The european colour of biotechnology is white

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DAN CAŞCAVAL[1)*], ANCA-IRINA GALACTION[2)]

[1)] Technical University "Gh. Asachi" of Iasi, Faculty of Chemical Engineering, Dept. of Biochemical Engineering, 71 D. Mangeron Avenue, 700050 Iasi, Romania, email: dancasca@ch.tuiasi.ro

[2)] University of Medicine and Pharmacy "Gr.T. Popa" of Iasi, Faculty of Medical Bioengineering, Dept. of Biotechnology, 9-13 M. Kogalniceanu Street, 700454 Iasi, Romania, email: galact@from.ro

** the corresponding author*

Abstract

The "white biotechnology" is a European concept, being directed to the identification and utilization of the natural renewable sources of raw materials for biosynthesizing valuable bioactive compounds, by means of clean processes which will improve the classical chemical technologies and cut the waste generation and high energy consumption. Involving the interdisciplinary cooperation between the fields of chemistry, molecular biology, genetics, microbiology, informatics and process engineering, the driving force of the white biotechnology is the sustainability by carefully managing of the finite resources. The specialized analysis on the trends in chemical industry indicated that the effective contribution of white biotechnology will strongly increase by 2010, if the political, economic or social factors will be favorable.

Keywords: white biotechnology, chemical industry, industrial biotechnology, biosynthesized chemicals, European Union.

Motto:

"Imagine a world where babies are born without defects, criminals are identified within minutes, diseases are identified and treated right in your own home, and there is enough food to feed everyone. The makings of a science fiction novel you might say, but this "fiction" is closer than you think. Every day new advances in the field of biotechnology bring the possibilities of curing disease, wiping out hunger, and improving the quality of life for all people closer to a reality. Some say we are undergoing a biotechnology revolution where the discoveries and products made are revolutionizing the way we live.

Now, imagine being a part of this revolution. Imagine working on a team that constructs a vaccine for the HIV virus, which causes AIDS. Imagine working in a company that produces a high-protein peanut which can be grown in drought conditions in third-world countries. Imagine being in the laboratory that develops a bacterium, which digests petroleum from oil spills. Imagine the sense of accomplishment and gratification you'd feel as a contributor to these breakthroughs. Imagine how you can help improve the quality of life for your friends and family."

Ellyn Daugherty [1]

Introduction

The industrial biotechnology has been considerably developed in Europe, concomitantly with the level of knowledge in the field, especially for the fine chemicals and food technologies (for examples, more than 70% of the overall enzymes production is located in Europe). This evolution of the biotechnology at large-scale is supported by favorable political and social sentiments and leads to the gradually replace of the chemical technologies by sustainable biochemical technologies with significant benefits.

According with the Lisbon strategy, the improvement of the current technologies by 2010 is the major European objective and it is also an economic, technological and social challenge [2]. This objective can be reached by defining a European industrial biotechnology unitary vision, by ensuring a feasible programme for developing biotechnology within EU Framework Programme 7, by increasing through knowledge and transparent information the public interest and support on industrial biotechnology, by establishing the partnerships between the public and private institutions.

Thus, the new concept of "white biotechnology" was born in Europe, and it joins all the initiatives dedicated to producing goods or services by sustainable biotechnologies. Because the white biotechnology is considered to be the "New Era" of biotechnology, in this paper the main aspects of this concept will be briefly discussed.

The concept of "white biotechnology"

For all who hoped in the faster progress of the more unit and "new" Europe, the disputes on the Common European Constitution represent another suddenly awakening into the European divergent opinions. However, an idea, which was only a dream in the past, is now unanimously accepted and becomes gradually a directive for all countries members of the European Union: the "white biotechnology".

But, what is biotechnology? "The term brings to mind many different things. Some think of developing new types of animals. Others dream of almost unlimited sources of human therapeutic drugs. Still others envision the possibility of growing crops that are more nutritious and naturally pest-resistant to feed a rapidly growing world population. This question elicits almost as many first-thought responses as there are people to whom the question can be posed." [3].

