Growth studies of a New Species of Xanthophyta:

The Significance of Renewable Source of an Essential Lipid

Sinafik Mengistu, David Nelson and Dr. Paul A Lefebvre - Department of Plant Biology; University of Minnesota

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Introduction

Production of eicosapentaenoic acid (EPA) from a new species of Xanthophyceae, *Heterococcus coloradii nelson*, was discovered among snow fields in the Rocky Mountains and may have beneficial health products without the serious environmental costs of fishing or the negative consequences of fish farming. Algae, which can be produced easily in large quantities with limited environmental cost, can provide this new source of essential nutrients. Growing algae may provide a much more cost effective and simpler production means of producing lipids. Furthermore, the maintenance of adequate levels of docosahexaenoic acid (DHA), which is poorly made in the human body from α-linolenic acid, is an important concern for human health. The metabolite of EPA, DHA, has been implicated in promoting healthy development of newborns, reduces the risk of heart disease, and decreases inflammatory factors.

Environmental Costs of Fish Farming

▪ Deposition of uneaten food and feces from fish increases populations of organisms arising that are comparable to other forms of organic enrichment, i.e. domestic sewage and wood pulp effluent.[1]

▪ Escapement of fish in conjunction with exploding sea lice levels may affect wild salmon populations. In turn this may increase the mortality rate of migratory salmon smolt thus decreasing returning populations.[6]

▪ There has been a depletion of nitrogen and phosphorus in the rivers of the Pacific Northwest because of a near 90% drop in normal salmon migration.[2]

Health Implications

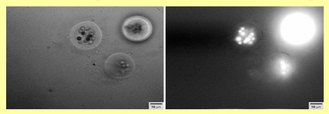
▪ Eicosapentaenoic acid (EPA) has the been implicated in the reduction of platelet aggregation, vasodilation, plaque-stabilization, and reduction in lipid action. Therefore the preventive effects of EPA on major cardiovascular events are of both clinical interest and therapeutic importance.[3]

▪ Polyunsaturated fatty acids (PUFAS), EPA, and docosahexaenoic acid (DHA) are important mediators during fetal brain development.[4]

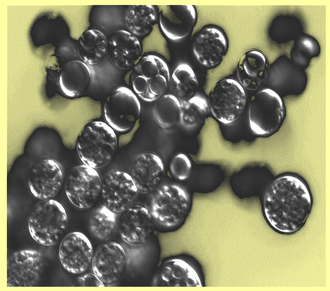
▪ Very long chain n-3 PUFAs like EPA possess hypotriglyceridemic properties during fasting and after meals[5], which can potently lower blood triglyceride (TG) concentration and ameliorate insulin sensitivity in animals with high-fat (HF) diet induced insulin resistance[7].

Fluorescence/Electron Microscopy

Scanning electron microscopy of *X.sp./Rhizobium sp.* Interaction, implications of a symbiotic relationship



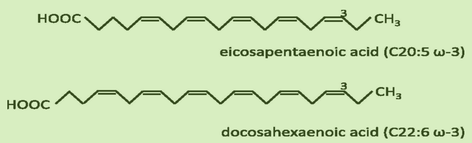
Picture on the right shows dye attached to PUFAs and illuminating ubiquitously throughout the algal cell



Algae grown in liquid BG-11 culture. Cell sizes range from 5 to 100 µm in diameter.

Agricultural Advancement

▪ *H. coloradii* is a robust algae that can be easily produced and harvested
▪Can produce oil up to 50% of its dry weight.
▪EPA alone, without DHA, can provide increased health state efficacy.



eicosapentaenoic acid (C20:5 ω-3)

docosahexaenoic acid (C22:6 ω-3)

▪ Fish do not produce EPA, but must consume the EPA from marine algae
▪ Inevitable consumption of contaminates
▪ Large environmental impact

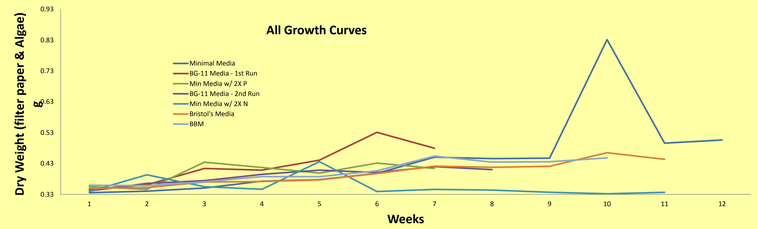
▪ By investigating growth patterns we may be able to increase the growth rate and production of lipids
▪ Can be grown at home as a renewable source

Future and Ongoing Research

▪ The algae may prefer growth on different types of surfaces. To study this, algae will be grown in flasks with a stir bar gently mixing the solution in order to simulate realistic water movement.
▪ In an attempt to characterize a major protein involved in the metabolism of EPA, the Δ12 fatty acid desaturase gene in *H. Coloradi* is being amplified out. In order to locate appropriate primes for PCR reactions an orthologous brown algae, *Ectocarpus siliculosis*, was used to define primers.

Methods

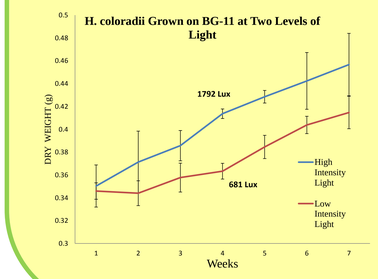
We evaluated what factors contribute to the overall production of EPA in the algae through several experiments. First we tested different growth conditions for *H. coloradii* by growing the algae in different types of media. The different media are BG-11, Bolds Basal (BBM), Bristol's, Minimal 2X P and 2X N. Superimposed below are the growth curves which demonstrate that BG-11 showed the greatest increase in dry weight.

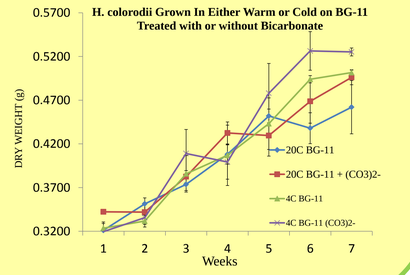


BG-11 media, which also has EDTA, contains more sodium ions than minimal media; this also has thiosulfate (NaS2O3), which is an important source of sulfur for amino acid production.

Results and Conclusions

▪We found BG-11 to increase the algal growth rate versus other media.
▪ Growth curves on the left show the elevated biomass created in different light conditions. Algal growth in brighter light resulted in increased biomass.
▪The BG-11 was then supplemented with bicarbonate which also further increased weight. This was seen to have a stronger affect when grown in the 4°C grow room versus the 20°C growth room.





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UROP University of Minnesota

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