Algae may be sustainable alternative for animal feed

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The pigs and poultry in Professor Xingen Lei's lab have been consuming feed one wouldn't expect in Ithaca: marine algae.

The Cornell animal science professor is testing the unlikely material as a new protein-rich source of feed to supplement and replace some of the corn and soybean meal mix traditionally given to food-producing animals.

By doing so, he could transform a biofuel byproduct into a valuable commodity, potentially freeing thousands of acres of cropland.

"Current animal feed directly competes against human food sources and, thus, is unsustainable," Lei said. "We must develop alternatives to soybean and corn for animal feeds."

Algae produces 50 times more oil per acre than corn, with a much smaller carbon footprint; uses nutrients more efficiently than land plants, with no runoff; and places no demand on high-quality agricultural land or freshwater supplies.

There are an estimated 1 billion swine, 1 billion cattle, 2 billion sheep and goats and 40 billion poultry worldwide. The average pig consumes about 660 pounds of feed by the time it goes to market, Lei said, so replacing just 10 percent of that feed with algae would save a whopping 33 million tons.

Lei's preliminary research found that dried defatted algae derived from biofuel production can replace up to one-third of soybean meal in diets for pigs and chickens. It is an attractive source because it is high in protein -- 20-70 percent, compared with about 10 percent in corn and 40 percent in soy.

Lei and his researchers are now working to determine which algae are best, and the proper ratios of algae, soybean and corn. They are also discerning whether there are risks or additional health benefits for humans in resultant products, such as meat and eggs.

The samples are shipped to his lab from Hawaii, where algae is being cultivated on a few acres near the Kailua Kona Airport as part of a $15 million pilot project by Cellana and a multi-university consortium led by Cornell professors Chuck Greene, professor of earth and atmospheric sciences, and Jeff Tester, professor of chemical and biomolecular engineering.

Ramping it up to commercial scale will require thousands of acres and hundreds of millions of dollars, said Greene.

Which is where Lei can help. Turning a biofuel byproduct into a value-added product could be the key to commercial viability and may spawn other new industries. The global animal feed market is expected to exceed 1.5 billion tons per year by 2020, 15 percent of which (220 million tons) is protein, Lei said.

Not the seaweed found along coastlines or in sushi, Lei's algae is a dried version of their single-cell cousin. Its simpler structure means it is easier to break down, without the complex cellulose that presents challenges to the production of plant-based biofuels like corn-derived ethanol.

It also has a high lipid, or oil, content -- around 30 percent, compared

with 4 percent in corn -- and its own inherent stress response can be harnessed to help in oil production. When starved of nutrients, the algae undergoes physiological changes causing it to exude oil -- a process being studied by Beth Ahner, professor of biological and environmental engineering, and Ruth Richardson, associate professor of civil and environmental engineering.

With further innovations, the process could actually remove substantial amounts of carbon dioxide from the atmosphere, Greene said, and its use in the production of jet fuel could help the U.S. military meet its goal of switching to a 50/50 blend of fossil and biofuels by 2020.

Provided by Cornell University