
**Summary of the SIBC-Workshop
in Ratsherrensaal, Casino Basel, Basel / Switzerland
on July 7, 2009**

Participants of the panel were:

Franz Kaufmann, Ciba Spezialitätenchemie (now part of BASF); Manuela Avi & Hans-Peter Meyer, Lonza; Matthias Kittelmann, Novartis; Beat Wirz, Roche; Roland Wohlgemuth, Sigma Aldrich

**Part 1: Communication Barriers
moderated by Manuela Avi, Lonza**

Statements formulated by SIBC:

1. Academic research should primarily deal with research and not development (e.g. explore reaction types)
2. We need a global, open innovation platform
3. We need a global biocatalysis consortium

Do you agree with these statements?

- Consortium is a great idea if the right people meet. Europe is far ahead the US regarding a consortium, such a thing does not exist there. Academics are born to talk not to listen, but it is important to hear others. Industry doesn't bother to give the information needed by academia – the information given is either short term or very unspecific. He assures the audience that all chemical engineering students at his school have been introduced to biocatalysis
- 10 years ago strategic research was funded by industry, now funding is within specific targets in short time. How to establish long-term funding for strategic research?
- The technology is mature what is needed now are enzyme platforms, to be able to cope with time pressure.
- What is meant by consortium and what should it do? Only define problems or work on them?
- Industrial Biotech is not limited by easy access to cultures, does not see companies sharing collections. A consortium is not needed for the access of strains. Thousands of strains are available.
- A limitation with big companies is that there is a lack of knowledge regarding biocatalysis → Better education is needed.
- These days the vast majority of students gets exposed to the biological ways of doing things, e.g. biofuel discussions in public. Biological transformations cannot be overlooked anymore. It is the job of industry to remind academics about this fact.
- Academia should do R&D and not be involved in IP issues and they should work under process conditions / on larger scale (molar instead of mmolar)
- The invention rate in chemical synthesis is still high, if biology is not more active and faster, the ratio between chemistry and biocatalysis will remain constant.
- Biocatalysis competes chemistry, only the better process will win. Do we need large consortia to speed up innovation? Comment from M. Avi: the consortium is needed for exchange and not to speed up innovation
- Switzerland has a well structured innovation landscape: 1) Academia is responsible for innovation and publications 2) Fachhochschulen do applied R&D and IP, they have to generate income 3) Industry does applied R&D. Biology is chemistry and biocatalysis needs chemists. It is important not to force universities to work on special subjects, but industry should draw out what academia finds. E.g. all the "Omics" came from university.

Part 2: Technological Aspects moderated by Beat Wirz, Roche & Franz Kaufmann, Ciba Spezialitätenchemie/BASF

Questions formulated by SIBC:

1. Chemistry: Is biocatalysis still solving the right problems? Are there opportunities in peptide synthesis? What is the potential of biocatalysis in non-selective synthesis?
2. Biology: Does it take too long to find/taylor new enzymes? Is enzyme engineering affordable for industry in terms of costs and risk?
3. Interdisciplinarity: Why is real interdisciplinary work so rarely achieved? Is Academia too competitive?
4. Outlook: What will be the next big thing after biocatalysis? Will "synthetic biology" provide solutions for chemical synthesis?

Chemistry

- Biocatalysis will not work in non-selective synthesis. Oil is too cheap for non-chiral bulk commodities. You will have to convince the management to switch technologies.
- Process from acrylonitrile to acrylamide is a good example for the potential of biocatalysis in bulk chemical synthesis
- is pleased to see initiatives working on the synthesis from renewable resources as e.g. CLIB in Germany, no medical biotech. In Germany, research on renewables is funded, 50 % will be bioprocessed.
- Costs of enzyme / process is not the problem, the cost of raw material might be more problematic. "Very stable", "very active" is more difficult, but more important, in industrial biotech than in red biotech
- Products in feed, food, cosmetics, etc are non-chiral, so there are markets. Why not look more into polymerization, stereoselective C-C bond forming

Molecular Biology / Microbiology:

