minimum qualifications for admission as a regular student are an undergraduate degree from an accredited U.S. college or university or equivalent degree from a recognized foreign institution of higher learning and a GPA of at least 3.0 on a 4.0 scale.

- All prospective students must submit scores from the GRE General Test. In cases where foreign students encounter difficulty in taking the examination, submission of scores may be delayed with permission of the Graduate Division. Foreign students must also submit TOEFL scores (see Graduate Bulletin for exceptions). A minimum TOEFL score of 100 in internet-based test is required.

- All applicants are expected to have completed courses or equivalents in physics, chemistry, basic biology, genetics, biochemistry, physiology and one additional upper division course in cellular or molecular biology. While not a requirement, physical chemistry is highly recommended. Students may be accepted with deficiencies in one or more of these areas, however deficiencies must be made up during the first year as a graduate student. Such courses may not be used for graduate credit.

General guidelines and requirements for PhD degree in MBBE

1. A temporary committee: Graduate Chair appoints a temporary committee for each PhD student. The committee comprises the student’s supervisor (major advisor), Graduate Chair, and a faculty member. The committee advises on course work and other academic and research related matters.

2. Course work. Students are required to take a minimum of three high-level courses and MBBE401 (Molecular Biotechnology). The courses must be pre-approved by the major advisor and Graduate Chair. Graduate students are encouraged to take one credit seminar (MBBE 610 or equivalent) each academic year. They require at least two seminar credits for PhD degree. The dissertation proposal or defense seminar cannot be used to meet this requirement.
3. **Two-page proposal.** Students need to discuss with their major advisors about their research projects and write a two-page proposal. The proposal must be submitted to the Graduate Chair within the first semester. The proposal should have the following sections: (i) Introduction (background and justification), objectives, and approach. A sample proposal is attached at the end of this section. If the scope and objectives of the project are changed or modified later, the temporary committee should be informed and a copy of the revised proposal should be submitted to the Graduate Chair.

4. **Qualifying exam:** PhD students have to take a qualifying exam within the first, second or third semester. As a part of this exam, students are asked to write a manuscript from the results obtained within the first one or two semesters.

5. **Permanent committee:** After completing the qualifying exam, a PhD student can form a permanent committee in consultation with his supervisor and the Graduate Chair.

6. **Presentation in a symposium:** Students are encouraged to make a poster presentation in the CTAHR symposium in the first year. They must make a presentation the CTAHR symposium or another UH symposium in the second year and should continue to make presentations in subsequent years until graduation.

7. **Other presentations:** Students are encouraged to make oral and poster presentations in other national and international conferences. A number of travel scholarships are available from the Graduate Student Organizations. Often the supervisors provide funds for student travel. Students can also make presentations in a number of research symposia organized at the UHM campus. These include Tester Symposium, Microbiology Symposium, and BioMed Symposium.

8. **The first manuscript:** Students should try to complete the manuscript that was started as a part of the qualifying exam and get it published as soon as possible.

9. **Committee meetings:** Students should meet at least once a year with the committee.

10. **Proposal seminar:** There should be frequent discussion between the student and the major advisor about the progress and direction of research. When a student and the major advisor both agree that the project is going well and there are some good data, the student may be allowed to write a full proposal and then present a proposal seminar. All graduate faculty and students are invited to the proposal seminars.
Seminar notice must be posted in appropriate places in the department and other important places one week before the seminar. Seminar notice must also be sent by email to all MBBE graduate faculty and students. A proposal seminar must not be delayed beyond three years. If it is delayed beyond three years, the Graduate Chair will discuss with the committee and consider transferring the student to the MS program. Please see below for guidelines on how to present a proposal seminar.

11. **Revision of dissertation proposal.** Sometimes, a project may not go as expected and run into unexpected problems. Under such a situation, the project may have to take a new direction and some of the objectives may have to be modified. The student should invite a committee meeting and present a revised proposal.

12. **Comprehensive exam:** It is an oral exam given by the committee and the Graduate Chair. The Graduate Chair or a representative appointed by him serves as the moderator for the exam. The committee will ensure that the student has learnt molecular biosciences or bioengineering and mastered the subject well. The comprehensive exam must not be delayed beyond three years. If it is delayed beyond three years, the Graduate Chair will discuss with the committee and consider transferring the student to MS program.

13. **Review of literature:** The students are encouraged to conduct an extensive literature review related to his/her research subject. He/she should discuss with his/her supervisor about the main focus of the “review of literature” chapter of his/her dissertation. This must be completed and forwarded to the committee within the first three years.

