

First postdoctoral school in Romania: a case study of innovation and best practice in engineering and technology education

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ABSTRACT: Postdoctoral education plays an important role in the Romanian research environment. The aim of this paper is to present a new approach to improving academic staff competences, in order to improve the value of highly qualified human resources at *Lucian Blaga* University of Sibiu (LBUS), Sibiu, Romania. This improvement results from promoting the first postdoctoral school in Romania. Gathering together researchers from different domains is only possible by having the same aims, targets and good communication. The postdoctoral school has developed targets that have a great impact on the economy, engineering, food safety and agriculture. These fields were for a long time ignored but now need to be developed. Described in this paper is the first postdoctoral school established in Romania together with its needs, outcomes, benefits and weaknesses. This is an almost historical concept for many countries and in Romania it comes as a new and unexplored venture. Postdoctoral schools have been developed mostly using European funds and flexible exchanges of personnel with foreign research centres and universities.

INTRODUCTION

There is a great need for agricultural and extended education in Romania and to sustain an effort for a long time. Romania's ability to produce a sustainable agricultural system faces several key constraints. There is a slow pace of privatisation, lack of respect for contractual obligations, low confidence in the judiciary, and bureaucratic red tape and corruption [1]. Agriculture will be the driving force in the economic stability of Romania. Co-operation between the Romanian Government and universities seems to provide opportunities to Romanian academic institutions for continuing education.

The first postdoctoral school in Romania called *Postdoctoral Studies School for Biodiversity and Food Biotechnologies* is part of an innovation strategy in engineering and technology education, and has been developed at *Lucian Blaga* University of Sibiu. This project forms the basis for innovation and best practice in engineering and technology education at university level. Postdoctoral research education of academic staff and young researchers is beneficial by promoting best practice in engineering and technology education in Romania.

In the postdoctoral school, what started as individual research by a group of academics has turned into high level research reaching the level of invention. This is an appropriate way forward, and not only for Romania.

In this paper, the authors focus on a case study concerning a postdoctoral research project to establish a new ecological and ultra fast and highly secured method of chicken egg stamping. This accords with the European Union traceability requirements for food safety. The authors present the link between engineering technology and the food industry to secure food products in Romania by applying optical impulse lamps for egg stamping as a new environmentally friendly technique. Interdisciplinary research and collaboration between researchers from various fields and universities in Romania is encouraged by this project.

FIRST POSTDOCTORAL SCHOOL IN ROMANIA A TOOL FOR SUSTAINABLE DEVELOPMENT

The term, globalisation, can be used to summarise changes happening at the international level. The shrinking importance of national borders has a considerable impact on the academic world. Closely connected to such global changes, which influence the knowledge system, are societal, institutional and micro-social changes in Europe and in national knowledge systems [2].

After much discussion and debate at symposia, congresses and national conferences, followed by meetings with prestigious members of the Romanian Academy, the Academy of Agricultural and Forestry Sciences, the Academy of Medical Sciences, the Academy of Romanian Scientists and the Academy of Technical Sciences of Romania, science

and doctoral supervisors repeatedly expressed their desire to establish a postdoctoral school with an objective to develop research and interact with scientists from other fields in order to produce applicable results for national and international economies.

Some of the European directives can be mentioned to express the importance of the postdoctoral school and the need for researchers in the interdisciplinary fields of Nature 2000, habitat and birds, environment: Directive 2001/18/EC, Environmental Risk Assessment (ERA), Protocol on Strategic Environmental Assessment, Directive 2005/36/EC of the European Parliament and the Council of 7 September 2005 on the recognition of professional qualifications and the National programme on Reform MECI 2007/2010, to name a few.

The Romanian Academy has shown initiative by starting the first postdoctoral school in Romania, with the original title, *Postdoctoral School for Livestock Biodiversity and Food Biotechnologies Based on Eco-economy and Bio-economy for Eco-sanogenesis*. The importance, utility and complexity of this project are related to its being the first to start postdoctoral research projects in Romania.

Several postdoctoral schools have been implemented recently in Western countries, but through Priority Axe no.1, a school also has been launched in Romania. This enables PhD candidates to be better prepared with the required knowledge and by performing scientific study, will enhance their scientific careers.

Unfortunately, the potential of the agricultural sector in Romania does not correspond to the reality, because over 70% of food is imported and over 3.5 million hectares of agricultural land is not used for agricultural purposes. However, it is known that Romania has the potential to feed between 40 and 80 million people, if scientific methods are implemented and used correctly, as in Western countries, and which is outlined in the *Good Practice Guide*.

The objectives of the School include the organisation, operation and development of the first postdoctoral school in Romania, which will be formed of highly qualified researchers in genetics; genomics; genetic engineering; bioengineering and biochemistry in conservation; development of livestock biodiversity, including transgenesis and cloning of farm animals. As well, research will include biological models compatible with human xenotransplantation; using genotyping for animal food traceability, in order to achieve food security and safety for people and animals related to food chemistry and environmental chemistry.

Through this project, the following are to be achieved:

- Increase access and participation in continuous vocational training through postdoctoral schools for the first time in Romania;
- Support of co-operation among universities, research entities and companies in order to fulfil all set-up and operating requirements for postdoctoral schools in Romania;
- Human resource development through postdoctoral scientific research, to address the most important scientific areas identified by policies and strategies necessary for Romania;
- Increase the motivation of scientific researchers by stimulating involvement in scientific work, requiring creativity, innovation and intellectual property protection. Includes encouraging the setting up of elite clusters of scientists, according to the European strategy to win a leading place in the global hierarchy of the knowledge society, and in this particular case of biodiversity and agro-food biotechnology for eco-sanogenesis [3].

This is the way in which results can be implemented directly into the economy and have an immediate impact on the agricultural, economical and educational sector. Development means technology, human health, economy and best education. The question is how to develop agriculture, education and the economy in order to achieve sustainable development of the society.

The Romanian Academy, via the project of the first postdoctoral school in Romania, gathers together experts from all the emerging fields that have to be developed in Romania. The objectives of interdisciplinary, multidisciplinary and transdisciplinary postdoctoral professional training involve the same target group, including the main professional categories (i.e. biologists, livestock engineers, veterinarians, agronomists, economists, ecologists and chemists).

These people participate in the 21st Century to ensure humanity's food resources, respecting the principles of bio-economy and eco-economy, in such a way that the humans will become a wise partner of nature as manufacturer, regulator and consumer in intensive and/or traditional agroecosystems [3].

The first postdoctoral school is funded by the European Social Fund through the Operational Programme Human Resources Development. The scientific basis of a new paradigm of integrated eco-bio-economy have been presented and developed at national and international symposia, with an acknowledged academic orientation.

On the other hand, the authors intend to further develop the perspectives of zootechnical engineers regarding the innovative concept of integrated eco-bio-economic engineering, with a socio-economic impact upon increasing bio-food

resources for humans and farm animals in the context of preventing and combating a new global food crisis, in a changing multi-polar world.

It is of great importance to make these experts work together, exchange and improve their knowledge between homologous equals in other universities or research institutions and laboratories. Hence, this will allow to implement in Romania the best practices of other countries directly into education, the economy and technology.

On the other hand, applying cutting-edge technology is not always the best way to achieve food safety or quality. It is important to develop technology without destroying the concept or the quality of the products, to think sustainably and to act on a small scale at first.

Furthermore, growing complexity leads to higher demands in interdisciplinary approaches to research and education. Consequently, students need to master a high level of knowledge of other disciplines in order to understand the latest developments in their own discipline. Similarly, cutting-edge research depends increasingly on teamwork between different disciplines [2].

CASE STUDY

The Benefits of Egg Stamping

Food safety is an increasingly important public health issue. Governments all over the world are intensifying their efforts to improve food safety. These efforts are in response to an increasing number of food safety problems and rising consumer concerns [4].

Modern intensive agricultural practices contribute to increasing the availability of affordable food and the use of food additives can improve the quality, quantity and safety of the food supply. However, appropriate controls are necessary to ensure their proper and safe use along the entire food chain.

Other challenges, which need to be addressed to help ensure food safety, include the globalisation of trade in food, urbanisation, changes in lifestyles, international travel, environmental pollution, deliberate contamination, and natural and man-made disasters [4].

When it comes to food safety, eggs must be seriously considered. Salmonella bacteria in food is the number-one cause of food-borne illness. Four out of five cases of Salmonella serotype Enteritidis food-borne illness (food poisoning) come from raw or undercooked eggs. This makes egg safety a crucial part of a food safety plan. This is because eggs can be contaminated with Salmonella on the farm. Therefore, the egg pasteurisation process eliminates the risk of Salmonella and other dangerous microbes, such as the Avian flu virus. By pasteurising eggs, it is possible to eliminate the risk of harmful Salmonella bacteria and viruses [5].

Egg stamping enables shell eggs to be traced from the farm to the table. This has advantages for consumers, retailers and also for producers. The main advantage for producers is that, if there is a food safety issue, or any other quality problem with eggs, the source of the egg can be located quickly. Egg stamping, also known as egg marking, egg coding or egg printing, is compulsory in the European Union [6].

In the European Union, from 1 January 2004, Council Regulation EC/5/2001 amending Regulation (EC) No. 1907/90, required all Class A eggs sold at retail level within the EU to be marked (stamped) with a code identifying the establishment (production site), country of origin and method of production (i.e. 0 for organics, 1 for free range, 2 for barn, 3 for cage) [7].

Egg stamping allows traceability of each egg sold to consumers. It means that if there is a quality problem with a sold egg, the problem may be quickly traced and addressed at the source. It avoids many farms being involved in a possible recall until the problematic eggs are traced. This, in turn, benefits the whole industry as an isolated problem is less likely to be blamed on all producers. This is particularly important if (or when) there is a food safety problem.

Cutting Edge Technology for Food Safety

The standard, ISO 22000, was developed by the International Organization for Standardization dealing with food safety. This is a general derivative of ISO 9000. The ISO 22000 international standard specifies the requirements for a food safety management system that involves interactive communication, system management, prerequisite programmes and HACCP (Hazard Analysis Critical Control Point) principles.

The most common techniques these days for egg marking or egg stamping is ink stamp or laser marking. Both of these techniques provide reliable information about the product and traceability code for food safety. To improve the existing cutting edge technology used for egg marking, it is proposed to use gas discharge lamps instead of laser, as shown in Figure 1.

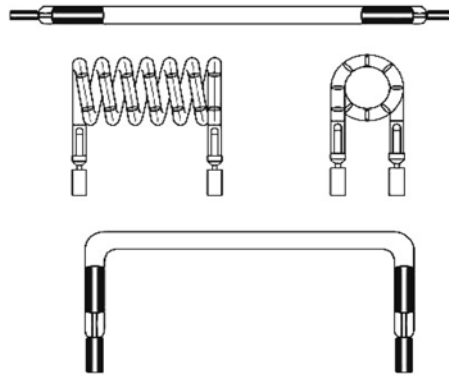


Figure 1: Geometrical shapes of lamp for optical radiation impulses of light.

The advantage of this method is that more than one egg can be marked at the same impulse energy. Using the same energy as lasers, gas discharge lamps can stamp 20 to 50 eggs simultaneously, providing a safe method of low energy consumption and egg pasteurisation at the same time. Energy efficiency of these lamps is 70% compared to an average of 3% for laser. The construction of the device is very simple as it is using only a non-coherent radiation focaliser, as presented in Figure 2.

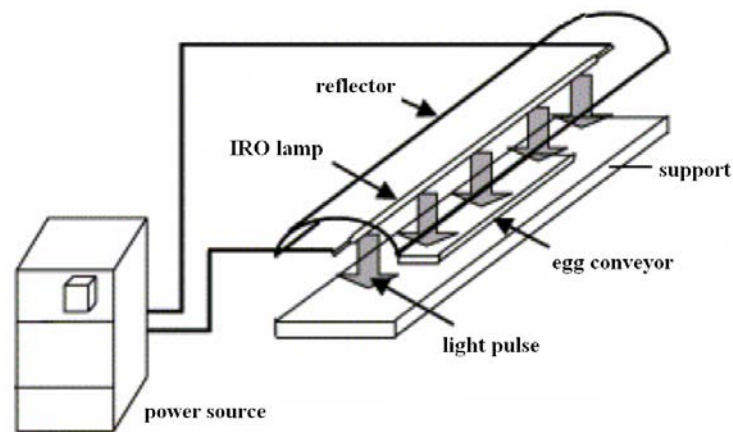


Figure 2: Experimental module for optical radiation impulses of light.

The method of egg marking presented above uses radiant energy to cause discoloration of the shell for a traceability code or freshness date, without penetrating the egg shell or damaging the product since there is no penetration of the shell. Regulatory agencies and the food industry need fast, automated, cost-effective analytical methods that are accurate, reliable, and safe and that minimise waste.

These achievements are the result of laboratory research and experiments carried out during postdoctoral research at the interdisciplinary *Postdoctoral School for Livestock Biodiversity and Food Biotechnologies Based on Eco-Economy and Bio-Economy for Eco-Sanogenesis*. Further research and application for an invention patent are proposed, and the results are expected to be applied in industry.

CONCLUSIONS

Postdoctoral research education of academic staff and young researchers is beneficial from the point of view of best practice in engineering and technology education in Romania. A large amount of European funds were attracted to Romania for developing projects almost for every sector of the economy and for rehabilitation of the environment, environmental protection, medicine or infrastructure.

However, on completion of each project, there was no more financial support from outside the country, and it was very hard to maintain continuity of effort to achieve proposed targets or goals. Perhaps this is because of legislation, restructuring or political instability, or a lack of infrastructure or education. However, when looking at the entire picture, Romania has huge agricultural potential, which is not yet fully developed and exploited.

Postdoctoral education plays an important role in the Romanian research environment. A new ecological, ultra fast and highly secure method of chicken egg stamping, in accordance with European Union traceability requirements for food safety, is one of the outgoing research activities among others at the first postdoctoral school of the Romanian

Academy. This is a foundation for the link between engineering technology and the food industry. It is crucial to maintain education at the higher levels and to have a well-prepared society, in order to make a difference and to promote development of the country.

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