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Microbial protein as an alternative protein source enabling circular bio-economy

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Conventional water treatment technologies remove nutrients via resource intensive processes. Similarly, bio-waste is digested in best case scenarios and seldom nutrients are reused as fertilizers. Thus, new approaches for residual nutrient recycling are needed. The increasing meat demand by a growing global population puts higher demands on protein supply. However, vegetable protein production is inefficient, generates large amounts of waste, has a high land and water footprint and is energy intensive. Moreover, the agricultural soils are limited and if more protein should be produced to secure food supply, new and lower-footprint modes to produce protein-rich feed or food ingredients are needed. Production of microbial protein from residual streams not only reduces the demand of vegetable protein, but also reducing the burden of anthropogenic activities by treating waste with more resource and cost efficient processes. Despite its potential, several barriers exist when introducing microbial protein produced from residual resources. For organic wastes which may be polluted with heavy metals, pharmaceuticals and other recalcitrant components or pathogens, several barriers should be put in place when extracting nutrients. We have successfully applied electro-dialysis for nutrient extraction from bio-pulp or urine as a means to recover ammonia free of pollutants. Furthermore, extracted nutrients have been successfully fed to a methanotrophic microbial culture that accumulated protein suitable for substitution of soy or fish meal proteins. When residual streams are byproducts from industry which are safe for reuse, e.g. byproducts from food industry, microbes can be grown without pretreatment. As example, we have cultivated green microalgae and methanotrophs in effluents from potato processing industries and produced biomass with high quality protein (Rasouli et al., 2018). Thus, we have successfully demonstrated that microbial protein can be produced from recovered resources as a promising alternative to traditional protein sources or microbial protein produced with first generation strategies (i.e., relying on fossil fuels).

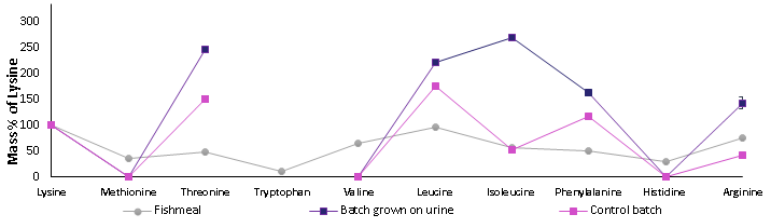

Fig.1 Amino acid profile of microbial protein grown on recovered residual nitrogen from urine and control batch.

Rasouli, Z., Valverde-Pérez, B., D'Este, M., De Francisci, D., Angelidaki, I., 2018. Nutrient recovery from industrial wastewater as single cell protein by a co-culture of green microalgae and methanotrophs. Biochem. Eng. J. 134, 129–135.