An Alternative to Petroleum? Harnessing the Power of the Humble Algae

Located 45 minutes north of Tokyo by the Tsukuba Express train is the nature-filled campus of the University of Tsukuba. Considered the heart of Tsukuba Science City and designated as an International Strategic Zone by the Japanese Government, this world-class university has become the hub of academia-industry collaboration to foster innovative solutions to pressing global issues. The university is well-known for its cutting-edge, interdisciplinary research in supercomputing, nanotechnology, cancer treatment, genetics, personal care robotics, pharmaceuticals, and medical technologies. Tsukuba is also developing solutions for future global energy production using innovative algae biofuel technologies.

The use of algae as a high yield alternative to fossil fuel is pioneered by Dr. Makoto Watanabe, Professor of Bioenergy at the University of Tsukuba. Despite the important role of algae during the evolutionary history of the earth, it is currently being used only in nutritional supplements or as food in certain countries. Dr. Watanabe strongly believes that using algae instead of a more traditional crop could be a more practical and productive way to produce biofuel.

Microalgae is now counted among the most promising sources for biofuel. Developing a productive mass culture system for oil-producing algae, however, constitutes a major challenge for algal biofuel production. Dr. Watanabe has been working on establishing an outdoor system since 2012 using vacant agricultural land in Tsukuba. His fuel production system allows for the cultivation, concentration, harvesting, extraction, and refinement of algae oil.

“Botryococcus braunii,” a type of green algae which lives naturally in fresh and brackish waters, produces hydrocarbons (petroleum-based oil). Moreover, the growth of this microalgae is accelerated if organic waste water is added from households or industry. In Dr. Watanabe’s laboratory, work is being done to combine algal biomass production and water treatment processes.

Dr. Watanabe first learned of the potential of algae as an undergraduate student. While in graduate school, he became involved in the taxonomical classification of algae. He started tackling the issue of pollution in the form of red tide and algae blooms while he was a researcher at the National Institute for Environmental Science. He moved on to

his current position at Tsukuba in 1992. In 2004, Dr. Watanabe directed his focus on “Botryococcus” which generates biofuel in the form of hydrocarbons through photosynthesis. The amount of fuel that can be extracted from microalgae per hectare per year is roughly 47-140 tons. To compare, corn yields around 0.2 tons and oil palm around 6 tons under the same condition. Considering that microalgae does not compete with food crop production, it has 10 to 100 times higher efficiency of oil productivity than terrestrial oil-crops. In addition, it requires a smaller cultivation area than terrestrial plants and does not require crop land for cultivation. Indeed, the possibilities are enormous for algal biomass energy and the University of Tsukuba is proud to be at the forefront of this research and development effort.

Dr. Makoto Watanabe in his algae fuel research lab