

CONTROL TECHNIQUES USED TO MANAGE AND MITIGATE FOOD FRAUD

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ABSTRACT

This paper aims to synthesize in a logical and coherent approach the main control techniques used in managing and combating food fraud, as well as to discuss their effectiveness.

Given the impact that food fraud can have on consumers' health and well-being, anti-fraud control techniques used throughout the food chain are an important and relevant topic, still insufficiently addressed and accepted in the relevant economic environment.

The objectives of the article include presenting the current context of food fraud, different anti-fraud control techniques and relevant examples, as well as drawing conclusions and recommendations for the future. By addressing this topic, the article aims to contribute to raising awareness about the importance of preventing and combating fraud of any kind in the food industry.

Preventing and combating food fraud involves a multidimensional approach that includes food monitoring and control, enforcement of regulations and standards, and international cooperation. By implementing these measures, authorities can help protect consumers against fraudulent practices in the food industry.

In conclusion, monitoring and controlling food supply chains is a proactive and essential approach to effectively combat food fraud. By applying these measures, it can be ensured that food reaches consumers with guaranteed authenticity and safety, thereby protecting public health and strengthening trust in industry.

Keywords: food fraud, control technics, food safety

INTRODUCTION

Food fraud dates back to ancient Rome and Athens, where there were laws on counterfeiting wines with flavours and colours [7]. Even though food fraud is an old problem, it is still topical. Food fraud is a problem that affects all food supply chains and therefore the entire food industry, customers and consumers. Food supply chains are becoming increasingly vulnerable due to globalisation and its prolongation [1], [11]

With greater awareness of food safety and quality, consumers are increasingly demanding reassurance about the origin and content of food consumed, while producers must be able to confirm the authenticity of components of marketed products in compliance with government legislation. Therefore, protecting the rights of consumers and processors of genuine food products and preventing fraudulent or misleading practices relating to food adulteration is an important and challenging issue in the food industry. As a result, scientific and technological advances have taken place in recent years in determining food authenticity. [11]

Modern food authentication techniques focus on newly developed techniques and their recent applications in authenticating and combating food fraud.

Techniques specific to the identification of falsifications include various spectroscopic technologies, methods based on isotopic analysis and chromatography and other DNA-based techniques, enzymatic analysis, electrophoresis and thermal methods.

Within this general framework for addressing quality, food occupies a particularly important place in EU policy; The quality requirements imposed on these products are due, on the one hand, to the prospects of increasing the number of consumers with the acceptance of new members (and implicitly to the substantial increase in food trade), and on the other hand to the numerous and costly crises in the agri-food sector it has faced (BSE crisis – bovine spongiform encephalopathy, nitrofurans, hormones, mycotoxins, etc.) and which have jeopardized confidence in quality and safety food from the EU. [12]

In this context, the European Union recommends monitoring food products from the stage of obtaining raw materials to the final consumer. This strategy aims to protect and regain the confidence of consumers in the Member States by adopting concrete legislative actions, based primarily on the precautionary principle.

Throughout its existence, the European Union has sought to provide its full members with advantages that they alone would not have obtained, namely the four free movements: for persons, goods, capital and labour. [5]

Products accepted on the market circulate freely, without being subjected to multiple and costly checks in terms of time and money. In order to achieve this desideratum, however, compliance with harmonized standards at European level must be achieved and proven, which give the presumption of seriousness in terms of achieving quality and especially maintaining its constancy. In the European Union, national quality specifications will be replaced by directives that are common. EU directives set minimum conditions that certain products and services must meet in order to be sold on the European market. For products covered by these directives, suppliers must demonstrate compliance with current European Union standards.

The food industry is in the unique position of being a victim of food fraud and also largely responsible for food fraud incidents [12]. Therefore, the food industry needs a clear understanding of food fraud, as well as guidance on preventing and mitigating food fraud.[13]

However, within these documents, definitions of food fraud often differ, as well as the types of food fraud that may occur. Therefore, prevention and mitigation strategies are pervasive and not specific to a particular supply chain, which increases ambiguity. The authenticity of agri-food products has not been officially defined, nor is there a European or national regulatory framework: there are no sanctions for economic operators /

individuals who intervene in the food chain with inauthentic / falsified products, product characteristics, procedures / technologies for obtaining are not regulated, there is no validated, unanimously recognized definition - there are nuances between the approach of specialists in Europe and those in the United States when the definitions of food fraud, integrity, and economically motivated adulteration of food are brought up.

