Introduction to Research
Prof. Prathap Haridoss
Prof. Sathyanarayana N Gummadi
Department of Metallurgical & Materials Engineering
Department of Biotechnology
Indian Institute of Technology, Madras

Lecture – 43
Research in Bio Technology

Prof. Prathap Haridoss: Hello, it's our pleasure to have with us Prof. Sathyanarayana Gummadi. He is a Professor in the Department of Biotechnology, here at IIT, Madras. And, he has been with us here for over 15 years now. He has considerable experience in research and a lot of success in research. His areas of research include survival of microbes under extreme conditions and exploiting this aspect for industrial applications. He also looks at molecular and biochemical basis of phospholipid trans location in cellular membranes. So, these are 2 major areas of trust areas of research for Professor Gummadi. He has written several books, several chapters in various books.

He is also NASI Scopus Young Scientist Award winner in the year of 2012 in the field of Biological Sciences and this is given by Elsevier which is you know, body of a journal publication process which you know, which is where lot of scientists publish. He is also in the editorial board of several journals. So, you can see that you know he is very well qualified to discuss research with us in the area of Biotechnology and he has a lot of experience that would be very valuable for us to learn from and listen to. So, thank you for joining us.

Prof. Sathyanarayana N Gummadi: Thank you.

Prof. Prathap Haridoss: So so, let me begin by asking you this general question, in biotechnology are there areas that are considered traditional areas of research which perhaps have been there for a while, where you know if you do a search you will see a lot of literature already existing and so on?

Prof. Sathyanarayana N Gummadi: I think in Biotechnology has evolved from 2 basic disciplines in the country. So, one is from engineering if you say, it came from Chemical

Engineering. Traditional area of research in Chemical Engineering in terms of biotechnology is biochemical engineering, bioprocess engineering to develop process for production of certain metabolites cum industrial valued compounds. Which is replaced by a chemical process; just we want to convert chemical process into non-metallic friendly metabolites. That is one traditional way of approaching, researching from engineering point of view.

And from basic science point view, so biotechnology evolved in M.Sc. programs and B.Sc. programs where they have strong background in terms of Biochemistry, Molecular biology and Genetics. So, these 2 are the traditional areas of research which initially bio-tech started up in country. Now, it became highly multidisciplinary where it's been working with several fields of engineering and sciences in terms of research.

Prof. Prathap Haridoss: Okay and, in a similar sense I mean, are there you know specific areas that you feel are interesting to highlight as very recent areas of research in biotechnology where you know may be which has sort of gain prominence, might let us say the last 5 years or something like that.

Prof. Sathyanarayana N Gummadi: From industry point of view production of therapeutic proteins, monoclonal antibodies, vaccines, so the drugs for human diseases become a very prominent. So, a big technology has taken over from traditional microbial biotechnology to animal cell cultures and plant cell cultures for production of various drug molecules, so called as the reason term they give it is Biosimilars. So, Biosimilars means the compounds that are similar to what we have in our body.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: For example, for blood deficiency people you give Erythropoietin. So, Erythropoietin is what we have it our body.

Prof. Prathap Haridoss: Have it already in.

Prof. Sathyanarayana N Gummadi: In our body. So, we need to produce certain same compound, with the same structure in Vitro, using memorized cell culture.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: So, that's one of the recently taken over industry, industrial aspects of research where large investments are going on. Secondly, computational biology, people are working on developing new software's in terms of bioinformatics to find structures, structure of proteins, DNA molecules. So, which in turn helpful in making that target in term from bioinformatics. And, recently a very catchy what is coming up is large data analysis.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: Our institute is also very famous in working on large data analysis, big group working on it one. So, in which biotechnology place one of the major roles in large data analysis because there is a huge amount of sequence in data available from human genomes. So, which need to be analyzed and unless to find out, so what could be the probabilities in for disease and all that, so these are the new recent.

Prof. Prathap Haridoss: Very interesting I think, yeah. So, that shows how may be computing.

Prof. Sathyanarayana N Gummadi: Computing.

Prof. Prathap Haridoss: You know facilities are so critical.

Prof. Sathyanarayana N Gummadi: So, critical.

Prof. Prathap Haridoss: For and even you know computational techniques that people specialize in. So, even in biotechnology there's a lot of computation that is inherent to the successes.

