

## Social determinants of the implementation of innovative biotechnology in Poland and other EU countries

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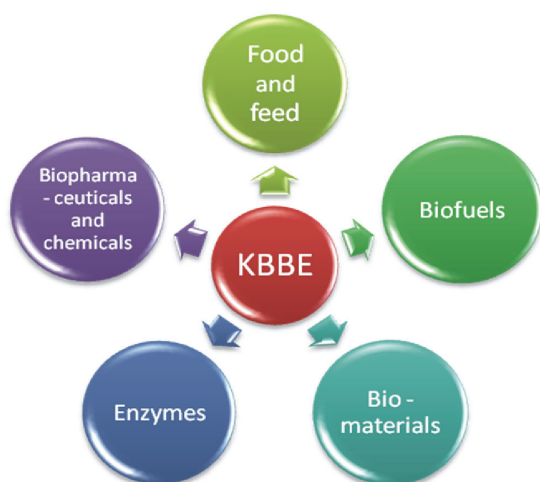
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### The concept of Knowledge-Based BioEconomy (KBBE)

As the world's population continues to grow we use natural resources at an accelerating pace. Unfortunately, most of these resources are unsustainable so the depletion of raw materials becomes a serious problem for the global economy. We can assume that over the next few decades, some of the natural resources may be completely exhausted. Therefore, attempts to find an effective long-term solution to reduce the possible effects of this state of affairs are being made. Innovative biotechnology seems to be an answer to the difficulties facing the world. The application of biotechnology to agriculture, healthcare and industry has become the basis for Knowledge-Based BioEconomy (KBBE), which offers prospects of global economy based on knowledge and renewable raw materials (Fig. 1).



**Fig. 1.** Knowledge-Based BioEconomy and the diversity of sustainable production of goods

The implementation of KBBE concept is currently one of the priorities of the European Union (EU), and it results in the transformation of the economy. The main challenges for bioeconomy identified by the EU and the European Technology Platforms include: “sustainable production and development, improving public health, mitigating climate change and integrating and balancing social development” (The European Bioeconomy in 2030...).

Since Poland is a large importer of many biotechnological products, it is important to know the factors that affect the optimal development of bioeconomy in our country. In order to identify the prospects and limitations of KBBE, we need to develop an understanding of the biotechnology progress and realize that public resistance prevents the commercialization of the innovative solutions. The development of any innovation science is a long-term process based not only on the research, but also on an efficient and deliberate government policy as well as social acceptance and a public dialogue. All of these factors are interconnected and form the Biotechnology Value Chain (Fig. 2).

The entire society consists of consumers of biotechnological products, who therefore have a right to be reliably informed. Knowing and understanding the attitudes toward biotechnology will help plan effective communication with the general public. An open dialogue may increase public acceptance of innovative technologies and accelerate the implementation of the biotechnology products.

### Public perception of biotechnology

Over the years, trends in public attitudes toward biotechnology have been analyzed in many countries



Fig. 2. Biotechnology Value Chain from science to the market

worldwide (Twardowski, 2007; Krysiak and Twardowski, 2009). The results of those studies illustrate the trends and dynamics of the changes in attitudes expressed by the public opinion. Genetically modified (GM) food, bio-fuels and use of biotechnology innovations in the field of medicine seem to be critical issues for the public perception. The most recent survey conducted in 2010 (Eurobarometer 73.1. Biotechnology Report, 2010) revealed that the Europeans are rather optimistic about the perspectives of biotechnology. The majority of respondents (53% of the Europeans and 51% of Poles) believe that biotechnology will bring positive changes in the future, while only 20% think that the effect will be negative (Fig. 3). In comparison to the studies from 2005, the number of people with a positive attitude has not changed, whereas the number of respondents with concerns regarding potential adverse effects associated with biotechnology and genetic engineering has increased by 8% (12% in 2005) (Eurobarometer 64.3. Europeans and biotechnology in 2005: Patterns and Trends, 2006).

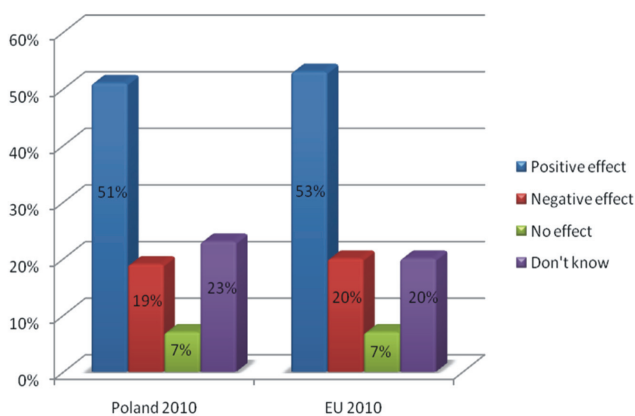


Fig. 3. Opinion of Poles and the Europeans about potential effects of biotechnology in the future

Comparing different European countries, significant differences between them are observed. The most enthusiastic about biotechnology are the respondents in Iceland (79%) and Estonia (77%). In comparison, only 38% of Bulgarians and 35% of Austrians hold a positive view of it. Some aspects of biotechnology arouse great

interest of society. It is also worthwhile to emphasize that depending on whether biotechnology is used in medicine, agriculture or industry, public acceptance of it varies significantly.

### Public perception of medical biotechnology

The Europeans are most optimistic about the implementation of biotechnology in the medical sector. Depending on the type of research, the level of social acceptance ranges from 55 to 69% (Fig. 4). However, those respondents often stress the need for additional legal regulations. Interestingly, people present a higher approval of the research on embryonic stem cells (63%) than for xenotransplantation (57%). This situation might be the effect of the ethical and religious concerns about the disruption of the “natural law”.

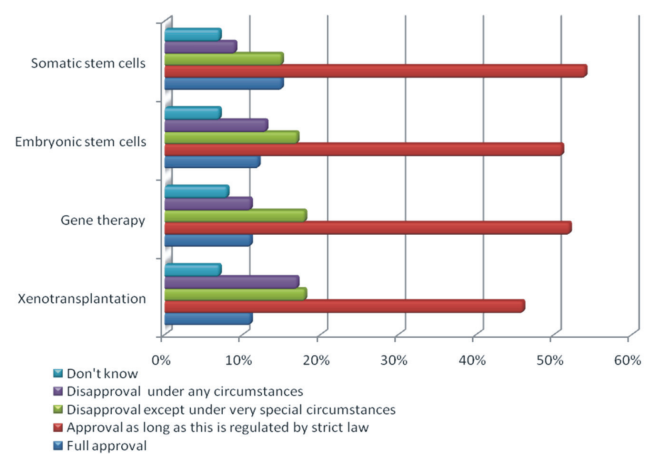


Fig. 4. Public perception of medical applications of modern biotechnology in the European Union

The discovery of stem cells attracts huge interest and has been widely discussed in the media. The information provided by the media is controversial and indicates the innovative nature of this issue. The discussion is focused on the ethical aspects and exaggerated expectations rather than on scientific facts. Most of the non-professionals understand the differences between embryonic stem cells and non-embryonic “somatic” stem cells, but they are not aware of the fact that stem cells can also be categorized by their potential to differentiate into

other cell types. In order to investigate the views of the public opinion in the Eurobarometer (Eurobarometer 73.1, 2010), a simplified system of classification was used for the first time.

The survey results reveal that the majority of Europeans approve of the embryonic stem cell research. However, only 12% of the respondents do not see the need for additional regulations on this issue. In Poland, the number of supporters is smaller (49%), which may be associated with the course of the public debate. The biggest controversy concerns the cells derived from human embryos. On the one hand, the scientists emphasize the role of embryonic stem cells in the treatment of incurable diseases, but on the other hand the representatives of the Catholic Church, some policy makers and "pro-life" organizations condemn the use of human embryos under any circumstances.

It is also worth presenting the attitude of the Europeans towards gene therapy and regenerative medicine. Regenerative medicine "is the process of creating living, functional tissues to repair or replace tissue or organ function lost due to age, disease, damage, or congenital defects" (Eurobarometer 73.1. Biotechnology Report, 2010). The aim of this procedure is to use structures grown in a tissue engineering laboratory to regenerate damaged tissues and organs. Currently, commercial access to such specimens is limited to the use of artificial skin. However, in the nearest future more products providing regeneration of connective, bone, cartilage and adipose tissue are expected. Despite these promising prospects, the development and application of regenerative medicine has raised many moral and ethical concerns.