Food information shall not mislead the purchaser, in particular as regards the characteristics of the food, its nature, identity, properties, composition, quantity, date of minimum durability, country of origin or place of provenance, method of manufacture or production - it shall not attribute to the food effects or properties which it does not possess. Label declarations must comply with what is laid down by regulations and what the food actually contains.

In this context, we emphasize the need for public policies in the food field, even if the very concept of public policies in the field of food (food policy) is an "ambiguous concept" that requires debates on the interrelation with other areas of public policies or the need for an integrative approach of food policy with public policies related to consumer health, agriculture, environment, security, research and education, tourism, culture, transport, etc.[8]

The responsible authorities, in collaboration with other stakeholders, must ensure appropriate conditions so that safe (harmless/wholesome), quality (intrinsic nutritional value, energy supply due to biomineral compounds, vitamins and other bioactive compounds, bioavailable nutritional value) and authentic food products reach consumers' meals.

Simply, food regulations address the control of food businesses with local, regional, national and international rules and regulations for food production and sale, including food safety and quality and industry lobbying activities. Out of the referred aspects of the food industry, food regulations become pivotal in the food trade as those are to ensure food safety, quality and honest offering keeping food trade comfortable for the economic growth.

Due to technical and legal complications and the involvement of different institutions with responsibilities in food safety and security, food regulatory systems are complex in nature. A well-structured, efficient and accessible regulatory system is key to the development of the food industry.

In 2003, WHO and FAO made a joint publication on ensuring food safety and quality: guidelines for strengthening national food control systems. With a great interest in promoting national food control systems, especially in developing countries, WHO and FAO presented this publication aimed at national authorities concerned with ensuring food safety and quality in the interests of public health and consumer protection. Its guidelines are also helpful to a number of other stakeholders, including consumer groups, industrial and commercial organisations, farmer groups and any other groups or associations influencing national policy in this area.[6]

As the WHO and FAO identified common factors undermining national food control systems, its guidelines sought to advise national authorities, particularly in developing countries, on strategies to strengthen food control to protect public health, prevent fraud and deception, avoid food adulteration, and facilitate trade. These guidelines therefore appear to help formulate recommendations on food fraud and ways to prevent and combat

it, considering the local food regulatory environment, policy feasibility and socio-cultural elements.[8]

FAO published *Strengthening National Food Control Systems: Guidelines for Assessing Capacity Building Needs* (2006). It provides robust assistance in developing food regulations and standards in the field of food fraud and food control at the level of each state. FAO recalls the five essential components of working in a food control system as follows:

- Food Control Management
- Food law
- Food inspection
- Official Food Control Laboratories
- Information, education and communication on food safety and quality

2. CONTROL TECHNIQUES USED TO PREVENT AND COMBAT FOOD FRAUD

In general, control techniques used in managing and combating food fraud are divided into two categories: detection techniques and prevention techniques.

2.1. Food fraud detection techniques

Food fraud detection techniques are used to identify food that has been contaminated or adulterated.

Detection techniques include DNA analysis, near-infrared spectroscopy (NIR), high-performance liquid chromatography (HPLC), and tandem mass spectrometry (MS/MS). These techniques are used to detect contaminants and adulterants such as pesticides, heavy metals, food additives and allergens. [1],[5]

- **Mass Spectrometry**

Identifies chemicals present in food by measuring the masses of molecules. It can detect illegal additives or contaminants. [2]

- **Liquid or Gas Chromatography**

Chromatographic techniques in their various forms are among the most important methods used in food analysis. The term 'chromatography' covers techniques based on the adsorption and/or division of analytes between a mobile and a stationary phase. Thus, gas chromatography (GC), either as gas to liquid chromatography (GLC) or gas-solid chromatography (GSC), is a method in which the mobile phase is gaseous. In liquid chromatography (LC), commonly referred to as high-performance liquid chromatography (HPLC), the solid stationary phase is applied to a column and the mobile phase is pumped through the column. Thin layer chromatography (TLC) systems consist of a flat solid phase and a liquid mobile phase. Due to the superior capability of GC and HPLC, the two techniques have often been used for authentication purposes - i.e. identifying forgeries in natural juices. [5]

- **PCR (Polymerase Chain Reaction)**

Used to identify and quantify specific DNA or RNA. It helps detect fraud regarding species labeling or food origins.

In food authentication, species identification is a predominant scope. Apart from methods based on immunoassays, the so-called polymerase chain reaction (PCR) is of utmost importance for the purpose of species authentication and has a number of advantages over immunoassays - such as the relatively high stability of DNA and its predictable behavior [7]. PCR allows millions of times amplification of a DNA fragment that is framed by two primers. [5]

- **Atomic Absorption Spectrometry**

Determines the concentrations of metals or minerals in food. Useful for identifying unwanted metal contamination.

Spectroscopic techniques, especially infrared (IR) spectroscopy and nuclear magnetic resonance spectroscopy (NMR), as well as UV-Vis spectrophotometry, are widely used in food authentication. [9]

- **Infrared spectroscopy**

Identifies chemical compounds by analyzing infrared radiation absorption. It can be used to authenticate the origin of food. [6],[12]

These laboratory techniques are essential for ensuring food quality and safety, identifying potential fraud and helping to maintain consumer confidence in food.

2.2. Techniques to prevent and combat food fraud

Prevention techniques include supply chain tracking, food labeling, risk analysis and internal audit. These techniques are used to prevent food fraud from occurring by identifying and eliminating risk factors in the supply chain, as well as ensuring compliance with food safety regulations and standards.

- **Quality Certifications and Standards**

Adopt and comply with internationally recognized certifications and quality standards certifying the origin, production process and quality of food. [10]

- **Supply Chain Monitoring**

Supervise the entire food production and distribution chain to identify vulnerabilities to fraud and ensure product integrity throughout the process.

- **Batch Tracking Techniques**

Implement batch tracking systems to monitor every stage of production and distribution, making it easy to quickly identify and fix any issues.

- **Certification and Labelling**

Adopt and implement certification and labelling standards certifying product quality and origin, providing transparency to consumers and reducing the risk of fraud. Using modern

labelling technologies such as QR or RFID codes to provide consumers with access to detailed information about the product and its origin. [7]

- **Food control and health claims on food labelling**

Health claims on food labels are claims by food manufacturers that their food will reduce the risk of developing a disease or certain conditions. In today's world, food manufacturers use these health claims through a marketing communication tool to promote their products to competitors in their aggressive market sales campaigns. However, it has been widely experienced that most of these health claims have no scientific basis and has therefore been a violation of the honest supply of food to the consumer. Therefore, these misleading and fraudulent health practices must be controlled in the food industry, both for consumer protection and for fair commercial competition. [3]

- **Cross-sectoral collaboration**

Cooperation between government authorities, industry organisations and consumers to share information and develop joint strategies to combat food fraud.

- **Rigorous Control at Borders and Points of Entry**

Step up controls at borders and points of entry to prevent fraudulent or non-compliant food from being placed on the market.

- **Consumer education**

Providing information, education and advice to all stakeholder groups along the entire food chain is an increasingly important role for food control systems [4].

Informing consumers about signs of recognition of authentic products and promoting awareness of the risks of food fraud.

Raising consumer awareness of the risks associated with food fraud and promoting responsible behaviour in purchasing and consuming food.

In general, control techniques are effective in managing and combating food fraud, but there are still many challenges and issues that need to be addressed. These include the lack of standardisation of detection and prevention techniques, as well as the need to develop new techniques to deal with new threats and risks.

These techniques properly combined and applied, help ensure food safety and prevent fraud in the food industry.

To prevent food fraud, a number of techniques and practices are used throughout the food industry.

3. CONCLUSIONS

The main conclusions that can be drawn and that can contribute to combating and preventing food fraud are:

Strengthen monitoring and control of food products at different stages of the supply chain to detect and prevent fraudulent practices.

Improve the enforcement of regulations and standards in force, including by applying sanctions for violations found.

Promote international cooperation to combat cross-border food fraud, including through the exchange of information and collaboration with international organisations.

Encourage the use of advanced technologies to detect food fraud, such as enzyme techniques, biosensor techniques, immunochemical techniques, DNA-based techniques, chromatography methods and spectroscopy.

By implementing these measures, authorities can contribute to increasing the safety and quality of food products, thus protecting consumers against the risks associated with the consumption of counterfeit or adulterated food.

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