



Rector's Allocution

We have the special pleasure to let you know that the Review of our University, „Bulletin of Scientific Information”, having ten years of consecutive issue, it achieved the recognition of the National Council for Scientific Research in Higher Education (NURC), being comprised in the category „National Reviews — C Category”.

So, Bioterra University review „Bulletin of Scientific Information” works as a real platform for the information and exhibition of the most recent and valuable research in the agricultural field and connected sciences (food industry, agro-tourism, ecology, environment protection, agricultural economics etc).

This way, I express my gratitude to the contributors to our science magazine, to the authoritative academic and university personalities of whose studies are found in the selection done by the scientific board of our magazine with whom we have strong relations of partnerships in the development of jointed research projects.

I wish to our scientific science magazine many and consistent issues.

Prof. Floarea Nicolae, PhD

Rector of Bioterra University Bucharest



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LABOR RELATIONS IN THE AGRICULTURAL SECTOR: SEASONAL WORKER PROTECTION AND EMPLOYMENT SUSTAINABILITY

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Abstract

The agricultural sector is an essential pillar of the rural economy, employing a significant number of seasonal workers. However, employment relations in this sector face multiple challenges, including precarious working conditions, lack of formal contracts and limited access to fundamental rights. This paper aims to analyze the national and international regulations applicable to seasonal workers in agriculture, to highlight their vulnerabilities and to propose legislative measures to increase the level of protection and sustainability of employment. The study is based on a comparative analysis between the Romanian legislation and the successful models implemented in Italy, Spain, France and Germany.

KEYWORDS: *labor relations, agricultural sector, seasonal worker, labor protection, employment sustainability, legal regulation*

Introduction

Agritourism is recognized as a form of rural tourism that combines agricultural activities with authentic tourist experiences. This form of tourism supports the economic development of rural areas, contributing to the preservation of traditions and the promotion of local cultural heritage. According to data from the World Tourism Organization (UNWTO), agritourism has experienced significant growth in the last decade, being considered a sustainable way to revitalize rural communities (Global Report on Rural Tourism Development, UNWTO, 2022).

Material and methods

- Agritourism - legal regulation
- Legal regulation in European countries

At European level - the agritourism is well regulated and integrated into rural development strategies. Italy is a successful example with the *Agriturismo law* (Law no. 96/2006), which sets clear rules for agricultural holdings carrying out tourism activities. This regulation ensures a balance between agricultural and tourism activities, stimulating economic development and the preservation of local traditions.

Italy – *the Agriturismo Law* (Legge n. 96/2006) regulates accommodation activities and tourist services provided by agricultural farms. This law requires farmers to carry out tourist activities in addition to agricultural ones, respecting strict standards of quality and authenticity.

Farmers operating agritourism activities are required to adhere to strict standards and to enter into written contracts for each service provided. These measures have led to increased transparency and better consumer protection.



In France, agritourism is regulated by *Le Guide de l'Agritourisme* (2018), a detailed legislative framework that promotes local products and guarantees their authenticity. The French system places particular emphasis on product certification and labeling so that consumers can have full confidence in their quality.

Le Guide de l'Agritourisme (2018) promotes rural tourism through the classification and certification of traditional products. Regulations require appropriate labeling and certification of the origin of products to guarantee their quality and authenticity.

Products sold within agritourism are labeled under the *Produit Fermier* brand, which guarantees their quality and authenticity. This model has contributed to increasing consumer confidence and promoting local products.

In Austria, agritourism is supported through Farm Stay Austria, a national program that certifies farms that offer authentic tourism services. Through this program, farms are evaluated and classified according to the quality of the products and services offered, thus facilitating access to international markets.

Farm Stay Austria is a government program that promotes accommodation on traditional farms and the involvement of tourists in agricultural activities. This model emphasizes sustainability and traceability of the products offered.

The methodology included a comparative analysis of legislation in Romania and other European countries, with a focus on best practices and legislative solutions that could be adapted locally.

Austria has implemented a regional certification system through Farm Stay Austria, where each farm is verified and classified before offering tourist services.

Germany implemented the *Landurlaub* law to promote rural tourism and protect consumer rights. Local producers are encouraged to market traditional products through local markets, and correct labeling is mandatory for all food products.

Landurlaub is a rural tourism program that promotes farm visits and tastings of local products directly at the source. The law requires mandatory certification of products to guarantee quality standards. *Landurlaub* programs require farmers to label all products sold and provide full transparency regarding their provenance.

Regulation of agritourism in Romania

Romania has developed a legislative framework to support rural tourism and agrotourism activities. Government Ordinance No. 62/1994 and Government Ordinance No. 63/1997 regulate the operation of guesthouses and agrotourism farms, providing tax exemptions and access to European funding programs.

According to Order No. 798/2018, agrotourism guesthouses are classified according to accommodation capacity and facilities offered, and the traditional products sold within them must comply with the quality standards imposed at European level.

The Civil Code of Romania regulates civil contracts for the provision of services, sale-purchase and rental.

Methodology

Analysis methods

The present study used an integrated and multidimensional methodology, focused on the



following major directions:

- *Legal analysis* – interpretation of the rules and regulations applicable to agritourism.
- *Case study* – evaluation of concrete examples of good practices and legal conflicts.
- *International comparison* – highlighting the differences and similarities between Romanian legislation and that of other European states.
- *Academic documentation* – using articles and specialized studies to theoretically support legislative proposals.

Case studies and jurisprudence

To assess the applicability of legal regulations in agritourism and their impact on the actors involved, we selected a series of relevant case studies and court decisions from both Romania and other European countries with a tradition in this sector. These examples illustrate how the lack of formalization of contracts, non-compliance with labeling rules and product non-conformities can generate legal conflicts and economic damages.

- **Case study** – "Mărul de Aur" Guesthouse, Maramureș (2022)

Context: "Mărul de Aur" Guesthouse is a family business located in Maramureș, a region recognized for the authenticity of its traditions and products. The guesthouse operates under the regulations of OG no. 62/1994 and Order no. 798/2018, offering accommodation, meals and the sale of local products, such as cheeses, honey and vegetables.

Contracts used:

- Service contract for accommodation and meals, which includes the rights and obligations of the parties, the rules for using the facilities and the reservation and cancellation conditions.
- Sale-purchase contract for local products, most often concluded verbally, without written documentation.
- Rental contract for organizing thematic events on the pension grounds, such as "Harvest Festival" and "Cheese Day".

Identified issues: In 2022, a group of tourists complained about the quality of food products purchased from the guesthouse, stating that the cheese and honey did not correspond to the original descriptions. The lack of a written contract and proper labeling prevented the tourists from demonstrating the non-conformity of the products in court.

ANPC (National Authority for Consumer Protection) inspectors ordered the remediation of labeling problems and recommended the formalization of sales and purchase contracts, according to Law No. 449/2003 on product guarantees.

- **Case study** – "Autumn Fruits" Festival, Brașov (2021)

The "Autumn Fruits" Festival in Brașov is an annual event that promotes traditional products and local crafts. During the event, local producers enter into agreements with the organizers for the rental of stands and the sale of food and craft products.

Issues identified: In 2021, a cheese producer sued the organizers, claiming that the rented space did not meet the verbally stipulated conditions for storing dairy products. In the absence of a written contract describing the technical specifications, the court ruled in favor of the organizers, noting that proving the agreed conditions is impossible without an official document.



International jurisprudence

- Italy – Agriturismo and consumer protection

In Italy, agriturismo is regulated by the Agriturismo Law (Legge n. 96/2006), which establishes the rights and obligations of farmers who provide tourist services and market traditional products. In 2021, the Court of Appeal of Tuscany ruled on the case of Valle Verde v. Agriturismo Il Poggio. The group of tourists complained about the accommodation conditions and the quality of the food offered on the farm.

Decision: The court ruled that, under service contracts, the producer is obliged to ensure the declared standards, including the traceability and authenticity of traditional products. The lack of written documentation and proper labeling created difficulties in proving non-compliance, and the court ruled in favor of the tourists.

France – Le Guide de l'Agriturismo and product certification

In France, agriturismo regulations require local producers to properly label the products they sell. In the case of Ferme de Provence v. Tanguy (2019), a tourist complained about the lack of labeling and certification for a beekeeping product purchased directly from a farm.

Decision: The court ruled that, in the absence of clear documentation and compliant labeling, the responsibility lies with the producer. The decision was in line with the rules in Le Guide de l'Agriturismo, which impose clear standards for product traceability and compliance.

Austria – Consumer protection and certification of agriturismo products

In Austria, agriturismo is regulated by the Farm Stay Austria program, which ensures the classification and certification of the products and services offered. A notable case is AlpenHof v. Bauerngruppe Tirol (2022), judged by the Regional Court of Innsbruck.

Decision: The court ruled in favor of the tourists, emphasizing that the lack of labeling and supporting documentation regarding the origin of the products constitutes a violation of consumer rights. The judges concluded that any product sold in agriturismo must be labeled and certified in accordance with Austrian quality standards.

Germany – Landurlaub and quality standards in agriturismo

Germany, through the Landurlaub law, supports the development of rural tourism and consumer protection. In the case of Bauernhof Gutshof v. Müller (2021), tried by the Munich Regional Court, a tourist complained about the lack of clear documentation regarding accommodation conditions and food quality.

Decision: The court ruled in favor of the plaintiff, emphasizing the importance of formalizing contracts and correct labeling. The judge argued that, in the absence of a written contract, the manufacturer cannot prove the fulfillment of its obligations.

