ALGAE-BASED BIODIESEL FOR HOUSEHOLD APPLICATIONS

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ABSTRACT
This paper presents the preliminary results of a research and developmental work on biodiesel production. An algae-based biofuel extraction system was developed for household applications. It consists of three modules: algae growth media preparation, biofuel-bearing algae growth chamber, and biodiesel extraction system. The details of the design and fabrication of these systems will be discussed. Further, the results of experiments on the selection of algae specimens and the influence of environmental variables on the growth process will be elucidated.

INTRODUCTION
The current energy crisis cannot be solved by biofuel or any one alternative energy source alone. In fact the costs associated with the biofuel production and transportation is currently high. Carbon emission, and its relation to global warming, has prompted research into bioprocesses that reduce the existing levels of CO₂ in atmosphere. Microalgal production would consume CO₂ and can potentially serve the purpose of CO₂ mitigation from currently high levels. The cost of biodiesel extraction from microalgae is the largest fraction of the total algae-based biofuel production cost. Further, the removal of the waste produced, and possible pollution of the environment have been issues of concern [1]. Still, microalgae have several desirable characteristics that make them more suitable for biofuel production. These include semi-steady state production, high lipid content and suitability to grow in various environments [2]. Main advantages of microalgae include a higher photon conversion efficiency, a higher CO₂ sequestration capacity, ability to grow in liquid form, use of wastewater sources of N and P as nutrient, non-seasonal production, small foot print, non-reliance on fertilizers and pesticides, and production of valuable byproducts such as proteins, polysaccharides. [3-7]. Environmental and economic sustainability requires alternative energy sources to be not only CO₂ production neutral, but also have the capability to sequester carbon from the environment. In this light, microalgae based biofuel is a desirable alternative for other fuels which currently consist 66% of the global energy need [8].

Based on these, we have developed a biofuel production system that combines solar and bioprocess-based energies to produce biofuel. The proposed system does not produce waste more than what is involved, does not pollute the environment, since it is enclosed, and does not incur transportation cost, since it is generated and used at home.

Operational parameters such as temperature, light cycle and intensity, dissolved oxygen, CO₂, pH, water quality and its salinity are important for the growth of algae. Further, source of carbon (e.g. organic or inorganic), type of nutrients (e.g. phosphorous and nitrogen, vitamins, and minerals) and affect the growth of algae. Removal of the reactants and the products or byproducts also influence the bioprocess [9], however, specific productive types of algae are needed to effectively compete with other less productive species in producing a constant supply of biofuel. In this regard, cell fragility, and its density, presence of growth inhibitors, aeration of the media or mixing, presence of pathogens such as bacteria, fungi and