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The dimension of food safety between the priority of ensuring food security and the risks of genetic modification

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Abstract:

This scientific paper aims to explore the relationship between achieving food safety and the use of genetic modification applications, in order to achieve food security, which is considered one of the most important issues at the forefront of the agendas of countries around the world, especially the advanced ones.

Countries' economies have sought ways to achieve acceptable levels of food security by balancing the provision of products that maintain food safety standards on one hand, and employing genetic modification technologies to increase the abundance of agricultural crops and livestock on the other . However, the use of biotechnology for this purpose has not been free from criticism due to its impact on food safety. This is what we will attempt to discuss in this study, highlighting international and local trends regarding the suitability of genetically modified products for consumption to ensure food security and their non-impact on public health.

Keywords: Food Safety, Genetic Modification, Food Security, Consumption, Public Health.
JEL Classification Codes: Q18, Q16, D12, I18.

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INTRODUCTION

Food security is one of the most important international issues currently at the forefront of concerns. It has significantly attracted the attention of leaders and officials in their quest to find the most effective means and shortest possible paths to ensure it and eradicate the scourge of hunger worldwide. This is because food is one of the essentials upon which existence is based and one of the foundations upon which life and the dynamics of societies and nations are built.

Talking about food security necessitates addressing the issue of food safety; it seems to be largely harmonious and interactively related to the idea of food safety and its freedom from risks and health hazards. Accordingly, the importance of the study is evident in the leading role of food safety in influencing public health and the budgets and economies of countries, where international policies strive to achieve the necessary balance to ensure this security, meeting the increasing food needs of the population sustainably and making it available to all.

Amidst all this, the necessity arose to search for effective solutions to the problem of food security, and countries and organizations resorted to promising scientific solutions by introducing genetic modification techniques to improve the genes of living organisms.

But these newly introduced technologies in food systems are not without the ongoing debate about their negative impacts and potential risks to safety and public health.

Therefore, this study aims to clarify the issue of food security and the food shortages that countries suffer from, presenting one of the radical solutions represented by the adoption of genetic modification applications as a solution to this dilemma.

From this perspective, the study's issue revolves around the strategy of achieving a balance between maintaining food security and meeting the globally increasing demand for food.

How can countries respect food safety standards while using genetic modification technologies to achieve sustainable food supply? There are subsidiary questions that we have chosen to highlight, as follows:

- What is meant by food safety?
- What is the essence of food security?
- What does genetic editing technologies mean?
- What are the threats posed by the consumption of genetically modified materials to ensuring food safety?

In order to address the posed issue and the series of sub-questions, we decided to employ the descriptive method to present and explain the issue of food security, identifying its causes and discussing one of the strategic solutions to eliminate it or at least reduce its severity; namely, genetic modification techniques.

This includes outlining the objectives sought from their use, as well as describing the potential risks arising from their introduction into the genetic makeup of plants and animals in pursuit of a more abundant product.

We also employed the analytical method by sifting through the current data and analyzing it by breaking down our main issue into sub-units, addressing their explanations to clarify ambiguous matters, critiquing them, and providing alternative solutions, leading to precise and robust research results.

We based our study on three main axes; in the first axis, we addressed the concept of food safety and its connection to food security. As for the second axis: the content of genetic modification techniques and their potential effects on food safety. As for the third axis: the reality of food safety in the context of consuming genetically modified materials and organisms to ensure food security.

1. Sustainable Food Security and Food Safety...A Knowledge-Based Approach

Food safety and food security are often confused due to their overlapping aspects.

To clarify this, we will first address the concept of food safety (first section), and then touch upon the essence of food security (second section).

1.1 The meaning of food safety

Among the definitions of food safety those that indicate the interconnection and sequence of a set of procedures in compliance with the laws and regulations established by government entities and relevant regulatory bodies concerning manufacturing, handling, storage, adherence to refrigeration chains, labeling, and specifications aimed at protecting the safety and security of food materials and their suitability for consumption; At the global level, the right to food safety is considered one of the rights recognized by international organizations and treaties concerned with this field.

Articles 1and 2 of the preamble of the Constitution of the Food and Agriculture Organization (FAO) require all member states of the organization to implement, individually or collectively, activities aimed at improving nutrition and living standards.

This involves a set of legal texts aimed at enhancing the effectiveness of production and distribution processes of food products, specifically those of agricultural origin (Belharash, 2024, p. 413).

International organizations such as the Food and Agriculture Organization and the World Health Organization are intervening and working diligently to improve the current deteriorating situation marked by the spread of foodborne diseases and the risk to food safety (Food and Agriculture Organization (FAO), n.d.).

On the national level, Algeria has sought to enshrine the right to food safety by establishing a set of legal and regulatory texts, which we will review in the third section.