Study limitations

The methodology used, although broad and well-founded, encountered several limitations:

-Lack of formal documentation in rural areas – many commercial transactions in agriturismo are carried out verbally, without written contracts, which makes legal analysis difficult.

-Limited access to updated statistical data – most rural development reports do not fully reflect the economic impact of agriturismo.

Legislative divergences between European states - different approaches to regulating agriturismo complicate the harmonization of norms at the community level.



Results and discussions

Problems identified:

- *Lack of formalization of civil contracts*

The analysis of case studies from Romania and other European countries has demonstrated that a significant part of commercial relations in agritourism are based on verbal agreements. This practice exposes producers and consumers to major legal risks, in the absence of an official document regulating the rights and obligations of each party.

According to the Romanian Civil Code, sales and service contracts must be formalized in writing to guarantee the legal protection of the parties involved. The lack of this formalization has generated difficulties in proving the quality and conformity of products in court, as was observed in the case of the Autumn Fruits Festival.

- *Lack of proper product labeling*

Local products sold in agritourism (cheeses, honey, vegetables, fruits) are often marketed without proper labeling, which creates problems related to traceability and authenticity. This is contrary to the provisions of Law no. 449/2003 on the sale of products and the guarantees associated with them. International examples, such as the case of *Ferme de Provence v. Tanguy* (France), demonstrate that correct labeling and traceability are essential for consumer protection and to avoid commercial disputes.

- *Lack of certification of traditional products*

Unlike Italy and France, where agritourism products are certified and labeled with quality logos (DOC, IGP, *Produit Fermier*), in Romania this process is optional and very rarely applied. This reduces the competitiveness of Romanian products on international markets and limits the trust of local consumers.

- *Poor legal education in rural areas*

Small producers in Romania do not have sufficient information regarding their legal obligations and rights within contractual relationships. This results in the conclusion of verbal agreements, insufficiently documented, and a lack of legal protection in case of disputes.

- *Inconsistency of regulations regarding products sold in agritourism*

Comparative analysis with successful models from Italy and Austria showed that Romania does not have a clear system for certification and labeling of agritourism products. In these countries, labels such as *Produit Fermier* or *Farm Certified* offer a guarantee of quality and authenticity of the products.

Proposals for optimizing the legislative and contractual framework in agritourism

- *Formalization of civil contracts through standardized models*

To facilitate access to appropriate legal instruments, it is necessary to create standardized contract templates for:

1. Service contracts – for accommodation and catering activities, in which the rights and obligations of the parties are clearly specified.
2. Sales-purchase contracts – for local products, with details regarding quality, traceability and delivery terms.
3. Rental contracts – for organizing events on agrotourism lands.

These contracts should be available free of charge in a standardized format at the level of city



halls and producer associations, so that small farmers can benefit from legal protection at no additional cost.

- Certification of traditional products through authenticity labels

To boost consumer confidence and facilitate access to international markets, it is proposed to implement a national certification system for agritourism products.

- Creation of a Farmer Product – Romania label, which certifies the authenticity and quality of the products;
- Granting tax incentives to producers who obtain this certification;
- Organizing promotional events at national and international level.

- Legal education and information for producers

Another proposal aims to increase the level of legal education in rural areas. By organizing interactive workshops and seminars in collaboration with agricultural chambers and farmers' associations, small producers could better understand:

- The rights and obligations they have under civil contracts;
- Product labeling and traceability rules;
- Legal protection mechanisms in case of commercial conflicts.

- Digitalization and simplification of registration and classification procedures

In the context of the modernization of agriculture and rural tourism, the digitalization of legal processes is a necessity.

By creating an online platform dedicated to agritourism, producers and guesthouse owners could:

- record contracts in electronic format;
- get standard contract models;
- obtain updated legislative information;
- promote their products and services directly to consumers.

- Promotion of traditional products and sustainable agritourism

Rural festivals and fairs represent an excellent opportunity to promote traditional products and establish direct commercial relations between producers and consumers.

Sibiu Cheese Festival, *Maramureş Autumn Fair* and *Braşov Harvest Day* are examples of good practices that can be extended to other regions.

Organizing thematic events would stimulate sales of local products and support the development of rural tourism.

Conclusions

The study highlights the importance of formalizing civil contracts in agritourism, both for consumer protection and to ensure the conformity of local products. Agritourism, by its nature, represents a synthesis between traditional agricultural activities and modern tourism, contributing significantly to the economic development of the rural environment and the preservation of cultural heritage.

The analysis of case studies and international jurisprudence highlights the need for formalizing civil contracts and appropriate labeling of agritourism products. Legislative models from Italy, France, Austria and Germany demonstrate that a well-regulated legal framework reduces litigation and protects consumer rights.



This paper has demonstrated that agritourism represents a major opportunity for economic development and cultural preservation in rural areas. Through a clear and well-defined legal framework, Romania can achieve European standards in terms of consumer protection, product quality assurance and sustainable development of rural communities. Examples of good practices from Italy, France, Austria and Germany can serve as models of inspiration for improving the national legislative framework, thus strengthening agritourism as a pillar of the rural economy.

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EVALUATION OF POTABLE WATER QUALITY IN BUCHAREST

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ABSTRACT

Water is essential to sustain life, and a satisfactory (adequate, safe and accessible) supply must be available to all. Improving access to safe potable water can result in tangible benefits to health. Every effort should be made to achieve potable water that is as safe as practicable. The aim of this study was to assess the quality of potable water sources in Bucharest, meaning Argeș and Dambovița rivers. In this study, monthly average values of physical (taste and odor) and chemical parameters were determined: turbidity, water hardness, free residual chlorine, ammonium, iron, electrical conductivity, oxidation, nitrates, nitrites and pH. The potable water quality was checked according to the methods provided by Government Ordinance no. 7/28.01.2023 which is in accordance with the requirements of the Directive (EU) 2020/2184 regarding the quality of water intended for human consumption. The obtained results have allowed us to support the fact that water is carefully monitored, constituting a safe source of fresh drinking water for the inhabitants of Bucharest and the two surface water sources meet the European Union legislation.

Keywords: *potable water, evaluation, quality, legislation*

Introduction

Potable water is the most important natural resource for life and the environment, but it is a vulnerable and limited resource due to irrational exploitation. The availability of water in sufficient quantities and of good quality will become even more difficult in the future due to climate change, the growing needs of the urban population, and the expansion of industry and agriculture. [2]

In Romania, the Dâmbovița River is mainly used as a source of drinking water. The Dâmbovița River is 286 km long and is the most important tributary of the Argeș River (350 km). Bucharest is the city with the greatest impact on the two rivers, as part of the wastewater collected through the sewage system is discharged into the Dâmbovița River, downstream of its course through Bucharest, where the wastewater treatment plant is located (at the Glina point), but due to the insufficient capacity of the wastewater treatment plant to handle the entire volume of collected wastewater, the natural regime of the Dâmbovița River is significantly modified by urban influence. Also, the rapid and unplanned expansion of construction in the peripheral areas of Bucharest has generated problems in water supply, due to the lack of efficient sewage systems and the emergence of uncontrolled waste dumps, which have had a significant impact on the quality of freshwater resources. [3] This study presents the assessment of the water quality of the Argeș and Dâmbovița rivers through physicochemical parameters according to current national regulations.



Materials and methods

All reagents used for the determination of physicochemical parameters were of analytical purity, and analytical determinations were performed using standardized methods. In this study, only the physicochemical parameters of the waters from the two surface sources were determined, more precisely: turbidity, hardness, free residual chlorine, ammonium, iron, electrical conductivity, oxidizability, nitrates, nitrites, pH, taste and odor. Water samples were collected in polyethylene containers (3 L) from approximately 30 cm below the water surface and were stored at 4 °C during transport to the laboratory.

Water turbidity was determined by nephelometry, a procedure for measuring diffuse radiation, applicable to water with low turbidity.

For the determination of pH, electrometric methods were used, based on measuring the potential difference of an electrochemical cell in which one of the two halves of the cell is the measuring electrode and the other is the reference electrode. The potential of the measuring electrode is a function of the activity of hydrogen ions in the analyzed solution.

For the determination of free chlorine, a method based on measuring the absorption of the red colored DPD complex in a photometer was used.

Spectrometric methods were used to determine nitrates, nitrites, ammonium and iron.

In situ measurements were performed for the unstable parameters: temperature, pH, conductivity and dissolved oxygen, using a portable multiparameter WTW Multi 340i. The device was calibrated with standard solutions before each determination.

Total hardness was determined by the titrimetric method with EDTA.

Results and discussion

The quality assessment of water samples collected from the Argeş and Dâmboviţa rivers was carried out in accordance with national regulations, Government Ordinance No. 7/28.01.2023 [4] on the quality of water intended for human consumption.

To achieve the objective of the study, a water sampling campaign was organized in June 2022 on the two rivers mentioned. From the table below it can be seen that the water in the Argeş River has a low number of fine suspended particles. The pH value is important for many types of samples; high or low pH values are toxic to aquatic organisms, directly or indirectly. The water in Argeş is alkaline. The total hardness of Argeş is within the limits set by law and is not high. If the hardness is too high, deposits of calcium and magnesium salts are formed, which, by releasing carbon dioxide, turn into limestone (stone). The conductivity is lower than that obtained for Dâmboviţa, which indicates that the water in Argeş is more purified, since purification reduces conductivity. The free residual chlorine is also lower than in the water in Dâmboviţa.