- What will the achievements of synthetic biology be? Now 5 years after metabolic engineering, where are the achievements?
- Development of biocatalysts is too long. A toolbox would be a solution or enzyme development should be applied to second generation processes, these are less time critical.
- Chemical process development is much faster, because biological systems are much more complex. In biology every little step in development is a problem. Predictability is generally missing. Development of biocatalyst is just the first step, the work starts afterwards => expression, reaction engineering, DSP have all to be addressed. Synthetic chemistry had the same problems 50 years ago, but developed a toolbox and methodology to solve these problems.
- Enzyme engineering cannot compete with chemistry in terms of development times
- Academia should be encouraged through funding to do more in enzyme platforms.
- Take a look at chemical papers, they publish on how to produce stuff in quantities and do not concentrate on kinetics, processes and 10% yields as biocatalysis does.
- We need robust and flexible processes that can be integrated in chemical processes
- Investigate successful biocatalytic processes: high expression levels, easy DSP... and concentrate on these topics. We cannot compete with nature => focus on relevant products
- We need to combine the best of both worlds; we have to come up with processes with chemical and biocatalytic steps.
- Do not distinguish methods – that is irrelevant. What counts is how we get somewhere

Interdisciplinarity/Interaction:

- Interdisciplinarity is a key issue in biocatalytic process development, industry has to provide interdisciplinarity in its working environment.
- Look at genomics: Interdisciplinarity is also present in academia, but what is industry looking for?
- Environmental issues are a chance for biocatalysis
- The universities must know what to search for.
- Such information exists: The enzyme list (published in Green Chemistry (?)), which was assembled by chemists of 6 companies.

Outlook

- “next big thing” is merging of bio- and chemocatalysis
- Synthetic biology comes down to HTP screening and might deliver new technologies. Some small molecules achievable by molecular engineering means ... (?)
- Synthetic biology offers opportunity to create new expression systems & regulate pathways => will have major impact in synthesis of chemical compound. It might deliver a toolbox and methodology.
- Companies want to produce chemicals in a cleaner way. Synthetic biology has a great potential here. Evolving an enzyme nowadays takes 3 months up to 1.5 years. The know how we have generated in this field in the last years will give a boost.
- Interdisciplinary work is key for success.
- Biodiversity should be used to find new activities and in addition we need a reclassification of wrongly classified enzymes.

Part 3: Economic Barriers **moderated by H.P. Meyer, Lonza**

- Brazil government has invested in biofuels in the 90s, today Brazil is leading in biofuels => why not invest public funds today? Why shouldn't the public fund biofuels?
- Biofuels will pave the way for an efficient infrastructure for biomass based products. Just like fossil fuels fostered the development of the petrol infrastructure
- Financing bio-based commodities only by industry would turn into a fundamental problem
- Funding for biobased commodities will be difficult, because there are still a lot of basic problems to be solved which require too much research for too cheap products. An alternative would be to work within "biocommodities" => nitrogen based commodities
- Public funds are limited => we have to focus on most urgent and interesting topics. In Europe we do not have the natural resources (e.g. land) to be compatible with renewables.
- Alternatives for fuels would make oil accessible for chemistry. The future would be a technology to utilize biowaste to produce biofuel. In Europe there is much discussion, less action, in the US there is much more action in this field. Europe has to move here.
- Europe is leading in delivering enzymes & materials for detergents and textiles => why not invest public funds?
- Focus should be given to fine chemicals and pharmacy. Without focus, investors do not know in what they invest, and they will not do so. In Red Biotech, the goal of investment is very clear.
- White biotech delivers on demand, the problem is finding suitable targets.
- To focus on topics, to tell people what to do or what not to do (e.g. EU projects) would not be a solution, because it would limit research => problem of motivation
- Major question is why are R&D expenses in biocatalysis so low?
- Why was textiles, paper, detergent industries not listed in the slides? Response: industrial biotech already established in those areas, listed were areas with more potential
- The list of "unmet synthetic needs" is the thing to work on, why not through a competition?

Cathy Kroll / Swiss Biotech Association

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