As a consequence of the "living Earth" and "in-law" with the other important fields of the current and future interest, the actual trend to implement "the white biotechnology" is the natural evolution of human society

and is considered to be “the third wave of the biotechnology”. It involves the interdisciplinary cooperation between the fields of chemistry, molecular biology, genetics, microbiology, informatics and process engineering. By applying the white biotechnologies many kinds of products used in daily life, ranging from cheese to biodiesel, can be produced. White biotechnology is a prime example of interdisciplinary cooperation. Its technology pool is gleaned from the fields.

Being directed to the identification and utilization of the natural renewable sources of raw materials for biosynthesizing valuable bioactive compounds, by means of clean processes which will improve the classical chemical technologies and cut the waste generation and high energy consumption, the driving force of the white biotechnology is the sustainability by carefully managing of the finite resources. Therefore, according with the definition given by Gro Harlem Brundtland, the former Chair of the World Commission on Environment and Development, in its report *Our Common Future* (April 1987), the sustainable development imposes the equilibrium of three equally important requirements, of economic, ecologic and social types. This idea has been also underlined by Thomas Rachel, German Presidency of the Council of the European Union at the opening ceremony of the International Conference *European BioPerspectives - “En Route to a Knowledge-Based Bio-Economy”(*31 May - 1 June 2007, Cologne) [4].

It is very important to think of the white biotechnology not only in terms of its potential economic benefits, but also in terms of environmental protection or of the starting-point for new business. The industrial biotechnology has become a hot topic especially among the manufacturers and companies using chemical synthesis technologies, because the biotechnology possesses the potential to improve and, then, maintain the level of products competitiveness. Owing to the fact that by diminishing the costs the pressure of competition could not be longer reduced, the forward-thinking companies, with important research infrastructure, currently use active and aggressive marketing strategies to promote the white biotechnology.

In the last twenty years, more and more chemical technology for bioactive compounds production, use for human health or feed, are replaced by biotechnologies. In 2006, the all over the world market of these compounds exceeded $4{,}400 \times 10^9$ € (Table 1) [5].

Table 1. Market of biosynthesized chemicals.

Biosynthetic compound	Sales in 2006 (Billion €)
Amino acids	3,430
Antihelmintic agents	1,000
Antitumor agents	1,000
Bioinsecticides	125
Hypocholesterolaemiant agents	8,400
Immuno-suppressive agents	2,000
Organic acids	3,150
Plant growth stimulators	120
Vitamins	3,050

Most of these biotechnologies offer important economic and environmental benefits compared with the chemical technologies. In the purpose to identify and underline the benefits of the utilization of bioprocesses at industrial level, the Öko-Institut Freiburg from Germany, a scientific institute specialized on environment monitorization, analyzed comparatively some biotechnologies for antibiotics, vitamins and other bioactive compounds production *vs.* their corresponded chemical technology. In the case of antibiotics production, the use of biotechnology leads to the reduction with about 65% of materials and energy consumption and saves 50% of the costs (Figure 1). Similar benefits have been identified for vitamins production (the one-step biochemical technology for vitamin B2 replaced the 8-steps chemical technology, reducing the costs and the environmental impact with about 40%), biopolymers production (17-55% less raw materials consumed), or enzyme utilization in industry (the use of enzymes in the textile industry needs with 25% less energy and results in over 60% less emissions) [6].

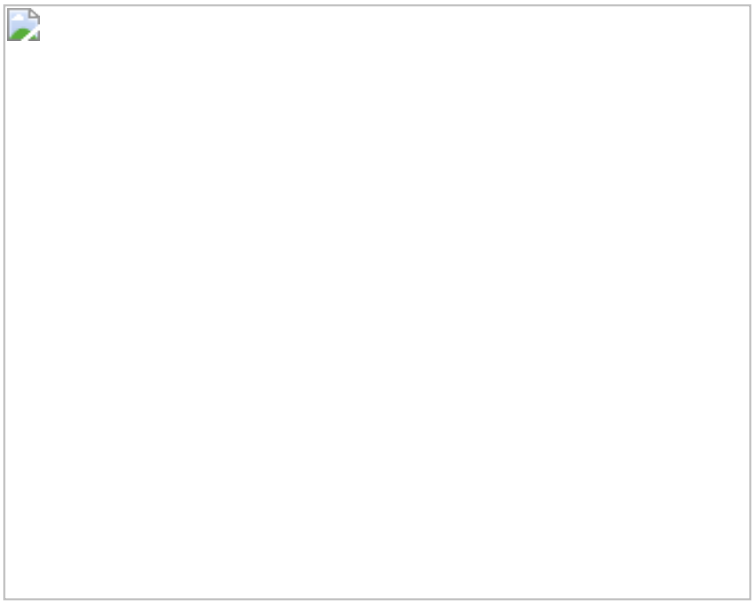

Figure 1. The advantages of biotechnology *vs*. chemical technology for antibiotics production.

