

Biotechnologies in the Czech Republic: current status, trends and challenges

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ABSTRACT

This review presents an overview of the current status of the biotechnology sector in the Czech Republic (CR), its future trends and main challenges. CR is the country that laid down the principal laws of heredity, introduced the contact lens to the world and successfully developed the compounds on which current anti-AIDS drugs are based. The history of Czech biotechnology is strongly associated with typical local industries such as beer and wine production. Research institutions focus traditionally on the plant and animal biotechnologies. Recently, biotechnology-related achievements have been oriented preferentially towards nanotechnology, pure biotechnology and human healthcare. The public biotech sector includes, above all, EU programmes. Since 2007, there has been a major investment in large EU-funded research infrastructures outside the Prague region to equalize the competitiveness in other regions (Brno, Olomouc) and to complement the existing research institutes. The private sector includes some global companies - Teva Pharmaceutical, Sanofi, Lonza Biotec and Gilead Sciences, among others. The local structure consists almost exclusively of small companies and only several middle-sized companies with a quite high orientation on the inland market. Recently, some clusters were established as platforms for exchanging information on the development of science and technology, identifying synergies and possible collaborations to address critical issues covering the full value chain from R&D to production in the fields of Czech biotech. The big chance for CR biotechnology is the technical crossover with biotech and other sciences, as a possible boost of bioinformatics-driven R&D&I due to very strong ICT in CR.

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Introduction and historical overview of Czech biotechnology

Czech Republic is the country that laid down the principal laws of heredity, introduced the contact lens to the world and successfully developed the compounds on which current anti-AIDS drugs are based. Nowadays, the investments in R&D in the Czech Republic are higher than in any other country of the former Eastern Block. The government also passed a series of important laws which give advantageous conditions to private companies spending money on R&D; among the benefits for companies deriving from this law is to deduct their R&D expenses from their tax base [1,2].

The Czech Republic counts more than 18 research institutes, which work primary in the basic research domain. There are also approximately 120, mostly small, companies which work in the life science domain. Although they are quite small, they cooperate

with foreign institutes, companies and universities. They employ mostly highly skilled researchers who have experience in their domain and often also experience abroad [3].

The history of biotechnology in the Czech Republic is strongly associated with typical local industries such as production of beer and wine. Nowadays, the Czech Republic is the largest beer producer in the world. The first written evidence about wine production on vineyards planted by Rome legions in Pálava mountains, South Moravia is dated in the year 276. In the year 1100, the first written evidence about Czech brewing was given by Vratislav II, the King. Most of the Czech breweries were founded in the twelfth century. In 1348, Charles University Prague, the oldest home for study of natural sciences in Czechia was established. In 1358, a king's decree on the wine production in the Czech lands was issued by Karel IV, the Emperor. In 1707, Technological University was established in Prague as the first technical university

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worldwide. In 1837, Jan Evangelista Purkyně formulated the cell theory. The principal laws of heredity were formulated in 1866 by Gregor Johann Mendel. In 1907, Jan Jánský discovered the four blood types. After World War II, some biotechnological industries were developed, such as production of penicillin (Roztoky), pharmaceutical and chemical companies Galena, Lachema, Rakona and many others. Most of these companies, after the Velvet Revolution (1989), were acquired by global biotech companies.

The two successful scientific inventions in the past in material and medicinal chemistry research in the Czech Republic mentioned above – Otto Wichterle's hydrogels as biocompatible materials and Antonin Holy's antivirals as the gold standard for treatment of numerous viral diseases today (AIDS, hepatitis B) – have been accidentally boosted by particular USA pharma companies to become the leaders in their respective markets. Nevertheless, these two extraordinary inventions did not initiate systematic transfer development of the lead compounds into proof-of-concept, preclinical or clinical trials [1,2,3].