The survey results indicate that 44% of the Europeans support regenerative medicine as long as it is strictly regulated by the law, further 11% of respondents accept this sector of medicine without seeing the need for any regulation. 17% of the Europeans are totally against this practice (Fig. 5). The highest acceptance for regenerative medicine was observed in Spain (72%) and Portugal (68%) while the lowest in Switzerland (34%) and Austria (30%). In Poland, more than half of the population (53%) approve of this practice.

Respondents were also asked for their opinion about gene therapy that involves treating diseases by directly intervening at the genome level. Sixty-three percent of the Europeans approve of the research involving human gene therapy and the need for legal regulations was ex-

pressed by the majority of the respondents once again. The country analysis reveal that the biggest supporter of such practice is Belgium (77%), Spain (77%) and Norway (76%), while the lowest support was found in Germany (43%) and Austria (37%). In Poland, 53% of the population approved human gene therapy.

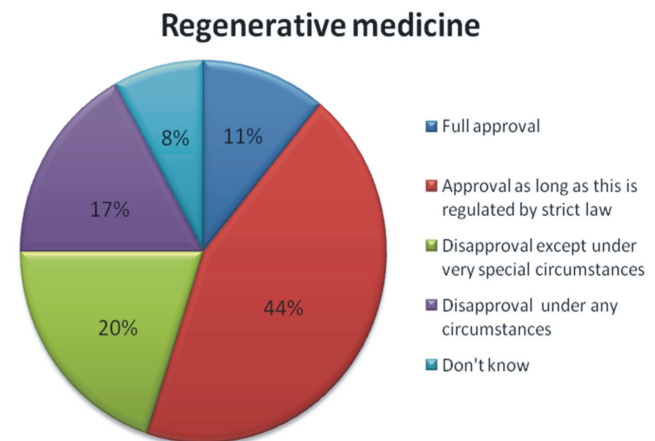


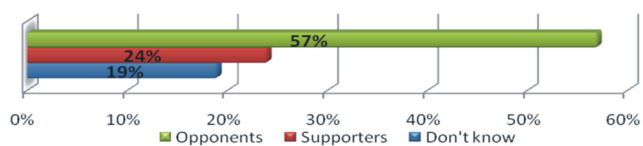
Fig. 5. Approval of regenerative medicine by the Europeans

### ***Public acceptance of genetically modified (GM) food***

The introduction of commercial agrobiotechnology products has faced the greatest religious, moral and safety concerns. The European Commission decides on whether to allow production and import of certain GM food and feed. On the one hand, Poland as a Member State has the opportunity to actively participate in the discussion on this matter. On the other hand, our country is obliged to comply with the regulations adopted by the community. The strategy established by the EU is crucial and determines the regulations for GM food and feed production and distribution. Therefore, a strong objection of the European society (including Polish) towards agrobiotechnological products may result both in lower financial benefits for the EU and a greater gap between the regions and the countries.

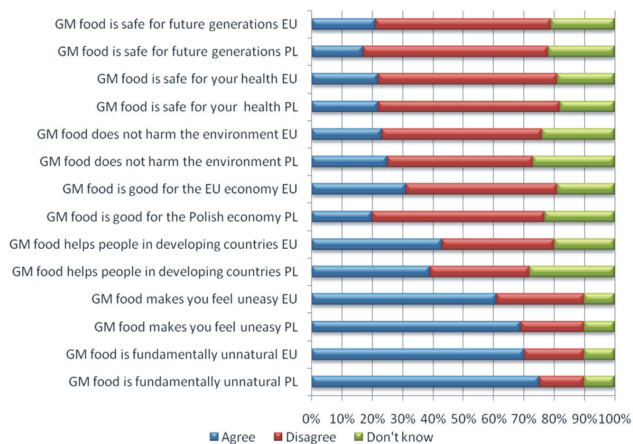
The public debate on the implementation of agrobiotechnology in food and feed production is very dynamic and reflects the negative public attitudes. The Eurobarometer survey results revealed a disapproval of GM food, as only 24% of respondents supported the research in this field (Fig. 6).

More detailed questions reveal that only 22% of Poles as well as other Europeans perceive GM food as safe for their health, most of the respondents (69% of Poles



**Fig. 6.** Approval of the development of GM food in Poland in 2010. Source: Eurobarometer 73.1, Biotechnology Report (2010)

and 61% of other Europeans) say that those products make them feel “uneasy”. Moreover, 61% of Poles find GM food potentially harmful for future generations and only 20% feel that such products might improve the economy (Fig. 7).



