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# Non-Photosynthetic Food Production

The entire human food system is photosynthesis-based, i.e. it originates as plant matter/biomass. Contrary to popular perception, domestic animals are not the most inefficient link in the human food chain, photosynthesis in plants is. While the theoretical energy efficiency of photosynthesis is about 26%, when you take into account nonabsorbable incident light, energy expenditure by the plant, downregulation of the photosynthetic process due to excess sunlight, photorespiration, and limited growing seasons, the real-world sunlight-to-food conversion is actually less than 0.1%. This sunlight-to-food efficiency translates into a land requirement of about 13,000 m2/person. This land requirement is a driving force behind huge swaths of the Earth's ecosystems being destroyed for agriculture.

Researchers at the Julie Ann Wrigley Global Institute of Sustainability at Arizona State University have developed a novel approach to improve on the overall food system efficiency. Rather than using photosynthesis to convert water (H2O) and carbon dioxide (CO2) into carbohydrates and other nutrients and food, it uses alternative processes to convert H2O and CO2 into hydrogen-, carbon-, and nitrogen-containing compounds to use as a medium or substrate for the growth of food/feed organisms. This system can be powered by any source of energy; solar, wind, nuclear, and can provide a more than 100-fold decrease in the land requirement for food production relative to current practices.

The method provides nutritious food production, including complete protein, without any arable land, or even without sunlight.

Potential Applications

- Non-photosynthetic food production for human or animal consumption
  - Resource-constrained communities (e.g. lacking local arable land)
  - Locations where space is paramount (e.g. spacecrafts/stations)
  - Augment or replace a substantial portion of staple diets

Benefits and Advantages

- May allow for a more than 100-fold decrease in the land requirement for food production relative to current practices
- Provides nutritious food production, including complete protein, without any arable land
- 100x more energy efficient
- Can be powered by any source of energy (solar, nuclear, wind, geothermal, hydropower, etc.)
- Helps sustainably support a growing human population
- Can provide a healthier nutritional profile, especially per resource input, than current practice

For more information about the inventor(s) and their research, please see

Dr. Stechel's departmental webpage

Dr. Ermanoski's departmental webpage