Country priorities and trends in Czech biotech segment

The scientific and research institutions focus *traditionally* on plant and animal biotechnologies. In their supplementary activities, they apply their knowledge especially in medicine, pharmacy and in diagnostic biotechnologies. Private enterprises satisfy the demand for materials and services, especially in the industrial and microbial biotechnologies. In the industrial biotechnologies, the dairy and brewery industry branches are involved to a large extent of 90% in the specialized activities and with almost 50% in supplementary activities. Besides breweries and dairying, the field of Czech biotechnological private enterprises is quite evenly split into private enterprises focussed on biomedicine and pharmacy, environmental and plant biotechnologies. From another perspective, the fields of knowledge that have remained less exploited, both academically and in terms of potential technological transfer, are in animal biotechnology and in diagnostics [4,5].

Recently, biotechnology-related achievements have been oriented preferentially towards three areas: nanotechnology, pure biotechnology and human healthcare. Here, the Czech enterprises target primarily the world market, not the local one.

Nanotechnology is a promising Czech inventory sector, recently expanding from the traditional chemical

structures to biological materials (hyaluronic acid) with Contipro launch of a patented multi-nozzle system. Contipro is one of the world's leading manufacturers of hyaluronic acid and derived applications. Elmarco's Nanospider technology, a process for producing a range of organic and inorganic nanofibers, has scaled up from the laboratory to industrial production. These inventions brought already more than 50 patents and Czech nanotech companies are the world leaders today.

Elmarco Nanospider Technology was managed by the Nafigate Corp. This company is involved in another promising biotechnological project: original microbial biotechnology for conversion of waste frying oils into bacterial bioplastics called polyhydroxyalkanoates (PHA). The cooperation with the Faculty of Chemistry BUT resulted in patented and licenced biotechnology Hydral, which was globally awarded with numerous prizes such as Frost & Sullivan Technology Innovation Award 2015, Eastern European Business Elite Award 2016 etc. The technology is recently very close to pilot-scale operation, the pilot plant should be launched in the region of Central Europe. FCH in cooperation with Nafigate has recently developed several patents and applications of PHA for their use in cosmetics, nanofibers, 3D printing etc [5,6].

Besides the above mentioned nanotechnology realized by Contipro and Elmarco, *vaccines* have been traditionally a strong Czech expertise (Biogena, USOL) with the current rise in revenues of multiple enterprises (Sevapharma, Biopharm, Bioveta, Dyntec, Baxter, Sotio) targeting both veterinary and human medicine. Assisted reproduction using *in vitro* fertilization (IVF) is another strong discipline of clinically-oriented Czech biotechnology with the leading position on the world market.

Human and veterinary diagnostic products and services represent a promising field but currently with low numbers of certified *in vitro* diagnostic (IVD) products. Both global companies and local SMEs target partially the international market, although still exhibiting low investment into own R&D&I. Global biotech MNCs (Baxter, Lonza) produce several products for the world market but their R&D&I is virtually absent in CR. Medical applications of materials such as hydrogels (Medicem, Wake) and other tissue replacements show a promising development. In the field of pharmacological therapeutics, there are both active MNC producers of generics (Zentiva, Teva) and a few established SMEs with a rather small portfolio of innovative products [5,6].

