HRVATSKO DRUŠTVO ZA BIOTEHNOLOGIJU
CROATIAN SOCIETY OF BIOTECHNOLOGY
KROATISCHE GESELLSCHAFT FÜR BIOTECHNOLOGIE
SOCIÉTÉ CROATE DU GENIE BIOLOGIQUE

prehrambeno biotehnološki fakultet | faculty of food technology and biotechnology

Sveučilište u Zagrebu
University of Zagreb

Food biotechnology and biotechnological foods

Anita Slavica

overwiev

- planetary boundaries;
- transition towards post-petroleum society;
- research and innovation for smart specialization strategy (ris3) 2014-2020 – HR;
- biotechnology, food biotechnology (FB) and biotechnological foods (BF);
- some interesting ongoing FB&BF projects
- EFSA

planetary boundaries (1)

- „planetary boundaries define the safe operating space for humanity with respect to the Earth system and are associated with the Earth's biophysical subsystems or processes."[1]

- from the Holocene (the earth's physical environment has been relatively stable, the past 10000 years) to the Antopocene (the environment greatly influenced by human activities, since Industrial revolution)

- nine Earth-system and associated thresholds processes could generate unacceptable environmental change (three of them have been crossed)[1]

[1]Rockström et al. (2009) Nature

planetary boundaries (2)

- nine Earth-system and associated thresholds processes could generate unacceptable environmental change (three of them have been crossed)[1]:
  - climate change;
  - rate of biodiversity loss (terrestrial and marine);
  - intereference with the nitrogen and phosphorus cycle;
  - stratospheric ozone depletion;
  - ocean acidification;
  - globar freshwater use;
  - change in land use;
  - chemical pollution; and
  - athmospheric aerosol loading.

[1]Rockström et al. (2009) Nature

transition towards post-petroleum society (1)

- a bio-based economy

  economic growth dinamics coupled with renewable biomass resources, environmental impact and quality of life;

  founded on locally sourced and produced plant and waste-derived materials, chemicals, fuels, food and feed;

- a European Public-Private Partnership (PPP) reguired;
- focus of bio-based PPP on[2]: sustainable biomass supply and new value chains;

  biorefineries;

  development of markets, products and policies (global policies, biomass supply policies, research and innovation policies, market support policies);

[2]Bio-Based-Industries- PPP-vision-2030

transition towards post-petroleum society (2)

- a European Public-Private Partnership (PPP) reguired;
- focus of bio-based PPP on[2]:
  - research and innovation (R&I, capitalising prominent knowledge base) vs technological, political and commercial challenges;
  - R&I - to invest above 2.8 billion EUR (2014-2020);

[2]Bio-Based-Industries- PPP-vision-2030

transition towards post-petroleum society (3)

- a European Public-Private Partnership (PPP) reguired;
- focus of bio-based PPP on[2]:
  - R&I (1)
    - to develop multi-functional catalysts;
    - to employ extremophiles and extremozymes;

[2]Bio-Based-Industries- PPP-vision-2030

transition towards post-petroleum society (4)

- a European Public-Private Partnership (PPP) reguired;
- focus of bio-based PPP on[2]:
  - R&I (2)
    - bioactive ingredients (proteins and protein derivatives, carotenoids, polyphenols and prebiotics) are widely used as additives in the food, feed, flavouring, fragrance, cosmetics, chemicals, textile, nutraceutical and pharmaceutical industries;
    - global demand for bioactive compounds and proteins in 2030 is expected to outstrip current production capacities;

[2]Bio-Based-Industries- PPP-vision-2030

transition towards post-petroleum society (5)

- a European Public-Private Partnership (PPP) reguired;
- focus of bio-based PPP on[2]:
  - R&I (3)
    - to isolate proteins and other bioactive compounds from underexploited and new sources, valorise them through additional biomass processing, and developing new (protein) derivative solutions for food/feed applications;
    - to bring down imports of protein (*e.g.* soy) for feed in Europe by 15% by 2020;

[2]Bio-Based-Industries- PPP-vision-2030

transition towards post-petroleum society (6)

- a European Public-Private Partnership (PPP) reguired;
- focus of bio-based PPP on[2]:
  - from the new value chains to integrated value chains - linking industries involved in

    biomass supply (bussines development, breeding and plant production, productivity increase and soil fertility, harvesting and mobilisation, forestry, farming),

    biorefineries (primary conversion: refining of biomass into its valuable components, secondary conversion: valorisation of intermediates and products; transport, storage) and

    product innovation (biochemical, biomaterials, advanced biofuels, food & feed ingredients);

[2]Bio-Based-Industries- PPP-vision-2030

transition towards post-petroleum society (7)

- a European Public-Private Partnership (PPP) reguired;
- focus of bio-based PPP on[2]:
  - from **the new value chains** to integrated value chains - linking industries involved in

    biomass supply (bussines development, breeding and plant production, productivity increase and soil fertility, harvesting and mobilisation, forestry, farming),

    biorefineries (primary conversion: refining of biomass into its valuable components, secondary conversion: valorisation of intermediates and products; transport, storage) and product innovation (biochemical, biomaterials, advanced biofuels, food & feed ingredients);

[2]Bio-Based-Industries- PPP-vision-2030

transition towards post-petroleum society (8)

- a European Public-Private Partnership (PPP) reguired;
- focus of bio-based PPP on[2]:
  - primary **biomass** production (sectors)[3]:

    agriculture

    (starch-sugar and oilseed raw materials; natural fibles - flax, hemp; horticulture substrates, side streams and bulbs; agricultural co-products and residues - straw and pruning);

    forestry (Sweden, Germany, France, Finland and Italy); and

    fishery;

  - EU biomass utilisation in 2011 at around 2 billion tonnes: 21% was used for food, 44% for feed[4]
  - generate a lot of employment (> 10 million jobs) but low turnover (43% out of a total turnover of 1 trillion EUR)[5].

[3]European Bioeconomy in figures (2016)

[4]SIRA

[5]Eurostat (EU-28, 2013)

transition towards post-petroleum society (9)

- a European Public-Private Partnership (PPP) reguired;
- focus of bio-based PPP on[2]:
    - **value chains**:
        - lignocellulosic based value chain;
        - forestry based value chain;
        - agricultural crops value chain; and
        - organic waste based value chains;
    - investments above 2 billion EUR (2013-2015)[3].

[3]European Bioeconomy in figures (2016)

transition towards post-petroleum society (10)

- developing new (protein) derivative solutions for food/feed applications[4]
  - end-users should see a product's value and are willing to pay the premium;
  - potential hurdles involved in deploying different or new products or new product functionalities:
    - policy and regulatory requirements,
    - a lack of consumer awareness and acceptance,
    - low public and private (industrial) demand,
    - resistance from established industrial sectors or unfavourable public perception of products and applications.

The bio-based products may be replicas of their fossil-based counterparts (drop-in products).

[4]SIRA

transition towards post-petroleum society (11)

- a European Public-Private Partnership (PPP) reguired;
- focus of bio-based PPP on[2]:
  - socio-economic impact:
    - reduce the impact on the environment;
    - help mitigate climate change;
    - foster regional competitiveness; and
    - contribute to food security.

[2]Bio-Based-Industries- PPP-vision-2030

research and innovation for smart specialization strategy (ris3) 2014-2020 (1)

- the ris3 policy rationale[6]:
  - to make innovation a priority for all regions;
  - to focus investment and create synergies;
  - to improve the innovation process; and
  - to improve governance and to get stakeholders more closely involved;

[6]NATIONAL/REGIONAL INNOVATION STRATEGIES FOR SMART SPECIALISATION (RIS3) - COHESION POLICY 2014-2020 (2014)

[7]Smart_Specialisation_Startegy_HR (2016) 2016-2020

research and innovation for smart specialization strategy (ris3) 2014-2020 (2)

- the economic rationale[6]:
  - to develop and implement strategies for economic transformation;
  - to respond to economic and societal challenges;
  - to make regions more visible to international investors and improve their internal and external connections;
  - to avoid overlaps and replication in development strategies;
  - to accumulate a 'critical mass' of resources; and
  - to promote knowledge spill over and technological diversification.

[6]NATIONAL/REGIONAL INNOVATION STRATEGIES FOR SMART SPECIALISATION (RIS3) - COHESION POLICY 2014-2020 (2014)

[7]Smart_Specialisation_Startegy_HR (2016) 2016-2020

research and innovation for smart specialization strategy (ris3) 2014-2020 (3)

- the ris3 2014-2020 - what is different from 2007-2014? [6]

  - „it is upgrading of the existing methodology for structural funds programming based on 15 years of experience in supporting innovation strategies in the regions to make innovation a priority for all regions”

[6]NATIONAL/REGIONAL INNOVATION STRATEGIES FOR SMART SPECIALISATION (RIS3) - COHESION POLICY 2014-2020 (2014)

research and innovation for smart specialization strategy (ris3) 2014-2020 (4) - HR[7]

- weaknesses
  - HR economy is dominated by traditional sectors and low-technology sectors;
  - involvement of HR in international value chains is very low;
  - HR innovation system needs better organization, coordination and verification;
  - collaboration between research instututions and industry is week, the number of scientific articles created in collaboration between academia and industry is only 27.4 (52.8 in EU) per million inhabitants;
  - access to a variety of sources of capital for business startup is very limited;
  - better ris3 is required.

[7]Smart_Specialisation_Strategy_HR_2016-2020

biotechnology, food biotechnology and biotechnological foods

„Biotechnology is the integration of natural sciences and engineering sciences in order to achieve the application of organisms, cells, parts thereof and molecular analogues for products and services."[8]

Food biotechnology is application of different technologies to change genes of different species (*i.e.* animals, plants or microorganisms) to make new species (GMO) which have desired production, nutrition related properties and marketing.

GMO is a product „non occur naturally by mating and/or natural recombination."[9]

Biotechnological foods (GM foods) refer to foods produced from genetically modified plants or animals.[10]

[8]European Federation of Biotechnology (EFB; 1989)

[9]https://ec.europa.eu/food/plant/gmo_en

[10]Zhang et al. (2016) Food Sci Human Wellness

food biotechnology and biotechnological foods (1)

- Why biotechnological foods are produced?[10]:
  - expansion of population (9.7 billion in 2050) and mitigation of malnutrition and hunger;
  - decrease in arable land for food production (from the current 0.24 to 0.18 ha per person by 2050),
    - increased demand for biofuel and feedstock production,
    - accelerated urbanization,
    - land desertification, salinization and degradation,
    - altered land use,
    - climate change,
    - water resource limitation;
  - bottleneck of conventional and modern breeding.

[10]Zhang et al. (2016) Food Sci Human Wellness

food biotechnology and biotechnological foods (2)

- GM crops grown commercially/field tested[11]:
  - herbicide and insecticide resistant soybeans, corn, cotton and canola;
  - GMO with therapeutic and pro-health value (vitamins A, C, E, unsaturated fatty acids, alimentary cellulose and probiotics - „Golden rice");
  - sweet potato resistant to a virus that could destroy most of the African harvest;
  - GMO with altered amino acid composition of proteins or carbohydrates - methionine rich sweet lupine or Amflora potato (amylopection for production of non-food starch);
  - variety of plants that are able to survive weather extremes;
  - GM plants (rice, maize, soybean, potatoes) as bearers of edible vaccines (*E. coli*, *H. pylori*).

[11]Bawa and Anilakumar (2013) J Food Sci Technol.

food biotechnology and biotechnological foods (3) – approved GM crops

ec.europa.eu/food/dyna/gm_register/index_en.cfm

Cookies | Legal notice | Contact | Search English (en)

PLANTS

European Commission > Food Safety > Plants > GMOs > New

HEALTH FOOD ANIMALS PLANTS

GENETICALLY MODIFIED ORGANISMS

- Legislation
- Authorising GMOs
- GMO Register
- Public consultations
- Traceability and Labelling
- Post-authorisation
- Transboundary movements
- Coexistence with conventional & organic agriculture
- Socio-economic considerations
- International affairs

Genetically Modified Organisms

EU Register of authorised GMOs

Search the register for products containing GMOs e.g. if you type 'cotton', you will get a list of all products containing cotton in their description..

This search covers the EU GMOs register (Regulation EC 1829/2003) and the products subject to EC decisions on withdrawal from the market.

Keyword(s) : plant

Registered / Withdrawn : All

Category : cotton

Reset search Search

Search conducted on : **Status** : *All* - **Keyword**: *plant* - **Category**: *cotton*

EU register of genetically modified food and feed

www.isaaa.org/gmapprovaldatabase/cropslist/default.asp

Contact | Purchase Publications | Site Map

INTERNATIONAL SERVICE FOR THE ACQUISITION OF AGRI-BIOTECH APPLICATIONS

ISAAA

CBU Join our new Crop Biot

ISAAA in Brief | ISAAA Programs | Knowledge Center | Biotech Information Resources | GM Approval Database

/ ISAAA / GM Approval Database / GM Crops List

Lists

- Crops List
- Events List
- Genes List
- GM Traits List
- Commercial Traits List
- Developers List
- Countries List
- Methods of Trait Introduction

GM Crops List

- Alfalfa (*Medicago sativa*)
- Apple (*Malus x Domestica*)
- Argentine Canola (*Brassica napus*)
- Bean (*Phaseolus vulgaris*)
- Carnation (*Dianthus caryophyllus*)
- Chicory (*Cichorium intybus*)
- Cotton (*Gossypium hirsutum L.*)
- Creeping Bentgrass (*Agrostis stolonifera*)
- Eggplant (*Solanum melongena*)
- Eucalyptus (*Eucalyptus sp.*)
- Flax (*Linum usitatissumum L.*)
- Maize (*Zea mays L.*)
- Melon (*Cucumis melo*)
- Papaya (*Carica papaya*)
- Petunia (*Petunia hybrida*)
- Plum (*Prunus domestica*)
- Polish canola (*Brassica rapa*)
- Poplar (*Populus sp.*)
- Potato (*Solanum tuberosum L.*)
- Rice (*Oryza sativa L.*)
- Rose (*Rosa hybrida*)
- Soybean (*Glycine max L.*)
- Squash (*Cucurbita pepo*)
- Sugar Beet (*Beta vulgaris*)
- Sugarcane (*Saccharum sp*)
- Sweet pepper (*Capsicum annuum*)
- Tobacco (*Nicotiana tabacum L.*)
- Tomato (*Lycopersicon esculentum*)
- Wheat (*Triticum aestivum*)

food biotechnology and biotechnological foods (4)

- in the period 1996-2013 additional global production of biotechnological foods of (in million of tons)[10]:
  - soybeans - 138;
  - corn - 274;
  - cotton lint - 21.7;
  - canola - 8;
  - or an increment of 32% of the arable land in the EU.

[10]Zhang et al. (2016) Food Sci Human Wellness

food biotechnology and biotechnological foods (5)

- improvement in food processing[10]:
  - tomatoes (polygalacturonase - ripening);
  - potatoes (cyclodextrin glycosyltransferases - brightness)
  - fast-growing salmon;
  - milk with reduced content of lactose;

[10]Zhang et al. (2016) Food Sci Human Wellness

food biotechnology and biotechnological foods (6)

- health and other risks[11] ("tampering with Mother Nature"):
  - health risks: (1) allergenic effects; (2) secondary and (3) pleiotropic effects;
  - evolution of resistant insects;
  - pest population to shift to another plant population that was once unthreatened;
  - formation of new viruses and therefore new diseases.

[11]Bawa and Anilakumar (2013) J Food Sci Technol.

ongoing FB&BFprojects (1) - proteins

- **GreenProtein**
  - production of high-added value, food-grade and fully functional proteins and other ingredients, out of vegetable residues from the packed salad processing.

- EU28 imports 77% of the protein it requires - vulnerability for our economy, risking our self-sufficiency and food security;
- food waste losses €442/ton of produced food material.

http://cordis.europa.eu/project/rcn/205400_en.html

ongoing FB&BFprojects (2) - proteins

- the research partnership **PROMINENT**
  - valorisation of proteins from side streams (wheat and rice processing) of the agro-food sector;
  - the main end product categories: pasta, biscuit, cake and beverage food models;
  - fulfilling market requirements (functionality, taste, purity, cost, safety) in the food segment;
  - expected impact: increasing the value of the protein fraction by at least 100%, opening of new markets for the European agro industry in food applications currently dominated by animal proteins.

ongoing FB&BFprojects (3) - proteins and food aditives

- **Croatian Science Foundation (CSF): GbP-FFood**
  - bran and press cakes as source of food additives (fibers, proteins, essential fatty acids, minerals, vitamins, bioactive compounds);
  - ultrasound treatment + fermentation (enzyme):
  - new products not yet recognised by end-users.

http://www.hrzz.hr/default.aspx?id=164

ongoing FB&BFprojects (4) - polyphenols

- **CSF: NutriOliWa**
  - olive oil press cake: extraction and preservation of polyphenols (functional food, food additives)
  - management of side streams produced in agriculture

http://www.hrzz.hr/default.aspx?id=164

ongoing FB&BF projects (5) - oils

- **FIRST2RUN**
  - low input and underutilized oil crops grown in arid and marginal lands and not in competition with food nor feed, are valorized for the extraction of vegetable oils;
  - these oils will be further converted into bio-monomers (mainly pelargonic and azelaic acids) as building blocks for high added value bioproducts (biolubricants, cosmetics, bioplastics, additives) throught the integration of chemical and biotech processes.

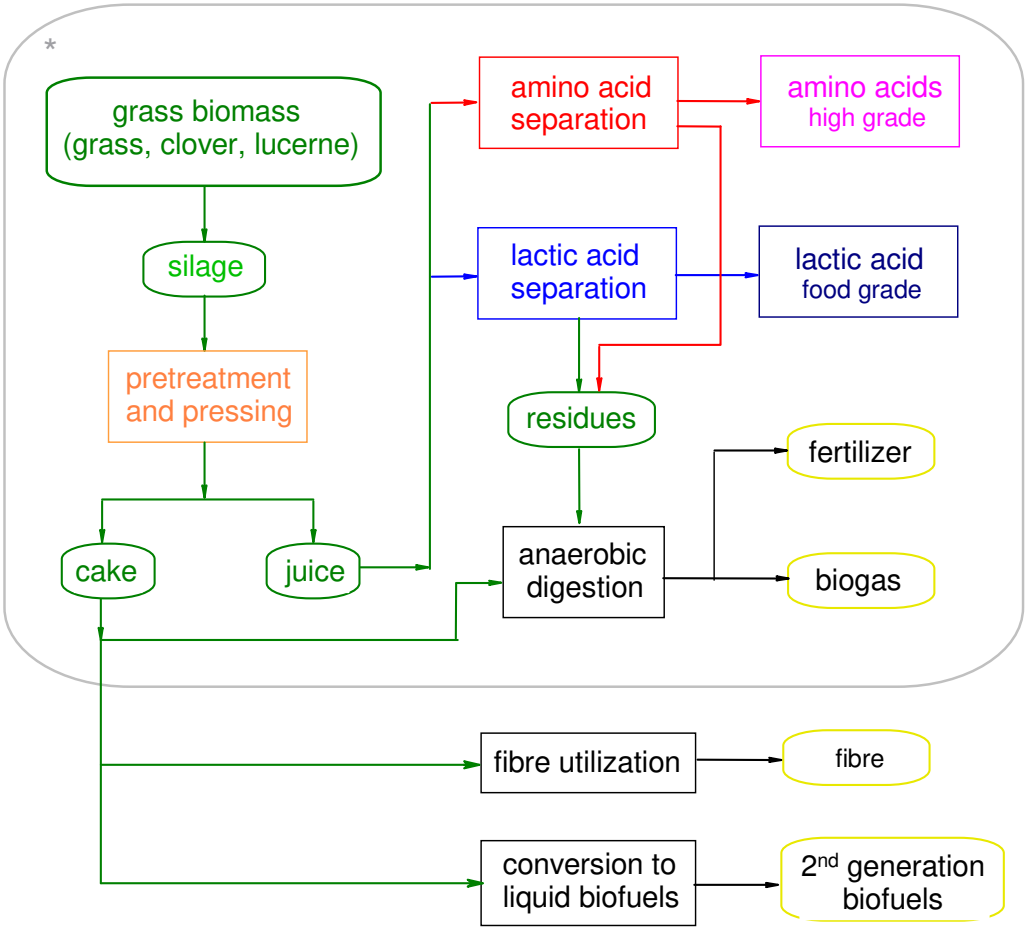
https://www.bbi-europe.eu/projects/first2run

ongoing FB&BF projects (6) - macroalgal biorefinery

- **MACROCASCADE**
  - marine living resources under-exploited in Europe - seaweds, microalgae, shellfish, molluscs, finfish and aquaculture residues and waste;
  - to prove the concept of the cascading marine macroalgal biorefinery;
  - covers the whole technological value chain for processing seaweed to health promoting feed and food supplements, prebiotics, antibiotic agents, anionic polymers, and chemicals for paint, cosmetic and detergent formulations.

https://www.bbi-europe.eu/news/macro-cascade-project-funding-awarded-prove-novel-seaweed-biorefinery

schematic diagram of the Green Biorefinery, Upper Austria, Utzenaich (demonstration plant*)



The European Food Safety Authority (EFSA)

www.efsa.europa.eu

efsa
European Food Safety Authority

Calendar english (en)

Search site

About News Discover Science Publications Applications Engage

Plant toxins in tea, herbal infusions, food supplements

Pyrrolizidine alkaloids in food, in particular for frequent and high consumers of tea and herbal infusions, are a possible long-term concern for human health.

News Statement Video

Food additives: EFSA workshop and open plenary in November

Webinar: how to publish in Knowledge Junction

Plant toxins in tea, herbal infusions, food supplements

Antibiotics: more evidence on link between use and resistance

HIGHLIGHTS all news

EVENTS go to calendar

efsa Join our scientific panels

Are you a food-safety scientist? Apply now! Deadline 8/9/2017

SEP 12 2017 107th Plenary meeting of the AHAW Panel Parma, Italy

SEP 13 115th Plenary meeting of the BIOHAZ Panel

Thank you for your attention!