

The Backstage Story of My Auto-Reusable Fluoride Receptors

Dr. Suchibrata Borah*

Indian Institute of Technology, Bombay-400076

Email: suchibrata@iitb.ac.in

Before going to the depth of my story let me offer you a tour to my world (*even if you don't want to*). I am a 28 year old researcher (*age is important*). Currently I am in Indian Institute of Technology (*IIT*), Bombay working as a Post-Doctoral Fellow (*PDF*). I did my PhD in Chemistry from Tezpur University, Assam in 2017 and this is a story from my PhD time about a publication, which changed my perception towards research.

19 March 2015. A foggy morning. A very pleasant one for someone who can sleep upto 9 am and enjoy the slightest cold left after the winter. However, not a very enjoyable one for someone like me a so-called researcher who has to wake up at six in the morning to leave for UV slots. Oops, I forgot I may have to describe what an UV slot is, right? An UV-visible spectrometer machine is an instrument that helps us to understand about the energy levels of a molecule and how it interacts with other molecules (*do not tell me that you don't know what a molecule is!*). Now in our department we have only one UV-visible spectrometer, which runs without any tantrum (*I mean error*). So, particularly for that UV instrument crowd is always higher (*see, PhD is not only about how you perform. It is also, about how the instruments perform*). today I got slots from 7 to 11 am. Anyway, sadly today is my birthday and it sucks. Who on this earth goes to work before time on his/her birthday?

I reached my lab at 7 am and started working. It has been two years since I have joined here and until now, I got no publishable results. My guide himself is a confusing person or he

* Dr. Suchibrata Borah, Post Doctoral Fellow from Indian Institute of Technology, Bombay, is pursuing her research on "Water Soluble N-Heterocyclic Carbene based Catalysts." Her popular science story entitled "How I Met My Auto-Reusable Fluoride Receptors" has been selected for AWSAR Award.

only confuses me on purpose that I have never understood. After I joined PhD, I initially worked on metal-organic frameworks (MOFs). One and half years passed and I got no results. Then my confusing supervisor became more impatient than I did. He thought if I change my topic I might get results. Therefore, here I am working on fluoride recognition. Now a day anion recognition is an interesting field to invest on because after the discovery of crown ether compounds and their interaction towards anions, recognition of anions has become a vast area for researchers. From the green chemistry point of view also it is very exciting to study the different interactions of toxic anions (*here I am considering fluoride as the anion and I hope you know that excessive intake of fluoride has many severe health implications such as fluorosis and osteofluorosis etc.*) with receptors. A receptor is like a crab and anions are its prey. It catches the anion which is suitable from all the conditions such as size, pH etc. A more specific receptor is always a better one because that is how we can recognize a specific anion.

Fluoride receptors work via different mode of interaction. Among them hydrogen bonding is the most common and desired one (*hydrogen bonding is like a complicated relationship where an electronegative atom like N, O, F (I hope at least you know the meaning of these letters) etc. of a molecule are not directly attached to a hydrogen but attracted towards a hydrogen atom of another molecule or the same molecule from a different part and develops a relationship lesser intense than a direct bond*). I have already synthesized four molecules containing an oxime bond and trying to find out their interaction with nine different anions including fluoride. An oxime is a group having the bond pattern -N-O-H.

Knock knock. Someone opens the door. It is Monica. We joined in PhD together in same lab. But, I bet my supervisor likes her thousand times more than me. Do you know why? Because she has already published one article in Chemical Communication (*it is a very highly acknowledged journal*).

“Sir is asking for you Suchi” -she said

“Okay, coming in a minute”

Among the four receptors, two of it is showing good results. One receptor is highly active towards fluoride. One is totally inactive. I can explain why. There is difference in pattern though the structures are almost same. But, that is not the tough part. Problem is, results of the other two receptors are not conclusive.

“May I come in Sir”

“Please come in”

“Sir you called me?”

“Ooh yes. I wanted to know what is the result of your receptors. It has been 6 months since you have started working on these receptors. Clock is ticking Suchi. You don't have your whole life for PhD.”

Whenever my sir start talking about time, I wonder he has already forgotten his own struggle or he just pretend to forget that. “Manjhi the mountain man”-PhD trailer spoof released few days back. They said it right “Don't wait for your guide. Who knows he is waiting for you”

“Suchiiii.....?”

“Yes sir. I have already started writing manuscript for the first two receptors. However, results for the next two are inconclusive. I think they are not very good receptors. We should discard these two”

My supervisor is not very aged. He still has the urge for results and publications unlike few other faculties in my department. His eyes are more notorious than deep. He looked at me for few seconds.

“PhD is not only about working hard blindly and getting publications. It is about learning how to make strategies, schemes and proceed systematically. It is also about learning how to observe your results from different angles, which I don't think you have learned yet. Write the first manuscript quickly and figure out what you want to do about the other two. Now, go.”

Uuuggghhh. Why doesn't he understand that these two mysterious compounds are good for nothing. I came out of his chamber, went to the lab, sat on a chair and started thinking. Whenever a good colorimetric receptor recognizes an anion, it changes color. For example in my case it is colorless to yellow. After recognition, color remains days after days, months after months. It is like the crab's claw, it doesn't release its prey once caught. If you want to release it you have to put external force to get it back from the crab. In case of reversible receptors, you have to add external agents to get the receptor back. However, in my later two receptors, the color fades away after half an hour and become colorless automatically. I don't know why! Why? Why? Ooh may be because it doesn't need any external force for reversibility. All the UV data before fluoride addition overlaps with that of the receptor after half an hour of fluoride addition. Which means the attraction between the receptor and fluoride is not very strong as like the previous one. The presence of mild attraction force, suitable solvent works as the driving force for the receptor to release fluoride anion and thus gains its original structure. Therefore, when fluoride is added to the same used receptor solution for the second time, it regains color or we can say it detects fluoride again.

Yes. I may have found some logic behind the strange phenomena. I want to tell about it to my sir immediately. However, it is 5.30 already. I ran towards his chamber. He was closing.

“Sir, I need to talk.”

“Can we talk about it tomorrow?”

“No.”

Staring at me he said- “Okay..go on.”

I explained to him whatever understanding I had. He was quiet for a moment. Then he said-

“I think you have found the answers. We can name your special compounds auto-reusable receptors as they function on their own without any external agents. Gather all the information to support your claim and manuscript is all yours.”

“Thank you sir.”

Today I am the happiest person on earth. Not a very bad birthday I guess. Today I could also realize why our supervisors push us beyond our limits because they know we can do better. In PhD, you cannot stop trying because you will never know at what point success will come and touch your feet. Everyone has a different clock. So, keep trying.

In next four months, I collected all the data including UV-visible, FT-IR, Single crystal XRD etc. and completed writing the manuscripts. My paper containing the first two auto-reusable compounds got published in November 2015 in RSC Advances.

Reference: Borah, S.; Konwar, G.; Borborah, A.; Gogoi, N. *RSC Adv.* **2015**, *5*, 101701-101706.