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Public perception of science: Biotechnology as an example

“Biotechnology is defined as a set of technologies organized in a horizontal way that includes a range of techniques derived from or related to molecular biology, which employ the properties of living beings or some of its components, in order to develop new industrial processes, goods, or services.” (Muñoz, 2000; pp. 186-187).

Old biotechnology

An association of biotechnology with food has been established throughout the history. Around 6000 B.C. Babylonians made the brewing. By the year 4000 B.C. Egyptians learned to use yeast to make bread. Production of wine from the fermentation of grapes is mentioned in the Old Testament of the Christian Bible. Other craft methods are known from antiquity such as preparation of vinegar, yogurt and cheese. Many centuries later, in the 19th century, Pasteur contributed greatly to control these processes by means of scientific methods. Indeed, Pasteur's theory of fermentation caused by the activity of microorganisms allowed to explain and to resolve difficulties of conservation and transport milk, beer, wine and vinegar over long distances. Also, it allowed to improve the production of some foods such as bread, yoghurt and beer.

Contemporary biotechnology

Biotechnology has undergone deep changes since the last quarter of the 20th century due to the extraordinary advances in molecular biology and genetics. Contemporary biotechnology has given rise to controversial issues such as genetic modification of unicellular organisms, genetic diagnosis, bioremediation, production of medicines by microorganisms, cloning cells or human tissues for therapeutic purposes, experiments with animals and their cloning to obtain therapeutic substances, genetic modification of plants and crops to increase resistance to plagues, production of genetically modified foods to improve their properties, etc.

Factors influencing on public perception of the biotechnology

Biotechnology covers a large field of scientific and technological topics, therefore maybe we should talk of biotechnologies. In any case, the analysis about the public perception of biotechnology is determined by its complexity and multifaceted nature (Acevedo, 2006).

The evolution of social debates about the most controversial issues related to biotechnology can be outlined as follows:

- a) In the 1970s decade it was the application of genetic engineering for modifying unicellular organisms in the laboratory and its unpredictable consequences. Thus, references to "Frankenstein monster" or "Golem" were frequent as metaphors.
- b) In the 1980s and 1990s decades debates and criticism went about the environmental risks of genetically modified (GM) crops, and the consequences of modifying animals genetically.
- b) In recent years the main discussions have focused on the possible harmful effects of GM foods on human health and the environment.

According to Muñoz (2004), the diversity of social debates related to biotechnology issues is as a consequence of a cross- and interdisciplinary nature of biotechnology deeply connected to (i) economy and trade of powerful industries such as pharmaceutical, food..., (ii) national, regional or local interests, (iii) culture, (iv) moral and religion, etc.

"There are different factors at the core of the debate: cognitive deficiency, risk, uncertainty, religious and moral values, interests, confidence, are some of them which come into play. Sometimes some of these factors clearly emerge as a causal element of the debate. In other cases, several of them are intermingled."
(Muñoz, 2004; p. 145).

The case of transgenic foods (GM foods)

Factors that may influence the social controversy over GM foods

- ✓ Rejection of the consumers to take risks when the direct benefits are not perceived.
- ✓ Lack of confidence of the citizens in the agencies responsible for regulation of food.
- ✓ Influence of lobbies and other pressure groups.
- ✓ Coincidence of the GM foods commercialization with some diseases animals (e.g., “mad cow disease”, “avian bird flu”...).
- ✓ Perception by citizens of certain laxity of the experts in general, and scientists and technologists in particular, to manage the consequences of biotechnologies.
- ✓ Protectionist interests of a lot of governments (e.g., in EU), which put strong constraints and barriers to trade of GM crops and foods.
- ✓ Scarce attention to the information demanded by consumers about the labeling of GM foods, despite they have rights of know about it.
- ✓ Biased and sensationalist treatments of GM foods in many mass-media.

Implications for science education

The ability to negotiate and resolve controversial technoscientific issues with social interest –socioscientific issues (SSI) in science education– is currently considered an essential component of scientific and technological literacy for all (Sadler, 2011), as well as a public understanding of contemporary technoscience.

Furthermore, the relationship between science education and values education –or rather the ***education for assessing***– is manifested more strongly in controversies about SSI. From this perspective, values education should focus on the problems of the world today. Many of these problems are related to scientific developments, such as biotechnology. Thus, science education should incorporate competences for negotiating and resolving controversies about SSI (Acevedo, 2006; Kolstø, 2001).

Use of SSI in science education is a powerful resource to promote scientific and technological literacy (Acevedo et al., 2005; Kolstø *et al.*, 2006), especially when appropriate treatment methodologies are used in the classroom (García-Carmona, 2006; Kolstø, 2000; Kolstø & Mestad, 2005; Martín-Gordillo, 2005a,b; Martín-Gordillo & Osorio, 2003; Sadler, 2011). In this way, it contributes to promote the citizen participation to make decision about technoscientific issues, favoring the dissemination of scientific and technological culture.

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