



UNIVERSITATEA TEHNICĂ A MOLDOVEI



Centrul Universitar „Bogdan Petriceicu Hasdeu” din Cahul

FACULTATEA DE ECONOMIE, INGINERIE ȘI ȘTIINȚE APLICATE



**CONFERINȚA ȘTIINȚIFICĂ NAȚIONALĂ
„INOVAȚIA: FACTOR AL DEZVOLTĂRII
SOCIAL-ECONOMICE”**

12 DECEMBRIE 2025

CAHUL 2026

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Economia inovațională: management, finanțe și contabilitate pentru dezvoltarea durabilă

Secția II

Creativitate și inovație în domeniul educației și al științelor sociale

Secția III

Științe inginerești și cercetări aplicative

Secția IV

Inovație prin cooperare și transfer tehnologic

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SECȚIA I
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FISCAL INSTRUMENTS FOR DECARBONIZATION: ASSESSING THE ECONOMIC
EFFECTIVENESS OF GREEN TAXATION VERSUS DIRECT ENVIRONMENTAL
INVESTMENTS IN ROMANIA

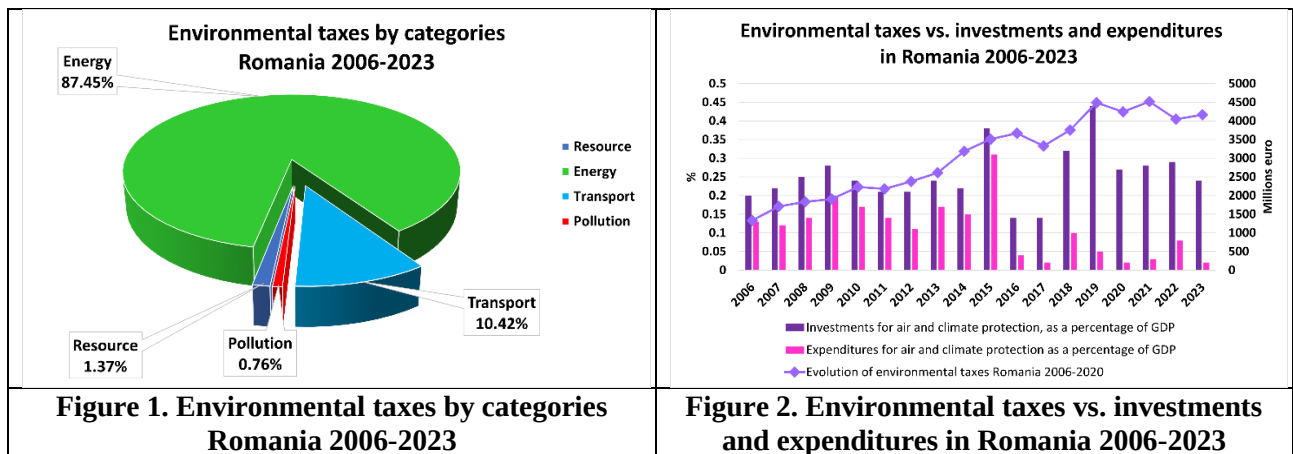
Carmelia Mariana BĂLĂNICĂ DRAGOMIR, ORCID ID: 0000-0001-7743-928X
 "Dunărea de Jos " University of Galati, Galati, Romania

Ciprian CUZMIN, ORCID ID: 0000-0002-2830-6728
 "Dunărea de Jos " University of Galati, Romania

*Corresponding author: Carmelia Mariana Bălănică Dragomir, e-mail: Carmelia.Dragomir@ugal.ro

Introduction and Background

Environmental taxes are a fundamental instrument of environmental policy, falling within the broad category of economic instruments intended for environmental protection, pollution control and sustainable management of natural resources. In Romania, the annual collection of environmental taxes is structured into four main categories: energy taxes (including transport fuels); transport taxes (excluding fuels); pollution taxes and resource taxes.



The impact of climate change is becoming increasingly evident and widespread, which makes, in the current socio-economic context, environmental taxes a key factor in ensuring the sustainable development of the entire society. Green taxes (or environmental taxes) have their origin in the tax system used in public accounting and are defined as mandatory expenditures (tax levies) that are collected either through national public administrations or through European Union bodies.

Methodology

According to processed statistical data (from the National Institute of Statistics) for the period 2006-2023, the structure of environmental taxation indicates a predominant concentration on the energy sector.

Results

More precisely, the highest share is held by energy taxes, which represent about 88% of total environmental revenues. In second place are transport taxes, with a share of approximately 10%. In contrast, resource taxes and pollution taxes register insignificant percentages (of approximately 1% each) in total

revenues. This distribution highlights the major dependence of environmental tax revenues on energy consumption and transport, while suggesting a reduced use of direct taxes on pollution and resource extraction as levers to discourage environmentally harmful behavior.

Conclusions and Implications

These fiscal instruments are essential not only as sources of revenue, but also as market mechanisms that internalize the external costs of pollution, thus orienting economic decisions towards practices that are less harmful to the environment. Therefore, environmental taxation plays a vital role in stimulating environmentally friendly behavior and in financing measures to mitigate and adapt to the effects of the climate crisis.

Keywords: *Climate changes, Environmental taxes, Sustainable development*

IMPROVING BUSINESS EFFICIENCY WITH IoT

Andrei POPA, ORCID ID: 0000-0003-2006-6923

Cahul State University "Bogdan Petriceicu Hasdeu", Cahul, Republic of Moldova

*Corresponding author: Andrei Popa, e-mail: 4andreipopa@gmail.com

Introduction and Background

Artificial Intelligence helps to identify feasible entrepreneurial solutions. In this context, the Internet of Things (IoT), by collecting and using data, enables appropriate responses to the challenges facing entrepreneurs, increasing their efficiency and comfort. Using the IoT reduces costs and effort through automation, helps identify bottlenecks, monitor situations, and evaluate relevant results.

Methodology

To achieve the research objectives, a synthesis of several studies on the Internet of Things (IoT) was conducted. The analysis allowed for the formulation of conclusions and justifications. **Results:** The Internet of Things (IoT) is a network of electronic devices (also called "things") containing sensors, software, and other technologies that are connected to the internet to exchange data with other devices and systems, often without direct human intervention, automating tasks, collecting information, and optimizing processes in homes (smart homes), cities, healthcare, and industry, as well as interacting with other devices and people (also called "users") [1].

The concept of "things" encompasses a wide range of possible devices, such as smart home sensors and lighting, wearable medical devices, security system components, and components related to autonomous driving - all of which are connected to the internet. The vast majority of data exchanges between these devices occur through the transmission of data and the receipt of commands [2]. IoT is typically highly automated or augmented with intelligent software. This means that only a small amount of human-computer interaction is required, sometimes none at all.

The development of this technology stems from the need to automate logistics and delivery documentation, as well as to digitalize quality control, safety, and security of goods (especially food products and pharmaceuticals) (Figure 1).

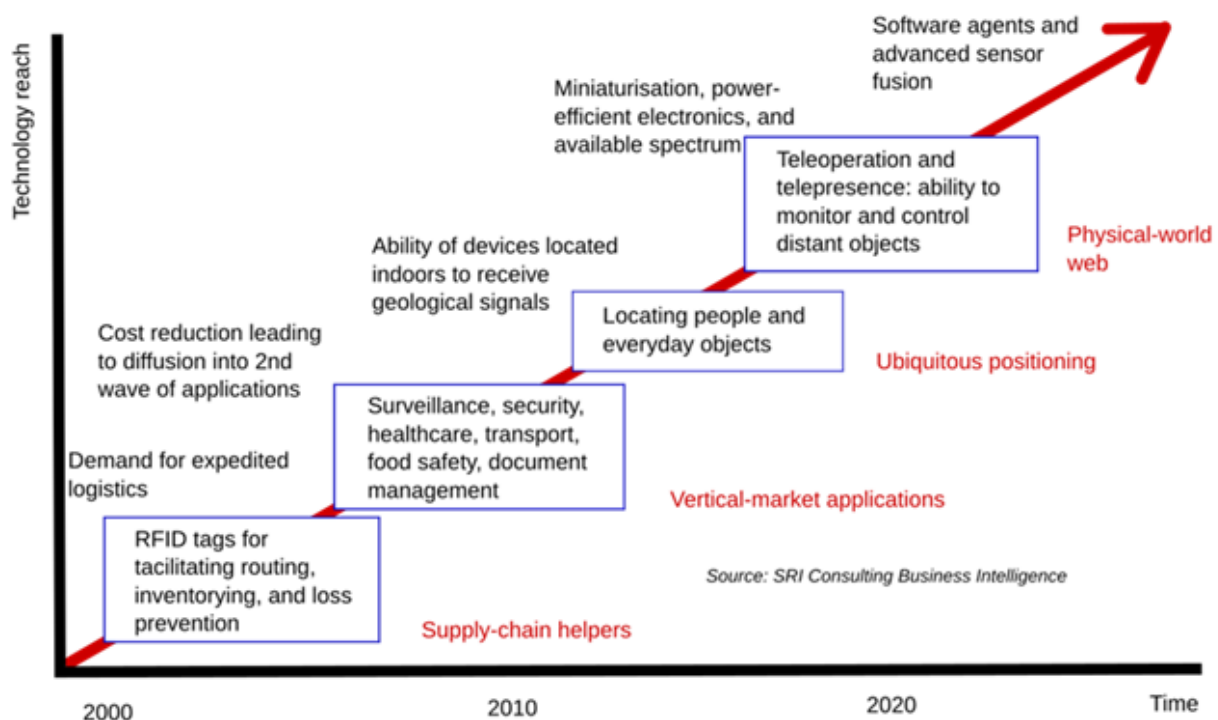


Figure 1. Technology roadmap: The Internet of Things

Source: [3, p. 1]

The core concept of the Internet of Things is to enable objects to observe the physical world and exchange information to support actions. As technology has advanced, responses to specific patterns have become automated, while the rules for triggering actions are set by humans. Consequently, "objects" can collect data (via sensors), send, receive, and act upon it. Communication between devices occurs automatically (M2M – machine-to-machine communication) [4] or with users, without the need for text input or direct commands.

IoT devices are used for a variety of purposes, such as:

- *In homes* – smart speakers, light bulbs, thermostats, refrigerators, and washing machines.
- *In communities* – smart meters, traffic management systems, and pollution monitoring.
- *In medicine* – smart watches and patient monitoring devices.
- *In industry* – manufacturing equipment and inventory management systems..

The Internet of Things (IoT) simplifies everyday tasks (e.g., cleaning, climate control), optimizes resource consumption (e.g., energy, water), and provides valuable data for rapid decision-making (e.g., predictive maintenance, traffic management).

Since the 1980s, the volume of data worldwide, as well as the computing technology required to store it, has grown exponentially. Advances in databases and analytical tools have made it possible to process and analyze in real time the vast volumes of data generated by IoT devices, intelligent vehicles, and equipment. This speed and throughput are crucial for the Internet of Things (IoT). Experts believe the IoT will drive a significant portion of global economic activity. The Internet of Things is a vector of digital transformation on the path to an economy characterized by increased efficiency, productivity, safety, and profitability.

Conclusions and Implications

The Internet of Things (IoT) can be successfully deployed on a large scale, bringing benefits such as cost reduction, time savings, and improved quality of life. The impact of IoT technology will grow over the next decade as manufacturing, agriculture, trade, transportation, finance, and other sectors transform their core processes and business models to harness the benefits of artificial intelligence.

Keywords: *Internet of Things, Artificial Intelligence*

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THE IMPACT OF GOVERNMENT GRANTS AND SUBSIDIES IN THE REPUBLIC OF MOLDOVA ON STIMULATING ECONOMIC DEVELOPMENT

Irina ȘCHIOPU, ORCID ID: 0000-0002-8790-3469

Cahul State University "Bogdan Petriceicu Hasdeu", Cahul, Republic of Moldova

Ana MARIN-MUSTEAȚĂ, ORCID ID: 0009-0009-9908-5473

Cahul State University "Bogdan Petriceicu Hasdeu", Cahul, Republic of Moldova

*Corresponding author: Irina Șchiopu, e-mail: schiopu.irina@usch.md

Introduction

In the context of modern economic challenges, grant and subsidy financing plays an increasingly important role in public interventions aimed at supporting productive sectors, increasing competitiveness, and attracting investments—especially in a landscape shaped by issues such as migration, limited opportunities for small and medium-sized enterprises, and the need to align with European standards. Grants and subsidies have become essential tools for stimulating sustainable development, supporting the business environment, and reducing regional disparities.

In the Republic of Moldova, the efficient use of public funds is crucial to the process of European integration and strengthening economic resilience, thus justifying an in-depth analysis of how these resources are managed and capitalized upon.

Material and Methods

From a theoretical and scientific perspective, this research was conducted using various qualitative research methods, such as comparison, analysis and synthesis, induction and deduction. Additionally, the observation method and the study of statistical data were applied.

Results

Grants are non-refundable funds allocated for activities of public interest, while subsidies represent a form of non-refundable resource transfer from the state budget to a particular beneficiary—mainly small and medium-sized enterprises—in exchange for meeting specific conditions. These transfers are intended to reduce production costs and stimulate competitiveness. Both instruments require transparency and monitoring to prevent inefficient use of public money.

This analysis is grounded in the theory of public goods, agency theory, and allocative efficiency theory, which justify state intervention and the need for rigorous impact evaluation.

The research findings show that grants and subsidies are essential instruments for modernizing small and medium-sized enterprises, developing the agricultural sector, and supporting innovation in every country, including the Republic of Moldova.

During the period 2020–2024 in the Republic of Moldova, programs managed by AIPA (Agency for Intervention and Payments in Agriculture) and ODA (Organization for Entrepreneurship Development) financed over 6,000 projects, attracted investments of approximately 3 billion lei, and generated more than 10,000 jobs.

The analysis demonstrates a positive economic impact, with beneficiaries experiencing a 15–20% increase in productivity and strengthened capacity to compete on both domestic and international markets. Case studies, such as the "PARE 1+1" program, confirm a significant multiplier effect on private investment.

Success depends on transparency, monitoring, and managerial capacity, while the main challenges include bureaucracy, corruption, lack of coordination, and difficulties in measuring real impact.

Conclusions

State grants and subsidies substantially contribute to the economic development of the Republic of Moldova; however, their effectiveness depends on process transparency, beneficiaries' managerial capacity, and institutional coordination. To maximize impact, it is necessary to reduce bureaucracy, improve project monitoring, and strengthen the strategic framework. Implementing modern public management practices will ensure optimal use of financial resources and support sustainable national economic development.

Keywords: *economic development, public funds, grants, subsidies, etc*

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ASPECTS SPECIFIC TO THE COMPLETION PHASE OF THE FINANCIAL AUDIT MISSION

Anatolie IACHIMOVSCI, ORCID ID: 0000-0002-5393-0100

Academy of Economic Studies of Moldova, Chisinau, Republic of Moldova

*Corresponding author: Anatolie Iachimovschi, e-mail: iachimovschi.anatolie.constantin@ase.md

Introduction and Background

The study is carried out in the context of the growing need to ensure the rigor and credibility of the final stages of the financial audit mission, a stage in which the decisive conclusions on the fidelity of the financial statements are formulated. Research is important because this stage represents the culmination of the audit process, directly influencing the quality of the auditor's opinion and users' trust in financial reporting. The specific objective of the study is to analyse and clarify the procedures, responsibilities and critical criteria applied at the completion stage of the audit, in order to improve the accuracy and robustness of auditors' professional decisions.

