

**Session Cross-cutting: April 13th 11.00 hrs**

**5s4b: : Waste reduction and novel resources for sustainable production of safe food or feed**

## **THE ENVIRONMENTAL IMPACT OF ALTERNATIVE PROTEIN SOURCES – CONTRIBUTION TO CIRCULAR FOOD SYSTEMS**

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Novel protein sources are crucial for meeting the increasing global demand for sustainable proteins, and achieving UN Sustainable Development Goals (SDGs). Environmental impacts of alternative protein sources are examined in relation to different stages of production and processing. Life cycle assessment (LCA) studies of insects, algae, single cell proteins, cultivated meat, mycoprotein, as well as vegetable protein sources, such as Rubisco protein extracted from sugar beet leaves, are compared and analyzed for six environmental impact categories: global warming potential, ozone layer depletion, energy demand, acidification potential, water footprint, and land use. Results of a few LCA studies (both from the authors and other literature) were used as basis for the data pool. The results showcased how the use of residual streams, optimized production, and processing of novel protein sources can contribute to a circular food system. Alternative protein sources demonstrated different potential for the circularity and upcycling of nutrients back in the food system. Thus, insects and vegetable sources have a wide range of reliance on waste streams, but their efficiency depends on the nutritional profile of the streams. Single cell proteins cultivated meat and mycoprotein rely on additional processing steps and cultivation media preparation, which in a great degree defines their efficiency. Mostly carbohydrates and amino acids are consumed from the cultured medias, leaving the other components as a source for further treatment or utilization. Based on the analysis of the results, an index of alternative proteins' production efficiency and circularity is proposed. Application of the index for optimization of environmental and other sustainable impacts will be based upon the further analysis of the production chains. Preliminary conclusions identified scenarios for more sustainable use of resources in the aim of maximizing contribution of alternative protein sources to the circular food systems. Further directions for the studies are proposed as well to define the potential of other alternative protein sources for the circularity of the nutrient in the food system.

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*Keywords: alternative protein sources, circular food systems, life cycle assessment, index*