1.2 Definition of Food Security

The Food and Agriculture Organization (FAO) defined "food security" as providing food to all individuals in the quantity and quality necessary to meet their needs continuously for a healthy and active life (World Bank Group, n.d.).

The United States Department of Agriculture (USDA) defines food security as "the ability of all individuals to access sufficient food at all times to ensure an active and healthy life." The concept of food security is based on several laws and legal references with international legitimacy, including the Rome Declaration on World Food Security, issued by an international conference held in the Italian capital, Rome, on November 13, 1996. As Article 25 of the Universal Declaration of Human Rights states, "Everyone has the right to a standard of living adequate for the health and well-being of themselves and their family" (Food and Agriculture Organization (FAO), n.d.).

Additionally, the International Covenant on Economic, Social and Cultural Rights reinforces in Article1of prosperity (Wikipedia contributors, n.d.).

Nationally, since independence, Algeria has adopted agricultural policies aimed at achieving food security and self-sufficiency in light of the increasing population. This term was defined in Article 3 of Law 08-16 (Law No. 08-16, 2008), which states that food security is "the ability of every person to obtain sufficient, safe, and nutritious food easily and regularly, allowing them to lead an active life."

2. Genetic modification of foods

We will highlight through this section the meaning of genetic modification techniques (first requirement), and then address the impact of these techniques on food safety (second requirement).

2.1 The meaning of genetic modification techniques

Genetic engineering is defined as human manipulation of the genetic material of a living organism to achieve changes, improving traits, functions, and production both in quantity and quality. This is done using various methods, such as the CRISPR technique, which allows for the precise insertion, deletion, or

modification of specific genes. Any living organism produced using these techniques is considered a genetically modified organism. Bacteria were the first microorganisms to be genetically engineered in 1973, followed by mice in 1974 through the production of insulin, which resulted from the genetic modification of these bacteria in 1982 (genetic engineering).

The applications of this science include medicine, scientific research, industry, agriculture, veterinary medicine, and mic.

2.2 The impact of genetic modification techniques on food safety

We will try, through the following two sections, to present each team's position, highlighting the foundations on which they based their choice.

2.2.1 The Positive Impact of Genetic Modification Techniques on Enhancing Food Security

The intervention of genetic engineering technology and the radical modifications and improvements it entails represent, according to this group, a real solution to achieving global food security.

Recent statistics from the Food and Agriculture Organization (FAO) of the United Nations confirm that 37 countries in the world, approximately 854 million people, including 20 African countries, suffer from severe food shortages, which is 12.6% of the world's population, and need immediate food assistance (United Nations Food and Agriculture Organization (FAO), n.d.).

Many scientists have called for the adoption of these technologies, including "Ahmed Mostagir" in his specialized research on agricultural crops, stating that the world does not deny that genetic engineering is the only solution to the global food problem; reliance on this science is essential to overcome the food crisis and ensure global and local food security. Professor "Mohamed Nabil Al-Awadi," a professor of agricultural engineering at Ain Shams University, adds that genetic modification and genetic engineering applications are

necessary to provide the world with food and address excessive population growth. (Al-Arab Newspaper). In addition, a team of American scientists has succeeded in producing genetically modified animals with resistance to certain diseases, as well as increased milk production and notably enhanced meat growth, resulting in a bountiful and abundant yield of dairy and meat compared to that of ordinary natural animals (BBC News, 2024).

As for Canada, 80% of foods contain genetic modifications (Al-Arab Newspaper), proponents of this view rely on the reassurance of nutrition experts, expressing their certainty that genetically modified foods are mostly of high quality.

2.2.2 The Negative Impact of Genetically Modified Foods on Food Safety

The proponents of this approach acknowledged the dangers of biotechnological methods used to introduce various genetic modifications to both plants and animals alike.

Speaking of animals, some studies contrary to the initial opinion have proven that the introduction of certain proteins into cattle breeds in England led to a malfunction in their brain system (Wikipedia contributors, n.d.), causing what was previously known as mad cow disease. On March 20, 1996, the British Health Minister shocked the world by announcing that ten young people were suffering from neurological symptoms and mental retardation.

These symptoms resembled those of Kuru disease and mad cow disease in humans. These young people had indeed been exposed to the disease for a few days before the announcement. This announcement means that the disease can be transmitted from cattle to humans.

Most countries' measures, from banning the import of British beef to requiring EU member states to ban the import of British cattle, indicated that mad cow disease was spreading.

This shows how sensitive the world has become, as it has become more sensitive to food safety and cleanliness of its sources (Abdel-Salam, 1998).

And considering cows as an important source of animal food, genetic engineering in this manner has affected food security instead of enriching this product and increasing its availability.