Prof. Sathyanarayana N Gummadi: We have big computation group in our department and have very strong interaction between our department and computer science people.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: Doing a lot of projects.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: And, recently we hired an interdisciplinary faculty for this area.

Prof. Prathap Haridoss: OK. Very nice, very nice you know. So, let me also look at it, let us say, looking at it from the student perspective. When students come in here for, specifically for an MS or a PhD degree, if you see you know incoming students based on let's us say, the backgrounds that they have or the range of backgrounds they have and so on. Are there specific areas that you feel they face challenges in where they settle into an MS PhD program? Is the training that is there in traditional colleges that are out there adequate to prepare them for MS, PhD at least as they enter in here in biotechnology? Or you do see some specific you know lack in that they need to address or and if so, you know, how are they going about overcoming such thing.

Prof. Sathyanarayana N Gummadi: I think the new coming student they have lack of lot of hands on experience on newly experiments. So, especially in biotechnology all experimental people, so need to have lot of experience to handle lot of equipment's to do an accuracy. So, that is what lacking in them.

Prof. Prathap Haridoss: Okay and so, it's probably also got to do with, I think in biotechnology may be the requirement for you know say cleanliness and you know, thoroughness in an experiment is probably even more critical because may be our hands can themselves completely pollute sample.

Prof. Sathyanarayana N Gummadi: Sample.

Prof. Prathap Haridoss: So, you may not know what culture you know you are developing there if you not careful may be. So, I think then what you are suggesting is that you know, it's not just may be the ability to start an experiment in an experiment, but the rigger with which that experiment is framed. So, that is something that is people are lacking, as they come in okay. So, are there some you know special courses that you run which particularly to address this. I mean, how do you alert the student that you know their sort of deficient in these? And how do you you know bring them up to the standards that you feel are required?

Prof. Sathyanarayana N Gummadi: So, I think most of us train them in the first one year while they do course work and all that. So, they undergo with some seniors in research scholars and do preliminary experiments. So, we make sure that, they are well equipped to carry out experiments in their own labs. Now, what we expect them to do.

Prof. Prathap Haridoss: Ok ok.

Prof. Sathyanarayana N Gummadi: So, first year majorly we do out time for them to do this.

Prof. Prathap Haridoss: Of course, I mean as you already mentioned that you know there are you know may be specific industries that are looking at what research you do and so on. Of course, at the same time there is some times this impression that an MS degree or a PhD degree has a tendency to come across as being very academic, in the focus because that is how we go about it. Because that level of you know focus and concentration is required to get to carry out research. And, sometimes also a MS and PhD research is on some cutting edge activity which may be the society might benefit a little later from, it may not be like you know is not directly beneficial for them. So, in this scenario, where do you see the industry fit in? How interested are they in what are the current research activities in the field? Or how far you feel they are behind or how far they you feel in line with whatever are going on in the high and research in biotechnology?

Prof. Sathyanarayana N Gummadi: So, to be frank the number of industries biotech available now is much less compared to other fields.

Prof. Prathap Haridoss: Okay Is that just a Indian thing or internationally you also see that.

Prof. Sathyanarayana N Gummadi: Internationally also.

Prof. Prathap Haridoss: Internationally also, OK ok

Prof. Sathyanarayana N Gummadi: Because, it involves high investment to do and the success of the industries also, probability of getting success is also very low.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: Because, most of the thing formal drugs you screen it, do clinical trials and get it to a compound it takes so much investment.

Prof. Prathap Haridoss: So, much investment time and so many regulatory aspects.

Prof. Sathyanarayana N Gummadi: Regulatory aspects. So, especially in those kinds of industries people look for very specific training.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: ; Like Protein expression, how to make potassium, how to make strain improvements, down streaming processing. So, job aspects in those areas are good. For example, in our department students have finished in bio process engineering, so that job placements are better compare to fields from other areas were people have to go for post doctoral training, get more experienced in this one. Then chances of getting good jobs are high. This is so very wide and interdisciplinary, that is the problem. So, people has to, some industry needs a person to be trained on that area.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: So, based on that PhD problem and then post doctoral training, might suit to that company.

Prof. Prathap Haridoss: So, do you see students also I mean given that they are doing something totally new and interesting with respect to maybe you know, aspects that can be used in human systems and so on. Are there people opening you know, are there people who are opening their own companies after they graduate, do you see enough of an entrepreneurial you know element in this field or you think again as you said investment is too high and may be therefore, it's not possible what do you.

