

Using Palm Oil Mill Effluent to Produce Single-Cell Proteins

Palm Oil production has continued to increase in recent years, driven by growing global demand. Currently production stands at 54 million tons annually. With palm oil production comes vast quantities of palm oil mill effluent (POME). An estimated 5.0 to 7.5 tons of water is used to extract and process one ton of palm fruit, about half of which becomes POME, a waste stream that

contains high concentrations of solids, oil and grease, and readily degradable organic matter. On average, the chemical oxygen demand and the biological oxygen demand represent very high levels of organic material, roughly 100 times that of municipal wastewater. The large volumes and high organic content of POME present a significant water treatment issue for palm

oil producers, most of whom use anaerobic pond systems for treatment of POME.



Disadvantages of Anaerobic Pond Systems



Anaerobic pond systems have a number of disadvantages:

- **Long Treatment Times**
- **Greenhouse Gas Implications**
- **Large Required Land Area**
- **Incomplete Digestion of Organic Material**

The result? Water with high levels of COD discharged into fields. If water enters local waterways, it could lead to aquatic pollution by depleting oxygen. Land application may be harmful to soils due to the low pH and concentration of fine cellulosic materials.

The Need for Sustainable Alternative Treatment

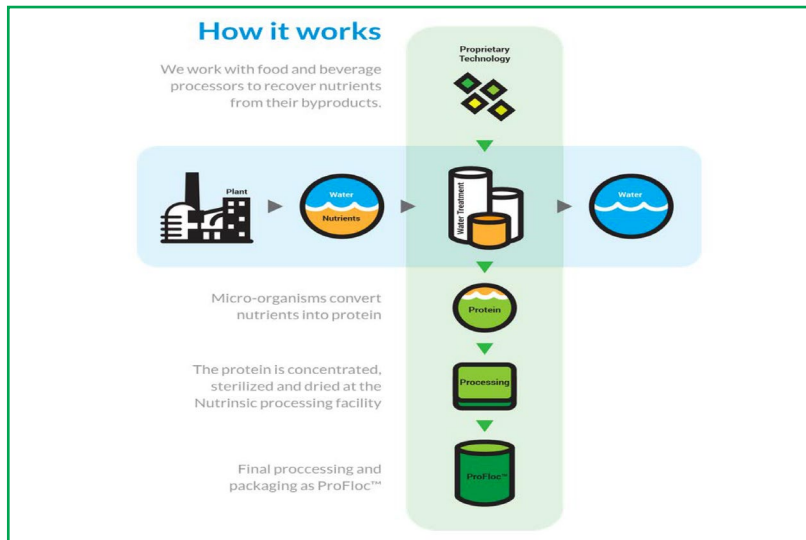
There is a real need for the development of sustainable treatment options. One approach, which also generates a value added product, is the production of single-cell protein (SCP) in conjunction with an aerobic water treatment process in place of anaerobic ponds. SCP refers to protein (derived from bacteria, yeast or algae biomass) that can

be used as an animal or human food additive or as fertilizer. The biomass produced is the resulting protein product.



The Nutrinsic process is different.

Nutrinsic Corporation has developed an economical and sustainable process to produce SCP using effluent from the food and beverage industry.



Nutrinsic Technology has already been demonstrated at several commercial breweries.

A large number of other effluents from various food industries have been successfully utilized at bench scale in the laboratory.

The Nutrinsic Process

The Nutrinsic Process may provide significant benefits:

- **Cleaner effluent water**
- **Production of single cell protein for sale**
- **Improved economics for mills**
- **Mitigation of discharged greenhouse gases**

The process entails modification of the aerobic wastewater treatment process to augment protein production by the bacteria responsible for wastewater treatment. This is accomplished

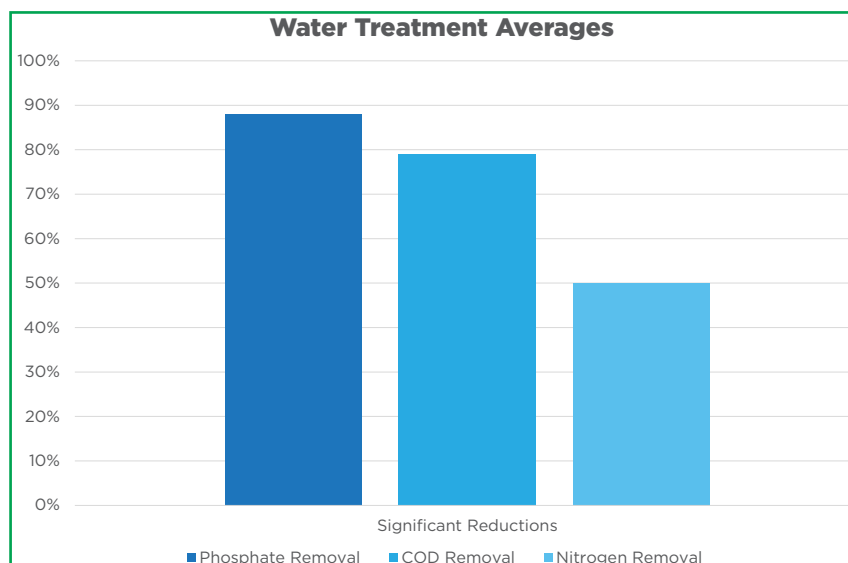
by providing naturally occurring bacteria with nitrogen and micronutrients to supplement wastewater nutrients, enabling production of large amounts of protein. This level of nutrient supplementation is not typical in aerobic water treatment. Another key aspect of the process is to limit the mean cell retention time in the aerated basins to promote rapid cell growth and turnover, thus “harvesting” young cells at peak protein levels. Harvesting SCP is a straightforward process of concentration, drying, sterilizing and packaging. Recent research

has demonstrated that this can be successfully applied to POME. POME was processed for 65 days in our laboratory bioreactors. Bacterial cells were harvested and dried to produce our SCP product, ProFloc™. **Protein content was consistently above 60% of the total dry biomass.**

Profloc™ Analysis:

<u>Fraction</u>	<u>Percentage</u>
Protein	63
Oil	4
Carbohydrate	17
Ash	12
Moisture	4

POME is a Viable Feedstock for Production of High Quality SCP



The high COD of POME means more food for bacterial growth, which means greater potential for the production of quality SCP. Metrics for the successful treatment of POME show significant reductions in nitrogen, phosphorus and COD levels. As demand for palm oil and protein grows, our technology provides a sustainable alternative. Integration of an aerobic treatment process, along with SCP production into palm oil mills has potential to provide numerous benefits.