Methodology

The research approach is based on the procedural analysis of the final stages of the financial audit engagement, with a focus on the techniques used to formulate the opinion and evaluate the most recent adjustments to the financial statements. Methods include reviewing audit documents, final analytical review, and assessing residual risks to confirm that the evidence collected is sufficient and adequate. The study uses a descriptive-analytical design that aims to identify key practices and clarify how they contribute to ensuring a coherent and well-founded audit opinion.

Results

The completion phase of the financial audit engagement confirms that the evidence collected is sufficient and adequate to support the auditor's opinion, and the final review contributes significantly to reducing the risk of misreporting. The analysis of the proposed adjustments shows that a significant part of the identified differences are accepted by management, which improves the accuracy of the financial statements. The final analytical procedures usually indicate only minor variations, confirming the stability of key indicators after the necessary adjustments have been made. The assessment of subsequent events and the continuity of the company's business ensure that managerial assumptions are verified and uncertainties regarding reporting are reduced. Overall, the final conclusions strengthen the credibility of the audit opinion and ensure that the report complies with professional standards.

Conclusions and Implications

The study highlights how the completion phase strengthens the credibility of the auditor's opinion by integrating the conclusions of the tests, analyses and reanalysis of the identified risks. The results suggest the need for more standardized procedures and in-depth analytical tools capable of improving the rigor of final checks. These findings can guide both the improvement of professional practices and the development of research directions on the optimization of evaluation and documentation processes in financial audit.

Keywords: *Additional Procedures, Internal Control, Material Risks, Office Review, Professional Reporting, Reasonable Assurance*

ENHANCING ENTERPRISE PERFORMANCE THROUGH CAPITAL INVESTMENT IN INNOVATION

Nadejda BOTNARI, ORCID ID: 0000-0002-5464-7243

Academy of Economic Studies of Moldova, Chisinau, Republic of Moldova

*Corresponding author: botnari.n@ase.md

In contemporary knowledge-driven economies, enterprise performance is increasingly conditioned by the capacity to generate and apply innovation. Innovation has become a core determinant of value creation, complementing classical production factors such as labor, capital and natural resources. The transition toward innovation-intensive economic development is grounded in scientific progress, technological advancement, and the ability of firms to convert knowledge into competitive products and processes.

Investment in research and innovation strengthens the innovation cycle—research, knowledge generation, innovation and performance—thereby stimulating productivity growth, enterprise competitiveness and national economic development. The efficient capitalization of innovation, however, requires sustained financial resources, organizational capabilities and favourable institutional frameworks.

Statistical data from the National Bureau of Statistics of the Republic of Moldova indicate that, during 2021–2022, only 11.4% of enterprises were classified as innovative, marking a 1.2 percentage-point decline compared to 2019–2020. Approximately 420 innovative enterprises were recorded, of which 185 implemented multiple types of innovation, 64 focused on product and process innovations, while 171 adopted organizational or marketing innovations. The manufacturing sector accounted for the highest innovation activity, with 194 innovative enterprises—16.4% implementing organizational and marketing solutions, 8.1% product and process innovations, and 24% multiple innovation types.

In 2022, total innovation expenditure amounted to 759 million MDL, with 66.9% concentrated in industry and 33.1% in services. Within industry, the manufacturing sector represented 52.2% of total expenditure, while within services the leading domains were information and communications (13.8%) and financial and insurance activities (10.7%). Sales revenue generated from newly introduced products reached 3,420 million MDL, of which 1,887.9 million MDL originated from industry and 1,532.1 million MDL from services.

Despite these developments, Moldova's innovation performance remains modest. The Global Innovation Index positioned the country 60th out of 132 economies, registering a four-position decline compared to the previous year. In 2023, Moldova ranked 81st in the innovation input sub-index and 50th in the innovation output sub-index, indicating inefficiencies in transforming resources into measurable outcomes.

Strengthening the contribution of research and innovation to economic growth requires increased investment in scientific research, institutional innovation programmes, and externally funded projects. Enhancing the efficiency of the research–knowledge–innovation–performance chain presupposes the creation of robust partnerships between research institutions, innovation and technology transfer structures, universities, and the business environment. Equally important are support mechanisms for cooperation, consultancy services, and the development of innovation-oriented policies aimed at increasing competitiveness and long-term sustainability.

Keywords: *innovation, enterprise performance, capital investment, Global Innovation Index, innovative enterprises, innovation expenditure*

BUDGET - MAIN COORDINATE IN FINANCIAL MANAGEMENT – ACCOUNTANT

Rodica CUȘMĂUNSA, ORCID ID: 0000-0003-0444-9799
Academy of Economic Studies of Moldova, Republic of Moldova

Iuliana ȚUGULSCHI, ORCID ID: 0000-0001-8544-7327
Academy of Economic Studies of Moldova, Republic of Moldova

Natalia CURAGĂU, ORCID ID: 0000-0002-1953-0330
Academy of Economic Studies of Moldova, Republic of Moldova

*Corresponding author: Rodica Cușmăunsă, e-mail: cusmaunsa.rodica.gheorghe@ase.md

Introduction

The general budget expresses the operational and financial plans of the entity's management for a specified period and includes a set of budgetary financial statements. For these reasons, we consider it current and important to study the budgeting process and present them in stages of development.

The purpose of this article is to research and examine the theoretical and applicative aspects related to the reporting of key aspects of the budgeting process and the presentation of the budget development stages, and the objective resides in investigating and elucidating the problem presented above.

Therefore, the provisions of national accounting regulations, as well as the works, research and opinions of local economists and scientists in order to formulate conclusions and recommendations on the problems addressed.

Methodology

The research method stems from the analysis of theoretical and practical material regarding problematic aspects related to the budgeting process and the presentation of the budget development stages. At the base of the theoretical foundation were the analysis, synthesis, deduction and inductive method used for a clear and representative interpretation.

Results

Well-managed entities generally go through the following stages of budgeting:

1. planning the entity's performance as a whole, as well as the performance of the subunits;
2. developing a frame of reference, a specific set of forecasts with which to compare the results effective;
3. investigating deviations from plans. If necessary, the investigation is followed by corrective measures;
4. reiterated planning, depending on the results and any changes in the basic conditions.

It is necessary that the entity approves the Budget Preparation Regulation, being a useful guide for managers who are responsible for preparing budgets. This regulation must also include and describes the objectives, budget preparation procedures and deadlines for submitting them for approval.

The budget preparation process is called the budgetary cycle. Budgeting is a technique of management. Respectively, in order for the prepared budgets to be as rational and useful as possible, the members of the budget committee must:

- ✓ ensure the cooperation and participation of employees (supervisors, some workers, etc.);
to communicate the budgetary provisions as clearly as possible;
- ✓ to plan the preparation of budgets well in advance of the start of the period to which they relate, in order to be sure that the budget is adopted before a new budget period;
- ✓ to create an efficient tracking and reporting system with the help of which it is possible to compare, periodically, the results obtained with the plan provisions;
- ✓ to be ready at any time to take measures to remedy the divergences reported in the situations or reports comparative.

Conclusions

Budgeting is a continuous dynamic process of planning the entity's activity for a relatively short period of time. Budgets are a fundamental component of most control systems managerial. When managed intelligently, a budget provides a frame of reference for evaluation performance, motivates managers and employees of the entity.

Keywords: *managerial accounting, budget, budgeting, budgetary cycle*

SOCIAL ENTREPRENEURSHIP: DRIVER FOR SUSTAINABLE AND INCLUSIVE ECONOMIES

Liudmila ROȘCA – SADURSCHI, ORCID ID: 0000-0003-1358-0019

Cahul State University „Bogdan Petriceicu Hasdeu”, Cahul, Republic of Moldova

*Corresponding author: Liudmila Roșca-Sadurschi, e-mail: liudmila.sadurschi@gmail.com

Introduction and Background

Social entrepreneurship has emerged as a crucial socio-economic phenomenon, offering innovative and sustainable solutions to contemporary challenges such as social inequalities and climate change. Distinct from traditional, profit-maximizing entrepreneurship, it prioritizes generating social and environmental value. While well-established in the European Union, contributing significantly to GDP and employment, in the Republic of Moldova, the sector is in an early development stage. This study aims to analyze the role of social entrepreneurship as a pillar for sustainable and inclusive development, diagnose the current situation in Moldova, identify key gaps, and formulate policy recommendations.

Methodology

The research adopts a qualitative and descriptive approach, reviewing theoretical literature on social entrepreneurship definitions from scholars like J. Gregory Dees, Joseph Schumpeter, and EU regulatory frameworks. It incorporates comparative analysis of European cases (e.g., EU Social Economy Action Plan) and Moldova's fragmented legal landscape, supplemented by statistical data from sources like the European Social Enterprise Monitor (ESEM), Eurobarometer, and local reports from EU4Moldova and UNDP. Data synthesis identifies gaps and opportunities through secondary sources, without primary empirical collection.

Results

The research highlights that social entrepreneurship in Moldova is still “in its infancy” and is characterized by small initiatives (approximately 100-150), predominantly in areas such as: agriculture, crafts, rural tourism and social services. Such initiatives are mainly structured as NGOs or limited liability companies, employing 3-10 people per enterprise, mostly women and young people from rural areas. While, at the EU level, the social economy represents approximately 6.5% of GDP and employs over 40 million people [1], with 75% of Europeans recognizing its societal importance and supporting dedicated policies[2].

For the development of this sector in the Republic of Moldova, major development gaps have been identified: 1) the absence of a comprehensive legal framework that would define and support social enterprises[3]; 2) the lack of systematic statistical data[4]; 3) limited business management skills among initiators; 4) strong dependence on external grant funding; and 5) low awareness among policymakers and the public. Instead, key opportunities include alignment with EU policies, continued donor support, growing market interest in local and ethical products, and the demonstrated resilience of local social entrepreneurs.

Conclusions and Implications

Social entrepreneurship represents a strategic tool for fostering resilient, equitable, and inclusive economies. For the Republic of Moldova to harness its full potential, a systemic shift is imperative. This requires the adoption of a clear and stimulating legal framework (inspired by EU models), the development of a support ecosystem (financing, training, incubation), and the explicit inclusion of the social economy in national development strategies. Such measures would enable social entrepreneurship to become a genuine engine for the country's sustainable and inclusive growth.

Keywords: *social entrepreneurship, social impact, inclusion, sustainable economy*

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POSSIBILITIES OF INTEGRATION OF THE CIRCULAR ECONOMY IN THE WALNUT INDUSTRY OF THE REPUBLIC OF MOLDOVA

Slavic GÎRNEȚ, ORCID ID: 0000-0002-7628-0788

Cahul State University „Bogdan Petriceicu Hasdeu”, Cahul, Republic of Moldova

*Corresponding author: Slavic Gîrneț, e-mail: girnet_slavic@yahoo.com

Introduction and Background

The circular economy is a restorative and closed economy. Its distinctive feature is the minimization of the consumption of primary raw materials and the volume of recyclable resources, which is accompanied by a reduction in waste sent to landfills, while reducing the area of landfills and unorganized landfills. The world's population is growing every year, and the need for resources is not slowing down. If we leave everything as it is, then some of the Earth's resources will be completely exhausted in 20-100 years, according to various estimates. The solution may be a circular economy, which is based on the principle of „take – make – reuse”.

A circular economy involves preserving products, components and materials with maximum benefit and value. Unlike linear economics, it is about optimizing the system, not the components. This includes careful management of material flows in biological and engineering cycles. The concept of cyclical economy implies the organization of an economic system and the management of resources and value in such a way that the economic well-being and prosperity of citizens depend less and less on the consumption of depleted resources. In addition, it is assumed that economic activity does not exhaust natural systems, but, on the contrary, increases natural capital. A direction, proper to apply, in the current conditions of Moldova, and in the nuts industry where the volume of waste represents a share of over 70% of the production volume.

Methodology

Scientific research is based on such methods as: tabular and graphical methods, scientific abstraction, historical and logical method, classification and comparison, analysis and synthesis, induction and deduction, forecasting and modelling of economic phenomena, etc.

Results

In the context of the above, I will present a study on the culture of nucifers, the case of the Republic Of Moldova, and the categories of waste that rees from the practice of the respective activity, which would later serve as a basis for the analysis of the possibilities of implementing the circular economy in this area. Carrying out activities of planting, maintenance, development of Walnut crops is regulated by law no. 658 of 29.10.1999. Thus, for the purposes of this law, the notion of Walnut includes the following nut crops: common walnut, black walnut, almond, hazelnut, edible chestnut, and pecan. The analysis of the statistical data in the field reflects a relatively small trend of increasing the areas with walnut crops by about 15 percent in the last 5 years of activity, from 34 thousand ha in 2020 to 39 thousand in 2024, in the context of the reduction by 7 percent of the fruit plantations in the entire Republic of Moldova, this slowing pace of development of walnut crop areas is largely influenced by the current economic conjuncture in the Republic of Moldova , which increasingly stimulates the process of deforestation of plantations by agricultural households. For the analysis of the problem of waste, proper to Walnut crops, the Walnut culture was taken as a reference, which is argued by the decisive share, about 95% of the area of Walnut plantations in Moldova. Our own nut assortment for Moldova is a relatively large one, which includes a varied number of native and foreign souries, highlighted in the respective table, such as: - Cazacu, Calarasi, Lunguete, Lara, Chandler etc. Regardless of the category of walnut crops practiced basically the types of waste that can be obtained on such plantation can be reduced to: - green fruit peels, Woody / dried fruit peels, twigs and shoots, foliage, Woody Mass inside the fruit As a result of the studies conducted, we find that, in the environment at 1ha of walnut, the following results are obtained: - average W / ha = 3.22 t, the core, represents 53% of the dried fruit, equivalent to 1 t, the green peel, represents 42% of the green fruit, equivalent to 1.351 t, the Woody Peel represents 47% of the dried fruit, equivalent to 0.866 t. Besides these wastes, in walnut plantations can also be recorded branches and shoots that can reach a value between 200 kg and 1000 kg, this indicator has growth trends for Hazel orchards (from 500 kg – 1500 kg) where the process of growth of shoots is annual and much more intensive.

Conclusions

In the environment per 1 ha of walnut is recorded about 2.5 t – 3 t of waste, waste which through a rational and efficient organization of production relations in society, by applying the principles of circular

economy can bring a series of benefits both to the economic agents involved in the given activity, as well as to the social and natural environment.

Keywords: *innovation, entrepreneurship, reforms, circular economy, nut culture, recyclable waste*

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CHARACTERISTICS OF SOURCES OF INCREASING SOCIAL CAPITAL THROUGH EVIDENCE MEASURES

Iulia VICOL, ORCID ID: 0000-0002-5675-9994

Cahul State University „Bogdan Petriceicu Hasdeu”, Cahul, Republic of Moldova

*Corresponding author: Iulia Vicol, e-mail: iuliaboris@gmail.com

Introduction and Background

Share capital is a fundamental element of the equity of an economic entity, reflecting the financial basis necessary for the conduct of its activity. The increase in share capital is an important instrument of financial consolidation, used both to increase economic credibility and to comply with legal requirements. In practice, the increase in share capital can be achieved either through external contributions or through accounting measures, based on internal sources of the entity. Studying the sources of increase through accounting measures is relevant since these operations do not involve additional inflows of resources, but rather involve a redistribution of existing equity.

Methodology

The research is based on specific methods of economic and financial analysis. Documentary analysis of the specialized literature and accounting regulations in force was used to theoretically substantiate the study. The analytical method allowed examining the main sources of capital increase through accounting measures, and the comparative method was applied to highlight the differences between capital increase through internal sources and through external contributions. The generalization of the results contributed to the formulation of scientific conclusions.

Results

The analysis of the process of increasing the share capital emphasizes the characteristics of the main sources of its formation and the ways of reflecting it in the accounting records. The increase of the share capital through the entity's own sources is carried out by [1; 403-408 p.]:

- capitalization of retained earnings, which reflects the entity's self-financing capacity and its orientation towards long-term development. In this way, the accumulated profit, which previously had a temporary character and could be distributed in the form of dividends, is transformed into social capital, increasing financial stability and the degree of independence from external sources of financing. At the same time, the value of equity increases and the financial structure of the entity improves, which can positively influence its image in front of creditors and investors;
- capitalization of reserves, which contributes to the consolidation of the share capital and the strengthening of the financial stability of the entity. Reserves, previously constituted from profits or other sources, are used to increase the share capital, which leads to an increase in the level of permanent capital and an improvement in the financial structure;
- conversion of capital premiums into share capital, which contributes to strengthening the entity's financial position and increasing the level of share capital, increasing its capacity to absorb losses and guarantee obligations to third parties. Capital premiums have a complementary role to share capital, but this operation ensures a better correlation between it and the real value of the contributions made by shareholders;
- subsidies (for publicly owned entities), which support the implementation of investments or the performance of current activities and lead to the achievement of positive financial results, which can subsequently be capitalized in the form of retained earnings or reserves.

These sources do not involve additional inflows of economic resources, but lead to an internal restructuring of equity.

Conclusions

Increasing the share capital through accounting measures is an effective way to consolidate equity, without resorting to external sources of financing. This practice contributes to increasing the credibility of the entity towards investors and creditors, as well as to compliance with legal requirements regarding the level of share capital. At the same time, the correct application of these measures requires compliance with accounting principles and regulations in force.

Keywords: *share capital, capital increase, equity, accounting records*

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THE ROLE OF ACCOUNTING FOR FINANCING SOURCES IN AGRICULTURAL SECTOR MANAGEMENT

Sofia DONEA, ORCID ID: 0000-0001-5479-3788

Cahul State University „Bogdan Petriceicu Hasdeu”, Cahul, Republic of Moldova

*Corresponding author: Sofia Donea, e-mail: sofia.donea@feisa.usch.md

Introduction

The Republic of Moldova is a country with significant agricultural potential for the national economy. The domestic agricultural sector faces a series of specific risks that generate losses and limit its sustainable development.

Over time, the sustainable development of the agricultural sector has been insufficiently studied, transforming this activity into one of subsistence and low attractiveness. This situation has led to producers' inability to manage emerging crises and, in some cases, to the abandonment of the sector.

The subject of this study focuses on the importance of using accounting information to improve the quality of decision-making in the planning of activities and production. Accounting information reflects all economic and financial processes within an enterprise and allows for continuous monitoring of activities, forming the qualitative basis for the analysis of the agricultural sector.

Methodology

This study is based on approaches specific to accounting and finance, which represent an important informational foundation in economic sciences. Normative acts and scientific publications in the relevant field served as essential instruments in the research methodology, complemented by practical experience and data regarding the current situation in agriculture.

Results

Agricultural activity is complex, as production is obtained through processes of transformation of biological assets conditioned by environmental factors. The specific characteristics of agriculture are influenced by continuous changes, which require the monitoring and recording of effects resulting from the production process at all stages of transformation. Information regarding operational situations derives from accounting records.

The relevance of this study arises from the need to implement efficient financial management that would contribute to the long-term development of the domestic agricultural sector. It is important for agricultural producers to understand the effects of economic analysis in order to develop their own financing strategies. The lack of comprehensive accounting records distorts economic and financial indicators, leads to incoherent decisions, and ultimately reduces the financial stability of enterprises.

Financing policies in agriculture must highlight the specific risks of the sector, and decisions should be made based on risk-oriented analysis in order to select optimal sources of financing. The most commonly used sources of financing are subsidies, loans, and credits.

Subsidies represent financial resources provided by state authorities and various international institutions for specific purposes in agriculture. Financial support through subsidies is appreciated by agricultural producers; however, in recent years it has lost part of its effectiveness, as the impact of support on performance indicators is not evaluated and deficiencies in control mechanisms are observed.

Loans and credits are provided by banks and other financial institutions and involve a certain cost reflected by interest rates, repayment terms, and eligibility requirements. Resorting to loans and credits is risky, as producers often apply for financing without having a properly developed financial plan adapted to the real financial situation of the enterprise. The lack of complete accounting records does not provide a solid basis for managerial decision-making, generating financial risks at maturity stages, even when lenders impose control measures aimed mainly at protecting their resources through collateral.

In order to choose an appropriate financing option, producers must have an accurate overview of all economic and financial indicators calculated on the basis of complete financial statements, be familiar with financing conditions, and subsequently ensure efficient financial management.

Conclusions

The current situation of the domestic agricultural sector is characterized by insufficient financial resources, which hinders the long-term development of this branch. This generates permanent risks and a low level of monitoring and evaluation of financial policies among producers.

Agricultural producers do not sufficiently value comprehensive accounting records and fail to calculate financial indicators that would establish limits for financing operations and ensure sustainable development at the enterprise level.

The financial policy of an enterprise is considered efficient when the increase in the value of assets financed from various sources leads to higher revenues and profits. Subsidies in recent years tend to compensate for losses generated by various risks, creating dependency and reducing incentives for the implementation of effective management policies. Therefore, subsidies should be conditioned by efficiency indicators so that subsidy programs result in increased production volumes, sales, and profits.

The efficiency of financial resources attracted from financial institutions must be assessed based on costs, loan conditions, repayment terms, and the solvency of the enterprise, taking into account the seasonality of agricultural production. Profitability indicators also reflect the efficiency and performance of financial resource management.

Financial resource management is an essential instrument influencing the stability and development of the agricultural sector. However, the low level of monitoring and evaluation of financial policies, insufficiently qualified personnel, and the excessive and inefficient use of credit ultimately generate risks, losses, insolvency, and rural poverty.

Keywords: *accounting records, agricultural sector, financial resources, financing sources, management, risk*

SECȚIA II
CREATIVITATE ȘI INOVAȚIE ÎN DOMENIUL EDUCAȚIEI ȘI AL ȘTIINȚELOR SOCIALE/
CREATIVITY AND INNOVATION IN THE FIELD OF EDUCATION AND SOCIAL
SCIENCES/

ТВОРЧЕСТВО И ИННОВАЦИИ В ОБЛАСТИ ОБРАЗОВАНИЯ И СОЦИАЛЬНЫХ НАУК

STRENGTHENING INTERCULTURAL DIALOGUE AND INCLUSION IN MOLDOVAN
UNIVERSITIES

Alla LEVITSKAIA, ORCID ID:0000-0002-0520-805X
Comrat State University, Regional Economic Development Institute, Comrat, Republic of Moldova

Natalia ȘCIUCHINA, ORCID ID:0000-0001-5858-4924
Comrat State University, Comrat, Republic of Moldova

Ludmila ROȘCA-SADURSCHI, ORCID ID:0000-0003-1358-0019
Cahul State University „Bogdan Petriceicu Hasdeu”, Cahul, Republic of Moldova

*Corresponding author: Alla Levitskaia, e-mail: alla.levitskaia@gmail.com

Introduction and Background

The rapid increase in the number of refugees in the Republic of Moldova since 2022 has introduced new challenges for universities that must ensure equitable access, social cohesion and academic inclusion. Previous national studies highlight gaps in awareness, limited social interaction between local and displaced youth, and the absence of structured mechanisms supporting integration [1]. This study aims to assess students' attitudes toward refugees, analyse institutional policies on inclusion, and pilot intercultural educational activities that promote dialogue in Comrat and Cahul State Universities.

Methodology

A mixed-method approach was applied, combining an online survey of 210 students, focus-group discussions with refugee and local youth, and document analysis of university policies related to inclusion and student support [2]. Additionally, two thematic dialogue cafés were organised to test interactive educational formats and observe changes in students' perceptions.

Results

Survey findings indicate that although most students hold positive or neutral attitudes, only a minority report meaningful interaction with refugee peers. Key barriers include language differences, insufficient information about support services, and low visibility of institutional inclusion practices. Participation in thematic cafés improved understanding of legal and ethical aspects of migration and increased students' readiness for intercultural communication. Policy analysis revealed the need for clearer procedures to support refugee students and systematic incorporation of intercultural components into academic life.

Conclusions and Implications

The study demonstrates that research-based interventions and structured dialogue activities can significantly enhance intercultural competence and strengthen social cohesion in higher education. The outcomes provide evidence-based recommendations for improving university policies and serve as a scalable model for other institutions working with displaced youth. Future applications may extend the model to community centres and national educational strategies.

Keywords: *dialogue, higher education, inclusion, intercultural competence, refugees, social cohesion*

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AI FOR SUPPORTING MATHEMATICS LEARNING

Diana BÎCLEA, ORCID ID 0000-0001-5737-2209
 University of Lucian Blaga of Sibiu, Sibiu, Romania

*Corresponding author: diana.biclea@ulbsibiu.ro

Introduction and Background

Mathematics continues to be regarded as a foundational discipline, even amid rapid technological change and the ongoing effort to adapt educational practices to new challenges brought about by the emergence of artificial intelligence assistants. Concerns regarding how mathematics is taught and learned have long engaged researchers, teachers, and parents alike. In recent years, technological developments have prompted a rethinking of instructional approaches, particularly as AI tools are increasingly used to support students' learning processes and to promote deeper engagement with mathematics.

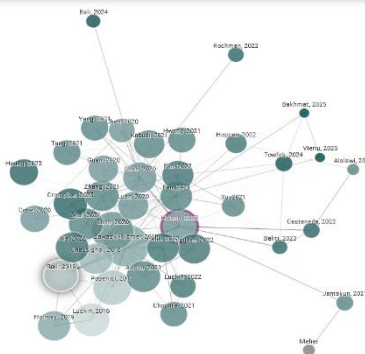


Figure 1. Bibliometric Network of AI in Mathematics Education.

Methodology

The study examined both AI tools specifically designed for mathematics learning and general-purpose systems that can be adapted for this purpose. Relevant sources were selected to identify how existing research describes and evaluates the role of AI in mathematics education. The overarching aim was to synthesize current findings and to highlight trends that illustrate how artificial intelligence is being integrated into mathematics teaching and learning.

Results

Previous work includes systematic reviews that map the evolution of AI applications in mathematics education [1]. A noticeable rise in publications on this topic has been recorded in recent years, with mathematics education emerging as a particularly active area of inquiry (Figure 1). Findings reported across studies suggest that AI can enhance student engagement, improve the precision of instructional feedback, and support pedagogical decisions informed by data [2]. Commonly referenced tools include ChatGPT, algorithmic learning platforms, and a variety of specialized applications such as Photomath, Mathway, WolframAlpha, Symbolab, MathSolver, Yippity, Magic School AI, and Curipod.

Conclusions and Implications

AI systems cannot function independently within educational contexts; their effectiveness depends on thoughtful integration into a broader instructional framework in which the teacher remains central. Key concerns—ranging from reduced opportunities for creativity and critical thinking to issues of algorithmic transparency, data privacy, emotional disconnect, and unequal access—underscore the need for careful, responsible implementation. The literature indicates that meaningful use of AI in mathematics education requires transparency, equitable access, and active collaboration among educators, researchers, policymakers, and developers. Ultimately, AI integration must align with core pedagogical principles to ensure that learning remains purposeful and relevant. The teacher's role therefore, remains crucial, both in terms of willingness to incorporate AI tools and in developing the competencies necessary to use them effectively.

Keywords: *artificial intelligence, adaptive learning, mathematics education*

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INTEGRATION OF DIGITAL RESOURCES IN TECHNICAL DRAWING INSTRUCTION

Alexei BOTEZ, ORCID ID: 0000-0001-8357-076X

Technical University of Moldova, Chișinău, Republic of Moldova

Mihail CRIVOI, ORCID ID: 0009-0005-3619-7217

Technical University of Moldova, Chișinău, Republic of Moldova

Angela ȘULETEA, ORCID ID: 0000-0002-8532-8632

Technical University of Moldova, Chișinău, Republic of Moldova

*Corresponding author: Alexei Botez, e-mail: alexei.botez@gddti.utm.md

Introduction

The digitalization of the educational process significantly transforms the way technical subjects, including technical drawing, are taught. In the context of vocational education, digital resources facilitate the development of students' visual and autonomous learning skills. This study focuses on the development and integration of a digital curricular support tailored to the current needs of students.

Material and Methods

The methodology included an analysis of the specialized literature on self-regulated learning and visual instructional design, as well as the use of questionnaires to identify the difficulties encountered by students and teachers. Digital support materials, differentiated worksheets, interactive tests, and 3D models were developed and integrated into the Moodle platform. The curricular support was structured progressively, combining theoretical content, applied exercises, and self-assessment tools.

Results

The integration of digital resources improved the understanding of complex graphic concepts through the use of 3D models, animations, and interactive visual materials. Students demonstrated significant progress in completing graphic tasks due to the graded worksheets and step-by-step guidance. Interactive tests with automatic feedback supported self-correction and strengthened autonomous learning. The use of the Moodle platform simplified access to resources, progress monitoring, and task organization. Teachers reported increased student motivation and better engagement in individual activities. The digital curricular support proved to be accessible, easy to use, and adaptable to different levels of preparation.

Conclusions

The integrated digital resources in technical drawing instruction have a significant impact on the development of students' professional, visual, and autonomous skills. The developed materials demonstrate the potential of an interactive and differentiated curriculum adapted to vocational education. Future research should examine the application of this model in other technical disciplines and explore advanced digital solutions for graphic instruction.

Keywords: *digital self-assessment, self-directed learning, curriculum support*

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DIGITAL TRANSFORMATION IN CAREER GUIDANCE: OPPORTUNITIES, CHALLENGES, AND BEST PRACTICES

Svetlana BÎRLEA, ORCID ID: 0000-0002-5926-4620

Cahul State University "Bogdan Petriceicu Hasdeu", Cahul, Republic of Moldova

Vitalie JITARIUC, ORCID ID: 0000-0002-9361-4460

Cahul State University "Bogdan Petriceicu Hasdeu", Cahul, Republic of Moldova

Irina TODOS, ORCID ID: 0000-0003-1012-7809

Cahul State University "Bogdan Petriceicu Hasdeu", Cahul, Republic of Moldova

Maxim ILICIEV, ORCID ID: 0000-0001-6645-306X

Cahul State University "Bogdan Petriceicu Hasdeu", Cahul, Republic of Moldova

*Corresponding author: Svetlana Bîrlea, e-mail: svetlana.birlea@feisa.usch.md

Introduction and Background

Accelerated digital transformation, platformization of work, and the emergence of technology-mediated professional roles challenge the epistemological foundations of traditional career counseling. The directive-diagnostic paradigm, grounded in trait-factor theory, conceptualizes career choice as a static matching process between stable individual traits and predefined occupational profiles. Such an approach proves increasingly inadequate in contexts characterized by digital disruption, algorithmic recruitment, and recurrent career transitions. Within this framework, higher education institutions assume strategic responsibility in redesigning digitally integrated guidance services, as reflected in the UPGRADE project – Enhancing Graduates' Employability Tracking in Moldova (Erasmus+ KA2), aimed at modernizing university career systems through digital monitoring and data-driven interventions. This study seeks to comparatively examine dominant counseling paradigms and to theoretically and empirically substantiate the superiority of the developmental (activating) model in cultivating digital career adaptability and professional self-determination competence.