Not to mention the plant, which health and civil organizations, as well as public opinion, in several European communities, have confirmed that biotechnology unintentionally increases harmful substances; thereby altering the nutrient levels in some foods, (Malika Al-Zagheeb, 2009) due to the spread of artificial and foreign genetic traits that disrupt the ecosystem.

3. The reality of food safety in the context of consuming genetically modified products to ensure food security

We will then address the active international efforts in this field that have worked to maintain food safety (the first requirement), and then move on to evaluating the Algerian experience in ensuring the safety of genetically modified food as a solution to the food security problem (the second requirement).

3.1 International efforts to maintain food safety in the face of genetically modified food consumption

Food safety is primarily a shared responsibility among members of the international community, and in this context, June 7 was chosen as World Food Safety Day (National Office for Food Safety, n.d.). The international community has worked on concluding several agreements and treaties against food safety and security, and we will attempt to outline the legal framework dedicated to maintaining food safety. Section One: Agreements and Promises We will outline below the various agreements, whether they are comprehensive for all members of the international community, at the European, Arab, or African level.

3.1.1 Comprehensive treaties for members of the international community and it is as follows

A. The International Treaty on Plant Genetic Resources for Food and Agriculture

It is a legally binding instrument, adopted by the Food and Agriculture Organization of the United Nations Conference in 2001 and entered into force on June 29, 2004. This agreement aims to establish its objectives, which include the conservation of plant genetic resources for food and agriculture and their sustainable use, and the fair and equitable sharing of benefits arising from the use of these resources (Al Meezan – Qatari Legal Portal, n.d.). Algeria was among the first countries to ratify this treaty and adopt it as a reference for establishing internal legislation in line with its objectives.

B. Biosafety Protocol

According to the definition by the Food and Agriculture Organization of the United Nations, it is a process of managing biological risks inherent in food and agriculture comprehensively, where the concept of agriculture includes everything related to agricultural engineering (United Nations Environment Programme (UNEP), 2024).

C. Cartagena Protocol on Biosafety

On January 29, 2000, the Conference of the Parties to the Convention on Biological Diversity adopted a supplementary agreement to this convention known as the "Cartagena Protocol on Biosafety." It is an international treaty governing the movement and transfer of genetically modified organisms from one country to another (World Intellectual Property Organization (WIPO), n.d.).

D. The Food Code

What is known as the "Food Code," which is considered the global reference for consumers, food producers, and manufacturers; it serves as the fundamental law for food safety (National Office for Food Safety, n.d.).

3.1.2 European laws and regulations

EU law defines genetically modified organisms as any living organism whose genetic material has been altered in a way that does not occur naturally through mating or natural recombination. In application of the precautionary principle, the European Union issued a directive in 2001 that allowed the marketing of genetically modified materials according to certain procedures (World Health Organization (WHO) & Food and Agriculture Organization (FAO), n.d.).

3.1.3 Arab laws and regulations

The issue of Arab food security is considered one of the most important issues that is receiving increasing attention from Arab countries, and the Arab Organization for Agricultural Development places it at the forefront of its concerns. In this context, the organization has created the guideline for organic farming in the Arab world by forming experts from member states (Arab Organization for Agricultural Development (AOAD), n.d.).

3.1.4 The African Model Law on Biosafety

It is the primary reference for establishing a common biosafety system in Africa, recommended by the member states of the African Union, and adopted in 2001. This law was developed with the assistance of a group of international and local experts (Massoud Khethir, 2021).

3.2 Evaluating the Algerian Experience in Ensuring the Safety of Genetically Modified Food as a Solution to the Food Security dilemma

They consist of a set of laws dedicated to food safety, represented by preventive and punitive policies to achieve the goal of food safety, which we present as follows:

3.2.1 The preventive policy adopted for the safety of genetically modified food

A. Laws protecting food safety

This particularly concerns Law 05-03 related to seeds, seedlings, and plant possession (Law No 05-03, 2005), as well as Law 09-03 related to consumer protection and the suppression of fraud (Law 09-03, 2009).

a. Law 05-03 concerning seeds, seedlings, and plant possession

This law aims to define the conditions for the certification of seeds and seedlings used in plant production, their production, propagation, and marketing.

b. Law 09-03 on Consumer Protection and Fraud Prevention

The Consumer Protection and Fraud Prevention Law did not explicitly and clearly address the precautions that must be taken regarding genetically modified organisms (plants), but we can infer the application of the general provisions of this law to this type of food, within the framework of implementing the provisions of Article 4 of this law, which includes the necessity of respecting the safety of food products placed for consumption and ensuring they do not harm the health of consumers.