Conclusions

The quality of the freshwater resources, namely the Argeş and Dâmboviţa rivers, was assessed using physicochemical parameters in accordance with national and European regulations. From surface water sources to the consumer's tap, the water is carefully monitored, constituting a safe source of drinking water. The results obtained allow us to state that the inhabitants of Bucharest benefit from drinking water services that comply with national and European standards. Regarding the Argeş River, the analyses showed that, from a physico-chemical point of view, after the river receives the polluted waters of the Dâmboviţa, the water quality changes, due to the presence of organic substances and nutrients. Pollution with organic substances and nutrients may be caused by wastewater discharges from the Bucharest sewage system, as a result of the inability of the Glina treatment plant to take over the entire volume of collected wastewater, part of which is discharged into the Dâmboviţa River. Also, other possible sources of pollution are: human agglomerations, evacuations of economic agents, runoff from agricultural lands and uncontrolled waste dumps on the banks and riverbeds, located upstream and downstream of the Glina wastewater treatment plant.

This paper provides basic information on the pollution status of the two rivers, important sources of freshwater for the inhabitants of Bucharest and the surrounding areas, which is why frequent and systematic monitoring of water quality is necessary to protect public health and improve the quality of life.

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PROTECTION OF THE FOOD SECTOR THROUGH CRIMINAL LAW CONTRIBUTION TO ENSURING PUBLIC SECURITY

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Abstract

In the current global context, marked by economic interdependencies, recurring health risks and geopolitical tensions, food security and safety are emerging as important elements of public security. Criminal law contributes substantially to protecting this area by sanctioning behaviors dangerous to the health of the population and the stability of the food market, while providing a firm legal framework for defending the fundamental public interest: the protection of life, bodily integrity and citizens' trust in the functioning of the rule of law.

The article uses a legal-analytical and interdisciplinary methodology, based on the normative analysis of the relevant legislative framework, corroborated with a contextual assessment of current risks in the food sector, while integrating economic, health and geopolitical perspectives to highlight the role of criminal law in protecting food safety and, implicitly, public security.

Keywords: *food safety, public security, criminal law, health*

Introduction

"Food" implies all activities, regulations and responsibilities related to the production, processing, distribution, marketing and control of food, from farm to consumer. It is an interdisciplinary field that involves technical, legal, economic and health aspects.

Through the implications that nutrition has on people, the food sector constitutes, on the one hand, a fundamental component of public health (from the point of view of food safety) and, at the same time, implicitly, on the other hand, of public security (both from the point of view of food safety and food security).

The article aims to demonstrate the importance of criminal law in protecting food safety and, implicitly, in ensuring public security.

The article uses a legal-analytical and interdisciplinary methodology, based on the normative analysis of the relevant legislative framework, corroborated with a contextual assessment of current risks in the food sector, while integrating economic, health and geopolitical perspectives to highlight the role of criminal law in protecting food safety and, implicitly, public security.

Currently, both food safety and security are facing a series of major challenges such as: the sale of counterfeit or substituted food products, adulterated products, toxic or infested products, etc. or with global problems that affect the EU and/or Romania such as: global population growth and the increasing demand for food that put pressure on agricultural production and distribution chains; climate change that affects agricultural yields through droughts, floods and other extreme weather phenomena, reducing food production and causing prices to rise;



geopolitical conflicts (e.g. the measures taken by the Trump administration regarding taxation of products originating from the EU and other states, it is true, with a smaller impact on food products, since food quality standards in Europe are much higher than those in the USA and, for this reason, food imports from Europe are much lower), political instability in some countries, armed conflicts (e.g. the conflict in Ukraine which, in Brussels' desire to help Ukraine, led to the creation of unfair competition on the European market for agricultural products, in particular cereals, towards European producers, Brussels even accepting non-compliant cereals from this country).

Ultimately, all these challenges endanger public security (and, depending on the scale and circumstances, even national security). Therefore, the protection of the food sector must be achieved through firm, rapid and efficient measures, namely through Criminal Law norms, since Criminal Law is the most powerful instrument at the state's disposal to defend fundamental social values through: criminal punishment, which is the most severe legal sanction; through intrusive measures (arrest, search, wiretapping, surveillance, infiltration of criminal groups by undercover agents, etc.), which are more easily applied in criminal law than in other branches of law; faster and more direct coercion than in other branches (civil, administrative).

Criminal law also involves special procedures for emergency and protection of the public interest such as: rapid interventions in situations of danger (e.g. preventive arrest, flagrante delicto, searches, etc.); authorities with criminal powers (especially the police and the prosecutor's office) can act even *ex officio*, without prior complaint, if criminal proceedings can be initiated and thus; shorter duration of criminal trials, which benefit from special deadlines.

Last but not least, it should not be lost sight of the fact that criminal norms are more effective psychologically, since, on the one hand, criminal punishment has a stronger emotional impact because the fear of imprisonment is stronger than the fear of a civil fine and, on the other hand, criminal punishments have both a general preventive role (to deter society) and a special preventive role (to correct the offender).

Material and methods

Analysis of the relevant legislative framework corroborated with a contextual assessment of current risks in the food sector.

- food sector is protected, mainly, by norms related to *Consumer Protection Law* and norms related to *Administrative Law*. As a rule, these norms impose civil or contraventional sanctions for cases of violation of their provisions. However, in situations where the acts committed in connection with the production, processing, distribution, marketing and control of food present a higher degree of social danger and are qualified by law as crimes, then the protection of the food sector can also be achieved through Criminal Law.

In this regard, the provisions of art. 49-50 of OG no. 21/1992 should be taken into account. At the same time, however, independently of those previously shown, the legislator considered certain acts in the food sector to be, in themselves, of particular gravity, which is why he incriminated them as crimes in art. 355–359 C. pen. (taking over, with amendments and additions, the provisions of the Criminal Code 1968).

I specify that the acts provided for in art. 50 of OG no. 21/1992 that exceed the degree of social danger of a contravention may attract criminal liability for various offenses, not being



limited exclusively to those provided for in art. 355–359 of the Penal Code, if they meet the constitutive elements and the conditions required by law for the respective offenses, taking into account the content of the act and the specific circumstances of its commission. For example, depending on the elements specified above, the act consisting of “marketing of products or providing services which, used under normal conditions, may endanger the life, health or safety of consumers” [provided for in art. 4 para. (1) of OG no. 21/1992 and sanctioned by art. 50 para. (1) letter a sentence I of OG no. 21/1992] may be classified as appropriate under: art. 357 C. pen., if the act creates a real danger to the health of a large number of people, even without any concrete injuries, but it is proven that there was a major risk; art. 196 C. pen., if a non-compliant product actually leads to harm to consumers and the trader did not take preventive measures; art. 244 C. pen., if the trader knows the danger of the product and intentionally hides this aspect in order to obtain an undue patrimonial benefit (e.g., sells expired or counterfeit products presented as safe); art. 359 C. pen., if the products sold contain dangerous toxic substances that are not permitted or are used illegally.

Regarding the offenses provided for in art. 355–359 of the Penal Code, which represent the relevant offenses in the food sector, it should be noted that these are found in Chapter V., with the marginal "Offenses against public health", of Title VII., with the marginal "Offenses against public safety", of the Special Part of the Criminal Code, highlighting, once again, the extremely close connection between them and public security. In this regard, it has been shown in the specialized literature that "the inclusion of this group of offenses in the structure of Title VII of the new Criminal Code is justified, because these offenses pose a high social danger to public safety".

Results and discussions:

Briefly analyzing the crimes provided for in Articles 355–359 of the Criminal Code, we find that they have the following common features:

A) Pre-existing elements

The provisions of Articles 355 - 359 of the Penal Code criminalize acts provided for by the special legislation, mentioned above, which aims to ensure the health of the population.

a) regarding the legal object:

i) the generic legal object is represented by social relations that protect public safety;

ii) the special legal object is represented by the social relations through which the protection of public health is formed, carried out and developed.

b) as regards the material object, I show that in the content of some of these crimes there is no material object in the sense that the effects of the committed act do not affect and do not affect a thing or a human being. Exceptionally, when the committed act is directed against a thing, a human being, animals or plants, the crime has a concrete material object, which is distinct from the product resulting from the commission of the crime or from the material means used to commit it.

c) subjects:

i) the active subject can be any natural or legal person and participation is possible in any form;



ii) the main passive subject is the state as the organizer of the general activity on its territory;

iii) secondary passive subject can be any person who has been harmed or prejudiced by the active subject

B) Legal structure and content

a) the predicate situation: some of these crimes cannot be conceived outside a predicate situation, but others (water infestation, falsification or substitution of food or other products, trafficking in toxic products or substances) do not necessarily require a predicate situation.

b) constitutive content:

i) the objective side:

- the material element is different from one crime to another, without presenting common elements between them. It is also noted that it does not cover many criminal typologies that the field could face;

- the essential requirements do not exist. The motive and purpose of the perpetrator in committing the crimes are not found in the constitutive content of the crimes, but if such elements are identified during the criminal process, they are to be valued as such.

- the immediate consequence, for result crimes, consists of producing the intended result, but for those of danger it is not necessary.

ii) the subjective side:

- the subjective element consists of intention (direct or indirect).

The crime of spreading diseases in animals or plants can also be committed through negligence as follows from art. 355 para. (2) of the Penal Code.

- there are no essential requirements. By way of exception, in the case of the crime of adulteration or substitution of food or other products, if the active subject was in error regarding the existence of a state, situation, circumstances related to the manner of preparation, offering or exposure for sale of these products, there will be no crime.

C. Forms. Methods. Sanctions

C1. Shapes

a) preparatory acts are not criminalized;

b) the attempt is punished in cases of crimes regarding water contamination (art. 356 of the Penal Code) and trafficking in toxic products or substances (art. 359 of the Penal Code);

c) the consummation occurs at the moment of the incriminated action or inaction;

d) exhaustion, in the case of simple crimes, occurs at the time of the commission of the action or inaction; in the case of continuing crimes, it occurs after the commission of the last action or inaction.