Material and Methods

The research employs critical literature analysis and comparative paradigm evaluation across five counseling strategies: directive-diagnostic, educational (behaviorist), psychoanalytic, humanistic, and developmental. Empirical findings from post-Soviet counseling practice and institutional career services were analyzed using reported longitudinal satisfaction and stability indicators. The methodological framework integrates conceptual synthesis, cross-paradigmatic comparison, and interpretation of documented outcome data.

Results

The directive-diagnostic model reveals three structural limitations in digitally transformed labor markets: disregard for occupational digital dynamism, a static conception of individual characteristics in rapidly evolving competence frameworks, and marginalization of the client's decisional agency in algorithmically influenced environments. Longitudinal evidence indicates that only 30–40% of individuals maintain their initial career choice, undermining the predictive validity of one-time assessment models. Comparative data demonstrate significantly higher three-year professional satisfaction rates for developmental counseling (89%) compared to directive approaches (68%). The developmental paradigm enhances decisional autonomy, reflective capacity, digital literacy, and adaptability by positioning the client as an active constructor of vocational identity in technology-rich contexts. Institutional applications within digitally oriented employability projects further validate its operational feasibility and systemic relevance.

Conclusions

The developmental paradigm represents a paradigmatic shift from prescriptive digital matching toward sustained competence formation and adaptive career construction in technology-driven environments. Its integration into higher education digital guidance systems constitutes a strategic lever for strengthening graduate employability, long-term satisfaction, and resilience in volatile, data-driven labor markets. The findings support reconfiguring counselor training, ethical governance of digital tools, and institutional policies toward activating, process-oriented models of professional accompaniment in the era of digital transformation.

Keywords: *digital transformation, career adaptability, developmental counseling, professional self-determination, vocational guidance, employability analytics*

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ТЕХНИЧЕСКИЕ НАУКИ И ПРИКЛАДНЫЕ ИССЛЕДОВАНИЯ

**THE POWER OF GENETICS IN THE FACE OF CLIMATE CHALLENGES: NATURAL
ADAPTATION FOR TODAY'S TIMES**

George TOADER, ORCID ID: 0000-0002-1379-9531
Saaten Union România SRL, Technical Department, Bucharest, Romania

Cătălin-Ioan ENEA, ORCID ID: 0009-0002-3364-7196
Suceava Agricultural Research and Development Center, Suceava, Romania

Cristina MELUCĂ
Teleorman Agricultural Research and Development Center, Drăgănești-Vlașca, Romania

Nichita NEGUȘERI
Suceava Agricultural Research and Development Center, Suceava, Romania

Leonard ILIE, ORCID ID: 0009-0000-8424-0535
Faculty of Agriculture, USAMV Bucharest, Bucharest, Romania

*Corresponding author: George Toader, e-mail: toadergeorge92@gmail.com

Introduction and Background

Agriculture faces unprecedented challenges due to climate change, requiring innovative strategies for crop and livestock resilience. Genetic approaches provide critical tools to develop varieties and breeds that can withstand environmental stress, pests, and emerging diseases. This study aims to investigate how natural genetic adaptation, combined with advanced selection techniques, can enhance agricultural productivity and sustainability in the current climate scenario.

Methodology

The study reviews existing research and case studies from innovative farming practices and advanced breeding programs. It synthesizes findings on genetic resistance, stress tolerance, and adaptability across plant and animal species. Emphasis is placed on integrating natural genetic potential with modern selection technologies to assess their effectiveness in practical agricultural contexts.

Results

Key findings indicate that crops and livestock with enhanced genetic resilience show significant improvements in productivity and survival under climatic stress. Studies report up to 25% increase in yield stability in drought-tolerant crop varieties and increased disease resistance in genetically selected livestock breeds. The integration of natural genetic traits with modern breeding techniques consistently leads to more resilient farming systems. Case studies highlight successful application in both smallholder and large-scale commercial farms, demonstrating practical benefits and scalability. These results suggest that targeted genetic adaptation can serve as a proactive solution to climate-related agricultural challenges.

Conclusions and Implications

The findings underscore the potential of leveraging natural genetic variation to build climate-resilient agricultural systems. Implementing these strategies can enhance food security, reduce vulnerability to environmental stressors, and guide future research in sustainable agriculture. Genetic adaptation emerges as both an immediate and long-term solution for climate-smart farming.

Keywords: *adaptation, agriculture, climate resilience, genetic selection, sustainability*

BIODEGRADABLE PLASTIC PERFORMANCE AND DEGRADATION BEHAVIOR IN ENVIRONMENTAL CONDITIONS RELEVANT TO FOOD PACKAGING SYSTEMS

Alexandra CİCANCİ, ORCID ID: 0000-0002-6968-9016

Cahul State University “Bogdan Petriceicu Hasdeu”, Republic of Moldova

*Corresponding author: Alexandra Cıcanrı, e-mail: alexandra.cıcanrı@feisa.usch.md

Introduction and Background

Biodegradable plastics are increasingly promoted as sustainable alternatives to conventional polymers used in food packaging, yet their real environmental performance remains dependent on specific degradation conditions [1]. Recent concerns regarding plastic accumulation in soil and aquatic systems highlight the need to assess whether biodegradable plastics truly offer advantages over traditional materials [2]. The objective of this study is to evaluate the degradation behavior of a biodegradable food-grade plastic compared with paper, conventional plastic, aluminum, and polyethylene in soil, distilled water, and compost, under controlled laboratory conditions.

Material and methods

Samples of each material were cut to equal size and exposed for 35 days to the three media. Mass measurements were performed at 7, 14, 21 and 35 days. Degradation efficiency was expressed as the percentage of mass loss relative to the initial weight. Environmental factors such as moisture, aeration and microbial activity were kept constant for all materials within each medium to ensure comparability.

Results

Biodegradable plastic showed the most significant degradation in compost, reaching approximately 25% mass loss after 35 days, indicating active microbial involvement. In soil, degradation reached around 16%, while in distilled water the material lost only about 7% of its mass, revealing limited degradation potential in aquatic environments. Paper degraded rapidly and completely in both compost and soil, confirming its high environmental compatibility. Polyethylene exhibited moderate degradation only in compost (~45%), but minimal changes in soil and water. Meanwhile, conventional plastic and aluminum showed almost no degradation under any tested conditions, persisting throughout the entire experiment.

Conclusions and implications

The findings demonstrate that biodegradable plastics degrade effectively only in environments rich in microorganisms and oxygen, such as compost. Their limited degradation in soil and aquatic settings suggests that environmental benefits strongly depend on appropriate waste-management infrastructure. Therefore, biodegradable packaging should be integrated with well-developed composting systems to ensure a real ecological impact. The comparison with other materials highlights the importance of selecting packaging not only based on composition but also on end-of-life conditions.

Keywords: *biodegradation, composting efficiency, environmental impact, food packaging materials, polymer degradation, sustainable alternatives*

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HOMOGENEOUS CATECHOL OXIDATION IN AQUEOUS SOLUTION

Larisa MOCANU, ORCID ID: 0000-0003-3306-5292

Institute of Chemistry of Moldova State University, Chisinau, Republic of Moldova

Maria GONTA, ORCID ID: 0000-0003-3476-0967

Moldova State University, Chisinau, Republic of Moldova

*Corresponding author: Larisa Mocanu, e-mail: lmordea@gmail.com

Introduction and Background

Catechol is a priority phenolic pollutant frequently detected in industrial and natural waters, exhibiting high toxicity and resistance to conventional treatment methods. Homogeneous catalytic oxidation processes represent an efficient alternative for the abatement of such recalcitrant organic contaminants. The objective of this study is to evaluate the efficiency and kinetics of the homogeneous oxidation of catechol in aqueous solution under controlled experimental conditions.

Methodology

The oxidation experiments were performed in a batch reactor using a homogeneous catalytic system based on ferrous ions and hydrogen peroxide. The effects of operational parameters, including initial catechol concentration (50 mg/L), oxidant dosage, catalyst concentration, and pH, were systematically evaluated. Catechol removal was monitored spectrophotometrically, while mineralization was assessed through chemical oxygen demand (COD) measurements. Reaction kinetics were analyzed using a pseudo-first-order models.

Results

The results demonstrated a rapid degradation of catechol, with removal efficiencies exceeding 60% within the first 200 minutes under optimal conditions. The highest oxidation rate was observed at acidic pH, confirming the strong dependence of the process on the reaction medium. Increasing the hydrogen peroxide concentration enhanced catechol conversion up to an optimum value, beyond which a scavenging effect was observed. The apparent rate constant increased from $1.2 \times 10^{-3} \text{ s}^{-1}$ to $6.8 \times 10^{-3} \text{ s}^{-1}$ with increasing catalyst concentration. COD removal reached up to 55%, indicating partial mineralization and the formation of intermediate oxidation products. Kinetic analysis confirmed that the oxidation process followed pseudo-first-order behavior with respect to catechol concentration.

Conclusions and Implications

The homogeneous oxidation process proved to be highly effective for catechol degradation in aqueous solution, offering fast reaction rates and high removal efficiencies. These findings highlight the potential of homogeneous catalytic oxidation as a viable treatment option for phenolic wastewater and provide a scientific basis for further optimization and scale-up of advanced oxidation processes for industrial applications.

Keywords: *advanced oxidation processes, aqueous solution, catalytic systems, degradation kinetics, phenolic pollutants*

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IDENTIFICATION OF POLYMERS AND ANALYSIS OF LABELING SYMBOLS ON NON-ALCOHOLIC BEVERAGE PACKAGING

Veronica DRAGANCEA, ORCID ID: 0000-0002-5938-0410
Technical University of Moldova, Chisinau, Republic of Moldova

Rodica STURZA, ORCID ID: 0000-0002-2412-5874
Technical University of Moldova, Chisinau, Republic of Moldova

Aliona GHENDOV-MOȘANU, ORCID ID: 0000-0001-5214-3562
Technical University of Moldova, Chisinau, Republic of Moldova

Dmitri LAZACOVICI, ORCID ID: 0000-0001-9078-1098
Technical University of Moldova, Chisinau, Republic of Moldova

*Corresponding author: Veronica Dragancea, e-mail: veronica.dragancea@chim.utm.md

Packaging for non-alcoholic drinks is an important category of plastic products, with direct implications for food safety, environmental protection, and the efficiency of recycling systems. In the context of the transition to a circular economy, proper management of this packaging becomes an essential objective, contributing to the reduction of waste generation and the valorization of resources through recycling. The labeling standardizing of plastic materials, including Resin Identification Codes (RIC) and recycling symbols, represents a fundamental tool both for efficient selective collection and for correctly informing consumers. In this regard, the present study aims to identify the polymers used in soft drink packaging marketed in the Republic of Moldova and to analyze the uniformity of labeling symbols, in relation to current requirements for sustainable waste management.

For this study, 85 packages were collected from retail outlets and other commercial units. The polymer types (PET, HDPE, PP) were identified through visual examination and by verifying the resin identification codes (RIC) printed on the packages. For each sample, the presence of recycling symbols, food contact markings (the fork and glass pictogram), the Tidyman symbol (indicating consumer responsibility in waste management), and any additional symbols related to deposit-return systems or single-use product classification were recorded. All collected data were then consolidated and comparatively analyzed to evaluate the frequency and consistency of symbol application on soft drink packaging.

Polyethylene Terephthalate (PET or #1) was identified as the sole material used for all analyzed soft drink bottles. PET is clear, durable, lightweight, shatter-resistant, and provides an effective barrier against carbon dioxide, thereby helping carbonated beverages maintain their carbonation. Although the bottles themselves were made entirely of PET, 35% of the packaging included secondary components such as HDPE caps and PP labels. Regarding labeling practices, the Tidyman symbol was present on 71.42% of the samples, while the food-contact symbol appeared on 25%. The deposit-return mark was identified on 19% of the packages, and the “single-use” label on 10.71%. In 14.28% of the samples, the visible information was limited to the PET marking and a basic disposal pictogram, with no additional labeling.

The results highlight variability in the application of labeling symbols, indicating the absence of a uniform approach at the national level. The study confirms the need to harmonize labeling symbols and inscriptions on plastic packaging in accordance with European circular economy requirements. Standardizing these elements would improve the efficiency of selective collection, increase consumer awareness, and strengthen the national plastic waste management system.

Keywords: *circular economy, deposit packaging, HDPE, PET, PP, recycling symbols*

Acknowledgments. The research was funded within the project "Assessment of the risks associated with the migration of potentially toxic components from plastic food packaging on the market of the Republic of Moldova", ERMAP-MD, call "Stimulating excellence in scientific research", 2025-2026.

THE USE OF BIOPROTECTIVE YEASTS TO REDUCE SULFITE CONSUMPTION IN WINEMAKING

Nicolai CUPCEA, ORCID ID: 0009-0005-6725-2725
Technical University of Moldova, Chisinau, Republic of Moldova

Rodica STURZA, ORCID ID: 0000-0002-2412-5874
Technical University of Moldova, Chisinau, Republic of Moldova

*Corresponding author: Nicolai Cupcea, e-mail: cupcea-nicu@mail.ru

Introduction

The reduction of sulfur dioxide (SO₂) in winemaking represents a critical challenge in modern oenology, driven by increasingly stringent European regulations (EU Regulation 2019/934) and growing consumer demand for "natural" wines with minimal chemical additives. However, the complete elimination of SO₂ remains microbiologically risky, as it is essential for controlling spoilage microorganisms and preventing oxidative degradation [1]. In this context, bioprotective non-Saccharomyces yeasts have emerged as an ecologically viable alternative to classical SO₂ treatment. This study investigates the application of bioprotective yeasts to white wine vinification in the Codru region (Republic of Moldova), aiming to evaluate their effectiveness in reducing SO₂ consumption while maintaining microbiological stability and sensory quality.

Methodology

Two white grape varieties—Glera (international cultivar, sensitive to oxidation) and Fetească Regală (local Moldavian variety, oxidation-resistant)—were vinified using a commercial bioprotective preparation: Zymaflore Égide TDMP (Laffort), containing a mixture of *Torulaspora delbrueckii* and *Metschnikowia pulcherrima* [2]. Bioprotective yeasts were inoculated directly into fresh must at 10 g/hL immediately after crushing and pressing, at controlled temperatures of 14–16°C. No initial SO₂ was added during the first 48 hours of the pre-fermentative phase. Subsequently, alcoholic fermentation proceeded with selected *Saccharomyces cerevisiae* strains following standard winery protocols. Microbiological monitoring (daily qualitative assessments for acetic bacteria and mold development), physicochemical analysis (pH, turbidity, optical clarity), and preliminary chemical evaluation (SO₂ additions, basic composition) were conducted throughout the experimental period (September–November 2025).

Results

Preliminary observations at 24 and 48 hours post-inoculation showed a complete absence of acetic bacteria and fungal contamination in both lots. Must clarity and freshness were preserved in both Glera and Fetească Regală samples, with no evidence of early oxidation. pH measurements remained stable (3.2 for Glera, 3.15 for Fetească Regală). Based on comparative analysis with conventional vinification protocols and extrapolation from international literature, a reduction of approximately 30–40% in total SO₂ requirement is anticipated: for Glera, from ca. 110 mg/L to 70 mg/L (36% reduction); for Fetească Regală, from ca. 90 mg/L to 60 mg/L (33% reduction). The bioprotective mechanism functioned effectively through ecological niche occupation and metabolite-mediated inhibition of spoilage organisms, without premature initiation of alcoholic fermentation.

Conclusions

This study demonstrates the technical feasibility and microbiological efficacy of bioprotective yeasts (*Torulaspora delbrueckii* and *Metschnikowia pulcherrima*) for reducing SO₂ consumption in white wine vinification under Codru region conditions. The integration of bioprotection into Moldavian winemaking practices offers a pathway toward aligning local wine production with European sustainability trends and market demands for "low-sulfite" products. Pending complete chemical analysis and sensory evaluation post-bottling (scheduled for 2026), these findings suggest strong potential for commercial application and regional extension to additional varieties and wine-growing zones. This innovation contributes to both technological advancement and environmental sustainability in oenology.

Keywords: *bioprotection, Codru region, low-sulfite wines, Metschnikowia pulcherrima, Torulaspora delbrueckii, white wine vinification*

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PROCESS FOR OBTAINING HYDRO-ALCOHOLIC EXTRACTS FROM BERRIES BASED ON MATHEMATICAL MODELING

Roman GOLUBI, ORCID ID: 0000-0003-4444-9515

National Institute for Applied Research in Agriculture and Veterinary Medicine, Republic of Moldova

Boris MORARI, ORCID ID: 0000-0002-1583-7474

National Institute for Applied Research in Agriculture and Veterinary Medicine, Republic of Moldova

Silvia NEMȚEANU, ORCID ID: 0000-0002-5075-5378

National Institute for Applied Research in Agriculture and Veterinary Medicine, Republic of Moldova

Maria-Marcela BARBAROȘ, ORCID ID: 0000-0003-0524-148X

National Institute for Applied Research in Agriculture and Veterinary Medicine, Republic of Moldova

Elena ZÎREANOVA, ORCID ID: 0000-0002-7625-175X

National Institute for Applied Research in Agriculture and Veterinary Medicine, Republic of Moldova

*Corresponding author: Roman Golubi, e-mail: romangolubi985@gmail.com

Introduction

Berries are an important source of substances with antioxidant properties, which can be successfully used to increase the nutritional value of new generation foods. The main task for food engineering researchers is to develop the optimal process for extracting these substances. Typically, water-ethanol hydromodules are used, where the parameters vary: sample-solvent ratio, temperature, pH value, and extraction duration.

Material and methods

As samples for research, three types of berries were selected: sea buckthorn, rosehip and black currant. Their content of substances with high antioxidant activity was determined by UV-VIS spectrophotometry: ascorbic acid (vitamin C), α -tocopherol (vitamin E), carotenoids (expressed as β -carotene), vitamins B1, B2, B6 and phenolic substances. The representative index for expressing the general antioxidant effect was the DPPH radical scavenging assay. To optimize the process of obtaining hydro-alcoholic extracts from berries, second-degree mathematical modeling with two factors was applied.

Results

The berries purchased from local farmers were processed according to the technological flow, which included: inspection and washing with a water jet at 1.5 bar, sectioning and separation of seeds (in the case of rosehip), freezing at -18°C . At the time of initiating the experiments, the samples were removed from the freezer and adjusted to $20-22^{\circ}\text{C}$, then they were crushed in a screw juicer and homogenized into a puree structure. For the extraction of substances with antioxidant properties (vitamins, carotenoids, phenolic compounds), a hydroalcoholic solution with a degree of 71.0% (wine distillate) was used in a ratio of 100 mL:10 mg puree. Thirteen experiments were performed, each in 2 repetitions, where the input parameters temperature and treatment duration had maximum, minimum and center values, plus "star" points ($+\alpha$ and $-\alpha$). The hydroalcoholic extracts of berries, obtained according to the planned variants in the mathematical model, were diluted 1:100 and introduced with an automatic pipette in a volume of 100 μL into 1 cm wide cuvette, where initially 3900 μL of 0.2 mM DPPH solutions were added. After 30 min of incubation in the dark, the cuvettes with solutions were read by a spectrophotometer, the wavelength being 517 nm. Using the Microsoft Excel (MS Office 2007), the values of the data field were calculated to obtain regression equations and the optimal combination of temperature and duration for the maximum possible value of the issue parameter, which is directly related to the increased content of substances with antioxidant properties. Based on this mathematical model, the extraction process was optimized for each type of berry and the maximum value of DPPH radical scavenging activity was established: 52.6% and 44.2% for extraction for 60 min at 20°C from rosehip puree and blackcurrant puree, respectively 31.7% for extraction for 45 min at 44°C from sea buckthorn puree.

Conclusions and Implications

The process of obtaining extracts from sea buckthorn, rosehip, black currant, rich in antioxidant substances was optimized by applying mathematical modeling. The efficiency of the process was confirmed by the DPPH test. These results will be useful for fortifying low-alcoholic beverages.

Keywords: *antioxidant activity, berries, DPPH assay, extraction optimization, mathematical modeling*

FUNCTIONAL PROPERTIES AND TECHNOLOGICAL APPLICABILITY OF ZIZIPHUS JUJUBA MILL FRUIT

Natalia SUHODOL, ORCID ID: 0000-0002-5609-5139

Technical University of Moldova, Food and Nutrition Department, Chisinau, Moldova

Olga DESEATNICOVA, ORCID ID: 0000-0003-4801-8173

Technical University of Moldova, Food and Nutrition Department, Chisinau, Moldova

Aurelia CHIRSANOVA, ORCID ID: 0000-0002-1172-9900

Technical University of Moldova, Food and Nutrition Department, Chisinau, Moldova

*Corresponding author: Natalia Suhodol, e-mail: natalia.suhodol@toap.utm.md

Introduction and Background

The study focused on the functional properties and technological applicability of Ziziphus jujuba Mill fruits, with an emphasis on exploiting their functional and technological potential. The native Ziziphus fruits were purchased from the commercial network, harvested in 2024, primarily processed, and frozen in the form of puree. Ziziphus jujuba Mill fruits have a high polyphenol content (up to 917.83 mg GAE/L), significant antioxidant activity (over 93%), and contribute to improving the nutritional value of processed products, while maintaining a high degree of sensory acceptability. In this context, there are real prospects for the industrial use of jujube in the development of functional products with added value.

Methodology

The research focuses on the formulation of a marshmallow-type product enriched with ziziphus jujube pulp in a proportion of 10% and 25% of the total mass. The total polyphenols content and antioxidant activity of the marshmallow-type product samples were determined by using Folin Ciocalteu and DPPH reagents.

Results

The results obtained confirm the significant contribution of Ziziphus jujuba Mill puree to improving the functional and sensory properties of the marshmallow-type product.

The products developed are distinguished by a high polyphenol content: 154.66 mg GAE /L for samples with 10% Ziziphus jujuba Mill puree added and 271 mg GAE/g for samples with 25% puree, compared to 70.51 mg GAE /L for the control sample. The samples with 10% and 25% Ziziphus jujuba pulp added showed increased antioxidant activity values of 4.99% and 19.34%, respectively, compared to the control sample, which recorded only 0.3%.

Conclusions and Implications

The organoleptic evaluation of the samples shows that the inclusion of Ziziphus jujuba pulp significantly changes the sensory profile of the final product. The control sample is notable for its pleasant texture, but has a less harmonious taste balance, scoring an average of 4.86. In contrast, the variants fortified with 10% and 25% Ziziphus jujuba puree bring added functionality and sensory diversity, achieving average scores of 4.79 and 4.61, respectively.

Keywords: *antioxidant activity, functional dessert, marshmallow, polyphenol content*

Acknowledgments. We gratefully thank TUM institutional subprogram 020405 "Optimization of food processing technologies in the context of the circular bioeconomy and climate change" for financial support.

ALFALFA (*MEDICAGO SATIVA L.*) - RELEVANT PROTEIN RAW MATERIAL FOR THE FOOD INDUSTRY

Iana CIUGUREANU, ORCID ID: 0009-0004-1910-7833

Technical University of Moldova, Food Technology Department, Chisinau, Republic of Moldova

Viorica BULGARU, ORCID ID: 0000-0002-1921-2009

Technical University of Moldova, Food Technology Department, Chisinau, Republic of Moldova

Angela GUREV, ORCID ID: 0000-0001-8493-5257

Technical University of Moldova, Food Technology Department, Chisinau, Republic of Moldova

Aliona GHENDOV-MOȘANU, ORCID ID: 0000-0001-5214-3562

Technical University of Moldova, Food Technology Department, Chisinau, Republic of Moldova

*Corresponding author: Iana Ciugureanu, e-mail: iana.ciugureanu@doctorat.utm.md

Introduction and Background

In the context of population growth, the diet must provide high-quality proteins, easily digestible and with a complete profile of essential amino acids, characteristics commonly found in animal sources. Vegetable proteins obtained from legumes and cereals have limitations, especially due to the incomplete supply of essential amino acids and less advantageous sensory properties. In this regard, it becomes important to identify alternative solutions for the valorization of vegetable proteins, such as those extracted from alfalfa (*Medicago sativa L.*), which is distinguished by high biomass productivity, 3–10 times higher compared to oilseed, legume or cereal crops. In this context, the purpose of this research was to investigate the quality indices and antioxidant potential of alfalfa, with a view to its further exploitation in the food industry.

Methodology

The local alfalfa variety was used for the research. Dry weight (DW), protein, fat and ash content were determined using the official AOAC method. Amino acid composition was determined by standard protocols involving cation exchange chromatography. The total content of polyphenols and flavonoids (TPC and TFC) and antioxidant activity (via DPPH, ABTS) were determined by spectrophotometric analysis for aqueous and hydroethanolic alfalfa extracts.

Results

The protein content of the sample of alfalfa leaves and stems, harvested in the budding phase, was 28.63% of dry matter. The high amount of protein in the respective alfalfa variety was favored by the vegetation conditions that contributed to the accumulation of nitrogen compounds, as well as to the quality of the accumulated proteins, with soluble proteins predominating. The alfalfa samples showed a fat content of 2.34%, a value considered typical for leaf biomass. The results for the ash content were 11.55%, representing a fairly high proportion of mineral fraction in the original alfalfa. The amino acid profile of alfalfa revealed a broad composition, comprising both essential and non-essential amino acids. Among the amino acids quantified, aspartic acid (1.95 g/100 g DW) and glutamic acid (1.91 g/100 g DW) were predominant. In addition, the alfalfa sample was richer in proline (1.01 g/100 g DW), leucine (0.97 g/100 g DW) and valine (0.95 g/100 g DW). Lower concentrations were observed for cysteine and methionine. The TPC and TFC values for the aqueous extracts of alfalfa were lower (2093.6 mg GAE/100 g DW and 584.1 mg QE/100 g DW, respectively) compared to the alcoholic ones (2583.0 mg GAE/100 g DW and 810.3 mg QE/100 g DW, respectively). This difference can be attributed to the higher efficiency of 70% aqueous ethanol in extracting polyphenolic compounds. The results showed that the DPPH• radical scavenging capacity was higher in the hydroalcoholic extracts of alfalfa compared to the aqueous ones (583.2 and 485.3 mg TE/100 g DW, respectively). The antioxidant activity determined by the DPPH assay is specific to phenolic compounds and depends on their concentration. At the same time, the scavenging capacity of the ABTS•⁺ radical cation was considerably higher for aqueous alfalfa extracts (3190.4 mg TE/100 g DW) compared to hydroethanolic extracts (2093.6 mg TE/100 g DW).

Conclusions and Implications

Alfalfa harvested in the budding stage demonstrated a high nutritional value, characterized by an elevated protein content and a balanced amino acid profile dominated by aspartic and glutamic acids. Extracts

obtained with 70% aqueous ethanol showed superior polyphenol levels and higher DPPH radical-scavenging activity, while aqueous extracts exhibited stronger ABTS^{•+} scavenging capacity. Overall, the results highlight alfalfa as a valuable source of proteins and bioactive compounds with notable antioxidant potential.

Keywords: *antioxidant activity; bioactive compounds; green leafy protein sources; sustainable crop*

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EVALUATION OF THE FUNCTIONAL PROPERTIES OF AQUAFABA IN VEGAN FOOD FORMULATIONS

Alina BOISTEAN, ORCID ID: 0000-0002-5374-5853

Technical University of Moldova, Department Food and Nutrition, Chisinau, Republic of Moldova

Aurica CHIRSANOVA, ORCID ID: 0000-0002-1172-9900

Technical University of Moldova, Department Food and Nutrition, Chisinau, Republic of Moldova

Aliona GHENDOV-MOSANU, ORCID ID: 0000-0001-5214-3562

Technical University of Moldova, Department Food Technology, Chisinau, Republic of Moldova

*Corresponding author: Alina Boistean, e-mail: alina.boistean@toap.utm.md

Introduction and Background

Aquafaba, the residual liquid derived from canned or cooked legumes, has recently emerged as a valuable functional ingredient due to its natural emulsifying and stabilizing properties [1]. According to previous research conducted at the Technical University of Moldova, aquafaba represents a significant food-processing residue—constituting up to 40% of the total mass of canned legumes—and has proven functional potential as a plant-based foaming and structuring agent, successfully replacing egg whites in various vegetable food products [2]. This study aimed to investigate how residual aquafaba collected from three different legume sources—chickpeas, white beans, and green peas—affects the physicochemical, rheological, sensory, and microbiological quality of vegan mayonnaise-type sauces.

Methodology

Aquafaba samples were collected directly as residual brine from commercial legume cans readily available on the Moldovan market. Vegan mayonnaise formulations were prepared according to a standardized recipe, and the resulting products were analyzed for dry matter, titratable acidity, pH, viscosity, sensory attributes, and microbial load using established analytical and instrumental methods.

Results

White bean aquafaba showed the highest dry matter content, while green pea aquafaba exhibited the highest moisture percentage among the three samples. All vegan sauces prepared from these aquafaba types met the required acidity specifications, and pH measurements indicated values below 4.6, confirming microbiological safety; the chickpea-based sauce presented the lowest pH, thus offering the most favorable acidic profile. Rheological analysis showed that the sauce formulated with chickpea aquafaba reached the highest viscosity, reflecting a thicker and more stable emulsion compared to the white bean and green pea variants. Sensory evaluation revealed that the chickpea and white-bean sauces received the highest scores for appearance, taste, and texture, aligning closely with consumer expectations for mayonnaise-type products. Microbiological assessment demonstrated acceptable colony counts across all samples, with the chickpea-based sauce again showing the lowest microbial load, confirming its superior hygienic quality.

Conclusions and Implications

The study demonstrates that the type of aquafaba—collected as a residual by-product from canned legumes—significantly influences the quality of vegan mayonnaise-type sauces. Chickpea aquafaba provided the most advantageous functional, sensory, and microbiological characteristics, highlighting its potential as an effective clean-label emulsifier for plant-based formulations. Moreover, these findings offer practical value for public catering enterprises that prepare vegan dishes, as the use of residual aquafaba can contribute to waste reduction and cost optimization in the production of vegan sauces. This approach supports both sustainable resource management and the affordability of plant-based menu items.

Keywords: *aquafaba, emulsification, sensory quality, vegan mayonnaise, viscosity*

Acknowledgments. The research was supported by the Institutional Project 020405 "Optimization of food processing technologies in the context of circular bioeconomy and climate change", Bio-OpTehPAS, running within the Technical University of Moldova.

