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Microbiome program: holistic study about microbial derived beneficial and risk factors in a circular food production system

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In a circular production system, where materials are being transferred through different compartments, the microbiome will connect these different compartments and microbes will circulate across the different ecosystems, bringing in eventual beneficial and detrimental features. It is of importance to have a resilient system, thus also the different compartments of a circular model (in this case animal/soil/plant) should be resilient as well, they must stay healthy and able to recover from perturbations, therefore reducing the use of antibiotics and pesticides. Diverse components of the animal diet (largely consisting of plant materials) can affect animal resilience, either directly or indirectly, via the gut microbiome and intestinal immune development, and animal behavior. This occurs by the microbiome-gut-brain-immune axis. Thus animal health and welfare in relation with the microbiome are influenced by nutrients (and therefore by circular feed products), both in a positive and negative way. Furthermore the use of animal products improves soil quality and hence can affect crop resilience against abiotic and biotic stressors such as soil-borne pathogens. This is where the soil and plant microbiome plays an important role. When the system is not resilient/healthy, antibiotics and pesticides are needed, and antibiotic residues and antibiotic resistance potential can circulate from animals via manure to soil and plants. This constant selection pressure remains on natural microbiomes consequently increasing antibiotic resistances in the circular production chain from animal to vegetable food and feed.

The microbiome of an ecosystem can be influenced by external factors and it is therefore a suitable target for increasing health and resilience. Microbiomes will link different compartments (soil, plant, animal) in a circular production system. Therefore this project will focus on the microbiome as a connecting system which can be influenced and can act

as a source of microbial factors. Hence the microbiome is a suitable target to increase plant/animal health and resilience in a circular production system. Accordingly the presented project aims towards understanding how to maintain a resilient microbiome among all the compartments in the circular system, and positioning microbiome research as driver to answer the following questions: (1) how alternative protein feed affects broilers health and welfare in association with their microbiome? (2) how can we value animal-based organic materials that shape the soil microbiome into useful products for agricultural practices that enhance soil quality and plant health? (3) How can we identify risk factors, in the form of for instance antibiotic resistance potential and toxins in microbes, and beneficial features, in the form of growth-stimulating microbes, in a circular agricultural production system? (4) Can we standardize metagenome sequencing and bioinformatic analyses for the different matrices from all involved ecosystems in the circular production system?

Keywords: