

IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (A1)
Interactive Presentations - IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (IPB)

Author: Ms. Anna Jurga
Wroclaw University of Science and Technology, Poland, annamjurga@gmail.com

FERTILIZER PRODUCTION FOR SOILLESS PLANT CULTIVATION IN CLOSED LIFE SUPPORT
SYSTEM - LESSONS LEARNED FROM 4 YEARS STUDY**Abstract**

This paper presents the research results collected as part of a PhD Thesis during 4 years of study on biological wastewater treatment and soilless plant cultivation for a future closed life support system. The use of nitrification process in aerobic activated sludge reactor was investigated to produce liquid fertilizer for lettuce hydroponic cultivation. Two configurations were examined: urine and a mixture of urine and greywater nitrification. The first configuration operation lasted 225 days, and the second 140 days. In general, the used reactor' set-up parameters assured stable operation of the processes. The high efficiencies were achieved in both experiments. The operation of the urine nitrifying reactor was disrupted by two major failures due to prolonged exposure of biomass to extremely high concentrations of Free Ammonia. The second configuration was fewer failures and was more stable. The values of the specific nitrification rate in both experiments' final, stable phases differed by an average of 50%. The feasibility of using diluted nitrified urine and a mixture of urine and greywater in soilless lettuce cultivation realized in this study showed the possibility of plant growth, but in a limited way in terms of quantity and quality. The main yield-reducing factors were elemental deficiencies (i.e. K, Mg, micronutrients) resulting from the composition of the treated wastewater. This was confirmed by measurements of parameters such as elemental composition, stress parameters, and photosynthetic pigment concentration. When using fertilizer based on a mixture of urine and greywater, the study showed that the elemental deficiency was the main growth-limiting factor and not surfactants presence. Despite poorer yield and quality of lettuce, organoleptic tests showed no differences in consumer perception. This is particularly important about fertilizer production using circular management (both terrestrial and space), where the aspect of consumer acceptance of the final product is particularly important. Enriching the fertilizers with the missing nutrients made it possible to obtain a yield similar to the reference in terms of quantity and quality.