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THE IMPACT OF AGRO-INDUSTRIAL BY-PRODUCTS IN CONFECTIONERY

Olga BOESTEAN, ORCID ID: 0000-0002-0390-3550

Technical University of Moldova, Department of Food Technology, Chisinau, Republic of Moldova

Natalia NETREBA, ORCID ID: 0000-0003-4200-1303

Technical University of Moldova, Department of Food Technology, Chisinau, Republic of Moldova

Oksana SHESTOPAL, ORCID ID: 0000-0001-7283-1055

Rybnitsa branch of Pridnestrovian Shevchenko State University, Rybnitsa, Republic of Moldova

*Corresponding author: Olga Boestean, e-mail: olga.boestean@tpa.utm.md

The use of agro-industrial by-products in the creation of new food products is an important direction for the utilisation of natural resources and the reduction of environmental impact. This study investigated the possibility of partially replacing cocoa powder with grape seed meal in truffles. Grape seed meal, rich in dietary fibre, proteins and phenolic compounds with antioxidant activity, was analysed in terms of its effect on the sensory and nutritional properties of the finished product.

The physicochemical parameters of plant by-products were determined in accordance with regulatory and legislative documents in this area [1]. The sensory and physicochemical quality of grape seed meal flour was analysed. The physicochemical characteristics were described by the following values: moisture content – $5.76 \pm 0.04\%$, ash content – $4.49 \pm 0.30\%$, lipid content – $8.42 \pm 0.61\%$ and protein content – $15.75 \pm 0.11\%$. When preparing experimental samples of truffles, the cocoa mass was partially replaced with grape seed meal flour in proportions of 5%, 10% and 25%.

Changes in the quality indicators of candies based on grape seed flour were noticeable. Grape seed flour is rich in fibre, which has the ability to absorb moisture. This led to a reduction in moisture content from 1.69 to 1.17%, i.e. by 1.4 times, and a decrease in sugar content from 36.4 to 28.3%, i.e. by 1.3 times. Adding it to sweets can reduce the energy value of the final product while providing nutritional benefits such as improved digestion and protection against oxidative stress [2].

Adding grape seed flour to a candy recipe affects its organoleptic characteristics, namely taste and colour. In terms of taste, grape seed flour has a slightly astringent taste with fruity notes that complement the main flavour of the candy, giving it an original, piquant taste [3]. As for the colour of truffles, grape seed flour does not have a decisive effect on their colour, as the change in colour is not noticeable against the background of cocoa powder; it can only change the colour, making it more saturated and intense [4]. Grape seed meal acts as a functional ingredient with antimicrobial activity, improving the microbiological stability of truffles, and provides nutritional benefits (antioxidants, fibre), making it a sustainable and safe alternative to cocoa powder.

The findings highlight the potential of grape seed meal as a sustainable and nutritious ingredient that can improve the functional profile of confectionery products while offering an innovative alternative to the traditional use of cocoa powder. The results showed that the addition of pomace leads to a significant increase in antioxidant and fibre content, contributing to a functional dessert with added value. Sensory evaluation showed that partial replacement of cocoa powder is favourable.

Keywords: *antioxidants, confectionery products, grape seed meal, sensory evaluation, sustainable ingredients*

Acknowledgments: The research was supported by Institutional Project, subprogram 020405 „Optimizing food processing technologies in the context of the circular bioeconomy and climate change”, Bio-OpTehPAS, being implemented at the Technical University of Moldova.

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SODIUM REDUCTION IN BAKERY PRODUCTS: CURRENT APPROACHES, CHALLENGES AND OPPORTUNITIES

Corina CARACACI, ORCID ID: 0009-0006-7198-4141

Tehnickal University of Moldova, Faculty of Food Tehnology, Chisinau, Republic of Moldova

Georgiana Gabriela CODINĂ, ORCID ID: 0000-0002-6575-0078

“Stefan cel Mare” University of Suceava, Faculty of Food Engineering, Suceava, Romania

Aliona GHENDOV-MOSANU, ORCID ID: 0000-0001-5214-3562

Tehnickal University of Moldova, Faculty of Food Tehnology, Chisinau, Republic of Moldova

*Corresponding author: Corina Caracaci, e-mail: corina.caracaci@doctorat.utm.md

Reducing sodium content in bread remains a critical objective in public health nutrition, given the established association between excessive sodium intake and increased risk of cardiovascular and other chronic diseases. The World Health Organization recommends that adults should consume less than 5 grams of salt per day (equivalent to about 2 grams of sodium), yet current intake levels in many countries significantly exceed this threshold [1]. As bread constitutes a significant source of dietary sodium globally, targeted reformulation strategies are essential to improve population health outcomes.

This synthesis reviews technological approaches and food innovation strategies aimed at reducing sodium in bread and bakery products. The methods considered include:

- Progressive reduction of salt content to allow gradual consumer adaptation and minimize sensory rejection.
- Partial substitution of sodium chloride with lower-sodium alternatives, such as potassium chloride, while addressing potential bitterness through careful optimization.
- Fermentation techniques, particularly sourdough and yeast-based processes, which enhance flavor complexity and amplify the perception of saltiness.
- Incorporation of flavor-enhancing compounds, including yeast extracts, glutamates, and nucleotide-based ingredients, to mimic the taste profile of salt while maintaining low sodium levels [2].

The reviewed strategies demonstrate that:

- Gradual salt reduction is effective in maintaining consumer acceptance over time.
- Potassium chloride and other substitutes can lower sodium levels significantly, though sensory challenges must be managed.
- Sourdough fermentation contributes positively to flavor development, supporting sodium reduction without compromising product quality.
- Flavor enhancers provide viable solutions to replicate saltiness perception, ensuring palatability in low-sodium bread formulations [3].

Achieving meaningful sodium reduction in bread and related products requires a synergistic approach that integrates technological reformulation with consumer education and supportive public policies. Such combined efforts foster long-term improvements in dietary patterns and contribute to better public health outcomes.

Keywords: *bread, consumer health, sodium chloride, technological processes, sourdough*

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DEVELOPMENT OF THE EXPERIMENTAL MODEL FOR THE FRACTIONATION OF POWDERFUL PRODUCTS (DERIVATIVES) IN THE MILLING INDUSTRY

Serghei TALPĂ,

„Alecu Russo” State University of Balti, Balti, Republic of Moldova

Natalia PÎNZARU,

„Alecu Russo” State University of Balti, Balti, Republic of Moldova

*Corresponding author: Natalia Pînzaru, e-mail: pinzaru.natalia@usarb.md

Introduction

In milling enterprises, for the optimal organization and management of the technological process related to the preparation of bread flour, the separation of derivative products (groats) according to quality parameters into fractions with different physical and technological properties is of particular importance [1,2].

Research Methodology

The technological process of grinding cereal grains into derivative products (groats and flour) consists of a totality of procedures and actions for their processing with the aim of obtaining high-quality derivative and final products [1,2]. In the mill room, vibro-pneumatic separators can be used as groat machines, whose working bodies perform complex spatial movements by applying high-frequency vibrations. As a result of the vibrations, the smaller, lighter, and rougher particles, which have reduced rolling properties, move to the upper layers of the product and end up in the accumulator for waste. The whole, full, and elastic particles with an increased specific mass move in the opposite direction, namely towards the lower layers, closer to the sieving surface, come into contact with the sieve surface, pass through the sieve (or sieves) openings, and accumulate in the conical accumulator for the sieved product.

Research Results

Vibration action allows for a considerable improvement of the geometric and kinematic parameters – the acceleration and frequency of the working body are increased 5-10 times, and the oscillation amplitude is decreased 6-8 times compared to existing machines. The vibropneumatic separator has an advantage over existing separation/sorting installations, as it has the possibility of adjusting the trajectory of particle movement (groats, middlings, flour particles) on the sieve surface (sieves), playing a decisive role in increasing the technological efficiency of qualitative separation of derivative products when grinding wheat batches into bread flour. The indicators of the technological efficiency of the vibro-pneumatic separator operation are presented in Table 1.

Table 1. Indicators of the technological efficiency of the vibro-pneumatic separator operation

Denumirea produsului	The size of the sieve holes	Mass of the upper weight kg	Mass of the lower weight, kg	Air flow speed m/s	Vibration frequency (oscillation), s ⁻¹	Ash content, % of the initial product	Ash content, % of the rejected product	Ash content % of the sieved product	Ash content, % of the light product	Yield of unmelted product %	Yield of sieved product %	Light product yield %	Technological efficiency E, a V cone.	Productivity, kg/h
Large grains	1,412	0,10	0,10	1,00	25	1,05	1,46	0,65	3,98	11,3	80,0	8,7	1,29	242,0
Medium grains	1,093	0,10	0,10	0,60	30	0,78	1,02	0,58	2,62	8,1	84,0	7,9	1,14	223,0
Small grains	0,450	0,20	0,20	0,40	35	0,65	0,93	0,51	2,23	5,3	90,0	4,7	1,15	218,0

Conclusions

The results indicate that the speed of the ascending air flow for processing coarse groats is 1.10 m/s, for processing medium groats – 0.60 m/s, for processing fine groats – 0.40 m/s.

Keywords: cereals, derived products, milling, vibrofluidized powder product, vibropneumatic separation

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ANALYSIS OF FACTORS INFLUENCING THE RELIABILITY INDICATORS OF DISTRIBUTION SYSTEMS IN THE AGRO-INDUSTRIAL SECTOR

Victor POPESCU, ORCID ID: 0000-0002-4634-2255

Technical University of Moldova, Department of Electrical Engineering, Chișinău, Republic of Moldova

Mihail BALAN, ORCID ID: 0000-0002-7788-345X

Technical University of Moldova, Department of Mechanical Engineering, Chișinău, Republic of Moldova

Vitali VIȘANU, ORCID ID: 0000-0002-2273-342X

Technical University of Moldova, Department of Mechanical Engineering, Chișinău, Republic of Moldova

Natalia ȚISLINSKAIA, ORCID ID: 0000-0003-3126-5792

Technical University of Moldova, Department of Mechanical Engineering, Chișinău, Republic of Moldova

Igor GÎDEI, ORCID ID: 0000-0001-6188-942X

Technical University of Moldova, Department of Mechanical Engineering, Chișinău, Republic of Moldova

Igor KURDOV, ORCID ID: 0000-0002-0731-5967

Technical University of Moldova, Department of Electrical Engineering, Chișinău, Republic of Moldova

*Corresponding author: Victor Popescu, e-mail: victor.popescu@ie.utm.md

Introduction and Background

At present, distribution systems in the agro-industrial sector are experiencing a growing number of failures, which undermine operational reliability and have a substantial impact on enterprises involved in the processing and storage of agri-food products. The underlying causes of these failures, as well as the patterns governing their occurrence, are not yet fully understood. However, identifying these factors and assessing their influence on the reliability of equipment used in agro-industrial distribution systems would enable the development of targeted measures to improve operational reliability and mitigate losses incurred by the affected enterprises.

Methodology

The study relied on graph and matrix theory, probability theory, statistical methods for experimental data processing, linear and nonlinear equation theory, and mathematical modeling, supported by numerical calculations performed in Microsoft Excel, StatGraphics, Curve Expert, and EasyFit 5.5 Professional.

Results: At the first stage of the research, the methodological concept of the analysis and processing of experimental refusal data in electrical distribution systems in the agro-industrial sector was developed, depending on the nature of their occurrence and on the influencing factors, which provides the opportunity to calculate and compare reliability indicators for systems with different lengths, regardless of the structural graph and the number of component elements. At the next stage of the research, the regularities of the refusal occurrence were established, conditioned by various influencing factors and distribution parameters, corresponding to Weibull, exponential, log-logistic, and lognormal functions, thereby enabling reliability forecasting of distribution systems with 95% confidence.

Conclusions and Implications

The results obtained made it possible to identify the regularities of the refusal occurrence, conditioned by each influencing factor individually and the distribution parameters, which permit forecasting distribution system reliability indicators with a 95% confidence level in the agro-industrial sector. It allows the operating services to ensure the reliability of operation and reduce damage to enterprises involved in the pre-processing and storage of agro-food products.

Keywords: *agro-industrial sector, distribution systems, influencing factors, reliability indicators*

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APPLICATION OF HIGH VOLTAGE DISCHARGES TO PRODUCT TREATMENT

Victor POPESCU, ORCID ID: 0000-0002-4634-2255

Technical University of Moldova, Department of Electrical Engineering, Chișinău, Republic of Moldova

Mihail ȘIT, ORCID ID: 0000-0003-0456-7437

Technical University of Moldova, Institute of Power Engineering, Chișinău, Republic of Moldova

Igor BEȘLEAGA, ORCID ID: 0000-0003-2982-6271

Technical University of Moldova, Department of Transport, Chisinau, Republic of Moldova

Mihail MELENCIUC, ORCID ID: 0000-0001-6575-8814

Technical University of Moldova, Department of Mechanical Engineering, Chișinău, Republic of Moldova

Tatiana BALAN, ORCID ID: 0000-0002-8897-105X

Technical University of Moldova, Department of Mechanical Engineering, Chișinău, Republic of Moldova

Ion VIȘANU, ORCID ID: 0000-0009-4475-0077

Technical University of Moldova, Department of Mechanical Engineering, Chișinău, Republic of Moldova

*Corresponding author: Victor Popescu, victor.popescu@ie.utm.md

Introduction and Background

Up to now, multiple research studies have been carried out aimed at improving the technologies for processing agricultural products, by researchers both nationally and internationally, however, the problems characteristic of these processing processes have not been definitively solved, especially those related to reducing energy consumption, increasing the reliability of the equipment and reducing costs. In order to solve these problems and to examine the peculiarities of applying high-voltage discharges to the processing of agricultural products, research was conducted to dimension and develop an experimental installation for the production and use of these discharges, on the basis of which experimental investigations were carried out, allowing the advantages of the proposed technology compared to existing ones to be evaluated.

Methodology

When solving the problems formulated for the research, the following methods were used: experimental methods; statistical analysis and processing of experimental data; mathematical modeling; and calculation techniques using specialized software such as "Microsoft Excel" and "StatGraphics".

Results

The research has shown that the effects of high-voltage discharges occur uniformly throughout the mass of the product in the processing chamber of the installation, causing compression, deformation, or crushing effects. Moreover, electrical discharges have a pronounced antibacterial effect, manifested by the destruction of microorganisms throughout the entire mass of the treated product. Due to these effects, the proposed technology can be used both in the food industry and in agriculture, for example: for the treatment and sterilization of liquid products (milk, vegetable and fruit juices, etc.); extraction of oils from oilseed crops; extraction of juices from grapes, fruits, and vegetables; extraction of various emulsions from stems, roots, and leaves of agricultural plants with therapeutic effects, subsequently used in the food industry, traditional medicine, or cosmetics; disinfection of agricultural waste and wastewater, etc. Unlike other processing technologies, the proposed technology requires the application of a facility that is structurally simple, has low cost and low electricity consumption, exhibits high reliability under aggressive operating conditions, is easy to use, and can be widely applied to the treatment of various products.

Conclusions and Implications

The results obtained made it possible to establish the specific characteristics of treating different products using high-voltage discharges. The advantages of applying the proposed technology were identified, including reduced electricity consumption, constructive simplicity of the installation, and increased operational reliability.

Keywords: *agricultural products, electrohydraulic effect, energy consumption, high voltage discharges, processing technologies*

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TECHNOLOGY FOR DEVELOPING DEVICES FOR CONVERTING THERMAL ENERGY INTO ELECTRICAL ENERGY

Alexandr OJEGOV*, ORCID ID: 0000-0002-8052-241X
 „Alec Russo” State University of Balti, Balti, Republic of Moldova

Pavel TOPALĂ, ORCID ID: 0000-0003-3779-4564
 „Alec Russo” State University of Balti, Balti, Republic of Moldova

Valeri CRECIUN
 „Alec Russo” State University of Balti, Balti, Republic of Moldova

*Corresponding author: Alexandr Ojegov, alexandr.ojegov@usarb.md

Introduction and Background

The aim of the research is to develop the technology and construction of thermoelectric converters consisting of strings of bi-component wires welded together by an active resistance method based on the Joule–Lenz effect, occurring when pulsed electric current passes through their contact areas, and subsequently assembled according to specific schemes into panels embedded in bodies with heat radiation absorption properties. The scientific outcome of the research consists in the development of a manufacturing technology for micro-couples and the construction of a new class of devices for converting thermal energy into electrical energy, based on couples formed by micro-welded metal wires of different natures, obtained by applying pulsed electric discharge machining (PEDM). The active energy conversion element consists of a converter that comprises a row of bi-component wires welded together using the PEDM method. The construction of the active element enables the transformation of thermal radiation energy into electrical energy through the Peltier–Seebeck effect.