**Fig. 7.** Attitude of Poles (PL) and the Europeans (EU) towards GM food. Source: Eurobarometer 73.1, Biotechnology Report (2010)

In our opinion, such a negative attitude towards GM food in Poland is the result of a combination of several factors:

- low level of general knowledge of biological sciences among lay people,
- negative image of transgenic plants presented by most media sources,
- lack of social campaigns to promote awareness of biotechnology innovation,
- propaganda against GM food organized by various environmental groups,
- lack of private sector activity in the popularization of scientific achievements.

Strong public resistance to genetically modified organisms (GMOs) is recognized by policy makers, therefore the official government position on this matter is nega-

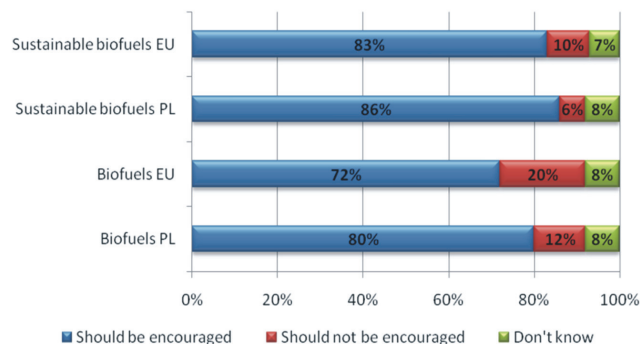
tive. Due to the Polish membership in the EU, domestic law must be consistent with EU legislation. At the same time, however, Polish representatives, at the EC sessions and committees, are obliged to express the Polish people’s negative attitude towards the introduction and distribution of GM food and feed.

**Awareness and approval of biofuels**

In recent years, due to the need for mitigating climate change and limited stocks of non-renewable resources, biofuels have attracted an increasing attention of governments and scientists, as well as investors. Biofuels can be defined as solid, liquid, or gas fuel derived in some way from biomass. The role of biotechnology in making biofuels more sustainable includes:

- increasing biomass yield per hectare (while reducing the production costs),
- improving the quality of crops,
- increasing the productivity and minimizing losses caused by biotic (insects, viruses) and environmental (drought, salinity) stresses,
- growing energy crops on non-agricultural areas,
- introducing dedicated micro-organisms and enzymes.

In the Eurobarometer survey, respondents were first asked about biofuels, in general, and later on specifically about sustainable biofuels. Overall, a large majority of the Europeans encourage further development of biofuels (72%), while only 20% are reluctant to research in this matter. For Poland these values are 86% and 6%, respectively. Even more respondents seemed to be optimistic when asked specifically about sustainable biofuels: eight in ten of the Europeans feel that this matter is well worth further research and only 10% do not hold this view (Fig. 8).



**Fig. 8.** Opinion of the Europeans on biofuels

### Possible perspective for the implementation of GM products in Poland and other EU countries

Progress in science and innovative technologies are always associated with the emergence of various risks. It is essential, however, to balance the profit and loss account. In the case of biotechnology, the costs associated with the failure of commercialization are much higher than the potential risks, as this innovative science offers technological solutions for many urgent challenges facing the world. Today, the application of biotechnology in agriculture, healthcare and industry is increasingly significant and contributes to a substantial part of economic output (OECD International Futures Programme). Therefore, it is needless to say that optimum conditions for the development of biotechnology should be provided. Research and development (R & D) are the principle factors, but we must not overlook other important factors, such as:

- the release of funds and rationalization of expenditure on R & D,
- supporting the development of public-private partnerships,
- improvement of legal regulations (harmonization of law),
- continuous education of the public in the natural sciences,
- public approval and acceptance for scientific research.

Given the low public acceptance of agrobiotechnology, more education seems to be the most important issue. It will also be significant to ensure transparent re-

gulations on biotechnology. Only in the case of optimal improvement in all three areas of science, law and social factors will the development of innovative biotechnology be guaranteed. Moreover, the freedom of choice whether to use biotechnological products will be safeguarded exclusively when the consumers are aware of both the profit and loss of biotechnology. Unfortunately, the advantages have not generally been popularized, while the potential hazards have been emphasized.

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