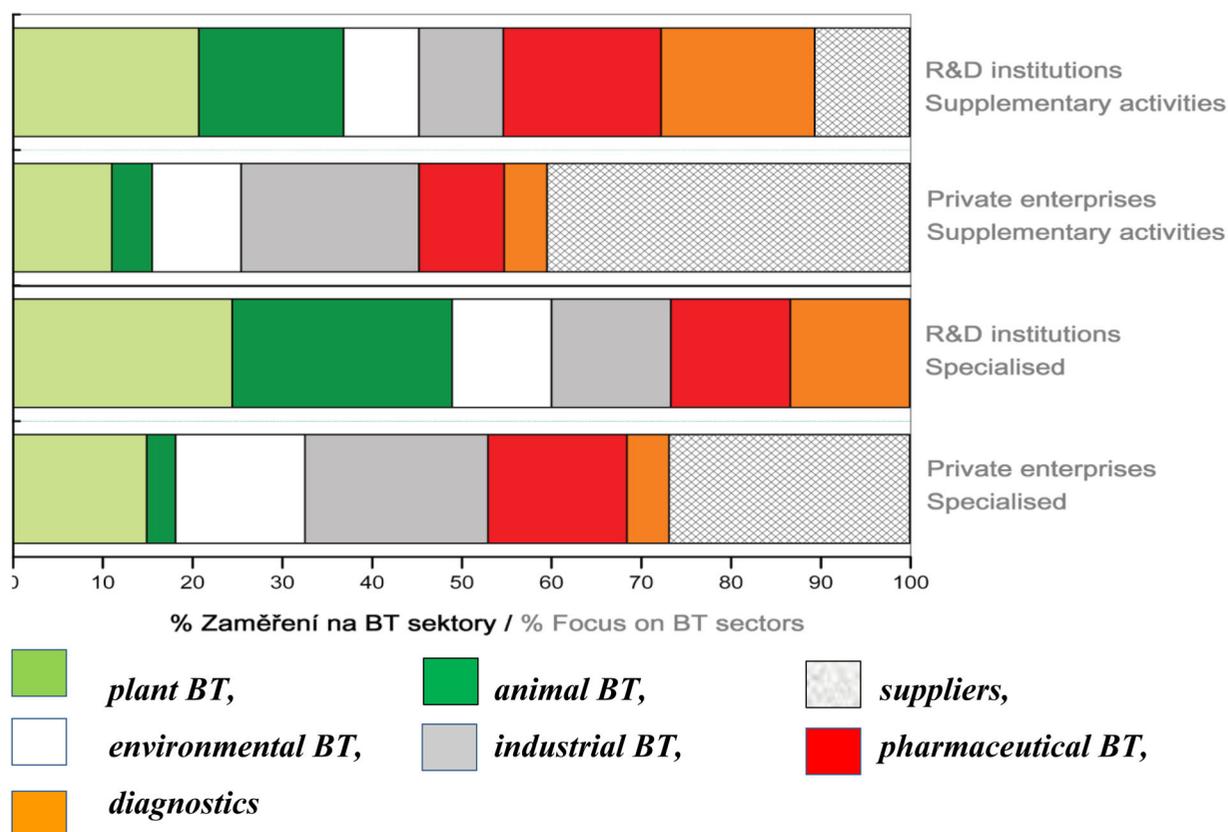


Figure 1. Specialisation of private enterprises and scientific and research institutes in the specified biotechnological branches. Data source: Gate2Biotech and Czech Statistical Office's database [5].

Figure 1 demonstrates the percentage of some main biotechnology sectors in the Czech Republic [5,6].

Business activities and the largest attention in the field of *plant biotechnology* is paid by Czech companies to growing conditions and plant protection, reproduction and propagation and plant pathogen diagnosis and genome mapping. On the contrary, little attention is devoted to genetic modification by introducing new genes. The focus of R&D is evenly distributed among all defined specialization fields of plant biotechnology.

In the field of *animal biotechnology*, the main business activities are biology of animal cells and genome mapping, and biodiversity of farm animals. On the contrary, little attention is devoted to veterinary diagnostic methods and transgenic manipulations. South Moravian Region, Prague and Pardubice region offer the widest range of services. The research focus lies in the biology of animal cells and the development of veterinary medicine and animal care.

Biotechnology in the fields of *medicine and pharmacy* (red BT) is focussed predominantly on immunology, therapeutic and diagnostic antibodies, vaccinology, structure and function of biomolecules and genomics in drug discovery. In the former

Czechoslovakia, unique preconditions for the dynamic development of molecular biotechnologies were created by unification of the possibilities of the molecular tools for genome analysis and genes expression (enzyme tools – endonuclease, polymerase, ligase, transcription factors) and mapping antigenic determinants (epitopes) by means of monoclonal antibodies and systematic work in the methodological issues of the molecular biotechnology. In our modern era designated as 'OMICS', efforts are put into integration and interpretation of extensive database files of sequence data using highly effective bioinformatics procedures as well as procedures of structure and system biology.

Among red BT, business activities in the field of *diagnosis and bioinformatics* are focussed on peptides, conjugates, oligonucleotides synthesis and DNA diagnostics. On the contrary, little attention is devoted on the application of biological processes for industrial applications of information processes. The main research trends lie in genome analysing techniques and DNA diagnostics.

Environmental biotechnology is focused mainly on biotechnological processes for soil and land treatment and biotechnological processes for water treatment, followed by bacteria as cell factories: microbiology

and microbial degradation processes/transformation of pollutants. On the contrary, little attention is devoted to isolation, breeding and genetic engineering of pollutants and biotechnological methods of air pollution control. The focus of research and development lies in biosafety, biotechnological methods for remediation of soil and wastewater and the use of bacteria as cell factories.

The *white biotechnology* is the branch in the scope of modern biotechnologies serving for *industry*. Czech companies pay the largest attention to the development of *bioprocessing techniques* (fermentation, immobilisation of biocatalysts) and, also, *biodiversity of microorganisms* in the production processes. Brewing, dairy and winery represent the most important part in this field. On the contrary, little attention is devoted to genome mapping of specific bacterial and yeast genomes and the genetic engineering of microorganisms and yeast. The focus of R&D lies in the research of enzymatic processes and the development of bioprocessing techniques.

One of the basic processes used by the industrial biotechnologies is *fermentation*. The core of traditional fermentation technologies consists in alcohol technologies. The fermentation industry and the following business is, owing to them, the source of considerable income of the state budget of many countries and the Czech Republic as well. The production of alcoholic beverages has not changed a lot historically, but, technologies are modernized, become more effective and the range of tastes is wider. The number one in the world is the light lager of Pilsner type, malt whisky and wine from grapes. It does not seem that this could change a lot in future. Also other microbial technology areas are a part of the classical fermentation production. They traditionally prevail in the *food industry*, especially in milk and cheese production and moreover in the bakery industry (yeasts) having an even longer tradition than the fermentative production. No less traditional is the production of the fermented vinegar; a little younger is the production of further organic acids usable in food industry (citric, lactic, gluconic, itaconic, tartaric, malic, fumaric etc., amino acids). The traditional microbial product is also glycerol or products of acetone-butanol anaerobic fermentation.

In the past, a great hope was associated with the *microbial biomass*, as a quickly growing source of proteins, bio-factors, vitamins of B group, ergosterol and phospholipids. At present, the production of microbial biomass, first of all yeast biomass, is applied as an approach for liquidation of some waste, a source for

the isolation of clean proteins and feed additives. Great hope is associated with the biomass of various artificially cultivated algae, be it as nutrition components or source of bio-factors. One of the most modern procedures is the preparation of enzymes, lipids, pro-vitamins and vitamins, nutrition bio-factors, drugs, precursors for the subsequent chemical and other production. Here, GMO, genetically modified (micro)organisms achieving higher yield, easier to cultivate and facilitating the subsequent isolation and purification of pure products are used quite often.

The fermentation production has a rich past, but what about the future? Concerning traditional food production, people are very conservative. The expectation is that the future will be similar. In the field of pharmacy and medicine, the peaks are probably lying ahead of us. What was a fantasy yesterday is becoming reality today and will be part of history tomorrow. The power engineering is regulated by the invisible hand of the market at most; as long as cheaper sources are available, nothing can stop mankind from sawing off the environmental branch its sitting on [5,6].

Cooperation of public and private biotech sector in CZ

The biotech segment in the Czech Republic is divided into two large sectors: *Public sector and private sector*.

The *public sector* includes, above all, EU programmes. Starting from 2007, there has been a major investment in large EU-funded research infrastructures outside the research-rich Prague region in order to equalize the competitiveness in other regions [4]. New state-of-the-art research facilities have been completed in Brno and Olomouc to complement the existing research institutes of the Academy of Sciences of the Czech Republic. There are 50% of biotech-oriented projects in the ERDF priority axis 1 and 2 with the flagships: BIOCEV – Biotechnology and Biomedicine Centre of the Academy of Sciences and Charles University in Prague, CEITEC – Central European Institute of Technology in Brno, ICRC – International Clinical Research Centre in Brno, IMTM – Institute of Molecular and Translational Medicine, Faculty of Medicine and Dentistry, Palacký University in Olomouc and some regional R&D Centers; Center for Algal Biotechnology in Třeboň (ALGATECH), Center of Haná Region for Biotechnological and Agricultural Research, BIOMEDREG, AdmireVet, RECAMO, IET, MRC (Material Research Centre FCH BUT), backed up by a multitude of ESFRI infrastructures [1,4].

Operational program Enterprises and Innovations is focussed on the innovative small and middle-sized enterprises. OP Education for Competitiveness (MEYS) was founded for the investments in the educational system and for improving conditions in the R&D. Other sources of innovation support are allocated first of all by the Technological Agency of the Czech Republic and the Grant Agency of the Czech Republic; additional grant providers are the individual ministries [7].

The Czech Republic is home to a number of noteworthy research institutes and universities recognised for their high-quality research in molecular genetics, immunology, analytical and pharmaceutical chemistry and biochemistry, oncology, neuroscience and metabolic diseases, among other fields. The majority of research institutes belongs either to the Academy of Sciences of the Czech Republic or to universities.

Just one example of the state-of-the-art research facilities in the Czech Republic is the Institute of Organic Chemistry and Biochemistry of the Academy of Sciences of the Czech Republic. The results of antiviral research conducted by Prof. Antonín Holý led to the discovery of antiviral compounds derived from nucleotides and nucleosides. Three of the compounds are used by Gilead Sciences for the treatment of AIDS (Tenofovir, Viread), cytomegalic retinitis (Cidofovir, Vistide) and hepatitis B (Adenovir, Hepsera). These drugs have given thousands of patients worldwide a chance for a better and longer life.

Other important institutes of the Academy of Sciences of the Czech Republic involved in biotechnology research are the Institute of Biotechnology, Institute of Experimental Medicine, Institute of Microbiology, Institute of Molecular Genetics and others [6].

The private sector includes both global and local enterprises. Examples of global companies conducting business, R&D and/or manufacturing in the Czech Republic include Teva Pharmaceutical, Sanofi, Lonza Biotec, Otsuka Pharmaceutical, Merck, Beckman Coulter and Gilead Sciences, among others. The structure of companies in the field of biotechnology reflects the development of the Czech society and economics in the last 25 years. This structure consists almost exclusively of small companies with less than 50 employees and only several middle-sized companies (e.g. Contipro, Apigenex, Bioendor), which together represent >90% of all biotechnology companies. A specific feature of the Czech biotechnological companies is a quite high orientation on the inland market [5,6].

The cooperation between the public and the private sector is only partly funded by private resources but mostly universities and private companies with the joint propose for public support at a national level, sometimes at an international level (Horizon 2020, BBI). Viewing the total expenses for R&D in the field of natural and medical science, there has been a gradual increase. In contrast with it, the structure of biotechnological companies in the Czech Republic does not change dramatically. One of the reasons is the considerable disproportion between the investments of the entrepreneurial and the governmental sector and public universities in research development. There is a considerably lower number of new companies (Enantis), low extent of cooperation between the academic and entrepreneurial sector and also a low capacity of risk capital investments. A problem that is more important than the low extent of cooperation is the low effectiveness. The cause is the motivation, on the one hand, where the target of the cooperation often acquires the financial means (subsidy), and the lack in preparedness of both parties on the effective cooperation. The reasons are finances, but also the slow change of thinking [5].

There has been a positive turn in the field of the cooperation and transfer of technologies in recent years. *Clusters* are platforms for exchanging information on the development of science and technology, identifying synergies and possible collaborations to address critical issues covering the full value chain from R&D to production in the fields of innovative therapeutic and diagnostic approaches, and communication between local and European communities in these fields - *CEITEC Cluster* for Bioinformatics, *CzechBio* and *MedchemBio*. Another example is the *National Biomedical and Biotechnology Park, Olomouc* (NBBP) – a public-private partnership project whose partners are the City of Olomouc, the Ministry of Industry and Trade, and Palacký University in Olomouc together with the University Hospital, the Olomouc Technology Park and the MedChemBio cluster, a platform supporting development of medicinal chemistry and chemical biology. *INBIT Biotechnology centre in Brno* is a biotechnology centre/incubator established as a part of the new Masaryk University campus in Brno. Located next to University Hospital Brno and the Central European Institute of Technology, the centre has the purpose of providing modern serviced laboratory and office spaces in order to gather together start-ups and R&D laboratories of established companies to facilitate cooperation and synergies with top academic scientists and medical doctors. Two

thousand square metres of the cutting-edge laboratory complex provides companies with fully serviced space with all standard amenities. INBIT is part of the JIC Innovation Park run by the South Moravian Innovation Centre established in 2003 by the Region of South Moravia, the City of Brno and four universities to promote enterprise skills development and commercialisation of research in South Moravia. The City of Brno, where Gregor Mendel discovered the principal laws of heredity, is now an education and research centre located at the nexus between Vienna, Prague and Bratislava [5,6].

The grand challenge for Czech biotech

The *main strenghts* of Czech Biotech sector include an overall high prestige of R&D in CR, strong historical focus on natural sciences in the Czech Republic – mainly chemistry, physics and mathematics, but not biology, medicine and life sciences in general. Further, promising trends in biotech can be considered, although showing low absolute numbers, as well as gradually increasing impact of scientific output in number and quality of publications, a steady growth in biotech patents from almost zero, with a slow but sustained increase in internalization of R&D. A bioech evaluation process started and has shown growing effectiveness linkage between support and outcome quality. It is necessary to note that biotech is considered a high priority discipline both in the Czech Republic and in the European Union [5–7].

Oppositely, the main *weaknesses* of Czech biotechnology include, above all, limited knowledge transfer to the commercial sector; a low number of patents, idea-driven start-ups and spin-offs. As a negative factor, there is 10-fold lower public institutions research support from the industrial partners compared to EU-27 and low interest in both parties. Public-private partnership is of low quality, with a weak and only very formal linkage existing between science and industry, often only for the purpose of subsidy drawing. The Czech biotech sector is considerably underdeveloped in comparison to other high-tech technologies/product areas in the Czech Republic and to the EU average. Another problem is poor transparency of public financial support and poor correlation to real R&D performance and economic parameters and quite excessive R&D&I public funding of existing enterprises with a lack of evaluation. The majority of biotech SMEs are oriented on the local market with a very small footprint and very limited expansion to the international market and slow growth rate. Large biotech MNCs are

not fully embedded in the Czech national R&D&I system, most of the existing links are based on production line (skilled and cheaper workforce). Czech R&D&I teams are small and isolated with limited interdisciplinarity and low flexibility, high degree of in-breeding, aged team leaders and low international mobility. The localisation of the Czech Biotech segment is centralised into 2 major corridors (Prague and Brno) with 6 other average regions and 4 extremely underdeveloped regions. Moreover, there is EU funding-driven two-speed development of regions (Prague vs. the rest of the Czech Republic) in the context of poor mobility and conserved research positions [1,7].

The main problems are interconnected with some *threats* such as lack of consensual long-term strategic R&D&I decisions in the Czech Republic, low political stability and poor general trust in political reforms in higher education and research, leading to frequent changes at all levels in the government and ministries. Scientific activities are paralyzed by frequent changes in legislation and other legal documents (including grant application calls). R&D decisions are substantially influenced by interest groups. Funding is directed to mainstream and established teams with long-term history but having very short-term funding packages based on major grant funding. There is no evaluation methodology for innovations and no correlative analysis of R&D&I performance to business data in the Czech Republic, at least in the biotech/pharma field. A massive tendency to waste talent due to poor human resource and research management practices and continuous emigration of the most talented individuals with minimal return policy should be mentioned as well.