Methodology

The developed devices present at least two wires of different metal welded by applying PEDM. To create the power electric discharge that will be used for the microwelding of metal wires, the pulse generator of R-C type was used. As materials for the metal wires used in the experimental research, pairs of materials with different electrical properties were chosen: electrotechnical copper - nickel; electrotechnical copper - carbon steel; electrotechnical copper - nichrome; electrotechnical copper – constantan; carbon steel - constantan. The diameters of the metal wires are between 0.3 and 1 mm.

Results

The technological regimes and equipment required for the micro-welding of components made of materials of various natures were established. The technology for developing devices based on the conversion of thermal energy into electrical energy was successfully implemented. The functional characteristics of the converters, as well as the feasibility of operating the devices and their active elements, were determined.

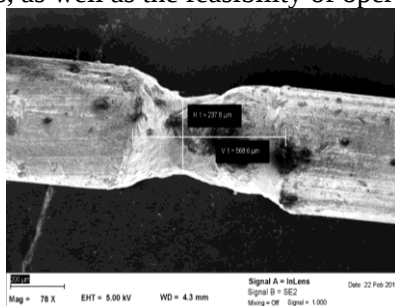


Figure 1. SEM of welded wires.

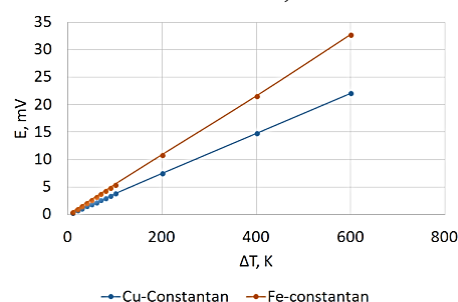


Figure 2. Thermo-voltaic characteristics.

Conclusions and Implications

The developed technology allows the construction of devices for converting thermal energy into electrical energy. The use of energy-saving technologies, such as pulsed electrical discharge machining, leads to a decrease in the production costs of devices.

Keywords: converter, energy conversion, metal wire, microwelding, pulsed electric discharge machining

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FORECASTING AND PLANNING URBAN FREIGHT IN THE CONTEXT OF E-COMMERCE GROWTH

Vadim NANTOI, ORCID ID: 0000-0003-4851-7407

Technical University of Moldova, Transportation Department, Chișinău, Republic of Moldova

Igor ROTARU, ORCID ID: 0000-0003-3636-4896

Technical University of Moldova, Transportation Department, Chișinău, Republic of Moldova

Dumitru CEBAN, ORCID ID: 0009-0005-1325-9657

Technical University of Moldova, Transportation Department, Chișinău, Republic of Moldova

Vasile PLĂMĂDEALĂ, ORCID ID: 0000-0003-1722-2649

Technical University of Moldova, Transportation Department, Chișinău, Republic of Moldova

Olivian PĂDURE, ORCID ID: 0000-0002-6024-3763

Technical University of Moldova, Transportation Department, Chișinău, Republic of Moldova

Corresponding author: Vadim Nantoi, e-mail: vadim.nantoi@tran.utm.md

Introduction and Background

The rise of e-commerce requires a new approach to socially responsible city logistics, as European cities face increasing congestion, emissions, and pressure on public space. The study proposes a predictive engineering and mathematical framework for forecasting urban freight growth. Our specific objective is to develop a robust modeling approach to forecast urban freight volume growth to support the creation of adaptive and sustainable urban master plans. Recent data from the European Commission (EC) show that the volume of low-value e-commerce shipments entering the European Union has surged dramatically. In 2024, approximately 4.6 billion low-value parcels (valued under €150) were imported into the EU. This represents a steep increase compared with 2023 and 2022: the recorded number more than doubled between 2023 and 2024 (from ~2.4 billion to 4.6 billion) and tripled since 2022 (from ~1.4 billion). Moreover, in 2024, roughly 91% of these low-value e-commerce shipments originated from China. In the Republic of Moldova, national postal service data reflect similar growth trends. In 2024, Moldova's postal market revenues grew by 35%, reaching 633 million lei. Around 10 million parcels were imported into Moldova that year. There has been a massive rise in cross-border parcel shipments from China to the EU and neighboring countries such as Moldova. This trend significantly increases the load on urban delivery and logistics networks, thereby elevating the volume of freight that urban planning and city logistics must now accommodate. Given such rapid growth, the proposed predictive framework becomes essential. Engineering and mathematical modeling—calibrated with empirical e-commerce flow data—will be critical for forecasting future urban freight loads, designing sustainable infrastructure and buffer zones, implementing efficient flow-control mechanisms, and preventing congestion, environmental degradation, and conflicts over public-space use.

Methodology

We employ an integrated approach utilizing time series analysis and stochastic differential equations to project last-mile delivery growth. The analysis uses granular traffic-flow and logistics data from Chișinău (Republic of Moldova), including official records showing that freight volumes increased by 12.5% in the last two years, alongside comparative data from EU urban centers. The core risk—curb-space competition—is quantified using a model that correlates delivery-stop frequency with variance in parking-search time, which directly affects CO₂ and NO₂ emissions.

Results

The SDE model reveals a nonlinear, high-volatility growth trajectory for parcel deliveries, projecting that volumes will exceed linear forecasts by approximately 18% over a five-year horizon. The analysis shows that the current rate of e-commerce expansion will lead to a 35% increase in peak-hour curb-space demand in central areas. Critically, this demand is correlated with a statistically significant 15% rise in emissions due to increased friction and time spent cruising for parking. However, the modeled adaptive master-plan framework—incorporating dynamic routing and consolidation strategies—demonstrates the potential to reduce CO₂ emissions by up to 25% by stabilizing operational turbulence.

Conclusions and Implications

The findings underscore that proactive, data-driven interventions are essential for urban freight stability. The proposed adaptive planning framework provides a vital decision-support tool for municipalities seeking to implement dynamic management systems that balance logistical efficiency with environmental and sustainability goals. The research offers a scalable template for cities, particularly in emerging markets such as Chișinău, aiming to harmonize logistics growth with European sustainability standards.

Keywords: *city logistics, curb-space competition, e-commerce, stochastic modeling, sustainable freight*

SECȚIA IV
**INOVAȚIE PRIN COOPERARE ȘI TRANSFER TEHNOLOGIC/
INNOVATION THROUGH COOPERATION AND TECHNOLOGY TRANSFER/
ИННОВАЦИИ ЧЕРЕЗ СОТРУДНИЧЕСТВО И ПЕРЕДАЧУ ТЕХНОЛОГИЙ**

**COOPERATION WITH ECONOMIC AGENTS IN THE IMPLEMENTATION OF THE
MASTER'S PROGRAM "SMART INDUSTRIES AND DIGITAL TRANSFORMATION"**

Valentina PRITCAN, ORCID ID: 0000-0003-0743-8577
Alecu Russo Balti State University, Balti, Moldova

Alexandr OJEGOV*, ORCID ID: 0000-0002-8052-241X
Alecu Russo Balti State University, Balti, Moldova

Vitalie BESLIU, ORCID ID: 0000-0001-9586-9005
Alecu Russo Balti State University, Balti, Moldova

*Corresponding author: Alexandr Ojegov, e-mail: alexandr.ojegov@usarb.md

Introduction and Background

The study program "Smart Industries and Digital Transformation" was opened through the implementation of the ERASMUS+ project NeedEDU4.0 and in collaboration with the company "DRAEXLMAIER AUTOMOTIVE" S.R.L, the RWTH University of Aachen, Germany, the Transylvania University of Brasov, Romania, Technical University of Moldova and B.P. Hasdeu Cahul State University, Moldova, for the training of engineer specialists in the field of industrial production. Thus, the development of the curriculum was carried out together with representatives of the company "DRAEXLMAIER AUTOMOTIVE" S.R.L, but also with the support of other enterprises from the Free Economic Zone (FEZ) Balti such as: "GG Cables&Wires EE" S.R.L, "Magnetec Components" S.R.L "Elektromanufacturing" S.R.L, "SAROB Production" S.R.L, S.A Moldagrotehnica etc. The curriculum was developed through the collaboration of the teaching staff from the Department of Physical and Engineering Sciences with managers from university institutions and enterprises, graduates of the faculty, senior students. Engineers, technologists, quality managers, as well as company directors (potential employers) were invited to the meetings to develop the plan in order to analyze the structure of the plan and the names of the course units. Meetings were organized with students and graduates of the specialty in order to identify aspects of improving the study program. In order to increase the quality of the program studies, the Department of the profile organizes consultations with partners (potential employers, teaching staff from other higher education institutions, personalities in the field, graduates, students). At the University, Faculty and Department levels, agreements are concluded with enterprises and institutions of the profile.

Results

The training of specialists in the general field of study Engineering and engineering activities is imposed by the development strategy of the Republic of Moldova, according to which the production industry has become a priority branch of the national economy, because it has very great advantages: the existence of world-renowned companies in the field on the labor market; the possibility of employing a large number of workers; a fast turnover cycle of current assets. All these companies operate according to the latest technologies and processes that constantly require development and innovation in order to be competitive on the world market. In this regard, this study program proposes to provide enterprises in the field with highly qualified specialists.

The master program is relevant because: the design took into account and continues to take into account the opinions of employers; it has a modern character and is oriented to the latest achievements in the fields of research-design-management activities, industrial technologies, industrial process organization, the use of computer-aided design, engineering and manufacturing, industrial information technologies, digital technologies. The study program is oriented towards modern achievements and good preparation of graduates in the fields of industrial perspective; there are a large number of companies with foreign capital that employ graduates of the program, which offer stable jobs.

Conclusions and Implications:

1. Master's program is developed in consortium with three universities and consulting, support and collaboration with EU Universities and economic agents.
2. The study program is attractive due to the possibility, after graduating, to get a stable and impressive jobs.

Keywords: *engineering, enterprise, industry, master, program, smart*

Acknowledgments. The results are presented the information of workpackages content of the ERASMUS+ project no. 101128623 "Enhancing Mechanical Engineering Education in Moldova for Industry 4.0" NeedEDU4.0.

ARTIFICIAL INTELLIGENCE AS AN ADVANTAGE FOR ENTREPRENEURSHIP IN A CIRCULAR ECONOMY

Andrei POPA, ORCID ID: 0000-0003-2006-6923

Cahul State University "Bogdan Petriceicu Hasdeu", Cahul, Republic of Moldova

*Corresponding author: Andrei Popa, e-mail: 4andreipopa@gmail.com

Introduction and Background

The current requirements for a competitive and sustainable economic activity require entrepreneurs to know not only the processes and technologies within the respective industry/branch, the methods of business planning and management, the laws and rules of the market (marketing), but also the applied information technologies, including the use of Artificial Intelligence (AI).

The use of Artificial Intelligence in a Circular Economy allows the aggregation of these skills in an interactive manner and helps to identify feasible entrepreneurial solutions. In this context, the **project "AI-Empowered Innovation in Natural Science and Engineering for Circular Economy" (AI-InnoScEnCe)**, funded by the European Union through the research and innovation program "**Horizon Europe**" [1], **ref. no. 101127683** (Image 1), which has as its main objective to increase the impact of academic research in engineering and economic sciences by promoting innovation and entrepreneurship oriented towards the circular economy.



Image 1. Logo of the "AI-InnoScEnCe" project [1]

Methodology

To achieve the research objectives, the following methods were used: synthesis of research on artificial intelligence and AI tools used in education and entrepreneurship education; empirical analysis; and formulation and justification of conclusions. The following sources of information were used: a number of scientific publications in the relevant field, materials obtained as part of the comparative study of the AI-InnoScEnCe project, and the database of the National Bureau of Statistics of the Republic of Moldova.

Results

"Artificial Intelligence", as a scientific term, was first described and used in academic language in 1956 by John McCarthy [2], who was based on the works of Alan Turing (e.g. [3, 4]), in which the existence of intelligent reasoning and thinking that could be implemented in intelligent machines was described. Artificial Intelligence (AI) has become an integral part of our lives and is seen as a tool that can be used to improve and develop all areas of human activity [5]. McKinsey Global Institute estimates that by 2030, at least 70% of companies will adopt some aspect of AI technology. Furthermore, within the next 10 years, approximately 60% of existing jobs have the potential to be automated [6]. Given this trend, companies will seek employees familiar with AI concepts and methods and able to apply this knowledge and skills to manage work in which AI plays a significant role [7].

The integration of AI into business is no longer a futuristic concept, but a reality that is gradually transforming the economy. Artificial Intelligence develops systems capable of imitating human thinking and intelligence to perform tasks, learn from data, reason (analyze), make decisions and continuously improve themselves. AI applications include:

- *Virtual assistance* - programming and assistance provided by virtual assistants.
- *Recommendation systems* - services that suggest content based on user preferences.
- *Artificial vision* - systems that allow machines to "see" and interpret visual information.
- *Industrial robots* - robots that can perform repetitive tasks and adapt to changes in production processes.

AI enables the creation of *personalized solutions*, and provides *instant feedback*. AI tools, such as *chatbots* and *generative models*, also help automate tasks such as *scenario creation* and provide entrepreneurs with both

real-time adaptive support and qualified recommendations. AI can also facilitate the *creation of multimedia content* and support entrepreneurs in *developing and presenting entrepreneurial and investment projects.*

AI tools used by entrepreneurs include:

- **Realistic simulations** - AI can power virtual reality and augmented reality scenarios, providing a safe practice environment.
- **Instant feedback and support** - AI-powered chatbots can answer customer questions at any time, allowing entrepreneurs to focus on increasing the quality and efficiency of the business. AI tools also provide continuous feedback on the implementation of projects started, helping entrepreneurs improve their work in real time.
- **Content creation support** - AI tools can help entrepreneurs create results of their entrepreneurial or investment projects, such as writing, editing, and design.
- **Scenario generation** - Artificial Intelligence can automate the creation of scenarios from large data sets to solve emerging problems.

Conclusions and Implications

The impact of AI will grow over the next decade as industry, agriculture, commerce, transportation, finance, and other sectors of the economy transform their core processes and business models to harness the benefits of *machine learning* [8].

