Innovative approaches to control safety of agricultural products

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Agricultural University – Plovdiv (AUP)

UNIVERSITY MISSION

The AUP provides training for three academic degrees – Bachelor's, Master's and Doctoral.

- **To provide high quality student-centered education guaranteeing competitiveness on the Bulgarian, the European and the world labour market;**
- **To achieve research results ensuring their rapid introduction into practice;**
- **To bring up citizens committed to civic virtues, capable of making policies and strategies in the agricultural sector;**
- **To preserve the traditional love of Bulgarian people to land and its fruit, their desire for knowledge and the values of Bulgarian agricultural education and science;**
- **The Agricultural University should earn the social acknowledgement as a leading institution in the area of agricultural business, science and education.**

About the AUP

Established	1945
Lecturing Staff	250
Administrative and support staff	160
Enrolled students	4000
Degrees awarded	Bsc, Msc, PhD
Bsc Study Programmes	18
Msc Study Programmes	33
PhD Scientific Majors in Bulgarian	23

DEPARTMENT OF MICROBIOLOGY AND ENVIRONMENTAL BIOTECHNOLOGIES

The Department consists of one associated member of the Bulgarian Academy of Science, three associate professors, two assistant professors, as well as the administrative staff.

An important work aspect of the scientific staff is to retain and expand the international cooperation with leading European and world universities in the field of educational and research. The Department`s lecturers take part in European projects such as: Leonardo da Vinci programme, Erasmus programme, Sixth and Seventh Framework Programmes, South East Europe Programme, Balkan Mediterranean Transnational Cooperation Programme, as well as projects subsidized by Structural Funds, Scientific Funds and other national funds.

In order to fulfill this purpose, a laboratory for microbiological analyses has been created where various tests and experiments of food products, water, soil samples, etc. have been conducted. The laboratory for microbial biotechnologies deals with the technologies used in the production of microbial preparations, soil improvers and fertilizers in modern agriculture. Both laboratories have modern equipment.

The main scientific research trends of the Department are as follows:

* Isolation and characterization of new microorganisms and their application in agriculture;
* Microbial control on diseases, insect pests and weeds;
* Inactivation of pathogens by ecological methods;
* Utilization of agricultural and food wastes;
* Isolation and characterization of plant growth promoting bacteria;
* Isolation and characterization of bacteria increasing quality of the crop productivity;
* Bioremediation of heavy metal contaminated soils;
* Study of pesticide and fertilizer effect on soil microorganisms;
* Bio-pollutants in agri-food chain;
* Study of traditional and new dairy products;
* Bio wastes composting

New behaviors of the consumers

Food Industry: Key Challenges

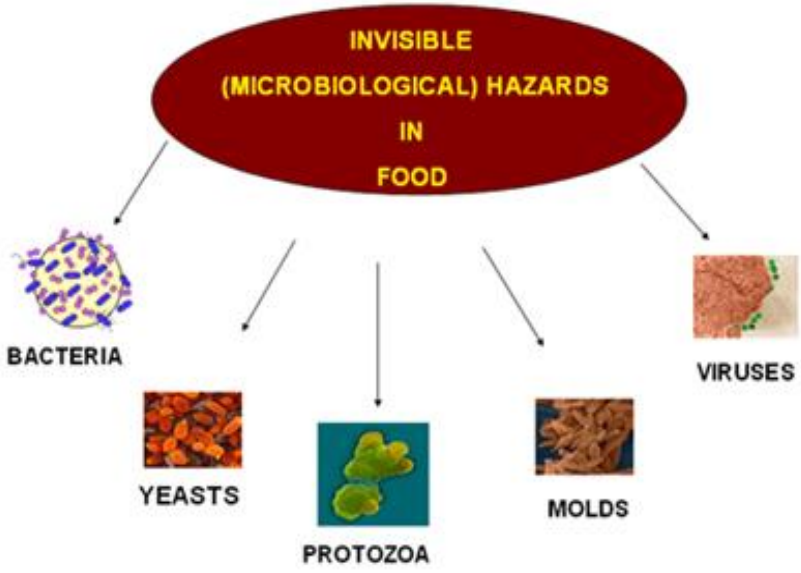
- *Increased international competition*
- *Increased worldwide food demand*
- *Concerns for food safety and quality*
- *Interest in added- value food*
- *Changing attitudes and emerging consumer trends*

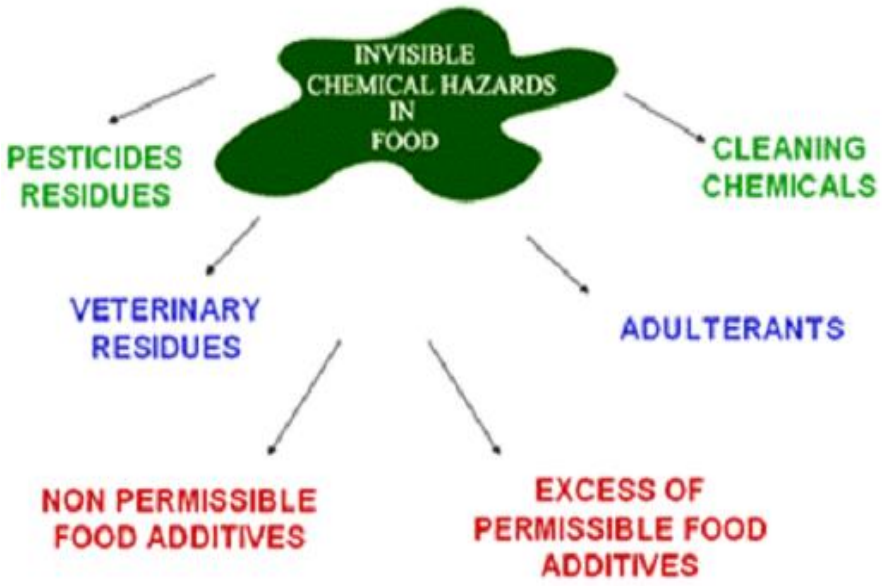
FOOD SECURITY

Food security is the state of having reliable access to a sufficient quantity of affordable, nutritious food, in accordance with its nutritional need and preference, for active and healthy lifestyle (FAO). Food security is ensured by three pillars:

FOOD SAFETY HAZARDS

- Presence of a physical, chemical or biological contaminant in raw materials, in products that are under process or in even in the finished products.
- Potential for the growth or survival of undesirable microorganisms or the generation of unwanted or unnecessary chemicals in finished products.
- Contamination of semi-finished or finished products with undesirable microorganisms, chemicals or by any unknown material.

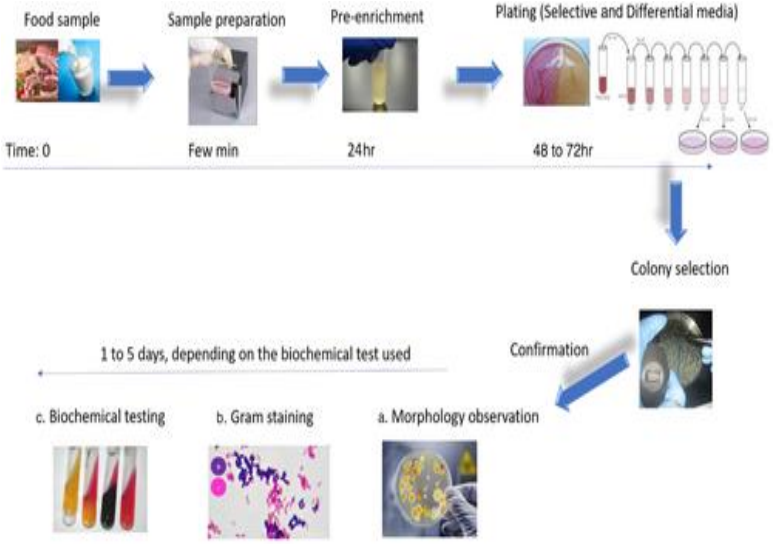


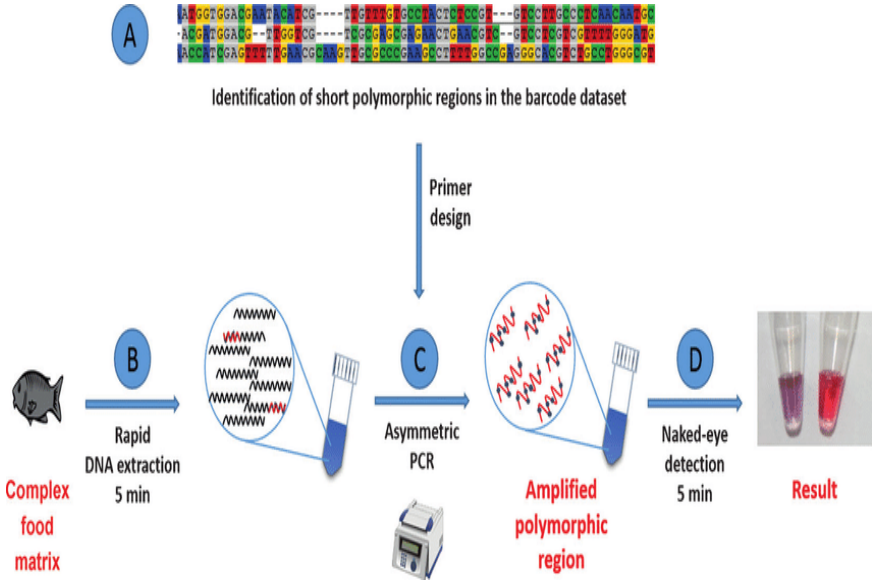


Source: Food safety – a key to healthy life, Shendurse AM, 2019

PCR-based techniques for the detection and quantification of biological objects used in the analysis of food products and raw materials

Current developments in molecular techniques make it possible to rapidly assemble information on the genome of various isolates of microbial species of concern. Such information can be used to develop new tracking and tracing methods, and to investigate the behavior of microorganisms under environmentally relevant stress conditions.





APPLICATION OF PCR IN MICROBIOLOGY

The detection of microbiological contamination is one of the main areas of application of PCR in nutritional analysis. Using the PCR technique, a wide range of pathogens have been detected: Bacteria (*Salmonella, Listeria, Legionella, E. coli, Staphylococcus aureus, Campylobacter*),

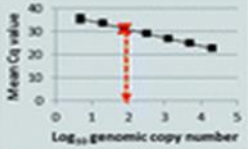
Viruses (Norovirus, Hepatitis and Influenza) or phytopathogenic viruses (TMV, CaMV)

Yeast and mold in food.

APPLICATION OF PCR IN FOOD AUTHENTICITY SPECIFICATION

The specification of the types and authenticity of the food is of great interest: meat products can be falsified due to an incorrect declaration (see the horse meat scandal).

Another application is the guarantee of the authenticity of the food for dietary or religious reasons. PCR methods allow to make an accurate quantitative and qualitative analysis for the presence and authenticity of pork, beef, horse, donkey, chicken, turkey and other types of meat. PCR is also used to identify fish species.

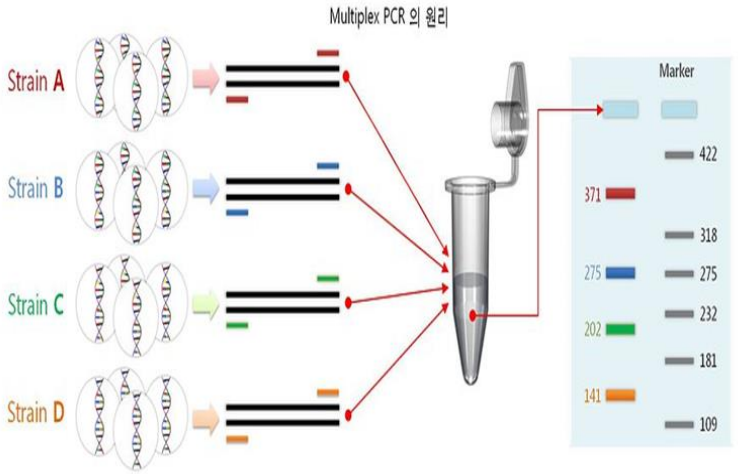
Test Sample	DNA Extraction	Horse Adulteration qPCR Test	Result
			
Suspect test sample	Sample processed and DNA extracted	Test samples analysed using the horse meat adulteration assay	Horse meat DNA detected

APPLICATION OF PCR IN BEER AND WINE PRODUCTION

In the production of beverages, the detection of microorganisms that cause decay is crucial. PCR is used to detect microorganisms that cause spoilage in beer and wine production, e.g. *Lactobacillus, Pediococcus, Megasphaera, Pectinatus, Dekkera bruxellensis* and *Oenococcus oeni.* The method can be used to control the process as well as to control the final product.

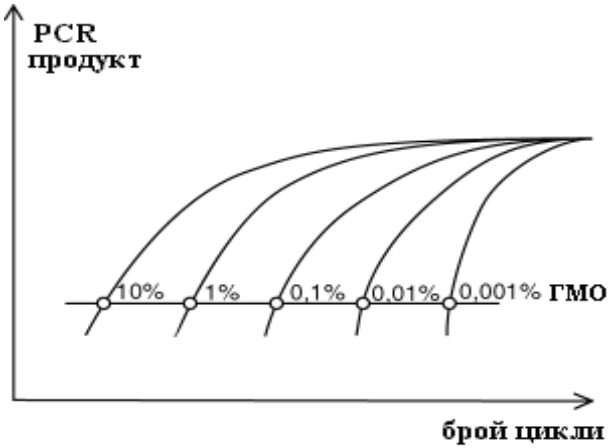
MULTIPLEX ANALYSIS FOR SIMULTANEOUS DETECTION OF ALLERGENS

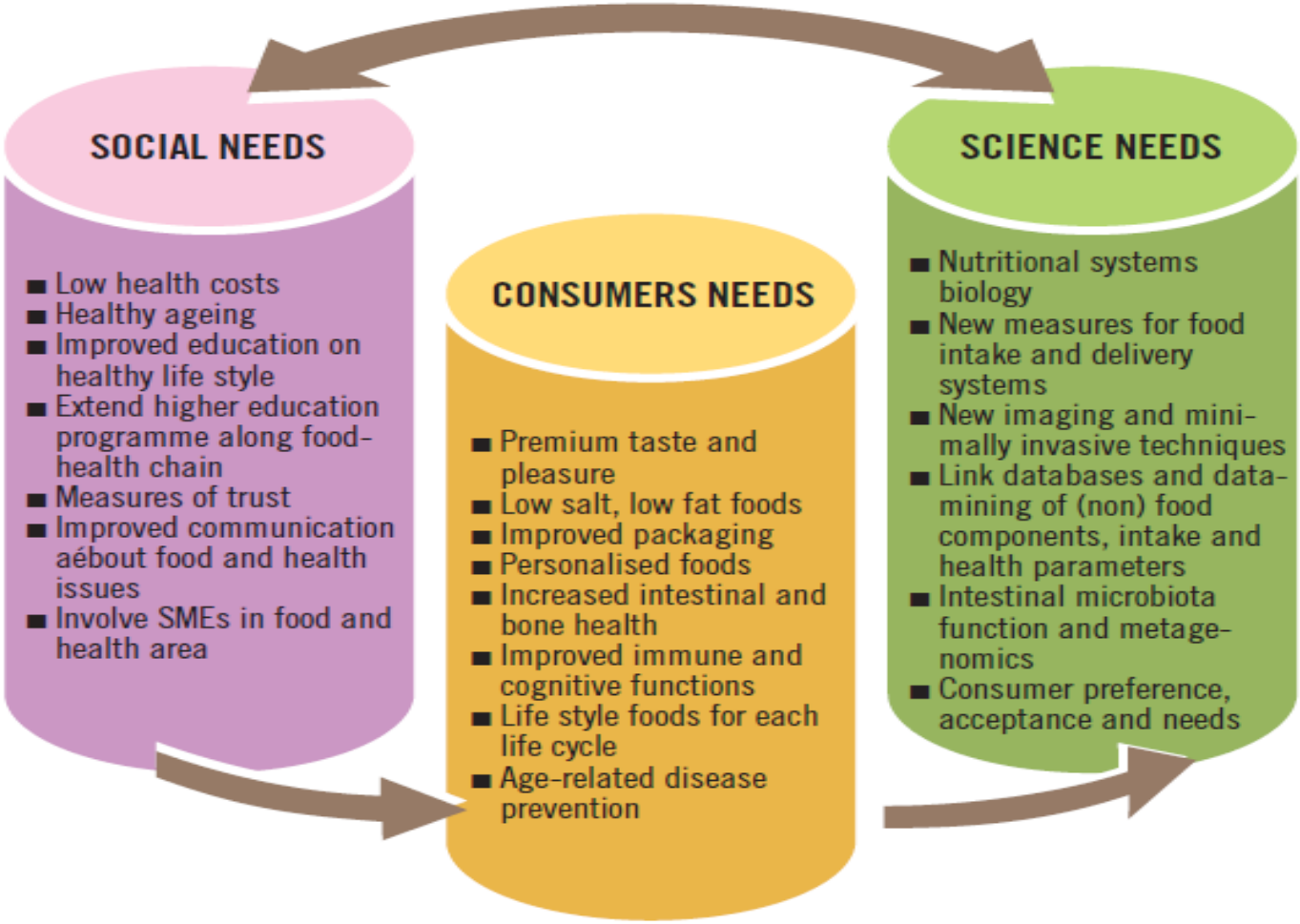
Food allergens can cause severe immunological reactions. To protect consumers, foods must be tested for allergens. PCR has been used successfully in very small amounts to detect allergens in foods such as soy, hazelnuts, peanuts, gluten, almonds, celery, sesame, mustard, fish or crustaceans. Multiplex analyzes are performed to detect multiple allergens simultaneously.



PCR methods for the evaluation of the GMO content in food

1. **Detection.** The purpose of the detection is to determine whether a sample contains GMOs. For this determination, a screening method can be used, leading to: availability analysis - positive / negative statement. Screening methods are usually based on PCR.
2. **Identification.** If a GMO is present, an additional analysis should be performed to detect the type of GMO. The only analytical methods that unambiguously allow the identification of each type of GMO are PCR-based methods.
3. **Quantitative determination.** If the product has been shown to contain GMOs, the next step is to determine the exact amount present in the sample. Typically, quantification is performed using real-time qPCR or PCR.




SOCIAL NEEDS
Low health costs
Healthy ageing
Improved education on healthy life style
Extend higher education programme along food-health chain
Measures of trust
Improved communication aébout food and health issues
Involve SMEs in food and health area
CONSUMERS NEEDS
Premium taste and pleasure
Low salt, low fat foods
Improved packaging
Personalised foods
Increased intestinal and bone health
Improved immune and cognitive functions
Life style foods for each life cycle
Age-related disease prevention
SCIENCE NEEDS
Nutritional systems biology
New measures for food intake and delivery systems
New imaging and minimally invasive techniques
Link databases and data-mining of (non) food components, intake and health parameters
Intestinal microbiota function and metagenomics
Consumer preference, acceptance and needs

Thank you for your attention