The McKinsey study focused on trends in chemical industry indicated that the effective contribution of white biotechnology will strongly increase by 2010, especially in fine chemicals production. These experts estimated the present contribution of the biosynthesized compounds to be of 30-60% in the fine chemicals market, respectively of 6-12% in the polymers and bulk chemicals market. The previsions indicate an increase from 10 to 20% by 2010, followed by a stronger development, if the political, economic or social factors will be favorable. In this case, the annually increase of the chemicals market in European Union is expected to be of about 11 to 22 billion €, added to the currently 360 billion €. These estimations are completed by the US National Research Council, which forecast that 10% of liquid fuels and 25% of organic chemicals will be produced from renewable sources by biotechnologies until 2020 [7,8].

Europe and the white biotechnology

In the European space, the interest on the biotechnology is expressed in the research programmes promoted by the proposals from the European Framework Programme FP7. Thus, the biotechnology is one priority of this programme and can be found in different areas of FP7, like "*Health", "Food, agriculture and fisheries, biotechnology", "Environment", "Energy"* etc. Its main contribution is to turn the laboratory discoveries into large-scale applications, from clinical ones to healthy food, renewable bioresources, "bio-solutions" for the sustainability of agriculture, fisheries, climate change, nanobiotechnology etc.

The Belgian Government has recently created an interdisciplinary platform for industrial biotechnology, with the main role to facilitating the cooperation and interaction between the industrial, academic and political activities. In The Netherlands this platform is more extended and covers the following main applications: bulk and fine chemicals production and materials recycling. Moreover, the Kluyver Centre for Genomics of Industrial fermentation is a large consortium which includes the most important academic and research institutes in this country: Delft University of Technology, Wageningen University and Research Centre, Leiden University, Nijmegen University, Utrecht University, Wageningen Centre for Food Sciences and NIZO food research. The major objective of this consortium is to improve the use of microorganisms in industrial fermentations by employing the microbial genomics, being focused on food and food ingredients production, beverages, pharmaceuticals, nutraceuticals, fine and bulk chemicals. The Kluyver centre overall budget for the last 5 years is of 55 million €.

In Austria, the Technologie Impulse Gesellschaft is an agency which promotes the interaction between the business sector and the research one, if the second results are of an international competitive level. This centre managed programmes having an overall research volume of 400 million € for the period of 1998-2004, most of them dedicated to the white biotechnology.

The German Ministry of Education and Research financially support the programme called BioProduktion, aimed to establishing partnerships in the field of industrial biotechnology. Since 2005, The

German Government has planned to invest more than 800 million € for the Biotechnology framework programme, especially for the white biotechnology.

In the United Kingdom, the programmes are directed to the maximization of the commercial benefits from the biotechnological activities, in this purpose three major themes being of interest: discovery and application of new biocatalysts, development of integrated processes, design and modeling of new biotransformation processes. Another important way to support this field is to provide information and advice (collaborative projects within the UK industry), 4.5 million € being considered for this action budget.

On the other hand, similar programmes have been promoted and developed in United States and Japan. In Japan, these programmes are dedicated to the improvement of the technological infrastructure of the industrial biotechnology, to the molecular engineering, biomolecular synthesis, structural genomics, bioinformatics and biocatalysis. In 2001, the overall budget allocated to these purposed exceeded 60 million €, but it has been significantly increased in the last years.

In United Stated, the main interest from the biotechnological viewpoint is for the enzyme and biomass technologies, especially applied in agriculture.

Conclusions

In Europe the white biotechnology is “at home”. Even in the absence of a specific legislation, the white biotechnology has been intensively promoted and, owing to its potential huge economic and environmental benefits, becomes more and more a serious competitor for the wide-used chemical technologies.

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