Keywords: *Artificial Intelligence, Entrepreneurship*

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IMPLEMENTATION OF DIGITALIZATION IN HIGHER EDUCATION BASED ON MATERIALS FOR THE STUDY PROGRAM "ENGINEERING AND MANAGEMENT IN AUTOMOTIVE TRANSPORT"

Valentina PRITCAN, ORCID ID: 0000-0003-0743-8577

Alecu Russo Balti State University, Balti, Moldova

Alexandr OJEGOV*, ORCID ID: 0000-0002-8052-241X

Alecu Russo Balti State University, Balti, Moldova

Vladislav RUSNAC, ORCID ID: 0000-0003-4195-9501

Alecu Russo Balti State University, , Balti, Moldova

*Corresponding author: Alexandr Ojegov, e-mail: alexandr.ojegov@usarb.md

Introduction and Background

The digitalization of education process for the study program "Engineering and management in automotive transport" was developed through the implementation of the ERASMUS+ project no. 101127683 - DIGITRANS - ERASMUS-EDU-2023-CBHE "Digital transformation of HEIs education process in Ukraine and Moldova for sustainable engagement with enterprises". The profile department constantly organizes scientific-didactic, methodical activities at the regional, national and international level in which potential employers, graduates and students involved in the study program Engineering and management in automotive transport participate. The proposed modernization of 7 courses and laboratory practicums will improve the quality of the educational process and update the educational and material base for high-quality training. All of this is to increase graduates' employability and support sustainable growth and jobs in Ukraine and Moldova, in line with the Green and Digital transition, through the implementation of supporting measures. The purchase of equipment for educational laboratories and the development of modern laboratory workshops will allow students to have the opportunity to conduct research at partner universities and enterprises. Introduction of integrated thematic complexes that will allow students to achieve additional learning outcomes.

Results

As part of the implementation of the DIGITRANS project, USARB purchased the equipment necessary for the development of planned courses practices. The equipment offers students a complete educational and research experience, adjusted to the requirements and advanced technologies of the modern automotive industry. Students learn how to combine automation, electrification, electronics and sensor technologies into an integrated system, which is essential in the development and operation of modern vehicles and transportation infrastructure. This equipment also supports the development of digital and technical skills, preparing them for the challenges of the ever-changing automotive industry, including the transition to electric and autonomous vehicles. Through the purchased equipment, the project contributes to the training of a new generation of engineers and specialists in automotive transportation, well-prepared to work with cutting-edge technologies and to meet the demands of the automotive labor market, including in the context of the green and digital transition. The equipment purchased with the support of the DIGITRANS project is used for educational and research purposes to improve the understanding and practical training of students in the field of engineering and management in automotive transport, especially in the context of new technologies in the automotive industry, such as electric and autonomous vehicles. The USARB also applies digital tools, such as online platform MOODLE, software for simulations, and e-books, with the aim of complementing traditional materials and offering opportunities for personalized learning.

Conclusions and Implications

1. The digitization of the process of training engineers in the automotive industry, facilitates access to up-to-date content, improve student engagement, and supports innovative teaching methods like active learning, and collaborative projects.
2. Integrating digital resources helps students develop critical digital skills, prepares them for modern workplaces, and promotes deeper understanding by allowing for virtual experimentation and system modelling.

Keywords: *automotive transport, digitalization, engineering, equipment, learning, study program*

Acknowledgments. The results are presented the information of workpackages content of the ERASMUS+ project no. 101128623 - DIGITRANS - ERASMUS-EDU-2023-CBHE “Digital transformation of HEIs education process in Ukraine and Moldova for sustainable engagement with enterprises”.

NORMATIVE ECOSYSTEMS AND SMART GOVERNANCE FOR INTEGRATION OF ARTIFICIAL INTELLIGENCE IN THE CIRCULAR ECONOMY

Ina FILIPOV, ORCID ID: 0000-0002-8524-6784

Cahul State University "Bogdan Petriceicu Hasdeu", Cahul, Republic of Moldova

Elena MANDAJI, ORCID ID: 0000-0003-0924-4602

Cahul State University "Bogdan Petriceicu Hasdeu", Cahul, Republic of Moldova

*Corresponding author: Ina Filipov, e-mail: inafilipov@gmail.com

The circular economy is approached in the Republic of Moldova mainly through strategic documents that establish general principles, but without operational mechanisms and without an integrated regulatory framework capable of supporting digital monitoring and institutional interoperability. The expansion of technologies, based on artificial intelligence can contribute to the efficient management of resources, monitoring production flows, preventing waste and leveraging data for public decisions oriented towards sustainability. The purpose of the research is to analyze how normative ecosystems and smart governance can facilitate the integration of artificial intelligence into priority areas of the circular economy in the Republic of Moldova, highlighting the role of cooperation between the public sector, the private sector and research, highlighting the role for technology transfer and the development of innovative solutions, oriented towards sustainability and resilience.

The research is based on the analysis of national strategic documents, including the *White Paper on Artificial Intelligence and Data Governance*, circular economy programs, including the *Program for Promoting the Green and Circular Economy in the Republic of Moldova for the period 2024-2028*, as well as the digital agenda, correlated with European good practices and *OECD recommendations on data governance and responsible artificial intelligence*. The study examines institutional interoperability, digital monitoring mechanisms and adaptive regulatory tools, focusing on sectors with circularity potential: waste management, sustainable agriculture, industry, energy and green logistics.

The results highlight that the adoption of artificial intelligence remains fragmented due to the lack of operational standards, unclear responsibilities, and the absence of a framework for assessing the impact of artificial intelligence on sustainability. In this context, cooperation between authorities, the private sector, non-governmental organizations and academic and research institutions become essential for technology transfer, testing of technologies in a controlled regime and the development of efficient data-based governance mechanisms. Developing adaptive regulatory frameworks and regulatory testbeds for artificial intelligence can accelerate the experimentation of innovative circular economy technologies and their safe and responsible deployment. These measures enable the practical implementation of circular economy principles, reduce the gap between strategies and outcomes, and create an adaptive regulatory ecosystem.

Through this approach, artificial intelligence becomes not only a technological tool, but also a mechanism for facilitating innovation and intersectoral cooperation, supporting the transformation of declarative strategies into concrete, efficient and sustainable actions. The results of the study provide a framework for formulating public policies oriented towards sustainability, innovation and technology transfer, highlighting how collaboration between diverse actors can accelerate the Republic of Moldova's transition towards a digitalized circular economy. The study suggests that the implementation of artificial intelligence can function as an adaptive mechanism in a sustainable economy, in which intelligent governance oversees and optimizes economic processes while respecting the national regulatory framework and European Union standards, maintaining the balance between growth and sustainability.

Keywords: *artificial intelligence, circular economy, smart governance, normative ecosystems, adaptive regulation, sustainability*

Acknowledgments: The research was conducted within the project 24159 – InnoScEnCE – „AI – Empowered Innovation in Natural Science and Engineering for the Circular Economy”, EIT Higher Education Initiative, European Institute of Innovation and Technology, HORIZON EUROPE Program, Pillar 3 Innovative Europe.

AI-BASED EDUCATIONAL PLATFORMS AS A VECTOR FOR COOPERATION AND TECHNOLOGY TRANSFER IN SCIENCE AND ENGINEERING FOR THE CIRCULAR ECONOMY

Irina VÎȘCU, ORCID ID: 0000-0001-7375-4186

Cahul State University "Bogdan Petriceicu Hasdeu", Cahul, Republic of Moldova

*Corresponding author: Irina Vîșcu, e-mail: viscu.irina@usch.md

Introduction and Background

The transition to a circular economy, conceptualised as a regenerative system that minimises resource input and waste, emissions and energy leakage [1,2], requires new forms of collaboration between universities and industry, as well as graduates able to address complex sustainability and resource-efficiency challenges [3]. AI-based educational platforms can function as shared digital infrastructures that connect scientific knowledge, real industrial data and project-based learning in science and engineering, in line with recent work on AI applications in higher education and STEM [4–6] and on AI-enhanced tools for engineering education [7]. Such platforms are particularly relevant as artificial intelligence and digitisation are increasingly recognised as key enablers of circular business models and innovation [8,9]. This study examines how such platforms can act as drivers of cooperation and technology transfer for circular-economy-oriented engineering education, building on sustainable models of university–industry collaboration [10].

Material and methods

The paper proposes a conceptual and applied model in which an AI-enhanced platform supports project work on real industrial problems related to circularity (product redesign, process optimisation, performance indicators). The methodology combines a descriptive case study in an engineering faculty with elements of mixed methods: analysis of platform functionalities, observation of student activity and collection of feedback from academic staff and industrial partners through questionnaires and semi-structured interviews, in line with approaches used in recent evaluations of AI in education and engineering learning environments [4,5,7].

Results: The analysis shows that the platform supports key circular-economy competences, such as systems thinking, life-cycle assessment reasoning, environmental impact evaluation, circular product and process design and data-driven decision making, which are consistent with systemic conceptualisations of the circular economy [1–3] and with emerging transdisciplinary frameworks for AI in STEM education [6]. Students report higher perceived relevance of learning tasks, better understanding of industrial constraints and increased motivation when working with real data and AI-supported simulations, echoing findings from AI-in-education studies [4,5]. Industrial partners value the access to conceptual prototypes and optimisation scenarios generated within student projects, as well as early contact with graduates familiar with their processes, aspects highlighted as central in sustainable technology transfer models [10]. The platform also enables continuous refinement of curricula based on aggregated learning analytics and partner feedback.

Conclusions

AI-based educational platforms can become effective socio-technical ecosystems for aligning engineering education with circular-economy needs, while simultaneously supporting knowledge co-creation and bidirectional technology transfer, in line with broader analyses of AI and digital technologies as accelerators of the circular transition [8,9]. Further research should refine impact indicators for such platforms, explore their contribution to sustainability competences in engineering education [6,7] and examine their scalability in wider industry–university networks focused on circular innovation [2,3].

Keywords: *AI-based educational platforms, Engineering education, Circular economy, Industry–university collaboration, Technology transfer, Learning analytics, Sustainability competences*

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MAPPING AND COMPARATIVE ANALYSIS OF ARTIFICIAL INTELLIGENCE APPLICATIONS IN THE CIRCULAR ECONOMY

Ilona POPOVICI, ORCID ID: 0000-0003-2487-6413,
Cahul State University “Bogdan Petriceicu Hasdeu”, Cahul, Republic of Moldova

*Corresponding author: Ilona Popovici, e-mail: ilonapopovici8@gmail.com

Introduction and Background

The transition toward a Circular Economy (CE) requires intensive digital innovation, with Artificial Intelligence (AI) identified as a crucial accelerator for achieving sustainability in areas such as resource management and production. This study examines the global landscape of AI and Machine Learning (ML) applications in CE systems, addressing the complexity of material flows and the demand for real-time data. The specific objective is to map the latest trends, methodologies, and best practices in the integration of AI to enhance material circularity, resource efficiency, and production sustainability.

Methodology

The analyzed material consists of a benchmarking of a large corpus of publications produced between 2019 and 2025, including academic articles and technical reports from the fields of engineering, computer science, and environmental sciences. The study focuses on the application of advanced AI techniques, such as Deep Learning (DL), Computer Vision, and hybrid AI + Multi-Criteria Decision Analysis (MCDA) models. The data used range from large image datasets (e.g., 40K-sample datasets from industrial environments for plastic waste classification) and operational Life Cycle Assessment (LCA) data to SCOPUS-indexed bibliometric corpora (comprising 104 documents) used for thematic analyses.

Results

The results demonstrate a broad and robust application of AI across at least four critical domains:

1. **Waste Sorting:** Convolutional Neural Networks (CNNs) integrated with IoT technologies enable intelligent, real-time classification of municipal solid waste, plastics, and construction and demolition (C&D) waste. The performance of various DL architectures was compared to guide optimal selection for industrial-scale sorting applications.
2. **Environmental Assessment:** ML models are used as surrogates to automate and streamline LCA in circular production systems, enabling rapid scenario exploration and the direct integration of AI into decision-support tools.
3. **Circular Materials Design:** AI/ML facilitates materials property prediction and design-space exploration, embedding circularity criteria (recyclability/reusability) from the early stages of product development.
4. **Reverse Logistics:** Hybrid models combining AI and MCDA optimize reverse supply chains for solid waste, improving the efficiency of return flows. In addition, AI enables the assessment of CE maturity at the firm level through ML-based text analyses.

Conclusions and Implications

AI is an essential operational tool that transforms CE from theoretical concepts into scalable, data-driven solutions deployable under real-world operating conditions. The implications highlight the necessity of integrating AI best practices, including dual validation through rigorous LCA studies and aligning AI projects with governance and ethical objectives within socio-technical systems. AI-based solutions can support EU Member States in strengthening their circular economy agendas, particularly with regard to the enforcement of sorting regulations.

Keywords: *comparative analysis, machine learning, life cycle assessment, reverse logistics, waste sorting, sustainability*

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APPLE AND PEAR BY-PRODUCTS – SOURCES OF BIOACTIVE COMPOUNDS FOR THE FOOD INDUSTRY

Alexandra CİCANCİ, ORCID ID: 0000-0002-6968-9016

Cahul State University “Bogdan Petriceicu Hasdeu”, Cahul, Republic of Moldova

Iurie RUMEUS, ORCID ID: 0000-0002-6392-7343

Cahul State University “Bogdan Petriceicu Hasdeu”, Cahul, Republic of Moldova

Irina VÎȘCU, ORCID 0000-0001-7375-4186

Cahul State University “Bogdan Petriceicu Hasdeu”, Cahul, Republic of Moldova

Liliana CECU, ORCID 0000-0001-5500-7785

Cahul State University “Bogdan Petriceicu Hasdeu”, Cahul, Republic of Moldova

Ana Maria BLEJAN, ORCID 0009-0008-2646-8492

University of Craiova, Craiova, Romania

Alexandru Radu CORBU, ORCID 0000-0002-6859-1981

University of Craiova, Craiova, Romania

Violeta NOUR, ORCID 0000-0001-9904-0157

University of Craiova, Craiova, Romania

*Corresponding author: Alexandra Cicanci, e-mail: alexandra.cicanci@feisa.usch.md

Introduction

Fruit and vegetable wastes and by-products derived from food processing industry represents nowadays, one of the most common environmental and economic problems. Huge amounts of wastes and by-products are generated [4]. The apple and pear pomace includes the peel, seeds, stem, cores and some edible parts, which traditionally are formed during apple processing. In recent years, researchers have established that these by-products are a valuable source of functional nutrients: phenolic compounds, pigments, dietary fibers, essential oils, enzymes, vitamins and fatty acids [3]. Therefore, valorization and conversion of these by-products into new reusable products can contribute to the mitigation of environmental problems and make a path towards sustainable development [2]. Apple pomace contains ample amounts of health promoting phytochemicals, including phenolic acids, flavanols, anthocyanins, and dihydrochalcones [1].

Methodology

Determining the current state of research through the study and analysis of scientific articles.

Results

Numerous researches confirm the opportunity of valorizing apple and pear by-products by using them in various areas of the food industry. More than 30 sources published in the last 20 years were identified and studied. The content of biologically active substances in by-products from apples, pears, or other plant products has been studied in these researches. Additionally, methods for extracting these substances have been proposed, and the possibility of integrating these by-products in various forms (powders, extracts) into traditional food products, such as bread, dairy products, and others, has been investigated.

Conclusions and Implications

This study established the increased interest of researchers in studying the potential for valorization of by-products from apples, pears or other plant products, due to their high content in biologically active substances.

Keywords: *valorization, by-products, biologically active substances*

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**CONFERINȚA ȘTIINȚIFICO-PRACTICĂ NAȚIONALĂ
INOVAȚIA: FACTOR AL DEZVOLTĂRII SOCIAL-ECONOMICE
12 decembrie 2025**

Secția I

**ECONOMIA INOVAȚIONALĂ: MANAGEMENT, FINANȚE ȘI CONTABILITATE PENTRU
DEZVOLTAREA DURABILĂ**

Secția II

CREATIVITATE ȘI INOVAȚIE ÎN DOMENIUL EDUCAȚIEI ȘI AL ȘTIINȚELOR SOCIALE

Secția III

ȘTIINȚE INGINEREȘTI ȘI CERCETĂRI APLICATIVE

Secția IV

INOVAȚIE PRIN COOPERARE ȘI TRANSFER TEHNOLOGIC

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