Prof. Sathyanarayana N Gummadi: I think 3-4 student start up entrepreneurship in our department, in collaborating with the faculty.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: So, they are in initial stages.

Prof. Prathap Haridoss: Ok.

Prof. Sathyanarayana N Gummadi: So, mostly they are making like of sensors, so devices to find out, to investigate some aspects especially in case of disease, how to find out.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: A person is having a disease or not. So, diagnostic kids and more success store in our department is from B. Tech group. So, they started Sea6 Energy, an energy based company.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: From seaweed they make energy.

Prof. Prathap Haridoss: OK ok.

Prof. Sathyanarayana N Gummadi: So, that is more successful and well established company.

Prof. Prathap Haridoss: OK ok.

Prof. Sathyanarayana N Gummadi: In our department now.

Prof. Prathap Haridoss: Ok So, so there is an element also.

Prof. Sathyanarayana N Gummadi: There is an element.

Prof. Prathap Haridoss: And, most of the other students I mean sorry, some amount go to the industry, after that is you are saying that very dependent on their research topic and saying some are opening entrepreneurial ventures. What about you know academia I mean, are there enough positions in academic you know institutions in let's say, in India that MS, PhD students could go to? Because that's normally where many seem to go and that's where they have decided also, many of the other departments, in your case what do you see that?

Prof. Sathyanarayana N Gummadi: There are lots of openings.

Prof. Prathap Haridoss: Lots of openings.

Prof. Sathyanarayana N Gummadi: Lots of openings for academic positions. People who ask for academic position are better to have more publications during the PhD one.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: And, Postdoctoral training abroad is highly preferential to get in good places.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: Then come back and join us as a better way in biological department.

Prof. Prathap Haridoss: Ok ok. So, that's the sequence that you are recommending something.

Prof. Sathyanarayana N Gummadi: Recommending students to come back and (Refer Time: 12:14).

Prof. Prathap Haridoss: Come back and Ok. And, let me ask you let's say something about you know, how you look at progress and research? So, because you have now I mean you have won several awards and so you have been very involved and you are also seeing all these journal from much, much close perspective because you are in the editorial board and so on. Generally, we look at you know the progress of students and as you mentioned you know, the number of publications and good channels and so on. Are there any other ways in which you feel you can gage the progress of a research student? Because, this research is such a different setting than say course work where it is very clear, there is an exam, there is grade, you get the grade and people say you did well or did not do well. But, in research, what all do you look at as when you see your students and you feel that this person is going as a researcher?

Prof. Sathyanarayana N Gummadi: The first thing that I recognized is that, whether a student is sending me a paper to read.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: Saying that this platform is paper interesting. So, I

can use this one.

Prof. Prathap Haridoss: OK ok.

Prof. Sathyanarayana N Gummadi: That is the first symptoms that he is into this field.

Prof. Prathap Haridoss: Oh Very nice. OK.

Prof. Sathyanarayana N Gummadi: So, he is thinking about the problem and trying to do it making self dependent on his work.

Prof. Prathap Haridoss: And, then make some judgment on the paper that is interesting to read and all that .

Prof. Sathyanarayana N Gummadi: On the paper that is interesting to read in all that. That's the one kind of evaluation I do. Second thing is that, do people come back with entirely new different way of experiments. We have regular set of experiments to do in our research.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: So, people will come; OK, let me try something else.

Prof. Prathap Haridoss: Some different ideas have to probe something.

Prof. Sathyanarayana N Gummadi: Different idea different have to probe this thing, sometime. So, that makes really expand our research area.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: Some of my students did like that. So, mostly from engineering and now I am becoming mostly a biological.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: Research in biological sciences is going there. So, that helps in them whether, they are on the right track.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: Progressing themselves and some of them even says that shall we write a grant for this one, I assist you.

Prof. Prathap Haridoss: Ok Very nice. So, they have really thought much more, they are getting confidence.

Prof. Sathyanarayana N Gummadi: Confidence in this one.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: So, there are some people I found then I made a routine in the lab that students when coming to third year, final year should make 1 rough draft of a person and give it to me.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: On his area. Then will see try it correct so, we will submit it. So, that helps them in recommendation later also, he is capable of thinking.

