AMPC

SNAPSHOT

Problem to Profit: Developing a sustainable feed base from agricultural wastes using single cell protein

Project Report Reference: 2017-1039 **Date: October 2018**

Project Description

Purple Phototrophic Bacteria (PPB) are an emerging technology that enables the treatment of wastewater streams while producing potentially valuable feed or feed additives. In this technology, the removal of organics, nitrogen and phosphorus from wastewater occurs anaerobically in the presence of infra-red (IR) irradiation. Nutrients and organics are assimilated and/or accumulated by the PPB, which convert soluble compounds into a harvestable biomass with high protein content.

Previous research (2016/1023) established the proof-of-concept by growing PPB on RMP wastewater in laboratory batch tests. Research in 2017-1039 focused on the development of reactor designs for a continuous laboratory process. The most critical initial decision in PPB technology development is the PPB growth mode. Options for PPB growth mode included:

- Suspended growth: PPB can grow in suspension, similar to an algae raceway. This growth mode would have simple and lower cost reactor designs, but much higher product harvesting costs.
- Attached growth: PPB can grow as part of attached biofilms. Biofilm reactors are more complex and the harvesting mechanisms require further development; however biofilms are highly concentrated compared to cell suspensions and the PPB product is higher quality.

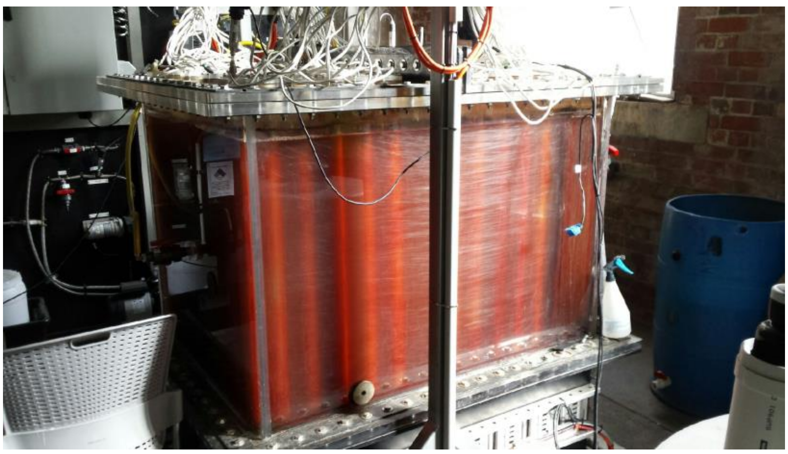

Figure 1: Example Attached growth PPB Pilot Reactor.

Project Outcome

Attached growth bioreactors and multi chamber photo bioreactors were constructed and operated at lab-scale with the following outcomes:

- PPB production from RMP wastewater was successfully achieved using both attached growth modes (such as biofilms) and using suspended growth modes.
- Areal productivity rates of > 10gVS m^{-2} d^{-1} have been achieved during initial testing, these productivity rates are within the range reported for large algae systems and can be improved through optimisation.
- Attached growth resulted in a relatively consistent PPB product with high protein content (approx. 65%).
- Suspended growth resulted in more variable PPB product quality between 30% and 70% crude protein, this is partly attributed to the capture of wastewater particles in the product,
- With either technology, capture of nitrogen in the PPB product and subsequent conversion to microbial protein was limited, largely attributed to the form of nitrogen entering the reactors.
- Harvesting is the most significant PPB production cost that requires optimisation
- Illumination cost is another area for significant optimisation

The research focus is now optimizing PPB yields, through the use of pre-fermentation and simplifying reactor design and operation for scale up the technology. Technology application pathways are shown in Figure 2.

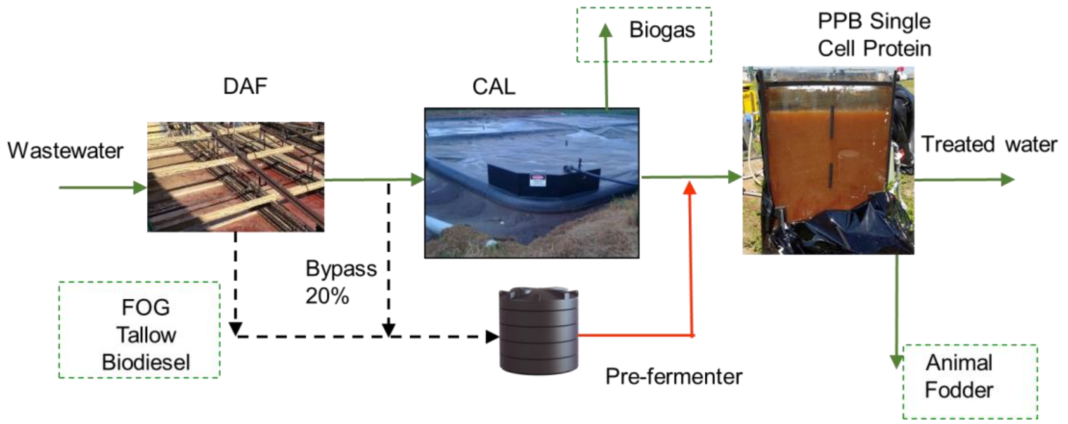

Figure 2: Options for PPB Technology Integration. PPB should occur after treatment in a CAL (to release N). Carbon can be supplied using a bypass stream, for pre-fermented DAF sludge.

Benefit for Industry

PPB technology shifts waste treatment operations to a resource recovery and value-adding paradigm. The technology integrates with existing biogas technologies and has potential to reduce or eliminate problematic waste steams (waste activated sludge, DAF sludge), while producing novel and sustainable feeds for livestock and/or aquaculture. However, markets still require development and the viability of PPB technology is heavily dependent on establishing product value. Figure 3 shows the value of 1ML of RMP wastewater converted to PPB valued at $62/tonne (organic fertilizer), $600/tonne (Meat Bone Meal analogue) or $1,200/tonne (Fish Meal substitute).

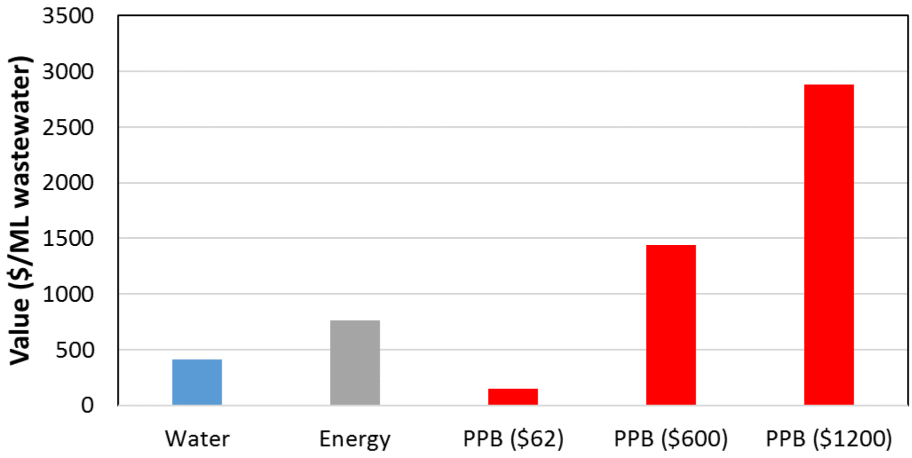

Figure 3: Potential value of 1.0 ML of red meat processing wastewater when recovering all N as PPB biomass (bottom). The composition of wastewater used in this analysis is 10,000 mg/L COD, 250 mg/L N and 50 mg/L.

USEFUL RESOURCES

Project final Report: