European Plant Science Organisation
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Draft Statement

Contributions from plant science towards Nutritional Security and human health

Brussels, 9.5.2020

Plant research and innovation can contribute through three main paths to achieve Nutritional Security (NS):

1) **Underutilised nutritious fruit and vegetable crops: improve their economic performance and further increase their nutritional quality – emerging over the past years and providing co-benefits in terms of NS and sustainable environment - the focus of this statement.**
2) **Biofortification: increasing micronutrients in staple crops and / or enriching compounds enhancing the bioavailability of micronutrients – a strategy developed over the past decade which needs to be continued for consumers depending on or preferring staple crop products.**
3) **Supplements: adding beneficial compounds during food processing for the end product – the most common strategy until now, but the mainly chemically synthesised compounds need to be replaced by their natural counterparts in future, e.g. from niche crops or agri-food side-products.**

Plant based foods are receiving a remarkable attention during the last decades in the research field of nutrition, due to the biological activities recognized for many classes of phytochemicals and the relevance that food security topics are obtaining in European countries. The availability and accessibility to nutritionally rich food sources are hallmarks for human health and wellbeing, that is why many efforts are being directed towards old and new generations of plant crops. At multiple levels, EPSO and scientists involved in the Nutritional Security (NS) working group are discussing the best strategies to increase the content in beneficial biocompounds in the daily diet of European consumers.

- Micronutrients
  - Iron, cobalt, chromium, copper, iodine, manganese, selenium, zinc and molybdenum.
  - (Pro)-Vitamins
  - Phytochemicals (carotenoids, flavonoids ..)
- Dietary fibers

Figure 1: Plant compounds with nutritional / health benefits

First level*: *Re-discovering underused species and landraces of fruits, vegetables and staple crops.

The promotion of biodiversity generates awareness on the nutritional value of plant food sources traditionally cultivated in local areas and lost in the last years due to the modern cropping systems and the requirements of modern global markets. Re-discover those characterized by a high nutritional value can greatly help to diversify our diet, 'diverse crops for diverse diets'. Examples of these important genetic and nutritional bioresources are local carrots, artichokes, thistles, colored corn, (rich in polyphenols and flavolignans)

or legumes such as chickpea, lupin seed, grass pea, (which can be an important protein source alternative to animal proteins) that can be promoted for the daily consumption and proposed for a healthy diet. Since most of our knowledge on phytochemical biosynthesis pathways and precise chemical characterization has been carried out on model plants or major crops, great efforts have to be directed in the near future towards similar studies in selected high value niche species.
Similarly, the economic performance of such niche crops or species has to be improved through publicly resourced plant breeding so that farmers can afford to switch from cultivating mainly staple crops to include in their portfolio as well high quality niche crops.

Second level: Use of new metabolic engineering / new breeding technologies to re-design high quality crops.
New genetic technologies can help to push the metabolic pathways towards the accumulation of specific classes of healthy bio compounds in fruits and vegetables thus accelerating the development of a new generation of crops characterized by a higher nutritional value. New advances are now rapidly developing based on the gene targeting and new breeding technologies (NBTs), allowing the achievement of new frontiers in the food research area. EPSO and its Working Groups (WGs) are actively discussing at European and local levels to point out the importance of open field experimentation of crops obtained *via* NBTs. Only if scientists will have the possibility to grow new crops in real environmental conditions, they will understand the impact of the new cultivars on environment and their overall quality and yield.

Third level: Promoting co-developing improved crops and agricultural management practices and post-harvest processes for these to keep or even enhance nutritional quality in the fresh and transformed products.
New crop management strategies and the development of minimal invasive techniques will help growers in establishing the best harvesting period when fruits and vegetables are at their maximum nutritional value, or help food processors to preserve and possibly increase the nutritional quality in the final transformed plant-based food - 'diverse crops with diverse cropping systems for diverse diets'. EPSO and the NS WG is actively discussing with the European Commission (EC) and European Technological Platforms about the importance of linking crop genetic improvement with management and processing with the ultimate goal to provide more nutritious food products to the end consumer.

Fourth level: Linking the concept of diverse diets enriched in different classes of nutritionally active biocompounds with the prevention of human diseases.
Modern methodologies are now rapidly developing also to identify and quantify minor healthy components in fresh and transformed plant products. The current knowledge has highlighted the importance of the positive impact of phytonutrients on human health, with a special view to their impact on the human microbiota - 'diverse crops with diverse cropping systems for diverse diets and human health'. Many classes of biocompounds (or their sub-products deriving by microbiota biotransformation) can provide a substantial contribution to the human gut microbiota *shaping*, in terms of microbial communities and probiotics abundances. On the other hand, a healthier microbiota profile is an important factor influencing our immunity response and general wellbeing. Several studies have shown the importance of phytochemicals assumption on the human immune system and the prevention of inflammation-based diseases such as cardiovascular, neurodegenerative and bowel diseases. The EPSO NS WG is actively discussing about the importance of addressing the link between specific sets of phytochemicals (with the quantity to exert their nutritional effect and the importance of the original food matrix) and the impact on a specific pathology. Only if we can get robust and scientifically sound results on these important issues, we will be able to propose their consumption for sub-groups of consumers at risk of specific diseases.

Fifth level: Linking the concept of diverse diets to human health AND environmental benefits.

While using improved underutilized crops we diversify the crops we cultivate and achieve not only more diverse diets for human health, but as well we increase the cultivated diversity (biodiversity) in agriculture leading to more resilience in production. Scenarios by the EAT foundation, looking at 'which crops we should grow to achieve healthier diets', point to similar crops as looking at 'which crops we should grow to achieve a lower environmental footprint'. This clearly underpins the recommendation by plant scientists to develop 'diverse crops with diverse cropping systems for diverse diets and human health and resilient production' as a multi-disciplinary and cross-sectorial approach to achieve Nutritional Security and Environmental Sustainability as co-benefits.

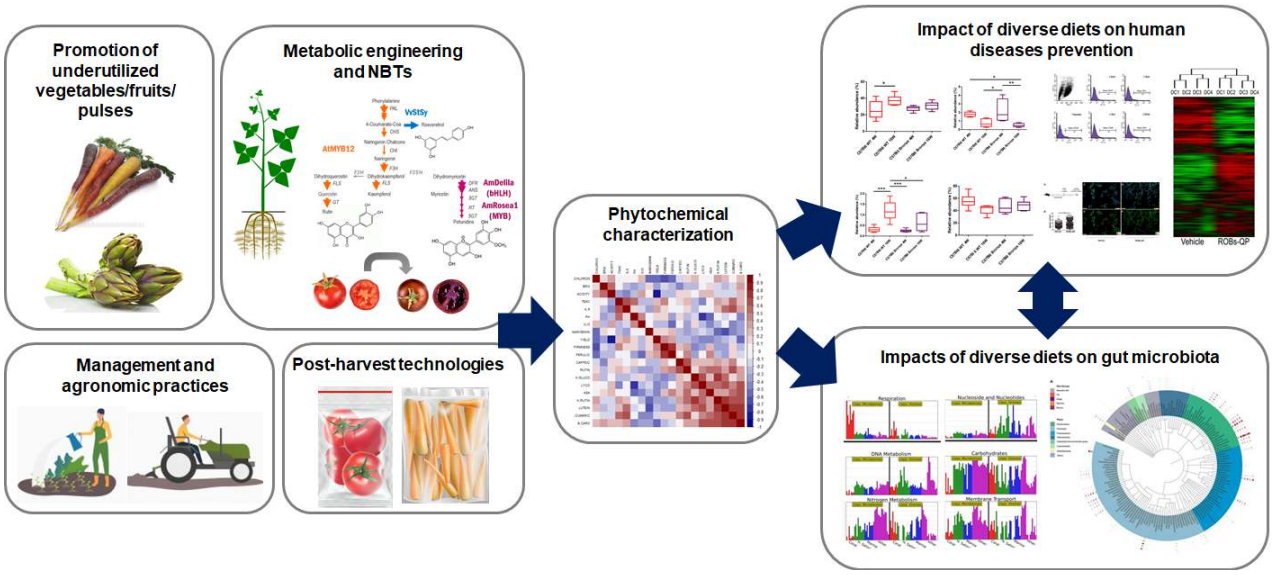

Figure 1. Schematic work-flow of the main multiple-levels advances in the nutritional field. Strategic actions for the promotion of biodiversity, metabolic engineering/NBTs (New Breeding Technologies), agricultural management practices and post-harvest technologies can be successfully applied to improve the nutritional value of plant-based food products. Such improvements need downstream metabolomic and biological assessments to test the impact of the new generation of plant-based products on human gut microbiota and the prevention of relevant human pathologies.

This draft statement was developed by the NS WG chairs Angelo Santino, Monika Schreiner and Chiara Tonelli together with Karin Metzlaff, following the workshop of the EPSO Nutritional Security Working Group on 27.11.2018 and discussions at the EPSO General Meeting in Vienna 2019. It will be further discussed at the next EPSO NS Workshop early 2021 and then finalised. Contact the authors by end June to express your interest to participate in this workshop.

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Useful links
EPSO www.epsoweb.org

EPSO Statement on the Horizon Europe Strategic Plan, 18.2.2020
EPSO submission on orientation towards strategic programming, 20.12.2019 (17.11.2019 Contribution ID 666b7610-ddca-4262-b4be-dc125b7ec2cf) to the EC
EPSO Genome editing – improving legislation and starting flagships to better address climate, environmental, food and health challenges, 4.11.2019
EPSO Implementing a Plants and Mircobiomes Strategy in Europe – Recommendations,18.10.2019
EPSO Submission to the EC consultation on EU research and innovation missions (FP9), 30.3.2018, incl. 1001 Crops – diverse crops for diverse diets and human health and sustainable production.

About EPSO

EPSO, the European Plant Science Organisation, is an independent academic organisation that represents more than 200 research institutes, departments and universities from 31 countries, mainly from Europe, and 2.700 individuals Personal Members, representing over 26 000 people working in plant science. EPSO's mission is to improve the impact and visibility of plant science in Europe, to provide authoritative source of independent information on plant science including science advice to policy, and to promote training of plant scientists to meet the 21st century challenges in breeding, agriculture, horticulture, forestry, plant ecology and sectors related to plant science. https://epsoweb.org | EU Transparency Register Number 38511867304-09