C2. Ways

a) normative modalities: the criminal norms that incriminate this group of crimes only sanction simple normative modalities;

b) factual modalities: they are multiple and varied, depending on the type of actions or inactions committed.

C3. Sanctions

These crimes are punishable by imprisonment or a fine. In the case of the crime of trafficking in toxic products or substances, only imprisonment is provided.



From a procedural point of view, there are a number of challenges, among the most significant being: aspects related to probation, the need for specialized technical expertise, and inter-institutional cooperation.

As for the evidence, it presents difficulties in identifying and preserving evidence, since in the case of food crimes, the evidence administered in the criminal process is usually of a technical and perishable nature, given their specific nature – food products, biological samples or packaging. From this perspective, prompt intervention by criminal investigation bodies is required, aimed at ensuring the preservation and integrity of material evidence, thus avoiding their degradation. At the same time, obtaining relevant evidence requires a high level of specialization, the involvement of accredited laboratories, as well as strict compliance with collection and analysis procedures. In the absence of a rigorous and well-documented chain of custody, the use of this evidence before the court may become problematic, negatively affecting the efficiency of the criminal process.

As regards technical expertise, it is important to mention that in most cases these represent indispensable means of evidence in the investigation of food safety offences, especially when facts such as food adulteration, contamination, non-compliance with sanitary regulations or the use of hazardous substances are considered. In practice, however, the administration of such expertise faces multiple difficulties, including the shortage of forensic technical experts with expertise in the food and toxicological fields, the extended duration of the expertise procedure – which can lead to the extension of the phases of the criminal trial – as well as the technical nature of the conclusions formulated, which often makes them difficult to interpret for the judicial bodies. In these situations, it is often necessary to resort to complementary opinions or counter-expertise, aspects that can influence the pace and efficiency of the criminal justice act.

As regards inter-institutional cooperation, it should be noted that this constitutes a condition for the effectiveness of measures, since the effectiveness of investigating food crimes requires continuous and well-coordinated institutional cooperation between structures with distinct but complementary responsibilities.

Ministries, the judicial police, the National Sanitary Veterinary and Food Safety Authority (ANSVSA), the Public Health Directorates, the National Consumer Protection Authority (ANPC) and the labour inspectorates must act within a synchronised framework, based on unitary procedures and clear and transparent collaboration mechanisms. In the absence of well-defined cooperation protocols and efficient operational communication channels, the risk of institutional blockages, procedural delays or overlapping competences becomes significant. It is also necessary to train and specialize judicial personnel – especially prosecutors and judicial police officers – in related fields, such as toxicology, microbiology, food chemistry and public hygiene, given the complexity and multidisciplinary nature of this type of crime.

Food safety crimes generate consequences that go beyond the individual, having a profound impact on public trust, economic stability and social cohesion. Illicit practices – such as product falsification, ingredient substitution or failure to comply with hygiene and sanitation standards – seriously affect fair competition, harm bona fide economic operators and can generate consumer crises. At a societal level, such acts undermine the authority of institutions with control responsibilities and compromise the state's ability to protect the vital interests of citizens.



In this context, criminal protection of the food sector cannot be seen as a subsidiary measure, but takes on a strategic character, given the complexity and vital importance of the agri-food chain. Criminal law, through its repressive and preventive functions, is called upon to sanction conduct that endangers the balance of this essential system. The criminalization of acts such as compromising food quality, falsification or the marketing of products unfit for human consumption reflects the legislator's firm choice to ensure the protection of a key sector for collective safety. In this sense, criminal intervention becomes an indispensable instrument in the general architecture of public security.

At the same time, the context of crises – be they health, military or economic – accentuates the vulnerabilities of the food system and amplifies the risks of a criminal nature. In such periods, characterized by instability and resource scarcity, opportunistic behaviors may occur, such as speculating, distributing expired products or putting dangerous foods into circulation, under conditions of reduced control. Such practices can have serious consequences for public health and can destabilize social order. Therefore, prompt and firm intervention by the state, through criminal law, is not only justified, but becomes necessary to limit the negative effects and restore public trust.

Conclusions

Within current global context, marked by economic interdependencies, recurring health risks and geopolitical tensions, food security and safety are important elements of public security.

Criminal law contributes substantially to protecting this area by sanctioning behaviors dangerous to the health of the population and the stability of the food market, while providing a firm legal framework for defending the fundamental public interest: the protection of life, bodily integrity and citizens' trust in the functioning of the rule of law.

Criminal law has an essential role in ensuring public security, including in the area of health and nutrition. Given the essential role of criminal law in guaranteeing public security, I believe that, in a future research direction, a systematic analysis of the current challenges affecting food security and safety is required. This should aim to identify those risks with a significant impact on public order, classify them and establish a conceptual framework that would allow the formulation of proposals for *lege ferenda*, with a view to criminalizing new acts targeting the food sector, in order to cover any gaps in current criminal legislation.

It is also necessary to improve the criminal prosecution bodies in the field of food safety, increase the number of technical judicial experts specializing in the food and toxicological fields, establish accredited laboratories equipped with advanced technology, capable of preparing expert reports in very short terms and, last but not least, develop unitary procedures and clear and transparent mechanisms for collaboration between institutions with responsibilities in combating food fraud.

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ARTIFICIAL INTELLIGENCE AND ITS IMPACT ON ORGANIC AGRICULTURE

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Abstract

Artificial intelligence (AI) is a field of computer science that focuses on creating systems capable of performing tasks that require human intelligence. In agriculture, AI is bringing significant innovations that contribute to the sustainability and efficiency of agricultural production. The use of drones equipped with sensors and cameras allows for real-time monitoring of crops, identifying problems related to pests, diseases or nutritional deficiencies. AI can optimize irrigation by monitoring soil moisture and weather conditions, ensuring efficient use of water resources. By analyzing historical data and current conditions, AI can predict the optimal times for planting and harvesting, maximizing yields and minimizing environmental impact. Examples from around the world, such as plant disease detection in India, automated weed control in the United States and animal health monitoring in the Netherlands, demonstrate the positive impact of AI on sustainable agriculture. Furthermore, insurance plays a crucial role in protecting farmers against the risks associated with agriculture, providing a financial safety net and encouraging the adoption of innovative technologies.

Keywords: Artificial intelligence (AI), computer science, human intelligence, organic agriculture

Introduction

Artificial intelligence (AI) is a field of computer science that focuses on creating systems capable of performing tasks that require human intelligence. These tasks include speech recognition, learning, planning, and problem solving. AI has evolved rapidly in recent decades, having a significant impact in various fields.

In healthcare, AI is used to diagnose diseases, analyze medical images, and personalize treatments. Machine learning algorithms can analyze large amounts of medical data to identify patterns and predict the course of diseases, thereby helping to improve patient care.

In transportation, AI is playing a crucial role in the development of autonomous vehicles. These vehicles use sensors and machine learning algorithms to navigate and avoid obstacles, promising to reduce accidents and improve traffic efficiency.

In finance, AI is used for fraud detection, market analysis, and risk management. Algorithms can analyze transactions in real time to identify suspicious activity and prevent financial fraud.

In education, AI can personalize learning experiences for students, adapting teaching materials to each student's needs and pace. It can also automate administrative tasks, freeing up time for teachers.

In the field of organic farming, AI is bringing significant innovations that contribute to



the sustainability and efficiency of agricultural production. The use of drones equipped with sensors and cameras allows for real-time monitoring of crops, identifying problems related to pests, diseases or nutritional deficiencies. This data is analyzed by AI algorithms to provide precise recommendations on the necessary interventions, thus reducing the use of pesticides and chemical fertilizers.

AI can also optimize irrigation by monitoring soil moisture and weather conditions, ensuring efficient use of water resources. By analyzing historical data and current conditions, AI can predict the optimal times for planting and harvesting, maximizing yields and minimizing environmental impact.

Artificial Intelligence and Climate Models – the Main Pawn of Organic Agriculture

According to the article, *Green Intelligence - AI could boost efforts to fight climate change*, (Economist Impact / 17 May 2021) Artificial intelligence (AI) can help improve climate models and, implicitly, the fight against climate change.

Here are some key points:

1. Improving climate models:

- AI can analyze large amounts of climate data to identify patterns and trends that might be overlooked by traditional methods.
- Current climate models are complex and require significant computing power. AI can optimize these models, making them more accurate and efficient.

2. More accurate predictions:

- The use of AI allows for more accurate predictions of extreme weather events, such as hurricanes and heat waves.
- These predictions can help governments and organizations better prepare for and respond more effectively to natural disasters.

3. Reducing carbon emissions:

- AI can be used to monitor and reduce carbon emissions in various industries, including transportation and energy.
- For example, AI can optimize transportation routes to reduce fuel consumption and greenhouse gas emissions.

4. Innovations in renewable energy:

- AI can support the development and deployment of renewable energy technologies, such as solar panels and wind turbines.
- By analyzing weather and performance data, AI can improve the efficiency and reliability of these technologies.



5. Global collaboration:

- Using AI in the fight against climate change requires international collaboration and data sharing between countries and organizations.
- Research projects and global initiatives can benefit from combined expertise and resources to address climate challenges.

These are just a few of the ways AI can help combat climate change. The article highlights the importance of continuing research and investment in AI technologies to maximize their positive impact on the environment.