14. **Publications:** Publications are essential requirements of a PhD degree in MBBE. Students are encouraged to publish several papers in refereed journals. There must be at least one publication as the first author in a standard refereed journal. Only under an exceptional situation, where research subject is very problematic, and the supervisor assures and convinces the committee and the Graduate Chair that a publication in forthcoming, a student may be considered for graduation without a publication on the day of defense. Please see below to understand how the “Department of Molecular Biosciences and Bioengineering” address should appear in the publications.

15. **Submission of dissertation to the committee:** Students are encouraged to write and submit the ‘Review of Literature’ chapter to the committee well in advance, preferably one year before submitting the complete dissertation. They can also write the chapters ‘Introduction’ and ‘Materials and Method’ in advance. All chapters of the dissertation must be first submitted to and corrected by the major advisor before submitting to the
rest of the committee. The committee members may refuse to read the chapters if these were not previously read, corrected and approved by the major advisor.

16. **Final dissertation defense**: The final dissertation defense seminar is perhaps the most important event for PhD. Therefore, a student must prepare well for this presentation. A student must get approval of the major advisor and the committee for presenting a defense seminar. The Graduate Division must be notified in advance by the student through the Graduate Chair about the date, time and place of dissertation defense. Graduate faculty and students must be invited to the defense seminar. Please see below for the general guidelines on preparing a dissertation/thesis defense announcement flyer and presenting a defense seminar in MBBE. Seminar notice must be posted in appropriate places in the department and other important places one week before the seminar. Seminar notice must also be sent by email to all MBBE graduate faculty and students.

17. **Citing “Department of Molecular Biosciences & Bioengineering” in publications**: Students who work under the supervision of co-operating or affiliate Graduate Faculty in a laboratory outside of the MBBE department should also cite “Department of Molecular Biosciences & Bioengineering” in their publications, at least as the second address. In this case, the address and affiliation of the supervisor’s laboratory can be the primary address. For example:


\(^1\), Hawaii Agriculture Research Center, Aiea, HI 96701

\(^2\), Department of Molecular Biosciences and Bioengineering, University of Hawaii at Manoa, Honolulu, HI 96822
List of approved courses for MBBE graduate students

All graduate students are encouraged to take MBBE 401 Molecular Biotechnology or an equivalent course as a prerequisite. The 600-level courses can be selected from the following list of courses. Students can select other courses after obtaining approval from the committee and the Graduate Chair.

400-level courses:

MBBE 401 Molecular Biotechnology  
MBBE402 Principles of Biochemistry  
MBBE405 Marine Genomics and Biotechnology  
MBBE406 Cellular Biology  
MBBE412 Environmental Biochemistry  
MBBE483 Introduction to Bioinformatics Topics for Biologists

600-level courses

MBBE 601 Molecular Cell Biology  
MBBE 620 Plant Biochemistry  
MBBE 621 Metabolic Engineering  
MBBE 625 Biosensors: Principles and Applications  
MBBE 651 Signal Transduction and Regulation of Gene Transcription  
MBBE 680 Methods in Plant Molecular Biology  
MBBE 683 Advance Bioinformatics Topics in Biology  
MBBE 687 Advanced Lab Techniques  
BE 604 Aquaculture Systems  
BE 606 Instrumentation and Measurement  
BE 622 Experimental Methods in Cause-Effect Modeling  
BE 625 Biosensors: Principles and Applications  
BE 634 Biological Treatment  
BE 638 Biosystems Modeling  
BE 648 Biosystems Simulation  
BE 660 Bioseparation processes  
CHEM 633 Molecular Spectroscopy  
PEPS 646 Plant Bacterial Interactions  
PEPS 630 Plant Virology  
PEPS 681 Pesticide toxicology  
BOT 674 Plant Growth and Development
BOT 669 Molecular Systematics and Evolution
CMB 621 Cell Molecular Biology I
CMB 622 Cell Molecular Biology II
CMB 680 Molecular Genetics
MICR 671 Advanced Microbial Genetics
MICR 632 Advanced Microbial Physiology
MICR 625 Advanced Immunology
TPSS 604 Advanced Soil Microbiology
TPSS 614 Cellular Genetics of Crops
TPSS 640 Tissue Culture
OCN 653 Methods in Microbiology Oceanography
Guidelines for preparing a proposal seminar

1. **What is the main idea of your research?** Immediately after the title slide, the main idea must be presented in a simple language, so that everyone in the audience can understand what the research is about. Here you describe what the overall goal is and what you want to invent, discover or develop.

2. **Next, you must give a good justification for your research.** Why is this research important? Why do you need to invest your time and public funds for this research?

3. **What is already known?** You are not required to provide an extensive review of literature. However, you must tell briefly what is known in this field.

4. **What is not known?** After telling briefly what is already known, you have to emphasize what is not known. This should connect you with the specific objectives.

5. **Hypotheses:** You may present your hypotheses here or tie them together with specific objectives (below).

6. **Specific objectives:** Generally, there should be two or more specific objectives. Three is a good number.

7. **Specific objective 1.** Describe how you will accomplish this. Show flow charts if needed. Explain briefly important methods and experiments for this objective.

8. **Specific objective 2.** Describe in the same way as for objective 1.

9. **Specific objective 3.** Describe as for objectives 1 and 2.

10. **Progress to date:** Describe your results so far for each of the objectives. You may not have results for all objectives. You must present convincing results for at least one objective (see below).

11. If you have a lot of results, show only the most important results. Discuss with your supervisor about your most important results. Other results must be available for presentation, if someone asks.

12. **Explain your results slowly.** Make sure that you provide interpretations of your results. Mere presentation of the results will not be enough. You have to explain what these results mean and how they relate to the objectives.
13. **Timetable for completion.** Show a timetable for rest of the experiments.

14. **Discussion with your supervisor:** It is essential that you show your slides and discuss with your supervisor at least one week prior to your presentation. It is also important to make the presentation before your supervisor and your colleagues in the laboratory. Listen to their criticism and try to improve your presentation. Your research subject may be very complicated and many in the audience may not understand some details or certain slides. However, all scientists and MBBE graduate students who come to attend your presentation must be able to understand the main idea and the important points.

**Guidelines for preparing MS/PhD Defense seminar**

Seminar notice must be posted in appropriate places in the department and other important places one week before the seminar. Seminar notice must also be sent by email to all MBBE graduate faculty and students.

For both proposal and defense seminars, you may assume that people in the audience have at least a BS degree and some background in biological sciences. That does not mean that everyone will be able to understand everything you present. There can be some high-level experiments that can be understood only by people trained in your research area. However, you should make the best efforts to make at least half of your presentation understandable to most people in the MBBE audience. It does not matter whether you are working on bioinformatics, cancer research, bioengineering, plant molecular biology or any other branches of molecular biosciences or bioengineering, you have to make at least 50% of your presentation understandable to most people in the audience. The following are the guidelines for preparing a defense seminar.

1. Discuss with your supervisor. He/she will help you to make difficult things easy.

2. As you progress in your research, try to make as many presentations as possible, keeping in mind that you are preparing for your final presentation.

3. Explain to your friends, parents, colleagues and others, whenever possible, what your work is about.

4. Do not show too many slides in your final presentation. If you have too many results, you do not have to present all. Present only the most important and most relevant results. Again, discuss with your supervisor about it.
5. Make a powerpoint presentation in front of your supervisor and your lab colleagues at least 10 days prior to your final presentation. Ask them for criticism and try to improve. If necessary, make another presentation before your supervisor 3-4 days prior to your final presentation.

6. **Title slide and a summary preview:** After reading the title, give a well-prepared speech for about 3-5 min describing in simple language what your research is about. Some points that can be addressed here are: how this research started, the most important findings (without details), benefits of these findings, and most importantly how you gained insight, experience, and expertise in research. You have to express your excitement for your work. This is like giving a preview of your presentation in simple words. This will make the audience interested in your presentation. This will also serve as a warm-up for your data presentation.

7. **The problem.** Describe the problem that your research addressed in one or more slides.

8. **Justifications for your work:** Why did you invest 3-5 years of your life for addressing the above problem? Why are these time and money investments justified? (at least one slide).

9. **What was already known when you started?** You may show a number of slides to present a brief review of literature. Discuss with your supervisor about specifics. This must be short. The review of literature must not be dull, it must be connected well with the problem.

10. **Overall goal of your research** (one slide): State how you addressed the problem.

11. **Specific objectives:** Dissect the overall goal into specific doable objectives (one slide).

12. **Objective 1.** State the objective 1 and the associated hypothesis (one slide). At this stage do not rush. In about one min, try to give a simplified preview of the methods and experiments you conducted in this objective. You should have a well-prepared 1 min speech here. This will help to maintain attention of the audience on your work.

13. **Experiments in objective 1.** Using a number of slides, describe the experiments and results for objective 1. You may show short flowcharts to describe methods. Whenever you present some results with tables or graphs, give enough interpretations. Always try to connect results with the problem.
14. **Objectives 2 and 3.** Present in the same way as for objective 1. Do not forget to give a 1 min simplified preview of experiments for each objective before going into details.

15. At the end, remind the audience about the problem you wanted to address and how your results addressed some questions. Here again you need to face the audience and stop depending on your slides. Tell briefly (in about 1 min) the highlights of your work.

**Guidelines for preparing dissertation/thesis defense announcement flyer**

1. Take a page in landscape page set-up and divide into two columns. Then fold the paper into half. This will make four half pages (both sides) from a standard A4 size paper. You may use a slightly thick paper.

2. Write your announcement in the format shown in the attached page. Briefly, in the front page, write your dissertation/thesis title, your name etc. In the second page, write the names of your committee members, your publications and future plan. In the third page, provide an abstract of your dissertation/thesis. You may include manuscripts in preparation also under your publications.

3. Prepare this at least one week before the presentation, get your major advisor’s approval and send three copies to the Graduate Chair.

4. If you would like Graduate Chair to send these copies to your previous mentors and your biology or chemistry teachers who helped you to come to the MBBE Graduate Program, please provide their addresses.

5. Print it on color papers. Put on the notice board, send to different people as invitations and distribute copies at the time of presentation. Send copies to all those people whom you acknowledge in your dissertation/thesis.
ORAL PUBLIC EXAMINATION
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Functions of *mid* and *pyd* genes required for mimosine
degradation by *Rhizobium* sp. strain TAL1145

Jonathan David Awaya

2:15 PM
October 13, 2005
Agricultural Science Building, Room 219

Department of Molecular Biosciences and Bioengineering
University of Hawaii at Manoa
COMMITTEE MEMBERS

Dr. Dulal Borthakur (Chair)
Dr. Sean Callahan
Dr. Tung Hoang
Dr. John Hu
Dr. Qing Li

PUBLICATIONS

2. Awaya J, Fox PM and Borthakur D (2003) Genes encoding a fructose-1,6-bisphosphate aldolase and a fructose-1,6-bisphosphatase are present within the gene cluster for mimosine degradation in *Rhizobium* sp. strain TAL1145. Plant Soil 257: 11-18.
3. Awaya J, Walton C and Borthakur D. The *pydA-pydB* fusion gene produces an active dioxygenase-hydrolase protein in *Rhizobium* and *Escherichia coli* that degrades 3-hydroxy-4-pyridone, an intermediate of mimosine metabolism (manuscript in preparation).

FUTURE PLAN

Postdoctoral research at Notre Dame starting on February 1, 2006
ABSTRACT

Mimosine and 3-hydroxy-4-pyridone (HP) are toxic aromatic compounds produced in tree-legume leucaena (Leucaena leucocephala). These can be degraded by some leucaena-nodulating Rhizobium strains, such as TAL1145. Previously, a cosmid clone, pUHR263, containing the mid and pyd genes for mimosine and HP degradation, was isolated from a clone library of TAL1145. The aim of this project was to identify genes for mimosine and HP degradation in pUHR263 and determine their functions. Mimosine degradation by Rhizobium involves at least two major steps; in the first step mimosine is degraded to HP, which is then converted to pyruvate, formate and ammonia in the second step. Two structural genes, pydA and pydB, encode a meta-cleavage dioxygenase and a hydrolase, respectively. pydA and pydB are required for degradation of HP, and pydC, pydD and pydE encode proteins of an ABC-transport system involved in the uptake of HP by TAL1145. pydA, pydB, pydC, pydD, and pydE are induced by HP, although pydA and pydB show low levels of expression in the absence of HP. pydA and pydB are cotranscribed while pydC, pydD, and pydE are each transcribed from separate promoters. pydR is located upstream of the pyd genes and encodes a transcriptional regulator for the activation of pydA and pydB in the presence of HP. Elucidation of the HP degradation pathway in Rhizobium sp. strain TAL1145 may provide a useful strategy to genetically engineer leucaena and rhizosphere bacteria to disrupt the biosynthesis of mimosine and for bioremediation of aromatic toxins, respectively.
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