Prof. Prathap Haridoss: OK ok ok .

Prof. Sathyanarayana N Gummadi: I think research apart from publications, so looking at their behavior, how well they maintain the observation book, data.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: So, meeting guide regularly or not. So, some student will regularly meet, everyday or twice in a day and come and show the results, what to do? These are some of the things that we evaluate that.

Prof. Prathap Haridoss: Ok In fact, I mean since you mentioned about student meeting regularly, what you think is a good frequency with which people should be meeting their guides and that is a change with time in their program? What what would you suggest?

Prof. Sathyanarayana N Gummadi: So, in my lab I daily meet them.

Prof. Prathap Haridoss: Meet them daily, fine.

Prof. Sathyanarayana N Gummadi: Daily meet them and see them.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: So, I think in this will, that is better have a daily contact and see you, what's happening and what's going in?

Prof. Prathap Haridoss: Great. So, let me sort of, I mean wind up this discussion with the one more general question for you, what advice would you gave to a student whose is aspiring to join an MS or a PhD program in biotechnology?

Prof. Sathyanarayana N Gummadi: First advice will be not technical this is general advice to any student.

Prof. Prathap Haridoss: Sure.

Prof. Sathyanarayana N Gummadi: First students should try to become a team member in a group, whatever he is trying. That's more important.

Prof. Prathap Haridoss: More important.

Prof. Sathyanarayana N Gummadi: So, that makes his life comfortable here and this is one of the parameter which is asked by all post doctoral positions or in any company, any where do it, whether the person is a team player or not.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: So, that is the first thing that they should learn in this program when they join.

Prof. Prathap Haridoss: Great, great, yeah.

Prof. Sathyanarayana N Gummadi: Second is to identify a problem as quick as possible.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: As quick as possible and make lab record book, observation book very clearly. Whatever they do, even if your experiment is fail that, they should mention as fail.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: When it comes so results. Data handling should be very powerful, that is very important nowadays because people say that this property is wrong, this is wrong, you have to prove them.

Prof. Prathap Haridoss: Yes, yes.

Prof. Sathyanarayana N Gummadi: Or they will say false data or something like that.

Prof. Prathap Haridoss: Yeah, yeah.

Prof. Sathyanarayana N Gummadi: So, the storage of data is very important, raw data's

everything.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: That they have to maintain and they should give a copy to guide and they should also keep reserve that copy for themselves. So that, any issues come it should be maintained up. Third is that they should be very systematic.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: So, systematic in the sense, kind of making a regular timing, coming to lab to work on these things. So, I think this will make them.

Prof. Prathap Haridoss: Okay So, these are things that they should tell themselves that you know these are the kinds of habits I should develop if I want to become a good researcher in I any field, but including biotechnology. Particularly, some of these things you feel are you know a very particular to biotechnology. And, I appreciate the point on being a team player because I think especially when people read for exams may be they have a tendency to read on the own or something and then they have to get use to being a team player and it helps them, it helps the other and in all ways it works very smoothly, yes.

Prof. Sathyanarayana N Gummadi: Also then, don't even talk their own lab people about their problem.

Prof. Prathap Haridoss: Their problem, OK.

Prof. Sathyanarayana N Gummadi: Should talk to that member or other lab members.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: So, more you talk you get quick solution.

Prof. Prathap Haridoss: So, internal communication is as important as the external communication.

Prof. Sathyanarayana N Gummadi: External communication. It is very important and reading up literature is very important.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: Make update on that field. You know, there are many websites where you can click it every week, you get updates what are the papers published on that area.

Prof. Prathap Haridoss: OK.

Prof. Sathyanarayana N Gummadi: Keep reading it up and have broad knowledge on the field is very important. So, that makes them successful in the carrier.

Prof. Prathap Haridoss: OK. Thank you Professor Gummadi, it is a pleasure that we could have you here and I think a lot of insight you have given which is very I think you know, very interesting to look at and I think a certainly students work you know new you are considering who do not know exactly, what they are getting into or what they may be getting into if they get into research. I think a lot of information you have shared will be very useful for them. Thank you so much for joining.

Prof. Sathyanarayana N Gummadi: Thank you for giving me an opportunity.

Prof. Prathap Haridoss: Yeah, sure.

Prof. Sathyanarayana N Gummadi: Thank you for that.