B. Executive decrees dedicated to food safety

Among these executive decrees, we particularly mention Executive Decree No. 93-284 related to the regulation of seeds and seedlings (Executive Decree 93-248, 1993), as well as the two subsequent executive decrees 06-246 (Executive Decree 06-246, 2006) defining the powers of the National Seed and Seedling Committee, and 06-247 (Executive Decree 06- 247, 2006) related to the official index containing the list of approved plant varieties, in addition to Decree 11-05 (Executive Decree 11-05, 2011) which amends it, noting Decree 10-69 which defines the procedures applied when importing and exporting plant health materials for agricultural use (Executive Decree 10-69, 2010), and finally Executive Decree No. 12-203 related to the rules applied in the field of product safety (Executive Decree 12-203, 2012).

C. Ministerial decisions affirming the principle of food safety

We specifically refer to the decision dated December 24, 2000 (Minister of Agriculture's Decision No. 65, 2000), issued by the Minister of Agriculture, which in its first article emphasized the prohibition of importing, producing, marketing, and using genetically modified plant material, in implementation of the provisions of articles: 2, 20, 23, 25, and 43 of (Executive Decree 93-248, 1993).

3.2.2 The deterrent policy to ensure food safety from the risks of genetically modified organisms

We will touch upon the various laws and executive decrees in this context, addressing them as follows:

A. The penalties stipulated by Law 05-03 regarding violations of food safety provisions resulting from the consumption of genetically modified materials

The legislator has criminalized a set of actions listed in these legal articles (Articles 67 to 73) (Law No 05-03, 2005), which include "the production, reproduction, distribution, or marketing of unapproved and unregistered seeds and seedlings in the national official register." This exposes anyone who commits these acts to physical and financial penalties. This means that anyone who endangers public health, whether human or animal, by producing, reproducing, or marketing genetically modified materials and organisms will be subject to these penalties.

B. The penalties provided under Law 09-03 regarding violations of food safety provisions resulting from the consumption of genetically modified materials

The Algerian legislator previously intervened by incorporating several punitive legal texts within the Penal Code as well as Law 89-02, which includes the general rules for consumer protection (Fath, 2021).

To reinforce its approach to maintaining food safety; and through the examination of the provisions of Law 09-03 concerning consumer protection and the suppression of fraud, we notice that the Algerian legislator has worked on establishing general concepts that encompass any case of food consumption posing a public health risk, and this is fully in line with the provisions of these articles (Law 09-03, 2009).

C. The penalties provided for by Executive Decree 12-203

This law, under Article 23, refers to the application of various physical and financial penalties outlined in Law 09-03 concerning consumer protection and the suppression of fraud (Law 09-03, 2009), when any violation of its provisions is committed. Thus, it confirms the effectiveness of this law's

provisions and the mandatory application of these penalties on anyone who dares to compromise food safety and security.

CONCLUSION

Food security has always been a global issue, requiring the collective efforts of individuals, nations, and organizations to ensure food availability for all, eliminate hunger and poverty, and adopt various means to achieve this goal .

Among these means is the use of genetic modification technologies as an alternative approach to producing higher-quality, more abundant crops with improved genetic traits.

However, this does not mean compromising public health and safety, especially given the uncertainties and scientific doubts surrounding these technologies .

The debate over incorporating genetically modified organisms (GMOs) into food systems and their potential risks continues at both international and regional levels. While some support their use, others oppose it due to concerns over health and safety .

Research and discussions remain ongoing to reach a definitive conclusion on this matter.

Through this research paper, we have reached the following findings:

- Food security is a cross-border global challenge, and efforts are still being made to find sustainable solutions to eradicate hunger worldwide.
- Governments are striving to secure food supplies, including through genetic modification technologies, also known as genetic engineering.
- Algeria has demonstrated a commitment to food safety by integrating environmental concerns into its development and food programs, aiming to provide safe and healthy food.
- Food safety remains a pressing issue for policymakers, organizations, and associations due to the uncertainties surrounding genetically modified foods and their potential health effects.

Study Recommendations

Based on these findings, we propose the following recommendations:

- Intensify research on genetically modified foods and organisms at both the international and national levels, particularly in Algeria, where reliable data on their safety and impact on public health remain scarce.
- Strengthen monitoring and regulation of GMO food safety by establishing both international and national regulatory frameworks. Currently, Algeria has only one specialized research center, the Constantine Biotechnology Research Laboratory.
- Utilize all available technological and biotechnological resources to deepen research on improving agricultural and livestock products through genetic engineering.
- Establish clear legal frameworks, particularly in the penal field, to regulate actions that may compromise food safety. This includes restricting the promotion of genetically modified foods for consumption without solid scientific evidence until further research provides a conclusive stance on the matter.

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