Algae research gives hope for renewable carbon-negative source of food and medicines

February 13 2014

Algae lake.

The University of Greenwich has won funding for three pieces of research related to algae. Algae have huge potential as a next generation renewable resource to manufacture a whole range of essential products including food, medicines and fuel. The challenge is to grow and process them in a way which delivers that potential sustainably. The three stories

are told separately to aid clarity:

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Bright pink-orange microalgae found in salt lakes and coastal waters could become a renewable source of food, plastics, health products and fuel as a result of new research announced today.

The University of Greenwich is leading a €10m international project to develop the microalga Dunaliella as a sustainable raw material that captures CO2 and can grow in some of the world's harshest environments.

The project will build a biorefinery called the 'D-Factory' which is going to turn every part of the alga into something useful.

Algae are known for their ability to convert CO2 and sunlight into chemical energy five times faster than crops grown in soil. This particular alga is able to produce up to 80% of its mass as fuel but is currently too expensive to cultivate for fuel alone. However it also produces a range of compounds of great interest in pharmaceutical, cosmetic, nutraceutical and other applications – and this may provide the solution.

Project leader Professor Pat Harvey at the University of Greenwich explains: "The race is on to develop a broader spectrum of compounds from algae which can be turned into high-value products including food and medicines.

"If we can make algae biorefineries commercially viable, we will have developed a new industry founded on an environmentally-kind raw material which is also sustainable. The potential is huge."

"By 2020 these algae may also provide us with sustainable fuel – the science is there but at the moment the costs don't add up."

The research brings together 13 research institutions and businesses from eight countries, including world leading experts in the biochemistry of Dunaliella, in large-scale cultivation of microalgae, in novel harvesting technologies and in bioprocessing development.

Together they aim to set a world benchmark for a biorefinery based on microalgae. Plans include the largest commercial cultivation of the single-cell organisms, in water raceways, lakes and photobioreactors.

The project hopes to demonstrate the business case for global investment in algae biorefineries, and in large-scale production of microalgae, within three years in order to raise investment for the first prototype D-Factory in Europe.

The Dunaliella alga has been chosen because it produces a wide range of compounds, appropriate for the 'biorefinery' concept which aims to use every element of a biomass. It can cope with extreme conditions, from salt caves in the Antarctic, to salt pans in the tropics. The high salinity and light intensity turns the microalgae orange by producing protective carotenoids. The pink-orange of many salt lakes containing Dunaliella is intensified by the presence of archaea, fellow single-celled organisms.

Seaweed could be next new biofuel

New research to turn seaweed into liquid biofuel aims to overcome two main barriers to the plant becoming a major source of renewable energy.

The University of Greenwich is a key player in a consortium of 12 UK universities and companies to develop manufacturing processes that can remove the high water content, and preserve seaweed for year-round use.

Ensilage – a method traditionally used by farmers to turn grass into hay for winter animal feed – has potential to stop the seaweed rotting. The research, backed by £1.6m from the Engineering and Physical Sciences Research Council, will also explore the conversion of wet seaweed to gas, which can in turn be converted to liquid fuel.

There is a global race on to develop the technologies to make seaweed a viable source of green power. The plant, a macroalga, turns sunlight into chemical energy three times more efficiently than land plants.

"Current biofuels may not be sustainable," says Dr John Milledge, Research Fellow at Greenwich and an expert in the commercialisation of algae. "First generation fuels such as bioethanol from sugarcane and corn, or biodiesel from rapeseed and palm oil, are in direct competition with food for arable land and water. They have an adverse effect on food prices and supply.

"Salt-water algae are therefore a very attractive proposition as an alternative biofuel if we can overcome the challenges." Dr Milledge is working closely with group coordinator Professor Pat Harvey at Greenwich, which is responsible for finding out whether UK's coasts can sustain large-scale biofuel production. The consortium is led by Durham University and builds on a range of the university's previous collaborative projects, which span its departments of Chemistry, Biology, Earth Sciences, and the Durham Business School.

Algae research into new medicines wins award

Drug discovery company IOTA Pharmaceuticals has chosen the University of Greenwich as its academic partner to research the potential of the microalga Dunaliella as a route to new medicines.

The collaboration has won a £5,000 SPARK Award and the sponsorship

of the Algal Bioenergy Special Interest Group (ABSIG).

IOTA is studying the biochemical pathways that produce Dunaliella's essential metabolites – small chemicals synthesised by the microalgae that can form the building blocks of more complex, therapeutically useful natural products.

"Over half of all human medicines originate from natural products", says Dr David Bailey, CEO of IOTA Pharmaceuticals. "We are focusing on the proteins catalysing these chemical transformations, using next-generation DNA sequencing approaches to identify, design and develop new processes for natural product synthesis."

The D-Factory, a bio-refinery research project led by Greenwich which will grow the algae in dedicated photobioreactors, offers IOTA an ideal platform through which to study the plant's properties.

At the moment Dunaliella is only used commercially for its high beta-carotene content. Professor Harvey explains: "The alga is simply freeze-dried and put in a capsule. So when someone takes it as a vitamin supplement they are also consuming chemicals which could be used for something else. We need to apply biotechnology to explore the production of a broader spectrum of compounds."

Provided by University of Greenwich

Citation: Algae research gives hope for renewable carbon-negative source of food and medicines (2014, February 13) retrieved 21 June 2024 from https://phys.org/news/2014-02-algae-renewable-carbon-negative-source-food.html