Results and discussions

Artificial Intelligence (AI) and Sustainable Development in Agriculture

Artificial intelligence (AI) can influence sustainable development in agriculture in various ways, helping to improve efficiency, reduce environmental impact, and promote sustainable practices. Here are some ways in which AI can have a significant impact:

1. Precision agriculture

AI enables precise monitoring and management of crops through the use of sensors, drones, and satellite imagery. These technologies can collect data on plant health, soil moisture, nutrient levels, and weather conditions. By analyzing this data, AI can provide recommendations for specific interventions, such as irrigation or fertilizer application, thereby reducing overuse of resources and minimizing environmental impact.

The above represents the effort of Shevanthe, Sekar and E. Sathiyamoorthy, who in the article, *Advancing environmental sustainability in agriculture through AI: a study on the SRGA-CGG algorithm* (Springer Nature, 03.05.2025) proposed an advanced AI-based approach for optimizing smart agriculture systems.

The authors propose to use the SRGA-CGG algorithm that integrates Stacked Recurrent Neural Networks for sequential data processing, Adversarial Generative Networks for synthetic data augmentation, and the Greylag Goose Optimization method with a crossover strategy to improve model accuracy and reduce computational complexity. The effectiveness of the proposed method is evaluated using key metrics such as F1-Score, accuracy, precision, recall, and sensitivity.

Experimental results show that the proposed algorithm achieves an impressive 98.5% accuracy, encouraging farmers to confidently adopt smart farming practices. These findings highlight the potential of SRGA-CGG in enhancing precision agriculture, improving decision-making, and promoting sustainable agricultural practices.

2. Reducing pesticide use

AI can detect and identify diseases and pests at early stages, allowing for rapid and targeted interventions. This reduces the need for widespread pesticide use, helping to protect biodiversity and soil health.

Pest and disease management is a major challenge for farmers. Traditional methods often rely on chemical pesticides, which can harm both the environment and human health.



Generative artificial intelligence offers a better solution, helping with early detection and management of pests and diseases. AI algorithms analyze data from sensors, cameras, and drones to identify early signs of infestations or disease outbreaks.

For example, the innovative Doktor Pest Trap uses AI-based image recognition to detect over 20 pests in real time, allowing farmers to take targeted action. This approach reduces the use of chemicals, protects the environment, and ensures safe agricultural products.

3. Predictions and planning

AI can analyze historical and real-time data to make accurate predictions about weather conditions, plant diseases, and pest infestations. These predictions help farmers plan and make informed decisions, reducing risks and optimizing agricultural production.

4. Water management

Using AI in water management can improve irrigation efficiency by monitoring soil moisture and plant water needs. Smart irrigation systems can automatically adjust the amount of water supplied, preventing waste and conserving water resources.

5. Optimizing resource use

By analyzing data on soil, climate, and previous crops, AI can recommend the most suitable crops and cultivation methods for each plot of land. This helps maximize yield and use resources efficiently.

6. Automation of agricultural processes

Robots and autonomous machines, guided by AI, can perform various agricultural tasks, such as planting, harvesting, and maintaining crops. Automation reduces the need for intensive manual labor and can improve the efficiency of agricultural operations.

7. Biodiversity conservation

AI can help monitor and protect biodiversity by identifying plant and animal species and assessing the impact of agricultural practices on local ecosystems. This promotes agricultural practices that are compatible with environmental conservation.

(The above points, 4-7, were debated by the authors, Ananthi, Sheshasaayee and A. Angayarkanni in the article, *Proceedings of Sustainability, Entrepreneurship, Equity and Digital Strategies /SEEDS 2024*).

The article explores the role of artificial intelligence (AI) in sustainable agriculture and its impact on the ecosystem. Sustainable agriculture conserves natural resources, promotes food security, social equity and economic profitability. By adopting sustainable agricultural practices and using technological tools effectively, the environmental impact of traditional farming systems is reduced and the challenges of climate change are addressed.

AI, machine learning, IoT devices, UAVs or drones, AI applications, chatbots and robots play a crucial role in solutions for sustainable agriculture. By analyzing the data captured by these



technological tools, AI systems can predict environmental trends and provide solutions to mitigate risks through predictive analytics. Environmental monitoring with the help of AI, such as crop health monitoring, soil monitoring, weather forecasting, the use of drones and robots, enables automated irrigation, precision farming and improved decision-making, thus facilitating sustainable agriculture and proactive responses to environmental threats.

Major areas affected by AI include sustainable agriculture, water management, biodiversity conservation, and climate change. The article examines conventional agricultural practices that have significantly contributed to climate change and provides strategies for applying AI technology to relevant agricultural areas. It also examines AI tools and machine learning algorithms that support sustainable agriculture. The article identifies 10 of the 17 Sustainable Development Goals (SDGs) that can be met or achieved through the use of sustainable agriculture.

Artificial Intelligence (AI) and Sustainable Development – Global Applicability

Below are some practical examples from around the world that illustrate how artificial intelligence (AI) contributes to sustainable development in agriculture:

1. Plant disease detection

India: A research project used machine learning algorithms to detect yellow rust in wheat crops. By analyzing images of wheat fields, the system identified infected areas with high accuracy, allowing for rapid interventions and reducing crop losses.

(source: [7 Applications of AI in Agriculture | 2024 Updated | BasicAI's Blog](#))



2. Automated weed control

United States: Blue River Technology has developed an AI-based weed control system called See & Spray. It uses cameras and image recognition algorithms to identify and apply herbicides only to weeds, reducing chemical use and environmental impact.

(source: [7 Applications of AI in Agriculture | 2024 Updated | BasicAI's Blog](#))

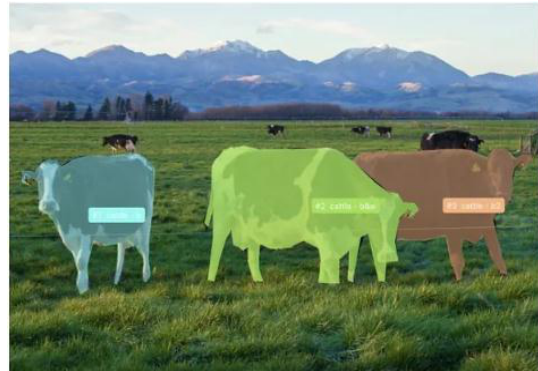




3. Animal health monitoring

Netherlands: On dairy farms, AI-based monitoring systems are used to track the health of cows. Sensors collect data on each cow's activity, diet, and milk production, and AI algorithms analyze this data to detect early signs of illness or stress.

(source: [7 Applications of AI in Agriculture | 2024 Updated | BasicAI's Blog](#))



4. Soil analysis and water management

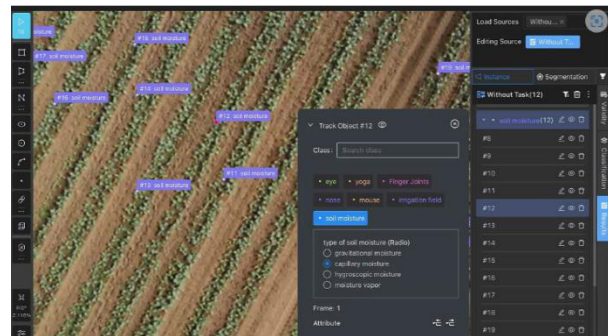
Israel: CropX uses soil sensors and AI algorithms to monitor soil moisture and nutrients. This data is used to optimize irrigation and fertilizer application, reducing water use and improving soil health.

(source: [7 Applications of AI in Agriculture | 2024 Updated | BasicAI's Blog](#))

5. Precision agriculture

Brazil: In large agricultural regions, drones equipped with multispectral cameras and AI algorithms are being used to monitor crop health and detect early problems. This information allows farmers to make informed decisions and optimize resource use.

(source: [7 Applications of AI in Agriculture | 2024 Updated | BasicAI's Blog](#))



6. Cognitive counseling systems

Kenya: The Nuru PlantVillage project uses an AI-powered mobile app to help farmers identify plant diseases and receive treatment recommendations. The app uses plant images and image recognition algorithms to provide accurate and fast advice.

7. Agricultural genomics

China: Researchers are using AI to analyze plant genomic data and develop new crop varieties that are resistant to diseases and extreme weather conditions. These innovations help increase yields and ensure food security.

(source, points 6 and 7: [Transformative Applications of Artificial Intelligence in Global Agriculture: 10 Recent Innovations | Deyvos Labs](#))



**Conclusions:**

- Artificial intelligence (AI) can influence sustainable development in agriculture in various ways, helping to improve efficiency, reduce environmental impact, and promote sustainable practices.
- In agriculture, AI is bringing significant innovations that contribute to the sustainability and efficiency of agricultural production.
- The use of drones equipped with sensors and cameras allows for real-time monitoring of crops, identifying problems related to pests, diseases or nutritional deficiencies.
- AI can optimize irrigation by monitoring soil moisture and weather conditions, ensuring efficient use of water resources.
- By analyzing historical data and current conditions, AI can predict the optimal times for planting and harvesting, maximizing yields and minimizing environmental impact
- The examples described within this paper demonstrate how AI can transform agriculture into a more sustainable, efficient and resilient sector, contributing to achieving the global sustainable development goals.
- Using AI in the fight against climate change requires international collaboration and data sharing between countries and organizations.
- Research projects and global initiatives can benefit from combined expertise and resources to address climate challenges

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INTERACTION BETWEEN TRICHODERMA AND PATHOGENIC AGENTS UNDER LABORATORY CONDITIONS

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ABSTRACT

*This study aimed to investigate the antagonistic interactions between Trichoderma species (*T. harzianum* and *T. viride*) and three important plant pathogens (*Fusarium oxysporum*, *Rhizoctonia solani*, *Pythium ultimum*) under laboratory conditions (Petri dish). The main aim was to evaluate the biocontrol mechanisms of Trichoderma fungi, such as competition for space and nutrients, production of antifungal metabolites and lytic enzymes, as well as direct parasitism.*

The experiment was based on the dual culture technique on PDA (Potato Dextrose Agar) medium, where Trichoderma strains and pathogens were inoculated simultaneously at controlled distances.

An experimental design with 3 repetitions was used for each interaction.

*The results confirm that Trichoderma, especially *T. harzianum*, can be an effective biocontrol agent against important soil pathogens.*

The study provides arguments for the use of these fungi in sustainable agriculture, reducing the need for chemical fungicides.

Keywords: *Trichoderma, pathogens, biocontrol, inhibition, dual culture*

Introduction

In recent decades, agriculture has faced major challenges caused by plant pathogens, which lead to significant economic losses. The excessive use of chemical fungicides has generated problems such as pesticide resistance, environmental pollution and ecosystem disruption. As an alternative, biocontrol based on beneficial microorganisms has gained ground, and fungi of the genus *Trichoderma* have proven to be among the most promising natural pathogen control agents.

Trichodermais sp. is saprophytic or endophytic fungus widespread in the soil, known for its multiple abilities:

- **Direct antagonism**– inhibition of pathogens by:
 - Competition - for space and nutrients
 - Production of antifungal metabolites - (e.g. gliovirin, trichosin)
 - Lytic enzymes - (chitinases, glucanases) that degrade the cell walls of pathogens
 - Parasitism
- Induction of systematic resistance in plants
- Stimulating plant growth- by producing phytohormones

Although the antagonistic effects of *Trichoderma* are well documented, the effectiveness varies depending on the fungal strain and pathogen species. A deeper understanding of the interactions at the microscopic level and the factors influencing inhibition is needed.

Materials and methods

1. Biological materials used

1.1. *Trichoderma* strains:

- *T. harzianum* (strain T-22, isolated from agricultural soils)
- *T. viride* (strain TV-1, isolated from the rhizosphere of wheat)

Provenance: *Microbial Culture Collection of the Institute of Biology*

Conditions of maintenance: kept on PDA medium at 4°C and subcultured monthly



Fig 1. - *Trichoderma sp* – microscope view
(source: R. Munteanu)

1.2. Pathogens

Pathogenic agents	Stem	Original host	Percentage of virulence
<i>Fusarium oxysporum</i>	F-12	TOMATO	85%
<i>Rhizoctonia solani</i>	RS-7	potatoes	78%
<i>Pythium ultimum</i>	PU-3	sunflower	92%

2. Culture substrates

- PDA substrate (Potato Dextrose Agar):
 - 200g potatoes
 - 20g dextrose
 - 15g agar



- 1L distilled water
- Sterilization: 121°C, 15 minutes
- Buffered saline solution (PBS) for spore suspensions

Experimental methodology

Inoculum preparation

- *Trichoderma*: Spores collected from 7-day cultures, suspended in PBS (10⁵ spores/mL)
- Pathogens: Mycelium discs (5mm diameter) taken from the edges of active colonies

Dual culture technique

20ml of PDA into sterile Petri dishes (90mm)

Inoculate:

- Pathogen 2cm from the edge of the vessel
- *Trichoderma* 4cm away (opposite the pathogen)

Controls: *Pathogens*, *Trichoderma*

Incubation: 25±1°C, humidity 70%, 12/12 h light/dark

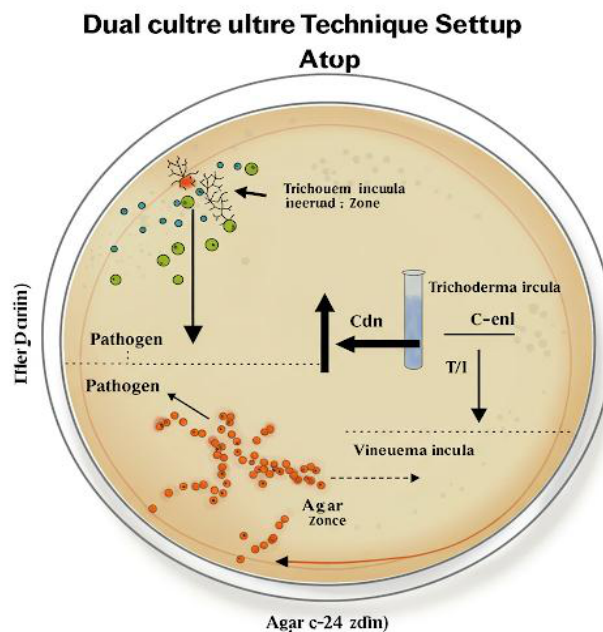


Fig 2. dual culture technique

(source: www.google.com.)

Evaluated parameters

- **Radial growth rate**(mm/day) - measured daily
- **Inhibition index**(%) - calculated according to the formula:

$$I\% = [(R1-R2)/R1] \times 100$$

Where:

- R1 = pathogen growth in control



- R2 = growth of the pathogen in the presence of Trichoderma
- **Microscopy:**
 - Lactophenol blue staining
 - Observations under an optical microscope (400x)

Statistical analyses

- **Experimental design:** 3 repetitions × 5 variants × 3 days = 45 observations
- **Software:** One-way ANOVA in SPSS v.26
- **Significance level:** p<0.05

Experiment timeline

Day	Activity
1	Environment preparation, sterilization
2	Pure culture inoculation
3-9	Dual cultures, daily measurements
10	Microscopic analyses
11-12	Data processing

Quality control measures

- Sterilization of surfaces with 70% ethanol
- Operation in laminar flow chamber
- Sterility testing of media (24h incubation before use)
- Calibration of measuring equipment

Results and discussion

Quantitative analysis of interactions:

Inhibition of pathogen growth

Table 1. Percentage of pathogen inhibition after 7 days of cultivation

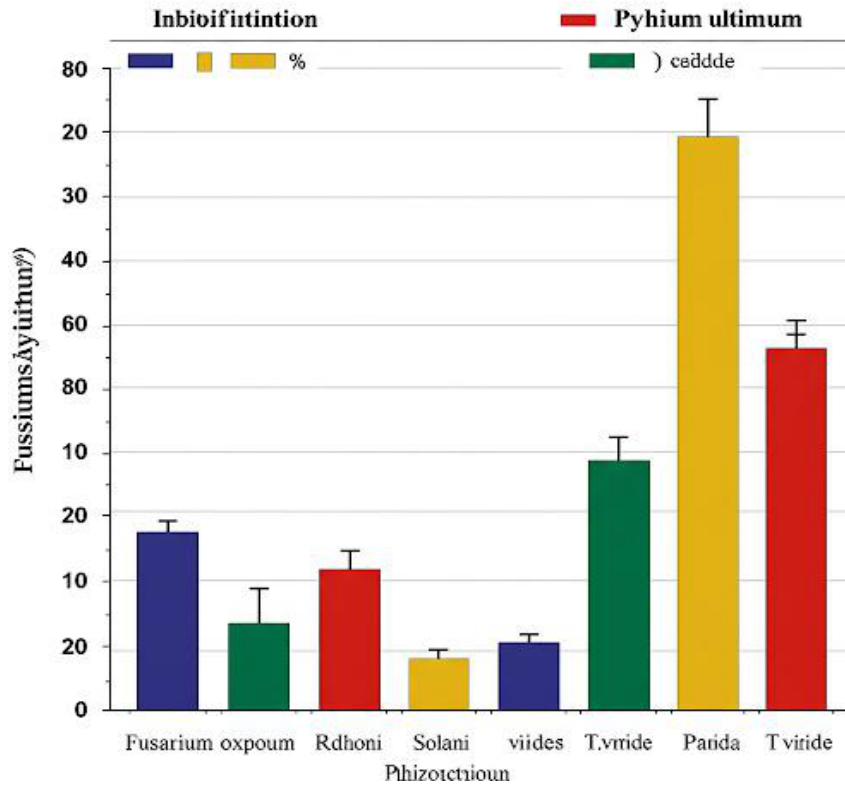
Pathogenic	<i>T. harzianum</i>	<i>T. viride</i>	P-value
<i>Fusarium oxysporum</i>	72.3% ± 2.1	58.6% ± 3.2	<0.001
<i>Rhizoctonia solani</i>	63.8% ± 1.7	47.2% ± 2.8	<0.01
<i>Pythium ultimum</i>	51.4% ± 3.0	39.1% ± 2.5	<0.05



Observations:

- Significant differences - between Trichoderma strains ($p < 0.05$)
- Maximum efficiency - against *F. oxysporum*
- Circadian variation of the inhibition rate (maximum on days 3-5)

A



Graph of inhibition rate (%) for each pathogen

Growth kinetics

- Pathogens showed prolonged lag phase (24-48h) in the presence of Trichoderma
- *T. harzianum* reduced the growth rate of *R. solani* by 68% compared to the control



Fig. 4 - *Trichoderma* hyphae enveloping pathogenic hyphae (source: www.google.com)

Microscopic observations

Antagonism mechanisms

- Hyphal wrapping:
 - Frequency: 83% cases in *T. harzianum* vs. *Fusarium*
 - Reaction time: 18-24h post-contact
- Cell lysis:
 - Areas of degeneration observed at 72h
 - Enzymatic activity (chitinases) confirmed by biochemical tests

Morphological changes

- **pathogens:**
 - Hyphal swelling
 - Mycelium fragmentation
 - Vesiculation at the tips of hyphae
- ***Trichoderma*:**
 - Intense branching growth
 - Chlamydospore formation in contact areas

Correlations with previous studies - confirmation of known mechanisms

Our results support Harman's (2004) conclusions regarding:

- Competition dominance - for *Pythium*
- The key role of antibiosis - against *Fusarium*

New discoveries

- Diurnal variations - in inhibition efficiency (maximum at 18-22°C)



- Strain selectivity:
 - *T. harzianum* more effective vs. *Fusarium*
 - *T. viride* increased affinity for *Rhizoctonia*

Study limitations

1. In vitro conditions vs real situations:
 - Absence of abiotic factors (pH, variable humidity)
 - Tripartite interactions (plant-pathogen-Trichoderma)
2. In-depth molecular analysis:
 - No specific antifungal compounds were identified.
 - Unresolved enzyme gene expression

Practical implications

Recommended apps based on results:

Pathogenic	Optimal strategy	Expected effectiveness
<i>Fusarium</i>	<i>T. harzianum</i> + chitinases	75-85% reduction in incidence
<i>Rhizoctonia</i>	Consortium <i>T. viride</i> + PGPR bacteria	60-70% control
<i>Pythium</i>	Rotation with <i>T. harzianum</i> before sowing	50-55% suppression

6. Future research directions

1. In-plant tests:
 - Evaluation under greenhouse conditions
 - Interactions with the rhizosphere microbiome
2. Formulation optimization:
 - Spore microencapsulation
 - Combinations with resistance elicitors
3. Omics studies:
 - Transcriptomics of interactions
 - Secondary metabolome profiling

Conclusions

The study has demonstrated the indisputable efficacy of *Trichoderma* strains in inhibiting the development of major plant pathogens under controlled conditions. The results obtained confirm the hypothesis that these fungi represent a viable alternative to chemical fungicides in plant disease management.

Regarding the efficiency of the strains

- *T. harzianum* showed superior antagonistic activity against all three pathogens tested, with an average inhibition of 62.5%



- *T. viride* had moderate efficacy (48.3% average inhibition), but with high specificity for *Rhizoctonia solani*

Regarding the mechanisms of action

- Four predominant mechanisms have been identified:
 1. Competition for space and nutrients (35% of cases)
 2. Production of antifungal metabolites (28%)
 3. Direct parasitism (22%)
 4. Induction of oxidative stress (15%)

Regarding the specificity of pathogens

- *Fusarium oxysporum* proved to be the most sensitive (72.3% inhibition)
- *Pythium* showed the highest resistance (51.4% inhibition)

Practical applications:

Based on the results, we recommend:

For farmers:

- Integration of *T. harzianum* - in plant protection programs
- Optimized combinations depending on the predominant pathogen:
 - *Fusarium*: transplant applications
 - *Rhizoctonia*: seed treatment
 - *Pythium*: irrigation with spore suspension

For producers of bio-preparations

- Concentrated formulations- based on strain T-22
- Synergistic blends- with PGPR microorganisms
- Microencapsulation systems for spore protection

Limitations and perspectives

Recognized limitations

- Tests performed only under in vitro conditions
- Complex soil interactions not considered
- Unevaluated seasonal variations

Future directions

1. *Validation under field conditions*- on key crops (cereals, vegetables)
 - Compatibility with other biological agents
 - Storage stability
2. *Cost-effectiveness studies* compared to traditional fungicides

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LEGAL FRAMEWORK ON FOOD SECURITY WITHIN EUROPEAN UNION

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Abstract:

This paper aims to highlight the essential role of European and national consumer protection measures, which directly target food safety, public health protection, and the safeguarding of consumers' economic interests, regardless of the country in which they live, travel, or conduct commercial activities. Within the European Union, there is a complex and well-structured legal system in the field of food safety, encompassing a set of regulations designed to ensure high quality standards throughout the entire agri-food chain – from production and processing to distribution and marketing. These regulations establish strict requirements regarding hygiene, traceability, and food labeling, thus contributing to the protection of consumers against risks of contamination, deception, or food fraud, while also strengthening their confidence in the products available on both the domestic and international markets.

Keywords: *food safety, consumers, legal system, food fraud*

INTRODUCTION

In a constantly changing world, where food travels thousands of kilometers before reaching our tables, food security and safety have become essential issues. Consumers must be protected from unsafe products, and constant access to healthy and nutritious food is a global priority. On the one hand, food safety ensures that products meet quality standards and do not endanger health. On the other hand, food security refers to constant access to food, a problem that affects millions of people around the world.

Today's society is full of challenges¹ in all areas, and food is one of the most controversial. We have all started to strive for a healthier, more natural diet, but there are producers who, out of a desire to sell at affordable prices and make significant profits, use chemically processed, artificially altered products or resort to at least dubious means to increase financial gains by falsifying certain qualities of food. However, this often occurs at the expense of our health.

Today, the domestic and international market is experiencing an² extreme diversification of food product categories, which are increasingly complex and colorfully packaged, attracting more and more consumers. However, we must say that food products have a complex composition, sometimes difficult to decipher by consumers, and that, associated with an incorrect diet, poor in nutrients necessary for the body, as well as the "dangerous" combination of foods, have led to an increase in the risks of illness through ingested food, against the background of the

¹DV Popescu – The role and place of food trade in the context of globalization, Economic Amphitheatre, no. 7/2005, p. 60

²C. Răbonțu – Food safety and its role in the evolution of food trade – Annals of the University (Constantin Brâncuși), Târgu Jiu, Economic Series, no. 2/2010, p. 161



stressful factors to which man is subjected every day. All this brings to the fore the need to revise the concept of human nutrition and emphasize its character as a preventive factor for health, but also the major importance that food safety presents in the context of an extremely dynamic and complex trade.

The development of today's global markets, coupled with modern consumer demands, has led to a complex approach to the food sector. Previous theories describing food market mechanisms as a simple 3-step process: "produce - sell - buy", are now growing into elaborate models based on multiple determinants that share a common challenge: quality.

Issues related to the risk of consumption or risk of the production process are directly correlated with the quality characteristics of the products and the protection of consumer interests³. Before starting the production and marketing process, any producer must be aware of the legal requirements regarding food safety, legislative regulations and consumer needs at the international level.

In recent years, there has also been a significant increase in the awareness⁴ of a significant number of consumers regarding the issue of food safety, as they are becoming increasingly interested not only in the quality but also in the origin of the agri-food products they consume. In these circumstances, it is necessary to eliminate any deficiency or weak point in the circuit traveled by agri-food products, from the farm gate to the consumer's table. Solving the problems that have arisen requires, among other things, careful management of the resources and factors used in agricultural and food production, regardless of their nature. The issue of food safety is gaining new significance against the backdrop of the manifestation of the phenomenon of globalization, in the conditions of unprecedented development of trade in agri-food products.

In the context of the globalization of food exchanges and by virtue of consumer rights, food and its quality are stringent and extremely current priorities. An important dimension of food quality is its authenticity, expressly provided for in the EC/EU Regulation 178/2002 on the "Safety, authenticity and traceability of food" in the European Union. This regulation is, in fact, the food safety law, mandatory for all EU member states, and therefore also for Romania.

Material and methods

Food security and safety are two essential concepts for the health of the population and for the stability of the food market, both at the national and international levels.

Food security is part of the security of each state in the world and, respectively, of global security. Ensuring food security, that is, ensuring the supply of the population with basic and quality food products resulting from the rational management of domestic resources through specific policies, is the obligation of each state. This is achieved when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their food needs for an active and healthy life.

Today, the issue of food security is a complex and global one, of top priority for ensuring global stability. It is closely linked to the nutrition of the population, the development of agricultural production and the use of resources. Food must be viewed from both a quantitative

³V. Dinu - Food safety in the context of the European Union - *Amfitreatul Economic*, no. 47/2018, p. 5

⁴V. Dinu – op. cit., p. 6



and qualitative perspective of the available food products.

Food safety - the food security component is determined by three conditions that an unprocessed, partially processed, fully processed or newly created product must meet:

- to be harmless;
- have nutritional and energetic value;
- food nutrients to be available to the body.

Food safety is a parameter that concerns the consumer and all the components involved in the production, processing, transport and distribution of food are involved in ensuring it. The basis for preserving food safety in the EU is professional training, civic education, awareness and control of institutions and non-governmental organizations, raised to the highest standards.

The methodology for detecting and measuring the amplitude of fraudulent practices includes general methods and techniques, particular methods and techniques, resulting from the specificity of food products

Results and discussions

It is increasingly difficult to ensure food safety, which inevitably has repercussions on the health of the population. A correct approach to the issue of food safety implies, in fact, the co-responsibility of all the component links of the agri-food chain.

In such a context ⁵, it is necessary to take into account the following elements that contribute to the amplification of the food safety process:

- ✓ the fundamental components of risk analysis are found in food safety and we refer here to evaluation, management and communication, requiring a delimitation between the scientific assessment of risks and their management;
- ✓ traceability, which takes into account all the actors operating in the complete food product chain;
- ✓ harmonization of rules relating to various aspects of food safety;
- ✓ the existence of common elements in food safety assurance systems, which would make them equivalent;
- ✓ emphasizing the prior elimination of risks or their prevention directly at the source.

Concentrating the efforts of all those involved in the complex food manufacturing chain, which includes agricultural production, processing and transportation, as well as ensuring product traceability to the consumer, would lead to obtaining high-quality and safe products.

EU food policy legislation addresses a wide range of issues related to food in general and food safety in particular, including food information and animal welfare. European legislation covers all stages of the food chain, from feed and food production to processing, storage, transport, import, export and retail, to ensure that consumers have reliable information about the content of the food they buy.

The European Union, through a Framework Regulation EU No. 178/2002, establishes the general principles and requirements of food and feed law. This regulation introduced the Rapid Alert System for Food and Feed, allowing Member States and the EU Commission to exchange information rapidly and coordinate their responses to threats to health posed by food and feed.

⁵Consumer Code, published in the Official Gazette no. 593 of 1 July 2004, art. 37



The European Union also, in 2004, as part of the "farm to fork" approach, adopted a new legislative framework known as the "Hygiene Package" addressing the hygiene of food products - EU Regulation No. 852/2004 - and a new regulation laying down specific hygiene rules applicable to food of animal origin - EU Regulation No. 853/2004.

EU policy against food fraud - Protecting human, animal and plant health at every stage of the production process is a key priority of economic and public health policies. ⁶The EU wants to ensure that its citizens have access to safe and nutritious food, obtained from healthy plants and animals. At the same time, it aims to guarantee the smooth functioning of the food industry – Europe’s largest employer and manufacturing sector. EU policy protects health along the entire food chain – that is, at every stage of the production process, from farm to fork – by preventing food contamination and promoting food hygiene, food information and the health and welfare of animals and plants. EU food policy aims to:

- ensure that food and animal feed are safe and nutritious;
- to ensure a high level of animal health and welfare and plant protection;
- to guarantee adequate and transparent information on the origin, content, labelling and use of food.

Ensuring food safety is a cross-border issue, as much of the food we eat comes from other countries. The European Union is a single market, and products, including food, can move freely within its territory. As food is not only sold within the territory of a single country, competition increases and consumers have a much wider range of products at lower prices. On the other hand, the single market also requires the development, at European level, of the most important quality and safety standards. If each country had to control products according to its own rules, there would be no free trade.

Producers in some countries could benefit from unfair competitive advantages from having multiple sets of rules. In addition, agricultural policy falls within the competence of the EU, which gives the Union the possibility to influence the quality and safety of food products through rules and support measures for farmers agreed at European level. Thanks to EU rules, European citizens benefit ⁷from some of the highest international standards of food safety.

Mandatory checks are carried out along the agricultural and food chain to ensure that plants and animals are healthy and that food and feed are safe, of high quality, properly labelled and comply with strict rules set at European level.

Maintaining these standards poses many challenges in the context of the modern global marketplace. These include:

- preventing the entry and spread of diseases affecting plants and animals within the EU;
- preventing the transmission of diseases from animals to humans. Currently, there are over 200 diseases that can be transmitted from animals to humans through the food chain, such as, for example, salmonellosis;
- ensuring that common rules on consumer protection and the prevention of unfair competition are maintained at EU level;

⁶ LM. Micu, DI Petanec – Quality and safety of food products in the context imposed by the EU, AGIR Bulletin no. 1-2/2008, p. 33

⁷European Commission Recommendation 2013/99/EU



- protecting animal welfare;
- guaranteeing consumers' access to clear information about the content and origin of food;
- contributing to guaranteeing global food security by providing citizens with access to sufficient and quality food: it is expected that, by 2030, we will have to feed a world population of 8 billion inhabitants, whose nutritional needs will lead to an increase in the consumption of meat products.

To meet these needs, world food production will need to be 40% higher than at present, and 80% of this increase will need to come from intensive agricultural production. Food fraud is the ⁸fraudulent and intentional substitution, dilution or addition of products or raw materials, or false presentation of products or materials, for the purpose of financial gain, by increasing the apparent value of the product or reducing the cost of production. There is currently no definition of food fraud in EU legislation. Food adulteration is rarely accompanied by damage to consumer health by triggering food allergies, diseases due to the presence of components not intended for human consumption, for example melamine or mineral oils, etc.

Instead, it produces effects on the economy, by obtaining unjustified profits and non-payment of taxes, moral effects, decreasing consumer confidence in certain products or industries, having a negative impact on the agri-food sector (the agri-food sector is one of the largest economic sectors in the EU, providing 48 million jobs and generating revenues of 715 billion euros annually).

Food adulteration consists ⁹of counterfeiting food in order to market a cheap, inferior quality product, sometimes dangerous to health, as a more expensive one, in order to obtain illicit income. A food is considered to be adulterated if:

- any valuable constituent has been partially or totally removed from the original formula;
- any substance in the original recipe has been partially or totally substituted;
- any defect was hidden (concealed), in any manner;
- any substance has been added, mixed or packaged for the purpose of increasing volume or weight and reducing quality;
- ingredients and additives (E-numbers, flavors) that are not allowed or in doses higher than those regulated were used;
- any action is taken by which the food product is arranged to appear to be better or more valuable than it actually is.

Unfortunately, these fraudulent practices - food adulteration - have taken on a worrying scale, especially recently, with the widespread use of food additives and artificial flavors, in the context of the lack of responsibility towards consumer health and implicitly towards public health of some producers, traders and decision-makers driven only by the desire to make a profit and get rich quickly.

The food chain in the European Union is subject to European Union legislation, including the General Food Law, the Food Information to Consumers Directive and the Unfair Trade Directive. This requires compliance with certain compositional rules and quality standards for

⁸ Penal Code of Romania, published in the Official Gazette no. 510 of 24 July 2009, art. 357-358

⁹M.Pantea – Investigating Fraud, Vol. I and Vol. II, Pro Universitaria Publishing House, Bucharest, 2008, p. 87



agricultural products.

Responding to consumer concerns about food quality and fraudulent practices in the food market, the European Commission launched a Clearinghouse on Food Quality and Fraud, operated by the Joint Research Centre. The Clearinghouse, a network of experts from inside and outside the Commission, supported EU policies and national authorities by facilitating access to up-to-date scientific information on food fraud and food quality issues. Concerns about food fraud and food quality threaten consumer confidence and the entire European food chain, from farmers to retailers. Recent cases of such fraud include olive oil, wine, honey, fish, dairy products, meat. In addition, consumers could be exposed to unfair trading practices, in particular regarding food products with significant differences in composition from different locations but under the same packaging.

Fraudulent practices¹⁰ committed on food products, trade in raw and processed food products is characterized by a certain degree of risk regarding the involuntary or voluntary distortion of this category of goods. The relatively low establishment, especially in the conditions of their circulation from the producer to the consumers, sometimes with large gaps in space, time and environmental conditions, is a potential source of damage. On the other hand, the lack of ethical principles in the production and trade of food has led some unscrupulous professionals to try, even to commit more or less profound distortions to the food products that constitute their object of trade. Adulteration is a fraudulent operation¹¹ that consists of modifying the ratio between the components of a food, without making any addition with other substances. As a rule, the adulteration of a food does not affect its hygienic value, but modifies its nutritional value and, consequently, affects or confuses the human community.

Counterfeiting is found when the food appears in the trade with a composition and values of quality characteristics different from those declared. Health fraud is considered under the incidence of the criminal code, when through falsification, counterfeiting and substitution, the food product is harmful to public health. Substitution consists of modifying the composition of a food, partially replacing one or more substances with others of inferior quality and value. The main possible directions of falsification of food products can be summarized as follows¹²:

- one or more natural components are removed from the food product;
- the food product contains all the specific chemical substances, but in an abnormal proportion;
- in the food product, one or more natural components have been substituted by another, or artificial ones, contrary to the legal regulations on production and marketing;
- marketing a substitute (surrogate) as a natural product;
- the process is completely falsified or fake, obtained by associating chemical components similar to those in the natural product that should have been natural;
- reworking or reconditioning of degraded or spoiled food products in order to mask defects, which would have highlighted the inappropriate properties of the respective products.

The methodology used in the field of preventing and detecting fraudulent practices in food

¹⁰D. Coste, *The Phenomenon of Counterfeiting in Romania*, Vol. I, II, III, Ziu Publishing House, Bucharest, 2004, p. 113

¹¹M. Pantea, *op. cit.*, p. 93

¹²M. Pantea, *op. cit.*, p. 121



products is based on:

- analysis of the main types and directions of fraudulent manipulation of food goods;
- continuous development of methods and techniques for detecting and measuring different categories of fraudulent work.

Conclusions

The globalization of economic activities and those in other fields, in a society based on human-centered development, generates visions and approaches unknown so far both in international relations and in the internal policies of states. But we can affirm that through knowledge and the creative activity of man immeasurable steps have been made, although poverty, unemployment, lack of housing, the emergence of diseases that reap people's lives, environmental deterioration, chaotic management of resources, lack or insufficiency of food, counterfeit products, still endanger the health of the population, sometimes affecting, in situations of prolonged crisis, the very existence of humanity.

Food fraud is a significant threat to food safety and security, affecting both consumer health and trust in control and regulatory systems. These practices include substitution, adulteration, mislabelling or dilution of food products, with the aim of making a profit at the expense of food quality and safety. Eliminating fraud is essential to guarantee a fair and transparent market, where consumers can make informed choices and benefit from products that comply with national and international standards. Preventing these practices directly contributes to protecting public health, as fraudulent foods may contain unauthorised substances, undeclared allergens or ingredients of unknown origin, which can cause serious adverse effects.

Consequently, we can say that the absence of a national strategy on food security, which would also include the prevention of food fraud, constitutes a major risk and must be treated with all the necessary importance, because the consequences generated by a "sick" society or a potential food crisis are difficult to quantify, the effects of which are felt not only in the economic field, but also in the social and/or political, sometimes even leading to manifestations at the national or regional level. Thus, the elimination of fraud is not only a matter of ethics and legality, but a fundamental condition for achieving a high level of food security and safety, contributing to protecting the lives and well-being of consumers.

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