The education system has been traditionally a flagship of CR. Despite of some decline in the quality of *tertiary education* with limited specialization at the secondary level, human resources development is the most promising chance for the future. There are several good examples of knowledge transfer cooperation between universities and the private sector. These projects (such as HYDAL Technology) definitely attract the attention of students of all levels who are interested in working on a topic, which has social, ecological and industrial aspects and overlaps. Another positive example, JIC in Brno area, should be pointed out as an exceptional functional project with international acknowledgement. This large-scale incubator scheme started financial support using innovation voucher applications for breaking the public/private barrier in 2009, and today this collaborative activity exists in 8 Czech regions including Prague [3,8].

The successful performance of companies operating in the life-sciences sector stems from a long track record in research and development and quality of education. More than 50,000 students were enrolled in life-sciences study programmes at natural sciences universities in the Czech Republic. Availability of a skilled workforce is one of the key determinants for the successful development of the life-sciences sector due to its high degree of dependence on knowledge and knowledge transfer from laboratories to hospitals. The availability of skilled, sector-oriented labour is one of the Czech Republic's major competitive advantages. Over 7,400 students graduate every year in major university centres in Prague, Brno, Olomouc and Hradec Králové [8].

Global biotech performance vs. current status in the EU and the Czech Republic

A substantial public benefit has been generated by an excellent example of biotech success worldwide and integration of public/private effort. It has been accomplished within the human genome project, which is a good example of basic/applied science coherent development. Today, the genome knowledge is just a seeding point for our future understanding of phenotypes. Bioinformatics has been already added to the standard biotech disciplines and since the ICT industry is traditionally very strong in the Czech Republic, the alliance generates one of the big promises for the brighter future of Czech biotech. Moreover, ICT and HEALTH are continued to be the prominent EU-funded areas (FP-7, Horizon 2020, ERA-Net) [3,6,7].

Based on current analysis, Europe is probably not the leading continent in the biotech area but it does recognize its potential for economic growth, its interconnection with many other high-tech disciplines and the importance for the quality of life of its population. Since the EU accession in 2004, the biotech sector in the Czech Republic has performed sustainably within the lower third in the majority of the fundamental indicators with very slow improvement in some parameters only. This is why our biotech focus must follow the same lines together with EU initiatives in the current financial period (2014–2020) as well as in the next period (2021–2025). A positive sign of continued EU support is that biotech has been identified as one of the Key Enabling Technologies (KETs) that will be supported under Horizon 2020 [2,7].

During the last 10 years, there has been a major investment in large EU-funded research infrastructures, which has created not only the promise for better

future of the Czech biotech, but also holds a major responsibility, and their progress will be evaluated systematically in order to accommodate the highest standards and long-term sustainability. A more significant development in the Czech biotechnological sector may be expected in future with a high probability [3,7].

Human resources development for the life-sciences sector is underpinned by the ability to draw extensive public support, which is made available to address the government's strategic objective of dealing with the country's aging population and improving the quality of life. To be part of this challenging task is increasingly attractive for both Czech and foreign students. On top of that, both national and European Union structural funds are targeted at further support for development of the country's research infrastructure, education and employment to ensure that the Czech Republic remains in the vanguard of skills provision. Further, many exchange programmes in Europe (Erasmus +, Ceepus) and across the world (Erasmus Mundus, Free Movers) are realized for students and researchers from universities and research institutions [8].

Unfortunately, we focus exclusively on the financial aspect of the development and we do not devote enough attention to the aspects of the development which are of principal importance for us. These are especially: effective communication, sharing experience and a certain extent of 'branch unification or tightness'. Abroad, various forms of national biotechnological associations are a common platform complying with most of these conditions. In the developed countries, they do not function as a universal tool for acquiring the state subsidies, but as the real communication platform. In the Czech Republic, however, acquiring financial means (mostly in the form of a subsidy) is generally perceived as a target and not as a means. In future, it is necessary to change this scheme.

Vision of Czech biotechnology and mission to the future

We hope that the Czech Republic's competitive cost-benefit ratio in human resources is due to the highly skilled graduates available at competitive costs and is just one of the reasons to consider the Czech Republic as a potential location for investment in the life-sciences sector. Competitive benchmarking charts show that while companies can achieve substantial savings in operational costs, the quality and availability of

experienced industry-specific staff in the Czech Republic are among the highest when compared with those in the most advanced markets in the life-sciences sector.

The development of the Czech Biotech sector is supported by effective patent protection, adoption of GMP, GLP and GCP standards, relatively non-restrictive genetic engineering and the government's policy goals comprising continuation of support for R&D and acceleration of the transfer of knowledge between the science and business communities. The country's membership in the European Union guarantees that licences issued in the Czech Republic are valid in all EU countries, which comprise a consumer market of over 500 million customers within a two-hour flight from Prague [1–3,7].

Czech biotech is considered as one of the most innovative science communities today. The development of this segment is based on a diverse set of markets and EU funding priorities for life science and biotechnologies (FP7, Horizon 2020). The big chance for Czech Republic biotechnology is considered to lie in the crossover with other areas such as energetics, environmental science and climatology. The technical crossover with biotech and other sciences is specific for the Czech Republic, as possible boost of bioinformatics-driven R&D&I due to very strong ICT in the Czech Republic. Innovation is an inherent part of the EU strategy for the next financial period (Research & Innovation) with support for TT and competitiveness. Close biotech connection between basic discovery and industry development is interconnected with high level of patent intensity, which is a competitive advantages on the biotech market and new infrastructures built in the Czech Republic in the field of biotechnology and biomedical science. ERDF-funded infrastructure activities worth of 1.5 billion EUR is associated with national investment (MEYS) into regional centres and support of technical education by the Education 2020 initiative [7,8].

Conclusions

The biotech industry is an essential source of rich economy growth, interconnects high-grade academic

science and commercial R&D&I and generates enormous amount of start-ups and spin-offs with high innovative potential. The true mission for the near future is to make strategic decisions on the priority definition in the research area as a single discipline without artificial division into basic and applied science. If the Czech Republic has an ambition to establish a competitive technology-rich economy, it must provide rapid and coordinated support for research, development and innovation at the front line, including biotechnology.

Disclosure statement

No potential conflict of interest was reported by the author.

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References

- [1] Council for Development, Research and Innovations. Available from: <http://www.vyzkum.cz/FrontClanek.aspx?idsekce=551861>
- [2] National Policy in Research, Development and Innovations of the Czech Republic for the years 2009–2015, s.5. Available from: <http://www.vyzkum.cz/storage/att/>
- [3] Web site of MEYS. Available from: <http://www.msmt.cz/strukturalni-fondy/op-vavpi>
- [4] Priorities of the Applied Research, Development and Innovations for the years 2009–2011. Available from: file:///C:/Users/marova/AppData/Local/Temp/National_RDI_Policy_of_the_Czech_Republic_2009%E2%80%932015.pdf
- [5] Biotechnology Report 2012; JAIP o.p.s. 2013. Available from: <http://www.gate2biotech.com/btr-2012/>
- [6] TACR web site. Available from: <http://www.tacr.cz/>
- [7] Standpoint of Commission bodies to the development in the field of the Partnership Agreement and Programs in the Czech Republic for the period 2014–2020. Available from: <http://www.mmr.cz/get-media/9cde059e-50e8-4ad2-8186-f6b91e93c468/draft-partnership-agreement-for-the-2014-2020-programming-period.pdf>
- [8] Operational Program Education for Competitiveness. Available from: <http://www.vzdelavani2020.cz>