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Biotechnology: the role of science and technology upon society

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Abstract: The use of biotechnology techniques in areas of science and technology and the discussion surrounding the impacts that these two fields have, is controversial. The applications of biotechnology have both positive and negative effects upon both humans and plants in the fields of health and crop production. This paper investigated and analyzed the key issues surrounding biotechnology applications for humans, other animals, plants and the environment. We concluded that there is a controversial scenario related to biotechnology applications upon the studied fields.

Keywords: biotechnological applications, ethics, review.

Biotecnologia: o papel da ciência e tecnologia na sociedade

Resumo: O uso de técnicas biotecnológicas em áreas de ciência e tecnologia e a discussão em torno dos impactos que esses dois campos têm é controverso. As aplicações da biotecnologia têm efeitos positivos e negativos sobre os seres humanos e plantas nas áreas da saúde e da produção agrícola. Este trabalho investigou e analisou as principais questões que cercam as aplicações biotecnológicas para os seres humanos, outros animais, plantas e o meio ambiente. Nós concluímos que há um cenário controverso relacionado a aplicações da biotecnologia sobre os campos estudados.

Palavras chave: aplicações biotecnológicas, ética, revisão.

1. Introduction

Biotechnology is broadly defined as any technique that involves plants, animals, micro-organisms or biological processes designated to genetic improvement through exploitation of living systems and their components, in order to benefit human life (CHAWLA, 2002). Biotechnology is not a relatively new discipline and it is used in different areas of science and draws the attention of many researchers. Indeed, traditionalists argue that many applications of biotechnology represent old practices that humans have been using to create products or process in attempt to improve their lives, such as the productions of wines and alcohol.

Contrastingly, modernists suggest that new biotechnology involving gene technology will have the greatest impact in different areas of science, affecting the society and the economic structures (DASILVA, RATLEDGE, & SASSON, 1992; MCEWEN & HARRINGTON, 2000).

New treatments for many diseases that use bacteria as a raw material began to be developed and made available for medical use. On the other hand, some applications of gene technology used in a health field are not in accord with the diverse cultural, moral and religious beliefs (THIEMAN & PALLADINO, 2004).

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Biotechnology has been a frequently used tool that can produce many products and achieve a variety of worthwhile aims. However, the successes of biotechnological applications are therefore dependent on society's structures and whether the population is or not prepared to receive its impacts. Thus, the uses of biotechnology are in the areas of science and technology and the discussion surrounding the impacts that these two fields have, is controversial. These significant factors have both positive and negative effects upon both humans and plants in the fields of health and crop production.

2. Biotechnology Applications for Humans - Field of Health

The field of biotechnology applied to health is considered one of the most controversial because of the ethical and moral issues; however, it is a breakthrough in new ways to combat diseases in humans Grace (2006). Currently, medical applications use the science of bioengineering to create tools to combat and the control of diseases. These tools are being developed not only to improve the quality of life, but also to reduce the price of medicines, making them accessible to all classes. Bioengineering techniques have markedly accelerated the pace of medical research and have created unprecedented opportunities for progress in medical science (WALKER, 2007).

The most successful medical biotechnologies are correlated with modern biotechnology, which makes use of genetic information, with recombinant DNA (rDNA), for the production of useful substances for humans (WALKER 2007). This technique involving recombinant DNA has many marketed products and many in clinical development. One of these products is the insulin, which is directly related to one of the most common diseases in elderly, the diabetes mellitus. Thieman & Palladino (2004) point out another advancement of biotechnology in the treatment of the diabetes disease was the discovery of the *in vitro* fertilization (IVF) technique. Through the IVF technique, researchers have discovered the existence of cells in the human body that have a high power cell differentiation, called embryonic stem cells (ES cells). These cells are classified as pluripotent because they are undifferentiated cells which can give rise to new stem cells and other different types of cells, organs and tissues. Moreover, techniques using stem cells can potentially benefit millions of people, having a significant role in the treatment of very common diseases in the population, such as diabetes. However, when discussing the applications of stem cells, the use of them to fight diseases is still unproven (THIEMAN & PALLADINO, 2004).

The main reason for many treatments of diseases not having been discovered yet is due to ethical issues in medicine, which prohibits research involving human beings, but only with animals such as rats, chickens and pigs.

3. Biotechnology Applications in Plants – Field of Crop Production

Regarding the applications of biotechnology in the field of crop production, agriculture and biotechnology are combined to make the cultivation of plants more efficient. This combination was and still is extremely important when combating pests and diseases, as well as for the production of grains, fruits and vegetables, with new features, such as higher concentrations of nutrients, modified oil composition and longer shelf life (Grace, 2006).

The biotechnology applied for plants, especially related to agriculture, is the most responsible for increasing the region's economy or country. He points out that American agriculture exported more than $57 billion in 2001, mainly with the exportation of grains and seeds. Currently, the field of genetic engineering in agriculture is one of the most relevant, especially regarding the production of genetically modified foods (GRACE, 2006).

Numerous studies have shown that the growth of agricultural production have contributed to the reduction of hunger and poverty worldwide. As an example, in India for every one million rupees invested on agriculture in the 1990s, 323 poor people were lifted above the poverty line. This field offers new varieties of staple crops, such as biofortification, which is one rich in micronutrients, giving opportunity to low-income people to receive necessary amounts of nutrients.

Biofortification provides a means for people who do not have a regular and sufficient diet to have access to these staple crops in an attempt to reduce hunger and mortality rates.

The increase in agricultural production faces some problems and creates negative impacts. The problem is that there is a small percentage of land in good conditions available for agricultural cultivation. There are some negative effects surrounding farm production because the designated production area needs to be deforested, resulting in a great loss of local biodiversity and carbon sequestration capacity.

The other negative consequence of increasing food production is significant increases in the costs of investment, which would result in increased food prices and may affect the economy (VON BRAUN, 2010).

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4. Conclusion

In conclusion, as presented in this article, the world faces controversy relating to biotechnology applications upon both humans and plants in the fields of health and crop production. As in all fields of science, biotechnology applied to health and agricultural production has negative aspects. As shown in this report, many advances in the field of health, for example in the treatment of diseases, may not continue due to moral issues and or diverse cultural attitudes. It must not be forgotten that research is an attempt to seek a better quality of life. It is worth noting that biotechnology is one of the more promising strategies. Regarding the applications of biotechnology in the field of crop production, seeking new areas for agricultural production has become a serious problem. What needs to be considered is that the agricultural sector should know how to further leverage their farmland, applying biotechnological techniques correctly. Even though biotechnological applications have negative aspects as mentioned above, their uses should continue so that the manufacturing processes become more efficient. More studies are needed not only to discover new applications of biotechnology, but to find out how to use them correctly and efficiently.

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